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PMP EXAM PREP BOOT CAMP

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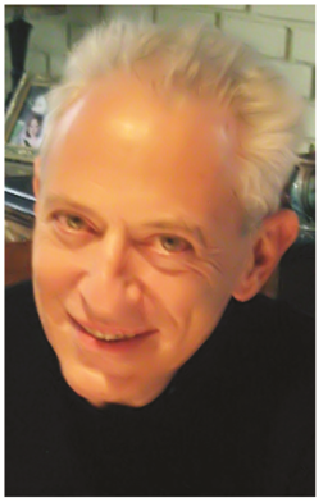
Student Edition 5.0



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Notice:

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All Inputs, Tools and Techniques and Outputs listed in this manual are from the *PMBOK® Guide,*5th edition.

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Conventions Used in This Study Guide

- **Exam Tip -** pay particular attention to these exam tips. They outline critical elements you need to know to help you be successful on the exam
- **Brain Dump -** every time you see the following symbol on a manual page or next to a formula, it indicates a formula that you need to memorize for specific questions on the exam:

- This guide focuses on the elements needed to pass the exam. As such, it is not a 'how to' guide. There are plenty of books on project management and its specialties upon which the reader can avail themselves. That being said, this guide contains a number of footnoted references that may be very useful to the project practitioner and are strongly recommended for further study after the reader has passed the PMP exam(!)

About the Author

Richard J Perrin (PMP CSM CSP ACP MBB) has worked in the aerospace, finance/brokerage, healthcare, energy, telecommunications, insurance industries and state/federal government for over 30 years. His efforts as a Director of Development for a telco startup helped his company garner the IEC Infovision Award for most innovative AIN product in 1998.

Working primarily for Fortune 100 and Global 10 companies as a Program/Project Manager, he has managed multi-million dollar, international infrastructure deployments, consulted in the creation of PMOs, functioned as proposal manager, developed workflows and business process focusing on the implementation of lean business process and quality practices for the publishing and telecom industries, as well as the public sector. He has served as a mentor and trainer, delivering formal instruction in CMM/CMMI, configuration management, requirements elaboration, project risk management and project management tools & techniques. For the last four years he has devoted his efforts to delivering coaching and training on Agile/Scrum processes across the United States. His book, *Real World Project Management* was published by John Wiley & Sons and released in January of 2008. He was a presenter at the March, 2010 Scrum Gathering in Orlando, Florida on the subject of Scrum and Lean Six Sigma. Most recently, he was selected by the Project Management Institute as an internal reviewer/contributor for the PMBOK® Guide, 5th Edition.

How to Use This Guide – READ THIS FIRST!!

Using this guide correctly will help insure you pass the PMP exam on your first attempt. Do the following:

- Review each chapter thoroughly. Then review specific areas in the corresponding chapter in the *PMBOK® Guide.* **Pay particular attention to the outputs for each Knowledge Area and the processes that feed into each Knowledge Area**. ***Memorize all Exam Tips and Critical Notes.***

- Take the chapter quiz, marking your answers on a separate sheet of paper. If you scored better than 80% you have a good grasp of the material. If not, mark the chapter for review on your second pass through the manual.
- Go through the remaining chapters using the same approach. When you have completed the guide you will then review the chapters in which you scored below 80%
- Retake the chapter quizzes in which you scored below 80%.
- When you have passed all quizzes at the 80% level, take the post-test; it is a full blown PMP exam simulation. Give yourself 4 hours to take the sim – if you score better than 80%, you are ready to sit for the exam.
- If you score less than 80%, *call the test center where you will be sitting for the exam and reschedule the test!* You can do so for up to 48 hours prior to the exam without forfeiting the exam fee.
- If you need additional testing material, sign up for practice tests at: http://iwebprep.com/Default.aspx

Chapter 1 :PMP® Examination Overview

Section Objectives

- Exam Questions
- Exam-Taking Tips
- Maintaining the *PMP®* Certification

	PMP	PMP %
Initiating	26	13%
Planning	48	24%
Executing	62	31%
Monitoring and Controlling	50	25%
Closing	14	7%
Total	200	100.0%
Passing		
Time Limit	4 hours	

PMP® Examination Overview

- The PMI certification examination consists of 200 multiple-choice questions, each question consisting of only four possible answers. The questions that you will see on your specific exam are selected from a bank of over 14,000 questions. There is no way to predetermine what the specific selection mix of questions will be.
- Unlike the GMAT, The PMI exam is non-adaptive. You may select questions for review and move on to other questions, returning to those questions that gave you difficulty, without penalty.
- The PMI examination is four hours and once begun, the clock will tick until four hours are complete, or the test taker submits the exam for grading prior to the completion of four hours.
- Make sure you answer all questions - no credit will be given for unanswered questions. In this case an unanswered question is the same as an incorrect answer.
- There are 25 'pretest' questions on the exam that carry no credit. You are only graded on 175 questions out of the 200 questions presented; however you will not know which questions are experimental and which questions you are being graded on.
- As of this writing there is no definitive passing score for the exam - for each of the sections outlined above you will be graded either a) Proficient, b) Moderately Proficient, or c) Below Proficient. According to the PMI Certification Department, the following is In effect:
  - **"**There are not a minimum or maximum number of domains or chapters in which candidate needs to demonstrate proficiency in order to pass the exam. The pass/fail rate is determined based on overall performance, not on how many questions were answered right or wrong in a particular domain or chapter .Each of the domains or chapters has a different number of questions within them that are relative to each other but not equal to each other. That means it is possible to score *Below Proficiency* in one of the domains and yet still pass the examination. It all depends on how many items were present in the domains that were failed. "[1]

[1] Helen Welsh, Certification Department, Project Management Institute

Examination Question Types

Questions on the *PMP®* certification exam are designed to test your analytical abilities, application experience, and general project management knowledge. The types of questions you will see on the exam will fall into the following general categories:

- **Situational:** A scenario or situation will be presented to you in which must analyze the question and choose the best answer based on your experience, analysis, and knowledge. Many test takers state that the predominant percentages of questions on the exam are situational.
- **More than one right answer:** Frequently, a test question will have two or more correct answers; however there will always be one answer that is more correct than the others. In this situation it is usually simple to eliminate at least two of the answers. Focus your attention on what the project manager needs to do next.
- **Extraneous information:** PMI is famous for the wordy multi-paragraph question, loaded with misdirection (red herrings) and nonessential information that has nothing to do with the actual question. When encountering such questions for the first time, read the answer set and the final paragraph first - this is usually the place where the actual question is contained.
- **Something you never heard of:** Don't be surprised to see a question containing something you have never seen before. The field of project management changes on a daily basis and the tools and techniques used by the project manager are expanding seemingly at a geometric rate. Take your best guess and move on.
- **Mathematical:** Expect to see anywhere from 5 to 10 questions involving formula computations. Earned value, PERT or questions involving standard deviation are typical computation questions.
- **Diagrams:** You may be asked to interpret a graph or construct a precedence diagram from instructions. On the computer at the test center, there may be a button on the screen that you can push that will bring up a graphic or some other diagram. Take advantage of all information provided.
- **Correct answer to a different question:** You will sometimes see answers that may be correct statements by themselves, but do not answer the question.
- **A new approach to a known topic:** You will frequently see questions that will present a different point of view or skew to a known topic. These questions will test concepts but using language that is different from what you studied for the exam. Thus it is critical that the concepts be understood ahead of simple rote memorization of project management knowledge.
- **Double negatives:** A number of questions are designed to be deliberately confusing ("which of the following would NOT be the least likely choice to make..."), which is another way of saying; "what would be your most likely choice".
- **Recall:** There will be a few fairly short questions that test your inventory of certain project management facts and knowledge areas.

Critical Note: Make sure you do a careful and thorough read of each question - *many of the answers to exam questions turn on a single word*. If you skim over or miss that key word, you will get the question wrong. *Read all questions carefully*. Answer what is asked!

Preparing for the Exam

PMP® exam is four hours and 200 questions - this means that you have approximately 1 minute and 12 seconds to answer each question. In order to ensure an optimal testing experience there are specific stress relievers you can employ that will help you get through the test with a minimum of angst. Consider the following as part of your test taking strategy:

Arrive Early. Consider traffic and time of day when making your way to the exam center. You don't want to arrive in a rushed or stressed state before the exam begins. ***It is strongly recommended that you scope out the exam facility a week or two before the actual examination, if at all possible***. You want to know what to expect walking through the door of the test facility. You will be under constant video monitoring and observation for the entire duration of the exam.

Rest Up. Take the evening off from studying the night before the exam - if you don't know the material by this point, cramming into late hours the evening before the test will simply multiply your stress level by a factor of two or three. It is most important that you be rested with a good night's sleep under your belt on the day of the exam. If you can, schedule the test for early afternoon instead of early morning.

Consider Earplugs. There may be some distracting noises in the examination room such as a fan, or test-taker for a different exam tapping a pencil on a desk. Bring earplugs just in case.

Dress in Layers. Frequently exam rooms are air conditioned to a point where they are too cold for many people. Therefore it is recommended that you dress in layers and remove layers or add layers as necessary to maintain your own individual comfort level.

Bring Food and Drink. If you get thirsty or need a nutritional boost during the exam, make sure you bring bottled water, bottled juices, or any snacks you will need for the four-hour test. If you have to leave the room to use a water fountain or go to a vending machine, the test clock will still be ticking.

Do the Brain Dump! Prior to the start of the exam and during the 15 minute tutorial you will have time to write on scratch paper all the formulas you will need for the test. While many of us pride ourselves on our airtight memories, rest assured that if exam panic sets in, all that you thought you had memorized will fly out of your head in an instant. Do yourself a favor and write down these formulas in an unstressed state prior to the actual start of the exam - this will pay dividends many times over while you are taking the exam. Some past test takers have actually reported that examination proctors upon handing scratch paper to the test-taker will state, "don't forget your brain dump".

Formulate a Plan. Have a strategy in mind prior to taking the test. If you know you will need to stand up and stretch after 90 minutes, allocate time in your strategy to do just that. The idea is that you want to pace yourself for your own maximum comfort and effectiveness on exam day. One effective plan involves the following approach:

- Go through the entire exam and answer the questions you can answer very quickly - within 20 to 30 seconds. Mark all other questions for review. You can frequently answer 80 questions in 45 minutes using this approach.
- Now approach all the 'marked for review' questions on the second pass - these questions will take you a little longer to answer but only because they require more thought. You can answer another 70 questions in the next hour and 15 minutes using this approach. Sometimes other questions and answers will jog your memory on a question you marked for review.
- You will now be left with your 50 most difficult questions on the third pass for which you have a full two hours to ponder the answers. Having this much time to approach your toughest questions is a real stress reliever and a major confidence builder for the exam.

Breathe! Students of yoga have utilized this technique for years. While in a stressed state, the simplest and most effective way to calm your system is by deep controlled breathing. This will produce a calming effect on your mind as well as your body, and can even lower blood pressure. If you feel a moment of

panic during the exam, sit back in your chair, close your eyes and breathe deeply and slowly for 15 to 20 seconds.

Useful Exam Tips

Think Like PMI! When you are answering questions for the exam, unless stated otherwise, assume the following is true:

- You are the customer if procuring services from an external vendor unless stated otherwise
- As the project manager you are in control of the budget, the timeline, and the resources
- The project is of sufficient size to warrant the use of a project management plan and all subsidiary plans
- You are following the formal processes as outlined by PMI, even if you don't use them in real life
- You have access to historical information and that formal project management processes are followed in your organization

The exam does not test memorization. Being a quiz kid with an eidetic memory will not help you pass the *PMP®* examination. You could memorize the *PMBOK® Guide*, 5th edition cover to cover and easily fail the exam. The *PMP®* exam tests your experience as a project manager as well as your understanding of project management concepts, and your ability to correctly analyze situations that occur on projects. ***While some memorization is required it is not the focal point of the examination.***
Answer all questions. You do not get any credit for an unanswered question. If you are completely stumped by a question there are only four possible answer alternatives. You have at least a 25% chance of getting it right. If you can eliminate at least two apparently incorrect answers your chances have improved to 50-50. *Always answer a question even if time is running out.*
Fill in the blanks. With a fill-in-the-blanks type of question, sometimes the correct answer is not grammatically correct. Don't let that stop you from filling in the correct answer.
Software calculator. You will be provided with an online, basic calculator that performs the following functions: add, subtract, multiply, and divide. A TI-83 graphing calculator with sophisticated integral and derivative calculus functions will not be allowed in the exam room.
Look for sweeping generalizations. Frequently you will see broad generalizations and questions using terms such as; "MUST, NEVER, AWAYS, COMPLETELY" or other absolutes. When referring to the project manager's actions, these terms are almost always wrong. Make sure you understand PMI's point of view first before attempting to answer questions containing these terms.
NEXT, BEST, WORST, LEAST, MOST, FIRST, LAST. On a number of exam questions you will be asked what is the BEST or FIRST action you should take regarding a specific situation. When we see questions like this, it is a tipoff that there is usually more than one correct answer. Read these questions carefully and understand what is being asked.
Cheerleader answers. There are a fair number of question responses that are what we call 'cheerleader' answers. Statements such as "quality is really important" or "scope verification is really time consuming" are answer choices that are guaranteed incorrect. Also keep an eye out for answers in which there is some type of emotional response to a situation. Project managers manage projects with data and fact. “Touchy-feely” answers can usually be eliminated immediately from consideration.
Use the whole exam time. Allow yourself the full four hours to complete the exam unless the following situation applies: you have answered all the questions and double-checked the answers. Studies have

shown that over-thinking answers on an examination will frequently cause test takers to second-guess themselves. More often than not, they will change correct answers to incorrect answers. Your first instinct on a difficult question will generally be correct. If you have used the three-pass method, double-checked your answers, and 30 minutes on the exam remains, your best strategy may simply be to submit your answers for grading.

Know PMI's recurring themes for the exam. The following themes need to be well understood to increase your chance of passing the exam the first time:

- The project manager puts the interests of the project ahead of his/her own self-interest
- The project manager is assigned during the Initiating phase of the project
- Organizations have a Project Management Office (PMO), that has clearly defined authority over the implementation of project processes
- The WBS is the foundation for all project management planning
- Stakeholders are engaged throughout the project
- Planning is a key element in all projects
- All roles and responsibilities are clearly defined and documented for the project
- Due to the uniqueness of the project, the project manager focuses on risk identification and risk management
- Project management plans are agreed, realistic and signed off by all relevant stakeholders
- The Project manager is responsible for realistically assessing all time, budget and quality constraints and resolves any issues with the management *prior to* the start of project work
- Continuous process improvement on the project is one of the key responsibilities of the project manager
- The project manager determines the quality metrics to be used on the project
- The project management plan is the key document by which the project is managed
- Projects are continually re-estimated throughout the life of the project so that an accurate budget and timeline may be forecasted
- Progressive elaboration is a key concept used by the project manager to tighten estimates as the project moves forward
- The project manager has authority. The PM can reject changes to scope and control the project budget and timeline for the benefit of the customer
- The PM protects the project from unnecessary changes
- In the event that scope changes must be made, the PM will ensure that a thorough impact assessment will be performed assessing changes to time, budget, resources, risks, quality, and customer satisfaction
- Project managers spend 90% of their time communicating with stakeholders to ensure everyone connected with the project knows what is going on
- Project managers proactively seek out additional risks, problems, and other changes to prevent future problems with the project
- Project managers have a fundamental understanding of contract language
- Project managers ensure organizational policies are followed for the duration of the project
- When closing a project, the project manager archives all project records
- Projects are not considered complete until final acceptance has been received from the customer and the PM releases resources upon project completion

Maintaining the PMP Certification

Maintaining the PMP Certification requires the credential holder to document 60 Professional Development Units (PDUs) every three years. This can be accomplished in many ways, including, but not limited to the following:

- Attend a PMI chapter meeting: 1.5 PDU
- Any PM training from a PMI Registered Education Provider (REP): 1 PDU per hour of training
- Any PM course offered by an accredited College or University: 1 PDU per hour of training
- Self study
- Speaking, lecturing or publishing articles on any aspect of project management

Consult the PMI website at www.pmi.org for a comprehensive listing.

CRITICAL NOTE:

Starting August 31, 2011, the exam section concerning Ethics and Professional and Social Responsibility will no longer be tested as a separate entity apart from the five process groups, but will be subsumed within each process group. This means that questions regarding ethics can appear in the Initiating, Planning, Executing, Monitoring and Controlling and Closing process groups.

In Summary…

- In this section we covered:
  - What types of questions to expect on the test
  - Study and test-taking tips
  - Requirements necessary to maintain certification

Chapter 2 : Project Life Cycle and Organization

Project Management Defined
Organizational Influences and
Project Life Cycle

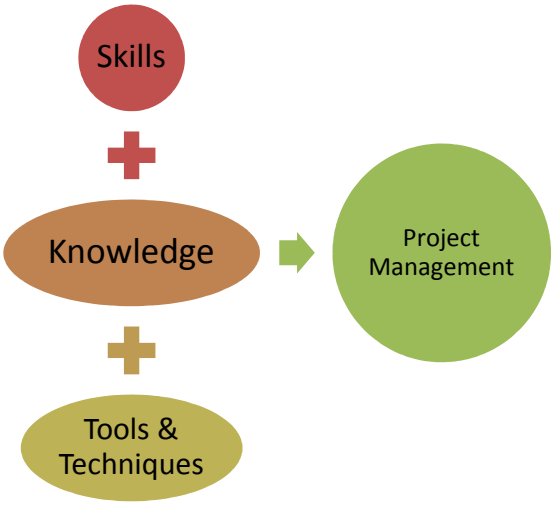
Section Objectives

- What Is a Project and What Is Project Management?
- The Project Management Life Cycle vs. the Project Life Cycle
- Portfolio Management, Program Management, Project Management, and Organizational Project Management
- Project Management, Operations Management, and Organizational Strategy
- Business Value
- Organizational Influences on Project Management
- Project Stakeholders and Governance
- Project Team
- Project Lifecycle

Definition of Project Management

According to PMI, project management is:

- The application of knowledge, skills, tools, and techniques to project activities to meet project requirements
- project management is accomplished through the appropriate application and integration of the 47 logically grouped project management processes comprising the five process groups



The five process groups are, in order:

- **Initiating**
- **Planning**
- **Executing**
- **Monitoring and Controlling**
- **Closing**

Critical Note: Many organizations implementing the PMI Project framework in their organizations make the mistake of thinking that the five process groups constitute project phases. They do not. According to PMI: "**The Process Groups are not project life cycle phases"**[2]

What Is a Project?

- A Project:
  - A time-scoped/time-boxed activity
  - Has a beginning, middle and an end
  - Creates a unique product, service or result
  - A 'progressive elaboration'

- Operations:
  - Endures for the lifetime of the product, process or service
  - Can be incrementally improved or enhanced over operational lifetime
  - Enhancements/improvement typically done as a series of smaller projects

[2] *PMBOK® Guide*, 5th edition, p 52

A project as defined by PMI states the following:

"A Project is a temporary endeavor undertaken to create a unique product, service, or result."
The project is completed when the objectives have been reached from the customer's perspective, when the project is terminated because its objectives cannot be met, or if the need for the project no longer exists.

The term 'temporary' refers to the execution of the project and not to the *product* of the project, which is usually created to deliver a lasting or sustained outcome. An example of this type of project would be a national coast-to-coast railroad system or a national monument.

The term 'unique' means you are doing something that is without like or equal. This does not mean that every aspect of the project is unique. A project may contain repeating elements such as processes or infrastructural elements.

Operations endure for the lifetime of the *product. Operations* address assembly-line type processes that are both predictable and repeatable. *Many projects contain repeatable elements that resemble operational processes.*

Point of view is also very important to consider when identifying an operational process or a project. To the customer the work effort may be a project, however to the performing organization the work effort may be purely operational and something they do all the time.

There are distinct similarities between projects and operations:

1. Both are performed by individuals
2. Both are subject to constraints including resources, schedule, risk and others
3. Both are planned, executed and controlled
4. Both are designed to meet organizational and/or strategic objectives

The key differences between projects and operations:

1. The project ends at some point, whereas operations continues for the lifetime of the product
2. The project may contain a number of unknown, unpredictable elements, whereas operational elements are both predictable and repeatable
3. Projects continually evaluate risk, whereas operational processes are usually designed to minimize or eliminate risk. (Operational elements are both predictable and repeatable)

Project Constraints

There can literally be hundreds of constraints on a project. Constraints are limiting factors that set up boundaries for the project. These boundaries may be necessary for the successful completion of the project, however sometimes boundaries and constraints may severely impact project optimization and ultimately customer satisfaction.

As of the printing of the *PMBOK® Guide*, 5th edition, PMI has abandoned the pure triple constraint model from previous years (cost-schedule-scope) in favor of a more inclusive definition that focuses on the following key constraints (*PMBOK® Guide*, 5th edition, p. 6):

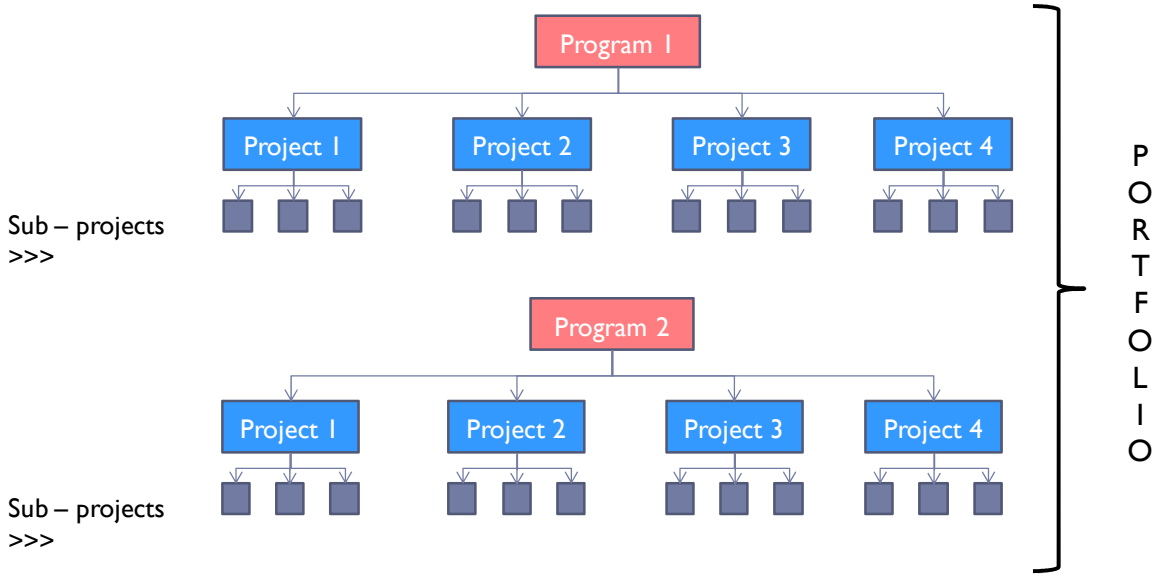
- Scope
- Quality
- Schedule
- Budget
- Resources
- Risk

All of the constraints have an impact on customer satisfaction. The project manager is responsible for balancing all the constraints on the project to drive the highest levels of customer satisfaction. Different constraints may come into play at different times in the project, and each of these constraints needs to be evaluated in terms of ultimate customer satisfaction and the needs of the project.

What Are Programs, Portfolios and Sub-Projects?

- A Portfolio:
  - A portfolio is a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives.
  - The projects or programs in the portfolio may not necessarily be interdependent or directly related

- A Program:
  - A program is a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually
- A Project:
  - A means of achieving the organization's strategic plan
  - Progressively elaborated
- A Subproject: Smaller portion of an overall project



A Program is a group of related projects. The purpose in managing a group of projects in this manner is to derive economies of scale, decrease risk and potentially create synergies for improved resource utilization, as well as reduce costs. Programs can also address administrative functions as well as ongoing operational functions.

A Portfolio can include a combination of projects and programs designed to meet the strategic objectives of the organization. The individual projects/programs may not be related to each other from a management perspective. For example, a financial organization may have a portfolio of individual products all relating to wealth building. It may have a different portfolio of products related to risk avoidance/mitigation. Each of the products within these portfolios may have been created through the execution of an individual project or a program. The portfolio helps to group these products in a manner that makes marketing and sales of these products more efficient and comprehensible to the organization's customers.

Subprojects are created by subdividing a larger project into smaller, more manageable pieces or components. This may be useful if the project follows a phase-gate approach to execution in which specific subprojects are completed within each project phase.

Process Comparisons

The following diagram displays the differences between portfolios, programs and projects:

	PROJECTS	PROGRAMS	PORTFOLIOS
Scope	Projects have defined objectives. Scope is progressively elaborated	Larger Scope. More Benefits	Portfolios scope changes with the strategic goals of the business.
Change	Project managers expect change and manage and control it.	Program managers expect change from inside/outside the program, and manage and control it.	Portfolio managers monitor changes in the environment.
Planning	PMs progressively elaborate high level information into detailed plans throughout the project lifecycle.	PgMs develop overall program plan and high level plans; guide detail planning at the component level.	Portfolio managers create/maintain processes for the aggregate portfolio.
Management	PMs manage the project team to meet project objectives.	PgMs manage program staff and project managers. Provide vision and overall leadership.	Portfolio managers manage or coordinate portfolio management staff.
Success	Success is measured by product and project quality, timeliness, budget compliance and customer satisfaction.	Success is measured by the degree to which program satisfies needs for which it was undertaken.	Success is measured by the aggregate performance of the portfolio components.
Monitoring	PMs monitor and control the work of producing the products.	PgMs monitor program components to insure goals, schedule, budget and benefits are met.	Portfolio manager monitor aggregate performance and value indicators..

From *PMBOK® Guide*, 5th edition

The PMO

The purpose of the PMO - Project Management Office - is to centralize the management of projects across the organization. Typically the PMO will provide one or all of the following for a project:

- Methods and procedures, templates, methodologies and policies for managing projects
- Guidance and training to the organization on project management concepts, principles, and how to manage projects within the organization
- A resource pool of project managers for various organizational initiatives

Depending on your organizational structure the PMO may play the following roles in your organization:

- Audit compliance with Project policies, standards, and procedures companywide
- Help to provide project resources
- Cancel projects
- Provide templates and standardized forms for project use
- Offer coaching, training and mentoring for project managers
- Serve as a centralized communications conduit for projects
- Manage dependencies between projects, programs, or portfolios
- Function as a stakeholder

Types of PMOs

- **Supportive:** provides support in the form of on-demand expertise, templates, best practices, access to information and expertise on other projects.
- **Controlling:** requires that support be used. Requirements might include adoption of specific methodologies, templates, forms, conformance to governance, and application of other PMO controlled sets of rules.
- **Directive:** "takes over" the projects by providing the project management experience and resources to manage the project

PMI defines three types of PMO's for the organization; supportive, controlling, and directive, all briefly defined above. The idea of the PMO is to integrate data and information from corporate strategic project and evaluate how the high-level strategic objectives are being fulfilled. Thus, the PMO is a liaison between the organization's portfolios, programs, projects and the corporate measurement system.

One of the key functions of the PMO is to support project managers which can include any or all of the following:

- Managing shared resources across projects administered by the PMO
- Identifying/developing project management methodology, best practices, and standards
- Coaching mentoring, training, and oversight
- Monitoring compliance with project management standards, policies, procedures, and templates via a project audit
- Developing/managing project policies, procedures, templates, and shared documentation
- Coordinating communication across projects

Project Management, Operations Management and Organizational Strategy

While operations management is outside the scope of formal project management, projects can intersect with operations at various points in the product lifecycle, for example:

- At each closeout phase in the project
- Developing a new product, upgrading a product, or expanding outputs
- Improving operations of the product development process
- Until the end of the product lifecycle

Operational stakeholders may impact/be impacted by the project and are best included in the stakeholder register, and their influence can be addressed as part of the risk management plan.

Organizations and Project Management

Organizations utilize governance to establish strategic direction, guide the pursuits of the business and align with business objectives. Therefore, if there is a change in the business environment, project objectives need to be re-aligned.

While many organizations implement projects to achieve specific goals, there are some organizations whose work is project-based. These organizations are known as PBO's or project based organizations. The general characteristics of a PBO are outlined below:

- Can exist in functional, matrix, or projectized organizations
- Can diminish hierarchy and bureaucracy inside the organization because work is measured by result rather than by position or politics
- PBO's can reference the entire company, a multi-firm consortium, or a network

The link between project management and organizational governance can be summarized in the following statement; the project may be judged on the basis of how well the delivered product or service supports organizational governance. Therefore it is critical that the project manager be knowledgeable about organizational governance policies that relate to the product or service as well as sustainability requirements as they relate to project deliverables.

Ultimately, the organizational strategy should provide guidance and direction to the project management process. If the project manager observes that the goals of a project are in conflict with established organizational strategy, it is the project manager's job to document and identify these conflicts as early in the project lifecycle as possible

Business Value

PMI defines business value as the "entire value of the business; the total sum of all tangible and intangible elements". [3] Therefore, successful business value realization is a combination of strategic planning and effective management. Bridging the gap between organizational strategy and successful business value realization requires the use of portfolio, program, and project management techniques:

- Portfolio management aligns projects programs and/or operations to the organizational strategy
- Program management aligns multiple project for optimize and/or integrated cost, schedule, effort, and benefits
- Project management enables the organization to apply knowledge, processes, skills, and tools to enhance the likelihood of success over a wide range of projects. Projects are means of achieving organizational strategy and objectives

[3] PMBOK Guide, 5th edition, p.41

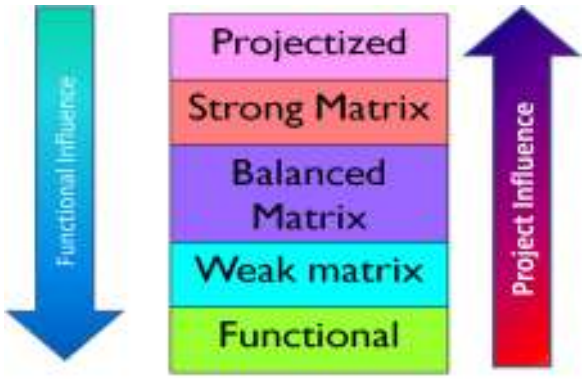
The Project Manager's Role

The project manager is assigned by the organization to achieve the project objectives. Depending upon the organizational structure, the project manager may report to a functional manager or an operations manager. In other situations the project manager may report to a program manager or a portfolio manager who is responsible for enterprise-wide projects and programs.

While the project manager is responsible for applying the correct tools and techniques to ensure the success of the project, effective project management requires that the project manager also possess the following characteristics:

1. **Knowledge.** What the project manager knows about project management
2. **Performance.** What the Project manager is able to accomplish while applying project management knowledge
3. **Personal.** How the project manager behaves when performing project related activities. The personal effectiveness of the project manager consists of personality characteristics, leadership ability, problem solving skills, attitude, and the ability to guide the project team while achieving project objectives and balancing project constraints

Organizational Influences on Project Management



Different types of organizational structures will have a positive or negative effect on the effectiveness of project management in your organization.

There are three fundamental organizational structures that you need to know for the exam:

- Functional
- Matrix (Weak, Balanced, Strong)
- Projectized

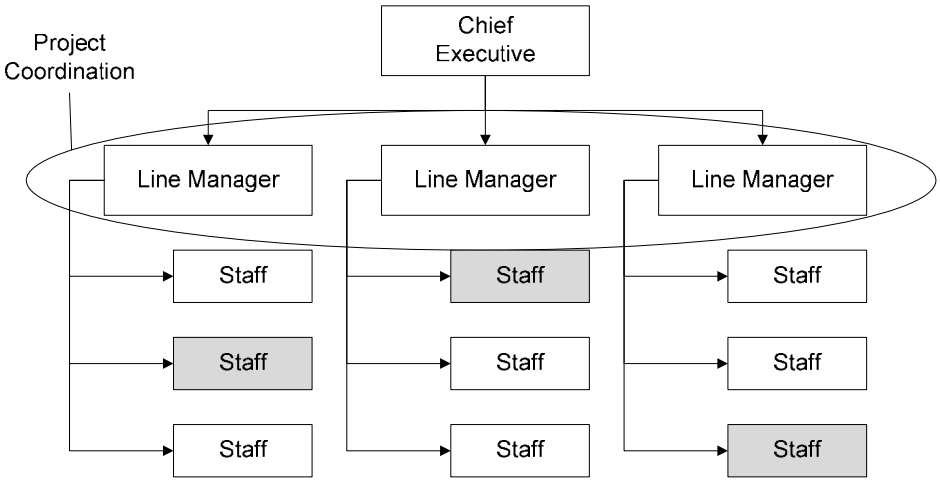
The influence of functional organizations in which project resources report to line managers or senior managers, impact the project manager's ability to influence the successful execution of the project.

In a Projectized organization project manager has ultimate authority over time, schedule, resources, and every other aspect of the project.

In a matrix organization project manager shares responsibility to a greater or lesser degree with line managers or senior managers when it comes to managing project elements such as budget, timeline, resource availability, communications and others.

An organization that uses a combination of organizational structures is called a "composite organization".

Functional Organizations



Gray boxes correspond to staff performing project activities

Drawing based on *PMBOK® Guide*, 5th edition, p. 29

In this organization type, the project manager has little to no authority on the project. Usually the project manager is part time and is often referenced as a 'project expediter' or 'project coordinator'. The functional hierarchy is that all the team resources report to a functional or line manager. The project manager has little or no input into performance reviews of the project team and frequently must approach functional managers 'hat in hand' to make the best case they can for project resources.

- **Exam Tip:**
  - **Project** _____is an assistant that cannot make or enforce decisions
  - **Project** _____have some decision making authority

Each of these designations can be found in a weak matrix organization as well[4]

[4] "Weak matrices maintain many of the characteristics of a functional organization, and the role of the project manager is more of a coordinator or expediter…" *PMBOK® Guide*, 5th edition p. 23

Functional Advantages and Disadvantages

- **Advantages**
  - Clearly defined career paths
  - Familiar structure
  - Direct supervisor reporting structure
  - Employees are experts

- **Disadvantages**
  - Employee's job difficult to change
  - Much contention for resources and project priority
  - Performance reviews and promotions are functional manager responsibility
  - PM has little or no authority
  - PM usually part time - no clearly defined career path for the PM

You'll notice from looking at the list above that with the functional approach to managing projects, the disadvantages clearly outnumber the advantages.

As the project manager in this type of environment, ensure that you have a very clear understanding of the structural hierarchy of the organization and that you work within the bounds of the tools that the organization has left at your disposal (generally few to none).

The Matrixed Organization

The matrixed organization was developed in the 1970s to attempt to combine the advantages of both the functional and the Projectized organization while minimizing the disadvantages. There are three types of matrixed organizations that PMI has defined:

- **Weak matrix.** Similar to the functional organization in that project resources report directly to functional managers
- **Balanced matrix.** With this organization type, project power and influence is shared between the project manager and the functional manager
- **Strong matrix.** Here most of the project authority is similar to the projectized organization in that the project manager has almost complete control of project resources, budget, timeline, quality, and customer satisfaction

Exam Tip: you may see the term 'tight matrix' on an exam question. A tight matrix simply means that the offices for the project team are co-located in the same room.

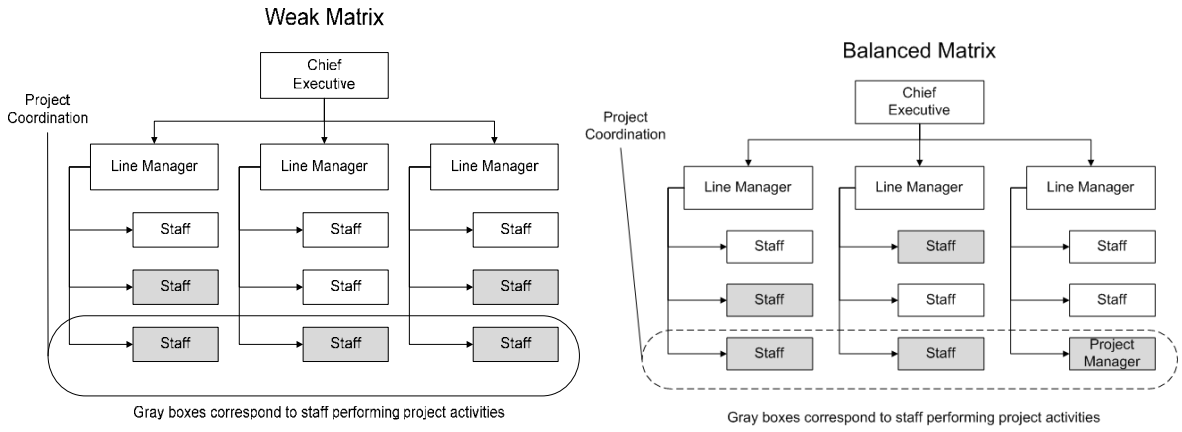
Matrixed Advantages and Disadvantages

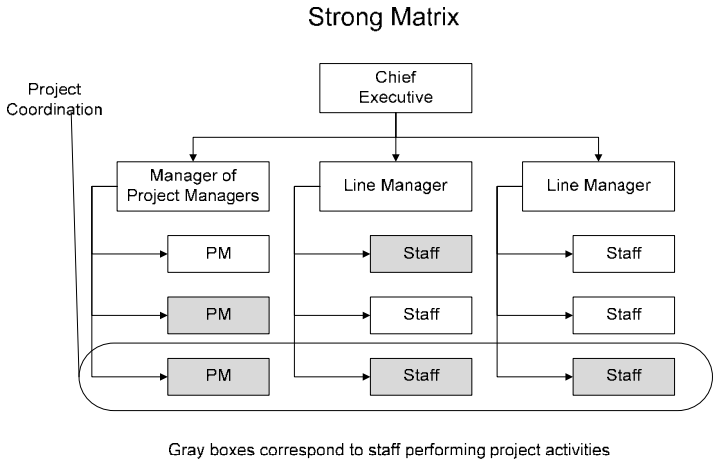
- **Advantages:**
  - Objectives remain visible
  - Increased support from functional managers

- Increased control by project manager
- Improved flexibility
- Job remains after project is complete
- Multiple inputs on team members' performance

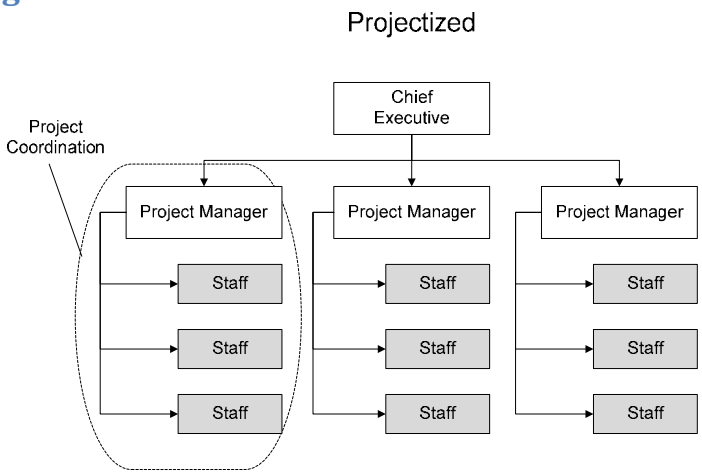
- **Disadvantages:**
  - Multiple bosses
  - Adds complexity
  - Additional policies and procedures are necessary
  - Different priorities or objectives may exist

Notice that in a matrix environment, the advantages outnumber the disadvantages. As with the other organizational types, you may be asked questions on the exam regarding the advantages and disadvantages of working in one of the matrixed environments. Some graphical examples of matrix organizations appear below (Drawings based on *PMBOK® Guide*, 5th edition, pp. 23-24):





Projectized Organizations



The projectized organization is one that derives its primary income from delivering projects. In this organization, the project manager has ultimate authority over the project, including the timeline, the budget, the resources, the scope, the quality and, ultimately, customer satisfaction.

In this environment the project resources are dedicated 100% to working on projects and focused on the project at hand. This approach is effective when the project is very high priority and requires the dedicated focus of everyone on the team. Typically, very large and complex projects are executed in a projectized environment.

Projectized Advantages and Disadvantages

- Advantages:
  - Dedicated project focus
  - Project loyalty
  - Efficient project organization
  - Efficient project communication
- Disadvantages:
  - Job is gone once project is complete
  - Resources are siloed rather than shared
  - Job functions and facilities can be duplicated

For the exam, the above outlined advantages and disadvantages need to be understood, as exam questions may make oblique references to the Projectized (or any other) organization type.

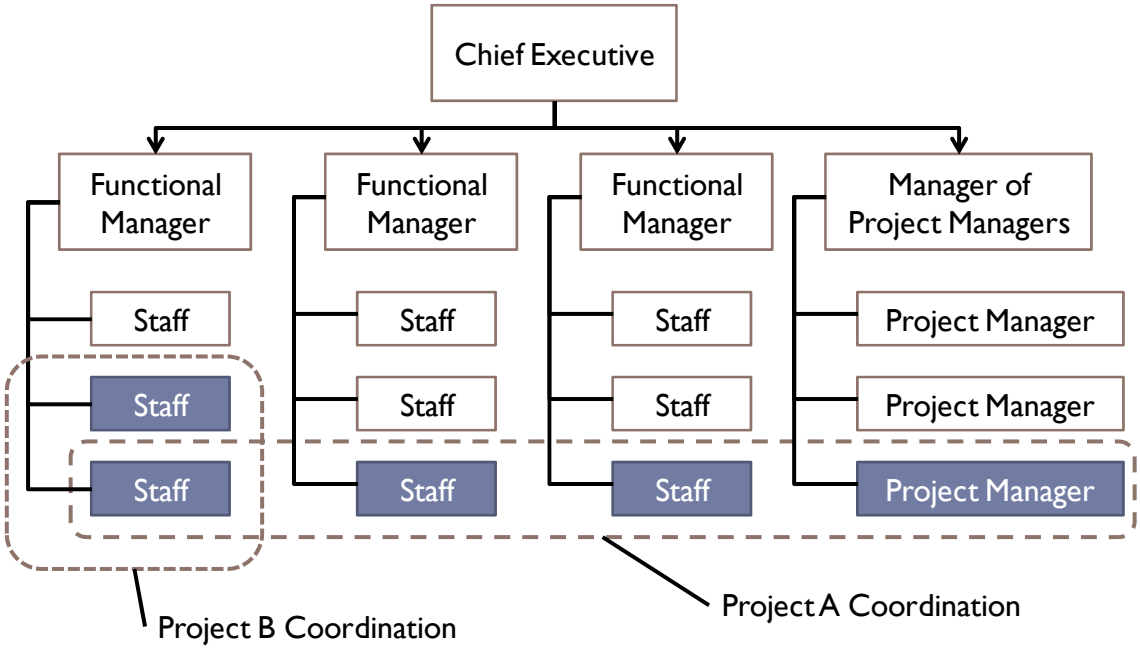
Example:

You are a project manager in which you have ultimate authority over the project, including the budget, the timeline, and the resources. While this dedicated focus serves the needs of the project, there may be a disadvantage in approaching a project in this way. Which of the following would be the BIGGEST disadvantage using this approach?

a. As the project manager, you get all the pressure
b. Line managers may not respect your authority
c. Your job may be gone once the project ends
d. Negotiating conflicting stakeholder needs is more difficult

A clear reading of the question describes a projectized organization type. Based on your understanding of the Projectized organization, you also understand the disadvantages of executing a project in this organizational environment.

Composite Organizations



The composite organization consists of elements of functional, matrix, and projectized organizations in that a project can be approached using any one of the three aforementioned methods. Depending on the complexity of the project, the organization may use all three approaches on the same project.

Since projects can include strategic, middle management, and operational levels, the project manager may interact with all three levels depending on:

- Strategic importance of the project
- Ability of stakeholders to exert influence on the project
- Degree of project management maturity
- Project management systems
- Organizational communications

This interaction can determine project characteristics including; project managers level of authority, resource availability, who controls the project budget, project manager's role, and project team composition.

What Is Your Organizational Structure?

Organization structure / Project characteristics	Functional	Matrixed Organizations			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

Drawing based on *PMBOK® Guide*, 5th edition, p. 22

The chart above summarizes the functional, matrix and projectized organizations.

Exam Tip: For the purposes of the exam assume that you are working in a strong matrix environment unless the question explicitly (or implicitly) states otherwise.

For the exam, you would do well to commit the above chart to memory.

Organizational Process Assets

Organizational process assets include plans, processes, policies, procedures, and knowledge bases used by the performing organization to execute projects. These assets can include formal plans, informal plans, lessons learned, historical information, completed schedules risk data and earned value data. Organizational process assets are inputs to most planning processes. By process group, organizational process assets may include the following:

- Initiating and planning:
  - Guidelines and criteria for tailoring organizational standard processes to project needs
  - Internal organizational standards such as policies, product and project life cycles, and quality policies and procedures
  - Templates (E. G. Risk register, work breakdown structure, network diagrams, etc.)
- Executing, Monitoring and Controlling:
  - Change control procedures, how standards, policies, plans and procedures will be modified, and how changes will be approved and validated

    - Financial controls
    - Issue and defect management procedures
    - Organizational communications requirements
    - Prioritizing, approving, and issuing work authorizations
    - Risk control procedures
    - Standardized guidelines which can include work instructions, proposal evaluation criteria, and performance measurement criteria
- Closing:
    - Project closure guidelines or requirements

Exam Tip: all of the above can be contained in the corporate knowledge base

Enterprise Environmental Factors

Enterprise Environmental Factors (EEF) are a recurring input to over 20 of the processes primarily in the Planning Process Group. These elements refer to conditions not under control of the project team that influence, constrain or direct the project. Their influence may have a positive or negative effect on the project's outcome. The key elements involving enterprise environmental factors include:

- Organizational culture and structure
- Government and industry standards
- Existing human resources
- Personnel administration
- **Company work authorization system***
- Marketplace conditions
- Stakeholder risk tolerances
- Commercial databases
- ____– _____ e.g., an automated tool suite, such as a scheduling software tool, a configuration management system, an information collection and distribution system, or web interfaces to other online automated systems).

***Exam Tip:** A work authorization system is designed to ensure that work is approved before it begins, and to ensure the work is done at the right time and in the correct sequence. Use of a work authorization system also helps to prevent scope creep as well as goldplating.

Understanding Stakeholder Needs

A stakeholder:

1. Anyone who is positively or negatively impacted by the project
2. Anyone who can exert influence over the project's objectives and outcomes.

Typical key stakeholders can include, but are not limited to:

- **Project manager**
- **Customer/user**
- **Performing organization**
- **Project team members**
- **Project management team**
- **Sponsor**
- **Functional/Senior Manager**
- **Operations**
- **Business partners**
- **Influencers**
- **PMO**
- **The public**

To iterate, a project stakeholder is anyone who can be positively or negatively impacted by the results of the project. As such, it is the job of the project manager to balance stakeholder needs while delivering the project's product. The project manager may have to deal with the following when addressing stakeholder needs:

- Conflicting stakeholder needs or interests
- Stakeholder disagreement regarding the product of the project
- Different communication needs from stakeholder to stakeholder
- Varying levels of stakeholder influence

It is the project manager's responsibility to identify all potential stakeholders on a project and make sure that they are treated as members of the project team. Failure to do so can sink your project late in the game. Taking the effort to determine stakeholder likes, dislikes, hot buttons, critical needs and influence can pay huge dividends for your project as it progresses.

Stakeholder identification is also a continuous process in that different stakeholders may be impacted at various phases of the project. Testing resources will have more of an impact or influence later in your project than they will near the beginning of your project when an initial high level design is being created.

Project Governance

Project governance is an oversight function that encompasses the project lifecycle. It provides the project manager and the project team with structure, processes, and decision-making models and tools for managing the project. It includes a framework for making project decisions, defining roles and responsibilities, and accountabilities for project success and determines the effectiveness of the project manager. The PMO may play some decisive role in project governance, and the governance framework may include any or all of the following elements:

- Deliverable acceptance criteria
- Escalation process for resolving issues during the project

- Relationship between the project team, organizational groups, and external stakeholders
- Project Org chart
- Processes for project communications
- Decision making processes for the project
- Aligning project governance and organizational strategy
- Project lifecycle approach
- Process for phase reviews
- Process for review and approval of project changes (I. E. Budget, scope, quality, schedule)
- Process for aligning internal stakeholders with Project process requirement

The Project Team

The project team includes the project manager and the resources who act together performing the work of the project to achieve its objectives. The project team can include but is not limited to the following:

- Project Management Staff: team members to perform project management activities
- Project Staff: team members to carry out the work of the project
- Supporting Experts: subject matter experts needed to help develop or execute the project management plan
- User or Customer Representatives: members who will accept deliverables or the product of the project
- Sellers: contracted organizations that provide components or services for the project
- Business Partners or Business Partner Members: external companies that have a relationship with the enterprise providing specialized skills or roles for the project

The composition of the project team will vary based on factors relating to organizational culture, scope, or location. The relationship between the project manager and the team can vary depending on the authority of the project manager; the project manager may be the team's line manager or may have little or no direct organizational authority over the team members. Basic team compositions consist of one of the following:

- Dedicated: team members are assigned to work full-time on the project. In this case the project team is usually co-located and reports directly to the project manager
- Part-Time: team members are assigned to projects to accomplish temporary additional work. As a result, the functional manager usually maintain control over the team members and the resources allocated to the project. In this case, part-time team members may be assigned more than one project at a time

Exam Tip: dedicated and part-time project team members can exist in any of the organizational structures: functional, matrix, projectized, or composite.

The Project Life Cycle

- "The project life cycle can be determined or shaped by the unique aspects of the organization...While every project has a definite start and a definite end, the specific deliverables and activities...will vary widely with the project"[5]
- The ***phases*** of a software project life cycle will differ from a construction project life cycle or a pharmaceutical drug development life cycle

Project life cycles are as unique as the industries they serve. Projects are generally broken into phases which are used to control project execution and ensure its success. Within an organization it is not uncommon to find established policies that standardize projects around a specific methodology or project approach. Other organizations may allow the project team to organize around the most appropriate approach for their individual project. Regardless of the approach taken by the organization there is no standard project life cycle that fits all organizations. It is truly a case of 'one size fits none'.

Organizational governance across the project life cycle must provide a consistent method for controlling the project and ensuring success. The phase structure provides a formal basis for such control. At the completion of each phase, a management review or 'decision gate' is executed to determine whether the project can continue, needs further adjustments, or should be canceled.

Thus a phase-end review can achieve two goals for the project:

- Authorization to close the current project phase
- Authorization to initiate the subsequent project phase

Implementing a project phase structure in a project can deliver the following benefits:

- Breaking down the work into smaller chunks enables more accurate budget and timeline estimates
- A phase structure can help prevent scope creep

Phase-to-Phase Relationships

As of this writing, PMI has elaborated two fundamental phase-to-phase relationships are contained within the project life cycle. These phases are described as follows:

- *Sequential Relationship*. This describes the traditional finish-to-start relationship. Phase 1 must be completed before phase 2 can begin. Traditional construction projects frequently use the sequential phase relationship when constructing a house or an office building.
- *Overlapping Relationship.* In this case, a subsequent phase can begin before the previous phase has completed. Stated differently, phase 2 can start before phase 1 is done. This technique allows for schedule compression called fast tracking, and overall reduction of the timeline of the project. This approach can increase risk and rework - interdependencies between the phases must be managed diligently to avoid risk and rework.

[5] *PMBOK® Guide,* 5th edition. P. 38

Graphic representations of the two types are shown below:

Sequential:

Overlapping:

Project Lifecycle Concepts

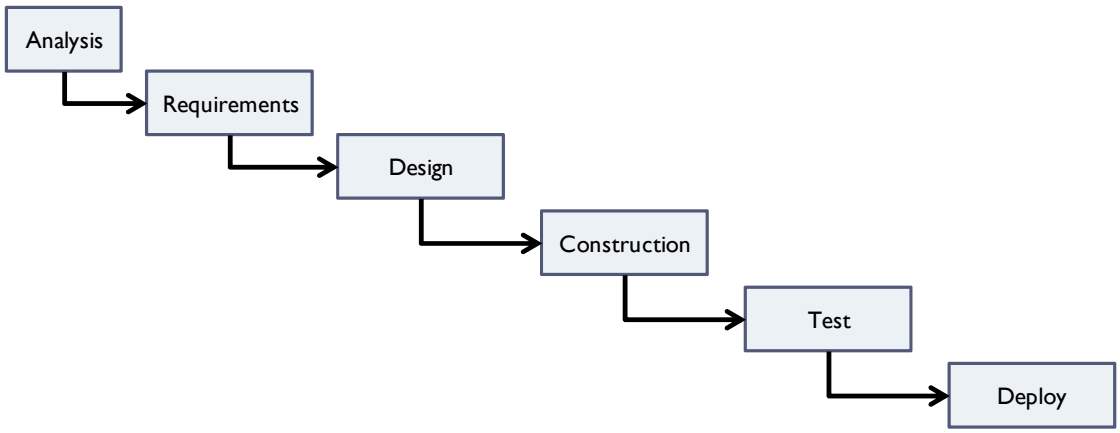
PMI has identified three distinct lifecycle concepts in the fifth edition of the PMBOK *Guide*®:

- **Predictive**
- **Iterative**
- **Adaptive**

A description of each type follows below.

<u>Predictive</u>

A predictive lifecycle is also known as a 'plan driven' or 'waterfall' approach to delivering the scope of the project. In this approach, the scope, time, and cost required to deliver that scope are determined as early in the project lifecycle as possible. As a result the project can proceed to a series of sequential or overlapping phases with each phase focusing on delivering a subset of the project's deliverables. The work in each phase is different in preceding or subsequent phases, therefore, the skill sets required of the project team may vary from phase to phase. The following graphic represents a typical waterfall implementation:



Iterative

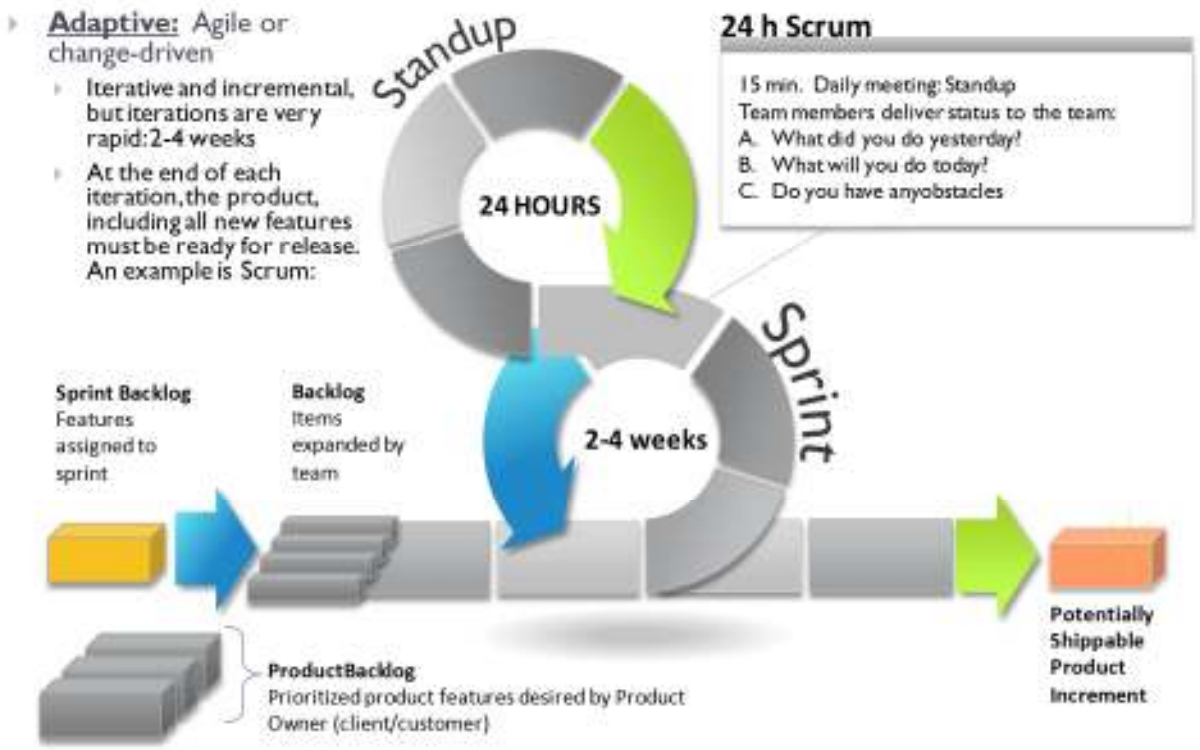
With an iterative or incremental lifecycle, project phases are intentionally repeated as the team's understanding of the product increases. The product is developed through a series of repeated cycles while the product incrementally grows at the completion of each iteration. Each iteration incrementally builds on the deliverables from the previous iterations until the exit criteria for the project are met. As a result, the work required for a given set of deliverables may vary in duration and effort. This approach is similar to PMI's concept of rolling wave planning: the immediate work for the current iteration is highly detailed, whereas work plans for an iteration several increments into the future may only be developed at a high level.

Adaptive

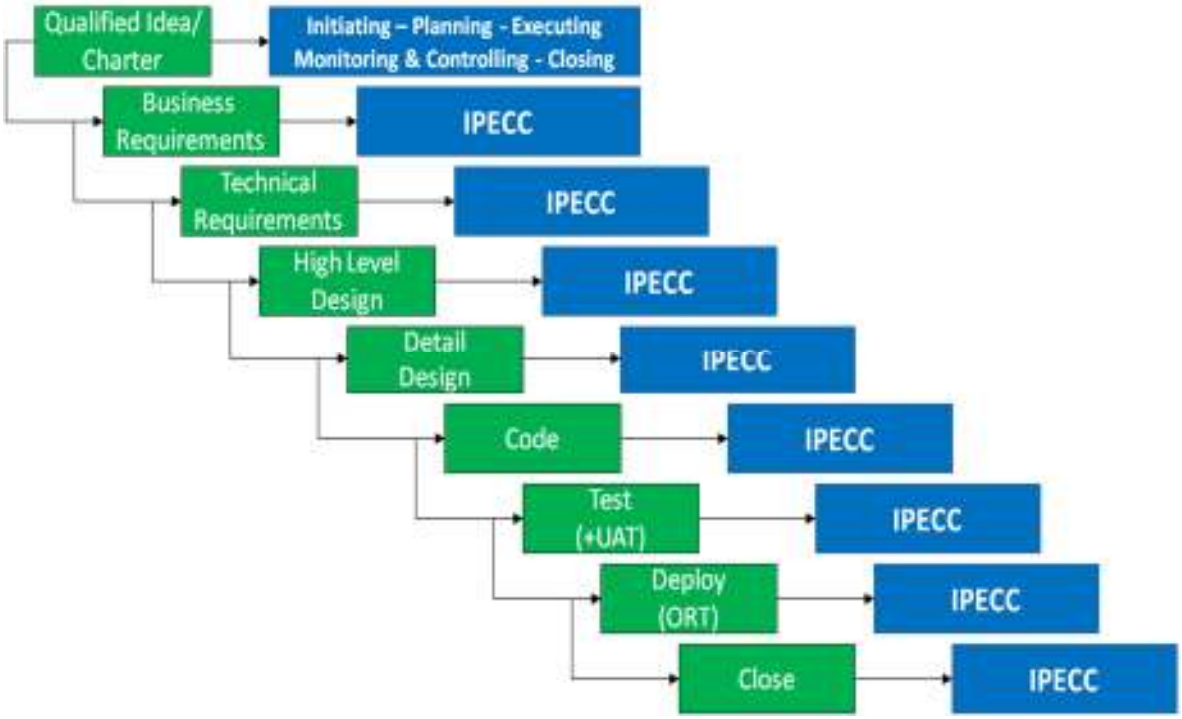
The adaptive lifecycle, also known as 'change driven' or 'agile' is designed to address high levels of change, risk, and/or uncertainty in a project. Agile projects are also incremental and iterative, but with the singular difference that the iterations are generally very short term; usually 2 to 4 weeks. Once a Project iteration length is selected for a project it remains consistent throughout the project. The overall scope of the work is decomposed into an element called a product backlog. The product owner, or business representative, collaborates with the performing organization to prioritize the product backlog and is ultimately responsible for deciding what gets developed and in what sequence.

In an adaptive cycle, the project team delivers an increment of the product to production standards, also known as a 'potentially shippable product increment' which is submitted to the customer for review and acceptance. Incomplete or defective features are not accepted for signoff at an iteration-end review.

One of the most effective agile methods currently used in the project management space is known as Scrum, a graphic of which appears below:



The Project Life cycle Versus the Project Management Life cycle



The example shown above does not need to be memorized. It demonstrates the difference between a specific project lifecycle and the processes contained in the Project Management Lifecycle. The IPECC acronym represents the five process groups.

The distinction between the *project management life cycle* versus the *project life cycle* is this:

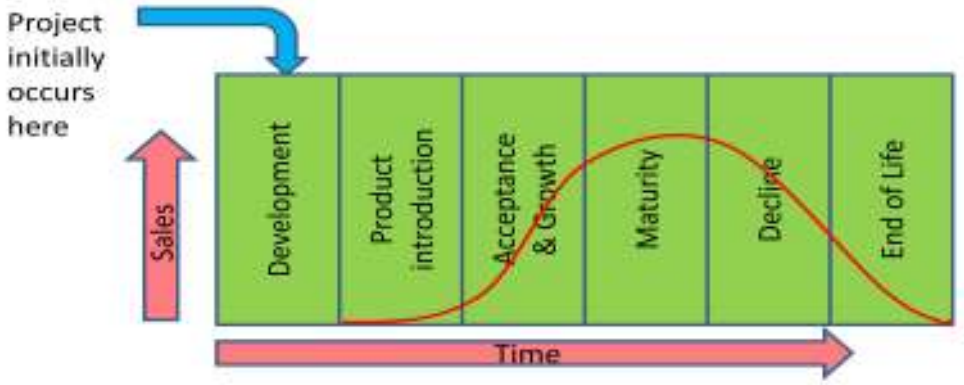
1. The project life cycle is frequently unique to each organization and industry. While there may be similarities between project life cycles, you will see distinct differences between a project life cycle for a construction project, a software project, an energy project, an airline project, a pharmaceutical project, etc. The clear distinction is this; while project life cycles may vary industry to industry,
2. The Project Management Life Cycle is immutable and always consists of the following five process groups:
   - **I**nitiating
   - **P**lanning
   - **E**xecuting
   - Monitoring and **C**ontrolling
   - **C**losing

The five process groups are applied to each phase in the project. *This means that no matter what project life cycle or phase structure you may use for your project, the five project management process groups will be executed within each phase of your project.*(*PMBOK® Guide*, 5th edition, p. 41, 43).

For example: You will ***initiate*** a phase, ***plan*** the work of the phase, ***execute*** the work of the phase, ***monitor and control*** the work as it is being executed for the phase, and finally you will ***close*** the phase or the project. Closing a phase includes a process called 'lessons learned' in which we identify what's working, what's not working, where we can improve, what puzzles us, etc. This lessons-learned process is applied at the completion of every phase of your project.

The figure above shows a generic software development life cycle. Notice that for each phase of the software development life cycle we execute the process groups defined in the project management life cycle: initiating, planning, executing, monitoring and controlling, and closing.

Defining the Product Life Cycle



- Endures for the life of the product
- A *project* may have been implemented to create to product
- Many smaller projects may be implemented to incrementally improve the product

The ***product*** is what is created as a result of executing a ***project***. When we talk about project management what we are talking about is the work that is being done in the project to produce and deliver the product of the project.

While your project may have taken two years to deliver its product, the product may have a much longer lifetime. As the product grows and matures, a series of smaller projects may be implemented to enhance, improve or change the product over time. Each of these smaller projects is in support of the product and ensuring its longevity in the marketplace.

However, just as a product may have been an ideal solution at one fixed point in time, the need for the product may have deteriorated significantly over the years. The Ford Model-T was at one point, an optimal solution for a specific transportation problem. Today the model-T is considered a quaint antique compared to the vehicles available today. The wood-burning/coal-burning locomotive at one point was an optimal solution for railroad transportation. Today, the use of diesel and electric engines has rendered the wood-burning/coal-burning locomotive obsolete.

Defining the product life cycle is important because from a strategic perspective, the organization must determine when it is of no use to the organization to utilize resources and funds to improve a product that is essentially at the end of its lifetime.

We will address stakeholder management more completely in the Stakeholder Management chapter.

MBO, OPM3™ and Progressive Elaboration

Management by Objectives (MBO) is a term that was first introduced by Peter Drucker in his 1954 book 'The Practice of Management'.

Exam Tip: MBO will only work if it is supported by management.

OPM3™- the Organizational Project Management Maturity Model. The model was based on the Software Engineering Institute's Capability Maturity Model Integration (CMMI) for software. OPM3™ helps organizations determine their level of maturity in project management.

Progressive Elaboration - this concept is *key* to the entire PMI framework. It fundamentally states that you cannot come up with a definitive estimate for timeline and budget at the very start of a project. Why? The reason is that there are many unknowns and very little analysis has been done at the beginning of the project. As the project team dives into the analysis, consults with subject matter experts, and begins to define the details of the project - only then can more accurate estimates be created.

The greater the number of the unknowns that exist in a project, the more a progressive elaboration is required to ensure project success.

Section Review:

- Definition of PM terms, such as project, PMO, stakeholder, project life cycle, product life cycle, project management life cycle, project management system
- The role of the project manager
- Definition of project constraints
- Project phase concepts
- Advantages and disadvantages of different organizational structures

Chapter Two Memory Check

1. A project is _____, _____ and delivers a _____, _____or _____
2. Three key constraints on a project are _____, _____, and _____ as well as quality, resources and risk
3. Three key characteristics of the project manager include; _____, _____, and _____ effectiveness
4. A _____is a group of related projects. A _____can be a collection of projects, programs or sub-projects
5. A _____centralizes and co-ordinates the management of portfolios, programs and projects
6. The _____ life cycle deals with the work done to accomplish the goals of the project, while the _____ life cycle deals with the lifetime of the deliverable(s)
7. The two categories of multi-phase project types are; _____, and _____
8. A stakeholder is anyone who is _____ or _____impacted by the project
9. The four basic organizational types are; _____, _____,_____ and _____
10. The term used to describe the process of delivering more accurate estimates for time and budget as the project progresses is called _____
11. Clearly defined career paths and little PM authority describe an advantage and a disadvantage of a _____organization
12. Project loyalty and the possibility of not having a job after the project completes describes an advantage and a disadvantage of a _____organization
13. Increased PM control and multiple bosses describes an advantage and a disadvantage of a _____organization
14. A project _____ has very little decision making authority on a project, whereas the project _____ has some decision making authority
15. The three types of matrixed organizations are referred to as: _____ matrix, _____ matrix and _____ matrix
16. The three type of project lifecycles defined by PMI are _____, _____ and _____
17. Three types of PMOs defined by PMI are _____, _____ and _____

Chapter 2 Test

1. The five process groups of the Project Management Life cycle are, in order:
    a. Initiating, Executing, Planning, Monitor and Control, Closing
    b. Initiating, Analyzing, Designing, Executing, Closing
    c. Initiating, Planning, Executing, Monitoring and Controlling, Closing
    d. Initiating, Planning, Monitoring and Controlling, Validating, Closing

2. You have just started a new position as a project manager with your new company. Upon starting your job you are informed by the line manager that all budgetary decisions rest with her and that all key project decisions will be her responsibility as well. Most likely, PMI would say you are functioning as a _____?
    a. Resource coordinator
    b. Project manager
    c. Functional expediter
    d. Project coordinator

3. The project manager that you just hired said that she came from a Projectized organization prior to working for your company. Your VP just asked you what that means in terms of her level of authority. You responded:
    a. she had responsibility for the project but not for the budget
    b. she had little responsibility for the project or the budget
    c. she split the project and budget responsibilities with the functional manager
    d. she was responsible for the budget and the project almost 100%

4. The company you are working for has decided to adopt Scrum as a project management method. You've never heard of Scrum before but decide to do some research and discover that Scrum is an agile method. What kind of project phase method is being adopted here?
    a. Iterative
    b. Sequential
    c. Overlapping
    d. Phase-neutral

5. Two junior project managers who are working on the same project are having a heated discussion(an argument) on the difference between the project management life cycle and the project life cycle. The first project manager is saying there is essentially no difference between the two while the second project manager is saying that there is a significant difference between the two. While this debate is occurring, a senior vice president from your division interrupts the two and asks them the following question: "When the project is completed what is the expected lifetime of the deliverable?" Essentially, what is the vice president asking them?
    a. He is asking about the status of the project life cycle
    b. He is asking about the status of the project management life cycle
    c. He is asking about the status of the product
    d. He is trying to determine if they understand life cycle costing

6. What is the *BEST* definition for a project manager's role on the project?
    a. Take instruction and direction from functional managers
    b. Assigned by the organization to achieve project objectives
    c. Balance stakeholder interests on the project
    d. Effectively manage the project team while also being an expert technical resource

7. Your project team has been assigned to work full-time on your current project. In terms of project team composition, this is best described as a _____ project team.
    a. Projectized
    b. Composite
    c. Focused
    d. Dedicated

8. You have just gotten a new job within an organization that can't spell 'project management' much less figure out how to run a project. Their project management process has been described by some in the organization as an 'adrenaline pounding thrill-ride usually resulting in a train wreck'. At your project kickoff meeting a number of the team members have expressed dismay at how the last project was managed and ask if this one will be just like the last one. In terms of the project approach, what is the *BEST* response you can offer?
    a. As the project manager, you will protect the team from executive interference
    b. You will take a life-cycle approach to managing the project
    c. You will ask the project team for a list of difficult stakeholders so that you can defuse problems before they begin.
    d. Your project management approach is calm, cool, and collected

9. The Director of Product Development and the chief engineer of the company have decided to add scope to the project you are managing. They have completed the necessary paperwork, received the required sign-offs and have told you to simply get it done. In this instance you are probably:
    a. In a strong matrix environment
    b. Project administrator
    c. Working a balanced matrix function
    d. Project expediter

10. The project team has been arguing about what should go into the project management plan. They've built the same product over a hundred times before and have always been bothered that the project management plan never seemed to get completed. They were determined to get it done *right* this time. The team has come to you for advice regarding the project management plan. The most *appropriate* response you can give them is:
    a. Use project phase concepts ; initiate, plan, execute, monitor & control, and close
    b. They need training in project management
    c. The 'project' is really operations
    d. Tell them to take direction from the PMO

11. Management by Objectives is most successful when:
    a. The organization's executives stay out of the way of the project team
    b. Management delegates the work of the organization to the most senior project managers
    c. You were managing projects in the 1950s. Technique is rarely used now
    d. It is supported by upper management

12. The portfolio manager from your division thought it might be helpful to the project teams if she delivered a short presentation on the elements in her portfolio. A number of team members, after receiving the e-mail announcement for the presentation, come to you and ask if this meeting is worth their time. After all isn't a portfolio just a big project? As a Senior Project manager your *best* response would be:
    a. You're right. The meeting probably would be a waste of your time
    b. Not really. A portfolio is a group of related projects managed together to achieve synergies between the projects and establish common methods and procedures.
    c. Not really. A portfolio can be a group of programs, projects, or sub-projects designed to help the organization meet specific business goals

d. Not really. A portfolio is a collection of documents, methods, and procedures that help us manage projects

13. The executives are debating about whether to implement a PMO for their organization. One of the executives thinks that PMO means 'project management overhead' while others are wondering about the actual value it will bring to the organization. As a senior project manager, they bring you in to the meeting on a consultative basis to help them get their hands around what value the PMO brings the organization. All of the following answers are correct *except*:
    a. The PMO serves as a disciplinary organization for project managers
    b. The PMO helps the organization align its projects around strategic organizational objectives
    c. The PMO provides the organization with project management standards, methods, and procedures
    d. The PMO helps to mentor and train project managers within the organization

14. All of the statements about the project life cycle are true *except* which of the following:
    a. The project life cycle consists of five distinct phases
    b. The project life cycle is different for every organization
    c. The project life cycle works with the project management life cycle to help meet project objectives
    d. The project life cycle can be modified depending on the needs of the project

15. You have contracted a third-party to install five rack-mounts and the server gear at your new data center for your new web service, which is designed to handle 50,000 simultaneous users. The performing organization stated you could have a custom-designed system and sit down with an architect to do that, however, they have a catalog of 10 systems that they can build from the simplest to the most complex. If you want to pick something from the catalog, the configuration is well known and well understood, and their installation time can literally be cut in half, saving you considerable funds. You selected one of the 10 catalog systems because there was one that coincided with your needs to a 99% level. You also assigned a senior project manager from your organization to coordinate all activities with the vendor for installation. A week later you hear the project manager having a heated discussion with one of the junior project managers about whether this installation constitutes a project or operations. The junior project manager maintains that the installation is time bound and delivers a unique product process or result and by definition, is a project. The Senior Project manager counters with the following argument: it is fundamentally operations because the performing organization does this all the time. The configuration selected came out of a catalog which means that the installation is a repetitive, predictable, and repeatable process which is why they could do it on such a narrow fixed-price basis. What is the *best* response you could give to the junior and senior project manager?
    a. The Junior Project manager is correct: this is a project
    b. The Senior Project manager is correct: this is operations
    c. This is a project that has elements of operations
    d. It really depends upon from whose point of view the question is being asked

16. All of the following reasons elaborate why is it important for the project manager to consider stakeholder influence on a project, *except* for which of the following?
    a. The negatively impacted stakeholder can create significant road blocks for your project
    b. All the stakeholders control your budget
    c. Stakeholders may supply technical expertise or resources to your project
    d. Stakeholders provide many of the key requirements that need to be fulfilled for the successful completion of the project

17. The organization wants you to manage a project with a very aggressive timeline. You have done an initial assessment of the statement of work, the timeline, resource availability, and the budget. Based on this

information you have reported back to senior management at their aggressive timeline is a fiction and it will be impossible to meet given the scope of work. Senior management then asks you what the most effective project phase approach would be employed to compress the timeline given that the project is fraught with many uncertainties, risks and is something that the organization has never tried before. The *most likely* response you would give to address this situation is:

a. You recommend the overlapping phase approach. This would allow work on a subsequent phase to start before the predecessor phase had completed
b. You recommend an iterative approach. It helps reduce complexity and is useful when partial delivery of a product is beneficial to the stakeholders
c. You recommend the inverse-evolutionary phase approach. Since his project sounds more like an R&D project you have no idea what the real scope is or when you will be done. Innovation cannot be timed on a punch clock
d. You recommend the adaptive phase approach. It addresses high-change, high-risk, high uncertainty projects effectively

18. Several junior programmers ask you about the difference between the product life cycle and the project life cycle. The *best* answer that you can give them in describing the difference between the two is:
    a. The product life cycle and the project life cycle coincide - the difference is that the product life cycle has to do with the product created whereas the project life cycle has to do with the work needed to create the product
    b. The product life cycle addresses the entire life time of the product, whereas the project life cycle is to work needed to create the product
    c. The product life cycle addresses the time that is needed to initially create the first iteration of the product, whereas the project life cycle endures for the lifetime of the product
    d. The real answer addresses the sequence of the two: product life cycle completes before project life cycle begins

19. You have just collected project information from stakeholders and are analyzing their input with the project team. One stakeholder is worried about whether the organization has the proper skill sets in-house to deliver the product of the project. This can be best described in project management terms as:
    a. A constraint
    b. A potential risk
    c. An issue
    d. A and C

20. You are the program manager for a large multimillion dollar program managing 10 projects, each with a project manager. Because of the varying complexity of the projects, there are at least three different project life cycle types are being used across the 10 projects. Some of the project managers are discussing whether the project management life cycle needs to change to adjust to different project life cycles. The *most correct* answer that you can give them is:
    a. The project management life cycle is applied to every project phase
    b. The project management life cycle may change depending on the specific project life cycle being employed
    c. There is no difference between the project management life cycle and the project life cycle
    d. The project management life cycle changes for each project

21. All of the following are project lifecycle approaches with the exception of _____.
    a. Iterative
    b. Linear
    c. Predictive
    d. Adaptive

22. The project manager must be knowledgeable about organizational governance policies that relate to the product or service as well as sustainability requirements as they relate to project _____.
    a. Risk
    b. Constraints
    c. Planning
    d. Deliverables

23. Projects can intersect with operations at various points in the _____ lifecycle.
    a. Project
    b. Product
    c. Project management
    d. Process development

24. You are working in an organization in which the PMO offers consulting services to projects. This type of PMO is best described as:
    a. Supportive
    b. Directing
    c. Controlling
    d. Consultive

25. Project governance is an oversight function that aligns with organizational governance practices. As such, the governance framework provides the project manager and the team with structure, processes, decision-making models and tools for managing the project. What is the PMO's role in project governance?
    a. The PMO has no role in project governance
    b. The PMO may have some role in project governance
    c. The PMO may play a decisive role in project governance
    d. The PMO plays a distinct leadership role in project governance

26. If the goals of a project conflict with the organization's business strategy, whose responsibility is it to identify these conflicts?
    a. Project manager
    b. Sponsor
    c. Program manager
    d. Portfolio manager

Chapter 2 Test Answers

1. C –Initiating, Planning, Executing, Monitoring and Controlling, Closing. *PMBOK® Guide*, 5th edition, p 51.
2. D – Project coordinators have minimal decision authority on projects. Thus by PMI's definition of a PM, (you are authorized to commit resources and spend money) you are not an actual project manager. A resource coordinator is an HR function and' functional expediter' is a made-up term
3. D – High to almost total control on a project identifies a projectized organization
4. A – Scrum is in agile method that utilizes the iterative approach to development
5. C – The first part of the question is a red herring. The VP is asking about the lifetime of the deliverable i.e. the product. This is a question about the product status.
6. B – The key job of the project manager is to meet the organization's project objectives
7. D – this is the definition of a dedicated project team. Projectized and composite describe organizational structures. Focused is a made-up term. *PMBOK® Guide*, 5th edition, p. 37
8. B – Taking a life cycle approach to the project is the best answer you can give. Answers A and C might be tactics you employ while managing the project. Answer D is meaningless
9. D – The director and the chief and an engineer have all the responsibility, therefore you are just a project expediter
10. C - Since the project team has done the same thing a hundred times before, this is an assembly line process, which makes it operations
11. D – This is the only possible answer, *PMP®* Exam Prep p 2-22
12. C – A portfolio can be a group of projects, programs, subprojects, or any combination of the previous. *PMBOK® Guide*, 5th edition, p 9
13. A – The PMO does not discipline project managers. Insubordination and other similar issues are the province of human resources, functional managers and senior management
14. A – The project life cycle changes for every organization. The *project management* life cycle consists of five distinct process groups. *PMBOK® Guide*, 5th edition, pp 48-49
15. D - That was like reading *War and Peace* wasn't it? Sometimes you get long-winded questions on the exam. Point of view is the most important element in this question; to the customer it is a project, however to the performing organization it is operations (it's an assembly line process)
16. B – If *all* the stakeholders control your budget, you're in trouble. Funding primarily comes from the sponsor/ senior management, who can be a potential stakeholder. *PMBOK® Guide*, 5th edition, p. 54
17. D - The project as described - a high-risk, high uncertainty project - is best addressed with an adaptive phase approach. *PMBOK® Guide*, 5th edition, p.46
18. B – Product lifecycle addresses the lifetime of the product; project life cycle is to work needed to create the product. *PMBOK® Guide*, 5th edition, pp 18-21
19. D – This is not exactly a trick question, but it's close. The scenario described is not only a constraint (no internal headcount with the skillset), but it is also an issue (if I need additional headcount, how do I go about obtaining it?)
20. A - The project management life cycle is *applied to every phase of your project life cycle* regardless what that project life cycle looks like. *PMBOK® Guide*, 5th edition, pp 18-21
21. B - Linear is not a project lifecycle defined by PMI.*PMBOK® Guide*, 5th edition, pp 44-46
22. D - Deliverables is the correct answer. *PMBOK® Guide*, 5th edition, p.15
23. B - Product lifecycle. *PMBOK® Guide*, 5th edition, p.12
24. A - the scenario describes a supportive PMO. *PMBOK® Guide*, 5th edition, p.11
25. C - the PMO may play a decisive role in project governance. *PMBOK® Guide*, 5th edition, p. 34
26. A - the project manager identifies and documents these conflicts. *® Guide*, 5th edition, p. 15

Chapter 3 **Project Management Processes and Knowledge Areas**

Topics Covered:

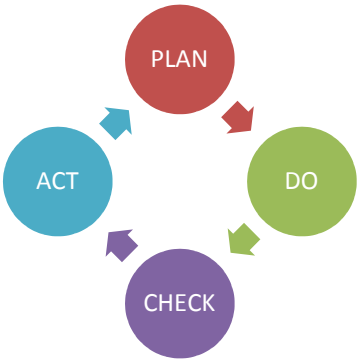
- Project Management Processes
- Project Management Process Groups
- Process Interactions
- Project Management Process Mapping

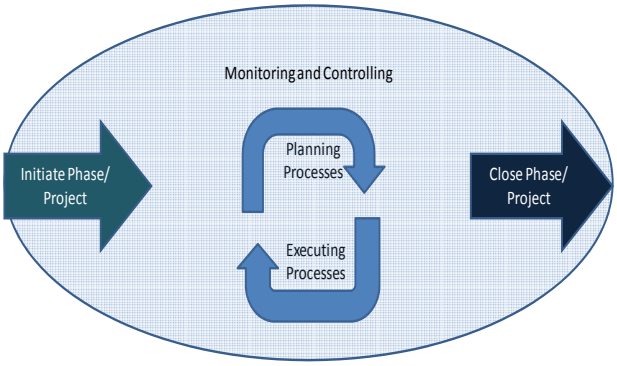
Section Objectives

- Identify the five stages of the PM life cycle
- List and define the 10 PMI knowledge areas
- Explain the processes and characteristics within each process group
- Elaborate the *PMBOK® Guide,* 5th edition1) inputs, 2) tools and techniques, and 3) outputs are. What you need to know about them to pass the exam
- Map the 47 major processes by knowledge area

The Project Management Process Groups

The five process groups are based on a variant of the Shewhart-Deming Plan-Do-Check-Act Cycle:



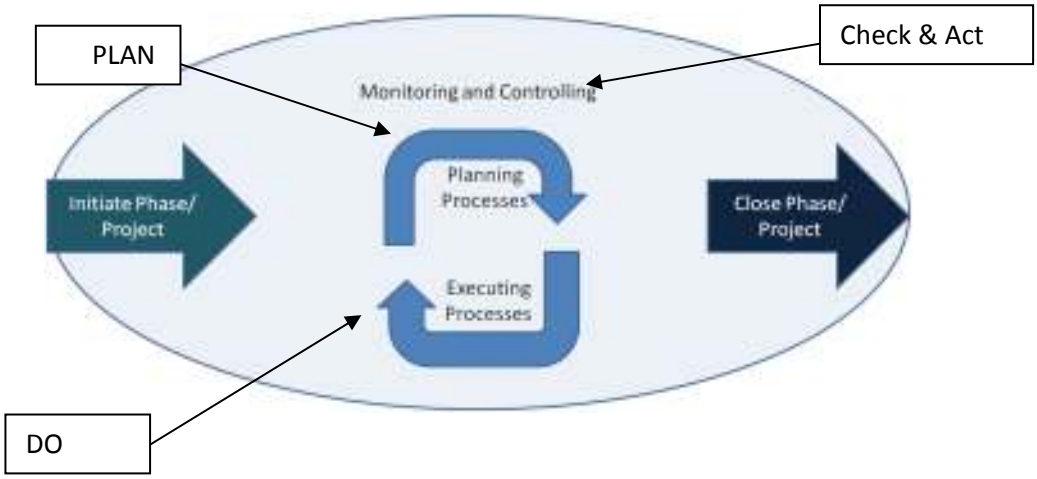


Notice that the Planning and Executing Processes are iterative[6]

The Shewhart-Deming plan-do-check-act cycle is the fundamental basis of incremental improvement for all manufactured product or business processes. The IPECC process is basically a variant on the Shewhart-Deming cycle:

- The initiating process is basically the entry point into the cycle
- The closing process is basically the exit point from the cycle
- The plan-do-check-act iteration maps in the following manner to the IPECC cycle:

[6] *PMBOK® Guide*,5th edition, p 50



Based on the *PMBOK® Guide*,5th edition, p 50

A key point to understand in the IPECC cycle is that Planning and Executing processes are *iterative.* Notice also that monitoring and controlling processes are an 'umbrella' type of process, in that all the other processes within the IPECC cycle are in some way monitored and controlled. We are constantly checking the results of our work and making actionable decisions based on what we discover.

Initiating Process Group

The key purpose of the initiating process group is to align the stakeholder's expectations with the project's purpose. The primary elements in initiating a project include:

Stakeholder process

- Identify stakeholders / stakeholder identification techniques*

Integration processes

- Determine phase/project goals
- Obtain authorization to start phase/project
- Determine initial scope
- Identify constraints and assumptions
- Select/assign project manager
- Project statement of work
- Define high-level resource requirements
- Determine initial financial resources
- Verify success criteria
- Create project charter/ charter elements*
- Obtain formal approval of charter

Several other supporting actions that help to complete the initiating process include the following:

- Subdivide large projects into phases
- Document the business case and the cost-benefit analysis*
- Project selection criteria (e.g. cost, feasibility, impact)*
- Ensure the project scope is achievable
- Identify high-level risks and requirements/ risk identification techniques*
- Facilitate resolution of conflicting stakeholder objectives
- Create an order of magnitude budget and schedule estimate
- Determine critical success factors for the project

* These elements address specific knowledge and skills needed by the PM in the Initiating process

Initiating Tasks

- Task 1: perform project assessment based upon available information, lessons learned from previous projects, and meetings with relevant stakeholders in order to support the evaluation of the feasibility of new products or services within the given assumptions and/or constraints.
- Task 2: identify key deliverables based on business requirements in order to manage customer expectations and direct the achievement of project goals.
- Task 3: perform stakeholder analysis using appropriate tools and techniques in order to align expectations and gain support for the project.
- organizational factors, historical data, and expert judgment, in order to propose an Task 4: identify high-level risks, assumptions, and constraints based on the current environment, implementation strategy.
- Task 5: participate in the development of the project charter by compiling and analyzing gathered information in order to ensure pressure stakeholders are in agreement on its elements.
- Task 6: obtain project charter approval from the sponsor, in order to formalize the authority assigned to the project manager and gain commitment and acceptance for the project.
- Task 7: conduct benefit analysis with relevant stakeholders to validate project alignment with organizational strategy and expected business value.
- Task 8: inform stakeholders of the approved charter to ensure common understanding of the key deliverables, milestones, and their roles and responsibilities.

Exam tip: The primary goals of the Initiating processes are:

1. develop the project charter and
2. identify stakeholders

Exam tip: In the Initiating processes, understand the following:

- Staffing levels are low
- Costs are low
- Chance of success is low

- Risk is high
- Stakeholder influence is high

Planning Process Group

While the main goal of the Planning process group is to create the Project Management Plan, other subsidiary management plans are also created here. This includes subsidiary management plans for scope, schedule, budget, quality, human resources, communications, risk, and procurement knowledge areas defined in the *PMBOK® Guide*, 5th edition. Below is a listing of the major elements you can expect to find as part of the Planning process:

- Create scope statement
- Create scope management plan
- Create WBS (work breakdown structure)
- Create network diagram
- Estimate activity durations
- Estimate costs
- Determine project schedule
- Refine time and cost estimates
- Create communications plan
- Develop Human Resource Plan
- Create Staffing Management Plan
- Develop Communications Management Plan
- Determine project budget
- Develop quality management plan
- Identify risks
- Qualitatively and quantitatively rank risks
- Develop risk response plan
- Adjust estimates as necessary
- Develop procurement management plan
- SOW (procurement statement of work)
- Create procurement documents
- Develop PM plan
- Obtain approval of plan
- Hold kick-off meeting[7]

Additional knowledge and skills needed by the PM for planning activities also include:

- Describing each work package in the WBS dictionary
- Evaluating other projects for potential positive or negative impacts on this project
- Identifying quality metrics for the project

[7] *PMBOK Guide,* 5th edition pp 47-55

- Requirements gathering techniques
- WBS tools and techniques
- Time budget and cost estimation techniques
- Scope management techniques
- Resource planning process
- Workflow diagramming techniques
- Type and uses of org charts
- Elements, purpose and techniques of:
    - Project planning
    - Communications planning
    - Quality management planning
    - Risk management planning
    - Procurement planning
    - Change management planning

With the planning process group, it is critical to understand that neither the project management plan nor any of the subsidiary management plans are finalized until a thorough risk assessment and identification has been performed.

The primary goal of the Planning process is to develop the project management plan.

Planning Tasks

- Task 1: review and assess detailed project requirements, constraints, and assumptions with stakeholders based on the project charter, lessons learned, and by using requirement gathering techniques to establish detailed project deliverables.
- Task 2: develop a scope management plan, based in the approved project scope and using scope management techniques, in order to define, maintain, and manage the scope of the project.
- Task 3: develop the cost management plan based on the project scope, schedule, resources, approve project charter and other information, using estimating techniques, in order to manage project costs.
- Task 4: develop the project schedule bits of the approved project deliverables and milestones, scope, and resource management plans in order to manage timely completion of the project.
- Task 5: develop the human resource management plan by defining the roles and responsibilities of project team members in order to create a project organizational structure and provide guidance regarding how resources will be assigned and managed.
- Task 6: develop the communications management plan based on the project organizational structure and stakeholder requirements, in order to define and manage the flow of project information.
- Task 7: develop the procurement management plan based on the project scope, budget, and schedule, in order to ensure that the required project resources will be available.

- Task 8: develop the quality management plan define the quality standards for the project and its products based on the project scope, risks, and requirements, in order to prevent the occurrence of defects is control the cost of quality.
- Task 9: develop the change management plan by defining how changes will be addressed and controlled in order to track and manage change.
- Task 10: plan for risk management by developing a risk management plan; identifying, analyzing, and prioritizing project risk; creating the risk register; and defining risk response strategies in order to manage uncertainty and opportunity throughout the project lifecycle.
- Task 11: present the project management plan to the relevant stakeholders according to applicable policies and procedures in order to obtain approval to proceed with project execution.
- Task 12: conduct kickoff meeting, communicating this sort of the project, key milestones, and other relevant information in order to inform and engage stakeholders and gain commitment.
- Task 13: develop the stakeholder management plan by analyzing needs, interests, and potential impact to effectively manage stakeholders expectations and engage them in project decisions.

Executing Process Group

The processes in this group are performed to complete the work in the project management plan that was designed to satisfy the project specifications. As the project manager, you are responsible for coordinating the activities of human resources as well as infrastructure resources and integrating the activities of both in accordance with the project management plan.

As a result, several or all of the plans created in the planning process may require replanning, updates and re-baselining during project execution. A large portion of the project budget is normally expended during the Executing Process Group processes.

The primary elements in the Executing process group include:

- Complete work packages
- Use a work authorization system
- Collect status information
- Hold meetings
- Acquire, develop and manage project team
- Distribute project information
- Obtain bids from outside vendors
- Select a vendor
- Negotiate vendor contract

- Manage contracts
- Perform quality assurance
- Manage Stakeholder Expectations

Additional knowledge and skills needed by the PM for executing activities also include:

- Project monitoring tools and techniques
- Elements of a statement of work
- WBS interaction elements within the project schedule
- Project budgeting tools and techniques
- Quality standard tools
- Continuous improvement process

The primary goal of the Executing process is to direct and manage project work.

Executing Tasks

- Task 1: acquire and manage project resources by following the human resource and procurement management plans in order to meet project requirements.
- Task 2: manage task execution based on the project management plan by leading and developing the project team in order to achieve project deliverables.
- Task 3: implement a quality management plan using appropriate tools and techniques in order to ensure work is performed in accordance with required quality standards.
- Task 4: implement approved changes in corrective actions by following the change management plan in order to meet project requirements.
- Task 5: implement approved actions by following the risk management plan in order to minimize the impact of project risks and take advantage of opportunities on the project.
- Task 6: manage the flow of information by following the communications plan in order to keep the stakeholders engaged and informed.
- Task 7: manage stakeholder relationships by following the stakeholder management plan in order to receive continued support and manage expectations.

Monitoring and Controlling Process Group

The focus in the monitoring and controlling process group is to measure the performance of the project and address change requests, recommended corrective and preventive actions, and implement defect repairs.

The elements in the Monitoring and Controlling process group include:

- Performance measuring
- Performance reporting
- Identify and control changes

- Verify and control scope
- Control schedule
- Control cost
- Control quality
- Risk monitoring and control
- Take corrective action
- Update PM plan
- Update actions and changes
- Inspections
- Accept/Reject work
- Identify & analyze trends
- Look for new risks
- Assess variances for change or corrective action
- Manage Stakeholders
- Contract administration
- Use quality control tools
- Project performance appraisals
- Perform earned value calculations

Additional knowledge and skills needed by the PM for monitoring and controlling activities also include:

- Performance measurement and tracking techniques (e.g. PERT, EV, CPM)
- Project control limits and thresholds
- Project performance metrics
- Cost analysis techniques
- Project plan management techniques
- Change management techniques
- Integrated change control processes
- Risk identification and analysis techniques
- Risk response techniques
- Problem solving techniques (e.g. root cause analysis)
- Reporting procedures

The primary goals of this process group are: Monitor and Control Project Work and Integrated Change Control

Typically, this is one of the lowest scoring process groups on the PMI exam. Make sure you spend adequate time studying and understand the concepts and actions taken in this area. You may see exam questions regarding the following actions required to complete the monitoring and controlling process group:

- Perform root cause analysis
- Secure additional funding, if needed
- Perform validated defect repair

- Calculate the ETC (estimate to complete)
- Reassess project control systems for effectiveness

Exam Tip. For the exam assume that:

- The project management plan and subsidiary plans are complete and realistic
- You measure the project against defined metrics to determine how well the project is performing
- You implement corrective actions for any variances
- If there are deviations from the project management plan, that is the responsibility of the project manager, and the Project manager is responsible for correcting those deviations without issuing a change request. CRs should be used only as a last resort in this instance.

Monitoring and Controlling Tasks

- Task 1: measure project performance using appropriate tools and techniques in order to identify and quantify any variances and corrective actions.
- Task 2: manage changes to the project by following the change management plan in order to ensure that project goals remain the line with business needs.
- Task 3: verify that product deliverables conform to the quality standards established in the quality management plan by using appropriate tools and techniques to meet project requirements and business needs.
- Task 4: monitor and assess risk by determining whether exposure has changed and evaluating the effectiveness of response strategies in order to manage the impact of risks and opportunities on the project.
- Task 5: review the issue log, update if necessary, and determine corrective actions by using appropriate tools and techniques in order to minimize the impact on the project.
- Task 6: capture, analyze, and manage lessons learned, using lessons learned management techniques and to enable continuous improvement.
- Task 7: monitor procurement activities according to the procurement plan in order to verify compliance with project objectives.

Closing Process Group

The primary elements in the Closing process group include:

- Perform final product verification
- Deliver final contract performance reporting
- Audits of all procured service/merchandise
- Obtain formal contract acceptance
- Create a contract archive
- Complete final performance reporting
- Obtain formal acceptance of project
- Document and lessons learned

- Create the project archives
- Release all project resources

Additional knowledge and skills needed by the PM for closing activities also include:

- Contract closure requirements
- Basic project accounting principles
- Close-out procedures
- Feedback techniques
- Project review techniques
- Archiving techniques and statutes
- Compliance
- Transition planning techniques

Closing Tasks

- Task 1: obtain final acceptance of the project deliverables from relevant stakeholders in order to confirm the project scope and deliverables were achieved.
- Task 2: transfer the ownership of deliverables to the assigned stakeholders in accordance with the project plan in order to facilitate project closure.
- Task 3 obtain financial, legal, and administrative closure using generally accepted practices and policies in order to communicate for a project closure and ensure transfer of liability.
- Task 4: prepare and share the final project report according to the communications management plan in order to document and convey project performance and assist in project evaluation.
- Task 5: collate lessons learned that were documented throughout the project and conduct a comprehensive project review in order to update the organization's knowledge base.
- Task 6 archive project documents and materials using generally accepted practices in order to comply with statutory requirements and for potential use in future projects and audits.
- Task 7: obtain feedback from relevant stakeholders using appropriate tools and techniques and based on the stakeholder management plan in order to evaluate their satisfaction.

The project is only complete when administrative closure of the project has been completed. Whether the project has completed all scope elements, has completed a specific project phase, or is canceled, the project is not officially closed until Administrative Closure has been completed.

If the scope of the project has been completed, the listing above is generally a good guide to the administrative closure process. However, if the project was terminated or stopped after a specific phase, you want to document the reasons for the early termination in your closeout documentation.

If your project was successful, and of course it will be because you are an excellent project manager, there is one final step you must never forget: CELEBRATE!

Project Information

During project execution, data from the project is continuously collected and analyzed for the purpose of reporting back to senior management and stakeholders on the status and progress of the project. PMI makes distinctions between three types of project information that may appear on the exam:

- **Work Performance Data**: this consists of the raw observations and measurements taking during the performance of project activities to carry out the project work. Examples can include percentage of work completed, quality and technical performance measurements, start and finish dates of scheduled activities, number and frequency of change requests, defect counts, costs and generations, etc.
- **Work Performance Information**: this is performance data collected from various monitoring and controlling processes which is analyzed and integrated across all project areas. Examples include status of deliverables, status of change requests, forecasted estimates to completion, etc.
- **Work Performance Reports**: work performance information that has been collected in project documents. This can be in the form of dashboard reports, stoplight reports, Jeopardy reports, status and progress reports, memos, recommendations, updates, etc.

Cross-Cutting Skills

PMI has defined what is described as cross-cutting skills needed by the PM that apply to all process groups. These skills include:

- Active listening
- Brainstorming techniques
- Conflict resolution techniques
- Cultural sensitivity and diversity
- Data gathering techniques
- Decision making techniques
- Facilitation
- Information management tools, techniques, methods
- Leadership tools, techniques
- Negotiating
- Oral and written communication techniques, channels, applications
- *PMI's Code of Ethics and Professional Conduct*
- Presentation tools and techniques
- Prioritization/time management
- Problem-solving tools, techniques
- Project management software
- Relationship management
- Stakeholder impact analysis
- Targeting communications to intended audiences
- Team motivation methods

CRITICAL NOTE:

Review the high level elements in the Initiating, Planning, Executing, Monitoring and Controlling and Closing process groups from pages 3-4 thru 3-13 regularly. As you review each knowledge area, specifically review the process groups that apply to the knowledge area. This is critical for maintaining a high level perspective for the PMP examination.

Knowledge Area Logistics

There are ten key knowledge areas contained in the *PMBOK® Guide*, 5th edition. Each key knowledge area along with its subsidiary processes all follow the same format when describing deliverables for each process:

- **Inputs**- these are the documents and processes that contain the data and information from the project which are then acted upon by:
- **Tools and Techniques** - which can include formal analysis, the use of mathematical models and templates to produce:
- **Outputs** - which are the desired results of the process

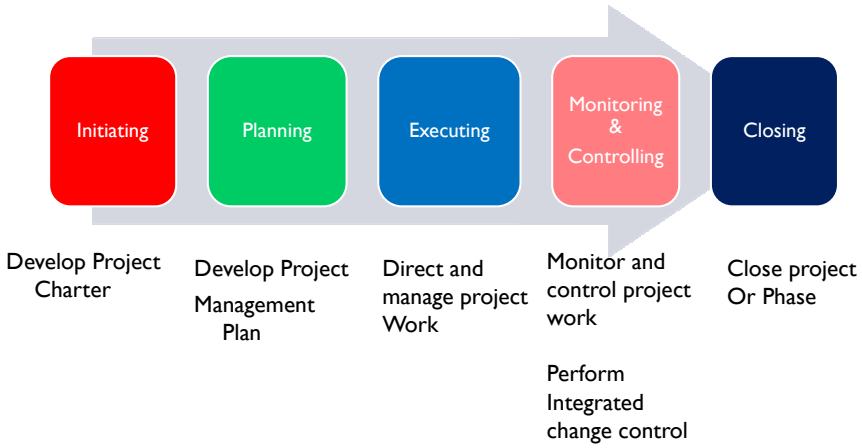
In this manual these elements will be represented in the graphic below:

The ten PMI® Knowledge Areas:

Project Integration Management	Project Human Resources Management
Project Scope Management	Project Communications Management
Project Time Management	Project Risk Management
Project Cost Management	Project Procurement Management
Project Quality Management	Project Stakeholder Management

On the next pages we will show the general processes that apply to each of the ten PMI knowledge areas.

Project Integration Management

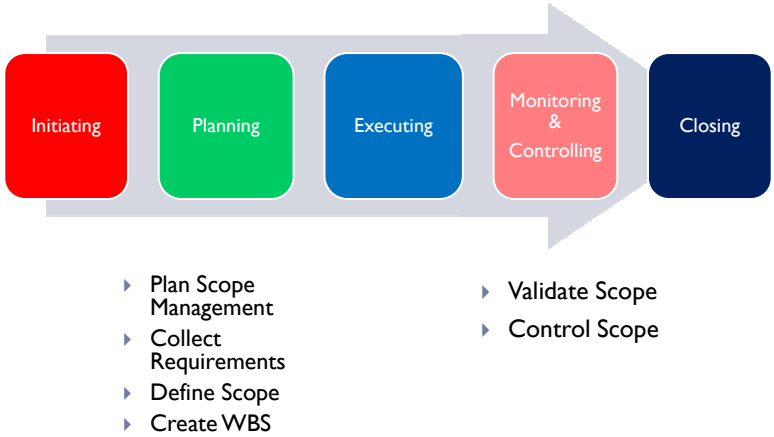


For the purposes of the exam, the primary job of the project manager is to assemble all the parts and pieces of the project into a coherent whole. The way the project manager does this is through Project Integration activities.

The Project Integration is the only area that has activities in all five of the PMI process groups. The following six processes and the primary goals of these processes are listed below:

- Develop project charter. Goal: the project charter
- Develop project management plan. Goal: the project management plan
- Direct and Manage Project Work. Goal: deliverables
- Monitor and control project work. Goal: change requests, work performance reports
- Perform integrated change control. Goal: approved change requests, change log
- Close project or phase. Goal: Final product, service, or result transition

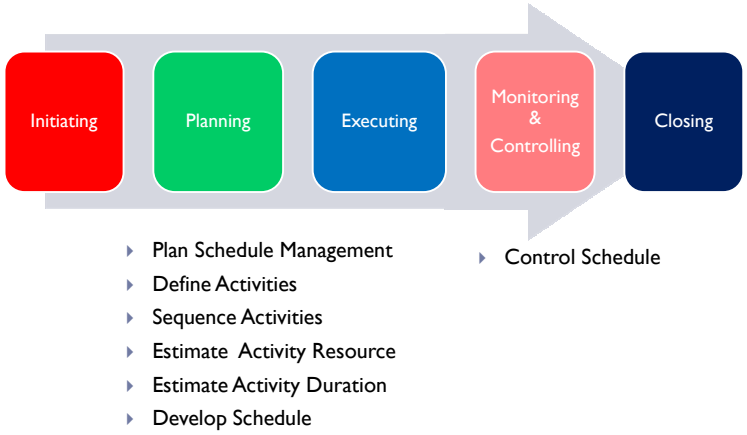
Project Scope Management



Project scope management focuses on the processes that are needed to ensure that the work of the project, and only the work required, is performed to deliver project success. The following processes and the primary goals of project scope management are defined below:

- Plan Scope Management. Goal: Scope Management Plan
- Collect requirements. Goal: requirements documentation
- Define scope. Goal: Project scope statement
- Create WBS. Goal: Scope Baseline
- Validate Scope. Goal: accepted deliverables
- Control scope. Goal: updates and change requests

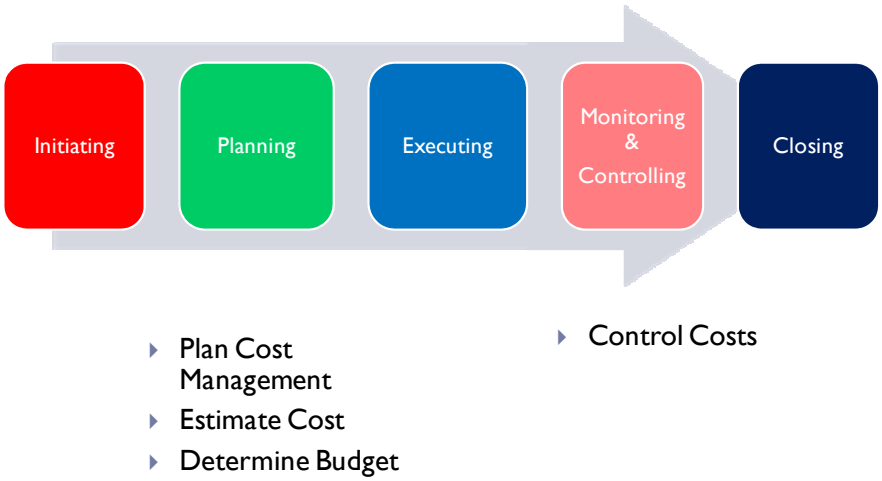
Project Time Management



Project Time management includes all the activities necessary to complete the project in a timely fashion. The following processes and the primary goals of project time management are defined below:

- Plan Schedule Management. Goal: Schedule Management Plan
- Define activities. Goal: activity list
- Sequence activities. Goal: project schedule network diagrams
- Estimate activity resources. Goal: activity resource requirements
- Estimate activity durations. Goal: activity duration estimates
- Develop schedule. Goal: schedule baseline
- Control schedule. Goal: schedule forecasts

Project Cost Management

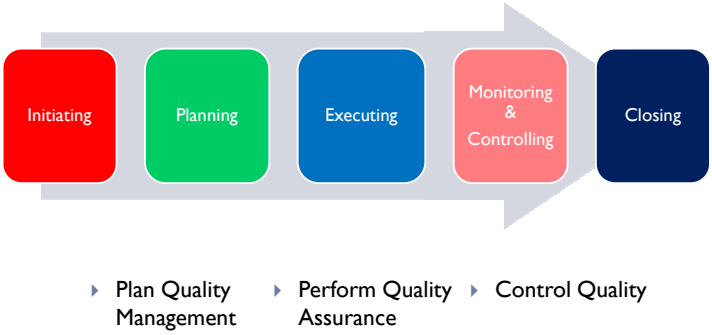


Project cost management involves the processes that are needed to estimate, budget, and control costs, so the project can be completed within the approved budget.

The following processes and the primary goals of project cost management are defined below:

- Plan Cost Management. Goal: Cost Management Plan
- Estimate costs. Goal: activity cost estimates
- Determine budget. Goal: cost performance baseline
- Control costs. Goal: cost forecasts, change requests

Project Quality Management

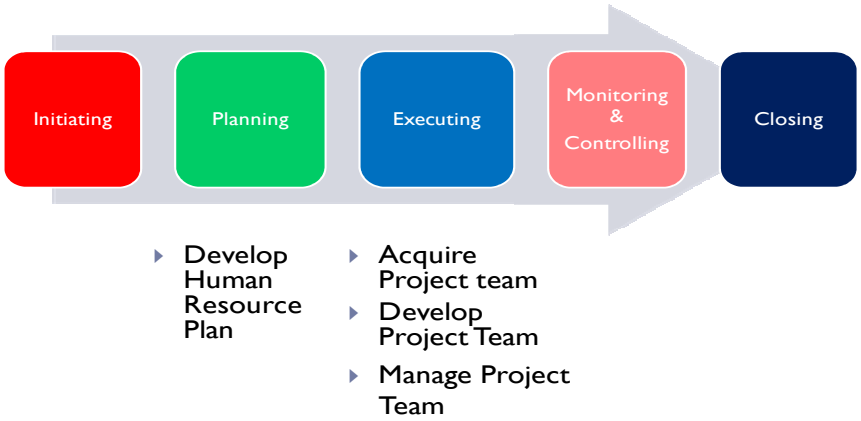


Project quality management focuses on the activities, quality policies, objectives, and measurements required to satisfy the needs of the project and ultimately the customer.

The following processes and the primary goals of Project quality management are defined below:

- Plan quality. Goal: quality management plan
- Perform quality assurance. Goal: change requests
- Control quality. Goal: verified deliverables, validated changes

Project Human Resource Management

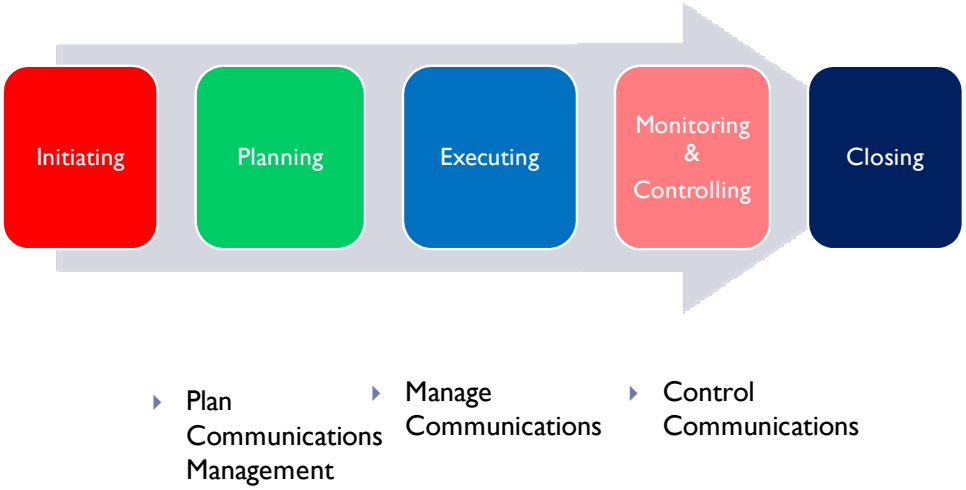


Project human resource management includes the processes that organize, manage, and lead the project team. The following processes and the primary goals of Project human resource management are defined below:

- Develop human resource plan. Goal: human resource plan
- Acquire project team. Goal: project staff assignments
- Develop project team. Goal: team performance assessments

- Manage project team. Goal: updates

Project Communications Management

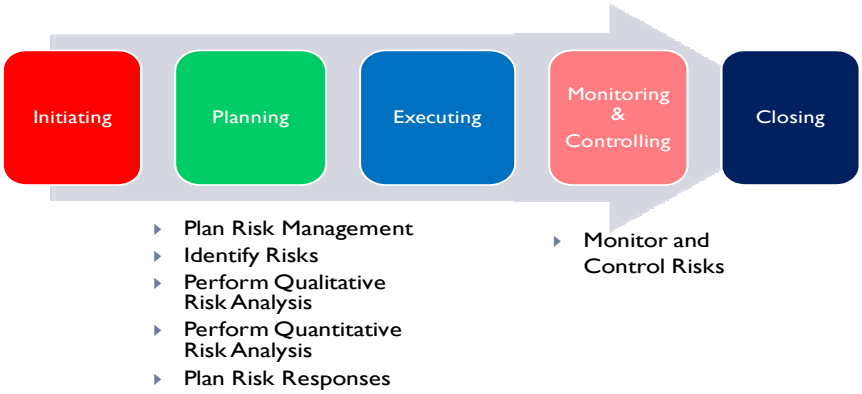


Project communications management focuses on the processes to deliver, collect, distribute, store, and retrieve project information to all internal and external project organization environments.

The following processes and the primary goals of Project communications management are defined below:

- Plan communications. Goal: communications management plan
- Manage Communications. Goal: project communications
- Control communications. Goal: work performance information, change requests

Project Risk Management

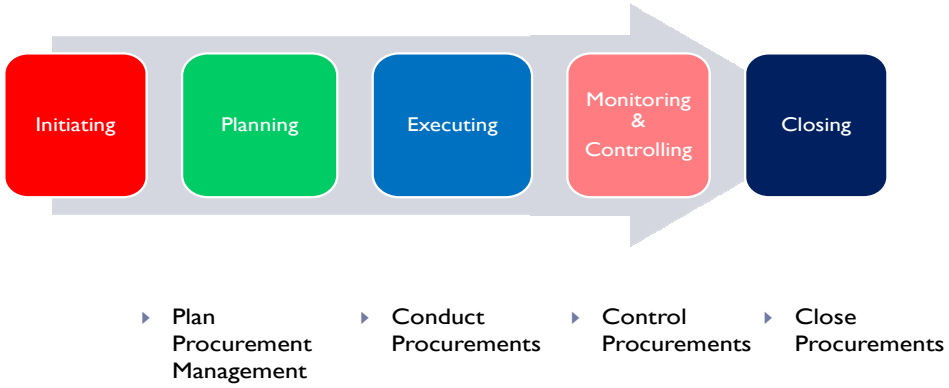


Project risk management focuses on the planning, identification, analysis, response planning, and monitoring and control of risk on a project.

The following processes and the primary goals of Project risk management are defined below:

- Plan risk management. Goal: risk management plan
- Identify risks. Goal: risk register
- Perform qualitative risk analysis. Goal: project documents updates
- Perform quantitative risk analysis. Goal: project documents updates
- Plan risk responses. Goal: project documents updates
- Monitor & control risks. Goal: project documents updates, change requests

Project Procurement Management

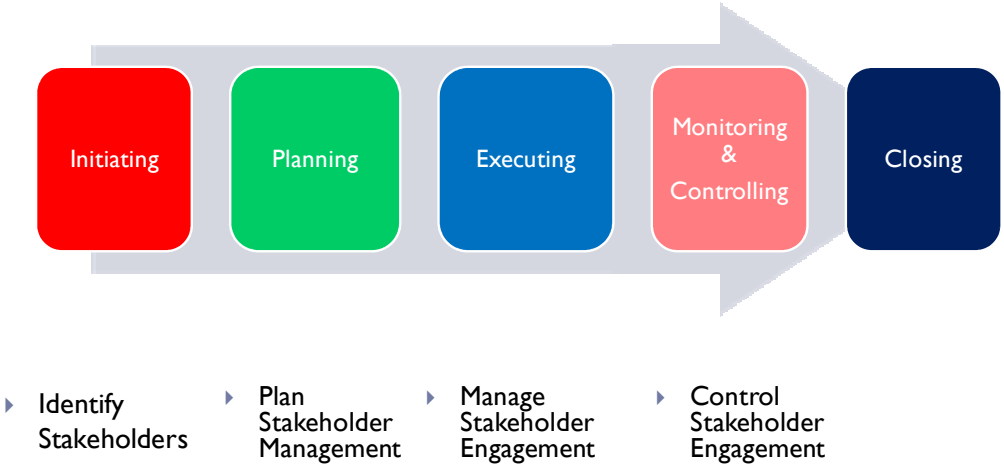


Project procurement management focuses on the processes needed to purchase or acquire products, services, or results from outside the project team or the organization.

The following processes and the primary goals of Project procurement management are defined below:

- Plan procurements. Goal: procurement management plan, procurement SOW
- Conduct procurements. Goal: select sellers, agreements (e.g. contract, sub-contract, PO, etc)
- Control procurements. Goal: procurement documentation, change requests
- Close procurements. Goal: closed procurements

Project Stakeholder Management



Project stakeholder management identifies the processes required to identify the people, groups, organizations that can impact/be impacted by the project. It involves analyzing stakeholder expectations in developing management strategies for effectively engaging stakeholders and project decisions and execution. Stakeholder management also focuses on continuous communications with stakeholders, managing conflict and promoting appropriate stakeholder engagement in project decisions and activities.

The following processes and the primary goals of project stakeholder management are defined below:

- Identify Stakeholders. Goal: stakeholder register
- Plan Stakeholder Management. Goal: stakeholder management plan
- Manage Stakeholder Engagement. Goal: issue log, change requests
- Control Stakeholder Engagement. Goal: work performance information, change requests

Role of the Knowledge Areas

A knowledge area can represent a set of concepts, terms, and activities that can constitute a professional field, a project management field, or some area of specialization. The ten knowledge areas described above are used on most projects most of the time. The interplay between the knowledge areas and the Project Management Process Groups are shown on the following page. For the PMP exam, it is expected that the credentialed seeker will commit the 47 processes and their respective knowledge areas, as well as the interplay with the Project Management Process Groups to memory.

Mapping Knowledge Areas to Process Groups

V Process Groups >>> V Knowledge Areas	Initiating	Planning	Executing	Monitoring & Controlling	Closing
4. Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work	Monitor and Control Project Work Perform Integrated Change Control	Close Project or Phase
5. Project Scope Management		Plan Scope Management Collect Requirements Define Scope Create WBS		Validate Scope Control Scope	
6. Project Time Management		Plan Schedule Management Define Activities Sequence Activities Estimate Activity Resources Estimate Activity Durations Develop Schedule		Control Schedule	
7. Project Cost Management		Plan Cost Management Estimate Costs Determine Budget		Control Costs	
8. Project Quality Management		Plan Quality Management	Perform Quality Assurance	Control Quality	
9. Project HR Management		Plan Human Resource Management	Acquire Project Team Develop Project Team Manage Project Team		
10. Project Communications Management		Plan Communications Management	Manage Communications	Control Communications	
11. Project Risk Management		Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Perform Quantitative Risk Analysis Plan Risk Responses		Control Risks	
12. Project Procurement Management		Plan Procurement Management	Conduct Procurements	Control Procurements	Close Procurements
13. Project Stakeholder Management	1dentify Stakeholders	Plan Stakeholder Management	Manage Stakeholder Engagement	Control Stakeholder Engagement	

Graphic above based on the *PMBOK® Guide,*5th edition, p. 61

It is strongly recommended that the process groups, knowledge areas, their subsidiary processes and primary goals of the processes be well understood for the examination.

Understanding Process Interactions

IMPORTANT NOTE: on the PMI, PMP exam, you will be assessed by process group, ***not*** by Knowledge Area. You will be graded as, 'proficient', 'moderately proficient' or 'not proficient' in each of the project management lifecycle process groups:

- Initiating
- Planning
- Executing
- Monitoring and Controlling
- Closing

While it is important to understand the processes in each knowledge area, it is more important to understand the interactions of the processes as they occur between the process groups. Many of the questions on the exam will test your understanding of what happens in each of the process groups. Notice on page 3 – 3 that the planning and executing processes iterate, and that this occurs under an umbrella of monitoring and controlling processes. In other words, all three process groups are occurring simultaneously, however, there are specific processes within those groups that occur in a cyclical fashion. Use the charts below to help you understand the process interactions. The specific interactions by knowledge area will appear at the beginning of each knowledge area chapter.

The table below outlines the specific, key output/deliverables by process group and knowledge area. You will find that if you address each knowledge area thoroughly, the contents of the table below will become committed to memory as you progress through this manual.

Initiating	Planning	Executing	Monitoring and Controlling	Closing
Integration: -Select Project manager -Create project charter	Project Management (PM) Plan	Deliverables Work Performance Data	-Change log -Approved CRs -CRs -Work Perf. Rpts.	Final product OPA updates
	-Scope Management Plan -Requirements Management Plan -Requirements Traceability matrix -Scope Statement -Scope baseline		-Accepted deliverables -CRs	
	Schedule Mgt. Plan Activity list/attributes Network diagrams Resource requirements Duration Estimates Schedule/baseline		-Work Performance Information -CRs	
	-Cost Management Plan -Cost estimates -Cost performance baseline		Budget forecasts	
	Quality: -Quality Management Plan -Metrics / checklists -Process Improvement Plan	CRs and updates	-Verified deliverables/changes -Work Performance Measurements -QC measurements	
	HR: Human Resource Plan	-Staff assignments -Team performance assessments -Resource calendars		
	Communications Management Plan	Project communications	Work performance information	
	Risk: -Risk Management Plan -Risk register/updates -Risk related Contract decisions -PM plan updates		Risk register Updates to: -Risk register -Project documents -CRs	
	Procurement: *-Procurement Management Plan* *-Procurement SOW* *-Make-or-buy decisions*	*Select Sellers* *Agreements*	*Procurements docs*	*Closed procurements*
Stakeholder Mgt: stakeholder register	*stakeholder management plan*	*issue log* *change requests*	*work performance information*	

In Summary…

- This section mapped the ten PMI knowledge areas:
- The five PM process groups and the importance in understanding the steps within each process group for the exam
- The definition of the 47 processes contained within each of the ten knowledge areas
- How those processes fit into the PM process groups

Chapter Three Memory Check

1. The five process groups that comprise the project management life cycle are: _____, _____, _____, _____ _____ and_____
2. The two primary outputs of the Initiating process are the project _____ and identify _____
3. The primary goal of the planning process group is to produce the _____.
4. The ten Knowledge Areas of the *PMBOK® Guide,*5th edition are, in short, _____, _____,_____, _____, _____, _____ _____, _____, _____, _____,
   and _____ _____
5. Over half of the processes that occur in the ten knowledge areas of the *PMBOK® Guide,*5th edition occur in the _____ process group
6. Only the _____knowledge area has processes in all five of the process groups of the project management life cycle
7. Two primary goals of the Monitoring and Control process group are to _____ project work and to perform _____
8. Early in the project the _____, and the _____of_____ are low – the _____ and _____ _____ are high
9. PMI defines how a project will tighten its estimates for budget and timeline as more is learned about the project as a _____ _____
10. There are ____ processes spread across the ten Knowledge Areas in the *PMBOK® Guide,*5th edition
11. Percentage of work completed, quality and technical performance measurements, start and finish dates of scheduled activities is known as _____ _____ _____, whereas status of deliverables, status of change requests, forecasted estimates to completion is called _____ _____ _____

Chapter 3 Test

1. You are managing a project in which the organization utilizes the 'waterfall approach' in executing projects. They have adopted the PMI 'methodology' and the IPECC approach has become the foundation for their internal project methodology. Senior management has approached you and has insisted that you use the phased approach as defined by PMI in delivering the project: initiate, plan, execute, monitor and control, and close (IPECC). What is the *most factual* information you can give senior management regarding IPECC process groups?
    a. You will follow the PMI methodology to the letter
    b. You will follow the PMI methodology if the specific project warrants its use
    c. The process groups are not project phases
    d. IPECC will only work if you use all the processes in the ten key process areas

2. What is the primary purpose of the Initiating process group?
    a. Determine the project goals
    b. Align stakeholder expectations with the project's purpose
    c. Determine the initial budget
    d. Identify processes and standards

3. Validate Scope is part of what process group?
    a. Planning
    b. Executing
    c. Closing
    d. Monitoring and Controlling

4. The completion of work packages, holding meetings, distributing Project information, negotiating contracts and performing quality assurance are all part of what process group?
    a. Executing
    b. Planning
    c. Initiating
    d. Closing

5. The Planning process group touches all ten of the key knowledge areas in that planning has to occur in each of these areas. Which of the following is *not* part of the planning process?
    a. Creating the WBS
    b. Develop the project management plan
    c. Estimate activity durations
    d. Identify stakeholders

6. You are a senior project manager at a company that has just hired several junior project managers. Part of your job is to mentor these junior project managers so that they can rapidly become effective in the organization. Each of these junior project managers is a PMP® so you are reasonably sure that they understand the PMI framework. You decide to find out how deep their knowledge goes and ask them, "How many of the processes in the key knowledge areas do we use all the time?" Which junior PM gave the *best* answer?
    a. Jr. PM#1: All the processes have to be used all the time; otherwise you're not following the PMI methodology.
    b. Jr. PM#2: All the Planning processes have to be used all the time; you have some flexibility with the other process groups
    c. Jr. PM#3: The Project manager and their teams are responsible for determining which processes are appropriate for the specific project

d. Jr. PM#4: ***All*** processes in the Planning group that address the triple constraints of cost, time, and budget, along with risk planning must be done on all projects. The remaining processes are at the discretion of the project manager

7. In the Monitoring and Controlling process group, one of the primary goals of that group is to monitor and control the project work. What is the second equally important, major goal of the monitoring and control process?
    a. Quality control
    b. Change control
    c. Scope control and verification
    d. Corrective action

8. You are just initiating a project for your organization. Which of the following is a true statement regarding the Initiating process?
    a. Risk is low but stakeholder influence is high
    b. Staffing level is high while chance of success is low
    c. Risk is high but the chances of success are also high
    d. Stakeholder influence is high while costs are low

9. Your project is in the planning phase and many of the stakeholders are excited about the product that will be delivered once the project is done. You have solicited input from the stakeholders, addressed technical issues with the technical team, estimated costs, determined the high-level project schedule, created a statement of work, created a work breakdown structure, identified and quantified risks, developed the project management plan and all subsidiary key knowledge area plans, and received stakeholder sign off of the plan. What is the *next* thing you will most likely do?
    a. Verify stakeholder input
    b. Hold a kickoff meeting
    c. Consult management for a go/no-go decision
    d. Place the project management plan under configuration management

10. In the Executing process group the main goal is to Direct and Manage Project Work. All of the following are elements in the executing process group with *one exception*:
    a. Complete work packages and use a work authorization system
    b. Obtain bids from vendors, select vendors and negotiate the vendor contract
    c. Collect status information and hold meetings
    d. Validate the deliverables as the project is being executed

11. When does the Closure process occur?
    a. Closure occurs only at the end of the project
    b. Closure activities can occur at the end of the project or at the end of a project phase
    c. Closure occurs before the closeout of any contracts on the project
    d. Closure occurs after the stakeholders have conducted user acceptance testing

12. The project you are managing includes many stakeholders, geographically distributed across the country. As part of the planning process you have put together a communications plan that will address the communications needs of all the stakeholders on the project, from the performing organization up to and including the sponsor. Part of this communications plan includes the distribution of information as well as reporting the performance of the team. The PMI process groups you are utilizing are:
    a. Information distribution and performance reporting occur in the Executing process group
    b. Information distribution and performance reporting occur in the Monitoring and Controlling process group

c. Information distribution occurs in the Executing process group while performance reporting occurs in the Monitoring and Controlling process group
d. Information distribution occurs in the Monitoring and Controlling process group while performance reporting occurs in the Executing process group

13. You are engaged in a large project that requires complex coordination between many departments in your organization. You have almost completed the planning phase and are looking for sign-off of the project management plan. You have addressed overall project integration activities, the budget, the timeline, the scope of the work, quality planning, resource acquisition, communications for a distributed team, and some procurement activities that require the use of external vendors. What has the project manager forgotten to do?
    a. Create a work breakdown structure
    b. Risk assessment
    c. Creation of a requirements traceability matrix
    d. Creation of a change management system

14. There are many reasons for creating a lessons learned document in a project. All of the following represent reasons why you would create a lessons learned document with the *exception* of:
    a. Creates an archive to advise future project teams about types of projects and resources they should avoid when initiating similar projects
    b. Serves as a historical record for what worked and what did not work in your project so that future project teams can make use of the information
    c. Used as a phase-end review tool so the team can implement incremental process improvement activities for the subsequent phases
    d. Gives all project stakeholders a chance to input what issue resolution approaches were most effective for them on the project

15. You have been brought into a project for a 'project rescue'. Management had issues with the previous project manager and dismissed him from the company. You sit down with the project team for the first time and discover that there is a lot of activity going on and that the project is well under way: the requirements have been completed and design work is about half way done. However, there is a lot of contention between the members of the performing organization. A number of people are arguing about who should handle what activities, how long they are going to take, and in what order the activities should occur. From listening to these arguments it becomes clear to you that the prior project manager *probably* did not do what?
    a. Obtain formal approval of the project charter
    b. Identify processes and standards
    c. Determine the project schedule
    d. Create a project management plan

16. The team has completed all design work and is ready to start creating a product of the project. There are construction and IT elements in this project, and the project manager has leaned heavily on the subject matter experts in the organization for their technical expertise and know-how. You have determined that some of the work needs to be contracted to an external vendor who has the necessary expertise to deliver what is needed for the project. You are in the process of selecting a vendor. What process group are you in?
    a. Planning
    b. Initiating
    c. Monitoring and Controlling
    d. Executing

17. All the following happen in the Initiating process with the *exception* of:
    a. Choose the project team
    b. Determine stakeholders
    c. Identify processes and standards
    d. Create the project charter

18. You are deep in the planning process for your project and have created a human resource plan in which you have identified what skill sets are needed, when they are needed, and when they will roll off the project. You are now focused on the process of acquiring, developing, and managing the project team. Which of these processes occur in the monitoring and controlling process group?
    a. Acquire project team only
    b. Manage project team only
    c. Develop and Manage project team only
    d. This is a trick question - none of them do

19. Within the Project Time Management knowledge area, in what order do the planning activities occur before you can develop the project schedule?
    a. Define activities, estimate activity duration, estimated activity resources, sequence activities
    b. Define activities, estimate activity resources, sequence activities, estimate activity duration
    c. Define activities, sequence activities, estimate activity resources, estimate activity duration
    d. Define activities, estimate activity duration, sequence activities, estimate activity resources

20. One of the Junior Project managers you're mentoring has come to you for help. She just started the planning process and sat down with the key stakeholders to begin the requirements collection activities for her project. At the end of the meeting the stakeholder who will be receiving the deliverable stated that he wanted to see a definitive budget estimate for the project within one week of the completion of the requirements collection process. She explained that might not be possible because the team will not have had enough detail at that point to construct a solid estimate. He said he didn't care and that he needed the estimate for the capital budgeting meeting that is occurring at the end of the month - two weeks from now. What is the *best* advice you can give your Junior Project manager?
    a. Take your best guess and double it. Since it is too early in the project to deliver a definitive estimate you tell the stakeholder this is the best estimate you can come up with at this point
    b. It is not possible to deliver a definitive estimate until the planning process is complete. The best you can do at this point is a rough order of magnitude estimate
    c. Escalate the issue to senior management as the stakeholder is obviously delusional
    d. Sit down with the delivery organization, work through the weekend if you have to, and come up with the closest estimate you can deliver.

21. Where do lessons learned activities occur?
    a. In between the monitoring and controlling process and the closing process
    b. Whenever there is an issue identified that needs to be addressed
    c. In each phase-end closing process as well as the closing process at the end of the project
    d. Only at the end of the project

22. What is a synonym for 'progressive elaboration'?
    a. Cyclical planning
    b. Quantified elaboration
    c. PERT estimates
    d. Rolling wave planning

23. You are managing a program to recruit new project managers for your organization. You have just completed a training session in which you have identified the five process groups in the PMI framework

and just asked the class the following question: “What is the purpose of the initiating process group?” Which of the student responses was the *best* answer?

a. Initiating kicks off the project
b. Initiating can kick off the project or a phase of the project
c. Initiating can kick off a project, a project phase, or contract
d. Initiating identifies the project manager and produces a project charter

24. What is the key primary benefit of the monitoring and controlling process group?
    a. It manages the change request process
    b. It plays a key role in measuring and managing procurement activities for the project
    c. You can observe project performance, measure it, and identify variances from the project management plan
    d. Insures, through metrics and measurement, that changes to the project management plan are prevented to eliminate scope creep

25. In an organization that uses 'hit or miss' project processes, they have come to you for advice on which of the five PMI process groups would be the best one to implement, if they had to boil it down to just one. What is the *best* advice you could give them?
    a. Executing processes would serve you best
    b. Planning processes would serve you best
    c. Initiating processes would serve you best
    d. Monitoring and Controlling processes would serve you best

26. You are a project manager in an organization with a strong PMO. One of the newly hired project managers told you that he has been a PMP® since 1998. While perusing the PMI website looking for some standards documentation, you happen to do a lookup on this person and find out that they are not in the PMI repository of PMP®s in good standing. What do you do?
    a. Call law enforcement and report the individual
    b. Report the individual to PMI
    c. Report the individual to his senior manager
    d. Report the individual to the PMO

27. Raw observations and measurements taking during the performance of project activities is defined by PMI as _____?
    a. Work performance information
    b. Work performance data
    c. Work performance report
    d. Work performance criteria

28. Processes that provide the project team with insight into the health of the project and identifies any area requiring additional attention are performed in _____.
    a. Planning
    b. Initiating
    c. Executing
    d. Monitoring and Controlling

Chapter 3 – Test Answers

1. C – The process groups are not project lifecycle phases. *PMBOK® Guide*, 5th edition, p. 52
2. B – While answers A, C, and D are partially correct, the purpose of the initiating process group is to align stakeholder expectations with the project's purpose. *PMBOK® Guide*, 5th edition, p. 54
3. D – Monitoring and controlling is the only correct answer. *PMBOK® Guide*, 5th edition, p. 61
4. A – Executing is the only correct answer. *PMBOK® Guide*, 5th edition, pp. 56
5. D – Identify stakeholders is part of the Initiating process
6. C – In *PMBOK® Guide*, 5th edition, p 48
7. B – Integrated Change Control is the only correct answer. *PMBOK® Guide*, 5th edition, p. 57
8. D – This is the only correct answer. *PMBOK® Guide*, 5th edition, p. 54
9. C – In phase gated process, when the planning work is completed and signoffs are received, we are looking for a go/no go decision from senior management
10. D – Validating deliverables is in the monitoring and controlling process group occurring in the Validate Scope process
11. B – Closure occurs at phase-end and project end activities
12. A – Information distribution and performance reporting both occur in the Executing process group. *PMBOK® Guide*, 5th edition, p. 301
13. B – Risk assessment is the only remaining knowledge area that was not covered
14. A – Lessons learned are not used to torpedo resources you had issues with or steer you away from uncomfortable projects. They usually focus on performance and process improvement
15. D – Only a well documented project management plan (which includes the entire scope baseline) would help to organize the work
16. D – Vendor identification and selection occurs in the Executing process group. *PMBOK® Guide*, 5th edition, p. 356
17. A – Choosing the project team is an Executing group activity. *PMBOK® Guide*, 5th edition, p. 267
18. D – It is a trick question; there are no processes in the Human Resources knowledge area that fall into the Monitoring and Controlling process group
19. C – Define activities, sequence activities, estimate activity resources, estimate activity durations is the correct sequence. *PMBOK® Guide*, 5th edition, p. 61
20. B – Your job is to give management a reality check, not feed in to a management wish- fulfillment fantasy or turn yourself and the team inside-out attempting to meet an impossible demand. This eliminates answers A and D. Answer C is something you might wish to say ☺, but will always be wrong on the exam…
21. C – Lessons learned occur when ever the closure process occurs: phase-end or end of project
22. D – Rolling wave planning is the correct answer. A and B are non-existent terms and PERT is used for schedule estimating
23. B – This is the most inclusive answer. A and D are both true but not complete. C is a red herring. *PMBOK® Guide*, 5th edition, p 44 "The Initiating Process Group consists of those processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project or phase"
24. C – *PMBOK® Guide*, 5th edition p 57
25. B – All the processes are important, but they all depend on Planning
26. B – Report the individual to PMI. The PMP® credential is issued by PMI, not your organization. Answer A is a red herring. Answers C and D, while seemingly appropriate, miss the point: the credential comes from PMI
27. B - This is the definition of work performance data. *PMBOK® Guide*, 5th edition p 59
28. D - This identifies a monitoring and controlling process. *PMBOK® Guide*, 5th edition p 57

Chapter 4 : Project Integration Management

Knowledge Area Processes:

- Develop Project Charter
- Develop Project Management Plan
- Direct and Manage Project Work
- Monitor and Control Project Work
- Integrated Change Control
- Close Project

Section Objectives

At completion you will know how to:

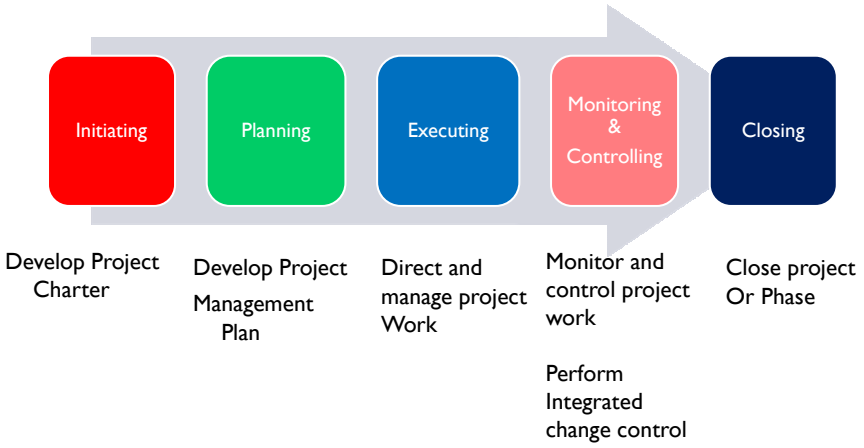
- Organize Integration management processes into the PM process groups
- List the elements and purpose of a project charter
- Describe the two fundamental project selection techniques
- Define a PMIS and its two key components
- List the components and importance of a project management plan
- Describe the components and importance of a change control system and a configuration management system
- Perform steps needed to implement changes

Integration Process Summary

The high level Project Integration Management outputs, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
-Project Charter -Select project manager	PM Plan	-Deliverables -Work Performance information -CR's	-CRs -Work performance reports	Final Product
			Approved CR's Change log	OPA Updates

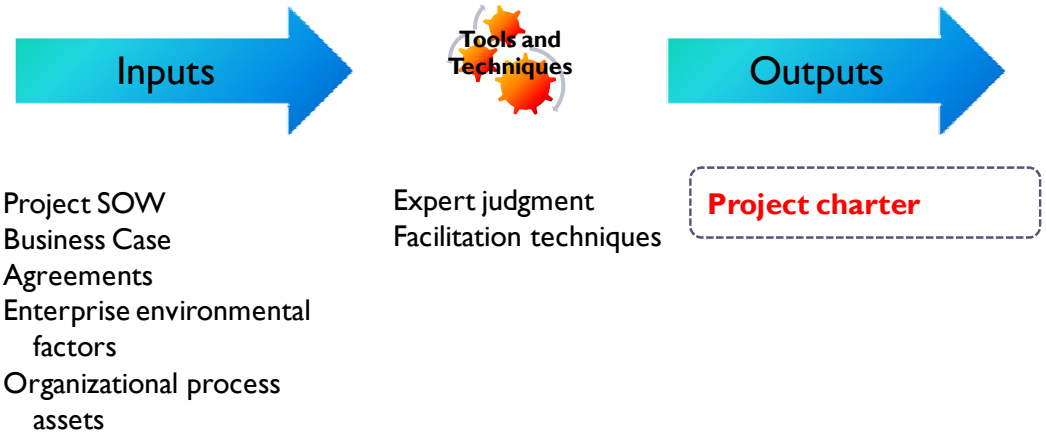
Project Integration Management



For the purposes of the exam it is important to know both the process areas within the Project integration management knowledge area, and which project management process group each of the processes fall into:

Process	Process Group
Develop Project Charter	Initiating
Develop Project Management Plan	Planning
Direct and Manage Project Work	Executing
Monitor and Control Project Work	Monitoring & control
Perform Integrated Change Control	Monitoring & control
Close Project or Phase	Close

Develop the Project Charter



Contrary to how many businesses do this, a project charter is a brief two or three page document (at most) that imparts high-level information about the project: The project description, project manager and their authority level, a high-level business case, stakeholders, high-level deliverables list, high-level project risks, defined project objectives, project approval requirements and formal sign off are all part of the project charter. Projects are initiated by someone external to the project such as a sponsor or other management function (e.g. portfolio manager, PMO, VP, etc.)

In one sense, the project charter functions as an excellent executive summary of the project. For the exam, know that a charter is a required element that must be completed and signed off before further project work can begin.

Charter Elements

Key charter benefits - elements for the exam:

- Formally recognizes existence of the project
- The PM is authorized to spend money and commit resources to the project (most commonly described benefit)
- Describes high-level requirements
- Links the project to other work in the organization

The charter elements may include, but are not limited to:

- Project title
- Project manager assigned and authority level
- Business need
- Project justification/business case
- Initial resources pre-assigned
- Stakeholders

- Initial scope and requirements
- Project/product description and deliverables
- Initial constraints and assumptions
- May include S.M.A.R.T. goals (Specific, Measurable, Agreed, Realistic, Time-bound)*
- High level budget estimate
- Sponsor Signature/signoff

*There are many variants on the SMART acronym. A few appear below[8]:

S - specific, significant, stretching
M - measurable, meaningful, motivational
A - agreed upon, attainable, achievable, acceptable, action-oriented
R - realistic, relevant, reasonable, rewarding, results-oriented
T - time-based, timely, tangible, trackable

Project Statement of Work

The project SOW is a high-level description of the products or services the project will create. It is usually created by the customer/sponsor.

Fundamental elements of an SOW:

- Business need
- *Product* scope description
- Strategic plan

Usually a summary if the work is being performed internally – the detail is developed in the WBS

For external services procured, the SOW is called the 'Procurement Statement of Work' (Details will be addressed in Section 12 on Procurement)

In regards to the project charter, the Project Statement of Work is more of a high-level summary. According to PMI, it is a narrative that describes products or services that are delivered by the project. (*PMBOK® Guide*, 5th edition, p. 75). For an internal project, work is actually detailed in the work breakdown structure (WBS) and the WBS dictionary. The Project Statement of Work references:

- Business need
- Product scope
- Strategic plan

A *contract*or procurement statement of work is a legal document that requires a legal review and review by contract administration professionals. Contract statements of work can run many thousands of pages on a large project, and legally obligates the vendor to deliver exactly what is in the contract statement of work. Details on the contract statement of work will be addressed in the Project Procurement Management section (Section 12).

[8] http://www.projectsmart.co.uk/smart-goals.html, Duncan Haughey, PMP

Business Case

The business case, in its most simple terms, tells us why the business organization is attempting the project at all. It is usually completed by a business analyst and includes the business need as well as the cost-benefit analysis. PMI states the business case is created due to one or more of the following:

- Market demand
- Organizational need
- Customer request
- Technological advance
- Legal requirement
- Ecological impact
- Social need

Agreements

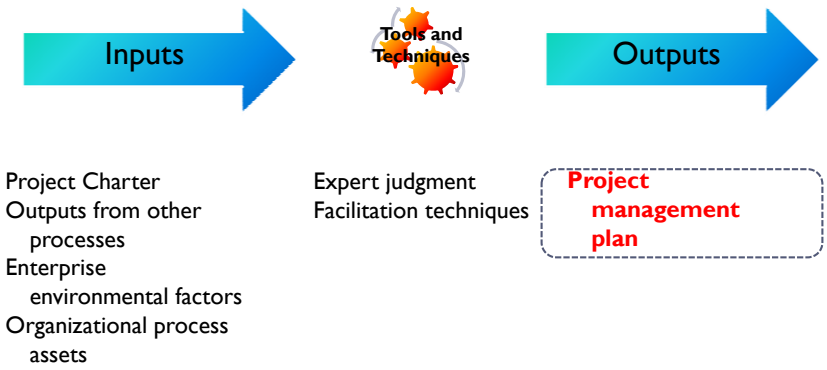
An agreement can take the form of a contract, service level agreement (SLA), letter of agreement (LOA), letter of intent (LOI), or a memorandum of understanding (MOU). Contracts are usually employed when the project is undertaken for an external customer.

Additional Financial Terms

Know what these terms mean for the exam:

- **Sunk costs** – what you have spent. Should not be considered when deciding whether to continue with a troubled project
- **Law of diminishing returns** – the more you put in, the less you get in return
- **Working capital –** assets minus liabilities; what the company has to invest in projects
- **Depreciation** – know these for the exam
    - Straight-line depreciation
    - Accelerated depreciation
        - Double declining balance
        - Sum of the Years Digits
- **Categories of cost**
    - _____ – attributable to the project
    - _____ – overhead items shared by multiple projects
    - _____ – costs that change with the level of effort
    - _____ – rentals/leases
- **Economic value added:** added value produced by the project above the costs of financing the project

Develop the Project Management Plan



Notice that the Project charter as well as organizational process assets (how the organization does projects) and enterprise environmental factors (what the organization is like) are the major inputs to the creation of the project management plan.

The project management plan essentially defines how you will execute, monitor and control, and close the project. When the project management plan is complete, it requires signoff by all key stakeholders on the project.

A critical element to remember is that the project management plan is not 'etched in stone'. If the project is managed as PMI recommends, as a progressive elaboration, adjustments to the project management plan will occur as the team learns more about the project - it is developed through all the integrated processes until the project is closed.

Project Management Plan Defined

- Always written out - *NOT* an MS Gantt chart (!)
- A repository for subsidiary plans needed for the project
- Created by the PM with input from stakeholders
- A formal document approved by designated stakeholders
- Progressively elaborated

The project management plan integrates all of the Knowledge Areas into a unified whole and serves as a repository for the subsidiary plans in the remaining knowledge areas. However, this does not mean that all the subsidiary plans are always used on every project. PMI clearly states:

"Project managers and their teams should carefully address each process and its inputs and outputs and determine which are applicable to the project they are working on... This effort is known as tailoring."[9]

[9] *PMBOK® Guide,*5th edition, p 48

The project management plan represents a consolidation of all the subsidiary management plans from all the other process groups as well as from Integration Management. Subsidiary plans can include the following:

- Scope management plan
- Requirements management plan
- Change management plan
- Configuration management plan
- Schedule management plan
- Cost management plan
- Quality management plan
- Process improvement plan
- Human resource plan
- Communications management plan
- Risk management plan
- Procurement management plan

Why the Project Management Plan Is Needed

- Defines the life cycle selected for the project
- Details the tailoring decisions made by the PM team used to manage the specific project, including the dependencies and interactions among those processes, implementation levels, tools and techniques and the essential inputs and outputs
- How work will be executed to accomplish the project objectives
- How changes will be monitored and controlled
- How configuration management will be performed
- How integrity of the performance measurement baselines will be maintained and used
- The need and techniques for communication among stakeholders
- The selected project life cycle and, for multi-phase projects, the associated project phases
- Key management reviews for content, extent, and timing to facilitate addressing open issues and pending decisions

Bullet points above described some of the major reasons why the project management plan is needed on a project; however there are several other critical reasons why you need a documented project management plan:

1. If there are changes to the project, that information will need to be captured in the plan. Changes may necessitate a change in direction or possibly a change in the schedule, budget, or scope of the project.
2. Capturing versions of the project management plan as the project changes can help identify trends or issues as the project management plan is executed.
3. Most importantly of all, the documentation is key to understanding what we did, why we did it, and, in the case of issues, what we did to correct problems.
4. Last and most simple is this: **if it is not written down it doesn't exist.** On a large project with many complexities it would be careless and unprofessional to trust critical project elements to

memory. A formal written record is essential if we are to evaluate our actions and whether they were successful or not. “How can you fix the problem if you don't know what's broken?"

Project Management Plan Components

- Baselines for cost, schedule, and scope
- Scope statement
- WBS (work breakdown structure)
- Cost estimates, schedule, and responsibility (ownership) for each deliverable
- Performance measurement baselines
- Staff requirements with cost estimates
- Subsidiary management plans for scope, schedule, cost, quality, communications, risk, configuration management, change management, requirements management, process improvement and procurement

Bullet points listed above describe some of the major components in a generic project management plan, however there are a number of other components that can be included. For example, on a software project, you might consider the following additional elements to include in your project management plan:

- Management philosophy
- Development philosophy
- Waivers
- Services
- Non-deliverable products
- Computer systems support
- Peer reviews
- Test philosophy
- Training needs
- Automated aids
- And others…

“The project management plan integrates and consolidates all of the subsidiary management plans and baselines from the planning processes…”[10]

[10] *PMBOK® Guide*, 5th edition, p. 81

Project Documents

There are a series of project documents that are used to help manage the project. These documents are not part of the project management plan but are frequently created and updated throughout the project.

Exam Tip: Knowing where these documents are created (knowledge area), the process where they are utilized, and whether they are inputs or outputs (or potentially both!), will give the PMP credential seeker an excellent overview for the exam. Be able to identify each of these documents and where they exist as inputs and/or outputs by knowledge area and process as well as process group:

- Activity attributes
- Activity cost estimates
- Activity duration estimates
- Activity list
- Activity resource requirements
- Agreements
- Basis of estimates
- Change log
- Change requests
- Forecasts
- Issue log
- Milestone list
- Procurement documents
- Procurement SOW
- Project Calendars
- Project charter
- Project funding requirements
- Project schedule
- Project schedule network diagrams
- Project staff assignments
- Project SOW
- Quality checklists
- Quality control measurements
- Quality metrics
- Requirements documentation
- Requirements traceability matrix
- Resource breakdown structure
- Resource calendars
- Risk Register
- Schedule data
- Seller proposals
- Stakeholder register
- Team performance assessments
- Work performance data
- Work performance information
- Work performance reports

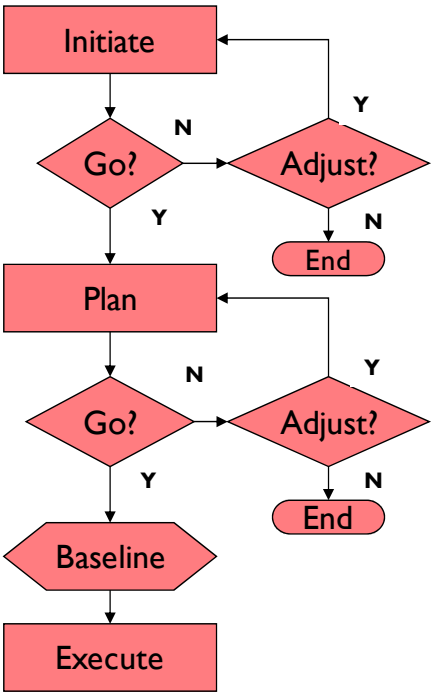
Baselining the Project Management Plan

The project plan is baselined:

- When all stakeholders have completed and signed-off on all the elements in the Project Planning Phase
- The baseline is the starting point by which all subsequent changes to the project are measured
    - The baseline represents the starting point of ***progressive elaboration*** activities
    - Critical for managing change against the reality of the project
    - Also key in defining Lessons Learned at the phase/project close
    - Once the PMP is baselined, is it subject to formal change control

The graphic below shows a generic phase-gated process for baselining a PM plan.

Once the project management plan is complete and all the stakeholders have signed off project management plan, the project management plan is ' baselined'. This means that we use the baselined project management plan as a yardstick against which we measure all subsequent changes to the plan. This information is captured in the performance measurement baseline(PMB):



"The performance measurement baseline is an approved scope-schedule-cost plan for the project work against which the project execution is compared to measure and manage performance. The PMB includes contingency reserve, but excludes management reserve "[11]

If there are significant changes to the project management plan - for example if there are major discovery elements that add significant scope, time, and budget to the plan - we can re-baseline the project management plan to accommodate those changes. Re-baselining the project management plan generally means that we are working to a new completion date, additional budget and sometimes additional scope elements as well.

If we are applying the project management life cycle for each phase of the project, we can capture lessons learned at the end of each phase and enter these elements in the project management plan as the plan is progressively elaborated.

Configuration Management

- A key element in the project plan that works hand in hand with the change control system
- Used to document all versions of:
  - Project documentation
  - Schedule
  - Scope
  - Deliverables (hardware, software, etc)
  - Completed project components

All this information is contained in the PMIS (Project Management Information System) – an EEF

Configuration management is a key element for both manufactured product as well as software products. As various versions of products are released in the marketplace due to improvements or corrective action, the configuration system must capture these changes so that the customer receives the correct version of the product at all times.

[11] *PMBOK® Guide,* 5th edition, p 549

Failing to keep a proper configuration file on a 15,000 BTU air conditioner and installing a replacement for a failed capacitor might cause the air conditioner to catch fire (or explode!) upon startup, if the configuration file does not reflect the correct hardware list for that specific model of air-conditioner.

Sending an incorrect software patch to a customer for a specific version of software could cause the software to fail catastrophically, if the software configuration system is not keeping track of the specific version of the software, and all concomitant components being used by the customer.

Project Management Information System (PMIS)

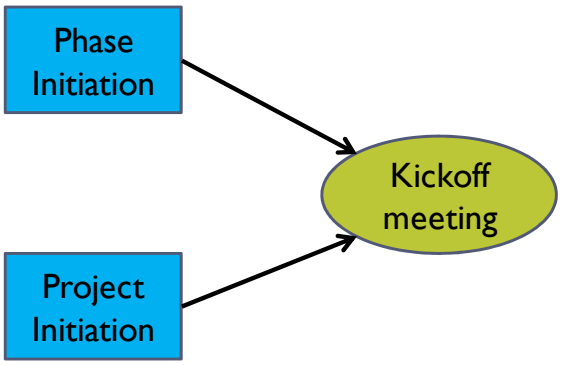
The PMIS includes:

- The Configuration Management System
  - Identifies and documents the functional and physical characteristics of a product or component
  - Controls any changes to such characteristics
  - Records and reports each change and its implementation status
  - Supports the audit of the products or components to verify conformance to requirements

- The Change Control System
  - The change control system is a collection of formal documented procedures that define how project deliverables and documentation are controlled, changed, and approved
  - The change control system is subsumed within the configuration management system- while the change control system tracks approved and rejected changes, the approved changes become part of the product and, as such, are maintained in the configuration management system.

The PMIS is usually an automated system, although it can also be manual. It is used by the project management team to support generation and versioned storage of all project documents and subsidiary documents feeding the PM Plan.

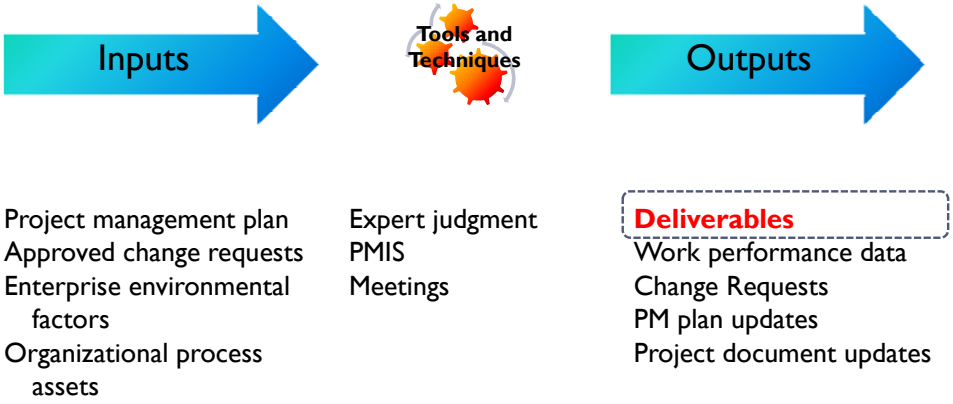
Project Kickoff Meeting



The kickoff meeting is called by the project manager and formally introduces the project team and all stakeholders to the project.[12]Optimally, it is best if the kickoff meeting can be held face-to-face with all participants. Due to the distributed nature of teams in the current business environment, this is not always possible. Therefore it is strongly recommended that use of videoconferencing or minimally conference calls with electronic support can be viable alternatives. Kickoff meetings can also occur at the beginning of project phases as well as at different levels in the organizational hierarchy e.g. business kickoff meeting, technical kickoff meeting, infrastructure kickoff meeting, etc. Some of the elements that need to be established in the kickoff meeting include, but are not limited to:

- **Project Review** - review the high-level details of the project including project risks, approximate schedule, approximate budget, high level scope, project constraints or any other required element.
- **Responsibility Assignment Matrix** - for any issues or risks that come up in the project a responsible party will need to be identified along with a due date for resolution.
- **Participation of Key Stakeholders** - it is important to determine upfront what kind of information your stakeholders need, when they need it, how frequently, and in what format
- **Escalation Path** - in the event there are project issues beyond the control of the project manager or the immediate performing organization, a clear escalation hierarchy for problems is required.
- **Frequency and Need for Meetings** - establish immediately the frequency of team meetings and their necessity. Status can be handled via e-mail or posted on an intranet - it may not require valuable team time to hold a meeting simply to report status. Also, decide the criteria for conducting a meeting.

Direct and Manage Project Work



This process performs the work described in the project management plan to achieve the project objectives. This includes managing the schedule, the budget, scope, quality, communications, human resources, risks, and procurements for the project. Because the primary job of the project manager is an integration function, we must keep all the knowledge areas constantly in mind throughout the project.

Exam Tip:
Change requests can include preventive actions, corrective actions or defect repairs. Keep this in mind as *change requests are a frequent output of most Executing and Monitoring & Controlling processes.*

[12]www.cioarchives.ca.gov, *1997.*

Project Execution Actions

- Staff, train, and manage the project team members assigned to the project
- Obtain quotations, bids, offers, or proposals
- Select sellers by choosing from among potential sellers
- Implement the planned methods and standards
- Create project deliverables
- Manage risks and implement risk response activities
- Manage sellers
- Adapt approved changes into the project's scope, plans, and environment
- Establish and manage project communication channels, both external and internal to the project team
- Collect project data and report cost, schedule, technical and quality progress, and status information to facilitate forecasting
- Collect and document lessons learned, and implement approved process improvement activities

One of the key aspects of Direct and Manage Project Work involves the implementation of the approved changes. These changes usually fall into one of the following four categories:

- **Corrective action**. Designed to bring future project work in line with the project management plan.
- **Preventive action.** Designed to reduce the probability of a negative result associated with project risks
- **Defect repair.** Designed to detect any defect in a project process or component with recommendations to repair and or replace the process or component
- **Updates.** Changes to project documents

Work Performance Information: Can be an input or an output. Typically addresses:

- Deliverable status
- Schedule progress
- Costs incurred

Other concepts that may be covered in the exam but not covered in the *PMBOK® Guide*, 5th edition are the concepts of "Ensuring Common Understanding and Being of Service".

Ensuring Common Understanding means that the project manager ensures everyone is kept up to date on all management plans, project schedules, elements that are in or out of scope, and more. In short it means 'keeping the project team and the stakeholders on the same page'.

Being of Service means the project manager assists the team to help find solutions to problems, facilitating technical meetings, removing roadblocks to project work, and others. In short it means 'how can I help you'.

Monitor and Control Project Work

Inputs	Tools and Techniques	Outputs
Project management plan Schedule forecasts Cost forecasts Validated changes Work performance info Enterprise environmental factors Organizational process assets	Expert judgment Analytical techniques PMIS Meetings	**Change requests** **Work performance reports** PM plan updates Project document updates

The monitor and control project work process is one that is done from the beginning of the project through the close of the project. It not only applies to the project at a macro level, but it also applies to each phase of the project as one of the five basic project management life cycle process groups. For the exam, understand that when the subject is discussed, you need to be able to put it in context. It could be referencing one of the five process groups OR monitoring and controlling within the Integration process.

Analytical Techniques can include: Regression analysis, grouping methods, multiple equation models, FMEA (Failure Modes and Effects Analysis), reserve analysis and trend analysis.

Corrective Action

Any action needed to bring future project performance in line with the project management plan is called a corrective action. The three basic steps of Corrective Action:

- Identify the need to take corrective action
- Take corrective action
- Measure the result to determine if additional action is necessary

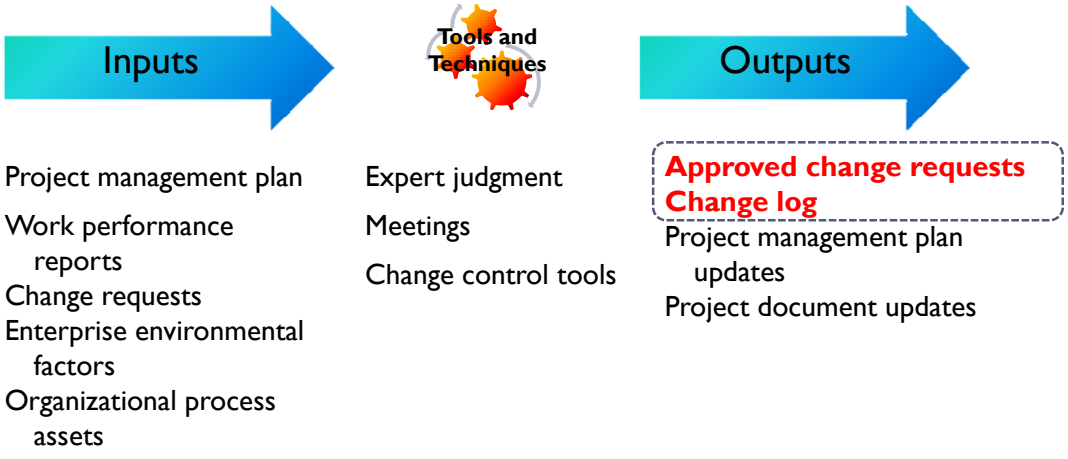
Corrective actions, preventive actions, and defect repair are recurring themes throughout the *PMBOK® Guide*, 5th edition. The key aspects of these actions for the purpose of the exam, appear below:

- _____**Actions.** This presumes you have metrics in place and that you are using these metrics to evaluate the current state of your project against the project management plan. You must be able to seek out root causes of issues and identify potential triggers that will let you

know when the project is heading off track. Once the correction is implemented, you need to have measurement tools in place that will validate the effectiveness of the corrective action.

- _____ **Actions.** These actions can occur as a result of implementing a corrective action. The focus here is on implementing process controls that will obviate the need for a future corrective action.
- _____ _____. According to PMI, defect repair is included in PMI's definition of *Rework*: "Action taken to bring a defective or nonconforming component into compliance with requirements or specifications."[13]***PMI strongly promotes defect prevention over defect repair.*** The primary issue with defect repair is that there are only two options when considering defect repair:
    - **Rework.** The output does not meet the project specifications and needs to be brought back into compliance. Rework is always more expensive than preventive action.
    - **Scrap**. This represents the total loss of the work investment and is the most expensive of any of the previous actions

Perform Integrated Change Control



Integrated change control is one of the more challenging areas in the exam. There can be up to 20 questions on the subject, so it is important that you grasp the concepts. The area is important because it impacts all aspects of your project; from the scope, timeline, and budget to the quality, human resources, risks and procurement aspects of the project.

It involves the processes for reviewing change requests, approving or rejecting change requests and managing changes into deliverables. Integrated change control also involves reviewing requests for changes or modifications to project documents as well as deliverables, baselines, or the project management plan.

There have been a number of studies done on software projects that show that a change in a project to correct a defect at the unit testing level, which costs a dollar, can cause the business up to 1000 times that amount if the defect is missed in user acceptance testing and actually delivered to the customer.

[13] *PMBOK® Guide*, 5th edition, p. 559

Key reasons for excessive changes on a project are due to, but not limited to, the following:

- Missed requirements
- Failing to engage a key stakeholder at the start of the project
- Stakeholder misunderstanding on what the project is designed to deliver
- A poorly designed WBS
- Inadequate risk assessment

Exam Tip: Work performance information is a frequent input to most M&C processes across the 10 knowledge areas.

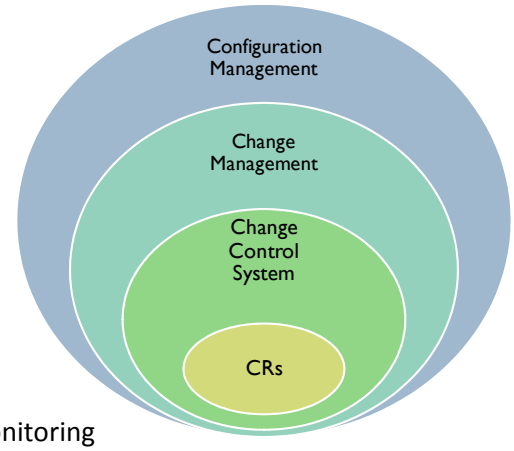
Change Requests and Configuration Management

Project changes must be tracked using a formal change management process. These changes also impact your configuration system and the configuration of the project's product. The graphic below shows where change requests sit in the configuration hierarchy. Ensure that you:

- **Identify the configuration items** - labeling and tracking of the configuration items
- **Implement configuration status accounting** - all appropriate data about the configuration item, including status to propose changes and the implementation status of approved changes
- **Perform a configuration verification and audit** - validation that the configuration item has been registered, approved, tracked, and correctly implemented

The steps needed to implement change:

- Identify actual need for change
- Impact assessment: cost, time, resource availability
- Identify change and response alternatives
- Create a documented CR (change request)
- Meet with internal stakeholders
- Meet with the customer, if required
- Submit to change control board (CCB) for ultimate approval (optional if no CCB exists)



Exam Tip: Changes can be *requested* by Executing or Monitoring &Controlling processes, *approved or rejected* in Integrated Change Control, or *implemented* by Executing processes. **Corrective and preventive actions do not usually affect the project baselines; only the performance against the baselines.**

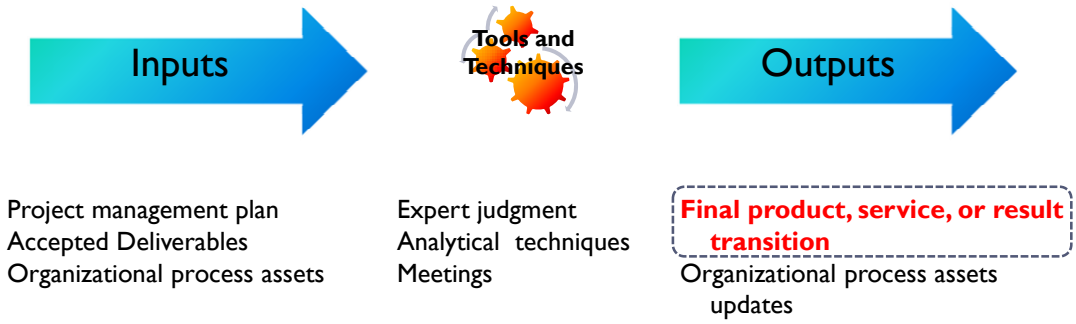
Executing	Monitoring and controlling
Change requests	Change requests
Implement change request	Approve or reject changes

Who Authorizes Changes? Quick Quiz…

- Changes to the Project Charter?
- Changes to the Performance baselines?
- Changes to the High Level Constraints?
- Changes to the Project Plan?

NOTE: While the selections above do not represent every situation, they generally represent change authority levels on a large project.

Close Project or Phase



The key element in this section is obtaining formal acceptance to close out the project phase or the entire project. Key elements to remember them in project or phase closure are the following:

- Validate the work was done to requirements for the phase or project
- Formal acceptance of the phase or project
- Complete all performance reporting for the phase or project
- Close any outstanding procurement contracts for the phase or project, if applicable
- Document and archive lessons learned for the phase or project
- Delivery of product increment or product for the phase or the project
- Specific updates to the organizational process assets include: project files, project or phase closure documents and historical information

Understand what the first sentence means - that administrative closure occurs not only at the end of the project, but also at the end of the specific *phase* of your project. Administrative Closure will also occur if the project is abruptly terminated.

Administrative Closure Activities

The high level steps in administrative closure of a project consist of:

1. Perform product verification
2. Complete final project performance reporting
3. Obtain formal acceptance of project
4. Perform lessons learned
5. Create project archives
6. Release resources
7. Celebrate!

Administrative closure can occur at the end of a project phase or at the end of the project itself. Administrative closure will be performed if the project is abruptly terminated for whatever reason. In any case, the following steps are part of administrative closure activities:

- Perform a product verification in order to satisfy the exit criteria for the phase of the project or the project itself
- Outline via a documented process, all the actions and activities necessary to perform a handoff of the product or service to production or operations management
- Complete and archive any final project performance reporting, which can include; phase records, lessons learned, whether the project met success criteria, etc.
- Gain formal acceptance of the project via a formal sign off from all designated stakeholders. If there were procurement activities within the project or the phase, ensure all procurement documentation signoffs have occurred prior to administrative closure

Contract Closure

The high level steps in the contract closure process consist of:

1. Perform product verification
2. Complete final contract performance reporting
3. Conduct procurement audits
4. Complete formal contract acceptance
5. Create a contract file

Contract closure occurs prior to administrative closure on a project. Why do you think this is the case?

a. It is a Gartner Group best practice for project management
b. Who will work on the contract if you close the project before the contract?
c. It gives the vendor time to submit final bills before the project closes
d. It gives the project manager one less thing to think about before closing the project

One of the more important aspects of contract closure is to perform a procurement audit of the final result. This requires a careful review of the contract statement of work and all of the deliverables.

The procedures for procurement contract closure are very similar to those of administrative closure with one or two differences:

- An evaluation of vendor performance on a contract may result in additional fees being paid to the vendor for outstanding performance. The incentive criteria are usually documented at the beginning of the procurement so that the vendor understands what they have to do to secure an incentive fee.
- If there are any outstanding claims against the vendor or the buyer due to disagreements or different interpretations of the statement of work - these elements must be resolved prior to contract closure.

Lessons Learned

Make sure Lessons Learned are reviewed at the end of each project phase and ask:

- What's working?
- What's not working?
- What still puzzles us?
- Where can we improve our performance and what improvements can we implement?

Final Lessons learned at the project close can be used to review:

- Did we effectively address project issues?
- How effective were our performance improvement efforts?
- What would we do differently the next time?
- What new processes need to be institutionalized to improve the project process?
- And more…

Most organizations perform a lessons learned activity at the end of the project - this is the *only* time they perform such an activity. The problem with this approach is that lessons learned collected at this point can never be applied to the current project; your project is already done…

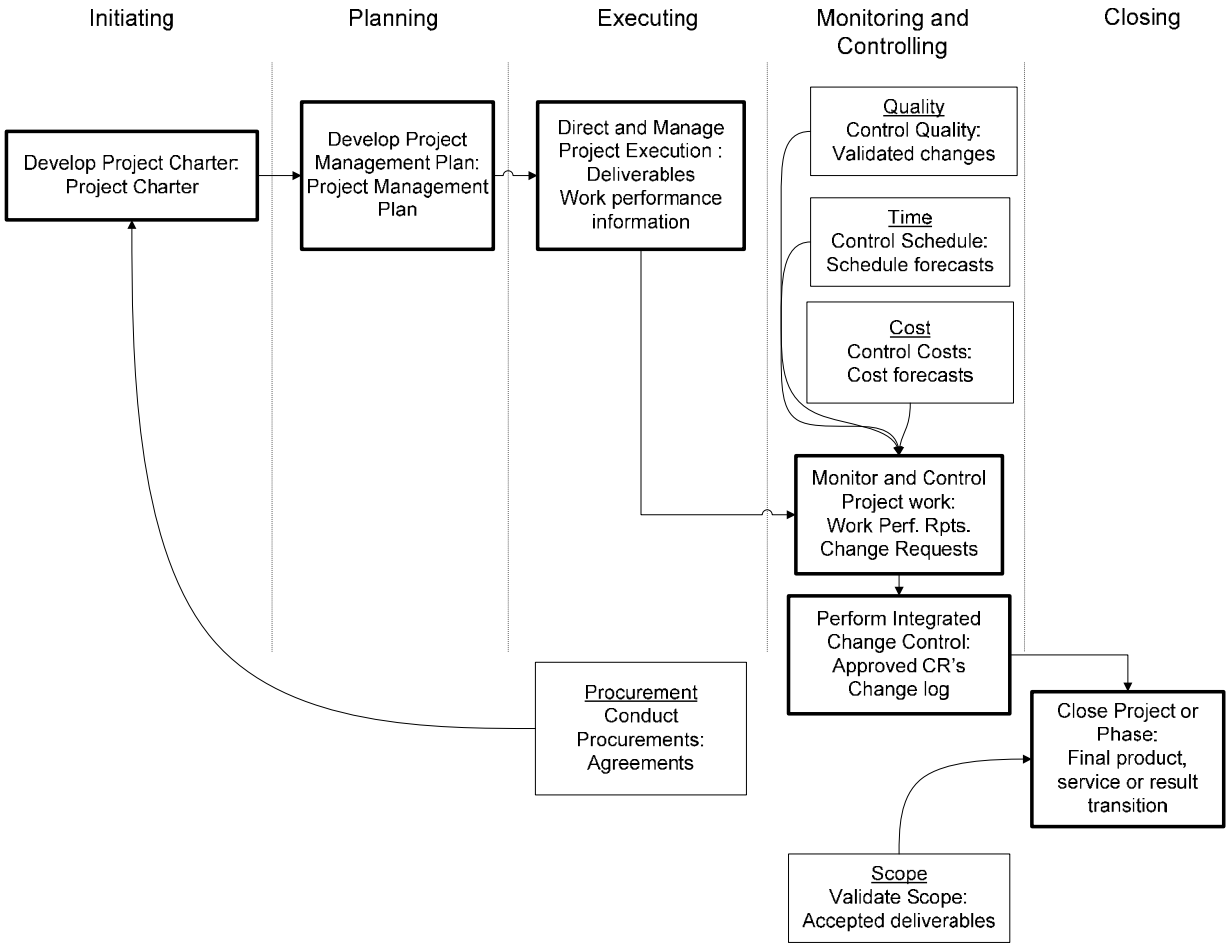
A key feature of the lessons learned activity is that, in a phase-gated process, it provides a checkpoint at which we can evaluate our progress to see how well we are performing and make adjustments moving forward. Elements that can be reviewed in a lessons-learned activity may additionally include some of the following:

- Why there were so many change requests and what can we do about it?
- Some stakeholders are very difficult to engage. This threatens certain project deliverables. What can we do better to engage them?
- Our unit testing needs improvement - let's identify activities and changes that can make it more effective.

A phase-end lessons learned review usually takes about an hour and can be of enormous benefit to the project team and stakeholders alike.

Project Integration Management – Key Process Interactions

The key inputs from the other Knowledge Areas to Project Integration Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

This section discussed project integration management, including:

- The similarities and differences between a project charter and PM plan
- Work authorization systems
- Definition and importance of baselines
- The iteration of recommended, approved, and implemented actions
- Change request documentation and evaluation
- Authority to make changes
- The similarities and differences between administrative closure and contract closure

Integration Process Check

Match up the definition with the process:

___Develop project charter

___Develop project management plan

___Direct and manage project work

___Monitor and control project work

___Perform integrated change control

___Close project or phase

A. The process of defining, preparing, and coordinating all of the subsidiary plans and integrating them into a comprehensive whole.

B. The process of tracking, reviewing, and reporting project progress against the performance objectives defined in the project management plan

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

D. The process of finalizing all activities across all of the project management process groups

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

F. The process of reviewing all change requests, approving changes and managing changes to deliverables

Chapter Four Memory Check

1. _____ _____ _____ basically describe the organization's culture while _____ _____ _____ describe how the organization does projects
2. The key benefits of the project charter are;
   a. _____
   b. _____
3. The enterprise environmental factor (EEF) that ensures that the correct work gets done in the correct sequence is called a _____ _____ _____, while the EEF that keeps track of information storage and distribution in an automated fashion for the project is called a _____
4. Templates, historical data, lessons learned, and financial databases are all _____ _____ _____
5. Two forms of accelerated depreciation are known as _____and the_____ _____ _____
6. The costs on a project that have already been expended are called _____ _____
7. The four categories of costs you can experience on a project are: _____, _____, _____, and _____
8. The key outputs of Direct and Manage Project Work are work performance information, change requests and _____
9. An action needed to bring future project performance in line with the project management plan is called a _____
10. Defect repair is another name for _____
11. One of the critical jobs of the project manager is to _____ unnecessary changes on the project
12. When performing closure on the project or a project phase _____ occurs before _____
13. The key output of Closure is the _____ _____, _____or _____

Chapter 4 Test

1. The project has been running smoothly; initiation phase is complete and the team is working on all aspects of planning. You had meetings with stakeholders several times to collect requirements and as a result, requirements documentation is almost complete, as are high-level and detailed design documents. As construction begins on the project, several stakeholders have indicated the need for changes to the requirements set. They are claiming these elements were missed in the initial requirements collection process, and they want you to add these elements to the project immediately. You perform an impact assessment and get it back to them only to hear that they are not going to allow any changes in the project budget or the timeline to complete these additional elements. What is the most effective tool that you could use to prevent this instance of scope creep?
    a. Change control system
    b. Configuration management system
    c. Murder Board
    d. Work Authorization System

2. Which of the following is true about change requests that result in corrective or preventive actions?
    a. They result in changes to scope
    b. They result in changes to the project plan
    c. They significantly increase risk
    d. They do not usually affect project baselines

3. The project you are managing involves 11 different teams scattered geographically across the country. The project sponsor is worried about how the work of 11 non-co-located teams is going to be coordinated for the project. You assure the sponsor that all relevant documentation will be captured in the corporate PMIS (project management information system). Within what key input does the PMIS reside?
    a. Project Management Plan
    b. Enterprise Environmental Factors
    c. Organizational Process Assets
    d. Work Authorization System

4. The *most critical* activity of the project manager on the project is to:
    a. Manage the project team
    b. Protect the Project from unnecessary changes
    c. Perform Integration
    d. Create the project management plan

5. You are managing a high visibility project with an aggressive deadline. The team has been burning extra hours every week in order to bring in the project on time - everyone is tired and is looking forward to a break after the product is delivered to the client. The deliverable was finally completed and passed through user acceptance testing at your location without a hitch. The product was handed off to the installation team and the installation team installed the product at the client site. Unfortunately when they attempted to use the product, there was a major system crash that caused an abrupt halt in their production cycle. This installation represented a major upgrade from a previous installation of the same product, and while the first installation worked very well, this installation 'crashed and burned'. What is the *most likely* cause of the problem at the client site?
    a. Adequate configuration controls were not observed
    b. The project manager failed to control scope creep
    c. User acceptance testing was flawed
    d. The installation team did not install the software properly

6. All the following statements about Approved Change Requests are true *except* which of the following?
    a. Approved change requests are an input to Direct and Manage Project Work
    b. Approved change requests are scheduled and implemented by the project team
    c. Approved change requests are an output of the Direct and Manage Project Work process
    d. Approved change requests can result in changes to the cost baseline, sequence of activities, resource requirements or changes to risk response alternatives (including changes to the project management plan)

7. You are working as a PMP® for a company that typically does not implement charters for projects. As a result, an unusually high number of projects in this organization fail on a yearly basis. You've just been placed on a high visibility project as the senior project manager and begin to work on elements of the charter with the project sponsor. Senior management doesn't understand why you're wasting your time on this activity. What is the *best* thing you can do in this situation?
    a. Tell PMI about a fundamental breach in the PMI framework
    b. Review the benefits of a well-defined project charter with senior management
    c. Refuse to take on the project as you know this will most likely result in a project failure
    d. Continue to work on the charter with the project sponsor. Demonstrate to senior management, on completion of the charter, how this benefited the project and have the data and fact to back it up

8. The project management plan is complete and is ready to be baselined. However, a key stakeholder just discovered a critical omission and requests an adjustment to the PM plan. What should you do next as the project manager?
    a. Implement a formal CR
    b. Make the adjustment
    c. Consult the change control board
    d. Inform the stakeholder that this constitutes scope creep and refuse to make the change

9. The project management plan is baselined when:
    a. The requirements and detailed scope statement are completed
    b. Senior management has reviewed the project management plan via a gated process and given you a 'go' authorization to proceed with the next phase of the project
    c. All the required stakeholders have signed off on it
    d. The required business and technical reviews of the proposed solution have been verified and validated by all stakeholders

10. Senior management has asked for an update on your project's budget forecasts and deliverables. This information will be contained in:
    a. Work performance information
    b. Status reports
    c. Progress reports
    d. Variance and trend analysis

11. Who can approve of changes to any of the primary constraints on your project such as scope, budget, or timeline?
    a. The Change Control Board
    b. The sponsor
    c. Senior management
    d. Key stakeholders

12. All of the following actions occur in the Direct and Manage Project Work process *except* which of the following?
    a. Adapt approved changes into the project's plans
    b. Collect and document lessons learned
    c. Determine the project life cycle for the project
    d. Staff, train, and manage project team members assigned to the project

13. One of the key activities in The Monitor and Control Project Work Process is to implement corrective actions to bring future project performance back in line with the project management plan. What is the *best* explanation regarding PMI's philosophy on defect repair?
    a. It is considered rework
    b. Defect repair is essential to bring nonconforming elements in the project back in line with performance standards
    c. It is a nonessential corrective action due to missed requirements
    d. It is most effective when it works hand-in-hand with inspection processes

14. You represent one of five project teams that are sharing a facility to deliver a high visibility project for your organization. Since you are sharing a facility, your teams share the expenses for heat, light, electricity, and technical support. What type of cost does this represent?
    a. Fixed
    b. Direct
    c. Variable
    d. Indirect

15. Your organization has decided to train project managers on the use of the tool Microsoft Project, in the hopes that this will help them manage their projects more efficiently. Some of the more technically savvy people on the project management team have become very adept at many of the features contained in this tool - performing what-if analyses, earned value measurements, network diagrams, resource calendars and more. One of the stakeholders asked to see the project management plan for their project and the project manager opened up Microsoft Project to show him the plan. PMI considers a tool like Microsoft Project to be *closest* to:
    a. The equivalent of a project management plan
    b. A bar chart
    c. A critical tool to help manage all project logistics
    d. A necessary supplement to the project management plan

16. You have delivered a product to a client on time, on budget, and to specification, however the client is not happy with the result. What is the *next* thing that should happen?
    a. Schedule a meeting with the team to and propose a potential remedy for the client
    b. Inform senior management of the client's unhappiness and discuss potential options to resolve the situation
    c. Close out the contract - submit final billing to the client.
    d. Quantify the client's issues and offer to address these issues in a subsequent release

17. In terms of integrated change control, the project manager's primary responsibility is to do all the following *except*:
    a. Ensure all changes are tracked and documented for the project
    b. Ensure that only authorized changes are entered into the change management system
    c. Ensure that all authorized changes are coordinated with Change Control Board (CCB)
    d. Ensure that all requested changes are made to the project baselines

18. Which of the following is true regarding the project management plan?
    a. Integrates and consolidates the subsidiary plans
    b. It is always highly detailed and focused
    c. It cannot be changed unless senior management authorizes the change
    d. B and C together

19. The project manager is assigned to a project _____?
    a. From the moment the project is conceived
    b. Always before the start of planning
    c. Prior to the creation of the charter
    d. By the project stakeholders

20. A project at your organization is in trouble. Management has reassigned the project manager on the project and has given you the job of bringing it back in line. You have analyzed the prior project manager's project management plan, WBS, scope baseline and found that he actually did a good job. The problem was that there was an unusual amount of discovery on this particular project; it seems that management failed to address that the project had a high degree of risk and uncertainty - greater than 40% - risks that the prior project manager had raised on the project. When the PM raised those issues, management's position was "well, just do the best you can". This is a $5 million project which is approximately at its halfway point, but the budget expended is close to $3.5 million dollars at this point. The project is $1 million over budget and 10% behind schedule. Management is alarmed at the budget burn rate and is thinking of canceling the project, even though what has been accomplished so far is high quality work that has exceeded customer expectation. What is the *best* advice you can give management at this point?
    a. With big budget overrun, talk with the team and then with the client about what scope elements can be removed and thus reducing overall costs
    b. Do not include the sunk costs as part of your decision process
    c. Discuss with management the most effective way to close the project down and see what part of the work effort can be salvaged
    d. Swap out high cost resources with lower cost resources to bring the budget in line

21. Double declining balance is a form of?
    a. NPV calculation
    b. Working capital calculation
    c. Constrained optimization method
    d. Accelerated depreciation

22. The project statement of work is fundamentally?
    a. Description of the product scope
    b. A legal document
    c. The same as the procurement statement of work
    d. An output of Direct and Manage Project Work

23. The correct steps, in order, for implementing a change to a project are which of the following?
    a. Identify alternatives, document the change, identify need for change, perform impact assessment, submit to CCB for approval,
    b. Perform impact assessment, identify alternatives, identify need for the change, document the change, submit to CCB for approval
    c. Identify need for change, identify alternatives, perform impact assessment, submit to CCB for approval, document the change
    d. Identify the need for change, perform impact assessment, identify alternatives, document the change, submit to CCB for approval

24. The difference between a configuration management system and a change control system is?
    a. The configuration management system is part of the PMIS - the change control system is not
    b. The change control system is part of the key PMIS - the configuration management system is not
    c. The change control system feeds into the configuration management system and is part of the configuration management system
    d. Both the change control system and a configuration management system are organizational process assets

25. You are reviewing the risks on your project with key stakeholders. After the initial risk identification matrix was created, the discussion centered around the stakeholder's tolerance for risk on the project. Stakeholder risk tolerance levels are part of:
    a. Organizational process assets
    b. Expert judgment
    c. Enterprise environmental factors
    d. Preventive action

26. Your company makes air conditioning equipment of all types. The company just issued a new discount line of window air conditioners. The account executives in the company are somewhat worried that the discount air conditioner market will undercut their higher priced models and will cut into their market and margins. You were assigned to manage the project that created the discount line of air conditioners and the project completed on time, on budget, and effectively passed all tests prior to the release announcement. One of the engineers in reviewing the final tests felt that one of the electronic components could be upgraded to a higher capacity without incurring additional cost to the manufacturing of the product. You reviewed the engineer's analysis and agreed that it would be a beneficial upgrade to the product. The upgrade of the part is *most explicitly* considered part of:
    a. The change management process
    b. The process improvement plan
    c. The quality assurance process
    d. The configuration management process

27. The project is entering the closure phase. All the following are considered outputs of closure and updates to the organizational process assets with the *exception* of:
    a. Scope verification
    b. Lessons learned
    c. Project audit
    d. Project management plan

28. Which of the following is *not* included in a project charter?
    a. Resource management plan
    b. Risks and constraints
    c. Business case
    d. Budget limits

29. Your project team is well underway with the construction of the product of the project. Some of the work has progressed and some deliverables have been reviewed by key stakeholders. During a deliverables review, one of the stakeholders found a discrepancy in one of the deliverables that needed to be addressed immediately. The team reviewed the stakeholder's issue and agreed that some action needed to be taken to bring the deliverable back into compliance. The *best* definition for this activity is called:
    a. Defect repair
    b. Corrective action
    c. Quality control
    d. Preventive action

30. The project management plan is created by:
    a. The project sponsor with input from senior management
    b. The project manager
    c. The project manager with input from the project team
    d. Senior management with input from the project manager

31. The key output of Direct and Manage Project Work Process is which one of the following:
    a. Creating the WBS
    b. Deliverables
    c. Enterprise environmental factors
    d. Performance reports

32. You have been assigned as project manager for a project with a number of stakeholders. After the initiating process was completed, you are engaged in planning for the project and discover that the stakeholders are at odds with each other about what they want from the project. One stakeholder wants to make sure they don't lose headcount, while another stakeholder doesn't know if they have the capacity or the resources to deliver the product of the project. Two other stakeholders refuse to use offshore resources because they feel it will demoralize their teams and the remaining stakeholders have an issue with the timeline. As the project manager what is your *biggest* concern at this point?
    a. Getting the project management plan approved
    b. Spending a lot of time on configuration management
    c. Getting the authority from senior management to make project decisions that the stakeholders will have to follow
    d. The best form of communications to implement for the project

33. A project charter can be all of the following except?
    a. Created with input from the project manager
    b. Validates the project against organizational strategy
    c. Includes a business case
    d. A contract

34. All the following are reasons for a change request with the *exception* of:
    a. A missed requirement in the planning phase
    b. A change to the high-level risks contained in the charter
    c. A change in federal regulations
    d. A change requested by stakeholder to address the competitive position of their product

35. You are evaluating software packages for your new ERP system. As the PM, you are going over decision criteria for the packages when you suddenly realize that you own 1000 shares of stock in one of the seller's companies competing for the contract. What should you do?
    a. Tell your senior manager and let her tell you what she would like you to do
    b. Remove yourself from the decision process
    c. Ensure you are being as impartial as possible and continue your evaluation
    d. Call your broker and tell him to sell your shares of the stock

Chapter 4 Test – Answers

1. D – One of the defined uses of a work authorization system is for the control of scope creep
2. D – They do not normally affect the project baselines. *PMBOK® Guide*, 5th edition p 97.
3. B – The PMIS is an enterprise environmental factor
4. C – All the answers are correct – a PM does all these things. However the most critical aspect is the PM functioning as an integrator: putting all the parts and pieces of the project into an integrated whole
5. A – If the system tested out OK prior to the site installation, that is a sure signal that the internal system and the client system are configured differently
6. C – 'Approved change requests' are an input to Direct and manage Project Work. *PMBOK® Guide*, 5th edition p. 65
7. B – You always want to show the stakeholder the effects of their actions/inactions. C and D are wrong – the PM does not take unilateral action unless authorized to do so by the organization. Answers like A are usually wrong – this is the equivalent of "I'm telling the teacher what you did!"
8. B – Prior to baseline, the PM plan can be adjusted without a CR, consulting the change control board, or addressing a scope creep issue. *PMBOK® Guide*, 5th edition p. 78.
9. C – While the other answers may occur in the planning process, baselines require stakeholder sign-off
10. A – Work performance information is where this data is contained. Per the *PMBOK® Guide*, 5th edition, p 90
11. C – Senior management must be consulted regarding high-level constraints
12. C – Determining the project life cycle occurs in planning. Per the *PMBOK® Guide*, 5th edition, p 77.
13. A – Defect repair is considered rework
14. D – Shared facility expenses are indirect costs
15. B – It is closest to a bar chart
16. C – You're done. PMI assumes that as the project manager, you have been obtaining customer sign-off for every intermediate deliverable on the project and that the customer has accepted those deliverables. If there were issues with the deliverables, you would have found this out long before the end of the project. The contract has been fulfilled according to scope, the budget, and the timeline. Closeout contract and submit your final bill
17. D –Implementing *all* requested changes can result in sub-optimizing the project. One of the PM's jobs is to protect the project from unnecessary changes.
18. A – It integrates and consolidates all the subsidiary management plans. *PMBOK® Guide*, 5th edition, p. 76
19. B – Always before the start of planning. *PMBOK® Guide*, 5th edition, p. 67
20. B – The sunk costs are never considered as part of your decision process. You have to decide where the project stands now, whether it is beneficial to complete what has been accomplished so far, and whether you can reach the goals of the project. This is a standard GAAP rule.
21. D – This is the only possible answer that is a form of accelerated depreciation
22. A – A project statement of work describes at a high level, the scope of the product of the project
23. D – This is the correct answer. *PMBOK® Guide*, 5th edition, pp 96
24. C – A and B are deliberate misdirection. D is incorrect. The change management system is subsumed within the configuration management system
25. C – Stakeholder risk tolerances are part of the enterprise environmental factors
26. D – While the upgrade represents a change that must be tracked, it ultimately impacts the configuration of the product
27. D – The project management plan is not part of project closure. *PMBOK® Guide*, 5th edition, pp 100-102
28. A - The resource management plan is a detail of planning and not of initiation, which is where the charter is created
29. A - Did you think it was a corrective action? Corrective actions are taken to bring the project into line at some future point. Defect repairs address immediate concerns
30. C – The project manager is always responsible for creating the project management plan with input from the subject matter experts on the project team
31. B – Deliverables. *PMBOK® Guide*, 5th edition, p. 65

32. A – Unless you can resolve stakeholder conflict, getting a project management plan approved will be your biggest concern. True, while you may have a more complicated job dealing with configuration management, it is not the immediate concern
33. D – A charter is not a contract. *PMBOK® Guide*, 5th edition, p.68
34. B – Change requests are necessary due to a change in scope, requirements, budget, or anything that impacts the product of the project. Assessment of risk is an ongoing *process* that occurs throughout the project
35. B – Even the appearance of a conflict of interest (CI)is best handled by removing yourself from the decision process. Answer A can get the organization into trouble at later date. Answer C does not deal with the conflict of interest. Answer D might still leave the appearance of a CI

Chapter 5 : Project Scope Management

Section Topics:

- Plan Scope Management
- Collect Requirements
- Define Scope
- Create WBS
- Validate Scope
- Control scope

Section Objectives

In this section you will be able to:

- Assign the scope management processes to the PM process groups
- Explain the components and importance of a detailed scope statement and scope management plan
- Define the difference between requirements and scope
- Define the differences between product and project scope
- Describe decomposition
- Define and create a WBS

Scope Process Summary

The high level Project Scope Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	-Scope Management Plan -Requirements Management Plan			
	-Requirements documents -Requirements traceability matrix		Accepted deliverables CRs	
	Project Scope statement		Work performance measurements	
	Scope baseline		Various document updates	

What is Scope Management?

For the exam, there are two aspects of scope that you need to understand: the product scope and the project scope. What this means is:

- Product Scope. What requirements do I have to fulfill to create the product of the project?
- Project Scope. What activities and processes do I have to perform to deliver the product scope?

One of the key elements in managing scope is to prevent 'scope creep'. This is a term that was coined by the United States Air Force to describe conditions in which additional scope elements are added to a project without any means or method for controlling such additions – i.e. any uncontrolled change to a project. In some instances, customers and stakeholders will add scope to a project, yet will not allow for additional time or budget to accommodate the changes. This is a classic scope creep situation.

Gold plating is a subset of scope creep. These are elements added to the project by the performing organization because a team member thinks it's a good idea or that the customer will appreciate the extra work. The problem with gold plating is that added scope elements from the project team may cost the project money that was never contained in the project budget. If you're adding elements to the project that the customer never asked for, they may wonder what you are doing with the rest of their budget!

Scope Baseline

In terms of scope, we will address two aspects of the scope management process:

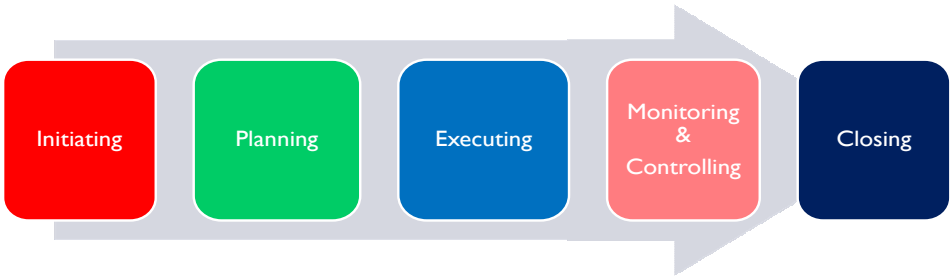
- Product Scope: the requirements that relate to the product of the project
- Project Scope: The work done needed to deliver the product of the project

There may be questions on the exam that reference the scope baseline. It is critical that you know that the Scope Baseline consists of the Scope Statement plus the WBS plus the WBS dictionary.

The scope baseline provides much of the input needed to create a Scope Management Plan. The three elements of the scope baseline; the scope statement, the WBS, and the WBS dictionary, will be addressed in detail in the upcoming pages.

The Scope Baseline:

Scope Management



- Plan Scope Management
- Collect Requirements
- Define Scope
- Create WBS

- Validate scope
- Control Scope

The process of scope management is performed to ensure that the project contains all the work and ***only*** the work necessary, to fulfill project objectives successfully. While the requirements of the project are outlined in a requirements management plan, the scope management plan typically contains the following elements:

- How changes to scope will be managed on the project
- Escalation hierarchy in the organization to resolve potential scope issues
- Description of any control systems that are used to manage scope and changes to scope

Plan Scope Management

Inputs	Tools and Techniques	Outputs
Project management plan Project charter Enterprise Environmental factors Organizational Process assets	Expert Judgment Meetings	**Scope management plan** **Requirements management plan**

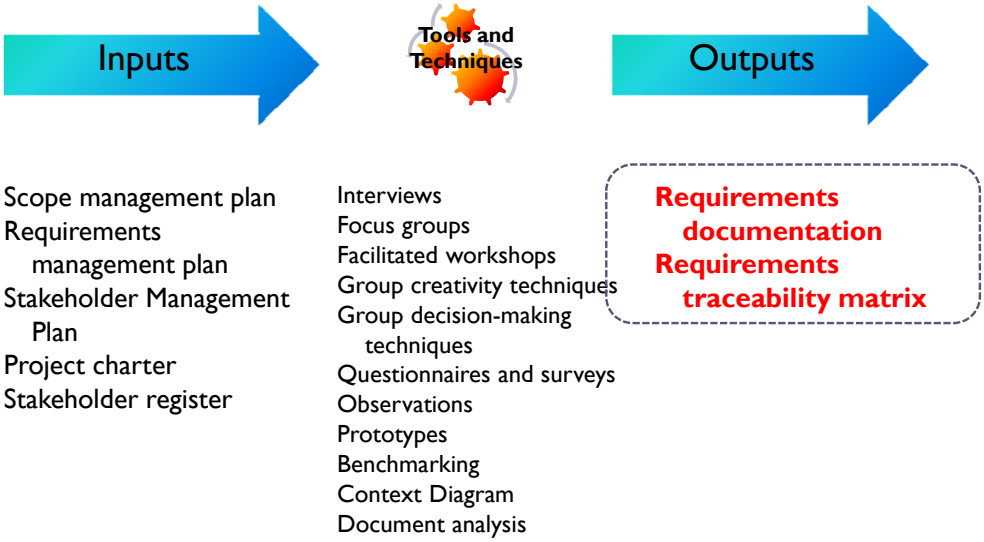
The Plan Scope Management process defines how scope will be defined, validated, and controlled. The elements in the scope management plan include but are not limited to the following:

- How scope and changes to scope will be managed
- Method for minimizing or eliminating scope creep
- Escalation path in the event there is a disagreement between stakeholders on required scope elements
- How the scope will be defined, developed, monitored, controlled, and verified
- Process for preparing a detailed scope statement
- Process for the creation and the maintenance of the WBS
- Process that defines how acceptance for the completed project deliverables will be obtained
- Process that defines how requested changes to the scope statement will be processed

The requirements management plan performs a similar function in that it describes how requirements will be managed, documented, and analyzed. The components of the requirements management plan include but are not limited to the following:

- Defines how requirements will be planned, tracked, and reported
- Process for addressing missed requirements
- Process for the prioritization of requirements
- Metrics that will be used to define the product and the rationale for using them
- Definition of a traceability structure that identify which requirement attributes are to be captured on a requirements traceability matrix

Collect Requirements



PMI defines a requirement as:

"A condition or capability that must be met or possessed by a system, product, service, results, or component to satisfy a contract, standard, specification, or other formally imposed specification. ."[14] Requirements include the quantified and documented needs, wants, and expectations of the sponsor, customer, and other stakeholders.

In short, you are establishing, *from the customer's perspective*, what the customer needs from the project in order for the project to be successful.

Unfortunately this is the first place in the project where the 'wheels start coming off the wagon'. In the upcoming section we will address what specific tools and techniques can be implemented to ensure a detailed elaboration of customer requirements.

There are also several classifications of requirements that may appear on the exam. These classifications are generally broken down into the following categories:

- Business requirements
- Stakeholder requirements
- Solution requirements, which described features, functions, and characteristics of the product or service. They can be broken down into functional and nonfunctional requirements:
  - Functional requirements describe product behavior
  - Nonfunctional describe elements such as reliability, security, performance, safety, level of service, supportability, etc.
- Transitional requirements can describe temporary capabilities including data conversion and tracking requirements

[14] *PMBOK® Guide*,5th edition, p. 558

- Project requirements which describes actions, processes, or other conditions the project needs to meet
- Quality requirements, which capture the quality criteria as defined by the stakeholders

Requirements Collection Tools

There are numerous tools for helping the project team get their arms around user requirements. A few are mentioned here and will be elaborated in the proper level of detail for the purposes of the exam.

1. **Interviewing.** On the exam also called 'expert interviewing'. The project manager and team members interview stakeholders or subject matter experts regarding the needs of the product or process. These interviews can be conducted face-to-face, via a video conferencing, over the phone, e-mail, or any other available method.
2. **Focus Groups.** Focus group is generally run by a facilitator and concentrates on a specific subject area. Usually the members of the focus group are selected based on similar interests or other identifying criteria.
3. **Facilitated Workshops.** This assembles different stakeholders who may have various perspectives on the product of the project. The workshop is facilitated by a moderator who engages the stakeholder team to talk about the project and arrive at a consensus around their requirements. Two key techniques are QFD; used to capture the voice of the customer (VOC), and JAD; used to facilitate design on a software project. QFD will be detailed in the chapter on Quality Management.

4. **Group Creativity Techniques:**
   a. **Brainstorming.** This is a group creativity technique for the purpose of generating ideas focusing on a specific problem. Using this approach as a requirements collection technique the idea is not to capture every idea from every participant, but to congeal the ideas into an actionable plan.
   b. **Nominal Group Technique.** Based on brainstorming but adds a voting process to rank ideas for further brainstorming or to prioritize ideas.
   c. **Mind-mapping -**created by Tony Buzan in the 1970s is a graphical representation of words, ideas, or other items arranged around a central keyword or idea. Mind maps are used as an aid for study, organization, problem solving, and decision making.
   d. **The Affinity Diagram.** Using a technique developed by Japanese anthropologist Jiro Kawakita, the KJ method as it is called, is designed to help people organize their ideas around how they think about the work. The steps in order are:

      I. Rapidly group ideas that seem to belong together.
      II. It isn't important to define why they belong together.
      III. Clarify any ideas in question.
      IV. Copy an idea into more than one affinity set if appropriate.
      V. Look for small sets. Should they belong in a larger group?
      VI. Do large sets need to be broken down more precisely?
      VII. When most of the ideas have been sorted, you can start to enter titles for each affinity set.

e. **The Delphi technique.** This technique was developed by the Rand Corporation in the 1960s. It requires that a group of experts participate in the decision process. It is most useful when there is contention or hostility in the decision process due to 'bandwagonism' or experts with widely varying opinions. In this case, all participants are anonymous to each other and all evaluations are funneled through a facilitator who distributes the result of the decision. Multiple rounds are used until the decision process narrows to a single solution or a solution set.

NOTE: For the exam, this approach is listed as a 'Group Creativity Technique', however, the creator of the technique, the RAND Corporation, states that the Delphi is actually a *group decision making technique*:

"This report deals with one aspect of RAND's continuing methods for improving *decision making*. It describes the results of an extensive set of experiments conducted at RAND during the spring and summer of 1968.The experiments were concerned with evaluating the effectiveness of the Delphi procedures for *formulating group judgments*"[15] (Emphasis, mine)

5. **Group decision-making techniques.**
   a. *The Analytic Hierarchy Process*. Developed by world renowned mathematician Thomas L. Saaty at Wharton in the 1970s. The process is especially useful when extremely complex or difficult decisions need to be made. The AHP was first referenced by PMI in the *PMBOK® Guide*, 2nd edition, p. 54.
   b. *Voting methods*- uses the **unanimous** approach - everyone agrees, the **majority** approach - more than 50% agree, the **plurality** approach - largest percentage not a majority, or the **dictatorship** approach - one person makes the decision for the group
6. **Questionnaires and surveys.** Typically used when a large group of individuals need to be contacted for their input.
7. **Observation.** One of the most effective of the requirements gathering techniques that has been used for years at Toyota and other Japanese companies is called, 'gemba' (where the action is or where the work occurs). The process is called 'going to gemba'. This is a key tool in the **QFD** process and is used in capturing the voice of the customer (VOC). In the United States this is frequently called 'shadowing'. The purpose is to discover how the customer actually uses your product or how they actually get their jobs done.
8. **Prototypes.** The prototype is a mockup or working model of the product. The prototype can be presented to users for feedback, suggestions, and recommendations and to give the users tangible evidence of what they think they asked for from the project team.
9. **Context Diagrams**. Essentially, a scope model describing business process and how people interact with the system. Context diagrams show inputs and the elements providing the input, as well as the outputs and the elements receiving the output
10. **Document Analysis**. Elicits requirements by analyzing documentation and identifying information relevant to the requirements.

Requirements Traceability Matrix

The Requirements Traceability Matrix tracks requirements and identifies:

[15] "The Delphi Method: An Experimental Study of Group Opinion" Dalkey, Norman C, p.iii, RAND Corporation, June 1968

- Source of the Requirement
- Responsibility for managing
- Work status
- Completion status

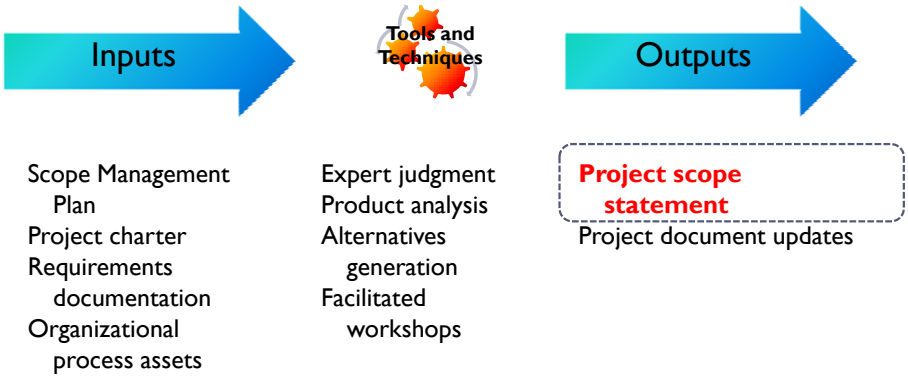
For a software project:

- Traces each requirement to one or more technical specifications needed to complete the requirement
- Ensure each development task traces back to a user requirement
- Critical for developing the test plans

This information is usually loaded into a table that lists the requirement, from the user's perspective, and traces that requirement to the work packages or activities needed to fulfill the requirement from the performing organization.

The key element to remember here is that the requirement addresses a user need for the project. Usually these stated needs are not technical in nature, and it is the job of the technical team to translate a user need expressed in plain English into the technical specifications that enable delivery of the customer's requirement. The requirements traceability matrix tracks all the technical specifications back to the originating requirement and can be supported by the WBS dictionary. This is an effective approach for ensuring that all your technical requirements track back to a specific user need.

Define Scope



The process of defining scope outlines the boundaries of what will be and what will not be included in the project to deliver the product of the project, and also includes detail on project risks, constraints, and assumptions. It is the project manager's job to deliver the project management's expectations regarding time, cost, and scope. After the initial analysis, the resulting budget and schedule may not meet management's expectations for the project. Therefore it is the project manager's job to develop options for meeting the schedule, cost and scope objectives for the project.

For example, if management wants the project completed in a year and your analysis shows, based on all project constraints, that the realistic project completion date is 18 months, it is the project manager's

responsibility to offer senior management options for the one-year completion time line. These options may involve various schedule compression techniques as well as negotiating a reduced scope.

One of the tools of Define Scope includes Product Analysis, which can use a process called 'value engineering'. Value engineering will be discussed in greater detail in the Project Cost Management chapter.

Scope Statement

A Detailed Scope Statement will include but is not limited to:

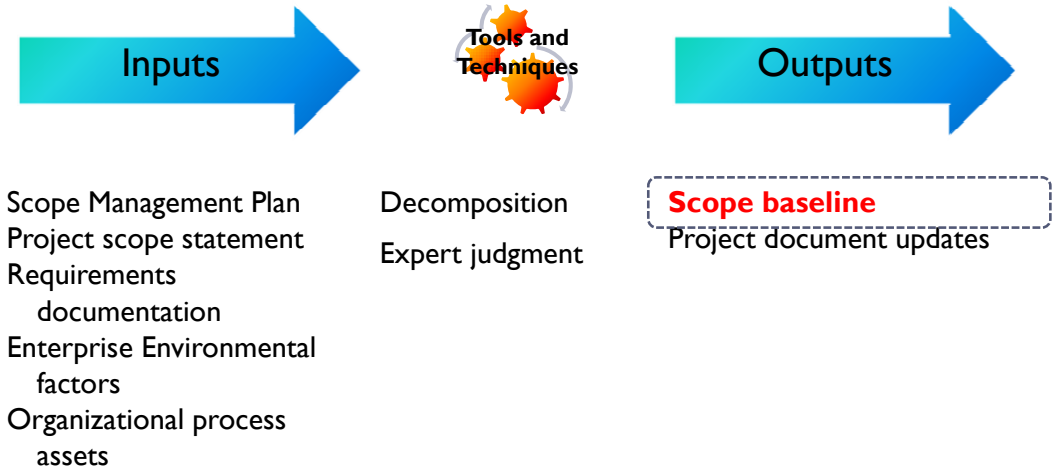
- Project objectives
- Product scope description
- Project requirements
- Project boundaries
- Project deliverables
- Product acceptance criteria
- Project constraints
- Project assumptions
- Initial project organization
- Initially-defined risks
- Schedule milestones
- Fund limitation
- Cost estimate
- Project configuration management requirements
- Project specifications
- Approval requirements

The key output from the Define Scope process is the Project Scope Statement. The scope statement details what is included in the project, what is not included in the project and requires input from stakeholders and subject matter experts alike.

The details outlined above are a partial listing of what can be found in the project scope statement - these details can be as unique as the project or the industry in which the project is being implemented.

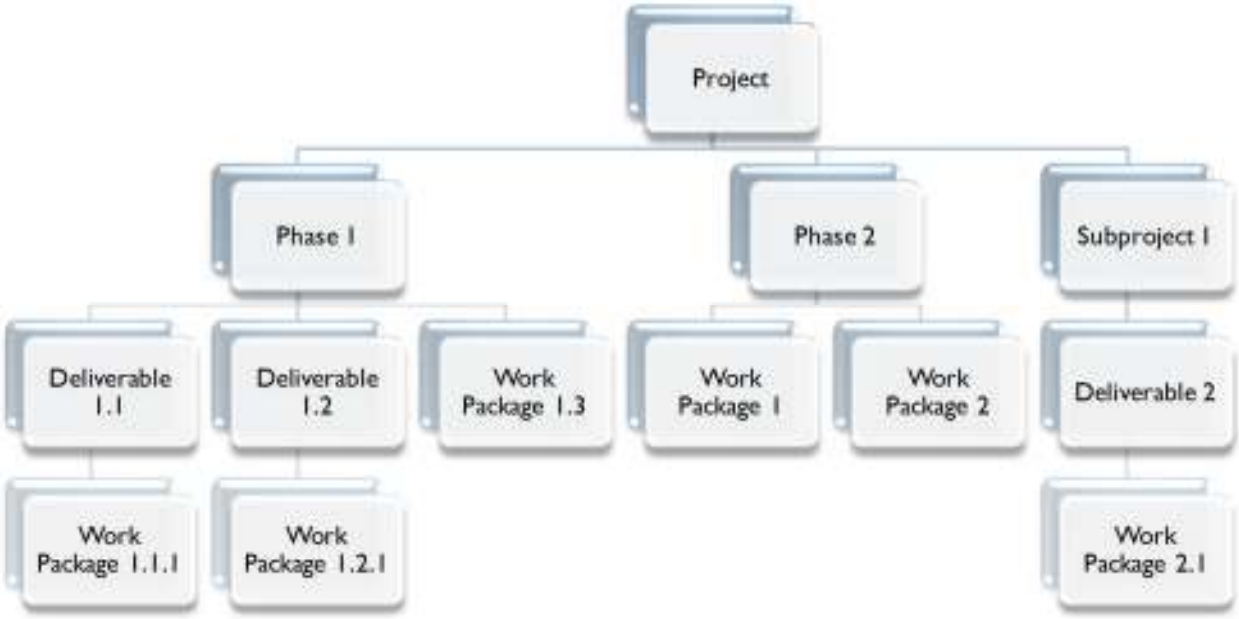
Exam Tip: The Project Scope Statement includes the requirements and the work needed to deliver the requirements

Create WBS



One of the most important tools in your project management arsenal is the creation of a WBS. If you have not created one before, this can be one of the most misunderstood aspects of the project management process. The WBS is not simply a list of activities that need to be performed, but a structured hierarchy created by the performing organization and stakeholders that keeps work from 'falling through the cracks' and allows for team buy-in of all the work.

WBS Defined



The picture above shows a generic version of the WBS. Notice that it resembles an org chart in its construction. There are any number of software tools that can help you programmatically create a WBS.

In outline form, the WBS can become a template and something that is part of your organizational process assets. This template can be customized for use on different projects without having to design it from scratch each time you start a project.

If you work in an organization that does not use a WBS on its projects, do yourself a favor and do it for yourself. While other people are losing sleep over project deliverables your project will be well under control because you have effectively utilized this critical tool.

Exam tips:

A higher level above a work package is called a '**control account'**. PMI states a control account is a control point where scope, cost, and schedule are compared to earned value for performance measurement. While a control account can contain multiple work packages, a work package can only be associated with only one control account.[16]

Code of accounts: Any numbering system that uniquely identifies each component in the WBS[17]
Chart of accounts: A list of all account names and numbers used in a company's general ledger.

WBS Benefits

The purpose of a WBS includes the following:

- Graphical hierarchy approach clearly identifies all work and allows for clear understanding
- Serves as communication tool among stakeholders
- Allows team to get their arms around the project and promotes team buy-in
- Becomes the foundation for planning
- A tool for evaluating scope changes
- Possibly useful as a template for future similar projects
- Allows team members to understand how their work fits in the project

While the WBS resembles an org chart, it is really a structure that defines, at the highest levels, how the organization thinks about the work:

- Successive drill downs occur until work packages are created
- Work packages are *deliverable* focused

Exam tip: substitute your concept of 'tasks' with the term 'activity'
Exam Tip: Decomposition is what you do to break down work to manageable work packages. The 'Create WBS' is the process you use to do it.
Exam tip: the WBS does ***not*** show cross-functional dependencies between work packages

[16] *PMBOK® Guide*, 5th edition, p. 132
[17] *PMBOK® Guide*, 5th edition, p. 531

WBS Dictionary

The WBS Dictionary contains:

- Description of the work to be done
- Who is responsible for delivering the work
- Quantified deliverables
- Activities and milestones
- Schedule for the work
- Assumptions
- Cost estimates
- Acceptance criteria
- Interdependencies

The WBS dictionary is one of the most important documents you can create outside of the project management plan. It outlines in specific detail the elements in the work breakdown structure defining ownership, due dates, dependencies, and acceptance criteria, and other elements. An example of a WBS Dictionary template is shown on the following page.

Notice that in addition to the fundamental information (name, owner, resources, due date, cost, duration, and acceptance criteria, etc.), this page also has information about cross-functional activity dependencies; dependencies on the prior activity or dependencies involving the successor activity. These dependencies can be identified here and detailed in the Activity Attributes of the activity.

"The development of the WBS Dictionary often uncovers ambiguity or other errors in the WBS itself, and results in revisions to the WBS"[18]

[18] Practice Standard for Work Breakdown Structures, Second edition, p 16, PMI® 2006

Name of Work Package or Activity	WBS Number	Due date
Owner	**Dependencies**	
	Predecessor	*Successor*
Assigned Resources	**Cost**	**Duration**

Work Package Description	
Work Package Deliverables	
Acceptance Criteria	
Assumptions	

Delivered by _____ ***Date***_____ ***Approved by*** _____ ***Date***_____

Validate Scope

Inputs	Tools and Techniques	Outputs
Project management plan Requirements documentation Requirements traceability matrix Verified deliverables Work performance data	Inspection Group decision making techniques	**Accepted deliverables** Change requests Work performance information Project document updates

The Validate Scope process is what you do to gain formal acceptance of the work product(s) and deliverables on the project from the stakeholders. Validate Scope occurs in the Monitoring & Control process group.

What do you need to validate scope? Below are some key inputs that will help you:

- Requirements Documentation
- Requirements traceability matrix
- The detailed Scope Statement
- Verified Deliverables from Control Quality

Exam Tip - exam questions will rarely ask you directly about scope validation, however they will use phrases such as:

- Obtaining customer sign off
- Review of deliverables
- QC inspection/audit
- Requirements validation
- Work product verification

These are all scope validation questions.

When Scope Validation Occurs

How do you know when you are 'done'?

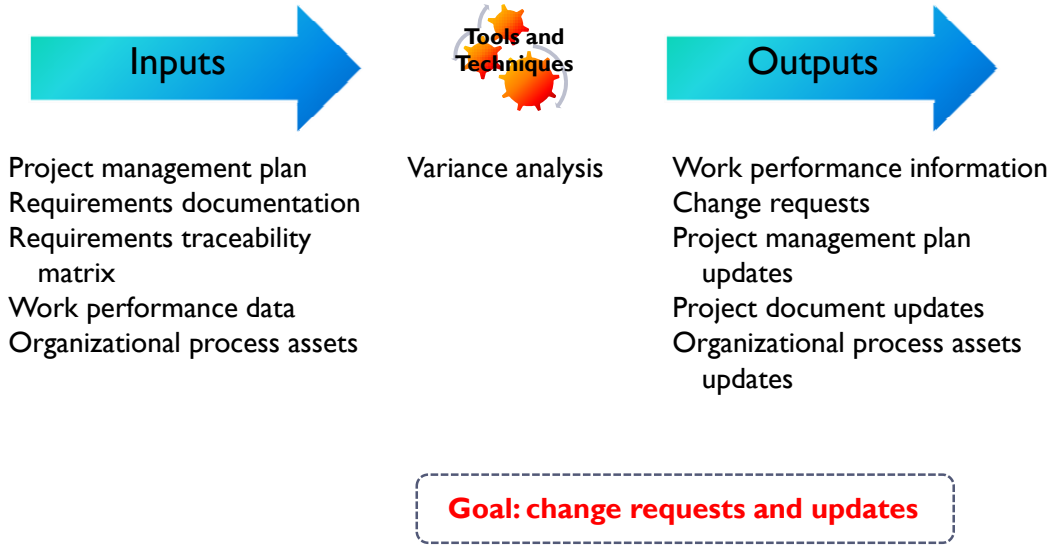
Scope validation primarily concerns itself with formal acceptance of deliverables by the customer. As such, it can occur not only at the end of the project, but also at the end of every project phase. As a result, delivered scope elements can be verified progressively as the project unfolds. This avoids the 'one-shot deal syndrome', where the product is only verified at user acceptance testing just prior to

release into production. Constant scope verification of deliverables allows the project manager and the project team to make incremental course corrections as the project progresses to ensure successful delivery.

Exam Tip: Understand that Validate Scope is similar to Control Quality. The difference is that:

- _____ _____ is the process of formalizing acceptance of the completed project deliverables by the customer
- _____ _____ is the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes. Control Quality usually occurs first because we generally verify the quality requirements prior to verifying with the customer that we are 'done'.

Control Scope



For the purposes of the exam, controlling scope means that you are measuring the work product against the scope baseline and that you are doing so frequently to ensure that the project stays on track.

This means that:

- You have a clearly defined scope baseline from project management plan
- You have verified the scope against the requirements traceability matrix
- You are measuring project performance against the scope baseline using variance analysis techniques to determine whether preventive or corrective actions are required
- You are determining the impact of scope changes against the timeline, budget, quality and product configuration

Since the process is fundamentally proactive, the project manager's job is also to focus on preventing unnecessary changes to the project - prevention of 'scope creep' is a big factor here.

Scope Control Methods

A key to controlling scope on a project is to determine where changes on the project are coming from, and how to limit the effect.

Preventing or eliminating scope creep on a project demands the implementation of an enforced change control system that requires:

- All requested scope changes must be documented
- All requested scope changes must perform an impact assessment
- All requested scope changes must be reviewed by the customer, the performing organization and the CCB (change control board)
- All requested scope changes can be either accepted or rejected

A key element in controlling scope is to have an enforced change control system that does not allow for undocumented, unapproved changes. In organizations that have large complex systems, undocumented changes can wreck havoc and cost millions. As organizations increase in size and the complexity of their systems increase, it becomes more important to have a documented and enforced change control process. The control of 'scope creep' and gold plating becomes a key process in scope control.

Quick quiz:
As the project manager on a large global hardware and software deployment, senior management feels that one of the best risk avoidance strategies is to have a firm grasp on change control. As a result, they want you to control scope creep and keep it to an absolute minimum. When discussing this with stakeholders, it turns out that the stakeholders have very different ideas on what constitutes scope creep. Which of the following is the *BEST* definition of scope creep?

a. Changes to the project through the change control system
b. Any variance to the scope baseline
c. Adding unapproved scope to the project while being held to your original time and cost estimates
d. The performing organization decides to add features to the project that they think the customer will like without gaining formal approval first

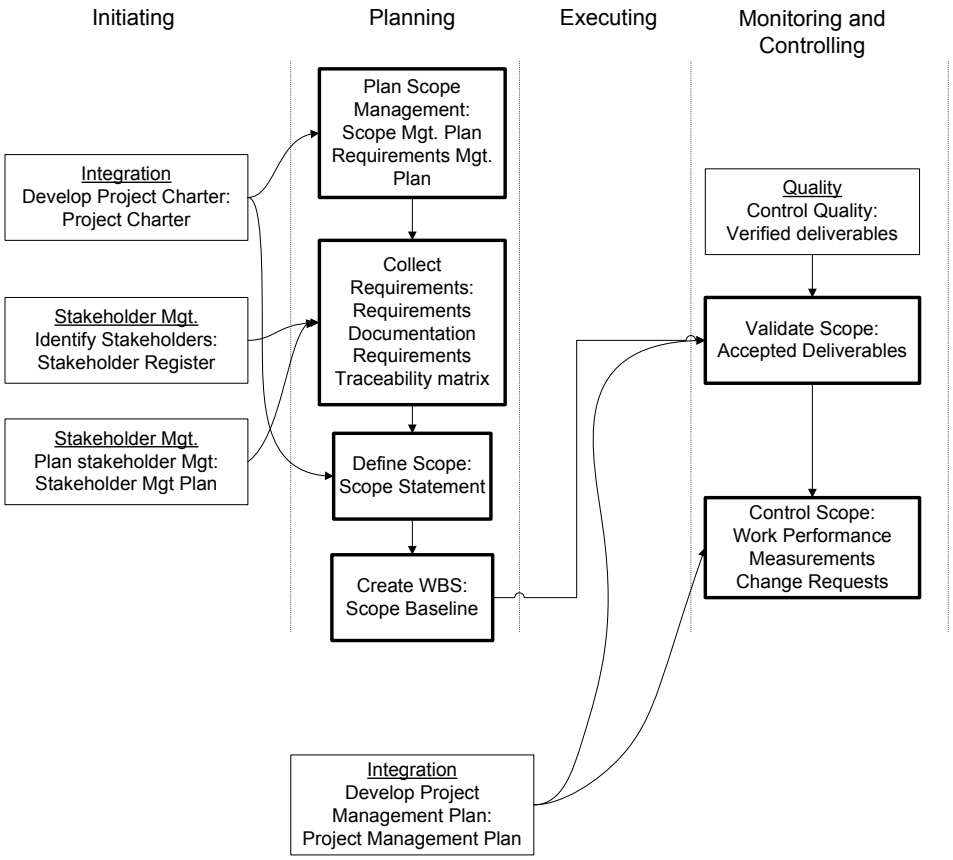
Exam Tip:

For the exam, the Project manager is responsible for controlling unnecessary changes to scope and for ensuring enforcement of the organization's change control system for the project.

Project Scope Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Scope Management processes are shown below. *Know these process interactions for the exam.*

- The key tools and techniques:
  - Create WBS uses Decomposition as the key tool & technique
  - Validate Scope uses Inspection as the key tool & technique
  - Control Scope uses Variance Analysis as the only tool & technique



In Summary…

This section discussed scope management, including:

- The components and importance of a detailed scope statement and scope management plan
- Requirements and requirements collection methods
- Requirements traceability matrix
- How and why a WBS is created
- The scope baseline
- The definition of scope terms, such as work package, WBS dictionary, and decomposition
- The process of scope validation

Scope Process Check

Match the process to its definition:

___Plan scope management

___Collect requirements

___Define scope

___Create WBS

___Validate scope

___Control scope

A. The process of subdividing project deliverables in project work into smaller, more manageable components

B. The process of formalizing acceptance of the completed project deliverables

C The process of determining, documenting, and managing stakeholder needs and requirements to meet project objectives

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

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

F. The process of developing a detailed description of the project and product

Chapter Five Memory Check

1. Adding features to a product that were never requested by the customer is called _____
2. Uncontrolled work added to a project by the customer without any adjustment for timeline or budget is called _____ _____
3. The scope baseline consists of the _____, ____, and the _____
4. The _____ scope are the requirements relating to the project deliverables, whereas the _____ scope refers to the work needed to create the deliverables
5. The key output that tracks requirements, the source of the requirement and the requirement completion status is called a _____
6. The output that is used by the team to get their arms around the project, serves as a communication tool for stakeholders, and is used by the team to see how their work fits into the project is called a _____
7. The lowest level in a WBS is called a _____
8. The _____ shows cross functional dependencies between work packages
9. The key output of the Validate Scope process is _____
10. The two processes in the Monitoring and Controlling process group for Scope are: _____ and _____
11. The process of breaking down work into manageable work packages is called _____
12. Formalizing acceptance of the completed project deliverables is called _____
13. The level above a work package is usually called a_____
14. The process of determining what will be and what will not be included in the project is called _____ _____
15. The tool used to capture the 'voice of the customer' is called_____
16. The 4 group decision voting methods are called _____,_____, _____, and _____
17. The four processes in the Planning process group for scope are: _____, _____, _____,_____
18. The key outputs of the Plan Scope Management process are the _____ _____ _____ and the _____ _____ _____

Chapter 5 – Test

1. The scope baseline consists of which of the following elements?
    a. Project management plan, WBS, scope statement
    b. Scope statement, risk management plan, WBS
    c. WBS dictionary, project management plan, scope statement
    d. Scope statement, WBS, WBS dictionary

2. The WBS is used for all of the following with the *exception* of:
    a. Allowing for team buy-in of the project
    b. Showing cross functional dependencies between work packages
    c. A communication tool between stakeholders
    d. Shows the team how their work fits into the overall project

3. Validate Scope defines a process that:
    a. Allows the customer to verify what was built against the requirements
    b. Occurs at the end of the project prior to closing
    c. Formalizes acceptance of completed project deliverables
    d. Verifies the scope management plan is aligned with the project management plan

4. Two team members are having a discussion about where certain project documentation should exist. They're discussing several elements of the WBS between which there are dependencies. Where can this information be found?
    a. WBS
    b. Detailed scope statement
    c. Scope management plan
    d. WBS dictionary

5. Your project team has come to you with an issue. It appears that during the requirements elaboration process there was a disagreement between the members of the technical team regarding what had to be built to satisfy a user requirement. As a result, some of the technical team members created features in the deliverable that the customer did not really ask for. What would have specifically helped to *avoid* this situation?
    a. Requirements management plan
    b. Requirements traceability matrix
    c. Scope statement
    d. WBS

6. Your stakeholders, a group of seven Ph.D.'s, have met to discuss the merits of moving forward with the project in a specific direction. The discussion started out fairly calmly until a point of contention was identified. At this point, the discussion began to escalate into an argument and finally ended in a shouting match between two of the Ph.D.'s. In addition, one of the members of the team had a differing opinion from his boss (one of the people engaged in the shouting match) and was reluctant to express his real views in the meeting. Which of the following would have been the best approach to avoid the previous scenario?
    a. Delphi technique
    b. Analytic hierarchy process
    c. The KJ method
    d. QFD

7. The team has been progressing ahead of schedule on their project deliverables. So far the customer is very pleased with the results and has commended the team for doing an outstanding job. At the last staff meeting one of the technical team members informed you that while he was working in the system, he noticed an issue that needed to be addressed. While it wasn't defined in the work breakdown structure, he ascertained that the fix would take at most an hour and wouldn't impact the deliverable. "In fact", he stated, "the customer will probably like what I did ". As the project manager, you talk to this technical team member off-line and inform him that what he has done is actually considered to be:
    a. Scope creep
    b. An undocumented change
    c. Gold plating
    d. WBS anomaly

8. Your project team members need to know, in very specific terms, what work needs to be completed on the project. Which of the following is the *least useful* in describing what that work is?
    a. WBS dictionary
    b. The product scope
    c. The project statement of work
    d. Requirements traceability matrix

9. What is scope decomposition?
    a. Breaking down the work into increments of less than 40 hours each
    b. Breaking down the work to the work package level
    c. Breaking down the work to the lowest level of detail possible
    d. Breaking down the work by functional area

10. Who *ultimately* controls changes to scope on a project?
    a. The project manager
    b. Senior management
    c. The change control board
    d. The customer

11. A key input to collect requirements process is?
    a. The project management plan
    b. The project charter
    c. The scope statement
    d. The risk register

12. A key stakeholder has been very difficult to manage on the project. He has been difficult to engage regarding his needed requirements for the project and frequently describes requirements in vague generalities. Then when something is delivered, he will complain that he was misunderstood or that the technical team 'screwed up' his requirement. Last week he demanded a change in scope and insisted that it be completed by the end of the week. After the change was implemented he was shocked at the price tag and immediately escalated to senior management, claiming that the technical team was 'raking him over the coals'. The project manager had provided him with all the necessary documentation to understand the nature and scope of the change. What was the *most likely* element that the project manager may have omitted in this case?
    a. CCB approval
    b. Determining the need for change
    c. Ascertaining cross dependencies for the change
    d. An impact assessment

13. Who creates the scope baseline?

a. The project team
b. The project manager
c. All the stakeholders
d. Senior management

14. What is the *best definition* below of the difference between the Collect Requirements process and the Define Scope process?
    a. Collect Requirements is really a part of Define Scope
    b. Collect Requirements details stakeholder needs while Define Scope describes in detail, the project
    c. Collect Requirements addresses all the detail necessary to deliver the product of the project, while Define Scope identifies project boundaries and constraints
    d. Both Collect Requirements and Define Scope use facilitated workshops as a tool and technique

15. The project management plan is an input to which of the following?
    a. Define scope
    b. Control scope
    c. Create WBS
    d. Collect requirements

16. A project stakeholder identified a defect that they want fixed immediately. You raise the defect with the technical team at the next technical team meeting. After reviewing all the documentation in the configuration management system, you discover that the so-called 'defect' is really an enhancement request. What is the *next* thing you should do as the project manager?
    a. Report the stakeholder to senior management for a violation of company policy
    b. Ignore the defect report. Treat it as a change request to perform a formal impact assessment. Show it to the stakeholder and ask him how he wants to proceed
    c. Engage the stakeholder's manager to discuss what can be done to keep the stakeholder honest in future encounters
    d. Meet with the stakeholder to discuss the discrepancy. The defect may simply be a missed requirement that needs to be addressed as a formal change

17. Collecting the voice of the customer is a tool and technique contained in which process?
    a. Define Scope
    b. Create WBS
    c. Collect Requirements
    d. Verify Scope

18. One level above the work package that helps identify cost centers or a charge code for the purposes of project accounting is known as a what?
    a. Component level
    b. Control account
    c. Cost breakdown structure
    d. Component package

19. The project team is tackling some work that they have never tried before - this represents groundbreaking work on the project you're managing. As a result they're looking for different ways of organizing the work, and specifically organizing the particular jobs needed to complete the project. They want to make sure these jobs are organized in the most efficient method possible. One of the *most effective* tools to help the project team organize how they think about the work is:
    a. QFD process
    b. Nominal group technique

c. Delphi technique
d. Affinity diagrams

20. The project you are managing is about 75% complete and at the monthly meeting with senior management, one of the key points is to review the variance analysis on the project. What is the purpose of the variance analysis?
    a. It measures project variances against scope baseline
    b. It measures the variances between the requirements traceability matrix and the WBS dictionary
    c. It measures variances between the scope statement and project management plan
    d. It focuses on measuring cost variances only

21. You are working with a highly experienced technical team; each member has a minimum of 15 years experience. You are hosting a meeting for the team to discuss the best way to move forward with the project from a technical standpoint. There are number of different requirements that have been discussed, however one of the team members is behaving like a heckler - making fun of ideas he thinks are not viable or telling people flat-out that they're wrong. This is beginning to disturb some of the other team members who have started to visibly disengage from the meeting. You ask this individual what the problem is and he responds, "Who died and put you in charge?" Once the meeting adjourns, you pay a visit to this team member's manager and are prepared to write-up this individual for insubordination. However what is probably the *real* problem?
    a. Lack of a work breakdown structure
    b. Absence of the requirements traceability matrix
    c. No project charter
    d. A flawed scope baseline

22. When performing the scope control process, which of the following statements is *correct*?
    a. Scope control validates the delivered scope for the project
    b. The work performance measurements produced are part of the PMIS
    c. The inspection process is a key tool and technique used in scope control
    d. Scope control is performed in concert with other control processes

23. You are in the requirements collection phase of the project. While a number of JAD sessions were held with the customer, there were still a lot of unanswered questions. The technical team lead decided that implementation of the QFD process would be best to collect the 'voice of the customer'. The project team has decided it would be best to visit the customer's facility to understand how the customer performs their work. The process of going to where the work gets done to observe the customer is called:
    a. Ishikawa process
    b. The Taguchi process
    c. Gemba
    d. The KJ method

24. The project management plan, verified deliverables, requirements documentation, and requirements traceability matrix are all considered:
    a. Outputs of the scope control process
    b. Inputs to the validate scope process
    c. Inputs to define scope process
    d. Tools and techniques of the scope verification process

25. Your team has just completed some work on a project and has submitted it to the users for verification. Once the users verify the results of this phase of the project, the team can start planning the next phase of the project, and it appears that you'll be ahead of schedule and slightly under budget to everyone's

surprise! The customer reviews the work product and is satisfied that it will meet the needs of the project. This is called:

a. An accepted deliverable which is an output of control scope
b. An accepted deliverable which requires formal sign off and approval by the customer
c. An accepted deliverable which is really an output of quality control
d. An accepted deliverable which requires project manager approval

26. The project scope statement is created in which phase of the project?
    a. Planning
    b. Initiation
    c. Execution
    d. Monitoring and Control

27. You just received an emergency e-mail from three stakeholders. It appears that five new requirements are needed to satisfy the needs of the project. These requirements were never identified in the formal Collect Requirements process and senior management is wondering exactly how these elements could have been missed. Upon investigation, the stakeholders confide that a new government regulation was just issued and which they have been given only two months to comply with the government's requirements. The sudden need for these new requirements can be *best* attributed to:
    a. A failure in the requirements collection process which will require a process improvement plan to correct
    b. A failure in the define scope process which will require corrective action
    c. Unforeseeable discovery
    d. A breakdown in communications between the government agency and the business

28. The validate scope process can occur at the end of the project or at the end of a project phase. What is used to validate the scope of the deliverables?
    a. Variance Analysis
    b. Expert judgment
    c. Technical performance measurement
    d. Inspection

29. Project team members want to be clear on the exact work that is necessary to deliver a work package. Which scope element provides the most detailed description of this information?
    a. Requirements traceability matrix
    b. WBS dictionary
    c. Scope Statement
    d. WBS

30. You are attempting to determine the impact of the project on the organization. You have discussed some of the technical aspects of the project with the development team. Where can you find out who can supply the information needed to obtain detailed project and product requirements?
    a. Project Charter
    b. Scope Baseline
    c. Stakeholder register
    d. Project management plan

Chapter 5 Test – Answers

1. D – Scope statement + WBS + WBS dictionary is the scope baseline
2. B – The WBS does not show cross functional dependencies between work packages
3. C – Formalizes acceptance of completed deliverables via a sign-off
4. D – The WBS Dictionary
5. B – The requirements traceability matrix tracks each feature and element in the deliverable back to a requirement. This is a useful approach for preventing gold plating – giving the customer something they did not request.
6. A – The Delphi technique is specifically designed to prevent bandwagonism and avoid head-to-head confrontations. It focuses the team on the facts and pulls the emotion out of the equation
7. C – This is a clear case of gold plating. While it falls under the general category of scope creep (answer A) and also an undocumented change (answer B), what the resource has done is a specific type of undocumented scope creep called gold plating
8. C – The project statement of work provides the least level of detail – it is an input to develop the project charter and is an Initiating activity. It is a "narrative description of products or services to be delivered by the project" *PMBOK® Guide*, 5th edition, p 68. It references the 1) Business need, 2) Product scope description (product characteristics) and 3) the Strategic Plan
9. B – Breaking the work down to the work package level
10. D – Of course it's the customer. Ask yourself, who is cutting the check for you to do all that work and what are they willing to pay for? The PM certainly doesn't and the CCB doesn't fund your project. Sr. Management can be subsumed under the customer heading.
11. B – The project charter. The ONLY input listed in the answer set to Collect Requirements is the Project Charter, *PMBOK® Guide*, 5th edition, p 111
12. D – With a clear impact assessment outlining the additional timeline, resources and budget, there would be no 'sticker shock' surprises.
13. A – Stakeholders have input but the actual scope baseline is created by the project team
14. C – The collect requirements process defines customer needs. The scope includes not only the requirements of the product, but the project scope including risks, constraints, and assumptions. *PMBOK® Guide*, 5th edition, pp 112, 120
15. B – Control scope is correct. *PMBOK® Guide*, 5th edition, p. 106
16. D – Answers A and C assume the stakeholder is dissembling. Answer B might shock the user. Discussing the issue with the user and providing options is the best approach
17. C – The voice of the customer is part of QFD, which in turn is considered a facilitated workshop technique, which it turn is a tool and technique of Collect Requirements
18. B – Control account is the only answer. *PMBOK® Guide*, 5th edition, p. 132. All the other answers are made up.
19. D – The affinity diagram is specifically designed for this function
20. A – It measures project variances against the scope baseline
21. C – The first part of the question is a red herring. The issue is that the team member doesn't recognize the PM's authority. This would have been addressed in the project charter
22. D – Scope control is performed simultaneously with the other control processes in the other knowledge areas. "Project scope control…is integrated with other control processes" *PMBOK® Guide,* 5th edition p 125.
23. C – Gemba is the only possible answer. QFD is a tool for "collecting customer needs, also known as the Voice of the Customer (VOC)". *PMBOK® Guide,*5th edition, p 114. The Gemba process is an integral part of QFD.
24. B – Inputs to the validate scope process. *PMBOK® Guide*, 5th edition, p. 133
25. B – The accepted deliverable requires signoff by the customer
26. A – Planning is the correct answer. *PMBOK® Guide*, 5th edition pp. 47, 120

27. C – This is what we call an ‘unknown, unknown’ when performing a risk assessment, and is usually called discovery: no one had any idea this regulation was on the horizon until the government agency dropped it on everyone
28. D – Inspection is a tool and technique of validate scope. *PMBOK® Guide*, 5th edition, p 133.
29. B – The WBS dictionary contains this level of detail. *PMBOK® Guide*, 5th edition, p. 132
30. C – The stakeholders provide this information. All stakeholders can be found in the stakeholder register

Chapter 6 : **Project Time Management**

Section Topics:

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

Section Objectives

In this section, you will be able to:

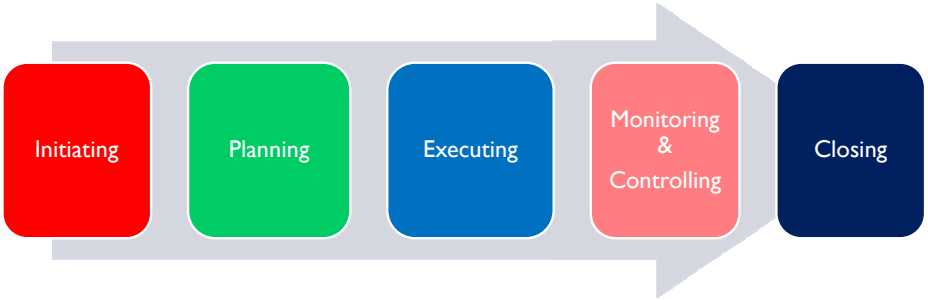
- Put the time management processes into PM process groups
- Define network diagrams and explain two ways to draw a network diagram
- List five techniques that can be used to estimate time
- Calculate critical path

Project Time Management Process Summary

The high level Project Time Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	Schedule Management Plan			
	-Activity list -Activity attributes -Milestone list		-Schedule forecasts -CRs	
	Schedule Network Diagrams		Various document updates	
	-Activity Resource Requirements -Resource breakdown structure			
	Activity duration estimates			
	Schedule baseline			

Time Management



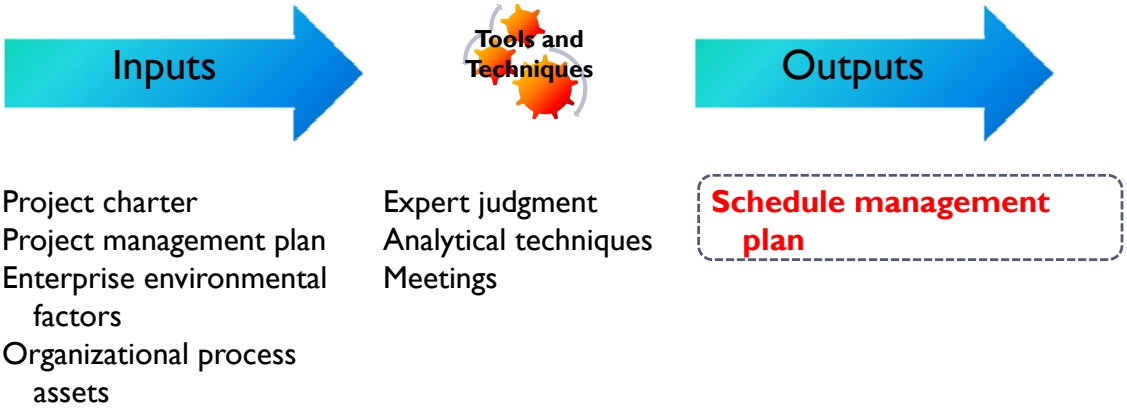
Plan schedule management
Define activities
Sequence activities
Estimate activity resources
Estimate activity durations
Develop schedule

Control schedule

One of the key jobs of the project manager is to ascertain if the project can meet its required end date, and develop options to ensure this will occur. This must all occur before project execution begins. Therefore the predominance of the processes in Time Management occurs in the planning phase; each process occurring in logical order, culminating in the development of the schedule. The purpose of the time management process is to determine a scheduling method, select a scheduling tool, and collect

project information to produce a schedule model. The schedule model is used to create the project schedule.

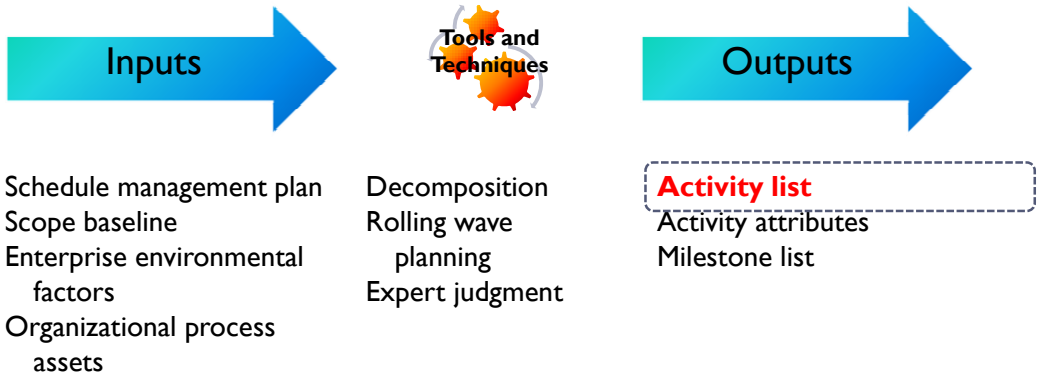
Plan Schedule Management



The Plan Schedule Management process defines policies, procedures, and documentation for managing and controlling the project schedule. Like the other management plans that are created as outputs to other knowledge areas, the schedule management plan can be formal or informal, generalized or highly detailed. The schedule management plan is usually used to establish the following:

- Scheduling methodology and tool
- Level of accuracy - used to determine control thresholds at which action can be taken
- Units of measure - defined for each resource which can include people, facilities, equipment, etc.
- Organizational procedure links that tie back to the WBS
- Project schedule model maintenance - used to update status and record progress of the project
- Control thresholds - the specific limits at which corrective actions may need to be taken. This can be ascertained in the form of a variance analysis
- Rules of performance measurement - can be expressed in terms of earned value management rules or other measurement rules of performance and can specify any of the following:
  - Rules for establishing percent complete
  - Control account levels
  - Earned value measurement techniques
  - Schedule performance measurements including schedule variance (SV) and the schedule performance index (SPI)
- Reporting formats - formats and frequency of reports
- Process descriptions

Define Activities



Defining activities essentially means we are defining *what* we are doing to implement the product of the project. It is here where we define what is being delivered for the project. While the WBS identifies deliverables down to the work package level, work packages are further decomposed into activities which identify the actual work necessary to complete the work package.

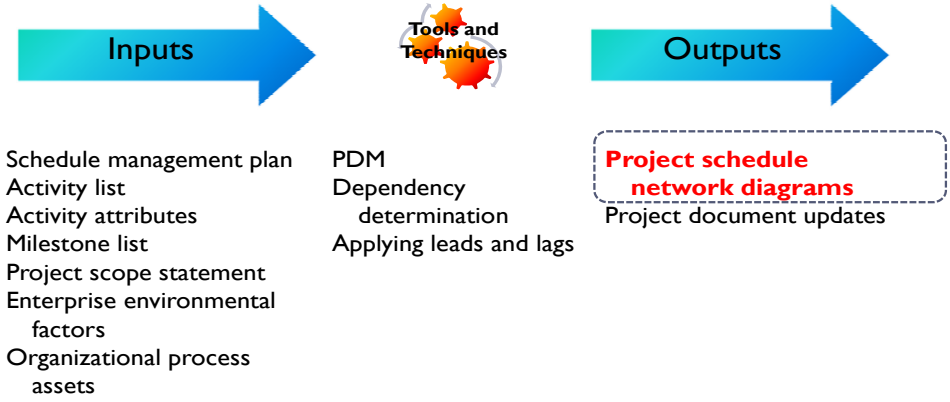
For the exam, understand that the term 'activity' is what PMI uses instead of the word 'task'. Activities are the foundation of providing estimates for budgets, scheduling, executing, and monitoring and controlling of project work.

The primary output from the process is the activity list; it describes what activities have to be performed to deliver the product of the project. Note at this point that it is simply an unordered list; no resources have been assigned, no durations have yet been developed.

The activity attributes give us detailed information about what is needed to fulfill the activity and details any functional dependencies between the activities.

The milestone list can be used to identify major or minor milestones of completion for the project.

Sequence Activities



After the activities are defined, they can be put in the proper order - this is called activity sequencing. We determine if there are activities that must occur earlier in the process versus later in the processes and if there are any dependencies between the activities. The tool that we use to diagram these dependencies is called the precedence diagramming method (PDM) and will be detailed on the upcoming pages. There are various commercially available software tools that can be used to graphically identify the sequence of activities. These tools are called network diagramming tools. For the purposes of the exam we will address the key approach - the precedence diagramming method (PDM) - on the upcoming pages.

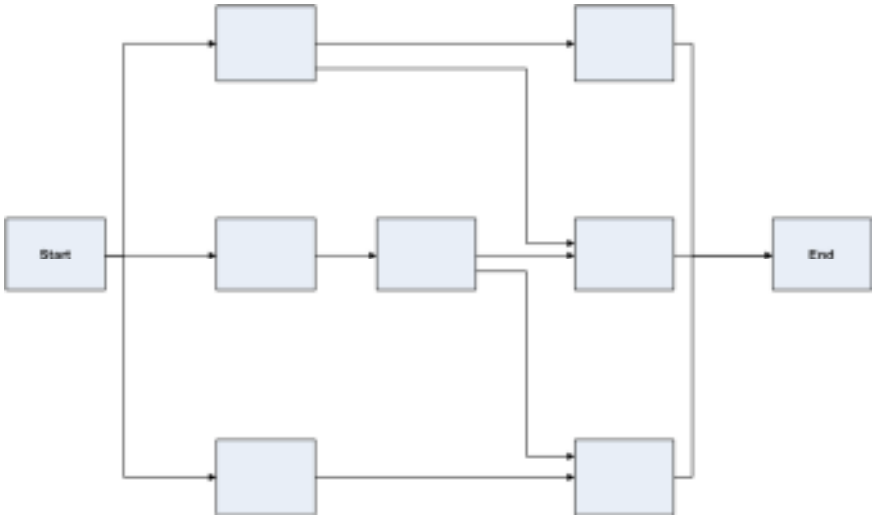
The key output from this process is to create a schedule network diagram.

Network Diagrams

A Network Diagram is similar in appearance to a flowchart, but there the resemblance ends very quickly. A network diagram is useful for the following reasons:

- Illuminates dependencies between activities
- Assigns durations to each activity
- Graphically identifies the workflow so the project team can understand the sequence of events
- Helps justify the time estimate for the project
- Identifies the critical path

An example of a network diagram appears below, minus any identifying markings.

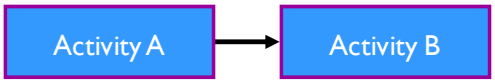


Notice that the diagram resembles a flow chart in design.

Precedence Relationships

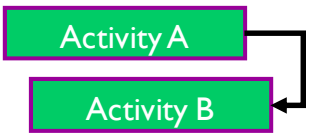
There are four types of precedence relationships in the precedence diagramming method (PDM); also known as the activity on node (AON) approach:

1. **Finish-to-start**: I must complete activity 'A' before I can start activity 'B'. For example: I must drive pilings for the apartment building before I can start construction on the steelwork. About 95% of all relationships in a network diagram use the finish-to-start relationship:

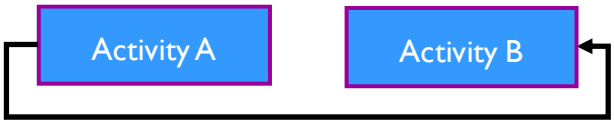


2. **Start-to-start**: I must start activity 'A' before I can start activity 'B'. For example: I must start clearing the driveway of snow before I start applying rock salt.

3. **Finish-to-finish**: I must complete activity 'A' before I can complete activity 'B'. For example: I must finish installing CAT 5 cable before I can complete hooking up PCs to the network. Most of the remaining 5% of network diagram relationships consist of the start-to-start, or finish-to-finish relationship



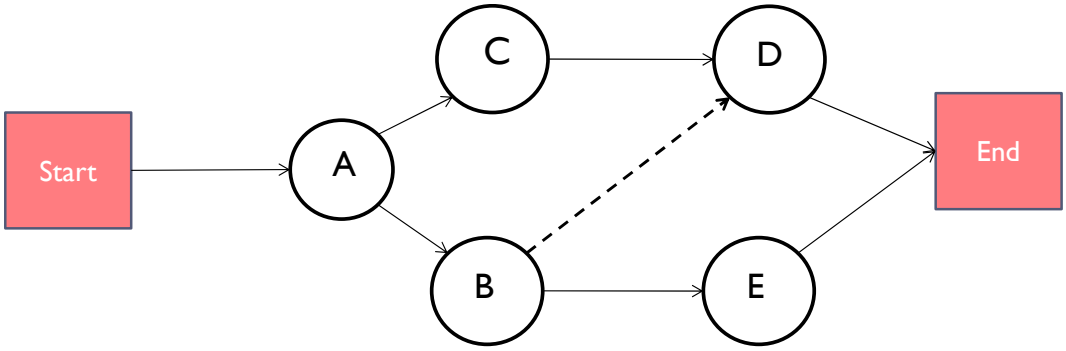
4. **Start-to-finish**: I cannot complete activity 'B' until I start activity 'A'. This approach is rarely used and you may wonder how this could possibly work. For example: let's say there was a lot of work you could complete in activity 'B' except one specific piece. A specific element is handled at the start of activity 'A'. Once activity 'A' has been started and the needed element has been completed, activity 'B' can also be completed



Activity on Arrow

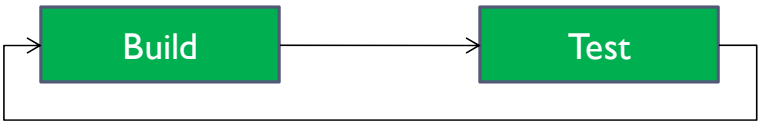
This is also known as the AOA diagram. ***NOTE:*** While this element is no longer mentioned in the *PMBOK® Guide,*5th edition, it continues to appear on the exam.

Activities are defined on the arrow – thus an activity is read as A-C or C-D. The dashed line is a dummy activity – they are sometimes needed to show multiple dependencies. ***Dummies carry a duration of zero***.



GERT

For the exam, you'll not see any questions about how to implement a GERT chart. You need to know what a GERT (Graphical Evaluation and Review Technique) chart is, that it allows for conditional branching and loops, and that's it.



Network Dependency Types

The activity sequencing process is determined based on the following four types of dependencies in your network diagram:

- **Mandatory Dependency -** the mandatory dependency describes elements that are legally or contractually required, or that are inherent in the nature of the work i.e. I must complete activity 'A' before I can start activity 'B'. This is also called 'hard logic'.
- **Discretionary Dependency**- in this case the dependencies are determined by the project team. This type of dependency can also be called 'preferred', 'preferential', or 'soft logic'. This type of logic is used based on how the organization prefers to handle specific dependencies.

- **External Dependency** - you are dependent on the needs of a third party or external organization, such as federal government, state government or a supplier.
- **Internal Dependency** - describe precedence relationship between project activities that are usually within the project team's control e.g. I might have to build part of my software before another part due to a management requirement.

Quick Quiz:

Q: You are working on a large financial project for a major international bank. The network diagram has been created for all of the major project activities: there are three parallel paths of development that all converge onto a single path. At the point of convergence there are some SEC regulations that need to be addressed before you can continue with the project. What kind of dependency does this represent?

Milestones

A milestone represents the completion of a key deliverable or of a phase in the project. Milestones are listed in the project management plan as well as the WBS dictionary and the detailed scope statement.

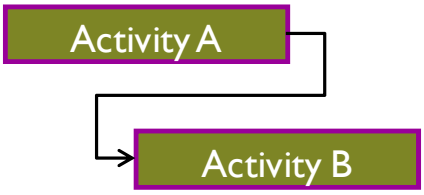
Milestones can also be used as checkpoints or as part of a high-level executive summary on the progress of the project. Milestones are frequently used as a mechanism for funding vendor activities. For example when the vendor reaches a milestone, some percentage of the contract funding is released as a partial payment.

A milestone list becomes part of:

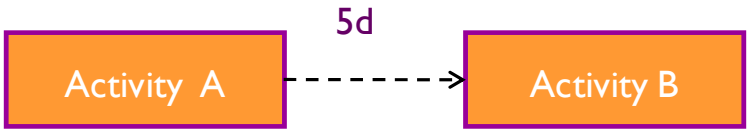
- The project plan
- The project scope statement
- The WBS dictionary

Leads and Lags

Leads can be applied on a project as a form of schedule compression also known as 'fast tracking'. For example: a software project may have requirements in a number of different components. As the requirements team completes the requirements for the first component, the development team can start working on its high-level design for the first component, while the requirement team starts requirements for the second component.



A lag is an imposed delay in starting a successor activity. The lag can be internally imposed or externally imposed depending on the situation. For example: there is a required lag between pouring concrete footing for a garage and starting to erect the walls of the structure. The concrete may require up to two weeks to 'cure' or set before the walls can be framed and a roof completed. In this case, the two weeks represents a lag in the project schedule.



Estimate Activity Resources

Inputs	Tools and Techniques	Outputs
Schedule Management plan Activity list Activity attributes Resource calendars Risk register Activity cost estimates Enterprise environmental factors Organizational process assets	Expert judgment Alternatives analysis Published estimating data Bottom-up estimating PM software	**Activity resource requirements** Resource breakdown structure Project document updates

The estimate activity resources process matches human resources to activities. Think about why this is important. Who performs an activity will have a bearing on the activity's duration. A new resource may take 3 to 5 times longer to complete an activity due to:

- Inexperience
- Lack of knowledge
- Unfamiliarity with the work environment
- Misinterpretation of stakeholder needs
- And others…

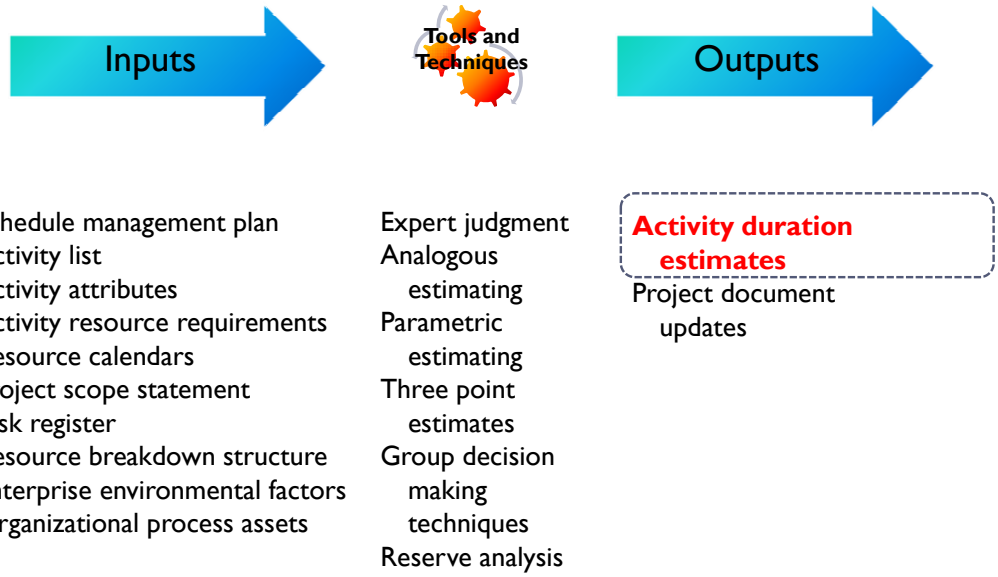
Quick quiz:

Q: Which of the following activities do you think involve Estimate Activity Resources?

- You develop a resource breakdown structure (RBS)
- Inquire of subject matter experts what resources will be needed
- Determine resource availability for the project

- Decompose activities into smaller parts to derive resource estimates
- Analyze the WBS and the activity list
- Perform an analysis of technical difficulty to build and deliver a project component
- Perform an analysis of the type of resources needed for the project
- Consult with HR on organizational resource use policies

Estimate Activity Durations



The Estimate Activity Resources process and Estimate Activity Durations are areas you need to understand very clearly for the exam. As the project manager, you are responsible for the following when estimating activity resources and activity durations:

- Obtaining historical information from past projects
- Coming up with your own estimates. If you are taking a project over from another project manager or there are management imposed constraints, your job is to assess the needs of the project and not take someone else's word for it
- Periodically forecasting the end to come up with your own estimates to completion (ETC)
- Reviewing estimates to ensure they are reasonable and checking for duration padding and risks
- Looking for ways to shorten the project timeline through the mitigation, reduction, or elimination, of risks
- Basing the estimate on the WBS
- Ensuring that the resources who are actually performing the work (the subject matter experts) are delivering estimates, instead of a stakeholder who is telling you what they *think* the estimate should be
- Managing the project to the schedule baseline
- Knowing when to implement a change if schedule problems occur
- Implementing a process to create the most accurate estimate possible
- Meeting any agreed estimates with stakeholders

Quick Quiz:
You have received duration estimates for project activities based on inputs from the project team's subject matter experts. While the expert judgment of these individuals is valuable, the organization sees no value in creating a work breakdown structure (WBS). They are insisting on receiving the duration estimates within 48 hours and have set an aggressive schedule for completion that is three months sooner than the estimates from your subject matter experts. What will be your *BEST* course of action in this case?

a. Since you have very little time to create an estimate, take your best guess and pad the estimate by 50%. This will handle any unexpected turns in the project and enable you to finish on time
b. You create your own WBS irrespective of what management thinks. Create as much detail in the WBS as possible given the time constraints, and give management options for how to best address the aggressive schedule
c. Management's aggressive schedule must be met at any cost. Let the team know you're a no-nonsense project manager and that you will expect them to deliver on management's demands
d. Tell management that you can meet their aggressive schedule demands. As the project progresses look for synergies and improvements that can bring the project in on time to meet the schedule demands

Duration Estimating Types

Knowledge of the following types of duration estimates is required for the exam:

- Analogous Estimating:
  - Project 'A' is like 3 previous projects we delivered
  - A form of expert judgment
- Parametric Estimating:
  - If it takes 1 day and costs x to build a widget then 1000 widgets will take 1000 days and cost 1000x
- Three-Point estimating (PERT and Triangular Distribution)
  - PERT: A weighted average using statistical methods
  - Triangular Distribution: Non-weighted average of three data points
- Bottom-Up estimating:
  - A detailed estimate based on reliable historical values
- Expert Judgment: Subject Matter expertise
- Reserve Analysis: covered in Risk Chapter
- One-Point estimate: Based on expert judgment, but has numerous negative effects on the project:
  - Easy for team members to pad estimates
  - Resources try to please the boss instead of meeting the needs of the project
  - Estimates are highly unreliable and contribute to hidden risks
  - Schedules are at best, unrealistic and at worst, unattainable
- Heuristics: Problem-solving by experimental and especially trial-and-error methods – a rule of thumb

Accuracy of Estimating Methods

Method	Advantages	Disadvantages
Analogous	Quick, low cost	Very 'rangy' – a form of expert judgment, if it's available
Parametric	Can be more detailed than analogous, faster than bottom-up	Parameters may not scale, accuracy can vary - may be more costly than analogous
Bottom-Up	More accurate Better team buy-in	Longer, higher cost, relies on WBS accuracy. Team may 'pad' estimates
Three-Point (PERT)	For well understood activities can be very accurate	Can be very inaccurate if ranges are based on unknown elements

The description of these methods will be thoroughly outlined in the Cost chapter.

Statistics for the Exam

You will not be asked to perform complex computations for the PMI examination. Everything will be either add, subtract, multiply, divide, and the occasional exponent. One element you must be very clear on is the concept of standard deviation (SD or 'sigma' level) and what percentage of a normal distribution of the sigma levels cover.

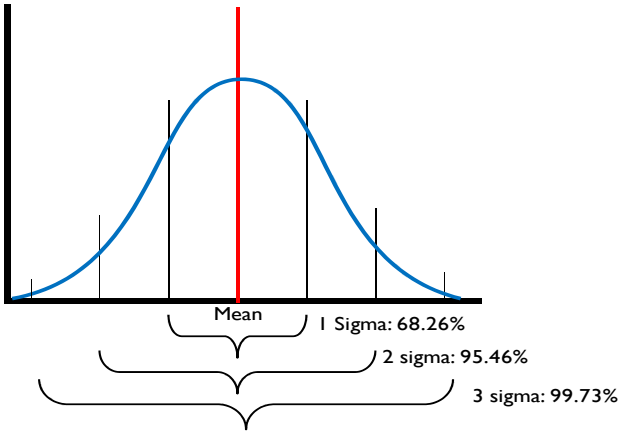
The diagram above shows a standard normal distribution, otherwise known as a bell curve. For the exam, understand the following:

- '**Average' or 'Mean'**- this refers to the arithmetic mean (*not* the geometric mean).To derive the average or mean of any group of numbers, simply total all the numbers in the group and divide that total by the sample count. Example - compute the average of the following set of numbers: 2,7,12,17,4,21,23. Adding up all the numbers totals 86. How many numbers were in the sample: 7. Then divide 86 by 7 to obtain the average: 12.29
- **Standard deviation -** this is also called the 'sigma' value, usually represented by the Greek symbol 'σ'. Standard deviation is a measure of precision; the smaller the standard deviation the tighter the precision

Approximately:
A range of 1 standard deviation ('1 σ') above and below the mean equals 68% of the population.
A range of 2 standard deviations ('2σ ') above and below the mean equals 95% of the population.
A range of 3 standard deviations ('3 σ ') above and below the mean equals 99% of the population.

Brain Dump!

See the graphical example below for exact percentages:



6 sigma is 99.999% or 3.4 defects per million opportunities.

Accuracy measures conformance to target values, while **standard deviation** measures the precision of the measurements. This will be discussed in greater detail in the Quality Chapter (Chapter 8).

For the exam you may see questions like this:

Q: You are managing a project with a schedule of 18 months. Based on your schedule calculation, you've determined the standard deviation on the schedule is six weeks. What is the range of the schedule computation to a 95% confidence factor?

a. 60 weeks to 84 weeks
b. 64 weeks to 80 weeks
c. 66 weeks to 90 weeks
d. it cannot be determined from the information given

Answer: C

Solution:

1 standard deviation = 6 weeks
2 standard deviations, (95% confidence factor) = 12 weeks
18 months = 78 weeks (52 + 26)
78 – 12 = 66 weeks
78 + 12 = 90 weeks

PERT Calculation

PERT:

Mean = $\frac{t_O + 4*t_{ML} + t_P}{6}$

Standard Deviation = $\frac{t_P - t_O}{6}$

Variance = σ^2

Triangular Distribution

Mean = $\frac{t_O + t_{ML} + t_P}{3}$

Standard Deviation = $\frac{t_P - t_O}{3}$

Variance = σ^2

Key:

t - time
O- Optimistic
ML – Most Likely
P- Pessimistic

Brain Dump!

The PERT estimate, also described as a Beta Distribution, can be calculated for time or budget. It is designed to accommodate a range of estimates from the most optimistic, to the most likely, to the most pessimistic, and then calculates an average.

The PERT estimate, uses a weighted average – notice that the Most Likely estimate is multiplied by a factor of 4. This is because the PERT is weighted to accommodate the 95% confidence factor of 2 standard deviations. In other words, PERT assumes that the most likely estimate is the most accurate and should get the heaviest weight in the calculation. Estimates used for PERT can be derived from published estimating data or expert judgment.

Question –
Your team has gotten back to you with the following estimates for the project:

- Optimistic – 10 weeks
- Most likely - 16 weeks
- Pessimistic - 34 weeks

What is the PERT mean, standard deviation and variance for the schedule?

For the exam, from the example shown above, simply apply the correct formula for the mean to derive the PERT estimate:

(10+(4*16) +34)/6 = 18 weeks

Use the second formula to compute the standard deviation:

(34-10)/6 = 4

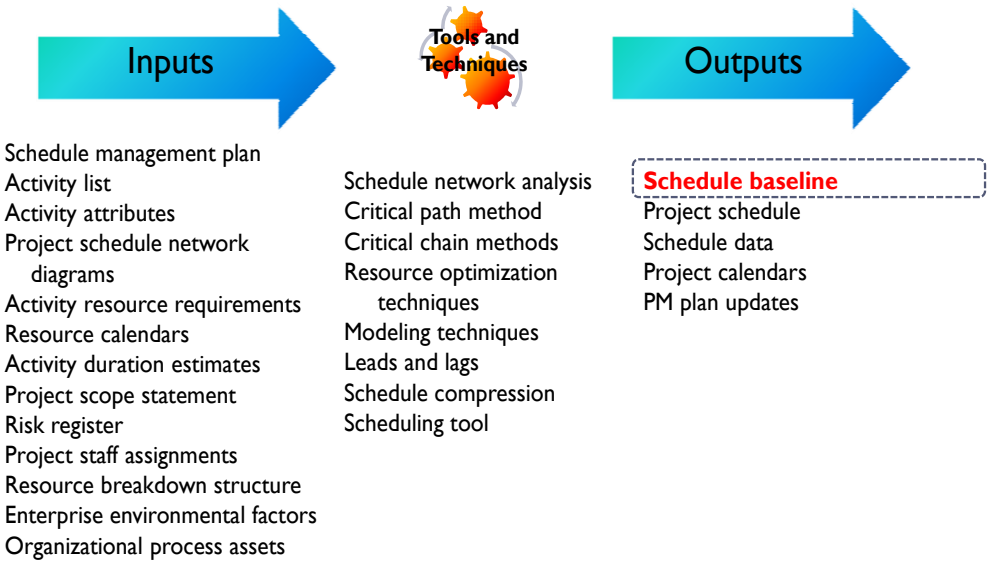
The variance is simply the square of the standard deviation:

$(4)^2 = 16$

Exam Tip: you simply need to memorize these formulas and answer the questions that appear.

Real World Note: In real world applications, the PERT estimate is simply a point estimate. In order to derive probabilities and confidence factors from this estimate, the PERT estimate is processed using the Monte Carlo analysis. This will enable the construction of a statistical model that will tie specific confidence factors to the PERT estimate.

Develop Schedule



The development of the project schedule is a culmination of the prior four steps we have just reviewed. In order to create the schedule we need:

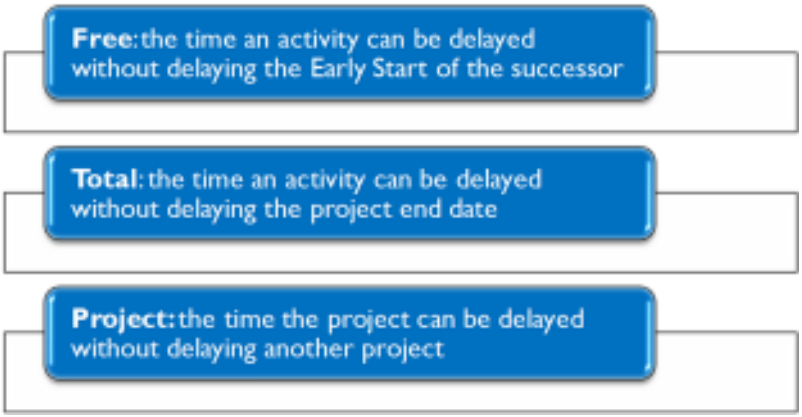
- An activity list
- Correctly sequenced activities
- Activity resource estimates
- Activity durations

The **schedule baseline** is a version of the project schedule and is a component of the project management plan. It is accepted, approved and signed off by the project management team. The schedule baseline documents the accepted schedule performance including start and finish dates.

Exam Tip: The difference between a time estimate and the schedule is that the **schedule** is calendar-based. Weekends, holidays, resource availability, vacation days and a host of other elements go into the final schedule. A **time estimate** for an activity simply relays how many hours or days it may take to complete the activity. The time estimate is also called **work effort** or **level of effort**.

Slack and Float

When constructing a network diagram, there may be activities that can be delayed without impacting the project schedule. These activities are said to contain **float** or **slack**. The terms 'slack' and 'float' are synonymous. For the exam, you need to know the definitions of the three types of slack/float that you can encounter on a project:



A number of activities in a network diagram occur in parallel. This is because different resources with different skill sets are able to perform their jobs independently. For example, the jobs of setting up a database, installing CAT 5 cable, developing a user interface, and installing a phone system all require different skill sets. It is quite possible to execute these activities in parallel as dependencies between them may be minimal.

Therefore, it is quite possible that while one path in the network diagram takes 10 weeks, a parallel path may only take 5 weeks. This is where we address the idea of slack or float in a project timeline.

Slack/float definitions:

- ES - early start, the earliest time in the network schedule an activity can begin
- LS - late start, the latest time in the network schedule an activity can begin without impacting the late finish (LF)
- EF - early finish, the earliest time in the network schedule an activity can end
- LF - late finish, the latest on the network schedule an activity can end without impacting the start of a successor activity

Float or Slack can be computed with the formulas shown below.

Slack/float = LS – ES or LF – EF

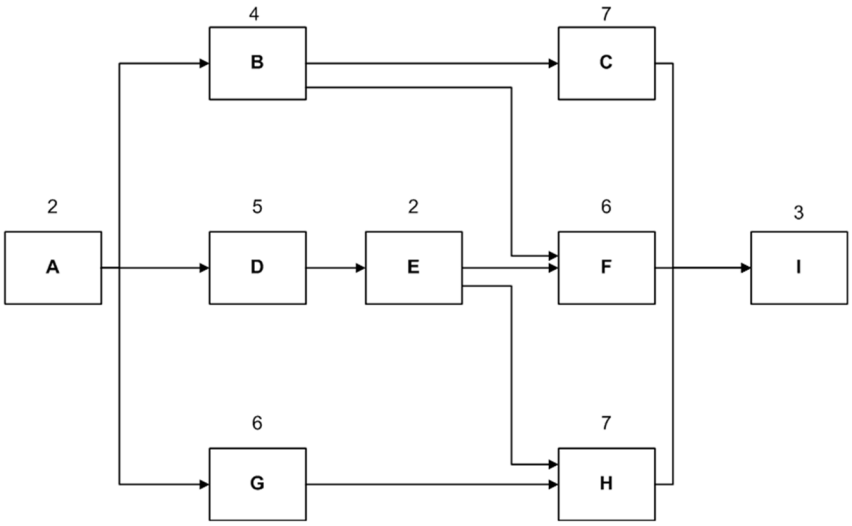
Critical Path Definition

The critical path in a network diagram is the longest path through the network that produces the shortest possible completion time for the project. It typically contains zero float. (With PDM sequencing, can have zero, negative or positive float depending on constraints.) The critical path outlines a series of mandatory dependencies in what is usually a series of finish-to-start relationships.

Critical Path Exam Tips:

- **There can be more than one critical path**
- **The critical path can change**
- **The critical path has _____float[19]**
- **A path with *negative* float means you are behind schedule. As the project manager, your job is to compress the schedule and eliminate negative float**

Critical Path: Quick Quiz



Compute the critical path for the network diagram shown above. All durations are in weeks.

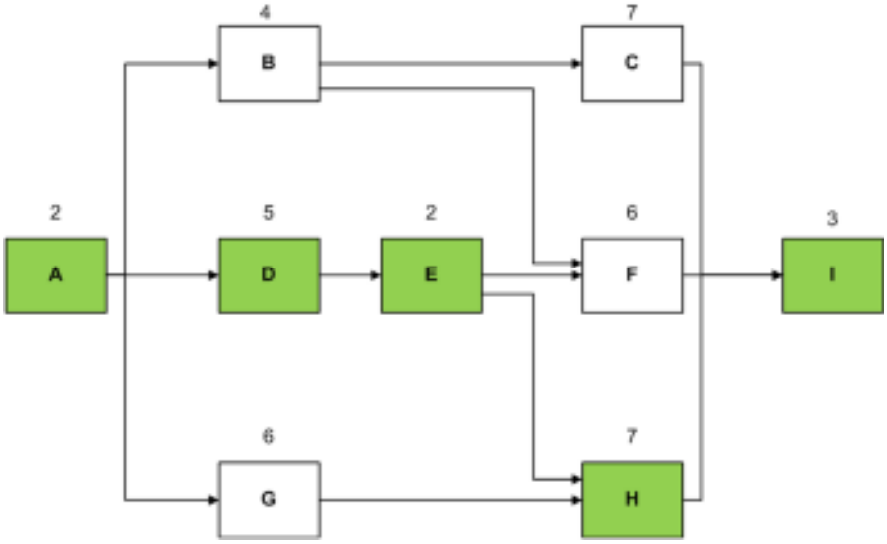
Considerations:

- Certain paths merge, for example:
  - Activities E and G merge into activity H
  - Activities B and E merge into activity F
- Merging paths create schedule dependencies based upon which path takes the longest to complete

[19] *PMBOK® Guide*, 5th edition p. 177

The longest path through the network diagram shown above will be the critical path. The solution appears on the next page.

Critical Path Solution

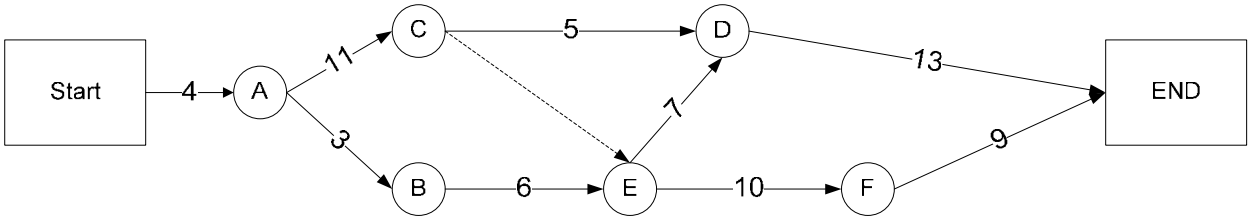


Notice that:

a. Activities D and E are in a mandatory dependency relationship: activity D must complete before activity E begins.
b. Since the combined time for activities D and E is 7weeks, activity G is not on the critical path because it only has a duration of 6 weeks
c. Notice that three paths converge into activity I. We determine the critical path by computing the duration of all possible paths to activity I:
    a. A – B – C-I: 16 weeks
    b. A – B – F- I: 15 weeks
    c. A – D – E– F-I : 18 weeks
    d. A – G – H-I: 18 weeks
    e. **A – D – E – H-I** : **19 weeks**

Also notice that there are 2 'near critical' paths, each at 18 weeks: A-D-E-F-I and A-G-H-I. As the project manager, you would keep an eye on these near critical paths to monitor for any schedule variances. Either one of these paths could become a parallel critical path or a new critical path if activities along these paths were delayed.

The diagram that appears below is called an AOA (Activity on Arrow) or ADM (Arrow Diagramming Method). While this approach is not referenced in the *PMBOK® Guide*, 5th edition, questions addressing AOA diagrams still appear on the exam, so we will cover the basics here.



Compute the critical path for the AOA above.

The key to understanding AOA diagrams on the exam:

- You may be given activity descriptions from which you will have to create an AOA diagram
  - AOA activities are always identified with two letters; A-B or A-C, etc. This is because the activity occurs on the arrow and not on the node
  - Dummy activities, if present, will be identified
- Dummy activities have no duration but do show schedule dependencies

The key to computing the critical path in the diagram above is to understand the impact of the dummy activity: completion of activity C-E.

The critical path is: **Start – A – C – E – D – End Duration: 35 weeks**

Network Diagram Setup

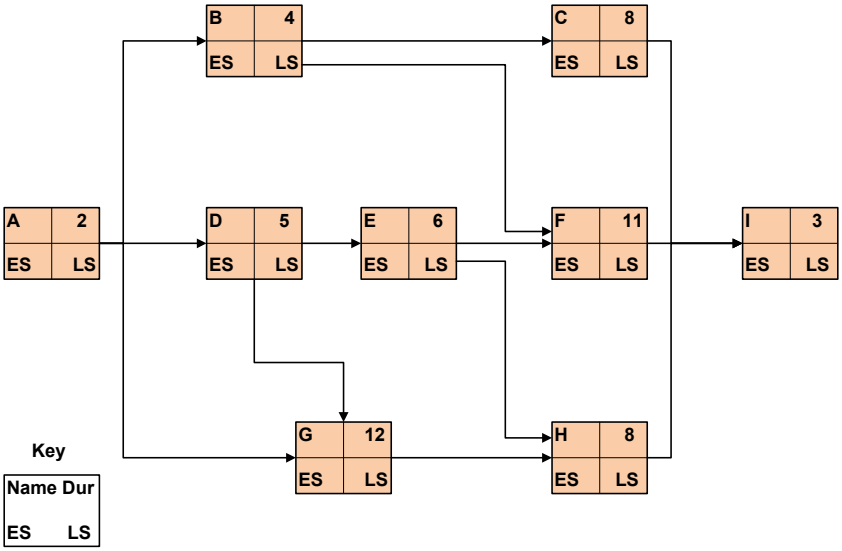
The standard approach to setting up a network diagram is to use what is known as the '7-box' method:

Early Start	Duration	Early Finish
ID		
Late Start	Float	Late Finish

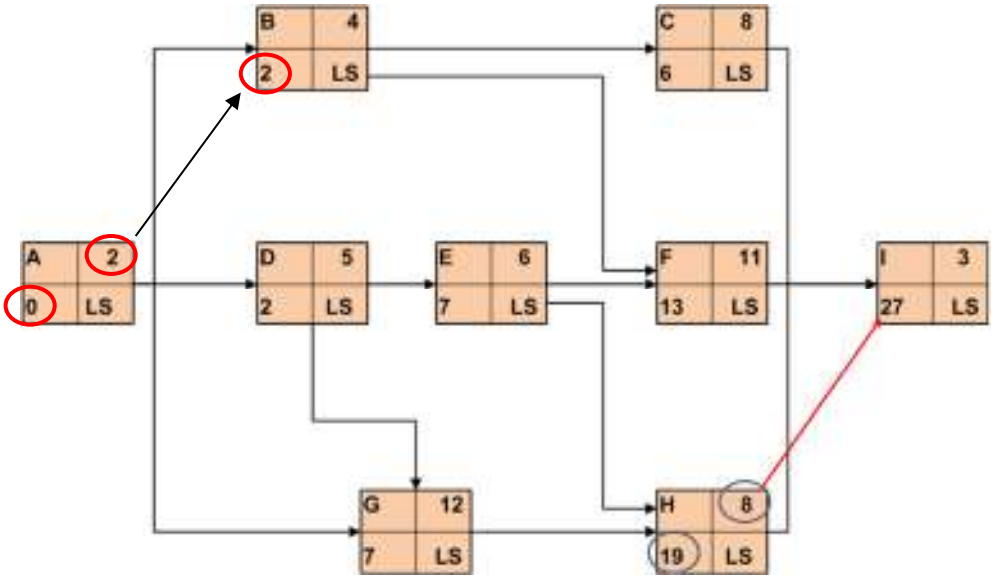
In the PMBOK ® Guide, 5th edition, p. 177, the 7-box method is shown to the left. It includes an activity ID, a duration, a float, early start(ES), late start(LS), early finish(EF) and late finish(LF) data. Unfortunately, the PMP credential seeker will not have time on the exam to draw 7 boxes for each node , so a shorthand is developed - a simplified way of setting up a network diagram is to use the '4-box' example shown below. Notice this is a new diagram with different durations. You'll also notice that early finish and late finish are not included. (They can be added if needed). Float can be shown over the top of each box, if needed.

For each activity, subdivide the box into a quadrant of four smaller boxes. The **activity identifier** appears in the upper left-hand corner of the quadrant. The **activity duration** appears in the upper right-hand corner of the quadrant. The **early start** for the activity is shown in the lower left-hand corner of the quadrant, while the **late start** for the activity is shown in the lower right-hand corner of the block. ***If the early start and the late start of an activity are identical; that activity is on the critical path.***

By filling in the values for the early start and the late start, we will be able to compute not only the critical path for the network, but also show any float or slack in the network diagram. An example appears below:



Computing the Forward Pass



Computing the forward pass allows us to ascertain the critical path in the network diagram. Early start figures are computed for an activity by adding the early start to the duration of the predecessor activity. For example:

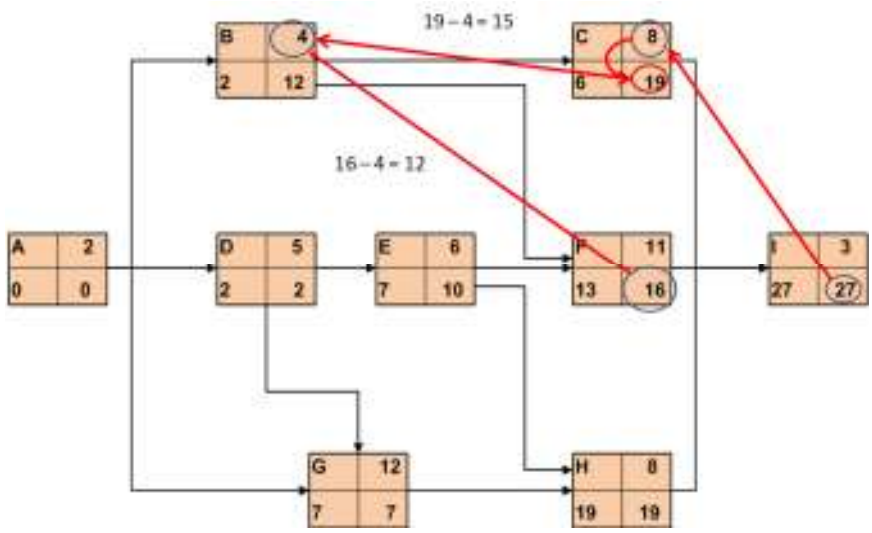
- The early start of activity 'B' is derived from taking the early start of activity 'A' (0) and adding it to the duration of activity 'A' (2). In this case 0 + 2 = 2. The number 2 now goes in the early start of activity 'B'.

When an activity has two predecessors, how do we determine the early start of the successor activity? For example, activity 'G' has two predecessors: activity 'A' and activity 'D'. What is the early start of activity 'G'?

- Adding the early start of activity 'A' to the duration of activity 'A' yields the number 2
- Adding the early start of activity 'D' to the duration of activity 'D' yields the number 7

When merging paths for a forward pass activity, the largest number wins. In this case the number 7 goes into the early start of activity 'G'. Look at the diagram above and see where else this concept applies.

Computing the Backward Pass



The Backward Pass is used to complete the late start computations for the network diagram. In this case, we take a late start of the successor activity, subtract the duration from the predecessor activity and the result is placed in the late start of the predecessor activity. For example:

The project is 30 weeks in duration: Activity 'I" Early start (27) + Activity "I" Duration (3). To derive the Late start of Activity "I", we take the project duration (30) and subtract the activity "I" duration (3): 30-3 = 27. Thus, the late start of activity 'I' is 27. We derive the late start of activity 'F' by subtracting the duration of activity 'F ' (11) from the late start of activity 'I' (27). 27 – 11 = 16. And 16 is the value you see in the late start of activity 'F'. We derive the late start of activity 'C' by subtracting the duration of activity 'C ' (8) from the late start of activity 'I' (27). 27 – 8 = 19. And 19 is the value you see in the late start of activity 'C'.

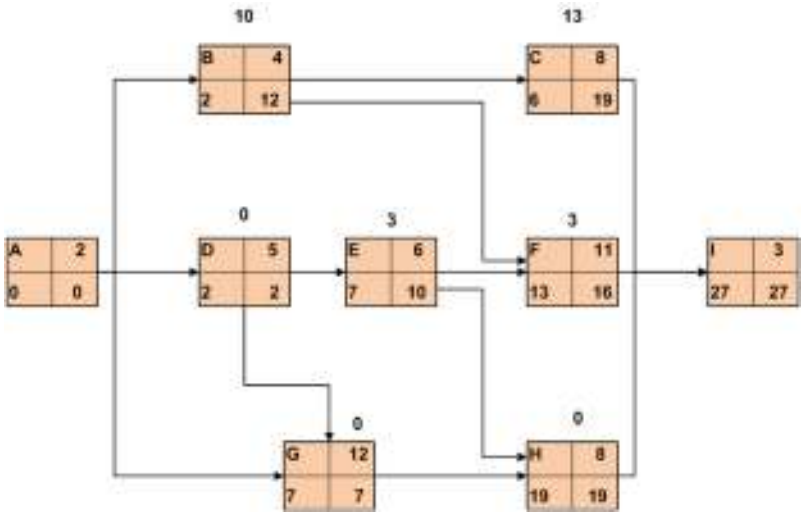
When an activity has two successors, how do we determine the late start of the predecessor activity? For example, activity 'B' has two successors: activity 'F' and activity 'C'. What is the late start of activity 'B'?

- Subtracting the late start of activity 'F' from the duration of activity 'B' yields the number 12

- Subtracting the late start of activity 'C' from the duration of activity 'B' yields the number 15

When merging paths for a backward pass activity, the smallest number wins. In this case the number 12 goes into the late start of activity 'B'. Look at the diagram above and see where else this concept applies. For critical path activities, early start and late start numbers will be the same. For any activity that has float/slack, early start will always be less than late start. ***All critical path elements will have identical ES/LS numbers (activities A, D, G, H and I are all on the critical path).***

Computing Float and Slack



The numbers above the activities in the network diagram showed the float for each activity. For the purpose of the exam be very careful how you answer the next questions:

- What is the total float for path A, D, E, F, I?
- What is the total float for path A, B, C, I?
- What is the total float for path A, B, F, I?

If your answers respectively were: 6, 23, and 13, none of your answers were correct. (!)

Exam Tip: when figuring the float for a path, the float values for each activity are not added together. The path float consists of the highest single value of float in the specific path.
Exam Tip: Critical path activities will have identical Early Start/Late Start dates

(The actual answers are 3, 13, and 10. The largest *single* path value is the float)

Schedule Compression Techniques

Schedule compression techniques may have to be used to address schedule constraints. There are two key tools in the project manager's toolbox that will allow the project manager to compress the schedule:

- Fast Tracking
- Crashing

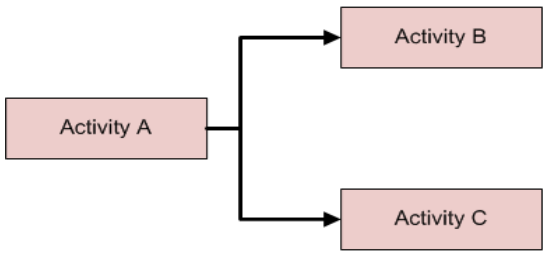
_____ allows for the overlapping of activities or setting up activities to run in parallel. If the dependencies created by running activities in parallel are not managed correctly, this can result in rework and increased risk. Another issue is resource over-load which can occur if the same resources are used on an activity and its immediate successor activity. By overlapping these activities or running them in parallel, the resource can suddenly find themselves putting in a 16 hour day. It is the project manager's job to ensure this burnout scenario does not occur.

_____ involves adding resources to critical path activities and always results in increased costs. This option can also result in having the team work overtime to achieve the project timeline constraints. This can result in team burnout, and unrealistic expectations regarding the actual time saved. Doubling the resource pool does not automatically mean that you will be getting twice as much work done in the same time. This is especially true on a software project. For further information, read the classic by Frederick Brooks entitled: *The Mythical Man Month.*

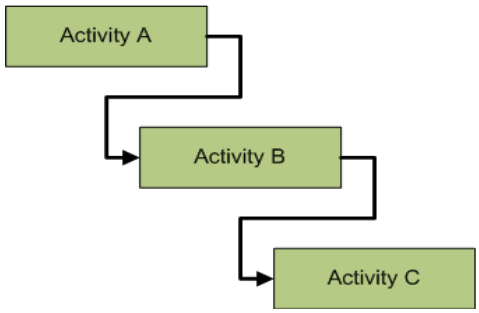
Below are two representations of fast tracking options compared to a current schedule:

Current Schedule

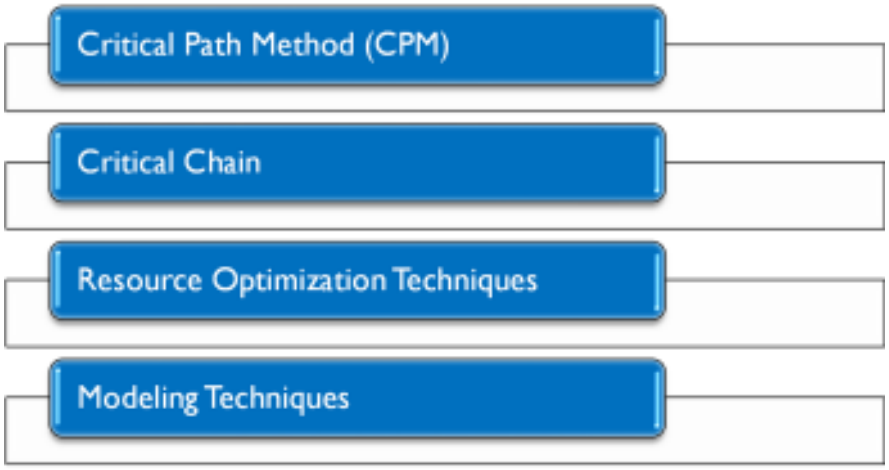
Fast Tracking Option #1



Fast Tracking Option #2



Scheduling Techniques

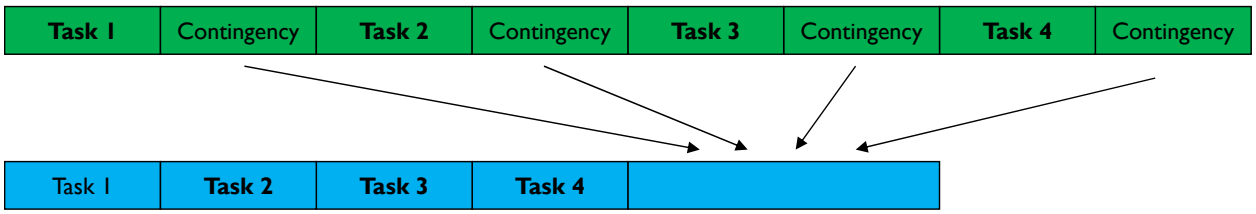


CPM (Critical Path Method) is the technique we just reviewed that computes the forward and backward pass in order to determine the critical path and any possible float in the network.

Critical Chain Method

The critical chain method is based on Eliyahu Goldratt's Theory of Constraints and described in some detail in the book *Critical Chain Project Management* by Lawrence P. Leach. It is a method of planning and managing projects that puts the main emphasis on the resources required to execute project activities. Contrasted to the Critical Path and PERT methods, which emphasize activity order and rigid scheduling, a Critical Chain project network will tend to keep the resources levelly loaded, but will require them to be flexible in their start times and to quickly switch between activities and activity chains to keep the whole project on schedule.

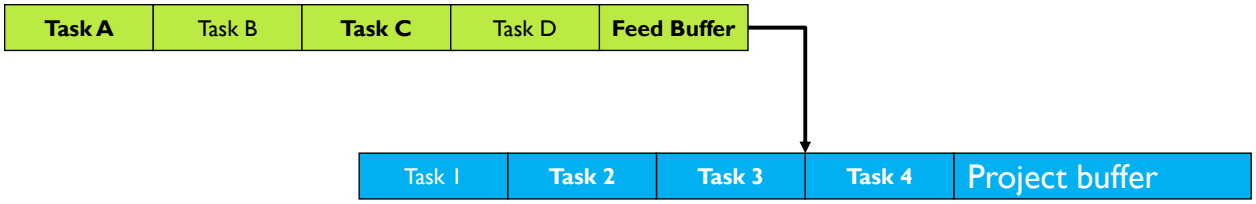
By cutting each task to its 50-50 estimate, we have reduced the project timeline by at least 50%. The project manager then adds a buffer to the end of the project timeline equal to 50% of the new timeline. The result is a project timeline that is automatically 25% shorter than the original critical path. See the example below:



Critical Chain project managers expect resources:

- To start the task as soon as input is received
- Work on the task 100% - no multi-tasking
- Pass on the task output as soon as it is completed

Critical chain project management also utilizes a technique called a feeding buffer. The feeding buffer is used on noncritical path activities or on parallel path activities to protect the critical chain from slippage. The idea is that if any of the activities on the parallel path are delayed only part of the feeding buffer will be expended without pushing out the end date of the project. An example appears below:



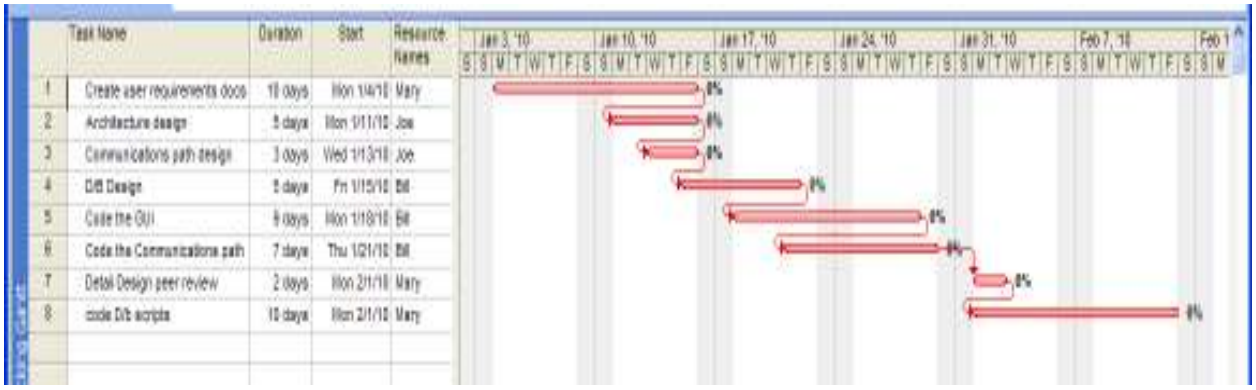
Critical Chain project managers expect 50% of the tasks to overrun (!)

Exam Tip: CCPM accounts for limited resources, adds duration buffers, and focuses on managing the time buffer and resources. With CPM, the focus is on managing float. *With CCPM, the focus is on managing the buffers.* <u>You may see CCPM as a possible answer to several exam questions</u>

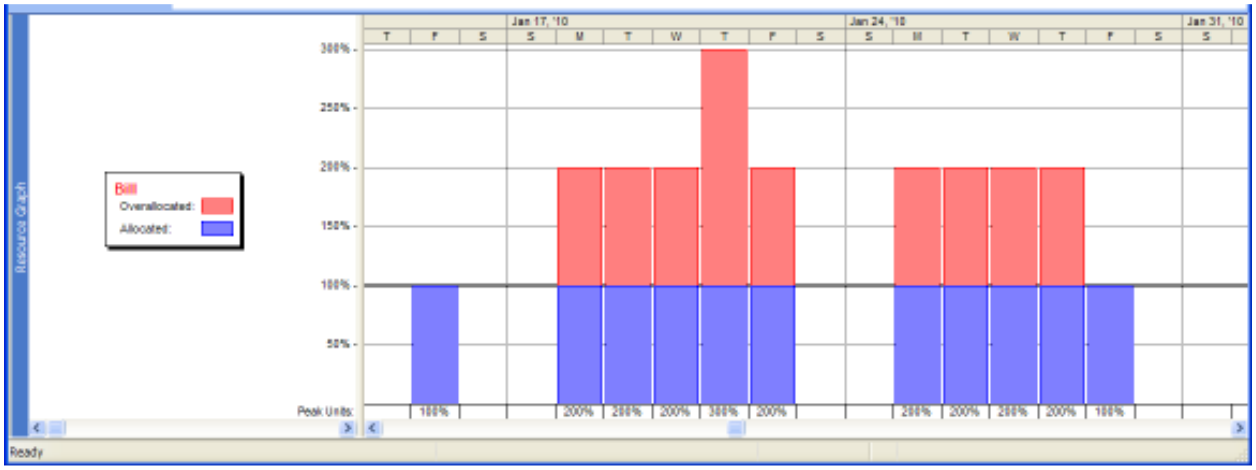
Resource Optimization Techniques

Resource Leveling is used to adjust the variation in resource loading, which can vary considerably from one project phase or time period to the next. The idea is to stabilize the number of resources working in each time period to prevent resource over-allocation, or when a project phase needs more resources than are currently available. This can result in a change to the critical path or an extension of the project timeline. Here is where you can use resource leveling heuristics or guidelines for performing the resource leveling.

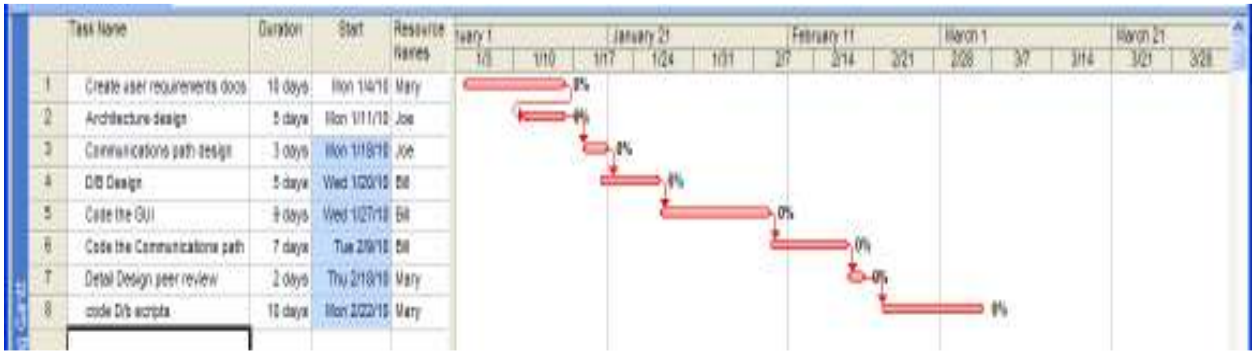
Resource leveling is a network analysis technique that is applied to a schedule after it has been analyzed by the Critical Path Method (CPM). It is particularly useful for illuminating resource over or under allocation at any point in the project schedule. In most organizations, however, resource over-allocation is the issue. Over-utilizing individuals with needed skill sets – e.g. assigning a resource to two or more tasks simultaneously within the same period - can lead to team burn-out, higher defect rates and other problems. Resource leveling an MS Gantt chart, where resources are being utilized at 125-150% of their standard work day, can push out the critical path far past the original schedule end date. See example below:



Notice that Joe and Bill show substantial overlap of activities. When displaying a graph of resource utilization, notice the following over-allocation levels for Bill. At one point it shows that Bill is working 24 hours in a 24 hour period!



While the original project timeline shows that the project work will complete in 6 weeks, this is a highly unrealistic estimate. When the timeline is resource leveled, notice the new end-date now sits at 9 weeks and provides for a consistent 40-hour/week allocation level for each resource. Also notice that the first two activities were not resource leveled because each activity is now being performed by a different person:



Resource smoothing, is used to adjust the schedule so that resource requirements on the project do not exceed predetermined resource limits on the project. In this case the projects critical path is not changed and the completion date of the project may or may not be changed. Activities can only be delayed within their free and/or total float boundaries. Using this technique, you may not be able to optimize all of the resources.

Modeling Techniques

What if analysis is used in scenario building activities to address the feasibility and the possibility of meeting the project schedule. This analysis is useful in creating contingency plans in the event that the schedule requirements have a risk of not being met.

The **Monte Carlo** analysis constructs a mathematical model based on statistical probabilities. The accuracy of the model is as accurate as the estimates delivered by expert judgment and /or historical data. There are any number of commercially available software spreadsheet tools and databases that allow for the construction of Monte Carlo analysis models.

The Monte Carlo Analysis uses a combination of the PERT estimate and triangular distributions to create the model, and indicates where further discussion may be needed to minimize or eliminate schedule risks. The analysis can be performed using a tool such MS Excel® with relative ease, or with more sophisticated modeling tools such as @Risk®, Crystal Ball®, Minitab®, and others.

While the PERT estimate is useful in describing schedule variances, the primary issue with the PERT estimate is that it is only a point estimate. In order to get a clear picture of the probability distribution, the estimates in the model must be run thousands of times in order to draw the cumulative distribution of possibilities. For the Monte Carlo approach to work:

- It uses a set of random variables called *stochastic variables* to help generate the model
- It uses the triangular distribution to identify the end points in the model

Exam Tip: The graph of this function is known as an 'S' curve and will be outlined in greater detail in the risk chapter.

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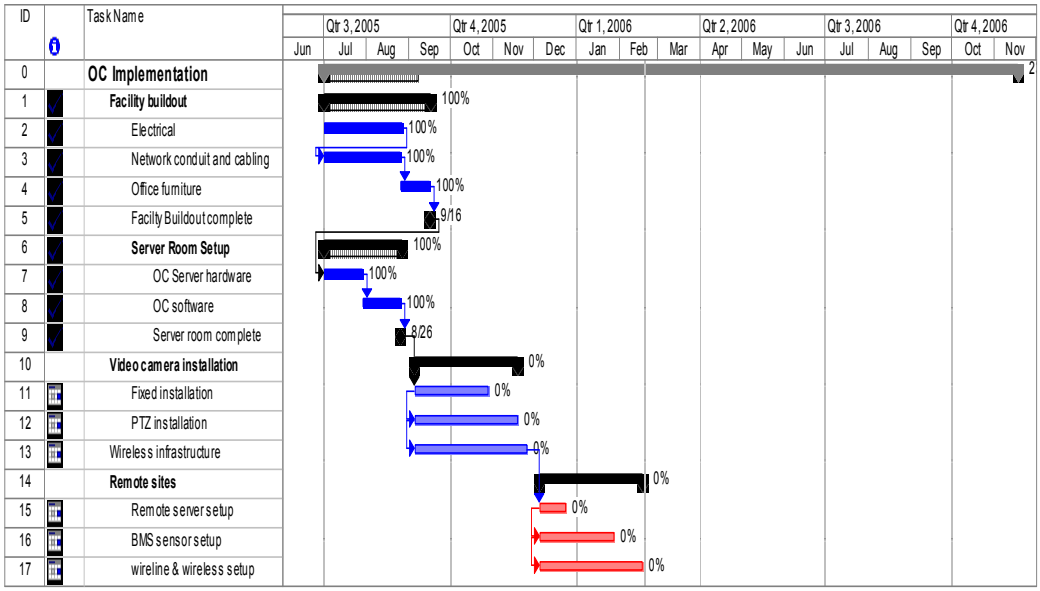
Bar Charts

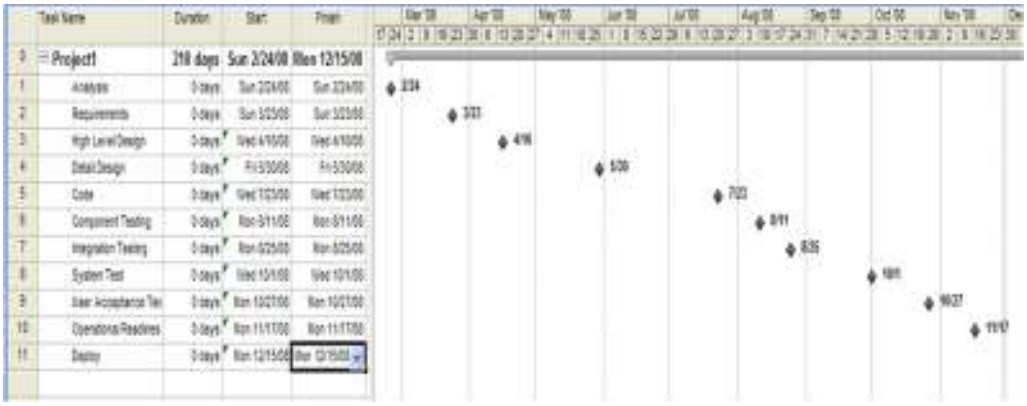


The diagram shown above is defined by PMI as a network diagram with logical relationships. For the examination, know that the bar chart is useful for progress reporting and with some of the more sophisticated bar chart tools (e.g.MS Project), it can allow you to plot multiple critical paths and perform what-if scenarios. The chart shown above was created from MS Project; it is not a standard bar chart, but is referred to as a *network diagram* by PMI. Standard bar charts will appear as simply the bars with no logical connections of any kind between bars.

As project management planning tools, they are generally inadequate and they are ***not*** project management plans. The original bar chart created by Henry Gantt was developed around 1910 and was allegedly used for the first time as a scheduling tool during the construction of the Panama Canal.

Exam Tip: Higher-level summary activities that occur between milestones in a bar chart are frequently called ***hammock*** activities[20].

Milestone Charts

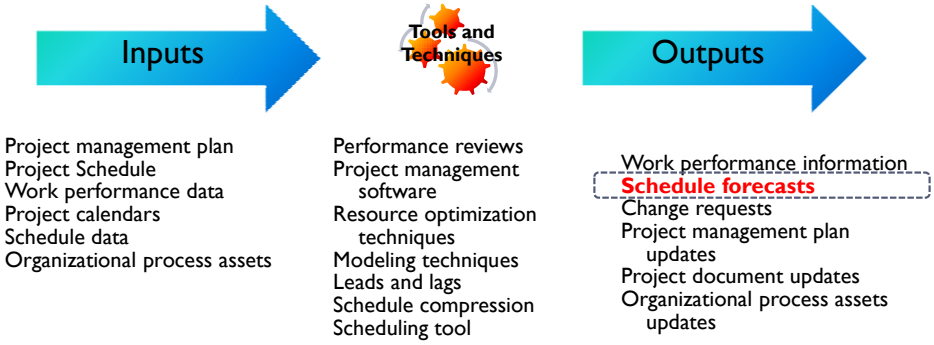


The milestone chart is similar to the bar chart, but it only shows major deliverables and major events in your project. From this perspective, it is a useful tool for producing executive summaries. The example shown above is a typical milestone chart representation.

Exam Tip: Milestones have no duration, and are simply an indicator that something has been completed or that a specific goal has been reached

[20] *PMBOK® Guide*, 5th edition, p. 182

Control Schedule



Control Schedule is contained within the Monitoring and Controlling process group. From the point of view of the exam, it is assumed that you as the project manager have been implementing sufficient process to monitor and control the schedule on your project. Unless an exam question states otherwise, you have been doing your job, you have been measuring the project against the schedule baseline, and you have been making corrections where necessary to keep the project on track and on time.

Notice that the tools and techniques of controlling the schedule include things like variance analysis, resource leveling, performing what-if scenario analysis, and schedule compression. If you are truly performing the process of progressive elaboration, you'll be learning more about the project as the project progresses. However, the plan is one thing, reality is something else. Take a tip from a 19th-century Prussian field marshal Helmuth von Moltke, who succinctly stated: "No plan of battle survives contact with the enemy. Planning is everything, the plan is nothing".

Controlling the schedule involves planning and *replanning*, measuring the result, making adjustments, adjusting metrics, adjusting progress and status reports, using a disciplined change control process, and applying your project management 'dental pick' to control unnecessary changes. Keep all these things in mind when you think of controlling the schedule.

PDM Exercises

Draw the network diagrams or perform calculations based on the information provided below. All durations are in weeks.

Exercise #1:

Activity	Predecessor	Duration
Start		-
A	Start	2
B	A	3
C	A	5
D	B	7
E	B,C	12
F	D,E	4
G	D,F	6
End	E,G	-

Answer the following questions:

1. What is the critical path?
2. Where is the float or slack, if any?
3. The customer needs the schedule brought in seven weeks sooner. You discuss options with the customer and decide to reduce activity 'E' by seven weeks. How does this affect critical path?
4. Starting with the original schedule, activity 'B' experiences a major discovery and as a result changes to seven weeks. How does this impact critical path, if at all?

Exercise #2:

Activity	Optimistic	Most Likely	Pessimistic	Predecessor
A	3	5	13	None
B	4	6	11	A
C	2	4	6	A
D	8	12	22	B
E	7	12	20	C
F	6	10	17	D, E
G	3	6	18	F
End				G

1. Compute the critical path
2. Risk on activity E sharply increases 21 weeks due to a major discovery. Which part of the PERT estimate does this impact and what is the impact on the critical path?

Exercise #3:

Activity	Predecessor	Duration
Start		-
A	Start	4
B	A	3
C	A	9
D	A	5
E	B,C	6
F	C,D	5
G	E,F	10
H	F,G	7
I	G	9
End	H,I	

Questions:

1. What is the critical path?
2. What is the near-critical path?
3. If the customer wanted to reduce the schedule by 4 weeks, what would be the resulting float?
4. What would happen if activities 'H' and 'I' change to a finish-to-finish relationship and the predecessor relationship between activity 'I' and 'G' is eliminated?

Exercise #4:

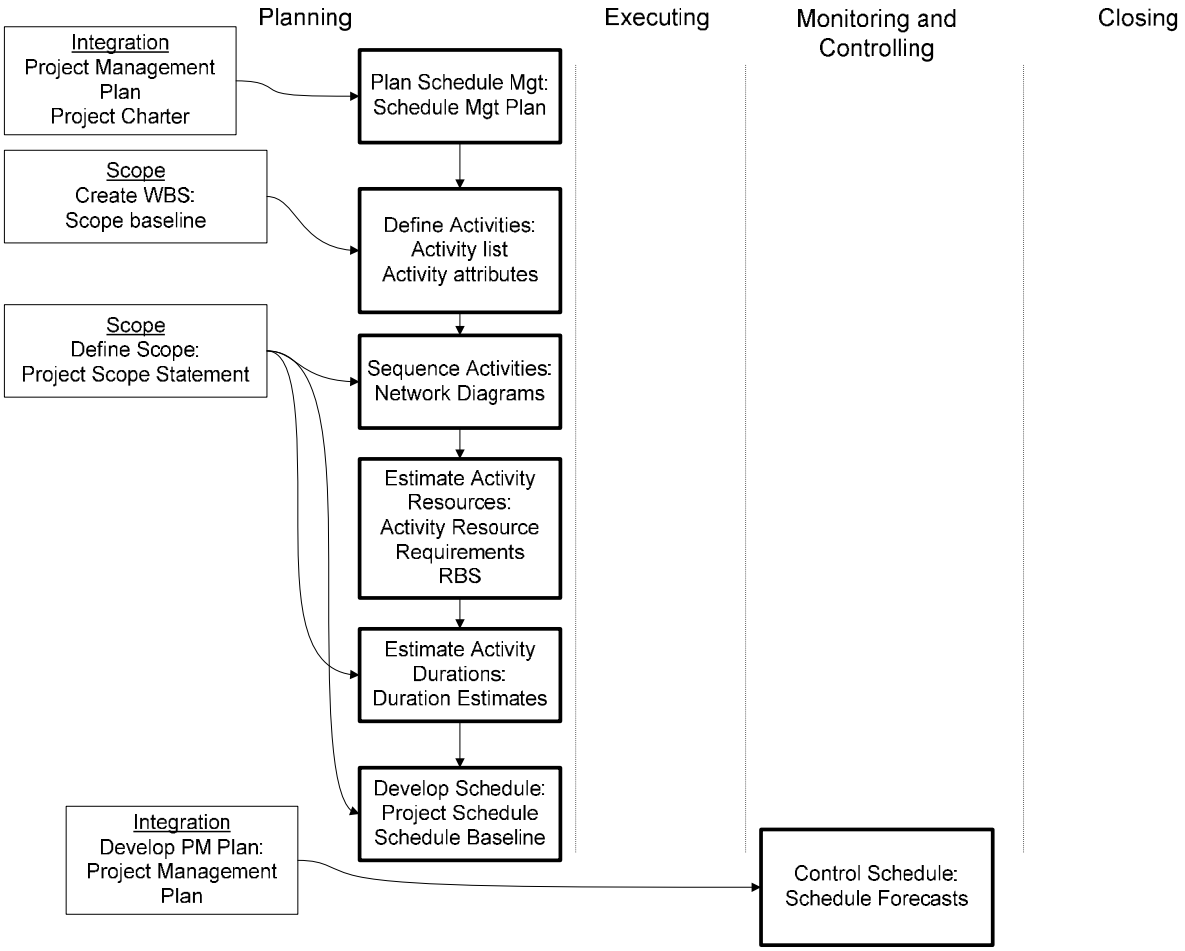
Activity	Duration
Start- A	4
A-B	3
A-C	11
C-D	5
B-E	6
C-E	Dummy
E-F	13
D-G	7
G-End	9
F-End	9

Questions:

1. What is the critical path?
2. What is the near-critical path?
3. If the customer wanted to reduce G-End by 2 weeks, what would the critical path be?
4. What would be the simplest way to reduce the schedule by 4 weeks?
   (Answers for PDM exercises in Chapter 15).

Project Time Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Time Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

Project time management, covers the following:

- Network diagrams: how to draw AON diagrams
- The CPM, PERT, Monte Carlo simulations, and critical chain to create time estimates
- Calculate leads, lags, slack, float, and critical path
- Crashing and fast tracking a project timeline

Time Process Check

Match the process to its definition:

___Plan schedule management

___Define activities

___Sequence activities

___Estimate activity resources

___Estimate activity durations

___Develop schedule

___Control schedule

A. The process of identifying and documenting relationship among the project activities

B. The process of estimating the number of work periods needed to complete individual activities with estimated resources

C. The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project model

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

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

F. The process of identifying and documenting the specific actions to be performed to produce the project deliverables

G. The process of estimating the type and quantities of material, human resources, equipment, or supplies required to perform each activity

Chapter Six Memory Check

1. The four possible precedence relationships in an AON network diagram are: _____-_____-_____, _____-__-_____, _____-__-_____, and _____-__-_____
2. The diagramming method that allows for conditional looping is called _____
3. The three types of network dependencies are known as: _____, _____, and _____
4. The completion of a key deliverable or a phase in the project is called a _____
5. Starting a successor activity before the predecessor is complete is called a ____, while a delay in starting a successor activity is defined as a____
6. The six processes in the Planning process group for Time Management are: _____, _____, _____, _____, _____and _____
7. Another name for the three point estimate is called _____
8. The most accurate and time consuming of the estimates is called _____-__ estimating
9. The sigma percentages are 1 Sigma = _____%, 2 Sigma = _____% and 3 Sigma _____%
10. The time an activity can be delayed without delaying the project end date is called _____
11. The earliest you can begin an activity is called the _____, while the latest time in the network schedule that an activity can begin without impacting the late finish (LF) is called the _____
12. Conformance to target values is defined as _____, while the precision of the measurement is expressed as _____
13. The _____ in a network diagram is the longest path through the network that produces the shortest possible completion time for the project
14. The time a project can be delayed without delaying the start of a successor project is called _____
15. The two primary schedule compression techniques are called _____and _____
16. The _____ analysis is used to build statistical models and perform what-if analysis
17. Stabilizing the number of resources working in each time period to prevent resource over-allocation is known as _____
18. _____ project management accounts for limited resources, adds duration buffers, focuses on managing the time buffer and resources
19. _____ describes the time an activity can be delayed before delaying the early start (ES) of a successor activity
20. Higher-level summary activities that occur between milestones in a bar chart are frequently called _____
21. In addition to various updates, a key output of the Control Schedule process is _____ _____
22. An activity that has no duration is called a_____
23. Computing the _____ pass allows us to ascertain the critical path in the network diagram, while computing the _____ pass is used to determine areas of float or slack in the network diagram

Chapter 6 Test

1. The blueprints for the new construction projects have been completed and construction is ready to begin. While the organization was thinking about erecting a modular structure, they decided on a more traditional approach. The foundation will be poured and cured before the framing begins. This is an example of:
    a. Discretionary dependency
    b. Mandatory dependency
    c. External dependency
    d. Internal dependency

2. You have determined your project will optimistically take 24 weeks to complete, with a most likely completion date of 36 weeks and a pessimistic completion date of 72 weeks. Based on this three point estimate what is the likely completion timeline for the project?
    a. 38.4 weeks
    b. 39.6 weeks
    c. 40 weeks
    d. 42.4 weeks

3. A finish to finish relationship is defined as which of the following?
    a. Both activities have to finish at the same time
    b. The predecessor has to finish before the successor can finish
    c. Both activities are on the critical path
    d. The predecessor has a defined lead while the successor has a defined lag

4. Your project is experiencing resource constraints at certain times in the project timeline, requiring you to adjust start and finish dates on the schedule. What tool is best to use in this situation?
    a. Resource leveling
    b. Feeding buffer
    c. Critical Path method
    d. Resource smoothing

5. Management from the customer side wants to bring in a project one month earlier than they had originally planned. Based on the current project timeline, product testing will have to be cut short. You have reviewed several options with the customer; they have decided that crashing the schedule would be the best approach to bringing in the project earlier. As a result of customer's decision, what is your *biggest* concern using this approach?
    a. Additional expense
    b. Availability of additional resources to perform testing in a shorter time frame
    c. Customer buy-in
    d. Developing an adequate reward system to address the overtime that will be needed to bring in this project one month early

6. The project optimistic estimate is 10 weeks and the pessimistic estimate is 40 weeks. What is the standard deviation of the estimate?
    a. 4
    b. 5
    c. 6.7
    d. 7.5

7. What is the *most correct* definition of the critical path in a network diagram?
    a. The shortest path through the network
    b. The longest path through the network
    c. The longest path through the network that contains zero or negative float
    d. The shortest path through the network that cannot be compressed

8. While executing the project it becomes obvious that you're not going to hit your end date. The project may be delayed by at least two months. This may impact the start date of another project that was due to start right after yours completed. What type of float *best* describes this situation?
    a. Total float
    b. Project float
    c. Free float
    d. Slack float

9. You have been discussing several estimating options with the project team. Some of the team members think that this particular project is similar to something that they worked on last year. However, the technical team has been quick to point out that there are some unknowns on this project that make parts of the project significantly different from last year's project. As the team starts performing a detailed analysis of the previous project, they uncover a great deal of historical information that would apply to the current project. In this situation the *best* estimating tool would be:
    a. Analogous estimate
    b. Parametric estimate
    c. Bottom-up estimate
    d. One-time estimate

10. Due to some uncertainty in your project schedule, you have decided to use weighted time estimates for the major deliverables. This type of estimate is also known as…?
    a. Monte Carlo analysis
    b. Beta distribution
    c. Parametric estimate
    d. Autoregressive moving average

11. You and the project team are planning the work of the project. In addition to all of the planning activities that you're engaged in, part of the team has been reviewing the customer requirements, and has started to outline a work breakdown structure as well as create elements of the WBS dictionary, breaking down the work packages into smaller increments. The *most accurate* way of describing this is that you are creating:

    a. A milestone list
    b. A deliverable list
    c. An activity list
    d. A scope elaboration

12. The biggest disadvantage of the parametric estimate is?
    a. It is just like an analogous estimate
    b. It does not take cross-functional dependencies into consideration
    c. There really is no disadvantage
    d. The solution may not scale

13. You have been discussing a key deliverable with your customer. The discussion has centered on the accuracy and precision of the deliverable. Customer has indicated that due to the nature of the deliverable, a high level of precision is not really required. They have indicated to you that a precision of

slightly less than 70% is adequate and acceptable. In terms of the Sigma reading, this number *approximately* translates to?

a. 1 Sigma
b. 2 Sigma
c. 3 sigma
d. 6 Sigma

14. The technical team has asked for multiple estimates on a specific product component's delivery time. They fed the results of their measurements into a three-point analysis which identified the optimistic as 4 weeks, the most likely estimate of 7 weeks, and a pessimistic estimate of 14 weeks. The variance equals:
    a. 1 and 2/3 weeks
    b. 1.29 weeks
    c. 2.77 weeks
    d. 7.66 weeks

15. The project team is progressing well with all planning activities. They have sat down with the customer for a JAD session to review some alternatives for proceeding with the project. The customer wants to model some of the potential paths forward to see which one of these paths offers the best solution. This type of analysis is *best* described as:

    a. Critical Path analysis
    b. Monte Carlo analysis
    c. Multi-objective algorithm analysis
    d. QFD analysis

16. Management has requested that you look for ways to compress the schedule on your project. It seems that the end date will be 2 months too late for the business to obtain a marketing advantage for that year. You and the project team have looked at various schedule compression techniques, and have decided that fast tracking will be your best approach. What is an advantage *and* a disadvantage of fast tracking?
    a. Some activities can be run in parallel but costs increase
    b. Some activities can be run in parallel but risk increases
    c. Some activities can be executed as overtime but costs increase
    d. Some activities can use the same resources but team burnout is an issue

Activity	Predecessor	Duration
Start	-	-
A	-	5
B	A	4
C	A	6
D	B,C	11
E	C	10
F	D,E	5
G	E	7
End	F,G	-

Create the Network Diagram using the grid above. All times in weeks. Use for the next three questions.

17. What is the critical path of the network described above?
    a. A-B-D-F-end
    b. A-C-D-F-end
    c. A-C-E-F-end

d. A-C-E-G-end

18. The customer has asked that you reduce activity D by 2 weeks. What impact does this have on the schedule?
    a. None. It is not on the critical path
    b. It will reduce the schedule like two weeks
    c. It will only work if you also reduce activity B by two weeks
    d. It will only work if you also reduce activity F by two weeks

19. The customer has demanded that you reduce the schedule by three weeks. What does this mean in terms of the Project schedule?
    a. You have decided that fast tracking is the best option to pull in the schedule by three weeks
    b. You have decided that crashing the schedule is the best option to pull in the schedule by three weeks
    c. Your project has negative float
    d. You cannot deliver the project three weeks earlier without impacting project quality

20. You have just been assigned a new project within your organization. After performing an initial analysis, it has become obvious that you will not have enough resources to complete the project by the requested due date. You bring your analysis back to the sponsor and to senior management, who respond with, "just do the best you can". In looking at various scheduling techniques, which of the following would be the *best* scheduling approach to handle this situation?
    a. Critical Path method
    b. Precedence diagramming method
    c. Resource leveling heuristics
    d. Critical chain method

21. A new design for an ocean-going oil tanker has prompted your organization to produce the first of a new generation of oil tanker. The project involves a complex project network diagram with a number of parallel paths. As the project progresses, the single critical path becomes 3 critical paths. As the project manager, what is your *largest* concern right now?
    a. Managing Communications
    b. Managing dependencies between the parallel path activities
    c. Managing multiple stakeholders
    d. Change Management

22. What is a key output from the Control Schedule process?
    a. Work Performance data
    b. Change Requests
    c. Updates to Enterprise Environmental Factors
    d. Risk Register updates

23. The project schedule has finally been completed for the project. In reviewing the resource estimates, you notice that several key resources have been assigned multiple activities on several parallel network paths. You have also noticed that the resources for the different time phases vary greatly, sometimes as much as 300%.What scheduling technique would be the best to use at this point?
    a. Critical chain
    b. Critical path
    c. Monte Carlo
    d. Resource leveling

24. What is the primary difference between critical path (CPM) and critical chain (CCPM)schedule approaches?
    a. There is fundamentally no difference
    b. CPM focuses on managing float while CCPM focuses on managing buffers
    c. CCPM focuses on extensive multi-tasking while CPM focuses on resource leveling
    d. CPM uses heuristics while CCPM uses mathematical modeling

25. Six sigma is?
    a. 95.46%
    b. 99.999%
    c. 68.26%
    d. 99.73%

26. Crashing a network schedule works only when_____.
    a. A complete risk assessment is performed
    b. The project team and the project manager agree on the course of action
    c. It is the best alternative to overtime
    d. Adding resources shortens activity durations

27. All of the following are inputs to Estimate Activity Resources with the *exception* of:
    a. Activity list
    b. Resource breakdown structure
    c. Resource calendars
    d. Organizational process assets

28. The technical team has been using the network diagram as a blueprint for the actual work to be done for the project. After reviewing the testing phase plan for the project, the technical team has ascertained that iterative testing might be necessary to successfully debug the software product. What type of network diagramming technique would be *most* useful in this situation?
    a. Precedence diagramming method
    b. Critical chain method
    c. Activity on arrow method
    d. GERT method

29. Several project managers were discussing the merits of various tools and techniques to predict and forecast project performance. For resource leveling, the first project manager used a series of guidelines or rules of thumb to aid in his decision process, while one of the other project managers used a modeling technique that used random variables to create several models of different resource loads; he could then see which might offer the best solution. Other names for the two techniques are *best* described as:
    a. The first approach is a 'what-if' analysis, the second approach is a heuristic
    b. The first approach is a heuristic, the second approach uses stochastic variables
    c. The first approach is a analogous approach, the second approach uses an SPC chart
    d. The first approach is a 'best guess' approach, the second approach uses a Monte Carlo

30. You and your project team have created and finalized the scope baseline for the project. Your team is now set on a task of developing a project schedule. Activities have been defined and they have been placed in the proper sequence. What is the *key* output of the Sequence Activities process?
    a. A milestone list
    b. Network diagram
    c. Dependency determination
    d. Network templates

31. As the project manager, you and the project team are decomposing the required work into smaller more manageable parts. What is the ultimate result of this decomposition effort?
    a. Work package
    b. Activities
    c. WBS
    d. Deliverables

32. All of the following are advantages to using a bottom-up estimate *except*:
    a. Based on historical data
    b. More accurate than other estimating methods
    c. Very quick to perform
    d. Allows the team better visibility into the work for buy-in

33. You decided to use a commercial bar charting tool to track project activities and create a network diagram. All of the following represent advantages for using a bar chart to create the project schedule with the *exception* of:
    a. You can model different critical path approaches using what-if scenarios
    b. You can use it as a project management plan
    c. You can perform resource leveling
    d. You can graphically display crosses and dependencies between activities

34. Your project has produced an optimistic estimate of 25 weeks, a pessimistic estimate of 95 weeks, and a calculated PERT of 40 weeks. What is the range of completion of the project with a 95% confidence factor?
    a. Between 20 weeks and 60 weeks
    b. Between 23.7 weeks and 57.3 weeks
    c. Between 16.7 weeks and 63.3 weeks
    d. Between 16.3 weeks and 63.7 weeks

35. Your team is reviewing the project activities and has started to estimate the durations of the work packages identified in the WBS. Some of these work packages and activities have significant uncertainty associated with them for which the team has created contingency buffers. The tool and technique that is used for this process is called:
    a. Expert judgment
    b. Reserve analysis
    c. Parametric estimating
    d. Three point estimating

Chapter 6 Test – Answers

1. B - This is a clear example of a mandatory dependency; The foundation must set before you can start erecting the walls of the structure.
2. C – (24 + 4*36 + 72) / 6 yields 240/6 = 40
3. B - This is the definition of a finish to finish relationship: I must complete activity 'a' before I complete Activity 'b'
4. A – Resource leveling is the tool that is used in this situation. *PMBOK® Guide*, 5th edition, p. 179.
5. B – Since the customer has decided that crashing is an option, answer 'A' has already been taken into consideration as well as answer 'C'. Answer 'D' is a complete unknown at this point. Of the four answers, the biggest concern is whether the testing resources are actually available to do the job
6. B – By straight calculation: (40-10)/6 or 30/6 = 5
7. C – By definition the, critical path is the longest path through the network that contains no float or slack. After the CP is created, there are schedule compression techniques that can be applied, but each of these techniques carries risk. (Fast track or crash).
8. B – Project float is the delay a project can incur without delaying a succeeding project. Total float addresses delaying the project and date. Free float addresses the early start of a successor activity. Slack float is a made-up term
9. C – The bottom-up estimate is based on verifiable historical data - in other words you're dealing with things that you've done before. The analogous estimate compares projects at a high level without getting into detail. The parametric estimate is designed to estimate repetitive activities and forecast a result based on the estimate from the initial activity. A1-time estimate is a total 'shoot-from-the-hip' estimate.
10. B – The weighted average uses the beta distribution or PERT technique. *PMBOK® Guide*, 5th edition, p. 171.
11. C – The key phrase in the question is 'breaking down work packages into smaller increments' which is the definition of creating activities. Milestones and deliverables are higher levels above the work package. Scope elaboration is a red herring
12. D – By definition, the biggest disadvantage of the parametric estimate in the answer set is that the solution may not scale. Answers 'A' and 'C' are simply incorrect, and answer 'B' applies to a WBS
13. A – By definition, one Sigma translates into 68.26%, slightly less than 70%
14. C – Variance is the square of the standard deviation. Standard deviation equals (14-4)/6 = 1.67. Therefore standard deviation squared equals 2.77
15. B – The technique that uses modeling is the Monte Carlo analysis. Answer 'C' is a constrained optimization method. Answers 'A' and 'D' are red herrings
16. B – By definition, fast tracking allows you to run some activities in parallel, but the downside is that there is an increase in risk.
17. D – A-C-E-G yields a critical path of 28
18. A – None. Activity 'D' is not on the critical path - shortening it will make no difference.
19. C – Notice the question doesn't ask you what you will do about it – it simply asks you 'what does this mean'? What it means is that your project now has a negative float of three weeks
20. D – By definition, the critical chain method deals with scarce resources
21. B - When a single critical path breaks into multiple critical paths, the biggest issue is managing the dependencies between those parallel activities. Managing communications or multiple stakeholders is something that you would do regardless of what your project schedule looked like, and a disciplined change management process is the least of your worries right now.
22. B – Change requests is the only correct answer. Work performance data is an input, updates occur to organizational process assets (not enterprise environmental factors) and updates to the risk register occur in the risk process.
23. D – If resources have been assigned simultaneous activities on multiple parallel project paths, then the resource load on the project can vary as much as 300%. Resource leveling is the only appropriate choice here

24. B – By definition, critical path method focuses on managing float while the critical chain project management method focuses on managing buffers. Answer 'A' is incorrect, and answers 'C' and 'D' are red herrings
25. B – Per the *PMBOK® Guide,* 5th edition, six Sigma is defined as 5-nines accuracy or 99.999%
26. D –Additional resources shortens activity durations. *PMBOK® Guide,* 5th edition, p. 181
27. B – The resource breakdown structure is one of the outputs of estimate activity resources. *PMBOK® Guide*, 5th edition, p. 143
28. D – Any type of iterative or conditional looping is performed in GERT
29. B – This question may fall into the category of something that you've never seen before (or barely remember…). A rule of thumb is a heuristic, while the second process uses random (also known as stochastic) variables. The other answers are added for a confusion factor☺
30. B – The network diagram is the key output of the sequence activities process. Network templates are a tool and technique of sequence activities. Answers 'A' and 'C' are red herrings. *PMBOK® Guide*, 5th edition, p. 143
31. B - The ultimate result of decomposition is that major deliverables are broken down into work packages which in turn are broken down into activities. *PMBOK® Guide,* 5th edition, p. 152
32. C – The bottom-up estimate is anything but quick
33. B – A bar chart is ***never*** a project management plan
34. C – By straight calculation: standard deviation is (95-25)/6 = 70/6 = 11.67. A confidence factor of 95% translates to two standard deviations above and below the most likely estimate. 40 – (2*11.67) and 40 + (2* 11.67) or 40-23.3 = 16.67 and 40 + 23.3 = 63.3
35. B – Reserve analysis defines contingency reserves as a method for dealing with schedule uncertainty

Chapter 7 : Project Cost Management

Section Topics:

- Plan Cost Management
- Estimate Costs
- Determine Budget
- Control Costs

Section Objectives

On completing this section you will be able to:

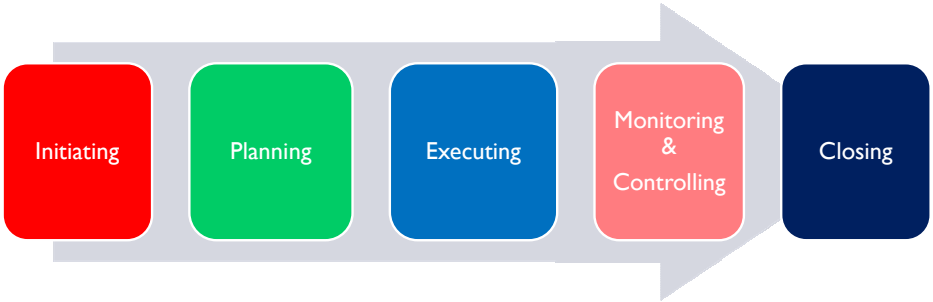
- Place cost management processes into PM process groups
- Define various cost estimating techniques
- Define and compute earned value
- Apply all earned value formulas needed for the exam

Project Cost Management Process Summary

The high level Project Cost Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	Cost management plan			
	-Activity cost estimates -Basis of estimates		-Cost forecasts -Work performance information -CR's	
	-Cost baseline -Project funding requirements		Various document updates	

Cost Management



Plan Cost Management
Estimate costs
Determine budget

Control costs

There are a dozen questions or so on the exam relating to earned value. If you have never done this before, don't worry. We will address all the needed computations and formulas relating to cost management for the exam in the pages following. The process of cost management is generally documented in the cost management plan. According to PMI, the cost management plan establishes the following:

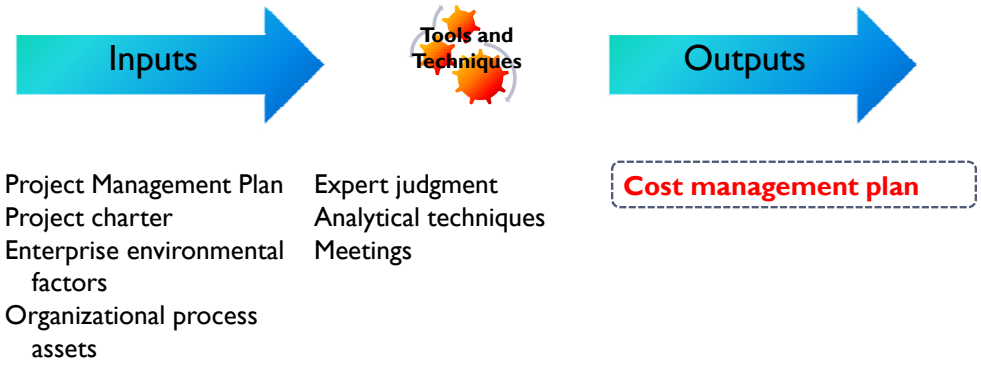
- Level of accuracy - activity cost estimates rounded to a prescribed precision
- Unit of measure - standard workweek, blended rates for resources and similar measurements are units of measure for the project
- WBS procedure links - the WBS component for project cost accounting is called the control account (CA)

- Control thresholds - levels of variance that are allowed before action needs to be taken
- Earned value rules of performance
- Reporting formats
- Process descriptions

Exam Tip - understand the following concepts for the exam:

- **Life cycle costing-** another way of saying this is the 'total cost of ownership'. It is not only the cost of the car that you must consider, but also what it will cost to maintain the vehicle over its usable lifetime. Delivering the product of a project is no different.
- **Value Engineering (from Define Scope)-** also called value analysis, value management, or value methodology. It began at General Electric Co. during World War II. Due to shortages of skilled labor, raw materials, and component parts, Lawrence Miles of G.E. looked for acceptable substitutes. Frequently, the substitutions often reduced costs, improved the product, or both. What started out as a constraint was turned into a systematic process which he called "value analysis".

Plan Cost Management

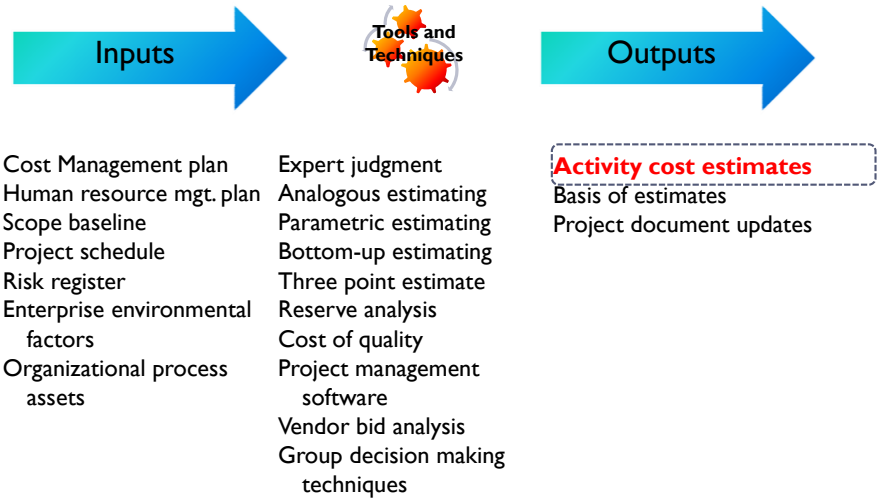


The Cost Management Plan establishes how cost on the project will be managed and is primarily concerned with the cost of the resources needed to complete project work. These costs can also include lifecycle costs which address recurring costs of using, maintaining, and supporting the product The cost management plan usually establishes the following:

- Units of measure (e.g. days, weeks, months, liters, gallons, cubic yards, weight, etc.)
- Level of precision (e.g. 2 Decimal Pl. precision, 5 Decimal Pl. precision, rounding up/down, etc.)
- Level of accuracy (e.g. tolerances or acceptable ranges)
- Organizational procedure links which tie back to control accounts in the work breakdown structure
- Control thresholds – variance thresholds for measuring cost performance before action needs to be taken
- Rule of performance measurement – EVM (earned value management) rules of performance
- Reporting formats and process descriptions

- Additional Details which can include descriptions of strategic funding choices, procedure to account for fluctuating currency exchange rates, and a procedure for cost recording

Estimate Costs



Cost estimates are based on the analysis of activities that were created in the WBS and further elaborated in Define Activities (what we are doing) and Estimate Activity Resources (who is doing the work). Therefore, many of the elements that were required for estimating the schedule are also true for estimating cost:

- Obtaining historical information from past projects
- Coming up with your own estimates. If you are taking a project over from another project manager or there are management imposed constraints, your job is to assess the needs of the project and not take someone else's word for it
- Reviewing estimates to ensure they are reasonable and checking for cost padding and risks
- Looking for ways to reduce project costs through the mitigation, reduction, or elimination, of risks
- Basing the estimate on the WBS
- Ensuring that the resources who are actually performing the work (the subject matter experts) are delivering estimates, instead of a stakeholder who is telling you what they *think* the estimate should be
- Implementing a process to create the most accurate estimate possible

The following occur here and in Determine Budget and Control Costs:

- Managing the project to the cost baseline
- Knowing when to implement a change if schedule problems occur
- Periodically forecasting the end costs to come up with your own estimate to complete (ETC)

What costs are estimated on a project? Any work needed to complete the project. A partial list appears below:

- Project manager's time
- Overhead
- Project management activities
- Leased equipment
- Hardware purchases
- Consulting resources
- Risk estimating
- Quality assurance

EXAM Tip:
Notice the three-point estimate has come back as a tool and technique for cost. The formula keeps the same format as PERT in the Time chapter, only 't' changes to 'c':

PERT for Cost

$$\text{Mean} = \frac{C_O + 4 * C_{ML} + C_P}{6}$$

$$\text{Standard Deviation} = \frac{C_P - C_O}{6}$$

Variance = σ^2
Where:
C – cost
O – optimistic
ML – most likely
P - pessimistic

Cost Types

For the exam, there are a few questions asked about cost types. The four fundamental types are listed below, all with a brief explanation of each:

- _____ **costs -**costs that change with the amount of work being performed such as costs for hourly consultants.
- _____**costs -** costs that are constant throughout the project such as equipment leases
- _____ **costs**- costs that are directly attributable to your project. Wages and salaries for team members, software licenses, etc.
- _____**costs -** costs that are shared by your project with other projects such as heat, light, building security, and other overhead items.

Cost Estimating Tools

There are three fundamental types of estimating tools that are used to estimate costs on a project:

- _____ estimating (also called a 'top down' estimate) compares a similar past projects to the current project in terms of cost. This is called an estimating 'heuristic' or rule of thumb - it is designed to give you a 'ballpark' estimate without having to use a lot of supporting detail.
- _____ estimating is highly detailed and uses the WBS to create the activity estimates for cost. Bottom-up estimating can be very accurate if there is enough historical data on which to base the estimates.
- _____ estimating or modeling as it is sometimes called, is based on the use of a parameter and repetitive units of identical work. If one unit costs 'x' dollars, then a hundred units will cost '100x' dollars.

Analogous Estimating

- *This* project is like *that* project:

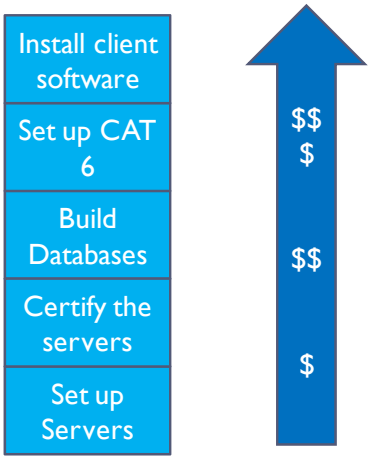
Advantages

- Little time and effort
- Less costly to create
- Activities don't need to be spelled out
- Overall project costs are capped

Disadvantages

- Less accurate than Bottom-up estimating
- Historical information or expert opinion may not be available
- Extremely difficult for project with high uncertainty

Bottom-Up Estimate



The bottom-up estimate is built from historical data. This means that your estimates are based on activities that you have performed before, and that the cost of these activities can be estimated to within a narrow range.

Advantages

- Improved accuracy
- Appropriate detail to monitor and control project
- Provides team buy-in to estimates

Disadvantages

- Longer time and higher cost to create
- Subject to padded estimates by team members
- Only as accurate as the WBS

Parametric Estimating

The parametric estimate is used when an activity can be priced repetitively for a project. For example, the project requires the setup of 1000 servers with the proper hardware and software configuration. How long will it take and how much will it cost? We priced the set up of one server as follows:

- Server set-up time: 4 hours
- Hardware load and configuration: 8 hours
- Load the database and configure all software: 12 hours
- Resource blended rate for the work: $65/hr
- Therefore 1 server setup costs: 24 x $65 = $1560

Using the parametric estimating approach, if one server costs $1560 to set up, 1000 servers will cost (we predict): 1000 x $1560 = $1,560,000. The key element for the parametric estimate to work is that the parameters must scale accurately.

Advantages

- Can be more accurate and detailed than analogous
- Can be quicker than bottom-up
- In certain situations, can offer a more accurate projection of project completion and total costs

Disadvantages

- Accuracy varies widely
- Can be more costly to produce
- Historical information may not be available
- Parameters may not be scalable

Estimate Types

Type of Estimate	Range	Process Area
Rough order of magnitude	-25% to +75%	Initiating
Definitive estimate	-5% to +10%	Planning

Brain dump!

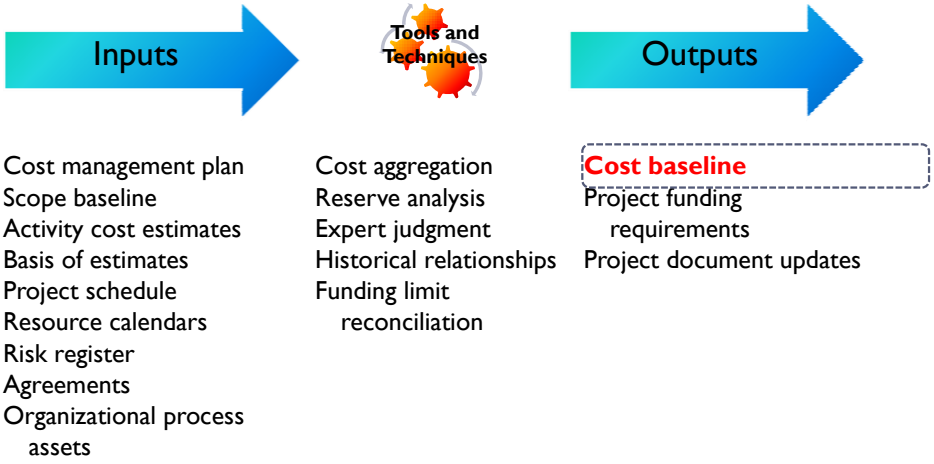
There may be some tricky questions on the exam about different types of estimates, and the questions may be asked obliquely. In other words, you will have to know the type of estimates, what the range of the estimate is and in which process area the estimate is used. You will then have to take this knowledge and apply it to the question at hand. For example:

'You have just completed the project charter for the project and have initiated the kickoff meeting. One of the stakeholders is being very insistent about the need for an accurate budget estimate. They are stating that they will not allow the meeting to adjourn until the team has hammered out an estimate that is within +/- 10% of actual. What is the *most correct* response you can offer to the stakeholder?'

a. You and the team will use your best efforts to comply with the stakeholder's request
b. It is too early in the project process to deliver an estimate at that level of accuracy
c. You state that the best you can do at this point is an estimate that is -10% to plus 25%

d. Since this request is unrealistic, you tell the stakeholder their request will be entered in the risk log and immediately reported to senior management

Determine Budget



Determining your budget requires a combination of all your activity cost estimates, scope baseline, project schedule, the resource calendars, contract information with external vendors and something called a 'basis of estimates'. Basis of estimates is an output of the Estimate Costs process. A basis of estimate is a detailed analysis on how the cost estimate was derived. The supporting detail can include:

- How the basis of estimate was developed
- Assumptions
- Constraints
- Possible range of estimates (e.g. $25,000 +/- 15%)
- Confidence level of the final estimate (a confidence factor represented as a percentage)

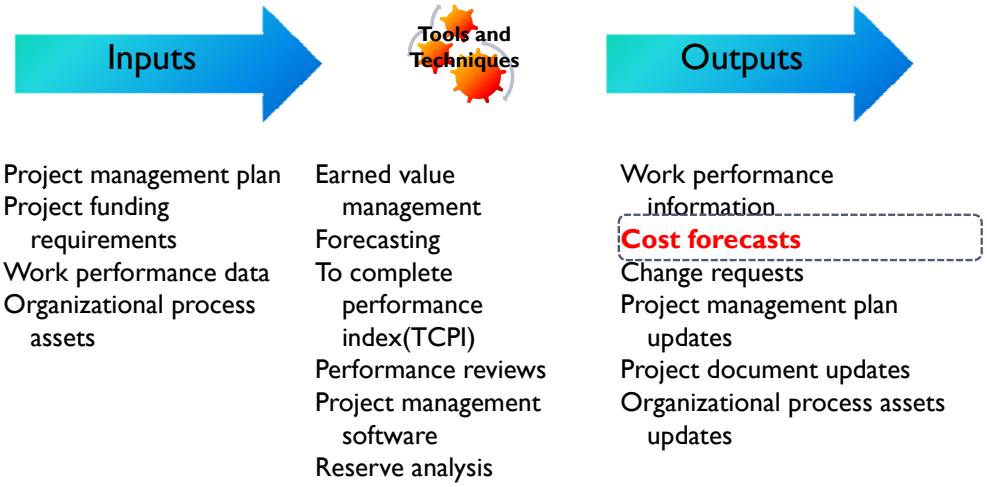
Understanding basis of estimates is a key component in deriving earned value calculations. Two key tools in the determine budget process are ***reserve analysis*** and ***funding limit reconciliation***.

- **Reserve analysis -** addresses management reserve and contingency reserve in a project. Contingency reserve addresses the known risks in a project while management reserve addresses the 'unknown unknowns'. To be covered in detail in the Risk Chapter.
- **Funding limit reconciliation -** addresses the variance between funding limit and the planned expenditures for the project. This will occasionally require the rescheduling of work to level out the rate of expenditure.

Exam Tip: the contingency reserve ***is*** included and management reserve amounts are ***not*** included in earned value calculations[21]

[21]Practice Standard for Earned Value Management, PMI, p. 8

Control Costs



Notice that the tools and techniques of cost control involve implementation of earned value calculations, delivering a forecast, calculating the TCPI (To Complete Performance Index) and variance analysis. In addition, you want to be consulting your cost management plan, as well as following strict change management processes on your project.

Exam Tip: know the difference between a Cost Baseline and a Cost (Total) Budget.

- Cost Baseline - the cost of all activities, work packages, project estimates and *contingency reserves*
- Cost (Total) Budget- includes the cost baseline with the addition of *management reserve*

Earned Value Definitions

Acronym	Name	Definition
PV	Planned Value	Planned cost of work to be done at this point in time
EV	Earned Value	Value of work actually accomplished
AC	Actual Cost	Cost of work
BAC	Budget at Completion	Total planned value for the entire project
EAC	Estimate at Completion	What do we think the project will actually cost
ETC	Estimate to Complete	From this point, how much more will it cost to complete the project
VAC	Variance at Completion	How much over/under budget do we expect to be at project end
TCPI	To Complete Performance Index	What cost performance goals must be met to stay within the BAC

Brain Dump!

You may see reference to some of the old acronyms for PV, EV and AC. They are respectively:

- PV - used to be called BCWS (budgeted cost of the work scheduled)
- EV - used to be called BCWP (budgeted cost of the work performed)
- AC - used to be called ACWP (actual cost of the work performed)

You may see reference to the old acronyms, but you will not have to memorize them.

Exam Tip:

PV (planned value) is a schedule reference. It refers to how much money you were planning to spend on a project at some point in the project schedule.

BAC (budget at completion) refers to how much you planned to spend for the entire project. This is an output of the planning phase.

Earned Value Formulas

Brain Dump!

Exam Tip:

Notice that cost and schedule variance are always represented in terms of dollars(!) Notice also that:

- When computing a cost or schedule variance, earned value (EV) is always the first number. If a variance is negative, you're either over budget or behind schedule. If a variance is positive, you are either under budget or ahead of schedule.
- When computing a cost or schedule performance index, EV is always in the numerator. Performance indices that are less than 1 indicate that you are either over budget or behind schedule. Performance indices that are greater than 1 indicate that you are under budget and ahead of schedule.

Name	Formula
Cost variance	$CV = EV - AC$
Schedule variance	$SV = EV - PV$
Cost performance index	$CPI = \frac{EV}{AC}$
Schedule performance index	$SPI = \frac{EV}{PV}$
Cumulative cost performance index	$CPI^C = \frac{EV^C}{AC^C}$

Analyze the following variances and indices. What do they tell you about the project?
CV = -$123 (you are $123 over budget)
SV = + $255 (you are ahead of schedule – you have earned $255 more in value than you had planned to spend)
CPI = 1.25 (you are achieving $1.25 in value for every dollar you spent)
SPI = .89 (you are at 89% of where you expected to be on the schedule)
TCPI= .95 (you have $0.95 of work remaining for every dollar in the budget)

Name	Formula
Estimate at completion (1)	EAC = AC + New ETC
Estimate at completion (2)	EAC = AC + BAC – EV
Estimate at completion (3)	$EAC = \frac{BAC}{CPI}$
Estimate at completion (4)	$EAC = AC + \frac{BAC - EV}{CPI_C \times SPI_C}$
To Complete performance Index	$\frac{BAC - EV}{BAC - AC}$ or $\frac{\text{Work remaining}}{\text{Funds remaining}}$
Estimate to Completion	ETC = EAC - AC
Variance at completion	VAC = BAC – EAC

Brain Dump!

The Estimate At Completion(EAC) is a budget forecast of the actual dollars ultimately needed for the project. It can be less than, but is very frequently more than, the original budget (BAC). There are four possible formulas that can be used to compute EAC, depending on the conditions listed below:

Key:
1 – Use if a new estimate was required (the original was flawed)
2 – Use if spending will continue at the budgeted rate: no BAC variance
3 – Use if current variances are typical of the future (current CPI will continue)
4 – Use if sub-standard cost and schedule performance will continue, impacting the ETC[22]

Exam Tip:
The simplest way to memorize these formulas is simply to write them out by hand every day, three times a day for one week. After that, write them down once a day from memory every day prior to the exam. You will have no difficulty rattling off these formulas for your brain dump prior to the start of the examination.

[22] *PMBOK® Guide*, 5th edition, pp 220-221

TCPI – what it means and how it works

Essentially it means: work remaining in $/ budget remaining:

- If TCPI is < 1, work remaining is less than the funds needed to accomplish the work.
- If TCPI is > 1, work remaining is more than the funds needed to accomplish the work.

Here is what PMI says about the TCPI calculation:

> "The to-complete performance index (TCPI) is calculated for projection of cost performance that must be achieved on the remaining work to meet a specified management goal, such as the BAC or EAC. If it becomes obvious that the BAC is no longer viable, project manager develops a forecasted estimate at completion. Once approved, the EAC effectively supersedes the BAC as the cost performance goal. "[23]
>
> - The equation for the TCPI based on the BAC: (BAC-EV)/ (BAC-AC)
> - The equation for the TCPI based on the EAC: (BAC-EV)/ (EAC-AC)

The TCPI is a specialized form of estimate to completion (ETC)

BAC Example:

If the budget at completion (BAC) is $50,000, with earned value (EV) at $20,000 and actual cost (AC) at $30,000, the formula becomes:

$$\frac{\$50{,}000 - \$20{,}000}{\$50{,}000 - \$30{,}000} = \frac{\$30{,}000}{\$20{,}000} = 1.5$$

In other words, the team will have to work at an efficiency of $1.50 for every dollar spent to bring the project in on budget from this point forward. (At best, very difficult).

EAC Example:

It is determined that the original BAC is not achievable, and we compute the EAC based on the idea that sub-standard cost and schedule performance will continue (EAC type #4).For this example, PV=$25,000. We compute the new EAC based on the following scenario:

CPI =EV/AC = $20,000/ $30,000 = 0.67 SPI = EV/PV = $20,000/$25,000 = 0.8
Thus EAC = $30,000 + [($50,000 – $20,000/ (0.67 x 0.8)] = $85,970
With TCPI = (BAC-EV)/ (EAC-AC) we have:

$$\frac{\$50{,}000 - \$20{,}000}{\$85{,}970 - \$30{,}000} = \frac{\$30{,}000}{\$55{,}970} = 0.536$$

In this case, our new EAC is $35,970 higher than the original BAC. This means the team will have to work at an efficiency of at least $0.536 for every dollar spent to bring the project in on budget from this point forward.

[23] *PMBOK® Guide*, 5th edition, p. 221

Earned Value Accrual – Measurement Methods and Progress Reporting

The measurement of earned value is typically broken down into three distinct areas:

- Discrete effort
- Apportioned effort
- Level of effort

Discrete Effort

Discrete effort describes activities that can be planned, measured, and that yield an explicit output. While discrete effort is usually measured in terms of the actual work hours it takes to complete a deliverable there are four measurement methods that are used to describe discrete effort:

- **Fixed Formula**. The activity is given a percentage of the budget value of the work package at the start of the work, and then the remaining value percentage is assigned when the work is completed. Typical fixed formula rules include
  - The 50/50 rule. You earn 50% of the value on the activity upfront and collect the final 50% of the earned value when the activity is completed
  - The 20/80 rule. You earn 20% of the value on the activity upfront and collect the final 80% of the earned value when the activity is completed
  - The 0/100 rule. Typically used when the deliverables can be completed in a short timeframe or within one reporting period - the activity does not earn any value until it is 100% complete
- **Weighted Milestone**. The weighted milestone approach divides a work package into measurable sections and is typically used on longer duration work packages. The specific amount of value is earned for each interim deliverable within the overall milestone and is accumulated as milestones are completed.
- **Percent Complete**. The earned value is computed by multiplying the work package BAC by the percent complete. On a construction project, this is relatively straightforward, however on a software project this can be difficult to impossible. (What does it mean to have 63% of a software feature completed?) A key point to remember the percent complete process is that completing 40 hours of an 80 hour work package does not mean the work package is 50% complete.
- **Physical Measurement**. This describes any measurable unit that can be explicitly connected with the completion of the work, e.g. cubic yards of poured concrete, yards of Cat-5 cable, flooring area, etc.

Apportioned Effort

Apportioned effort describes work that has a direct or supporting relationship to discrete work. Examples include activities for quality assurance, testing, inspection, project management activities, etc. The apportioned effort it is usually some percentage of the discrete effort. For example, if the development effort on a software project is 10,000 hours and the project manager's time in that project is computed at 10% of discrete effort, then the amount of apportioned effort is 1000 hours.

Level of Effort (LOE)

Level of effort describes activities that do not produce definitive products or deliverables such as helpdesk activities, troubleshooting, database tuning, etc. With level of effort, a planned value (PV) is assigned to each LOE activity for each measurement period and is credited as EV at the end of the measurement period. Since the EV for LOE activities are accrued in line with PV, LOE activities do not have a schedule variance, however they can have a cost variance measured by AC.[24]

Performance Reviews and Variance Analysis

Performance reviews are used to compare actuals to the plan. As such, they compare cost performance and schedule performance to their respective baselines and use variance analysis, trend analysis and earned value to compare actual performance to the plan.

The variance analysis is a key tool used to track any cost or schedule actual and compare it to the baseline.

[24] Practice Standard for Earned Value Management, 2nd ed., PMI, 2011, pp.36-40

Earned Value Practice Exercises

Exercise #1:

You are managing a small construction project. The vendor was hired to install an intricate parquet floor in nine sections. Each section is supposed to take one week to complete at a cost of $750/section. Assume spending continues at the current rate.

At this point in time, you are 4 weeks into the project and you have the following information:

- Expenditures to date: $3250
- Sections completed: 4.5

Fill in the following grid with your answers:

Value	Formula/Calculation	Answer	What it Means
PV			
EV			
AC			
BAC			
CV			
SV			
CPI			
SPI			
EAC			
ETC			
VAC			
TCPI			

Exercise #2:

Your current project is running with the following indicators:

- CPI = 1.07
- SPI = 1.1
- AC = $22,500

You are 4 weeks into a 12 week project, and some of the financial data is missing (the previous project manager left the project unexpectedly). Spending will continue at the budgeted rate – no BAC variance.

Given the information above, compute:

- EV
- PV
- BAC
- EAC
- ETC
- VAC
- TCPI for BAC

Exercise # 3:

You have run a PERT analysis on the major components in your project and have generated the following data:

Deliverable	Optimistic	Most likely	Pessimistic	PERT	Std. Deviation
Component 1	$5000	$10000	$15000		
Component 2	$3000	$7000	$14000		
Component 3	$20000	$35000	$80000		
Component 4	$15000	$30000	$63000		
Totals:					

Assume that components are developed sequentially.

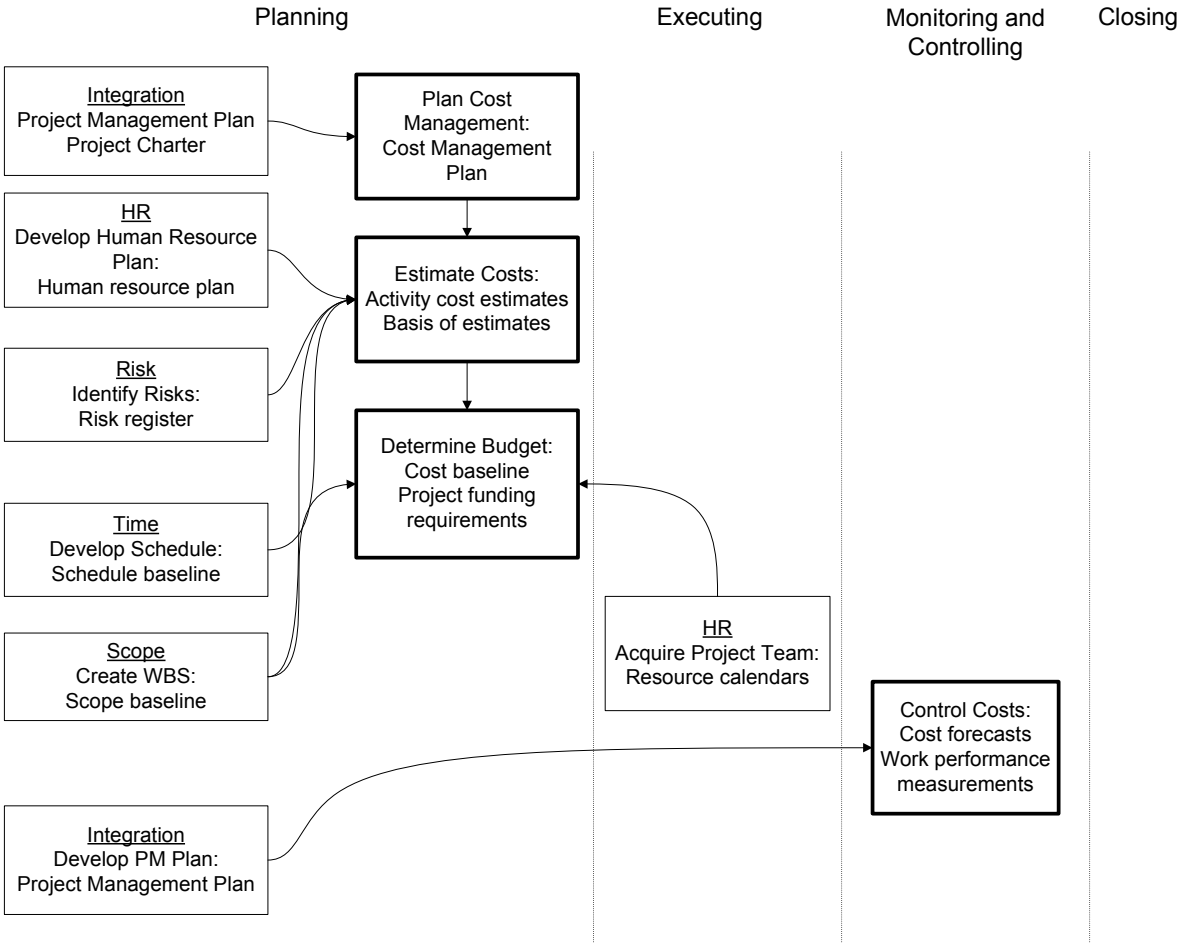
Questions:

1. What is the PERT estimate for the project – rounded to the nearest dollar?
2. Which component estimate is least precise?
3. What is the budget range to a 95% confidence factor?

Answers for EV exercises in Chapter 15.

Project Cost Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Cost Management processes are shown below. *Know these process interactions for the exam.*



Summary…

This section covered cost management:

- The advantages and disadvantages of analogous estimating, bottom-up estimating, and parametric modeling
- Applying earned value formulas, including CV, SV, CPI, SPI, ETC, EAC, and VAC
- Different methods that can be used to calculate progress made on a task

Cost Process Check

Match the process to its definition:

___Plan cost management

___Estimate costs

___Determine budget

___Control costs

A. The process of aggregating the estimated cost of individual activities or work packages to establish an authorized baseline

B. The process of monitoring the status of the project to update the project costs and managing changes to the cost baseline

C. The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs

D. The process of developing an approximation of the monetary resources needed to complete project activities

Chapter Seven Memory Check

1. The estimate that takes little time to create, but is not very accurate, is known as an _____ estimate
2. The rough order of magnitude estimate ranges from ___% to ____%
3. The key output of the Estimate Costs process is _____
4. A _____ is a detailed analysis on how the cost estimate was derived
5. The tool that addresses the variance between the funding limit and the planned expenditures for the project is called the _____
6. The two types of monetary reserves on a project are identified as _____ reserve and _____ reserve
7. The main output of the Control Costs process is _____
8. The cost baseline includes the _____whereas the cost (total) budget includes the _____ and the _____
9. What the work of the project is supposed to have cost by a specific point in the schedule is called the _____, whereas the total amount that the work should cost for the entire project is called the _____
10. The formula for CPI = __/ ___
11. The formula for SPI = __ / __
12. A new budget forecast is created to address variances in the project and replaces the BAC. This new forecast is called the _____
13. The amount of money that remains to be spent on a project that is 1/3 complete is called the _____
14. The formula for TCPI = ____–__ / ___–__
15. The formula for variance at completion (VAC) = ___– ____
16. the three methods of accruing earned value on a project are _____ _____, _____ _____, and _____ ___ _____

Chapter 7 Test

1. Cost variance is computed by:
    a. Subtracting planned value from actual cost
    b. Subtracting actual cost from earned value
    c. Subtracting budget at completion from earned value
    d. Subtracting BAC from ETC

2. You have just completed your project activity, work package, and contingency reserve estimates. What have you created as a result of completing these estimates?
    a. Bottom-up estimate
    b. Cost budget
    c. Cost baseline
    d. Definitive estimate

3. Several vendors have proposed solutions for your current project. Your organization has made it a requirement that the lowest price solution will be the one that is selected to deliver the project. The vendor was selected and the project was completed successfully and handed off to the maintenance organization for ongoing product support. A year into the product's release, it has become apparent that the maintenance costs are much higher than what the organization had anticipated. What did the project manager *probably forget* to do?
    a. Validate the vendor's credentials
    b. Perform adequate quality testing
    c. Earned value cost forecast
    d. Life cycle costing

4. What typifies an analogous estimate?
    a. More expensive than other estimate types
    b. Relies on extensive historical data
    c. Essentially a top-down approach
    d. May not scale effectively

5. Which of the following is *not* needed to generate a schedule performance index (SPI)?
    a. Earned value
    b. Actual cost
    c. Planned value
    d. Basis of estimate

6. Earned value = 650, planned value = 550, actual cost = 700. What is the schedule variance at this point in time?
    a. + 100
    b. – 50
    c. – 100
    d. – 150

7. What is estimate at completion (EAC)?
    a. The amount of money that was budgeted for the project
    b. The original budget plus the contingency reserves
    c. A budget forecast that takes project variances into account
    d. The budget at completion (BAC) times the TCPI

8. You are in the planning phase of the project and are using various tools to estimate project costs. Which of the following is *not* a tool or output of the estimate costs process?
    a. Details of the costs of all activities on the project
    b. Prioritized risks and contingency dollar amounts contained in the risk register
    c. Direct and indirect costs charged to the project
    d. Analysis of the vendor bids on the project

9. You have just initiated a new project in your organization. At the initial meeting with the stakeholders, several of them expressed concerns about the size of the budget. As the project manager, you coach the stakeholders by telling them that the project is being undertaken as a progressive elaboration. As a result, the initial budget estimate covers a wide range of+/-50% because not a lot is known about the project yet. This type of estimate is closest to:
    a. Budget estimate
    b. Rough order of magnitude estimate
    c. Definitive estimate
    d. Predictive uncertainty estimate

10. You have been keeping careful tabs on a 1 year project via weekly earned value calculations. A key factor is that an early product release will give your organization a decisive competitive advantage in the marketplace. However, at the last stakeholder meeting, one of the stakeholders questioned how well the project was really going. They are worried that the project is over budget and that if it continues in this way, the project will face a serious budget shortfall by the end of the project, jeopardizing its completion. At six months through the project, the SPI = 1.2, and the CPI = .95 and variances are expected to continue at this rate. What is the *best* response you can offer that would address this stakeholder's concerns?
    a. The team will implement immediate corrective action to bring the budget back in line
    b. With CPI of .95, this puts us well within the range of a definitive estimate of +/ -10%
    c. The team will discuss potential scope reduction that can bring the cost back in line
    d. At the current SPI, we will finish the project better than 10 weeks early.With an early finish, cost increase is small, but competitive position is greatly improved, increasing profitability

11. Cost estimates are based on all the following *except*?
    a. The scope baseline
    b. Procurement contract award
    c. Human resource plan
    d. Risk register

12. Project cost management is primarily concerned with _____?
    a. Cost of human resources
    b. Basis of estimates
    c. Assessing total cost of ownership
    d. Establish the cost performance baseline

13. You have been assigning earned value measurements to specific deliverables on your current software project. Some of the activities involve helpdesk efforts. In terms of earned value accrual this can be best described as
    a. Discrete effort
    b. Apportioned effort
    c. Level of effort
    d. Percent complete

14. Value engineering is used when the project team wants to?

a. Deliver the highest value to the customer with each deliverable
b. Evaluate multiple project solutions that will deliver the highest value to the customer
c. Calculate the cost of doing the work versus the value that is delivered
d. Reduce project costs without sacrificing scope

15. You've set aside a certain amount of your project funds to cover key, identified risks. What specifically did you use to determine how much should go into this fund?
    a. Bottom-up estimate
    b. Reserve analysis
    c. Variance analysis
    d. Upside-risk estimate

16. The estimate of the work accomplished is defined as:
    a. Actual cost
    b. Estimate at completion
    c. Earned value
    d. Budget at completion

17. Two of your junior project managers in the PMO are having a disagreement about the meaning of earned value. The first project manager is arguing that earned value is the dollarized amount of the work actually completed; the second project manager is arguing that the earned value actually represents the amount of money that the work is supposed to cost *within a given timeframe*, and when that work is completed, you have *earned* that much value. While you are listening to the argument unfold, a stakeholder on their project approaches them and tells both project managers that the original basis of estimate was less accurate than a rough order of magnitude. How does this information *mostly likely* impact earned value calculations?
    a. It makes no difference. They are still tracking work completed and there are dollars associated with the completed work
    b. Variances have little meaning when the basis of estimate is flawed or covers too wide a range. Earned value calculations may misrepresent the occurrence of actual variances
    c. The only impact may occur when calculating estimate at completion or estimate to completion. Variances may occur up to 25%
    d. You must start at the end of the project and work backwards to derive the correct earned value calculations due to the ranginess of the basis of estimate

18. You are three months into a six month project. Assume the budget burn rate is constant. The budget at completion (BAC) is $120,000. AC = $65,000. The SPI = 1.2. What is the CPI of this project? (Round to 2 decimal places)
    a. 1.32
    b. 1.25
    c. 1.11
    d. It cannot be determined from the information given

19. All of the following are incorrect regarding the computation of EAC *except*?
    a. EAC calculations always include the AC or the BAC, but usually both
    b. EV is always included
    c. SPI is always included
    d. ETC is never used in an EAC calculation

20. The project team has done outstanding work on a current project. While the stakeholders are satisfied with the product of the project, they have been consistently whining about the cost and have asked you,

the project manager, to review options that would help reduce costs on the project. Given that this scope has been reduced to the most essential must-have items, where are your best options for reducing costs?

a. Fixed and variable costs
b. Direct and indirect costs
c. Direct and variable costs
d. Fixed and indirect costs

21. Several stakeholders on the project have been questioning the effectiveness of some of the technical team. While the work is proceeding according to plan, some of the stakeholders are not satisfied with the work delivered to date, even though it meets requirements specifications. You have held several meetings with the stakeholders to try to get to the root cause of the problem. With some of the technical team present at these meetings, it becomes obvious that some of the stakeholders have had great difficulty in describing what they want. As a result, some of the delivered product doesn't meet stakeholder expectations. Currently your CPI is 1.3 and the SPI is .89. What is your *largest* concern right now?
    a. Clarifying the requirements collection process
    b. The schedule
    c. Managing stakeholder expectations
    d. An increasing probability that some technical team members may leave the project due to high levels of frustration with stakeholders

22. You are one year into a three year multimillion dollar project. The project CPI =.91 and the project SPI is 1.15. The Project is only earning $.91 for every dollar spent, while it is 15% ahead of schedule. As a result, the project manager has assembled the project team to review options for correcting the budget overage. Which of the following would *best* address the budget overage issue?
    a. One of the project team members recommends a fast tracking option, thus lowering the costs
    b. Since most of the complex technical work has been completed, it was suggested that the most experienced resources could be swapped out for less experienced resources, thus lowering the cost
    c. The business analyst recommended a negotiation with the stakeholders to reduce scope, thus lowering project costs
    d. The CFO's representative recommended firing all the consultants. Since 30% of our development budget is being burned by contractors, this would remove a huge financial burden, thus lowering costs

23. CPI is 1.2, SPI is 1.1. Four months later CPI is.91 and SPI is .86. The *most likely* reason for this change is:
    a. The project manager has not been keeping track of variances on the project to implement corrections
    b. As work packages were being executed, discovery on critical path activities caused estimates to change drastically on several of the work packages
    c. The WBS was inaccurate
    d. Several key stakeholders insisted on a last-minute scope change

24. Which performance index describes the cost projection of the remaining work that must be achieved to meet the goals of the project?
    a. TCPI
    b. EAC
    c. ETC
    d. CPI

25. In terms of progress reporting, when do project activities earn value?
    a. As soon as the activity begins
    b. Only after the activity has completed

c. According to the earned value accrual rules set up by the project manager
d. Determined by the Configuration Control Board in your organization

26. On the current project, it was decided that discrete effort should be plotted using the percent complete approach. All of the following are true about percent complete except…?
    a. BAC times percent complete = EV
    b. Completing 20 hours of a 40 hour work package means half the work is complete
    c. Percent complete represents what percentage of the work has been completed in terms of the cost of the work
    d. Defining percent complete criteria and agreed to by relevant stakeholders

27. You are having a discussion with the key stakeholder about the best estimating method to use for the upcoming project. You argue for what provides the best team buy-in, while your stakeholder argues for a bottom-up estimate. What is the *real* issue?
    a. There is no issue - you are both talking about the same thing
    b. The stakeholder is correct and you're just not getting it
    c. You are correct and the stakeholder is just not getting it
    d. You are both incorrect and need to explore other options

28. Your project is paying for heat, light and electricity along with other teams that are sharing a facility. What kinds of costs are these?
    a. Direct, Fixed Costs
    b. Indirect, variable Costs
    c. Fixed, indirect costs
    d. Variable, fixed costs

29. The charter for your project has been completed and you are well into the planning phase of the project. You and your key stakeholders have allocated costs to a number of the project's work packages and activities, and are ready to finalize plans when the director from the CFO's office raises some concerns about the budget burn rate. Based on the availability of funds and the work that has to be completed, he is asking if some of the work can be rescheduled to accommodate funding availability. As the project manager, you decide to use which of the following tools to help you address this concern?
    a. Expert judgment
    b. Funding limit reconciliation
    c. Cost aggregation
    d. Reserve analysis

30. What is a basis of estimate and how does it apply to Earned Value calculations?
    a. The basis of estimate is actually earned value (EV)
    b. The basis of estimate is a method for determining what the project should cost based on historical data or bottom-up estimating. It is the foundation for planned value (PV)
    c. The basis of estimate is created via the use of stochastic variables and advanced mathematical models, which will point to the most effective of the three major estimating tools for your project: analogous, parametric, or bottom-up
    d. The basis of estimate is a separate estimating function that addresses management philosophy. It is not used in earned value calculations

31. You have identified some high-level risks on your project which have been included in the project charter. At this point, there are many unknowns in the project and you have about 30% of what you need to start an effective planning process. You have offered the sponsor and the key stakeholders a rough order of magnitude estimate, however, the sponsor and the key stakeholders want to make sure the project will

be completed within budget limitations. What would your *best* response be to the sponsor and stakeholders?

a. Provide a one-time estimate, as there are too many unknowns at this point
b. Find a project that is similar to this one in the historical record and offer an analogous estimate
c. Help the stakeholders and the sponsor understand that if the budget is a key constraint, it impacts the scope of the project. Scope needs to be reconciled against budget limitations
d. Based on the known elements in the project, it may be possible to create a parametric estimate that will be an effective predictor of the actual project costs

32. Variance analysis, trend analysis, and earned value performance are all elements of:
    a. Work performance information
    b. Performance reviews
    c. Product verification
    d. Expert judgment

33. Your project's risk register contains all the identified risks you have surfaced in the planning phase of the project. Each one of these risks has a specific dollar value which is become part of your cost baseline. However, as planning progresses, the technical team informs you that there are a series of elements that are complete unknowns and have never been tried within the organization. How do you accommodate these unknowns in your cost budget?
    a. With a contingency reserve
    b. With a discovery reserve
    c. With a probabilistic budget estimate
    d. With a management reserve

34. Because of a significant number of unknowns on your current project, management and the key stakeholders have opted for an iterative development approach. The project will be executed in a series of 30 day increments. At the end of each cycle, the customer will receive a product increment they can try and then offer feedback and course correction to the development team. After a few development cycles, the rate of delivery and cost associated with the product delivery, has stabilized. Using these figures, the project manager extrapolated the end date and a final estimate at completion, which came in at better than a definitive estimate: cost and time line variances were less than 3%. The estimating method used on this project is *most similar* to:
    a. Bottom-up estimate
    b. Analogous estimate
    c. Parametric estimate
    d. Probabilistic estimate

Chapter 7 Test – Answers

1. B – CV = EV-AC
2. C – The cost baseline includes the contingency reserve. Cost budget additionally includes management reserve. Bottom-up estimate focuses on activities and a definitive estimate is a range
3. D – Life cycle costing includes the total cost + maintenance and support cost for the lifetime of the product
4. C – This is by definition, a top-down approach
5. B – Actual cost is part of the CPI calculation
6. A – SV = EV-PV or in this case, +100
7. C – EAC is a forecast
8. B – Risks and risk contingency amounts are not contained in the output of the estimate costs process
9. B - +/- 50% is the definition of a rough order of magnitude. A budget estimate is -10% to plus 25%. A definitive estimate is +10/ -5%, and a predictive uncertainty estimate is a made-up term.
10. D – This requires some critical thinking. Answer 'A' is premature. With a CPI of .95 it is somewhat of a knee-jerk reaction to start implementing corrective action when the problem may self-correct. Answer 'B' is technically correct, but at this point sounds somewhat dismissive of the customer's concern. Answer 'C' might be an option if there are no other potential methods for reducing costs, however that determination has not yet been made. Answer 'D' is the most reassuring - you are telling the customer that his one-year project will complete 10 weeks early, satisfying the need for a better competitive position. Since the project is designed to build a competitive advantage, finishing 10 weeks early may give the organization not only a significant competitive advantage but also a boost in profitability as well as market share. While it's slightly over budget, the benefits may greatly offset that amount in a big way.
11. B – Procurement contract award is an output of the conduct procurements process
12. A – It is the cost of the resources needed to complete project activities. Per the *PMBOK® Guide*5th edition, p 167.
13. C - helpdesk activities are described as level of effort earned value accrual method. Practice Standard for Earned Value Management, 2nd Edition, PMI, 2011 p. 40
14. D – Value engineering is a technique that is used to look for ways of reducing costs without sacrificing features or scope
15. B – The reserve analysis is explicitly used for determining risk contingency reserve amounts. *PMBOK® Guide*,5th edition, p. 173
16. C – Earned value is also defined as the estimate of the work accomplished. Actual cost is what you've spent to date. Estimate at completion is the new budget forecast based on project variances. Budget at completion was the original budget estimate
17. B – If the basis of estimate is a fiction, then your variances are also a fiction. Earned value or calculations work only when there is a solid bottom-up estimate or historical data on which to base the estimate. The estimator needs to know what the work is supposed to cost in order to compute accurate earned value
18. C – This is a two-part calculation. You must first derive earned value from the SPI formula; SPI = EV/PV. At this point you know SPI (1.2) and PV ($60,000). Thus solving for EV you get: EV = 1.2 * $60,000 = $72,000. You can now compute CPI = EV/AC or $72,000/$65,000 = 1.11
19. A – EAC calculations use AC three out of four times and BAC three out of four times. All the other answers are incorrect. *PMBOK® Guide*, 5th edition, pp 220-221
20. C – The costs that you can best control are costs that directly impact your project (direct costs), and variable costs (contract resources that work hourly). You have less control over fixed and indirect costs.
21. B – The first part of the question is a red herring. With an SPI of .89 your biggest concern is the schedule
22. B – Swapping out expensive resources for less expensive resources would most directly impact your budget and is the simplest thing to do, especially if there is no technical impact on the project. Fast tracking may not reduce your costs, but they reduce schedule. Reducing scope is a last resort when nothing else may work. Suddenly firing all the consultants may sink your project.

23. B – Significant changes in earned value, such as the one described, usually point to some kind of discovery on the project, especially since the product was sailing along smoothly until it appeared to hit a bump. Answer ‘A’ is highly unlikely as is answer ‘C’. Changing scope at the last minute would also force a change request which may cause a re-baseline of the project. This would not necessarily change its CPI or SPI
24. A – This is a definition of the To Complete Performance Index (TCPI)
25. C – Usually when reporting performance, activities get credit based on rules set usp by the project manager at the beginning of the project, which can be: 50-50, 80-20, or 0-100
26. B – Completing half the hours of work on a work package does not mean that 50% of the work is done. *Practice Standard for Earned Value Management 2nd edition, PMI, 2011, p. 39.*
27. A – Team buy-in is one of the advantages of a bottom-up estimate
28. B – This is a definition of an indirect, variable cost
29. B – This is one of the reasons for performing a funding limit reconciliation
30. B – The basis of estimate is what helps you determine the planned value for the project
31. C – Before we can deliver an accurate budget estimate, we have to know what's being built and analyze whether the scope can be delivered for the price requested. Answer ‘A' is a shoot-from-the-hip response – PMI does not approve. Answer ‘B’ still gives you an analogous estimate, not a definitive estimate. Answer ‘D’ is a mystery
32. B – They are all derived in performance reviews
33. D – Management reserves help you address the ‘unknown’ unknowns
34. C – This incremental development approach is most similar to a parametric estimate

Chapter 8 : Project Quality Management

Topics covered:

- Quality Planning
- Perform Quality Assurance
- Control Quality

Section Objectives

This section will enable you to:

- Place the quality management processes into the PM process groups
- Define quality as defined by PMI
- Understand the key quality theories and identify quality proponents
- Implement techniques used in cost-benefit analysis
- Understand quality control techniques

Project Quality Management Process Summary

The high level Project Quality Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	-Quality management plan -Quality metrics -Quality checklists -Process improvement plan	-CR's -Various document updates	-Validated changes -verified deliverables -QC measurements -CR's - Various document updates	

Quality Overview

Quality is a 'hot button' for PMI:

- PMI stresses prevention over correction as the preferred quality approach
- Continuous improvement is a recurring quality theme
- Focus on the concept that everyone in the organization is responsible for organizational quality in the project, product or service

There are a number of varying definitions for what constitutes quality in a product or service. Below are some definitions of quality, starting with PMI's definition:

- "The degree to which a set of inherent characteristics fulfills *requirements."*[25]
- The characteristics of an entity that bear on its ability to satisfy stated and implied needs[26]
- Fitness for use[27]
- "Quality in a product or service is not what the supplier puts in. It is what the customer gets out and is willing to pay for. A product is not quality because it is hard to make and costs a lot of money, as manufacturers typically believe. This is incompetence. Customers pay only for what is of use to them and gives them value. Nothing else constitutes quality."[28]

For the exam, the definition of quality by PMI (shown above) is the only definition of quality that you need to memorize.

Notice that in the sections we have reviewed up to this point, there are a number of activities that one can perform as part of the Monitoring and Control process group:

[25] *PMBOK® Guide, 5th edition* p.556
[26] ISO 8402, 1994
[27] Joseph Juran
[28] Peter S. Drucker, *Innovation and Entrepreneurship*, HarperCollins, 1985

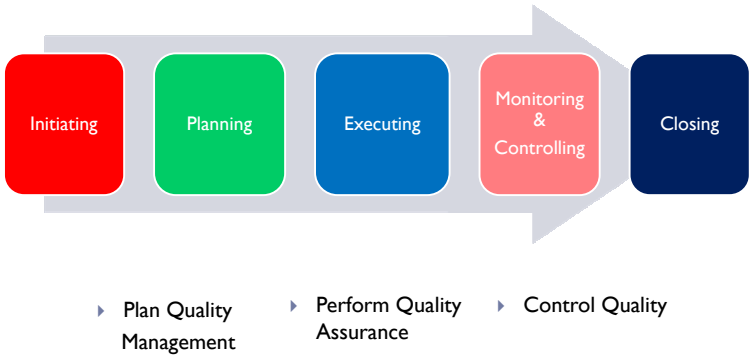
- Corrective Action
- Repair/Rework
- Preventive Action

With this chapter, we will focus on why PMI promotes preventive action above the other methods listed above.

PMBOK® Guide, 5th edition ISO Certification

The entire PMI credential system, which includes the *PMBOK® Guide*, 5th edition, is ISO-certified.[29] What that means in terms of ISO process is that the PMI framework is a process that enables practitioners to manage projects with a high level of control. When a process is in 'control' as defined by ISO, the process is both predictable and repeatable. Therefore the *PMBOK® Guide*, 5th edition defines a series of processes to control projects that give the project practitioner a high degree of predictability and repeatability in the process.

Project Quality Management



The process of Project Quality Management includes the organization's quality policies, methods, and procedures designed to meet the objectives of the project and to satisfy the customer's needs.

Failure to meet the quality requirements of a project can have negative consequences for all stakeholders involved in the project. In worst case scenarios, failure to meet the quality requirements of a project may render the end product unusable.

The project manager's job in performing project quality management includes some of the following elements:

[29]Per PMI press Release dated 10-8-2007: "The International Organization for Standardization (ISO) in Geneva, Switzerland, has bestowed the ISO 17024 accreditation upon PMI's credential system for the PMP."

- Performing continuous improvement activities
- Implementing a plan to continuously improve quality
- Determining specific quality metrics that apply to the project
- Verifying quality prior to the completion of a work package or a deliverable
- Help to facilitate quality audits of the project

The Quality Experts - a Short List

W. Edwards Deming

W. Edwards Deming was an American quality pioneer that developed the “14 Points for Management” and “Seven Deadly Diseases” of management.

Deming developed the 14 Points as the "…basis for transformation of American industry… Adoption and action on the 14 points are a signal that the management intend to stay in business and aim to protect investors and jobs".[30] The 14 points and seven deadly diseases are listed below:

The 14 Points	The 7 Deadly Diseases
Create constancy of purpose towards improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.	Lack of constancy of purpose.
Adopt the new philosophy.	Emphasis on short term profits.
Cease dependence on inspection to achieve quality.	Evaluation of performance, merit rating.
End the practice of awarding business on the basis of price tag. Instead, minimize total cost..	Mobility of management, job hopping.
Improve constantly and forever the system of production and service...	Management by use only of visible figures.
Institute training on the job.	Excessive medical costs.
Institute leadership..	Excessive costs of liability.
Drive out fear, so that everyone may work effectively for the company.	
Break down barriers between departments.	
Eliminate slogans, exhortations, and targets for the workforce asking for 0 defects and new levels of productivity.	
Eliminate work standards (quotas) and eliminate management by objectives.	
Remove barriers that rob people in management and the hourly worker of their right to pride of workmanship.	
Institute a rigorous program of education and improvement.	
Put everybody in the company to work to accomplish the transformation.[31]	

[30] *Out of the Crisis,* W. Edwards Deming, 1986, MIT Press, p.23

At the behest of Gen. Douglas MacArthur, Dr. Deming visited Japan several times between 1946 and 1948 for the purpose of taking a census. In 1950 the JUSE (Japanese Union of Scientists and Engineers) invited Dr. Deming back for executive courses in statistical methods. Dr. Deming insisted that the royalties on his seminar materials use to help the Japanese people, and as a result, the JUSE named their ultimate quality prize after him: 'The Deming Prize".

Since, as Deming asserted, management was responsible for creating the work environment, management is also responsible for 94% or more of the quality issues that occur in the environment.

One of Dr. Deming's most significant contributions was his development of what he called his 'System of Profound Knowledge'. The system consists of four parts:

1. Appreciation for system
2. Knowledge about variation
3. Theory of knowledge
4. Psychology

A **system** is a series of interdependent components that work together to accomplish the aim of the system. If there is no aim, then there is no system. The idea for any component of the system is to contribute its best to the system. With many businesses, unfortunately, management has the independent units of organizations compete against each other for resources, budget, etc. this sub optimizes the system and ultimately, leads to a degradation of overall system capability.

The key concepts Edwards Deming tried to get across to management was that it was critical for management to understand **variation** in a process, and who was responsible for addressing the variation in the process. He defined the two types of variation as ***Special Cause variation and Common Cause variation:***

- **Special Cause variation** occurs when a process exceeds its control limits. This type of error can be addressed by the operator of the system, for example, if a piece of equipment goes out of adjustment or out of calibration
- **Common Cause variation** is the natural variation or randomness in the process. Common Cause deviation is measured by standard deviation and is a measure of precision. Improving the precision and tightening the standard deviation is beyond the control of an operator of the system and can only be addressed by management

It was Dr. Deming's view that management in any form is prediction, therefore having a **theory of knowledge** helps us to understand that. Any kind of rational prediction is built on theory and requires systematic revision when impacted by reality. This is how knowledge is built: on a combination of predictions, observation, and adjustment of the prediction based on what has been observed. It is a fundamental empirical process.

Finally, knowledge of human **psychology** is necessary so that we understand people. Dr. Deming observed that a manager of people must be aware of differences in how people learn, the speed at which they learn, and what motivates them, as well as how to use these differences for optimization of everyone's abilities.

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[31] *Out of the Crisis,* W. Edwards Deming, 1986, MIT Press, pp 23, 24, 97, 98

Joseph Juran

Joseph Juran was a contemporary of W. Edwards Deming and also went to Japan to speak/lecture to Japanese managers and CEO's after his *Quality Control Handbook* was published in 1954. His visit marks Japan's use of QC as a management rather than as a specialist technique.

Juran's quality trilogy involves:

- Quality planning
- Quality control
- Quality improvement

Dr. Juran saw these items as keys to success. Top management can follow the sequence just as they would use one for financial budgeting, cost control, or profit improvement.

Several of the key points described by Dr. Juran are basics for business success:

- Management must commit time and resources for Success; CEOs must serve on the quality council
- Specific quality improvement goals must be in the business plan
- Responsibility for improvement must be assigned to individuals
- People must be trained and empowered to participate in the improvement process

Phil Crosby

Phil Crosby was the vice president of quality for 14 years at ITT under the legendary CEO, Harold Geneen. In 1979 he founded Philip Crosby Associates, a quality college attended by many business people because Crosby was considered a businessman, not a 'quality academician'.

Crosby stated that the cost of quality must become part of the company's financial system. As a result, he had 4 absolutes of quality management:

- Quality means conformance to requirements
- Quality comes from prevention
- The quality performance standard is 0 defects
- Quality measurement is the price of non-conformance

His 1979 book, *Quality is Free*, contained a stair-step model that the current CMMI is based upon.

Kaoru Ishikawa

Kaoru Ishikawa was one of the 1st winners of the Deming Prize in 1952. He promoted the idea of Company-wide Quality Control (CWQC) which includes the following:

- Involves participation of workers from the top to the bottom of the organization
- Requires a management philosophy that has respect for humanity
- Creation of quality circles

In an attempt to break down barriers between departments, he originated the concept of "next operation as customer". While working with a steel mill in 1950, he noticed that when operators were concerned about their own defects and traveled to the next department, they were considered spies(!) "Next operation as customer" was developed to remove those fears.

In 1968, Ishikawa published a book on 7 quality tools: histograms, check sheets, Pareto diagrams, flow charts, scatter diagrams, cause-and-effect diagrams, and control charts. Ishikawa maintained that the correct use of these charts would enable the worker to remove up to 95% of the defects they found on the job.

Armand Feigenbaum

Armand Feigenbaum is generally credited with the creation of the concept of 'total quality control' at GE in the late 1940s:

- TQC is a companywide process
- Quality is what the customer says it is
- All management must be involved in quality
- The most cost-effective, least capital intensive route to productivity

Feigenbaum also noted that the quality professional has an opportunity to become more than a functional specialist, but also a true businessman by providing valuable information and direction.

Important quality phrases:

- Failure driven companies: "If it breaks, we'll service it“
- Quality driven companies: "No defects, no problems, we are moving towards perfect work processes"

Walter A Shewhart

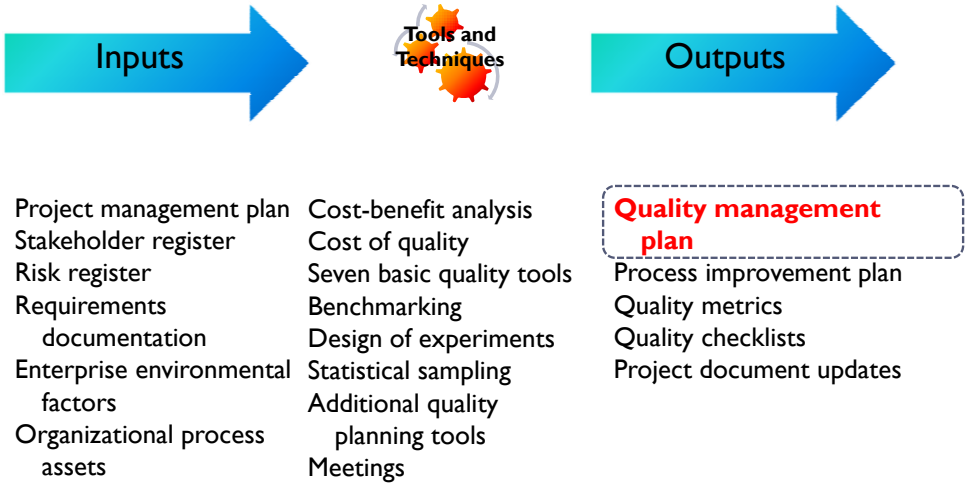
A founding member of Bell Labs in 1925, Dr. Shewhart was responsible for the creation of statistical process control in 1931 from his book, *Economic Control of Quality of Manufactured Product,* in which he determined that within +/- 3 σ of the arithmetic mean constituted, with rare exceptions, common

cause variation. Special cause variation, which can be addressed by an operator of the system, is usually outside of these control limits, i.e. > than +3 sigma or < -3 sigma.

Dr. Shewhart was also responsible for the creation of the plan- do-check-act cycle:

- Plan - what changes are desirable and what data is needed?
- Do - carry out the change or test decided upon, preferably on a small scale.
- Check - observe the effects of the change. What have we learned and what can one predict from what was learned?
- Act - what we learned will either lead to an improvement of all stages or some activity to better satisfy the customer. The results may indicate that no change is needed at all.

Plan Quality Management



Plan quality addresses the processes needed to identify all quality requirements and standards for the project and the project's product. It also documents how the project will demonstrate compliance with those standards.

Notice the extensive list of tools and techniques used in the Plan Quality process. We will be addressing all of the appropriate tools on the upcoming pages for the purpose of the exam.

Quality Planning Tools

- Cost-benefit analysis
- Cost of quality (COQ)
- Seven Ishikawa tools
- Benchmarking
- Design of experiments
- Statistical Sampling

- Additional Quality Planning Tools
- Meetings

Quality tools listed above will be described in greater detail on the upcoming pages. The first six items represent specific tools and concepts that are mentioned in the *PMBOK® Guide*, 5th edition. The seventh item - additional quality planning tools - is a catchall that PMI uses. For the exam, you may see certain elements covered under this heading that you've never seen before. We will also attempt to identify a number of these additional tools, you may see mentioned in a question on the exam.

Cost-Benefit Analysis

With the cost-benefit analysis, project manager weighs the cost of implementing the quality requirements against the benefit it will deliver for the project. While there is always some cost to implementing quality, as we will see on the upcoming pages, costs of failing to implement quality are significantly higher.

The ultimate benefit that has to be considered is this: what is the customer willing to pay for in terms of quality? If the product or process does not meet the customer's expectation of quality, will they pay for it? Stated in these terms, it may make a difference between whether or not you stay in business, based on whether you're meeting the customer's quality needs.

What are the benefits of meeting quality requirements in your project?

- Decreased Rework
- Decreased Costs
- Increased Productivity
- Increased stakeholder satisfaction

Cost of Quality

Prevention – the *lowest* cost of quality:

- Quality planning
- Quality training
- Reliability engineering
- Poka Yoke (Shingo)
- Zero Quality Control (ZQC) (Shingo)
- Data analysis
- Test engineering (FMEA)
- Voice of the customer (VOC)

Appraisal:

- Inspection
- Gage R & R (Repeatability and Reproducibility)
- Surveys
- Calibration / Test equipment
- Calibration

Philip J. Crosby was the vice president of quality under the legendary CEO, Harold Geneen. His belief was that a company that establishes a quality program will experience savings that will more than pay off the cost of the quality program – thus the title of his 1979 book, *Quality Is Free:*

"Each year your cost of sales rise faster than your prices. That means you have to eliminate or reduce costs to make a profit. The best single way to do that is by defect prevention."[32]

Notice the lowest cost of quality comes through prevention activities, and that these activities occur in the quality planning phase of a project. Two of the ideas came from the Toyota engineering genius, Shigeo Shingo.

Shigeo Shingo, developed the concepts of Poka Yoke (mistake proofing), and Zero Quality Control (100% source inspection).

FMEA (Failure Modes and Effects Analysis) was developed by the United States Army in 1949, and is described by PMI as a non-proprietary approach to quality management.

The voice of the customer (VOC) is a concept that originated in Japan, and focuses on capturing what the customer is asking for from the process. The VOC process excels at not only capturing the stated needs, but the *implied* needs as well.

- *Highest* quality costs >>>>>>
  - **Internal:**
    - Scrap
    - Rework
    - Service-after-Service
    - Excessive inspections
  - **External:**
    - High liability/insurance costs
    - Excessive warranty costs
    - Lost reputation, sales and customers
    - Low team morale
    - Decreased efficiency
    - Cost to regain customers, sales, and reputation
    - Negative press – increased competitive pressure

The highest costs of quality, or should we say of *poor* quality, are described in the *PMBOK® Guide,* 5th edition as "non-conformance" issues which include internal and external costs. Phil Crosby brought the real cost of quality into focus when he stated that "The cost of quality is the expense of doing things wrong. It is the scrap, rework, service after service, warranty, inspection, tests, and similar activities made necessary by non-conformance problems."[33]

Studies have been done on what it costs a software organization when defects are discovered in a unit testing situation versus when those defects are discovered after they have been delivered to the

[32]Philip J. Crosby, *Quality is Free*, 1979
[33]Philip J. Crosby, *Quality is Free*, 1979

customer. Studies suggest that the cost of delivering defects to the customer are anywhere from 1000 to 5000 times higher than catching them in a unit test.

Notice that some of the external costs of quality such as lost reputation, lost sales, and therefore, lost customers, can lead to the demise of the business.

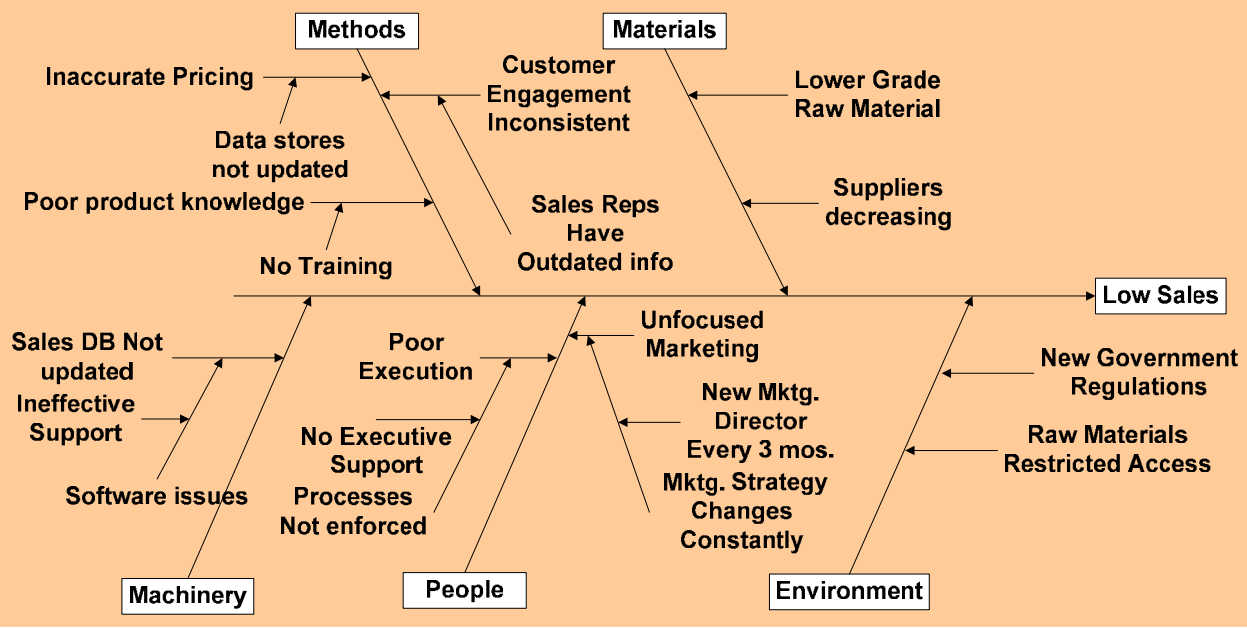
The Seven Basic Quality Tools

Included in the tools and techniques you see above are Kaoru Ishikawa's seven basic quality tools. Ishikawa stated that with the mastery of these seven tools, anyone with no more than an eighth grade education in mathematics will be able to correct 95% of the problems they face on the job.

These tools are:

1. cause-and-effect diagram
2. flowcharts
3. Check sheets
4. Histogram
5. Pareto chart
6. control charts
7. scatter diagram

Ishikawa Diagram



The Ishikawa diagram was developed by Kaoru Ishikawa, a Japanese quality guru and winner of the Deming Prize for individual performance in 1952. The Ishikawa diagram, also known as the cause and effect or 'Fishbone' diagram, is a tool that is used to perform root cause analysis in the graphic format.

The main effect pictured in the diagram is shown at the head end of the diagram. In this case, a specific product is experiencing low sales; that is the 'effect'. The spines on the remaining part of the diagram indicate high level causes (the major spines), and contributory causes (the smaller spines).

The idea is to drill down into the causes by continuing to ask 'why?' until you surface a potential cause.

The basic major spines of an Ishikawa diagram consist of the 5M's:

- Methods
- Materials
- Machinery
- Manpower (People)
- Mother Nature (Environment)

Other major spines can be added depending on need; 'money', for example.

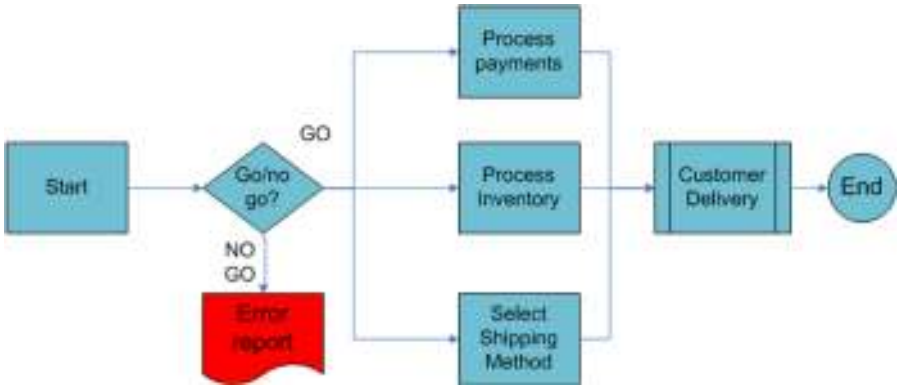
In Japan, the process of questioning what caused the effect is called the '5 whys' process. When you identify a cause ask, 'why did that happen'? Asking why at least five times will either get you to the root cause of the problem or identify a point where you need further information to understand the cause.

Flowchart

There are numerous tools, software and otherwise, that enable the drawing of flowcharts. Flowcharts, also defined as process maps, help to identify process flow, logic or a method for performing a specific activity or group of activities. Flowcharts can be used to show dependencies between activities or simply show a series of steps from start to finish. The SIPOC (supplier, input, process, output, customer) diagram is a type of flowchart. A more traditional example is shown below.

Exam Tip:

From the perspective of Quality Control, flow charts can be used to identify failing process steps and identify process improvement opportunities



Check Sheets

The check sheet has a variety of uses which can include but are not limited to the following:

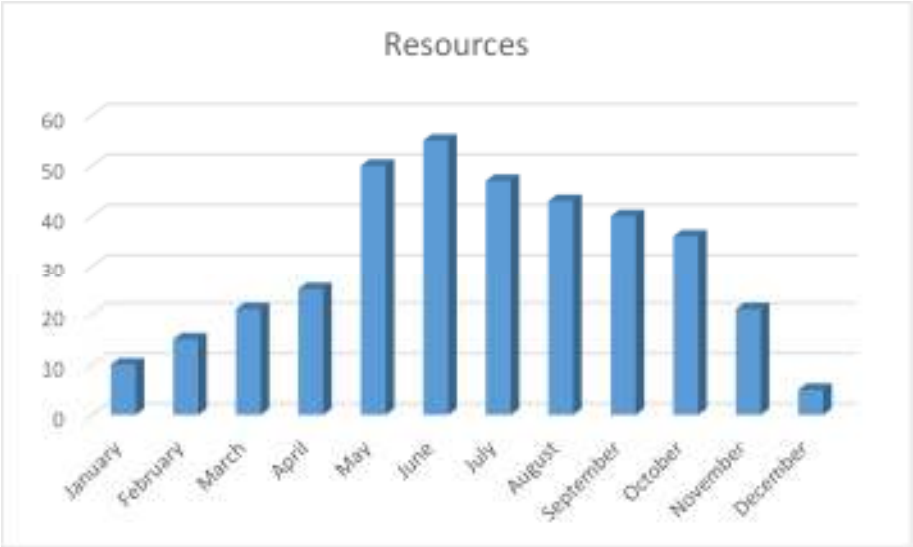
- Collecting data about potential quality issues
- Capturing required sign offs on project documents
- Steps taken for a defect analysis
- Collecting a tally of all required steps for testing a product
- and others…

An example appears below:

Defect/ Problem/ Symptom	Week						Total
	M	Tu	W	Th	F	Sa	
Delay	6						6
Missed Commitments							0
Defects							0
Errors							0
Repeat Fixes							0

Histograms

A histogram is a type of bar chart that can be used to capture data over time or to count specific data elements. Typical uses of the histogram are: sales by region, resources needed on a monthly basis, inventory counts at multiple warehouses, etc. An example appears below:



Pareto Chart

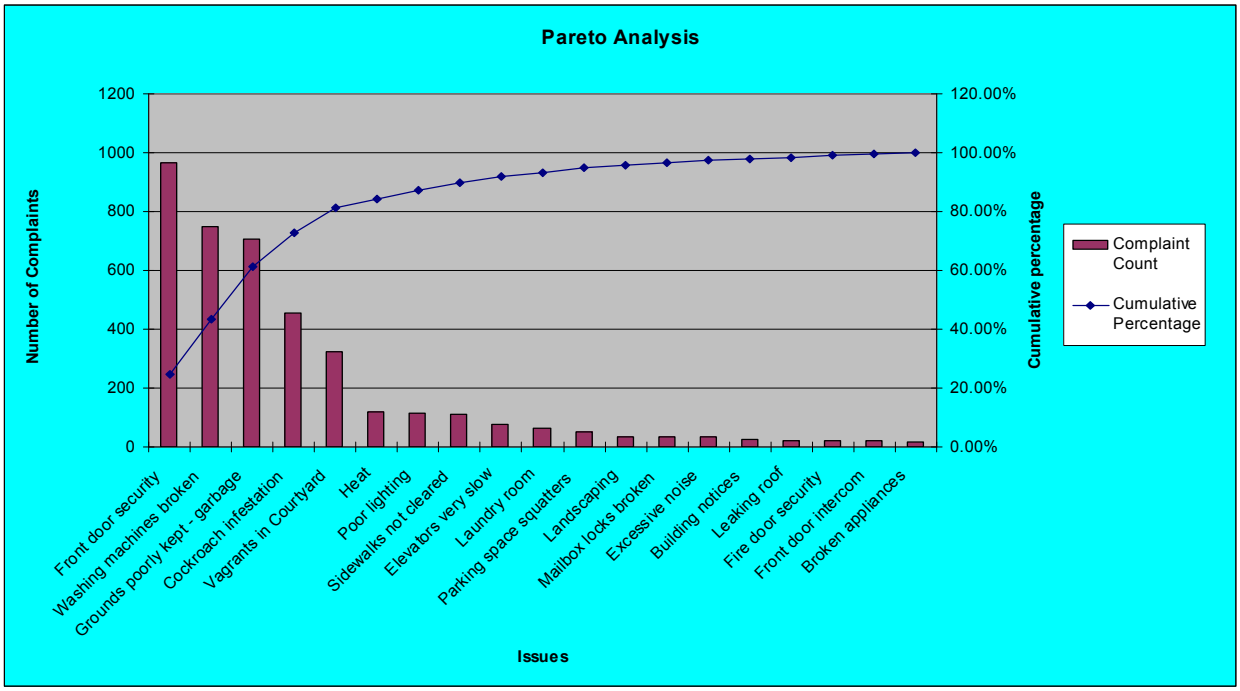
The Pareto chart was based on the work done by Italian economist Wilfredo Pareto in the late 19th century who discovered that 80% of the wealth in Italy was held by 20% of the population. Dr. Joseph Juran took Pareto's idea and applied it to general business process to see if this 80/20 rule would apply in a business environment. His discoveries included:

- 20% of the business produces 80% of the waste and rework
- 20% of your customers produce 80% of your revenues
- 80% of your customer complaints come from 20% of your customers

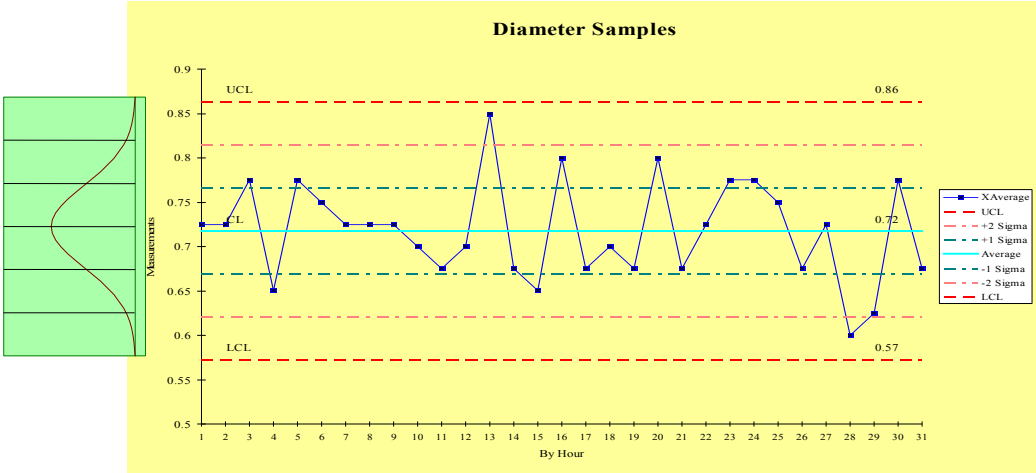
The Pareto chart is a key tool in Kaizen – it will identify which incremental improvements will produce the largest results for the least amount of effort.

For the exam, the Pareto chart is a prioritization tool used to identify critical issues in descending order of frequency, and identify your largest problems.

The Pareto chart is also a specialized type of histogram.


Pareto Analysis
Number of Complaints
Cumulative percentage
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Complaint Count
Cumulative Percentage
Front door security
Washing machines broken
Grounds poorly kept - garbage
Cockroach infestation
Vagrants in Courtyard
Heat
Poor lighting
Sidewalks not cleared
Elevators very slow
Laundry room
Parking space squatters
Landscaping
Mailbox locks broken
Excessive noise
Building notices
Leaking roof
Fire door security
Front door intercom
Broken appliances
Issues

SPC (Statistical Process Control) Chart Example



Control Charts are used:

- To determine if a process is stable and is exhibiting predictable performance
- To identify upper and lower **control limits** (UCL/LCL) which are calculated by the process
- To identify upper and lower **specification limits** which are established by the customer and the PM

Statistical Sampling:

- Identifies a particular part of the overall population for study
- Sampling techniques can be stratified, random, population and others
- Data is assessed by two measures: accuracy and precision
    - Accuracy: conformance to target values; correctness
    - Precision: dispersion of the data; standard deviation

Above is an example of an SPC (Statistical Process Control) data chart in which measurements have been collected on shaft diameters for a motor drive. Notice the bell curve to the left of the chart. While the Bell curve shows the probability distribution of all the data, the SPC chart shows the individual measurements that went into creating that bell curve.

The state of the statistical process control involves two types of limits:

- Process Control Limits - these are usually identified by the UCL (upper control limits), and the LCL (lower control limits). Process control limits are never selected by the project manager or by the stakeholders. They are always computed by the process itself and tell the practitioner whether the process is in a state of statistical control and whether the process is capable.
- Process Specification Limits - these limits, the USL (upper specification limits) and LSL (lower specification limits) are defined by the customer, or the customer with the help of the project manager. The specification limits indicate what levels of variance the customer can withstand before the process is deemed to be out of specification and in a state of error.

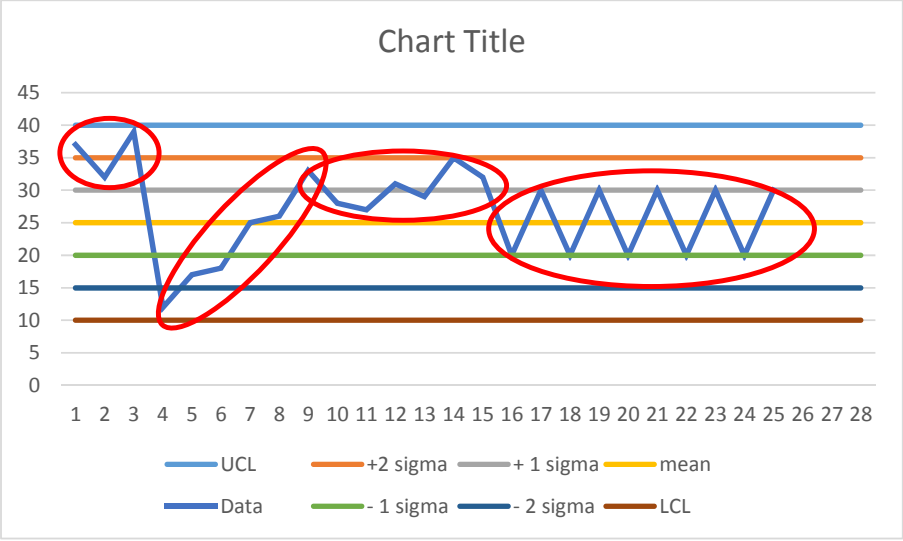
A process can be within statistical control (within the UCL and LCL) and yet be out of customer specification (outside of the USL or LSL). What this means is that the process is experiencing common cause variation (random) that cannot be corrected by an operator of the system. This is a situation that requires the help of management. Identification of these data points is performed with the zone test:

Stability Analysis/Zone Test

Typical zone tests include the following:

- The Rule of Seven - seven consecutive data points on either side of the mean may indicate an out-of-control situation
- The Rule of Six - six consecutive data points or more, trending in an upward or downward direction, may indicate an out-of-control situation
- The Rule of Ten - essentially 10 data points represented as a saw-tooth pattern alternating above and below the mean.
- Rule of 1 - a data point above the UCL or below the LCL
- The rule of 2-out-of-3 - 2 of three consecutive data points between +2 and +3 σ or -2 to -3 σ

The concept that binds these rules together is simply this: in a statistical process chart where the data supposed to be random within the control limits, one has no way of predicting where the data points will land at any given time. With the rules above, we are seeing a pattern where we are expecting randomness. This pattern is what Dr. Joseph Juran referred to as the 'signal in the noise'. See the example below:



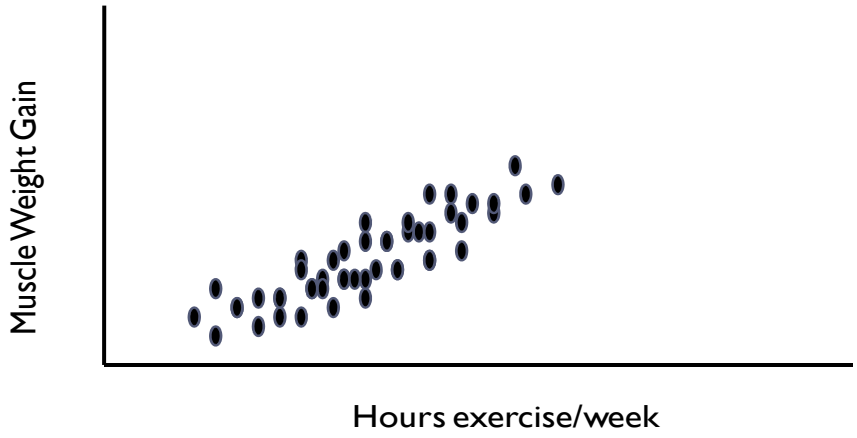
Scatter Diagram

The scatter diagram is used in trending and regression analysis. It plots data in an x-axis (in this case, hours of exercise per week) and compares it to data in y-axis (gain in muscle weight). For this example, the scatter diagram answers the following question:

Does a change in X (independent variable) cause a change in Y (dependent variable)?

- When there is a positive correlation - an increase in X corresponds to an increase in Y, we are trending in a positive direction.
- When there is a negative correlation - an increase in X corresponds to a *decrease* in Y, we are trending in a negative direction.
- When there is a neutral correlation - an increase in X leads to neither an increase nor a decrease in Y, we are showing no correlation of any impact between the measurements

For the scatter diagram to be effective or useful, the compared elements must be causally related in some way. It is very easy to develop a series of false-positive or false-negative measurements when comparing unrelated sets of data. Comparing US traffic deaths (x) to an increase in global warming (y) may show a positive correlation in the scatter diagram, but in reality are completely unrelated elements.



Benchmarking

Benchmarking activities compares project practices used in the past to those that are being used in the present. Thus, one can identify best practices, guidelines for improvements, and a method for measuring performance. Benchmarks can be obtained through industry publications or commercially available databases containing benchmark standards.

For example, in the construction industry, the RS Means Company offers a commercial database known as “CostWorks”, which contains construction cost benchmarks. This database contains 23,500 activities that can be performed at a construction site, and has these activities priced by geographic location (depending on where the construction is being performed), as well as by the skill of the crew (low, medium, high).

Design of Experiments (DOE)

Design of experiments was first developed by Sir Ronald Fisher for an agricultural experiment in the early 1920s. The typical scientific method process is to change one factor in time when performing an

experiment. This approach is very time-consuming, as Thomas Edison found out when he attempted to create a functioning light bulb.

With DOE, multiple factors can be experimented on simultaneously. This approach has two distinct advantages:

- Fewer total experiments need to be run, resulting in lower cost
- Interactions between factors can be tracked for potential synergies

The process is done today using sophisticated statistical software tools such as Minitab®, Crystal Ball®, @Risk® and others. This is a nontrivial process that requires training.

Exam Tip: Use DOE during the Plan Quality process to determine testing approaches and their impact on cost of quality. Use it to optimize the product or the process to drive high levels of customer satisfaction.

Additional Quality Planning Tools

- The **Loss Function** was developed by Genichi Taguchi as a quality tool. It establishes a financial measure of the user's dissatisfaction with a product's performance, as it deviates from a target value. Thus, both average performance and variation are critical measures of quality.
- **Matrix Diagrams** such as the House of Quality (HOQ) which is utilized in the QFD (Quality Function Deployment) process was developed in the late 1960s by Tokyo professors Mizuno and Akao. First utilized in the late 1960s at Bridgestone and again in the early 1970's at Mitsubishi's Kobe shipyards, the process enabled the company that built oceangoing oil tankers to reduce their production time from six months to four months, thus increasing their yearly productivity by 50%.
- The **Kano Model** was developed by Japanese social anthropologist Noriaki Kano in the 1980s. It is a theory of product development and customer satisfaction by focusing on product attributes that are perceived to be important to customers. This supports product specification and discussion through better development team understanding accomplished by focusing on differentiating the features of the product: what satisfies the customer versus what delights the customer versus what dissatisfies the customer.
- **Marginal analysis** is done from the point of view of the performing organization, and weighs the benefits or revenues from improving quality versus the costs to achieve quality.
- The **force field analysis** (FFA) - a tool used to weigh the pros and cons of a specific course of action. It is also used to evaluate current business situations and obstacles to goal attainment. The FFA views proactive and opposing forces working for or against the idea or proposed plan, and is used as a decision making or a tactical tool.
- **Nominal Group Technique** is a form of brainstorming utilizing a voting process to rank ideas in order of importance. See Chapter 5 – Group Creativity Techniques.

Quality Management Concepts

You may see a reference to any of the above-mentioned quality concepts on the exam. We will elaborate these concepts in some detail on the pages that follow.

What is important to understand is that the quality management concepts listed above have been around for 30 years or longer. These techniques represent a historical compendium of quality ideas and concepts that have been successful in the marketplace. While a number of the concepts are based on theories, those theories have been validated by practitioners many thousands of times across a broad range of businesses and business environments.

Zero Defects

Zero Defects was a concept offered in Crosby's book 'Quality Is Free'. The idea is not simply to exhort the team to try to be careful so as to not make any mistakes, but to identify what methods and processes can be implemented to systematically remove defects from the process. Once the processes have been developed to prevent defects, they become institutionalized as part of the project process.

Fitness for Use

Does the product or service meet the customer's need – i.e. is it fit for use by the customer?

Exam Tip: Understand the distinction between 'grade' and 'quality'. A product can be low grade but high quality as long as it meets your quality criteria:

- Is a Uniball Gel Pen™ equal in quality to a Montblanc ™? (What are your quality criteria?)
- What about in terms of grade? (The Montblanc™ may have better form, fit and finish)

Fitness for use as a quality principle embraces five dimensions that need to be monitored and addressed as needed by the project:

- First is the quality grade of the design. Are you building a Lexus or a Corolla?
- Second is the degree of quality conformance. How closely does the product or service match the tolerance requirements needed by the purchaser?
- Third concerns the reliability and/or maintainability of the product or service
- The fourth dimension concerns the safety of the product reflected in the potential risk or injuries associated with using the product or service
- The fifth concerns how the product or service will actually be used in the field by the customer. Operating a Harley-Davidson motorcycle in Miami, Florida may be very different than running it in Fairbanks, Alaska.

This principle was outlined by quality pioneer Dr. Joseph Juran in his book *Quality by Design.*

Kaizen

The concept of kaizen is to implement consistent and incremental improvement. In Japan: kai means 'to alter', zen means 'to improve or make better'. This concept was understood in the United States as far back as 1926 by Henry Ford who stated:

"If we reach a stage in production which seems remarkable as compared to what has gone before, then that is just a stage of production and nothing more. We know from the changes that have already been brought about that far greater changes are to come, and that therefore we are not performing a single operation as well as it ought to be performed".[34]

Modern implementations of kaizen focus on activities that reduce costs, reduce cycle times, drive higher customer satisfaction, and improve quality overall to help the business grow and sustain relationships with its customers.

Using the P-D-C-A (Plan-Do-Check-Act) cycle as an empirical process; repeated, incremental improvements can be realized that benefits the business and, most importantly, the customer.

Six Sigma

For the exam understand that Six Sigma defect levels are equal to 3.4 defects out of 1 million opportunities. This translates to a defect free percentage of 99.99966% or in short 99.999%.

This is designed to bring about 'rocket shot', 180° turn-around improvement in a process that is causing significant loss to the organization.

Six Sigma uses a five step process (DMAIC), which is a variant on plan-do-check-act, to implement the turn-around:

[34] *Today and Tomorrow,* Henry Ford, Doubleday, 1926, p. 48

- _____ – define the one biggest problem or issue causing loss to the business
- _____ – measure the current state of the process. This can be a painful reality check
- _____ – analyze options to address the problem
- _____ – implement the solution identified in the analysis phase
- _____– Monitor and control the result using statistical tools to measure the result of the change and monitor forward progress.

One of the newer implementations of Six Sigma is DFSS (Design for Six Sigma), which has the objective of determining the needs of customers and the business and driving those needs into the product solution. DFSS is relevant to the complex system/product synthesis phase, especially in the context of unprecedented system development. It is process *generation* in contrast with process *improvement* and, as such, uses the DMADV (Define, Measure, Analyze, Design, Verify) or the IDOV (Identify, Design, Optimize, Validate) approach.

Quality Philosophies

The **Just in Time** approach to production eliminates the unnecessary and expensive buildup of inventory in a manufacturing or service process. The idea of 'just in time' promotes the concept 'single piece flow', a key lean concept and one of the 14 points in the Toyota Production System. The Just in Time manufacturing concept was founded due to the contribution of Dr. Shingo Shigeo and Mr. Taichii Ohno of Toyota Motor Co. from 1949 to 1975.

Exam Tip: Just in time processes typically carry no inventory.

In view of his contributions, Utah State University founded the Shingo prize for excellence in manufacturing in 1988. This prize promotes world-class manufacturing and recognizes companies that achieve superior customer satisfaction and business results. The Shingo Prize has been compared as the manufacturing equivalent of the Nobel Prize (http://www.shingoprize.org).

The International Organization for Standardization (ISO) was reorganized in its current form at the end of the Second World War in 1946. ISO is a voluntary organization that promotes international standards for manufacturing. Organizations that are ISO certified know that their products will work in other countries where the same ISO standard has been implemented, thus removing barriers to trade.

TQM according to ISO 8402:1994, is defined as follows:

"TQM is a management approach for an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society." According to William Golomski (American quality scholar and consultant, 1924-2002) TQM was first mentioned by Koji Kobayashi at NEC (Nippon Electrical Company) in his acceptance speech for the Deming Prize in 1974.

CMMI

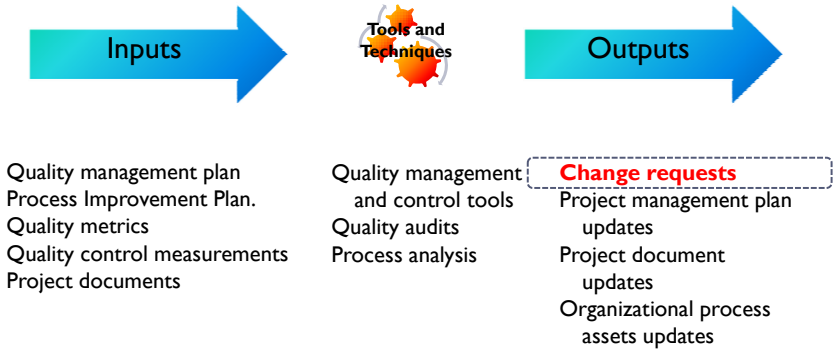
Level		
5	Optimizing	Continuous process improvement
4	Quantitatively managed	Quantitative management
3	Defined	Process standardization company wide
2	Managed	Fundamental project management
1	Initial	Fire Drill - adrenaline based management

The Capability Maturity Model Integration (CMMI) is the second major incarnation of the capability maturity model. The original CMM was 'sunset' in 2004 by the Software Engineering Institute and was replaced by the more robust CMMI by 2006.

The CMMI is fundamentally a process designed to help organizations improve overall software quality, which includes software design, development and deployment. The assessment levels for the CMMI are shown above. The stair-step model that was originally used in CMM was described by Phil Crosby in his book *Quality Is Free.*

The Software Engineering Institute (SEI) conducts audits of organizations that desire to be assessed at levels 2 and above in the CMMI model. Notice the use of the word 'assessed' - the SEI does not *certify* any organization for a specific assessment level. The assessment is conducted by a lead assessor and a team supporting the assessor. The assessment is good for three years, at which point the organization needs to be reassessed in order to maintain its assessment level.[35]

Perform Quality Assurance



Perform quality assurance is the process of ensuring that the quality standards set down by the organization are being followed for the project. This includes the performance of quality audits as well as process analysis (the third step in the Six Sigma process).

[35]http://cmmiinstitute.com/resource/cmmi-for-development-version-1-3/ CMMI Institute, Carnegie Mellon

Since Perform Quality Assurance occurs in the Executing process group, we focus on requested changes, continuous process improvement, and following organizational standards and practices. Perform Quality Assurance utilizes the data that was collected in the Control Quality process to assess whether the project is adhering to the appropriate quality standards.

Quality Management Tools

In addition to the seven quality tools described in the previous section, there are also seven quality management and control tools that are used in the quality assurance process. A listing of these tools with brief descriptions regarding their functions are described below:

- **Affinity Diagrams**. Similar to a mind map, affinity diagrams can be used to organize thoughts on how to solve the problem or to organize processes in terms of how to get a job done. This can be an effective tool in the define scope process to help the project manager and the project team understand how stakeholders get their jobs done
- **Process Decision Program Charts** (PDPC) defines a goal or an objective and the steps needed for achieving the goal.
- **Interrelationship Digraphs**. A graphic tool that maps cause-and-effect relationships for problems in which there are multiple variables or multiple desired outcomes.
- **Tree Diagrams**. This diagram is used to represent hierarchies such as the WBS, risk breakdown structure, organizational breakdown structure, and others. They can be represented horizontally or vertically. A specialized type of tree diagram is called the decision tree analysis which will be described in greater detail in the risk chapter.
- **Prioritization Matrices**. Defines issues and alternatives that need to be prioritize for decision-making purposes.
- **Activity Network Diagrams**. These types of diagrams include the AOA and the AON diagrams detailed in the time management chapter. They can be used with schedule methodologies such as PERT, CPM and PDM methods.
- **Matrix Diagrams**. Matrix diagrams shows the strengths of relationships between factors, causes, and objectives that exist between the rows and columns in the matrix. A well-known type of matrix diagram is known as a 'house of quality' used in the QFD process.

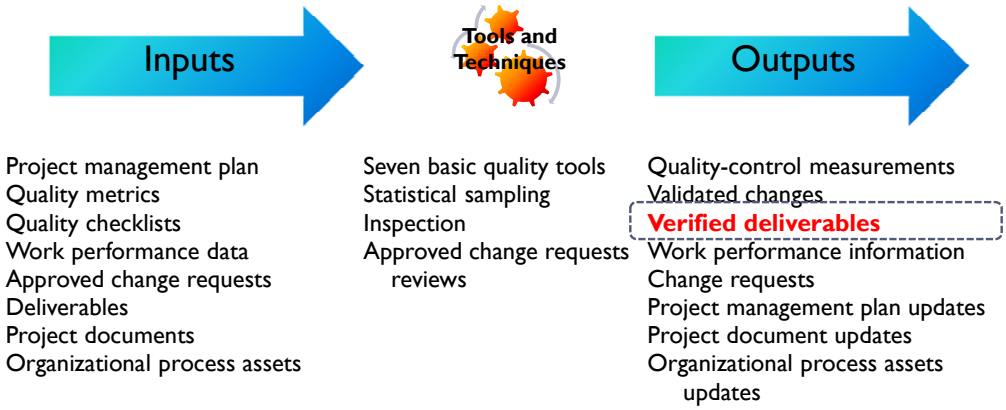
Quality Audit

Quality audits can occur with or without warning. The idea of performing an audit is to establish the following:

- Is the project team following the policies, standards, and procedures as outlined by the organization?
- Are any changes by way of corrective or preventive actions necessary to bring any part of the project back into quality compliance?
- Are there any improvements, lessons learned or new processes that contribute to best practices within the organization and that can be institutionalized as ongoing processes?
- Identify best practices, gaps or shortcomings
- Share good practices introduced, organizationally or industry-wide

- Offer assistance to help improve productivity and highlight contributions in lessons learned repository

Control Quality



Control Quality gives a project manager the opportunity to apply measuring and statistical tools to measure the effectiveness of the project team, the deliverables, and the overall level of customer satisfaction on the project. Also note the key output: Verified deliverables. This means that the deliverable has been validated against the customer's specifications.

Additional Statistical Terms

The normal distribution is the most common of the statistical distributions. In the world of statistics all distributions will approach the normal distribution, otherwise known as the bell curve, as the size of the sample approaches the entire population. In other words, given a large enough sample, everything becomes a normal distribution.

Probability is a term that is expressed as a percentage, and describes the likelihood of a specific event occurring. Another term you might see used in the exam is the concept of **Conditional Probability**. Conditional probability deals with causation; it is a cloudy day and there is a probability that it will rain. What is the probability that it is going to rain given that you have just heard thunder?

Statistical independence is the opposite of conditional probability. It states that the probability of one event occurring does not affect the probability of another event occurring. Flipping a coin, there is a 50-50 probability that I will either get heads or tails. If I flip the coin for a second time, the chance of getting heads or tails remains 50-50. The first coin flip has no impact on the probability of the outcome of the second coin flip.

Mutual exclusivity means that two events cannot occur in a single trial. If we throw a six sided dice, it cannot come up simultaneously on six and on five. If you flip a light switch on the wall, the light is either on or it is off. It cannot be in both states simultaneously.

Variable and Attribute Sampling

There are two types of data that will be referenced on the exam:

- Variable data – also called 'continuous' data
- Attribute data – also called 'discrete' data

The characteristics of the two data types appear below:

- Discrete Data:
  - Attribute
  - Yes/No
  - Pass/Fail
- Continuous Data:
  - Variable
  - Test Score
  - Height/Weight

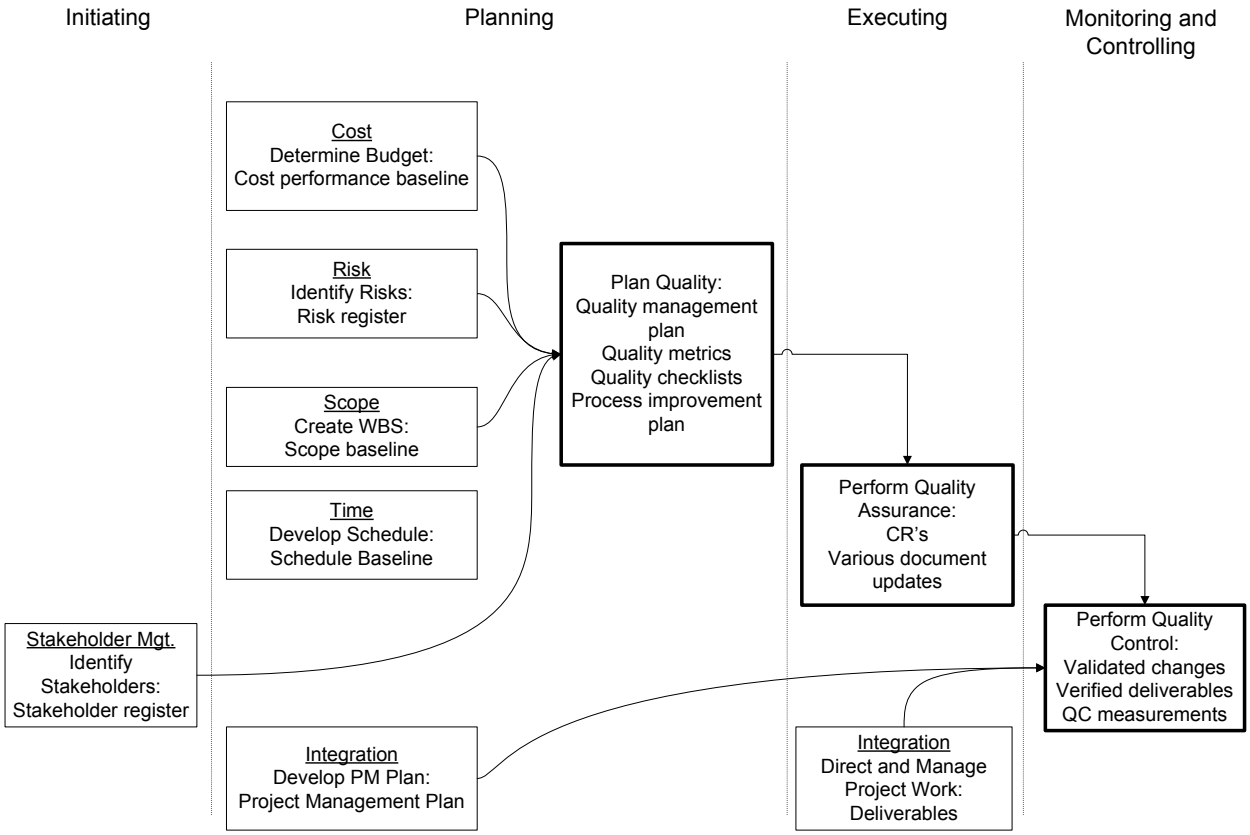
One of the key points you need to understand about variable data (continuous data) and attribute data (discrete data), is that *you cannot perform math on attribute (discrete) data*.

_____ represents an attribute, for example, the number on a football jersey or the number of a bus route. In this case, the attribute data is simply a label that helps to identify the football player or the bus route. If you have two bus routes, #252 and #121, performing a mathematical operation on these two numbers yields a meaningless result.

_____, on the other hand, enables us to perform mathematical functions on the data. The data can be added, averaged or have other operations performed on it. For example, I want to compute the average height of males in a specific population. The measurements that we take, accurate to an eighth of an inch, can be computed and averaged.

Project Quality Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Quality Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

This section discussed quality management, including:

- Quality theories, including Zero Defects, Fitness for Use, Deming, Kaizen, Six Sigma, CMM, and CMMI
- Fishbone diagrams and how they are used
- Standard deviation and definition of One Sigma, Two Sigma, Three Sigma, and Six Sigma
- How to read and use control charts, Pareto diagrams, run charts, and scatter diagrams

Quality Process Check

Match the process to its definition:

___Plan quality management

___Perform quality assurance

___Control quality

A. The process of auditing the quality requirements and results of quality control measurements to ensure that appropriate quality standards and operational definitions are used

B. The process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes

C. The process of identifying quality requirements and standards for the project and its deliverables and documenting how the project will demonstrate compliance with quality requirements

Chapter Eight Memory Check

1. The limits that are calculated on a statistical process control chart are the _____ limits, whereas the limits that are set by the customer are called the _____ limits
2. A comparison of project activities against a known standard is called _____
3. Weighing the cost of implementing quality against the benefit it will deliver for the project is called a ____-_____
4. The tool that is used to test multiple factors simultaneously is called _____ __ _____
5. _____ is the lowest cost of quality, while _____ is the highest cost of quality
6. The tipping point where benefits or revenues received from improving quality equals the cost to achieve that quality is called a _____
7. A process that establishes a financial measure of the user dissatisfaction with a product's performance, as it deviates from a target value, is described in Taguchi's _____
8. 'Fitness for use' was a concept pioneered by _____
9. The five levels of the CMMI are in order; _____, _____, _____, _____, _____
10. The amount of inventory carried in a _____ __ _____process is typically zero.
11. Six Sigma represents an accuracy of _____%
12. Continuous, incremental improvement in a product or process is called _____ in Japan
13. Deming observed that at least ___% of the cost of quality (or poor quality) is management's responsibility
14. _____states that the probability of one event occurring does not affect the probability of another event occurring
15. The key output of the Plan Quality process is the _____ _____ _____
16. A product that is not particularly attractive but meets your quality criteria for fitness for use can be described as _____ _____, but high quality
17. The key output of Perform Quality Assurance is _____
18. Data that you can perform mathematical computations is called _____ or _____, whereas data that describes a label or a pass/fail scenario is described as _____ or _____ data
19. The quality pioneer that promoted the idea of zero defects was _____
20. Kaoru Ishikawa created a diagram used to ferret out root causes of problems that was called the _____ ____ _____ diagram
21. The _____ _____ is used to determine if the data in an SPC chart is out of control, even though the data points are within the control limits of the chart
22. The _____ chart is used to identify critical issues in descending order of frequency
23. To determine if a change in 'X' corresponds to a change in 'Y', the chart that best displays this correlation is the _____
24. _____means that two events cannot occur in a single trial
25. The key output of Control Quality is _____

Chapter 8 Test

1. You are in the process of developing the quality management plan for your project. You have asked the technical team for some quality metrics that would be useful to document for the quality management plan. They've identified several other projects that are similar to this one, and seemed to think that the quality metrics established in these projects would also be applicable to the current project. This technique is called:
    a. Quality audit
    b. Process analysis
    c. Benchmarking
    d. Statistical sampling

2. The project team has collected a series of issues and ranked them by frequency. This data will be a key input into your process improvement plan. What specific tool or technique is used to chart in this data?
    a. Ishikawa diagram
    b. Pareto chart
    c. Scatter diagram
    d. Statistical sampling

3. The project stakeholders are somewhat concerned about the costs of delivering a quality product. While they want to make sure that the customer receives a high quality product they want to ascertain that the benefit of making certain quality improvements will actually translate into something the customer will buy. The process of comparing the quality expense to potential return on investment is called:
    a. Quality ROI
    b. Process analysis
    c. Monte Carlo analysis
    d. Marginal analysis

4. Part way through the project, one of the stakeholders approached you with a vexing problem. There was an issue with one of the components delivered in the project, however whenever the technical team tried to solve the problem, it kept coming back… As the project manager, you instructed the stakeholder that what was needed here was some form of root cause analysis. What is the best of the quality control tools to use in this situation?
    a. Ishikawa diagram
    b. statistical sampling
    c. Pareto chart
    d. scatter diagram

5. You are performing a quality audit on several aspects of your current project. Some of the process interactions are quite complex, so it is important to determine which of the processes have the greatest impact on the result. What type of management tool is the most appropriate to use in this situation?
    a. Affinity diagram
    b. Interrelationship digraph
    c. Prioritization matrix
    d. Process decision program chart

6. Who is responsible for project quality?
    a. senior management
    b. the project manager
    c. the sponsor
    d. the project team

7. You are facilitating your project kickoff meeting and several of the stakeholders have gotten into a discussion regarding specific quality attributes that the product should possess. One of the stakeholders has referenced an article from the Gartner Group about best practices. Another stakeholder is focusing on specific quality processes maintained within their organization. As the project manager you are attempting to reconcile the differences that the stakeholders are raising. What is the *real* issue?
    a. Quality practices should be determined and administered by the QA organization, *not* the stakeholders
    b. Product quality attributes are specific to the product - the stakeholders are focusing on the wrong elements
    c. Quality attributes are controlled by senior management and executed during quality control
    d. Quality attributes are documented in ISO specifications depending on the industry

8. The project management life cycle consists of initiating, planning, executing, monitoring and controlling and closing. What cycle is the basis for quality improvement?
    a. Analyze, Review, Execute, Control
    b. Plan, Do, Check, Act
    c. Prepare, Execute, Analyze, Act
    d. Initiate, Design, Observe, Verify

9. The usability of a product or a service by the customer was something that was described by Dr. Joseph Juran as:
    a. Usability quotient
    b. Quality trilogy
    c. Customer use satisfaction index
    d. Fitness for use

10. All of the following elements are external impacts of poor quality except:
    a. Cost to regain lost business
    b. Decreased efficiency
    c. Negative press
    d. Rework

11. One of the purposes of a statistical process chart is to measure the variances in a process and to help determine whether those variances are random variations in the process or 'attributable' causes. What does the standard deviation in the chart measure?
    a. Accuracy
    b. Precision
    c. Variance
    d. Process Capability

12. +/-3 sigma constitutes what percentage of the entire population measured in an SPC chart?
    a. 99.73%
    b. 95.45%
    c. 96.85%
    d. 99.98%

13. The cost of performing quality assurance activity falls under _____?
    a. Rework
    b. Warranty work
    c. Nonconformance work
    d. Conformance work

14. Your organization was focused on producing good quality for the customer. After a recent merger, however, the new management team is questioning the processes you were using to produce this level of quality. The new CFO claimed that many of these processes were extraneous and were costing the company too much money. As a senior program manager, you set up a meeting with the CFO to discuss his concerns. What is the *most effective argument* you could make for maintaining good quality within the organization?
    a. Good quality is good for the corporate image, retains customers and maintains productivity
    b. Good quality increases productivity, reduces cost, and decreases risk
    c. Good quality will ensure the CFO makes her bonus this year
    d. Good quality will improve positive press for the organization, reduce time-to-market, and increase profitability

15. Quality policies and standards are established in :
    a. Plan quality management
    b. Control Quality
    c. Perform quality assurance
    d. Monitoring and controlling process group

16. You have just reviewed the most recent audit from the quality assurance organization which has identified an out-of-control process. You call the members of the technical team in for an emergency meeting to address the situation, as this is a critical process in your development effort. Analyzing an out of control situation for remediation occurs in which process and results in the creation of?
    a. Perform quality assurance and project management plan updates
    b. Control Quality and change requests
    c. Perform quality assurance and change requests
    d. Control Quality and validated changes

17. Your project stakeholders have come to you with an issue: they're attempting to tune a process in one of the recent deliverables from the technical team. They're trying to analyze whether a change in the sensitivity of the logging process will result in greater accuracy from the performance logs. The *best* chart to use that would illuminate a cause-and-effect relationship would be?
    a. Pareto chart
    b. SPC chart
    c. Scatter diagram
    d. Ishikawa diagram

18. The SIPOC diagram is a type of....?
    a. Prioritization matrix
    b. Control chart
    c. Flow chart
    d. Cause-and-effect diagram

19. You are working with the marketing organization to help develop a new advertising campaign using a direct mail model. There are literally hundreds of combinations of elements that can be used in each direct mail piece. Testing the most effective approach that will produce the highest response rate will take months to complete and potentially cost many hundreds of thousands of dollars. What method would help reduce the time, dollars, and the actual number of tests that would be required to ascertain the best direct mail combination of elements?
    a. Six Sigma
    b. Design of Experiments
    c. Deming's 14 points
    d. The Juran Trilogy

20. Your technical team has just identified a process that requires some corrective action. Corrective action is closest to:
    a. Continuous process improvement
    b. Defect analysis
    c. Rework
    d. Constraint analysis

21. You have been reviewing the output on a statistical process chart. While all the data in the chart is contained within the upper and lower control limits of the chart, a potential issue has been identified: it appears that there were eight consecutive points on the chart that occurred between the mean and +1 sigma. In terms of statistical process control this specifically violates:
    a. The rule of 7
    b. The Taguchi loss function
    c. The zone test
    d. The 't' test

22. During the last quality planning meeting there were some disagreement between the stakeholders and the team on which quality tools would be the best tools to measure the state of the manufacturing process. As the project manager, you help facilitate the discussion by creating a list of pros and cons for each of the quality testing methods. Which would be the most effective tool in helping you decide on the best approach ?
    a. Force field analysis
    b. Monte Carlo analysis
    c. Pareto analysis
    d. Bayesian analysis

23. At the first project quality management team meeting with your team and key stakeholders, a lively discussion emerged about the cost of quality. As this discussion proceeded, it became obvious that some of the stakeholders did not understand the difference between the cost of conformance and the cost of nonconformance of the final product deliverables. What is the best definition of the cost of conformance?
    a. Money spent due to internal failures
    b. Money spent due to external failures
    c. Money spent to avoid failures
    d. Money spent on quality audits

24. The project sponsor and the technical team are sitting down to determine which features would best serve the customer in the upcoming project. The sponsor has indicated that they want to go beyond just simple customer satisfaction; they want to ***'wow'*** the customer. Which of the following processes would *best* demonstrate this distinction?
    a. The Kano Model
    b. Pareto analysis
    c. Monte Carlo analysis
    d. Fitness for use analysis

25. You're working in a lean manufacturing environment in which the watchword is 'just in time' (JIT). This is the end of a 36 month process that took your organization from a top-heavy, costly and time-consuming process to a process that reduced cycle time by 85% and costs by 78%. A process that is JIT typically caries what % inventory?
    a. 5%
    b. 0%
    c. 10%

d. 2.5%

26. According to the Software Engineering Institute, the capability maturity model integration (CMMI) standard is designed to help organizations improve their software process. At which level in the CMMI are projects placed under an umbrella of overall project management?
    a. Initial
    b. Defined
    c. Managed
    d. Optimized

27. Reviewing lessons learned, assuring quality practices, and identifying corrective actions is called:
    a. Quality control
    b. Process analysis
    c. Quality audit
    d. Defect analysis

28. Two members of your technical team are having an argument about the probability of given events occurring on the project. The first team member seems to think that there is some causal relationship between event 'B' occurring as a result of event 'A' occurring. The second team member is saying the events are not related to each other at all. "It's like flipping a coin," she said. "Each time you flip the coin there is still a 50-50 chance it will either be heads or tails, and each successive flip has nothing to do with the flip that came before it." What she is talking about is a concept that is known as:
    a. Mutual exclusivity
    b. Statistical independence
    c. Conditional probability
    d. Rational objectivism

29. Your technical team is discussing two possible ways a process can work. In the course of the discussion, one of the team members brings up an important point: we have to ensure that the customer cannot choose both paths at the same time. The choice of one path automatically negates the other, and vice versa. Otherwise the process could yield catastrophic results. The concept that is being discussed here is known as:
    a. Mutual exclusivity
    b. Functional independence
    c. Diametrically opposed processing
    d. Random displacement variance

30. Your team has been collecting information on a process that was set up to determine whether a specific function passed or failed. The type of data that you are collecting is known as:
    a. Variable data
    b. Continuous data
    c. Attribute data
    d. Concurrent data

31. The upper control limits (UCL) and lower control limits (LCL) of the process you are testing are: UCL = 55, LCL = 17. The upper specification limits(USL) and lower specification limits (LSL) of the process as required by the customer are: USL = 45, LSL =15. The data points that you have tested are all falling within the upper and lower control limits. What does this mean for the performing organization in terms of statistical process control?
    a. The process is out of statistical control but is meeting customer specification
    b. The process is in statistical control and is meeting customer specification
    c. The processes in statistical control but may not meet customer specification

d. The process is out of statistical control and does not meet customer specification

32. On your current project, you are evaluating parts off the assembly line in a manufacturing process to ensure they will fit inside of the chosen shipping container. Any part that will not fit inside the shipping container will be rejected as scrap. This type of testing is known as...?
    a. Statistical sampling
    b. Variable sampling
    c. Attribute sampling
    d. Continuous sampling

33. A Pareto chart is a type of:
    a. Cause-and-effect diagram
    b. Histogram
    c. Scatter diagram
    d. Run chart

34. You are having discussions with the project sponsor and the technical team to assure that the product being developed will meet the organization's quality standards. All of the following tools would be useful in measuring the product of the project against the organizational quality standards with the *exception* of:
    a. The Taguchi loss function
    b. Monte Carlo analysis
    c. QA audits
    d. The Kano model

35. One of your system developers has been tasked with implementing a corrective action to one of the components that was built for the current software project. The proper forms for implementing the change were correctly filled out and approved by the customer as well as the Change Control Board. As the developer was reviewing the code in the system, he noticed that this particular section of code was also responsible for another issue the project was experiencing. Fixing the second problem would *really improve the quality* of the component. He decided, "Well as long as I'm in here to fix the first problem, I might as well take care of the second problem as well. I'll simply amend the CR to include the second problem in addition to the first problem and make the correction". After completing the work developer tells you what he did. As the Senior Project manager you hold an off-line meeting in a conference room to coach the developer on how he could have avoided making this error, much to the developer's surprise. What is the *primary issue* with what the developer has done?
    a. What the developer did is considered scope creep
    b. What the developer did is considered goldplating
    c. What the developer did is considered a configuration management error
    d. What the developer did is considered insubordination

Chapter 8 Test – Answers

1. C – The process that is described in the question is known as benchmarking
2. B – Pareto charts are set up to rank issues in a frequency of occurrence order from the highest frequency to the lowest frequency
3. D – This defines a marginal analysis: where the benefits from improving quality equal the costs to achieve that quality. In this case, if the costs to make improvements does not translate into something the customer will pay for, then it may not be beneficial to make the improvement
4. A – The Ishikawa diagram is designed to surface core issues through a root cause analysis process
5. B – The scenario describes a type of root cause analysis which is best handled by an interrelationship digraph
6. B – The project manager is responsible for project quality. Senior management is responsible for overall organizational quality. The sponsor is usually the recipient of a quality product and the project team members are responsible for the quality of their specific element of the project work
7. B – *Product* quality attributes are as individual as the product being created and the customer for whom the product is being created
8. B – Plan, do, check, act. All the other 'cycles' are made up. *PMBOK® Guide*, 5th edition, p. 229
9. D – Juran defined the usability of product in the customer's hands as fitness for use
10. D – Rework is an internal cost of quality. *PMBOK® Guide*, 5th edition, p. 235
11. B – Standard deviation is a measure of product or process precision i.e. how closely the product conforms to target values
12. A – Per definition 99.73%
13. D – Quality assurance falls into the conformance work category. *PMBOK® Guide*, 5th edition, p. 244
14. B – Good quality increases productivity (less cycle time), reduces cost (fewer defects) and decreases risk that the product will be returned by the customer). Answer 'C', though important to the CFO, has nothing to do with the customer. Answers 'A' and 'D' while they may be true are not the core reasons for maintaining good quality
15. A – Quality policies and standards are established in the Plan Quality process. *PMBOK® Guide,* 5th edition, p. 231
16. B – Analysis of an out-of-control situation occurs in Control Quality and usually results in a change request to implement a corrective action. *PMBOK® Guide*, 5th edition p 253
17. C – Does a change in 'x' have an impact on 'y'? What describes this relationship is a scatter diagram
18. C – By definition, the SIPOC diagram is a type of flowchart. *PMBOK® Guide*, 5th edition, p. 236
19. B– Design of experiments is, by definition, the tool to use in this instance
20. C – Corrective action is closest to rework by definition. *PMBOK® Guide*, 5th edition, p. 559: "Action taken to bring a defective or nonconforming component into compliance…"
21. A – This explicitly defines the rule of 7: seven or more consecutive data points that are above or below the mean and within 1 standard deviation of the mean
22. A – force field analysis addresses pros and cons in a weighted format .*PMBOK® Guide*, 5th edition, p. 240
23. C – Cost of conformance is the money spent to avoid failures. *PMBOK® Guide*, 5th edition, p. 235
24. A – The Kano model explicitly captures dissatisfiers, satisfiers and delighters in a product or process
25. B – A just in time process typically carries 0 inventory
26. C – CMMI level for overall project management process initiation first occurs at the managed level
27. C – This is the definition of a quality audit
28. B – The scenario described addresses the concept of statistical independence. Mutual exclusivity states that you can't flip a coin and simultaneously get a head and a tail. Conditional probability is almost the opposite of statistical independence and the last term is made up
29. A – This scenario addresses mutual exclusivity. The other terms are made up
30. C – Attribute data is not an explicit measurement such as weight or height. It represents information such as on/off, pass/fail, high/low. No computable numeric data is addressed with attribute data
31. C - Since all the data points are falling within the control limits, the process is most likely in statistical control. However, the upper customer specification limit is inside the control limits for the chart, meaning

that the customer spec is tighter than what the process can produce. For any data points that are above 45 but less than 55, you will have a situation that does not meet customer specification but is still within statistical control!

32. C – The scenario described in the question defines a pass/ fail scenario, which is the definition of an attribute sample
33. B – By definition, the Pareto is a type of histogram (bar chart)
34. B – The Monte Carlo Analysis models probabilities of a possible future state and is not used as a tool for measuring quality standards
35. B – This is the de facto definition of Gold Plating

Chapter 9 : Project Human Resource Management

Topics:

- Overview of Project Human Resource Management
- Human Resource Planning
- Acquiring Project Team
- Developing Project Team
- Managing Project Team

Section Objectives

With this section, you will be able to:

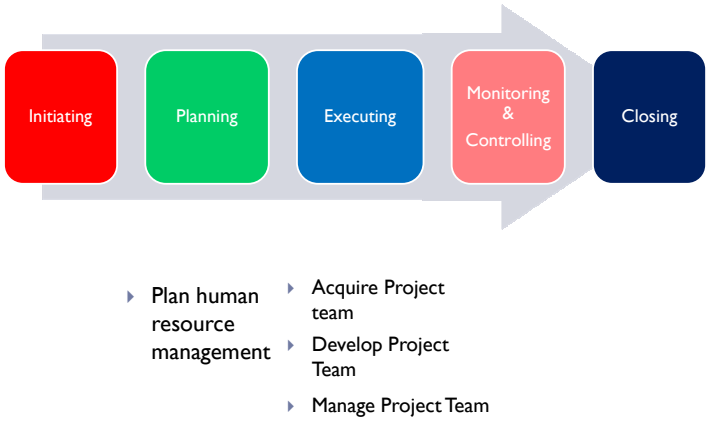
- Describe how to create and use a staffing plan
- Design a responsibility matrix
- List the four stages of the Tuckman team development
- Describe various motivational theories
- Describe leadership styles and the most appropriate to use
- Sequentially list the seven main sources of project conflicts

Project Human Resource Management Process Summary

The high level Project Human Resource Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	Human resource plan	Project staff assignments Resource calendars		
		Team performance assessments		
		CR's Various document updates		

Project Human Resource Management



Project human resource management describes the processes that enable the project manager to organize and lead the project team. A subset of the project team is the project management team, which is responsible for leadership activities in each of the five major process groups.

Part of the role of the project manager in managing the project team is to influence the team when human resource factors may impact the project, and to ensure professional and ethical behavior at all times when conducting project activities.

Human Resource Roles

The key responsibilities of each group are listed below:

The Project Sponsor

- Protects the project from external influences
- Provides funding
- Approves the charter and PM Plan
- Sets priorities between projects
- Identifies Project Manager and authority level
- Approves or rejects changes
- Formally accepts deliverables or product of project

The Stakeholders

- May have PM plan signoff responsibilities
- Validate Scope and deliverables
- May be part of the change control process for approvals/rejections
- Provide requirements

The Line (functional) Manager

- Provides project resources and SME's (in a matrixed organization)
- Participates in initial planning
- Manages project activities that fall to their area
- May address team member performance with the project manager

The Project Manager

- May contribute to writing the project charter
- Is responsible for all aspects of the project:
    - Project management planning
    - Communications to stakeholders
    - Change management planning
    - Creating all needed management plans (scope, time, budget, quality, communications, HR, risk and procurement)
    - Using metrics to measure project progress and implement changes or corrections when needed
    - Proactively addressing potential problems
    - Possesses the authority to accomplish the work of the project
    - Resolves variances to the project management plan with the team
    - Regularly and proactively addressing project risks with the team
- Ultimately responsible for project success or failure

The Portfolio Manager – Senior Management

- Responsible for executive level governance of the portfolio
- Ensures the project meets the strategic goals of the organization
- Engages senior executives for project support
- Responsible for driving the highest ROI for the project

The Program Manager – Senior Management

- Offers guidance to project managers on individual projects

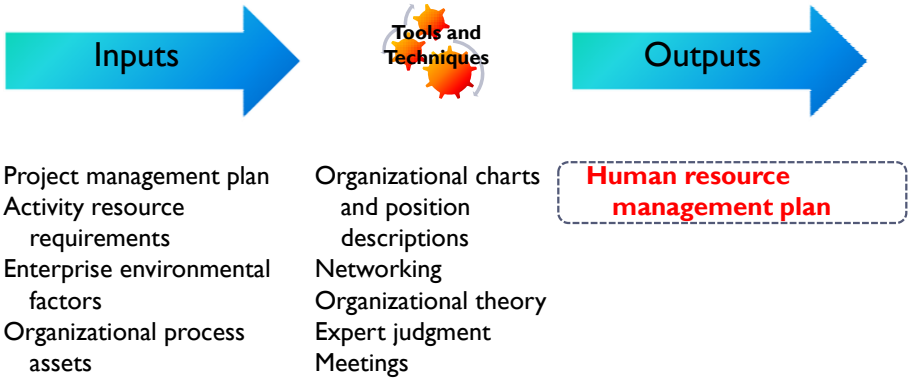
- Functions in an oversight capacity to ensure each project contributes to the overall benefit of the program

The Project Team

- Translates user requirements into technical specifications needed to deliver the product of the project
- Defines work packages and activities in the WBS
- Identifies dependencies between work packages and/or activities
- Provides time and cost estimates for the project manager
- Resolves internal disputes
- Complies with internal corporate standards, methods, procedures, quality requirements
- Can recommend process improvements, corrective actions or implement defect repairs

The above listing is only a partial listing of the responsibilities for each group. Readers would do well to study this list, as questions regarding any of the roles and responsibilities in this section may appear on the exam.

Develop Human Resource Plan



Developing the human resource plan includes the major headings listed below, along with a brief description of what is expected for each.

1. **Roles and Responsibilities**- can be assigned to a person or group. This defines roles, authority, responsibility, and competency. These individuals or groups can be within or outside the performing organization. The roles described for the project may not have a direct analog to a position within the organization. Thus it is the project manager's job to identify resources that can take on the responsibilities of the particular role needed for the project. These roles can be documented in a responsibility assignment matrix (RAM) in the form of a RACI chart (responsible, accountable, consult, inform)
2. **Org Charts -** an organizational breakdown chart (OBS) is critical for identifying management hierarchies in the project and identifying potential escalation paths should there be issues that the project manager has not been empowered to resolve. In a matrix organization this becomes a critical factor, as it may identify functional managers from whom the project manager secures resources for the project. The org chart also works hand-in-hand with a roles and

responsibilities chart, in that it will identify an unambiguous owner for each work package in the project

3. **Staffing Management Plan** - this plan describes how human resource requirements will be met for the project. The plan can be formal or informal, detailed or general, depending on the project needs. The staffing management plan is continually updated during the project and usually includes the following elements:
    - Staff Acquisition - identifies when specific resources roll on or off the project and the skill levels required of those resources
    - Resource Calendars - identifies when staff acquisition activities should begin as well as staff availability and hours available from a particular resource
    - Staff release plan - defines when resources are released from the project so that those resources are no longer charged to the project
    - Training - may be required if the performing organization is dealing with a new or untried technology. It is also beneficial in that it will help team members attain certifications that support their ability to meet project requirements. In PMI's view, training is not used as a 'perk'.
    - Recognition and Rewards - the idea of a recognition and reward system is that it tends to promote desired behavior on the project.
    - Compliance - this involves compliance with government regulations or union contracts in addition to established human resource policies
    - Safety - these include methods and procedures that are designed to protect team members from the potential safety hazards. These elements are not only included in a staffing management plan, but can also be included in the risk register

HR Enterprise Environmental Factors& Organizational Process Assets

When developing the human resource plan, the project manager needs to understand what enterprise environmental factors and organizational process assets can affect the outcome of the project.

Enterprise Environmental Factors - these elements need to be addressed thoroughly, especially when it comes to organizational and political issues. Remember the definition of a stakeholder? It is anyone that can be positively or *negatively* impacted by your project. If there is a negative impact on a stakeholder, that stakeholder may have a completely different agenda and may work *against* successful completion of the project. The project manager's job is to uncover any alternative agendas and work with stakeholders to ensure their needs are met.

Organizational Process Assets –the elements that will assist the project manager are standardized matrices such as standardized roles and responsibilities as well as any documented and repeatable processes. Usually an organization will have established templates and tools (e.g. progress reports, executive dashboards, change request forms, etc.) that are subsumed inside the organization's PMIS. Historical data from previous projects and organizational structures that have been successful on previous projects can serve as guidance for the project manager.

Roles and Responsibilities

The roles and responsibilities grid is a critical tool for the project manager. It can identify activities, documents, and other deliverables along with the person accountable for those activities, documents or deliverables. In other words, it provides a 'single wringable neck' and identifies to the project manager who owns the deliverable and is responsible for its completion.

The grid can be in a form as shown below, customized for the project, or there can be a standardized format based on what is required by way of methods and procedures for your project.

Key:

	Person A	Person B	Person C	Person D
Activity A	A		C	R
Activity B		C	A	
Activity C	R	A	I	C
Activity D		C	R	C
Activity E	I	R	A	

- Responsible
- Accountable
- Consult
- Informed

Staffing Management Plan

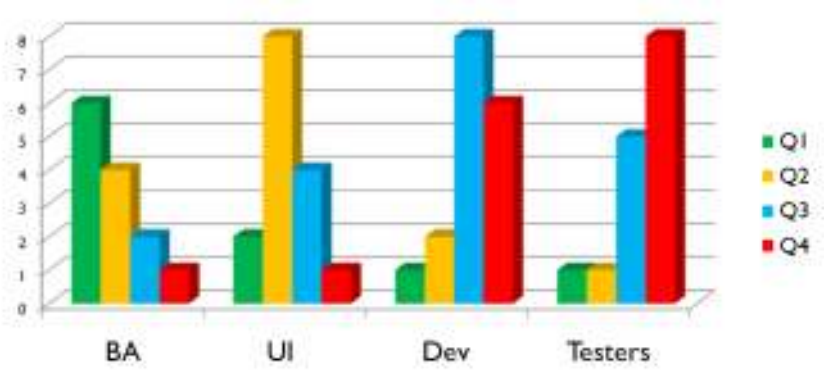
For a small project requiring few resources and a quick turnaround, the staffing management plan may simply be a single page that lists who's going to work on the project. For large, complex projects requiring large teams numbering into hundreds of people, staffing management plan is required to track the following:

- All needed resources for the project
- When the resources for the project are needed, available, and their anticipated duration on the project
- Any gaps such as needed skill sets or levels of expertise required for the project
- When resources roll off the project
- Any potential training needs

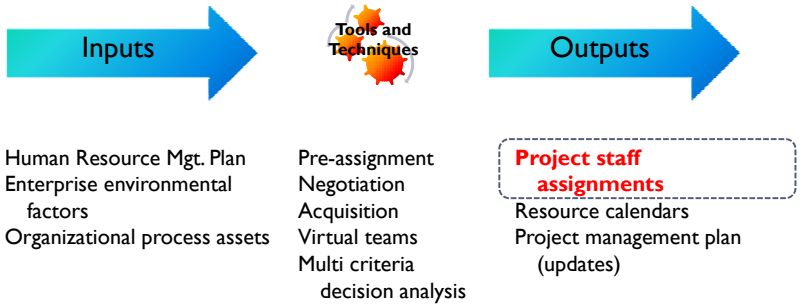
The Staffing Management Plan contains:

- The Resource Histogram: Shows what resources will be needed and at what times in the project
- Staffing Release Plan: Establishes method and timing for releasing resources

The Resource histogram is used to visually chart where resources are needed on the project and the hours needed from each resource on a daily/weekly/monthly basis. An example of a resource histogram appears below.



Acquire Project Team



Exam tip: This means >> 'acquire the final project team'.

The following actions are included:

- Know the pre-assigned resources
- Negotiate for the best resources available
- Hire new resources if it is an option
- Bring on contractors/consultants when needed
- Understand the impact of using virtual teams (i.e. non co-located or off-shore)

You may see a question on the exam that relates to a concept called the 'halo effect'. The halo effect is essentially a cognitive bias – for example: because of an individual's ability to perform well as a tactical planner, the individual's manager ascribes strategic planning expertise to the same individual. In short, because you are good at one thing, you will be good at everything we ask you to do.

In a psychology study published in 1920, Edward L. Thorndike asked commanding officers to rate their soldiers; Thorndike found high cross-correlation between all positive and all negative traits. People seem not to think of other individuals in mixed terms; instead we seem to see each person as roughly good or roughly bad across all categories of measurement.[36]

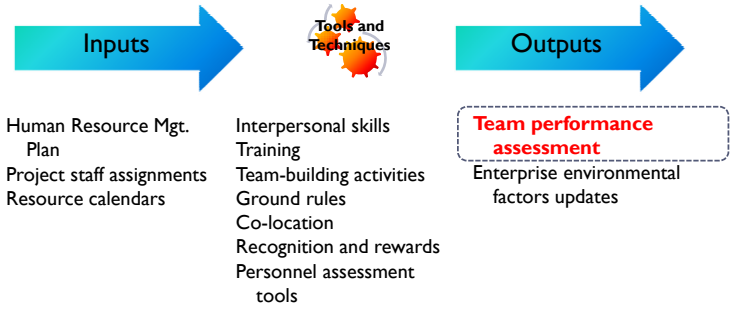
[36] http://en.wikipedia.org/wiki/Halo_effect

Multi-Criteria Decision Analysis

the multi-criteria decision analysis is used to help rate or score potential team members. The criteria are weighted based on the relative importance of the criteria. Typical selection criteria include but are not limited to the following:

- Availability
- Cost
- Experience
- Ability
- Knowledge
- Skills
- Attitude
- International factors

Develop Project Team



The Develop Project Team process is fundamentally about enhancing and improving the overall team environment to increase project performance. Therefore, it is the project manager's job to acquire the necessary skills that will help build, maintain, motivate, lead, and inspire project teams to achieve high performance and meet project objectives

.

For the exam, project managers do the following:

- Provide the team with challenges and opportunities
- Offer feedback and support
- Engage in collaborative problem-solving and decision-making
- Utilize effective and open communications between team members and stakeholders
- Manage conflicts in a constructive manner
- Facilitate an environment of teamwork and cooperation

Exam Tip:

Team performance assessments evaluate the entire team for the project as a whole. It is the primary output of the Develop Project Team process.

Project performance appraisals are an evaluation of an individual's performance on the project, and is a tool and technique of the Manage Project Team process

Project Manager Authority

The types of project manager authority are based on authority levels from general management practice. A brief description of these authority types follows:

- **Legitimate** - this authority is then assigned to you by senior management and is outlined in the project charter
- **Reward** - the project manager can issue rewards for exceptional job performance or perks. For example, 'comp time' is usually considered a perk for employees that have expended extra time on the job to meet a deadline.
- **Penalty** - this indicates the power of the project manager to coerce an employee into specific behavior through the threat of penalty, loss of status, or other negative. Writing up an employee for insubordination to force a certain kind of behavior is considered penalty power.
- **Expert** - expert power means that you are an expert in your area. People on the team defer to you or seek solutions from you because of your expertise. Expert power is always earned and never assigned.
- **Referent** – referent power addresses the charisma, personality, and leadership qualities of the project manager. Such a PM can exert a strong influence on a team due to their strong 'likability' factor.
- **Representative** - in this situation the team has decided that you would be the best person to serve the needs and interests of the team and have, in a sense, 'elected' you as their representative.

Expert and reward are the best forms of power according to PMI. The worst is penalty power.

The Tuckman Model

The **Forming – Storming – Norming – Performing** model of group development was first proposed by Bruce Tuckman in 1965, who maintained that these phases are all necessary and inevitable in order for the team to grow, to face up to challenges, to tackle problems, to find solutions, to plan work, and to deliver results. He added a fifth stage – Adjourning – in the 1970's.

Tuckman's model explains that as the team develops maturity and ability, relationships establish, and the leader changes leadership style. Beginning with a directing style, moving through coaching, then participating, finishing delegating and almost detached. At this point the team may produce a successor leader and the previous leader can move on to develop a new team.

The five stages are described as follows:

- **Forming**: High dependence on leader for guidance and direction. Little agreement on team aims other than received from the leader. Individual roles and responsibilities are unclear. Leader must be prepared to answer lots of questions about the team's purpose, objectives and external relationships.

- **Storming**: Team members vie for position as they attempt to establish themselves in relation to other team members and the leader, who might receive challenges from team members
- **Norming**: Agreement and consensus is largely forms among team, who respond well to facilitation by leader. Roles and responsibilities are clear and accepted. Big decisions are made by group agreement. Smaller decisions may be delegated to individuals or small teams within group. Commitment and unity is strong
- **Performing**: The team is more strategically aware; the team knows clearly why it is doing what it is doing. The team has a shared vision and is able to stand on its own feet with no interference or participation from the leader
- **Adjourning**: The break-up of the group, hopefully when the task is completed successfully, its purpose fulfilled

Motivational Theories

You may see reference to any of the four motivational theories shown above on an exam question. You will not see references to any of the above-mentioned theories in the *PMBOK® Guide,* 5th edition, however, it is important that you understand the fundamentals of these theories.

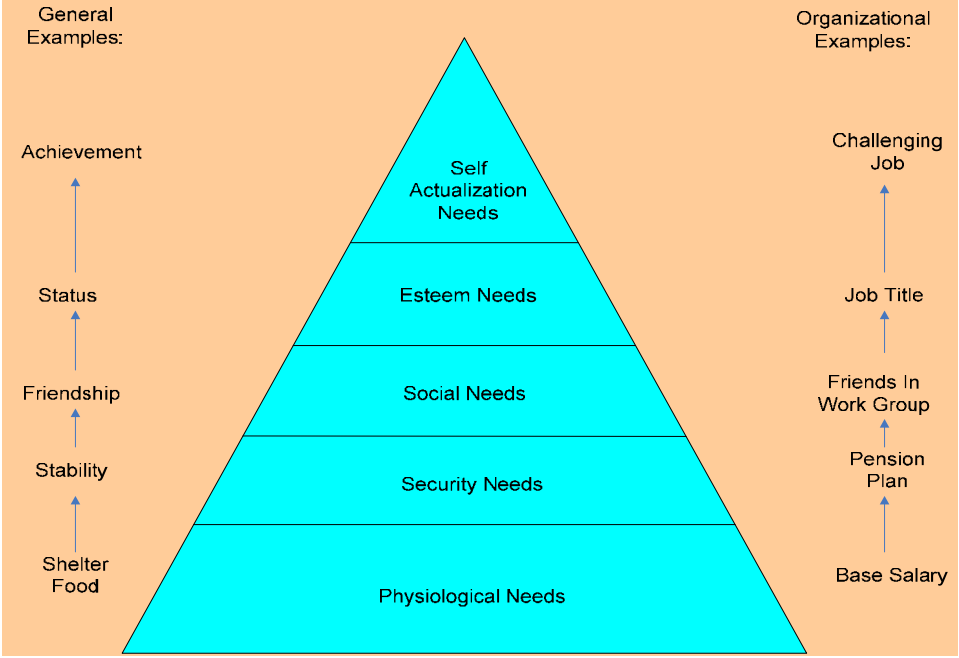
If you have never had any exposure to these theories, see if you can answer the following question, just for fun:

Q: You are a project manager in a matrix organization and are leading a team of people that report to various functional managers. One of these team members seems somewhat distraught; in spite of the fact that you think she's doing a good job on your project, she recently complained to you that her boss (the functional manager) does not seem to take notice of her extra effort on this project. In fact, none of the extra effort that she puts into the job appears to be recognized by her boss at all, and he continues to hammer her for more effort. At this point she is considering looking for another job, as she thinks that nothing she does will make a difference at this company. What motivational theory describes this situation?

a. Achievement theory
b. Herzberg's hygiene theory
c. Maslow's hierarchy of needs

d. Expectancy theory

Maslow's Hierarchy of Needs



Psychologist Abraham Maslow first introduced his concept of a hierarchy of needs in his 1943 paper "A Theory of Human Motivation"[37] and his subsequent book, *Motivation and Personality*.[38] This hierarchy suggests that people are motivated to fulfill basic needs before moving on to other needs.

Maslow's hierarchy of needs represents part of an important shift in psychology. Rather than focusing on abnormal behavior and development (Freud), Maslow's humanistic psychology was focused on the development of healthy individuals.

Herzberg's Hygiene Theory

Frederick Herzberg performed studies to determine which factors in an employee's work environment caused satisfaction or dissatisfaction. The findings were published in his 1959 book *The Motivation to Work*.

The studies included interviews with employees who were asked what pleased and displeased them were different from that causing job dissatisfaction. He developed the **motivation-hygiene** theory to about their work. Herzberg found that the factors causing job satisfaction (and presumably motivation) explain these results. The satisfiers were labeled *motivators* and the dissatisfiers were labeled *hygiene factors*. In this sense, the term "hygiene" means that they are considered maintenance factors that are

[37] Maslow, A. H. (1943). A Theory of Human Motivation, *Psychological Review 50*, 370-96.
[38] Maslow, A.H. (1943). *Motivation and personality.* New York: Harper.

necessary to avoid dissatisfaction but the presence of these factors does not provide motivation or satisfaction.

Herzberg often referred to these hygiene factors as "KITA" factors, (KITA is an acronym for Kick In The A...), which are defined as the process of providing incentives or a threat of punishment to cause someone to do something. Herzberg argues that these provide only short-run success because it is the motivator factors that determine whether there is satisfaction or no satisfaction. These motivators are intrinsic to the job itself, and do not result from 'carrot and stick' incentives.[39]

Expectancy Theory

While Maslow and Herzberg looked at the relationship between internal needs and the effort to fulfill them, Victor Vroom of Yale University separates effort (which arises from motivation), performance, and outcomes.

Vroom stated that for a person to be motivated, performance and motivation must be linked. He created three variables (shown above) called Valence, Expectancy and Instrumentality to account for this link.

Expectancy is the belief that increased effort will lead to a specific outcome; i.e. "If I work harder, the boss will reward the extra effort." This is affected by such things as:

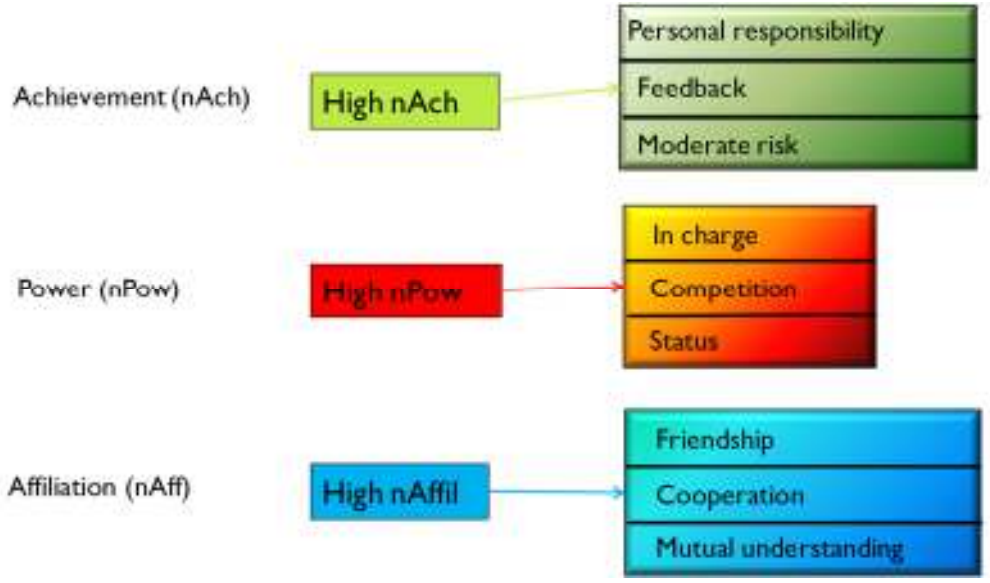
1. Having the right resources available (e.g. raw materials, time)
2. Having the right skills to do the job
3. Having the necessary support to get the job done (e.g. supervisor support, or correct information on the job)

Instrumentality is the belief that if you perform well a valued outcome will be received; i.e. "If I do a good job, there is reward or recognition I can receive."

Valence is the importance the individual places upon the expected outcome. For example, "If I am mainly motivated by money, I might not care about offers of 'comp' time."[40]

[39]Herzberg, F., Mausner, B. &Snyderman, B.B. 1959, *The Motivation to Work*. John Wiley. New York.
[40]*Work and Motivation,* Victor Vroom, Jossey-Bass 1994

Achievement Theory



David McClelland is noted for elaborating three areas of motivational need, which he described in his 1961 book, *The Achieving Society*.

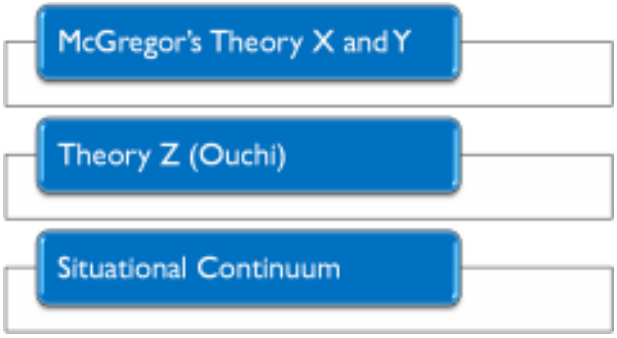
Most people possess and exhibit a combination of all three characteristics.

Some people exhibit a strong bias to a particular motivational need, and this 'needs mix' affects their behavior and managing style.

McClelland suggested that:

- Strong n-affil 'affiliation-motivation' can undermine a manager's objectivity because of their need to be liked, which affects the manager's decision-making capability.
- Strong n-pow 'authority-motivation' will produce a determined work ethic and commitment to the organization, however n-pow people are attracted to the leadership role and may not possess the required flexibility and people-centered skills.
- Strong n-ach people with strong 'achievement-motivation' make the best leaders, however there can be a tendency to demand too much of their staff in the belief that they are all similarly and *highly* achievement-focused and results driven.

Leadership Theories



In addition to the specific theories listed above, there is a listing of various leadership and management styles that may be referenced on exam questions. These elements are included in what you'll find discussed in the three leadership theories outlined on the next pages:

- Analytical - a manager with technical expertise that makes technical decisions for the project
- Autocratic - the PM has power to do whatever they want
- Bureaucratic - as the title implies, this management style focuses on following documented procedures exactly without deviation. This may be necessary on work involving government contracts such as DOD contracts or contracts with state and city government
- Charismatic -motivates the team to high levels of performance because of an energizing leadership style.
- Consultative - seeks input from the team to make decisions on the project
- Driver -issues orders and expects them to be followed. Some view this approach to management as 'micromanagement'.
- Influencing - this approach emphasizes collaborative decision-making and focuses on teamwork and team building.
- Laissez-faire - here the manager functions in a consultative capacity and basically stays out of the way while the team focuses on the work at hand. Sometimes this is approach is called a 'self organizing team'.

Theory X and Y

This was created and developed by Douglas McGregor at the MIT Sloan School of Management in the 1960s. It describes two very different attitudes toward workforce motivation. McGregor felt that companies followed either one or the other approach. He also thought that the key to connecting self-actualization with work is determined by the managerial trust of subordinates.

In this theory, which many managers practice, management assumes employees are inherently lazy and will avoid work if they can. They inherently dislike work. Because of this, workers need to be closely supervised and comprehensive systems of controls developed. A hierarchical structure is needed with narrow span of control at each and every level. According to this theory, employees will show little ambition without an enticing incentive program and will avoid responsibility whenever they can.

According to Michael J. Papa, researcher in organizational communication, if the organizational goals are to be met, theory X managers rely heavily on threat and coercion to gain their employee's compliance.

In this theory, management assumes employees *may be* ambitious and self-motivated and exercise self-control. It is believed that employees enjoy their mental and physical work duties. According to Papa, to them work is as natural as play. They possess the ability for creative problem solving, but their talents are underused in most organizations. Given the proper conditions, theory Y managers believe that employees will learn to seek out and accept responsibility and to exercise self-control and self-direction in accomplishing objectives to which they are committed. A Theory Y manager believes that, given the right conditions, most people will want to do well at work.

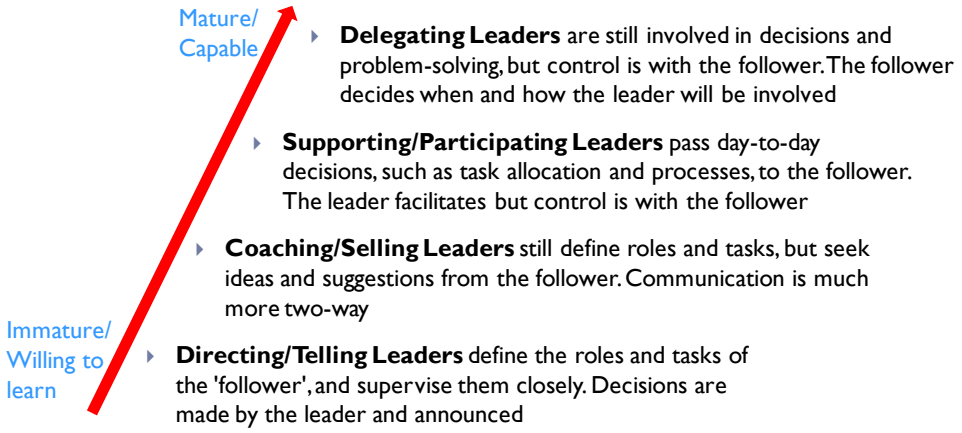
Theory Z

In ***THEORY Z***, Ouchi describes the art of Japanese management and shows how it can be adapted to American companies. He takes readers behind the scenes at several U.S. corporations making the Theory Z change and shows step-by-step how the transition works. Ouchi also examines the corporate philosophies that have become blueprints for Theory Z success, and looks at the evolving culture of "Z" people in society.

Theory Z focused on increasing employee loyalty to the company by providing a job for life with a strong focus on the well-being of the employee, both on and off the job.

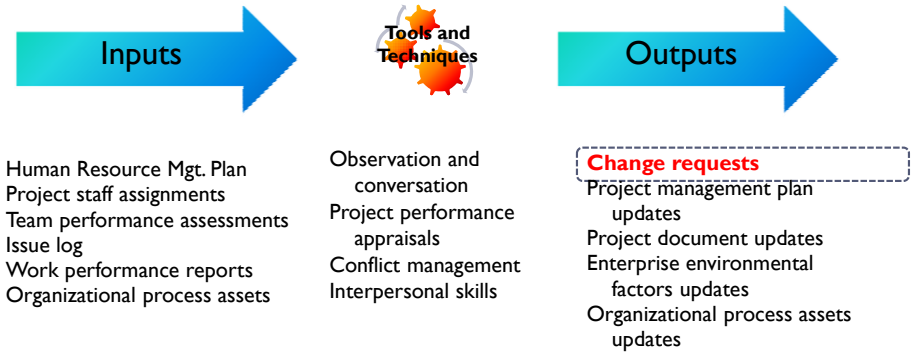
Theory Z management tends to promote stable employment, high productivity, and high employee morale and satisfaction.

Situational Leadership



The situational leadership model was developed by Paul Hersey and Ken Blanchard in the 1960s and is sometimes called the 'situational continuum'. What this means is the manager of a team will apply more influence and direction to managing inexperienced employees. As the team members grow in skill and capability, the manager moves from a directing approach (telling the employee exactly what to do) to a delegating approach (the employee knows the job, does the job, needs very little guidance, and will engage the manager when needed).

Manage Project Team



The Manage Project Team process specifically tracks team member performance on the project, provides feedback to team members, helps to resolve issues, and manages changes to project processes. The key element in managing the project team is the creation of change requests, updating the human resource plan, and updating the enterprise environmental factors and organizational process assets.

Since Manage Project Team occurs in the Executing process group, the project manager needs a battery of skills to create and sustain high performance teams.

The skills include:

- Communication Skills
- Conflict Management Skills
- Negotiation Skills
- Leadership Skills

Exam tip:

Team performance assessment addresses the effectiveness of the team as a whole. *Project Performance Appraisals* address the performance of individuals on the team.

Conflict Management

Past View of Conflict	Current View of Conflict
Is inevitable	Is necessary and has benefits
Is negative	Fosters team growth
Should be avoided	Produces more creative project solutions
Best resolved by avoidance or upper management intervention	Best resolved by team members and their immediate manager

Performed successfully, addressing conflicts and bringing them to desired resolutions can result in increased productivity and improved working relationships between team members. If conflicts escalate, it is the project manager's job to help facilitate a resolution.

For the exam, understand the following:

- Conflict forces a search for alternative solutions
- Conflict is a team issue
- Conflict resolution focuses on issues, not personalities
- Openness resolves conflict
- Conflict resolution focuses on the present, not the past

Causes of Conflict

There can be many causes of conflict on a project – however the list of seven below is in descending order of frequency.

- **Schedule -** schedule conflict can be due in part to the unavailability of resources when needed, however the real cause of schedule conflict is primarily due to this reason: management's insistence on a defined schedule in the initiating phase of a project when very little is known about the project itself. If the project faces a significant number of unknowns and uncertainties it will be very difficult if not impossible to establish an accurate schedule early in the project.
- **Project Priority –** frequently, management fails to prioritize projects. This in turn leads to stakeholder conflict about project priorities and a battle, or a series of battles ensues, usually centering around funding and resource levels for the current project load.
- **Resources -** resource availability can in itself be a conflict, even if project priority is not a conflict. This is especially true if a number of projects require highly qualified resources that are scarce in the organization. The resource conflict will occur if the organization cannot add headcount either permanently or temporarily with the use of consulting resources.
- **Technical opinions -** this can be an issue when there are highly skilled and experienced resources that have differing ideas on how to approach a technical solution for a project. A skilled Project manager will be able to facilitate a solution between battling technical experts.

- **Administrative overhead -** administrative processes can be seen as burdensome or can be seen as out-and-out obstacles to the completion of work on the project. If project team members are complaining about the extraordinary amount of administrative overhead required in completing work, the project manager needs to pay attention to what can be done to streamline those processes so that the administrative processes do not become more work than the *actual* work.
- **Cost -** budgets can sometimes be a source of contention on a project. The inability to purchase/lease key pieces of equipment, software licenses, hire consultants or add headcount due to budget constraints can critically hamper project progress. Here an effective project manager can help a project achieve its budget needs by socializing those needs with senior management.
- **Personality -** let's face it; some people on the project team just don't seem to get along no matter what you do. It's like trying to mix oil and water. An experienced project manager will either attempt to resolve the conflict peaceably through discussions with the feuding parties or will look for areas where they can work on the team where they will not have much contact with each other. In either case, sometimes personality disagreements can result in someone self-organizing off the team due to irreconcilable differences.

Conflict Resolution Methods

The following are considered the fundamental conflict resolution methods:

- Collaborate/Problem solve – Driving consensus by incorporating multiple viewpoints
- Compromise/Reconcile – each side gives up something and everyone is dissatisfied; a 'lose-lose' scenario
- Force/Direct – e.g. 'my way, or the highway'
- Smooth/Accommodate – avoids addressing the issue directly and applies a band-aid
- Withdraw/Avoid – a complete avoidance of the issue; postponing a decision

According to PMI:

- The best approach is collaborating/problem solving
- The worst approach is forcing
- Compromise, smoothing and withdrawing can lead to 'lose-lose' situations

For the resolution of conflicts, ensure that an issue log is established with an owner and a due date for resolution.

PMI also states that the PM should decide on the most appropriate resolution method.

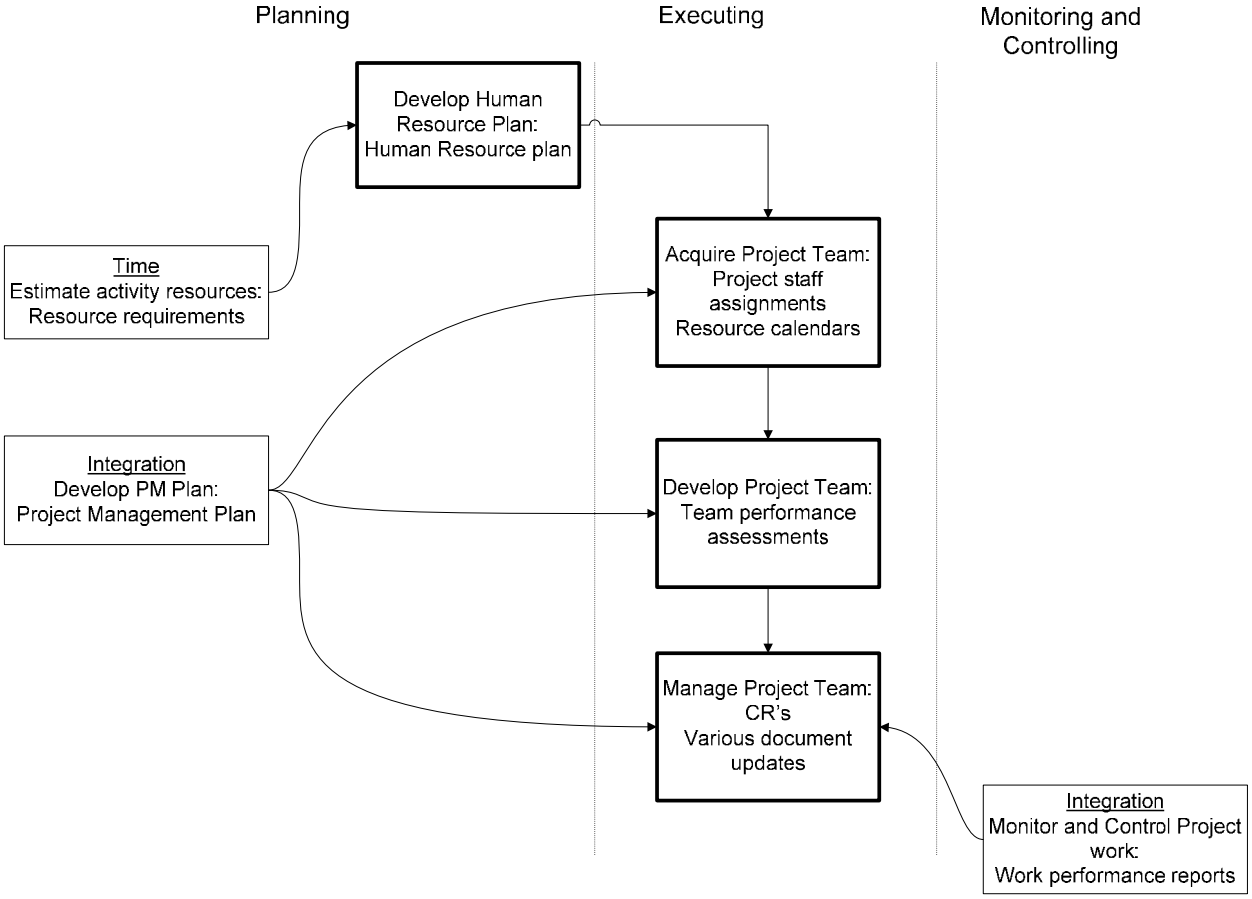
For the project manager, there is a brief listing of interpersonal skills that not only contribute to conflict resolution scenarios but that help drive to the strengths of the project team members. Key skills are:

- **Leadership** - imparting vision and inspiring the team to achieve high performance
- **Influencing -** particularly important in a matrix environment in which the project manager may have little direct authority over the team members. In this case, the ability to influence stakeholders becomes a key component in project success. Effective skills in this area include:

    - Interactive listening skills
    - Clear articulation of points of view and the ability to be persuasive
    - Seeing all sides of the issue from your stakeholders perspectives
    - Being a trusted resource - not taking sides when addressing stakeholder issues
- **Effective decision-making -** Strong negotiation skills to influence the organization for the success of the project

Project Human Resource Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Human Resource Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

This section discussed HR management, including:

- The need for a responsibility matrix
- The HR responsibilities of the PM
- Authority levels of the PM and which are the best
- Benefits of team building
- Concepts driving various motivational theories
- Techniques used to manage and resolve conflict

HR Process Check

Match the process to its definition:

___Plan human resource management

___Acquire project team

___Develop project team

___Manage project team

A. The process of improving competencies, team member interaction, and overall team environment to enhance project performance

B. The process of identifying and documenting project roles, responsibilities, required skills, reporting relationships, and creating a staffing management plan

C. The process of tracking team member performance, providing feedback, resolving issues, and managing changes to optimize project performance

D. The process of confirming human resource availability in obtaining the team necessary to complete project activities

Chapter Nine Memory Check

1. The processes in the Project Human Resource Management knowledge area occur in the _____ and _____ process groups of the Project Management Life cycle
2. The role that accepts the product of the project and provides financial resources for the project is the _____ whereas the role that sets organizational priorities between projects and the triple constraints is performed by _____
3. The _____ and _____ grid identifies activities, documents, and other deliverables along with the person accountable for those activities
4. Develop Project Team is in the _____ process group and has the key output of _____ _____
5. The two forms of project manager authority that PMI states are the most effective are _____ and _____
6. The four stages of team growth according to the Tuckman Model are, in order, _____, _____, _____, and_____
7. The psychologist who introduced his concept of a hierarchy of needs was _____
8. The management theory that assumes the average person dislikes work, has no ambition, avoids responsibility and is not too intelligent is entitled _____
9. _____ focused on increasing employee loyalty to the company by providing a job for life with a strong focus on the well-being of the employee
10. A key output of the Manage Project Team process is _____
11. PMI considers _____ as the best approach in resolving conflict while it considers _____ the worst approach
12. The leadership model in which the manager of a team applies more direction to managing inexperienced employees, and then moves to a delegating approach as the team members grow in skill and capability is called _____
13. Frederick Herzberg found that the factors causing job satisfaction (and presumably motivation) were different from that causing job dissatisfaction. He called the _____ _____ elements that, if not satisfied, would lead to job dissatisfaction
14. _____ is the belief that increased effort will lead to increased performance; i.e. "If I work harder, the outcome will be better".
15. The top three causes of conflict on a project are: _____, _____, and _____
16. _____ addresses the effectiveness of the team as a whole, while _____ address the performance of individuals on the team
17. The concept that individuals are motivated by the need for power, achievement and affiliation is known as _____ , developed by David McClelland
18. The type of power that a PM can exhibit by offering perks or other benefits is called _____ power

Chapter Nine Test

1. The hierarchy of needs is a motivational theory developed by:
    a. Herzberg
    b. McGregor
    c. Maslow
    d. McClelland

2. Your project is well underway and you have called for the first kickoff meeting with your stakeholders and your project team members. At this meeting, some of the stakeholders expressed bewilderment and wonder why you have been chosen to head the project. One of the stakeholders exclaimed, "You're not even in this division, how is it that you were chosen to head this project?" Anticipating this concern, you prepared copies of the project charter, which you pass out to all the group participants. Since the charter names you as the project manager, the type of authority that this displays is known as:
    a. Expert
    b. Referent
    c. Legitimate
    d. Representative

3. The PM has been called by two of your project stakeholders to help resolve an issue. He sets up a brief meeting with the two stakeholders to listen to their concerns about a particular aspect of the current project. After hearing their concerns, his comment to both stakeholders is this: "I think you both made some good points here. Jerry, I think if we take part of your solution and combine it with some of Bill's ideas, I think we can bring this to a successful conclusion." What type of conflict resolution technique was being employed by the project manager?
    a. Smoothing
    b. Confronting
    c. Withdrawing
    d. Collaborating

4. At the last progress meeting, some of the team members thought that they were going above and beyond the call of duty in delivering certain aspects of the project. The project manager agreed and thought that since these key members were carrying some extra responsibility, the project could afford some special rewards such as having dinner brought in after 6 p.m. and comp time for the extra hours expended by these employees. This type of reward is called:
    a. Fringe benefit
    b. Perk
    c. Team building
    d. Entitlement award

5. A resource histogram shows all of the following except:
    a. Number resources at any given time
    b. Specific activities
    c. Resource utilization
    d. When resources come on or off the project

6. A line manager in your organization is particularly difficult when dealing with project team members. He is suspicious of their work habits and feels that he must constantly micromanage their activities to ensure that the job gets done. This type of manager is known as:
    a. Theory X manager
    b. Theory Y manager
    c. Expectation theory manager

d. Achievement theory manager

7. What is a *key* responsibility of the sponsor for a project?
    a. Review requirements
    b. Creating the project management plan with the PM
    c. Protecting the project from outside influences
    d. Gatekeeper for unneeded changes

8. Theory Z is a leadership theory created by:
    a. W Edwards Deming
    b. Bruce Tuckman
    c. William Ouchi
    d. Ken Blanchard

9. The Human resource plan is an output of the Develop Human Resource Plan process. Which of the following will *most likely* be created in support of this activity?
    a. WBS Dictionary
    b. Stakeholder Register
    c. Risk Breakdown structure
    d. Responsibility assignment matrix (RAM)

10. Senior management has received ongoing progress reports on the current project you are managing. It seems that one of the technical team has done an outstanding job of delivering certain aspects of the product in development, and management has taken notice. A Sr. VP has commented to you that they would like to move this resource onto the strategic planning team because of his outstanding job in the development area. In management this is known as:
    a. The Achievement effect
    b. The Halo effect
    c. The Expectancy effect
    d. The Hygiene effect

11. At the last team meeting, several of the team members were tasked with delivering a short presentation to some of the stakeholders on certain product features under development. When the presentation had completed, one of the stakeholders asked a team member,' who was responsible' for delivering a specific set of features for one of the product components? The team member appeared a bit flustered and asked the PM for assistance with the question. What is *most likely* what the PM forgot to do?
    a. Create a WBS
    b. Create Resource breakdown structure
    c. Create a RACI matrix
    d. Create a staffing management plan

12. The Roles &Responsibility matrix is best described and used for which of the following?
    a. When a resource is available for work
    b. Defining ownership of project deliverables
    c. The specific job and deliverables due date
    d. The job and the reporting relationship to the next higher organizational level

13. The project manager is in the process of developing the human resource plan for the project. What is the *most likely* tool and technique she would use to help create the human resource plan?
    a. Staffing management plan
    b. Roles and responsibilities
    c. Resource breakdown structure

d. Risk assessment matrix

14. What motivational theory proposes that factors which act as dissatisfiers on a job will de-motivate the employee and become an obstacle to achievement?
    a. Hygiene theory
    b. Expectancy theory
    c. Theory Z
    d. Situational continuum

15. When discussing a recognition and rewards system on your current project, senior management has been reluctant to agree to this aspect of human resource planning. In fact, one senior VP made some decisions regarding the triple constraints on the project that not only created scheduling problems for the team, but also imposed some unrealistic expectations on the team as well. As a result, certain deliverables were missed and VP wants the individuals who were responsible for these missed deliverables to be punished. As the project manager, what is the most appropriate response to the VP's request?
    a. You will honor the VPs request, offer up the names of individuals who were responsible, and agree on an appropriate punishment.
    b. The VP was the one who caused these problems and should own up to his own mistakes.
    c. Resources should not be punished for poor planning and unrealistic expectations imposed by senior management
    d. You escalate the issue to the president of the company, stating that the missed deliverables were the result of the VP's managerial incompetence.

16. What are the five phases of the Tuckman model in order?
    a. storming, forming, performing, norming, adjourning
    b. forming, storming, norming, performing, adjourning
    c. norming, performing, storming, adjourning, forming
    d. performing, norming, forming, adjourning, storming

17. A new position in the company has been posted for a new senior manager with a very specific set of skills. One of your team members approaches you and asks about the position in confidence. You set up a meeting with this individual who asks you a series of questions about the position and concludes by saying, "I've seen a lot of positions like this posted but I don't think it will do me any good to apply for the job. It seems that when the company does something like this they already have the person in mind for the job but they simply have to post a job as a matter of corporate policy. I think my chances are slim to none of actually getting this job." What is being described here?
    a. Expectancy theory
    b. Fait accompli
    c. Hygiene theory
    d. Hierarchy of needs

18. An issue log will contain all of the following *except*:
    a. A due date
    b. An owner
    c. A probability
    d. A resolution

19. You've got some inexperienced team members in your organization - inexperienced but very bright. In working with them for the last six months you have changed your management approach from one of telling them how to do their jobs to the point where you're coaching these team members when they come to you with questions. A few of them are very close to the point where you could simply delegate

the work and step back, instructing them to call you if they run into difficulty. This describes something called:

a. Achievement theory
b. Situational continuum
c. Delegation authority
d. Progressive responsibility transfer

20. Someone on the technical team who was working on a production emergency into the wee AM hours made an error that impacted the production system; he was so focused on the emergency that he forgot to run a repayment tape that caused another day of interest to be charged to the brokerage at a cost of $25000. The group VP was furious and called you with a demand: "Give me the name of the idiot that screwed this up!" As the project manager what would be your *best* response?
    a. You agree to identify the resource – professionals need to own up to their mistakes
    b. You refuse to identify the resource – the production fix saved the company far more than the cost of the error
    c. You ask the VP what would be gained by punishing the resource – mistakes are part of the learning process
    d. You agree but first ask the VP what he plans to do with the resource; this event highlights an unusual and unexpected risk situation that needs to be addressed first

21. Of the major causes of conflict on a project, which of the following generally causes the *greatest* conflict?
    a. Technical opinions
    b. Schedule constraints
    c. Design constraints
    d. Personality differences

22. Which is not a motivational theory?
    a. Expectancy
    b. Achievement
    c. Tuckman model
    d. Hierarchy of needs

23. At the last progress meeting, several stakeholders and team members got into an intense disagreement on how certain components in the current project should be constructed. One stakeholder wanted one of the components constructed using a specific technology (the stakeholder used to be a former IT resource). The technical team strongly disagreed - the technical team lead stated that while the stakeholders could describe *what* they wanted, it was up to the technical the team to determine *how* they were going to best deliver it. The argument dragged on. After an hour, the stakeholders and the team members were no further along. Before you could speak, a senior VP who was also at the meeting stepped in and said the following, "This bantering is getting old. Either you figure out how to solve this problem or I will make a decision for you." The type of conflict resolution approach being used here is:
    a. Confronting
    b. Collaboration
    c. Forcing
    d. Compromising

24. You have just been assigned a new project and met the project team for the first time. At this first meeting a number of the team members challenge you and question your ability to effectively lead the team. What is the *best* type of project manager authority you could possess that would help put the team on your side and earn their respect?
    a. Legitimate
    b. Referent

c. Reward
d. Expert

25. Many organizations claim to do teambuilding activities with their employees. Which of the following would be the *most effective* teambuilding activity for a new team that has just been formed?
    a. Organize a red team/blue team game of capture the flag - after work
    b. Meeting for drinks after work (you're buying the first round)
    c. Gather the team in a meeting room for 2 hours to informally discuss the new project. Have the event catered and have some 'fun and games' afterwards (e.g. ring toss and 'pin the tail on the manager', etc…)
    d. Organize a baseball outing during a standard workday at your local MLB team - arrange to talk with some of the baseball players after the game about how they work as a team

26. The need for achievement, affiliation and power is best described by the _____ theory
    a. Motivational regression
    b. Achievement
    c. Herzberg
    d. Maslow

27. What is the *key* benefit of team co-location?
    a. Reduced costs from remote access
    b. Improved communication and team productivity
    c. Management can better monitor and control the work of the resources
    d. Can more quickly pass the storming phase described in the Tuckman model

28. At a meeting with team members on your project, you facilitate a review of how well the project was progressing at this point. While most of the team feels that the project is progressing well and that they are finding the work interesting as well as challenging, a few of the team members are expressing dissatisfaction and have some particular 'environmental' concerns. Specifically, a few of the team members are complaining about management and administrative policies that they feel are roadblocks to meeting certain goals of the project. What motivational theory do these concerns most likely address?
    a. Hygiene theory
    b. Theory of constraints
    c. Achievement theory
    d. Theory X and Y

29. At the last progress meeting, a few the team members got into an abusive verbal battle. There were significant differences on the technical direction the project should take, the meeting got ugly, and the PM had to disband the meeting and speak to the warring parties off-line in a conference room. What did the PM *probably* fail to do?
    a. Set a meeting agenda
    b. Establish ground rules
    c. Used the wrong conflict resolution technique
    d. Invited the wrong people to the meeting

30. What is the difference between Project Performance Appraisals and Team Performance Assessments?
    a. Project Performance appraisals are an output of manage the project team while team Performance assessments are a tool or technique of develop the project team
    b. Project performance appraisals help to clarify roles and responsibilities and provide feedback to team members, while Team Performance assessments measure performance in terms of technical success, performance on project schedule, and performance on budget

c. Project Performance appraisals are performed externally while team Performance assessments are performed internally
d. Both are tools and techniques of develop the project team

31. Your project team has pulled together nicely over the last several weeks. The team started with a bit of anxiety, but as they started working together , their behavior started to normalize and they're now functioning as high-performing team. Several months go by and one of your lead designers comes to you with some disturbing news –he will be leaving the team to take a senior management position with another company. After a rigorous search you find a replacement for this team member who just joined the team one week after the former resource departed. What phase of the Tuckman model are you in?
    a. Norming
    b. Performing
    c. Storming
    d. Deforming

32. Should training ever be used as a reward or a perk by the project manager for work well done by a technical team member?
    a. Yes, but only if the work is outstanding and warrants such a reward
    b. No; because training reduces overall project cost and schedule by increasing team member efficiency, you should be doing it anyway
    c. Only if you have the consensus of senior management
    d. Training should never be provided because the trained resource may find a better employment opportunity.
33. Management just contacted you to take over a project that is in jeopardy – the former project manager was fired. It appears that deliverables are being missed and that the project is late. The stakeholders are pointing fingers at the team members for their lack of delivery and team members are pushing back, stating that the stakeholders are not giving clear direction. What did the former project manager *probably forget* to create?
    a. Staffing management plan
    b. Resource histogram
    c. Responsibility assignment matrix
    d. Quality management plan

34. Your project team has been burning long hours to complete critical phase in this project. Some of the technical team members have shown extraordinary dedication and diligence and have put out effort that is above and beyond the call of duty. At a recent meeting with senior executive staff, you state that it would be appropriate to formally appreciate some of the extraordinary dedication that has been shown by some of the team members. The CFO, who was also at the meeting, calmly states that these team members are on salary and that if it takes them an extraordinary amount of time to get their job done, that is their problem. Immediately, several of the team leads that accompanied you to the meeting vociferously complain about the CFO's statement. A major argument breaks out and the team leads storm out of the meeting, furious. What is missing from the organization's business process?
    a. Conflict resolution methods
    b. Executive sensitivity training
    c. Disciplinary guidelines
    d. Recognition and reward system

35. The project manager spends most of their time on:
    a) Integration
    b) Communication
    c) Monitoring and control
    d) Planning

Chapter 9 Test – Answers

1. C – The hierarchy of needs was developed by Abraham Maslow
2. C – The project charter gives you legitimate authority on the project
3. D – This best describes a collaboration between the stakeholders
4. B – This is a perk. Fringe benefits are something all employees receive. Team building is an all-team activity. Entitlement award is made up.
5. B – Resource histograms do not show specific activities
6. A – This is a definition of a theory X manager
7. C –In this answer set, the sponsor's key responsibility is to protect the project from outside influences. The sponsor does not review requirements as a key element, and does not create the PM plan or protect the project from unneeded changes (the PM's job)
8. C – By definition, William Ouchi
9. D – The WBS is created in Scope planning, Stakeholder Register in Stakeholder Initiation and the Risk Breakdown Structure in Risk Planning. The only remaining logical choice is the Responsibility assignment matrix.
10. B – This is how the Halo effect is defined. All the other answers are made up
11. C – The RACI matrix would have cleared up this problem
12. B – The RACI matrix defines deliverables and their ownership. Resource calendars show resource availability, deliverables and due date is defined in detail in the WBS dictionary and answer 'D' defines resource breakdown structure
13. C – A key tool and technique is org charts and position descriptions – a resource breakdown structure fits this description
14. A – The hygiene theory describes the dissatisfiers in detail
15. C – The project team should not be punished for poor planning and unrealistic expectations imposed by senior management.
16. B – This defines the correct sequence: forming, storming, norming, performing, adjourning. *PMBOK® Guide*, 5th edition, p. 276
17. A – This describes a classic expectancy theory scenario
18. C – Probabilities of occurrence are contained in a risk register.
19. B – This describes the progression of the situational continuum
20. D – All these answers are in some respect, correct. However this best describes a unique risk situation that may not have occurred in the past. Blaming the resource in effect, does no good – this is a process issue not a resource issue
21. B – Schedule constraints are the number 1 cause of project conflict
22. C – The Tuckman model describes team development
23. C – The exec is forcing the situation
24. D – Expert power is considered the best type of PM authority by PMI
25. D – 'A' and 'B' are after work activities – usually a bad time for 'team building' exercises (people have children to care for and prior commitments). Option 'C' is too transparent a management promoted team building effort. The best team building efforts generally involve the team off-site where management can get to know their team members as individuals. Even if you are not a fan of baseball, the idea that you can consult a highly productive professional team about how they handle their own team building activities, can be useful to your organization.
26. B – This describes David McClelland's Achievement theory.
27. B – Communication and productivity are two stated benefits of team co-location
28. A – Administrative roadblocks are described as dissatisfiers in the hygiene theory
29. B – Establishing meeting ground rules will prevent many potential issues and non-productive interruptions from occurring in meetings
30. B - Described in Sections 9.3.3 and 9.4.2 of the *PMBOK® Guide,* 5th edition
31. C – Storming is what occurs if there are replacements on a team in the 'performing' stage. It will temporarily revert to storming as the new resources assimilate.

32. B –Training is frequently used as a perk for work well done. This is a fundamental error. Training may be necessary to guarantee the successful completion of the project. Per *PMBOK® Guide,* 5th edition, p 275
33. C – This addresses lack of ownership of deliverables
34. D – A documented recognition and reward system would go a very long way to avert this type of issue
35. B – 90% of the PM's time is communicate, communicate, communicate

Chapter 10 : **Project Communications Management**

Section Topics

- Plan Communications Management
- Manage Communications
- Control Communications

Section Objectives

After completing this section, you will be able to:

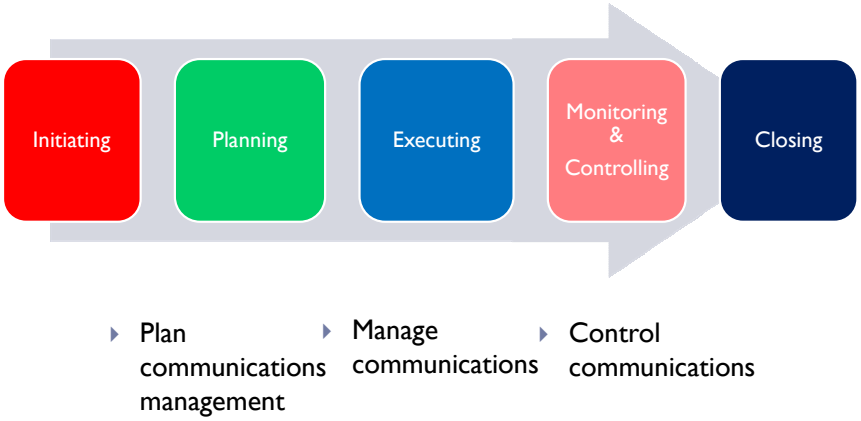
- Explain the importance of project communication
- Describe stakeholders and perform a stakeholder analysis
- Develop the stakeholder register
- List the components of a communications management plan
- Discuss the communications model
- Manage stakeholder expectations
- Determine which form of communication is appropriate
- Discuss the types of performance reviews

Project Communications Management Process Summary

The high level Project Communications Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	Communications management plan	-Project communications -Various document updates	-Work Performance info -CR's	

Project Communications Management



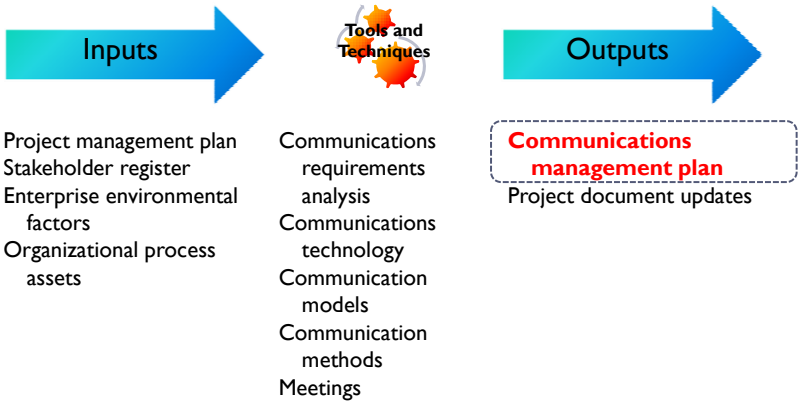
Project communications management identifies the processes required to assure the collection, generation, distribution, storage, retrieval, and the timely disbursement of project information to all project stakeholders and project team members.

Plan Communications identifies how information will be made available based on stakeholder needs and requirements, as well as defining an approach to Project communications.

Manage Communications addresses how information will be created, collected, distributed, stored and retrieved or otherwise made available to project stakeholders .

Control Communications addresses the process of monitoring and controlling project performance information to ensure the communications needs of stakeholders are met.

Plan Communications Management



The Plan Communications process involves determining the information needs of stakeholders and defining a communications approach to the stakeholders. It addresses the five 'w's + 'h': *who* needs information, *what* information is needed, *where* is it to be delivered, *when* and with what frequency it is to be delivered, *why* is information important, and finally *how* will it be delivered.

Since distribution methods vary widely depending on the distribution of the project team, it is critical that the communications management plan addresses all these variables, and identifies the means for meeting the communication needs of all the stakeholders.

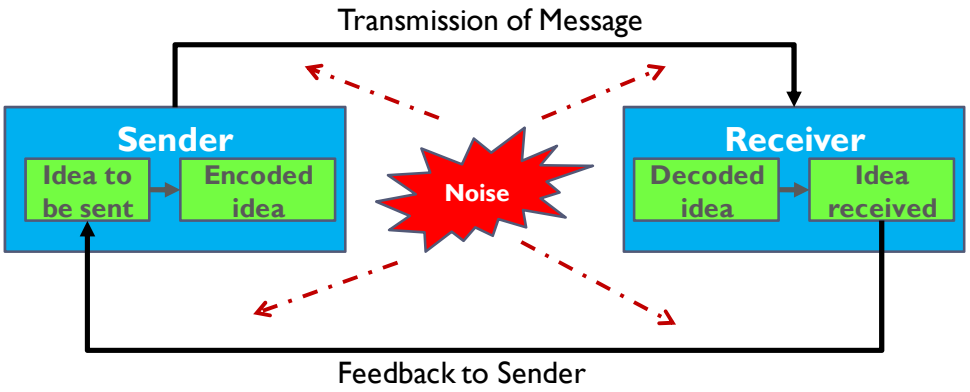
Communications Management Plan

The key output of Plan Communications is the creation of the Communications Management Plan. The primary tools for delivering the communications management plan include the following:

- Communications Requirements Analysis - determines the information needs of the project stakeholders. This can be accomplished by interviewing all stakeholders and determining their specific communications needs for the project.
- Communication Technology - defines the technology needed for the project communications. This can range from face-to-face meetings to video and audio communications platforms designed to facilitate meetings of distributed teams. The elements that can influence the choice of the communication technology include the following:
    - Urgency of the need for information
    - Availability of technology
    - Ease-of-use
    - Project environment
    - Sensitivity and confidentiality of the information
- Communication Models - will generally follow the encode-message-medium-decode process. See the following page for the sender-receiver communication model.
- Communication Methods - there are a number of communication methods, however, they can be broadly classified into three following approaches:

- **Interactive Communication** - this is between two or more parties if there is multidirectional exchange of information. This is the most common and most effective of the communication methods.
- **Push Communication** -this type of communication validates the message was sent, but does not validate that the message was delivered or that it was actually read by the recipient. This type of communication includes reports, e-mails, faxes, voice mail, letters, memos, etc.
- **Pull Communication** - this approach is generally used for large volumes of information, or for a large audience set that can access communications at their discretion. This can include intranet sites, e- learning sites, commercial databases, knowledge repositories, etc.

Communication Sender-Receiver Model



The Mathematical Theory of Communication co-authored by Claude Elwood Shannon and Warren Weaver in 1948, has become the most widely adopted sender-receiver communication model. The Shannon-Weaver model, combined probability theory with something Shannon called 'information entropy', which measured the uncertainty in a message. The sender- receiver model consists of:

- An encoded idea - in a form that the receiver can understand
- The message and feedback - the output of encoding
- Medium - the medium is the message is transmitted over
- Noise level - any environmental disruptions that can impact the reception of the message
- The decoded idea - the receiver's interpretation or understanding of the received message

It is the sender's responsibility to make sure that the information is clear and complete and to ensure that the message is correctly understood. It is the receiver's responsibility for ensuring the message was received in its entirety, understood and acknowledged to the sender.

Effective Listening consists of three basic building blocks:

1. **Feedback**
2. **Active Listening**
3. **Paralingual (vocal expression)**

Active Listening

The process of active listening basically involves the four following steps:

1. Look at the person, and suspend other things you are doing.
2. Listen not only to the words, but the feeling content.
3. Be sincerely interested in what the other person is talking about.
4. Restate what the person said.

Effective Communication means you are providing the right information at the right time in the correct format to the intended audience.

Efficient communication means you are providing only the needed information; no more, no less.

Management expert Peter Drucker noted that when a message is sent up from the lowest levels to senior management, the noise level doubles and the meaning of the message is cut in a half as it passes through each level in the organization's corporate hierarchy.

Communication Hierarchies

Complexity of team communication grows almost exponentially as the team size doubles based on the following formula:

$$\frac{N(N-1)}{2}$$

Where N = the number of team members

Therefore:

Lines of communication for a 5 person team = 10
Lines of communication for a 10 person team = 45
Lines of communication for a 40 person team = 780

Brain Dump!

The formula above is to be memorized for the exam. There are usually some tricky questions regarding the computation of lines of communication on a project. Make sure you read the question carefully, as the answer can turn on a single word. For example:

Q: You are managing a technical team of six highly skilled developers on an XP crash project for senior management. After one week on the project, the lead developer states that two additional resources are needed to complete the project. How many additional lines of communication are created as a result of this addition?

a. 12
b. 13
c. 15
d. 36

Most people get this question wrong because they either misread the question (it is asking for *additional* lines of communication), or that they forgot someone (did you forget to count yourself as one of the members of the team?). The answer is 'c'.

Meetings: Best Practices

- Publish and distribute agenda with team input before meeting
- Circulate minutes after meeting
- Facilitate meetings
- Assign deliverables to individual with due date
- Set meeting rules
- Meet regularly, or as needed
- Articulate expectations and responsibilities
- Summarize what has been discussed

If you work for an organization which holds meetings to report status, you are wasting your time. Status can very easily be reported via an e-mail, a quick 10 minute phone call, or a posting on the company intranet. Reporting status does not require a meeting. One of the jobs of the project manager is to ensure that people are using their time effectively on the project.

The purpose of getting people together for a meeting is that a decision that needs to be made, or a problem needs to be solved that requires a face-to-face conversation or a live conference call. The idea is to use the time effectively and to make sure that all the right participants are in attendance and have input into the process.

The ground rules set above are a good general guideline to facilitate meetings.

Always distribute the meeting agenda at least 24 hours ahead of the meeting. This gives meeting participants the opportunity to add critical agenda items, or to decide at what point in the meeting they need to participate. If there are issues and risks that need to be addressed, make sure there are deliverables assigned to individuals with the responsibility for completing their assignments, and always make sure they have a due date for completion.

Project Manager Communication

Project Managers spend 90% of their project time on COMMUNICATION activities.

It is one of the primary jobs of the project manager to ensure that all stakeholders are kept informed and updated on project progress, issues, risks, changes, corrective actions, preventive actions and a host of other elements we have discussed up to this point. The way project managers keep all stakeholders and project team members 'on the same page' is through proactive communications.

Many project failures are attributable to a lack of thoughtful and thorough communications, which is the responsibility of the project manager.

Manage Communications

Inputs	Tools and Techniques	Outputs
Communications management plan Work performance reports Enterprise environmental factors Organizational process assets	Communication technology Communication models Communication methods Information management systems Performance reporting	**Project Communications** Project management plan updates Project document updates Organizational process assets updates

The manage communications process addresses the creation, collection, distribution, storing, retrieving, and the disposition of project information according to the communications management plan. It enables efficient and effective communications between project stakeholders.

Effective information distribution includes some of the following techniques:

- Implementing sender-receiver models
- Determining choice of media
- Choice of writing style
- Meeting management techniques
- Presentation techniques
- Facilitation techniques
- Listening techniques

We have discussed the sender-receiver model and meeting management techniques on previous pages. Some of the other information distribution techniques appear on the following pages.

Communications Barriers/Enhancers

- Communication Barriers:
  - Distorted Perceptions
  - Distrusted Sources
  - Transmission Errors
  - Noise or Distance
  - Message not Clearly Encoded
  - Saying "it is a bad idea"
  - Hostility
  - Culture
- Communication Enhancers:
  - Make the Message Relevant for the Receiver
  - Reduce the Message to Its Simplest Terms
  - Organize the Message into a Series of Stages
  - Repeat the Key Points

Communication enhancers are used in presentation techniques and facilitation techniques. Notice that:

- 55% of the message transmitted comes through body language
- 38% of the message transmitted comes through vocal inflection (paralingual)
- Only 7% of your message consists of the actual words that you use.[41]

Here is a case in point:

Almost every child has played some version of the 'telephone game': people sit in a circle and the initiator starts a message, which he whispers into the ear of the person sitting next to him. The rule of this game is that you can only say the message once, and the person who receives it has to pass on whatever they *think* they heard to the person sitting next to them. This process repeats itself until it reaches the end of the circle. At that point the message usually bears no resemblance to the initial message, resulting in great hilarity among the telephone game participants.

Think of the consequences if some version of this happens on your projects in a business context - a meeting of stakeholders, a telephone conference, a distributed questionnaire or some other communication. If misinterpreted, the results can be disastrous. Therefore, when attempting to solicit information or get a message across, be aware of the communication barriers and do whatever you can to reduce their impact.

Types of Communication

There are four fundamental types of communication that occur under two standard headings: formal and informal. The four types are:

- Formal Written
- Formal Verbal
- Informal Written
- Informal Verbal

The grid below represents communications and their best practice usages:

Formal Written	Formal Verbal	Informal Written	Informal Verbal
•PM Plans •Project Charter •Long distance communications •Complex technical problems •Meeting minutes	•Presentations •Public Speeches •Keynote addresses	•Memos •E-mails	•Meetings •Ad hoc conversations

[41] "Silent Messages", Mehrabian, Albert, Wadsworth Publishing Company (January 1971)

Communication Situations

Here's a quick quiz for you: look at the grid above and decide what communication method you would apply to the situation on the left-hand side of the grid below.

- Formal written?
- Informal written?
- Formal verbal?
- Informal verbal?

Situation	Communication Type
Schedule a meeting	
Deliver oral presentation at a bidders conference	
Discussion with a team member regarding a project problem	
Notes taken during a conference call	
Changes to technical requirements	
Informing a team member of insubordination	

Performance Reporting

The performance reporting process focuses on the collection and distribution of performance information and includes the following types of reporting:

- Status reports - where the project now stands
- Progress Reports - what is been accomplished to date
- variance report - compares actuals to performance baselines
- Trend report - measures performance over time to determine if performance is improving, deteriorating, or staying about the same
- Earned value reports - reports on schedule, budget, and scope to assess project progress
- Forecasts - predictions of future performance. Can include forecasts of schedule, budget, scope, risks, quality, and other

Typical status or progress reports include elements such as:

- Project milestones reached
- Risk and issue status
- Requested changes
- Accepted and rejected changes
- Escalation status of Jeopardy items
- Expected deliverables due by the next status report

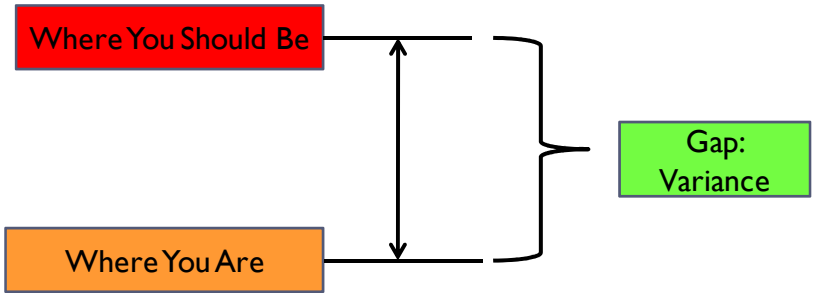
Performance reports can be simple, such as a one page status report, or highly complex such as a stoplight reports for a dashboard report including many factors.

Variance Analysis

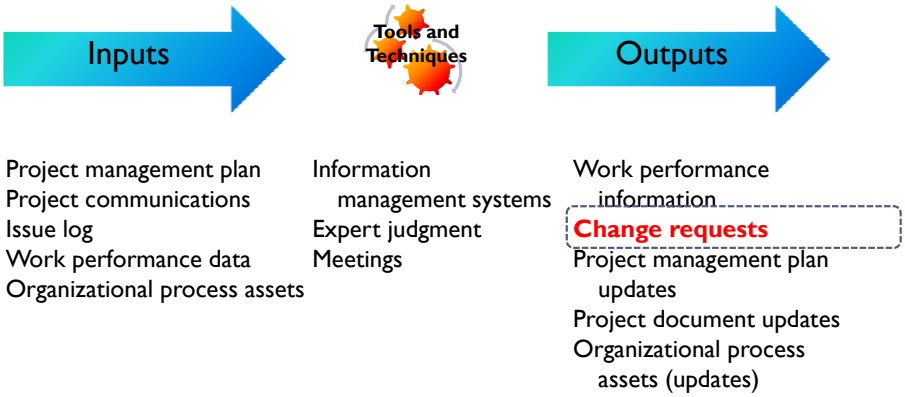
The Variance Report

This compares actual results against a planned a baseline. Ensure the following is done when constructing a variance report:

- Verify the quality, completeness and accuracy of the information
- Determine variances, including the use of earned value reports
- Determine the impact of the variances on project budgets, scope, timeline and other project elements (e.g. quality and risk).



Control Communications



The control communications process involves monitoring and controlling communications so that information needs of project stakeholders are met. The focus is to ensure optimal information flow at any moment in time to any stakeholder in any location. Since the communication process is iterative, the control communications process can trigger an iteration of the plan communications management or manage communications processes.

Communication Methods

Contemporary communication methods typically include:

- Group meetings
- Video Conferences
- Intranet wikis (web based)
- E-mail, voicemail, fax
- Conferencing tools (e.g. Webex®)
- Web based PM software, portals

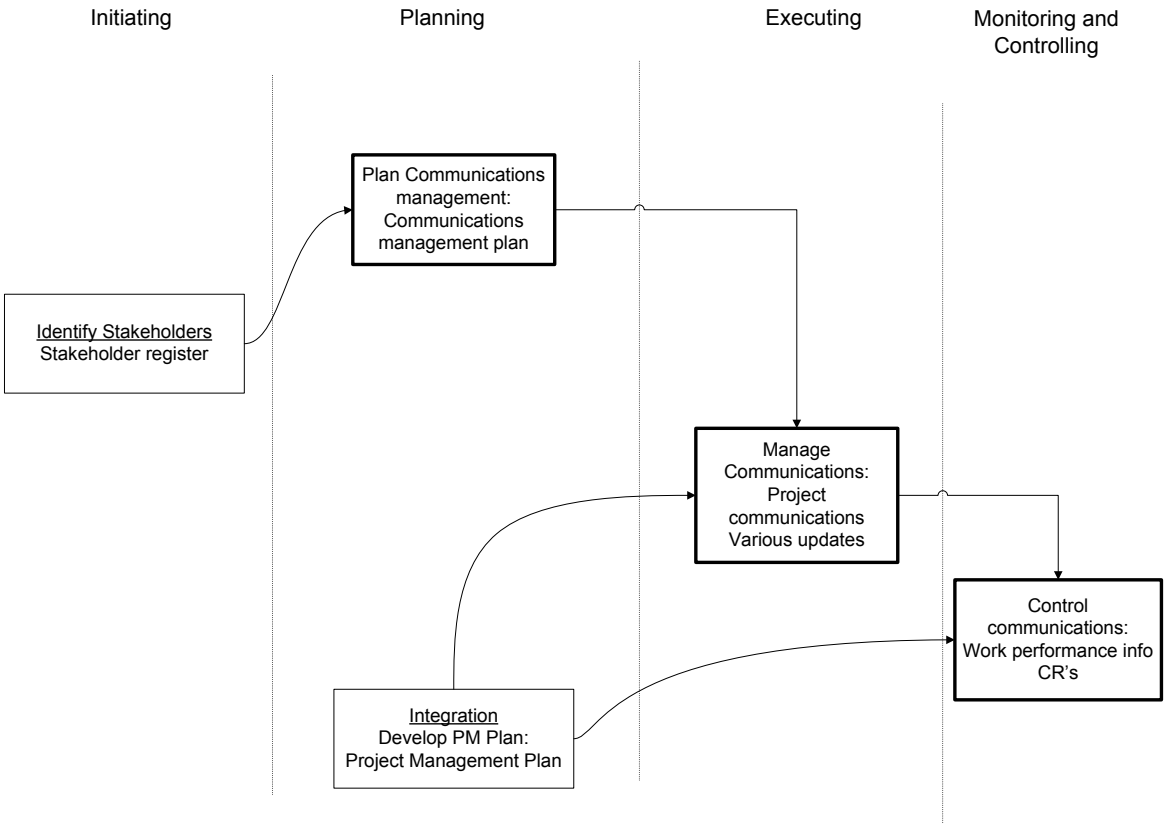
The communication methods listed above can all be implemented based on the needs of the stakeholder, and applied where appropriate. It is the project manager's job to identify for each stakeholder their preferred method of communication.

The project manager must also apply interpersonal skills and management skills to help build trust, resolve conflict, and overcome resistance to change by the artful application of management skills which may include some of the following:

- Strong presentation and speaking skills
- Excellent negotiation ability
- Effective writing skills

Project Communications Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Communications Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

This section discussed communications management, including:

- Active listening and communication skills
- Percent of a project manager's time spent on communicating
- Stakeholder identification, managing stakeholder expectation, stakeholder management strategy
- Best practices for holding effective meetings
- Lines of communication and communication methods
- How to use an issue log
- Variance analysis and forecasting
- Reporting and information distribution

Communications Process Check

Match the process to which description:

___Plan communications management

___Manage communications

___Control communications

A. The process of guiding communications throughout the entire project lifecycle to ensure the information needs of the project stakeholders are met

B. The process of developing an appropriate approach for project communications based on stakeholders information needs and requirements, and available organizational assets

C. The process of creating, collecting, distributing, storing, retrieving and the ultimate disposition of project information in accordance with the communications management plan

Chapter Ten Memory Check

1. Only ___ % of your message is conveyed in the words themselves, while __%of the message is conveyed in vocal tone and inflection and ___ % in body language
2. The formula that determines the number of communications channels is expressed as _____
3. The key output of the Plan Communications process is the _____
4. The three fundamental communications methods are known as _____, ____, and _____
5. Manage Communications occurs in the _____process of the Project Management Life cycle
6. The process of attentively responding and verifying what the sender of a message is communicating to you is called _____
7. The four basic types of communications are known as: _____, _____, _____, and _____
8. A _____ report describes where the project now stands, while a _____ report describes what has been accomplished, and a _____ report compares actuals to the performance measurement baseline
9. A project manager spends ___% of their time on communication activities
10. Providing information at the right time, in the right format to the right audience is called _____ _____.
11. Providing only and exactly the information needed is defined as _____ _____.

Chapter 10 Test

1. The project manager is managing a nine member team. Two members are removed and reassigned from the team. How many lines of communication have been removed from the team?
    a. 17
    b. 16
    c. 15
    d. 14

2. You are managing a project in which there is a large procurement activity. One of the stakeholders approaches you with the need for a change. You have an off-line meeting with the stakeholder and discuss the change, decide it can be done and agree to implement. What mistake has the project manager made here?
    a. You forgot to consult with senior management
    b. You forgot to consult with other stakeholders on the team
    c. Contract changes require a formal written approval
    d. You forgot to perform an impact assessment

3. You have just finished a recent progress meeting when an important technical issue emerged. With the help of two technical team members, you craft a detailed document, which is e-mailed to the rest of the team describing the issue and what can be done about it. What percentage of the message is actually going to be understood by the recipients?
    a. 55%
    b. 7%
    c. 38%
    d. 93%

4. All of the following are Forecasting methods with the *exception* of:
    a. Econometric methods
    b. Time series methods
    c. Judgmental methods
    d. Analogous methods

5. A variance analysis is used for:
    a. Comparing baselines to actuals
    b. Determining future performance
    c. Status reporting
    d. Statistical modeling

6. The *key* element needed in an issue log is?
    a. A resolution
    b. An owner
    c. A due date
    d. The issue priority ranking

7. You have been asked for a report by senior management that indicates current budget, current schedule, and where the project may complete in terms of budget and timeline. The best type or report to use in this situation is called:
    a. A forecast report
    b. A status report
    c. A progress report

d. A cumulative report

8. You just completed a meeting in which the stakeholders were tasked with various deliverables due at the next meeting. After the meeting, you sent down meeting notes to all the stakeholders reiterating the deliverables and the owners of those deliverables. At the next meeting, however, one of the stakeholders did not have their deliverable complete. They complained about having too much work and not receiving the follow-up e-mail message containing the meeting notes and the deliverable assigned to them. What would have been the *best* method for preventing such an occurrence?
    a. Contact the stakeholder's manager for possible remediation and or removal from the team, so that they can be replaced with a more responsible resource
    b. Confirm message receipt and review for misunderstandings with the stakeholder
    c. Change the communication channel to a more effective method
    d. Implement a verified pull system

9. When discussing a key technical issue with the team members on your project, which form of communication is most likely to help you best transmit your message?
    a. E-mail + IM (Instant messaging)
    b. Teleconference
    c. Face-to-face
    d. Face-to-face with whiteboard

10. When a message is being sent to a single receiver or a group of receivers, whose responsibility is it that the message is correctly understood?
    a. The receiver – by giving the ender feedback
    b. The sender – by correctly encoding the message in a form the receiver can understand
    c. Both the sender and the receiver
    d. It depends on the communication medium

11. All of the following are key elements in the active listening process *except*:
    a. Giving feedback to the sender
    b. Challenging unsubstantiated facts
    c. Showing interest in what the other person says
    d. Confirming and summarizing the message periodically

12. Project communications is a key output of what process group?
    a. Planning
    b. Initiating
    c. Executing
    d. Monitoring and Controlling

13. The principle difference between Effective communication and Efficient communication means that:
    a. Efficient communications provide only the information that is needed whereas effective communications ensure the timeliness and the format of the communications
    b. Efficient communications provide information to only the stakeholders who need it whereas effective communications ensure the guaranteed delivery of the communication
    c. Efficient communications focus on the most appropriate communication channel whereas effective communications focus on the fastest communication channel
    d. Efficient communications are optional whereas effective communications are required

14. You are managing a complex onshore team with resources from India, Ukraine, Nairobi, Ireland, Italy, France, Israel, and the United States. Several stakeholders have been invited to your most recent progress meeting. At the meeting, one of the stakeholders asked a question of one of the resources from

India. The resource from India responded by using a head gesture that was misinterpreted by the stakeholder (the stakeholder thought he was saying 'no' when, actually, the resource was indicating 'yes'). What type of barrier to communication does this describe?

a. Culture shock
b. Cultural difference
c. Distrusted resource
d. Noise

15. Which of the following *best* describes a stakeholder?
    a. Someone who is thinking about buying your product
    b. A reviewer of your product in an industry trade journal
    c. A project team member
    d. The CFO in another division of your company

16. You are managing three offshore teams: one in India, one in the Ukraine, and one in South America. What would be the best approach for handling communications with these offshore entities?
    a. E-mail
    b. Instant messaging (IM)
    c. Video-teleconferencing
    d. E-mail + IM

17. The team members on your project have approached you with a need for some training. You discuss the issue with the stakeholders and decide that an e-learning system online would be the best way to handle the situation. What type of communication best describes this approach?
    a. Push method
    b. Pull method
    c. Interactive method
    d. Collaborative method

18. How much does noise add to a missed communication?
    a. 20%
    b. It depends on the message
    c. The noise doubles for every level up the organization hierarchy it travels
    d. It depends on the type of communication channel being used

19. The Control Communications process yields:
    a. OPA updates- an output of the Monitoring and Controlling process group
    b. Status reports - an output of the Manage Communications process
    c. Performance reports - an output of the Report Performance process
    d. Project document updates – an output of the Plan Communications process

20. Almost every child has played the telephone game at some time. A number of people sit in a circle and the initiator of the message whispers a message to the person on their right. That person, in turn, whispers the message to the next person in the circle, and so on, until it reaches the last person in the circle. No questions may be asked of the person sending the message. The message is sent by each person only once. In terms of the sender-receiver model, what does the telephone game demonstrate about the communication process?
    a. It describes a message encoding issue
    b. It describes a transmission and feedback issue
    c. It describes a failure on the part of the receiver
    d. It describes a translation and re-encoding issue

21. The stakeholders on your project are very concerned about the outcome of the project. The organization is attempting a project in which there are significant unknowns, attempting technologies they have never used before. The stakeholders are looking to you, the project manager, for direction, problem solving, conflict resolution, and the ability to build a consensus for the new technologies in which there will be considerable resistance to change. What are the *most effective* tools or methods you can use to help build stakeholder trust?
    a. Expert power
    b. Formal authority
    c. Interpersonal skills and management skills
    d. Compromise and consensus building

22. One of your key technical team members is someone who the rest of the team looks to for technical leadership. However, just recently, you have noticed a drop in this resource's performance and have wondered if there are personal or health problems that are the cause of this performance change. What is the best form of communication, initially, that would be used to address the issue?
    a. Informal verbal
    b. Formal written
    c. Informal written
    d. Formal verbal

23. There have been some changes in your project that caused the schedule to slip and budget to be exceeded by a small amount. In order to quantify the results, you asked the technical team, as well as specific business-side stakeholders, for information that you can put into a variance report that will go to senior management. However, after the report was run, some of the results didn't make sense. What is the *most likely* cause of this discrepancy?
    a. The project manager did not use trusted resources
    b. The project manager did not verify the quality of the data
    c. The project manager went to the wrong stakeholders for information
    d. Team members are fudging the numbers because they think they will be blamed for the discrepancy

24. You are managing a project in which one of the stakeholders has been not only difficult but has dissembled on a number of occasions. Your project now stands to be delayed because this individual has just notified you, five minutes prior to the monthly meeting with the senior executive staff, that several of their deliverables would be late (even though he had this information 5 days ago…)! Since you know that you are ultimately responsible for the project, you do not want to appear as though you're 'pointing fingers' at someone else. You are reluctant to bring up the issue at the meeting which would land the problem directly in the stakeholders lap. What do you do?
    a. Talk to the stakeholder about his unethical behavior after the meeting, and seek a remediation
    b. Ask the stakeholder, in front of senior management, why he waited until 5 minutes before the meeting to give you critical information that was in his possession 5 days ago
    c. Work behind the scenes with other trusted resources to get the stakeholder fired for incompetence
    d. Initiate a 'stealth' mission to deal with other resources in the stakeholder's organization who will give you truthful information. Since the stakeholder has repeatedly lied to you, you are justified in using this tactic

25. Your team is working late to bring in some deliverables by a critical deadline. The senior VP, noticing that the team is working late, has decided to bring in dinner for the development staff. Your development team consists of resources from India, and the US. Thirty minutes later, the VP brings back four sausage and pepperoni pizzas. The developers from India looked at the pizzas for a minute and then walked away without eating. The US resources devoured the pizzas. The VP was puzzled by this. What did he miss?

a. Nothing - the VP did what he thought was best for the team
b. The VP didn't assess the cultural differences and needs of all the developers
c. The VP didn't realize it was too late at night to bring in food for some of the team
d. Some developers might not like the food prepared by this vendor

Chapter 10 – Answers

1. A – Did you forget the PM in the team count? (10*9)/2 = 45. (8*7)/2 = 28. 45 – 28 = 17
2. C – Don't get fooled by this question. It addresses a procurement issue, but it's really about the correct form of communication to use in the situation. Contracts always require a formal written approval if change to the contract is needed
3. B – Paralingual studies show that only 7% of the message is contained in the words. 38% is contained in the vocal pitch and tone. 55% is contained in the body language. Per analytical research from Albert Mehrabian in his book "Silent Messages".
4. D – Analogous is an estimating method, not a forecasting method
5. A – This is the definition of a variance analysis. (*PMBOK® Guide*, 5th edition, p. 352)
6. B – Without an owner, the issues do not get resolved
7. A – A forecast defines the potential future state of the project in terms of budget and timeline. Status tells you where you are now. Progress tells you what has been delivered to date. Cumulative is a made up term
8. B – Confirm receipt of the message and verify understanding with the stakeholder. Answer A is not a preventive approach. C and D might be potential solutions after you have determined the real issue
9. D – Face-to-face with a whiteboard is the most effective followed by C, B and A
10. B – The sender is responsible for encoding the message in a form the receiver will understand. The receiver will confirm receipt in the form of feedback and ask for clarification, if needed (answer A). C is not a possible scenario. D is subsumed in answer B – the sender is responsible for picking the best medium.
11. B – Active listening is not a 'challenge' process – it is a listening process
12. C – It is Executing. *PMBOK® Guide,*5th edition p. 288
13. A – Efficient communications provide only the information that is needed, whereas effective communications insure the timeliness and the format of the communications. *PMBOK® Guide,*5th edition p. 294
14. B – Cultural difference is the communication barrier. While the questioner may experience culture shock (!), it is usually the result of a communication barrier. There is no evidence to support the answers in C or D.
15. C – The team member is the stakeholder. Answer A describes a potential stakeholder. Answer B gets paid to review the product whether they use it or not (although their opinion may impact your sales!). Answer D is probably working to her own P&L, has nothing to do with your product and probably hasn't heard of it.
16. C – Since 7% of your message is conveyed through the words alone, a formal written approach may not be the best given differences in language. A video teleconference is the next best thing to being there: words + vocal inflection + body language
17. B – e-learning systems are de facto 'pull' methods – the user pulls value from the system on demand. *PMBOK® Guide*, 5th edition, p. 295
18. C – Per Peter Drucker. On any communication heading up the corporate communication hierarchy, the noise level doubles when passing through each level in the organization
19. A – Updates to the OPA (organizational process assets). *PMBOK® Guide*, 5th edition , p. 288
20. B – It describes a transmission and feedback issue: the signal is weak and feedback is prevented. Answer A is only partially correct. Since the message is whispered, it is not being put in the most effective form for this receiver to understand it. There is no evidence to support answer C or D
21. C – This scenario describes a stakeholder expectation scenario and, as such, the key tools and techniques for managing stakeholder expectation are interpersonal skills and management skills.
22. A – The first thing to do is to have an informal off-line conversation with the resource to assess the situation – this is an informal verbal communication. Answers B and D are premature – until you have details regarding the issue, these approaches may appear punitive in nature.

23. B – In all likelihood, the project manager did not verify the quality of the data. One of the key elements in performing a variance analysis is to verify the quality of the data going into the variance report. *PMBOK® Guide*, 5th edition, p. 352
24. B – Confronting unacceptable behavior with the appropriate management is the ethical thing to do. Answer A does not address the issue. Answers C and D would leave the PM open to a charge of unethical behavior himself!
25. B – The VP is culturally unaware. Had he done a little research, he may have discovered that many citizens of India do not eat beef or are vegetarian

Chapter 11 : Project Risk Management

Section Topics:

- Plan Risk Management
- Identify Risks
- Perform Qualitative Risk Analysis
- Perform Quantitative Risk Analysis
- Plan Risk Responses
- Monitor and Control Risks

Section Objectives

After completing this section, you will be able to:

- List the various categories of risk
- Create and update a risk register
- Assess the impact of risk to your project
- Quantitatively evaluate the impact of each risk and total risk
- Describe the seven risk response strategies
- Define workarounds

Project Risk Management Process Summary

The high level Project Risk Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	Risk management plan		CRs	
	Risk register		Various document updates	
	Project documents updates			
	PM Plan updates			

Risk Management Overview

The key aspect in understanding risk management is this:

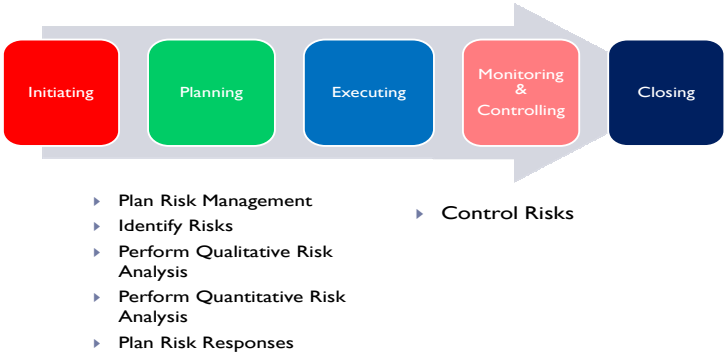
For the most part, risk management is done poorly on most projects and it is usually done very poorly (if at all) on technology or software projects.

There are entire project management methodologies based on a risk-driven approach to managing projects. Risk identification, management and response strategy impacts every area of the project management life cycle and the ten knowledge areas identified in the *PMBOK® Guide,* 5th edition.

Risk management touches on these key areas:

- Identify, quantify, evaluate, and manage risks
- Known risks vs. unknown risks
- Monitor identified risks for triggers or a change in severity
- Monitor for new risks
- Risks: can have positive or negative impacts

Project Risk Management



A key objective of performing project risk management is to increase the probability of project success by minimizing or eliminating negative risk events and increasing the probability of positive events.

For the exam, understand the following concepts:

- Risk Management includes the processes of planning risk management, identifying risks, performing qualitative and quantitative analysis of risks, planning responses to risks, and finally monitoring and controlling risks on the project
- Risk is always in the future
- Risk involves uncertainty - it may or may not occur
- Assess your organization's risk attitudes based on three general elements:
    - Risk appetite - what degree of uncertainty can the organization accept based on anticipation of a reward?
    - Tolerance for risk: are they risk tolerant or risk averse?
    - Risk threshold - at what level of the organization refuse to tolerate the risk?
- There will be known risks and unknown risks
- Risks can be negative or positive and are identified as threats or opportunities
- Risk is considered from the moment the project is conceived

Plan Risk Management

This process defines how you will conduct risk management activities for a project. It includes the process of defining and providing sufficient resources and time to perform risk management activities.

Planning for risk management begins when the project is originally conceived and should be completed early in the Planning process group. Understand that if risk is a significant aspect of your project management planning, you may need to enlist the help of risk management professionals within your organization or external to your organization.

Just as with quality, there is a cost in addressing the risk aspects of your project. However, understand that failure to address risks in a project can ultimately be much more costly, not only to the project, but also to the organization as a whole.

The Risk Management Plan

Components Include:	Which Define:
Methodology	How you will do risk management
Roles and responsibilities	Who will do what
Budgeting	What risk mgt. will cost
Timing	When we do risk mgt.
Risk categories	E.G. internal, external
Definitions of probability and impact	Will it happen and how severe the risk may be
Stakeholder tolerances	Risk tolerant or risk averse
Reporting formats	What goes into the report
Tracking	Audit of risk process

The output of the Plan Risk Management process is the creation and completion of the Risk Management Plan. The major categories in a risk management plan include:

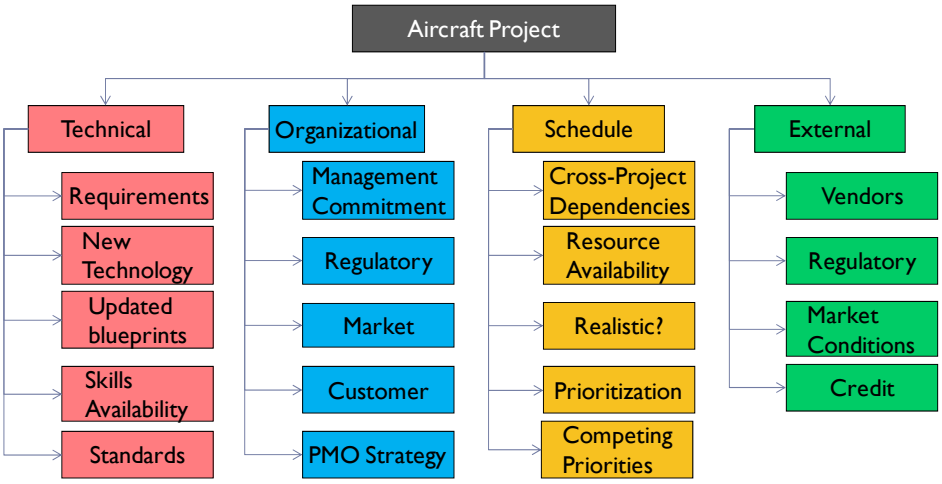
- Risk management methodology
- roles and responsibilities
- Budgeting
- Timing
- Risk Categories
- Definitions of probability and impact
- Probability and impact matrix
- Revised stakeholder's tolerances
- Reporting Formats
- Tracking

Risk Breakdown Structure

The risk categories in a project management plan can be graphically represented with a tool that is similar to the work breakdown structure (WBS) called a Risk Breakdown Structure (RBS).

The RBS enables you to see all project risks grouped by basic themes and the specific risk areas occurring in relation to each theme.

In the example shown below, notice there are high-level categories followed by subcategories in the risk breakdown structure. The categories demonstrated here are simply examples of what you can find in a risk breakdown structure. In reality, the number of risk categories and subcategories can number into the hundreds depending on the size of the project. An example appears below:



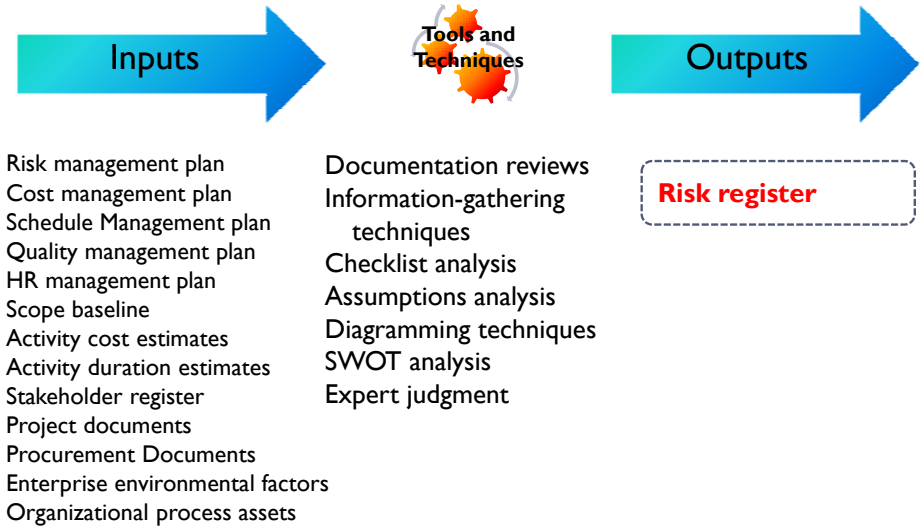
Categories of Risk

As we saw in the RBS, there can be any number of risk categories on a project - categories can number into the hundreds for a large project.

Tom DeMarco and Tim Lister in their 2003 book, *Waltzing with Bears,* identified five key risk categories on a software project:

- Scope Creep – from the stakeholders
- Inherent schedule flaws – usually due to unknown and uncertain elements, and also due to a miscalculation on the size of the product to be built
- Employee turnover – this possibility is usually left out of the estimation process, especially the time needed to ramp up replacement resources
- Specification breakdown – this is a show stopper, in which the customer cannot agree on what is being delivered, effectively bringing the project to a standstill. However, in reality, the conflict is usually so deep that it is often covered up and the project goes ahead with a flawed, ambiguous target. This will result in a project that is either canceled or does not meet customer expectation.
- Poor productivity –usually a result of the impact of the previous four risks described

Identify Risks



This process is used to determine which risks may affect the project, and can include the following resources when performing risk identification activities:

- Project manager
- Project Team
- Risk team
- Stakeholders
- Customers
- Subject matter experts

Identifying risks is an iterative process - new risks may become apparent as the project evolves. The tools and techniques of identifying risks on a project will be elaborated on the following pages.

Risk Information Gathering Techniques

The above-mentioned risk information gathering techniques are well established and have been in use for many years.

You may see reference to any one of these risk gathering techniques in an exam question.

Brainstorming and Delphi

Brainstorming is a technique developed by Alex Osborn (The 'O' in the advertising firm of BBD&O)in his book, *Applied Imagination*. The four fundamental steps to brainstorming are as follows:

1. **Focus on quantity**: The idea is to facilitate problem solving through the concept, *quantity breeds quality*. The idea assumes that the greater the number of ideas generated, the greater the chance of producing an effective solution.
2. **Withhold criticism**: In brainstorming, criticism of ideas generated is postponed until the team is ready to analyze the input. Instead, participants focus on extending or adding to ideas. By suspending judgment, participants will feel free to generate unusual ideas.
3. **Welcome unusual ideas**: To get a good and long list of ideas, unusual ideas are welcomed. They can be generated by looking from new perspectives and suspending assumptions. These new ways of thinking may provide better solutions.
4. **Combine and improve ideas**: Good ideas may be combined synergistically, to form a single improved good idea, as suggested by the counterintuitive "1+1=3". It is believed to stimulate the building of ideas by a process of association.

The Delphi Technique was developed by the RAND Corporation (an acronym for **R**esearch **AN**d **D**evelopment) in the 1960s and was created as an interactive forecasting method that relies on a panel of independent experts. Usually, all participants maintain anonymity. Their identity is not revealed even after the completion of the final report. This stops them from dominating others and using their authority or personality. This frees participants from their personal biases, minimizing the "bandwagon effect" or "halo effect", allowing them to freely express their opinions, encouraging open critique and admitting errors by revising earlier judgments.

Root Cause Analysis (RCA) and Expert Interviewing

RCA is a reactive method of problem detection and solving, initially. The analysis is performed ***after*** an event has occurred. This allows practitioners to identify process 'triggers', so that RCA becomes a pro-active method. In other words, RCA is able to **forecast** the possibility of an event **before** it might occur.

RCA is not a single, sharply defined methodology; there are many different tools, processes, and philosophies of RCA in existence. However, most of these can be classed into five, very-broadly defined "schools" that are named here by their basic fields of origin: safety-based, production-based, process-based, failure-based, and systems-based.

- Safety-based RCA descends from the fields of accident analysis and occupational safety and health.

- Production-based RCA has its origins in the field of quality control for industrial manufacturing.
- Process-based RCA is basically a follow-on to production-based RCA, but with a scope that has been expanded to include business processes.
- Failure-based RCA is rooted in the practice of failure analysis as employed in engineering and maintenance.
- Systems-based RCA has emerged as an amalgamation of the preceding schools, along with ideas taken from fields such as change management, risk management, and systems analysis.

Several RCA techniques include Kepner-Tregoe, FMEA, Pareto Analysis, Bayesian inference (conditional probability), Ishikawa diagrams and many others.

Expert Interviewing is the process of interviewing subject matter experts to obtain critical information for the project.

SWOT Analysis

	Strengths	Weaknesses
Opportunities		
Threats		

This one analysis is generally set up as a grid with strengths and weaknesses as the two major columns, and opportunities and threats as the two major rows in the grid. The idea is to see where the organization's strengths and weaknesses play against opportunities and threats using the four following comparisons:

- **Strengths-Opportunities**-identifies how organizational strengths help the organization to capitalize on opportunities
- **Weaknesses-Opportunities** - identifies organizational weaknesses, from the perspective of making the necessary improvements, to enable the organization to capitalize on opportunities
- **Strengths-Threats** - identifies how our organizational strengths help us deal with competitors or threatening situations
- **Weaknesses-Threats** - identifies how our organizational weaknesses leave us vulnerable to external competition or threats

SWOT analysis came from the research conducted by Albert S. Humphrey at the Stanford Research Institute from 1960-1970. The development of SWOT stemmed from the need to find out why corporate

planning frequently failed. The research was funded by the fortune 500 companies to find out what could be done about this failure.

The Risk Register

Risk Register				
Project		**PM**		
Project ID		**Updated**		
Sponsor		**Version**		

Risk Priority	Description	Probability	Impact	Result	Risk Category	Risk Trigger	Response Strategy	Contingency strategy	Owner	Entry Date	Response Due Date	Actual Date	Risk Realized?
				0									
				0									

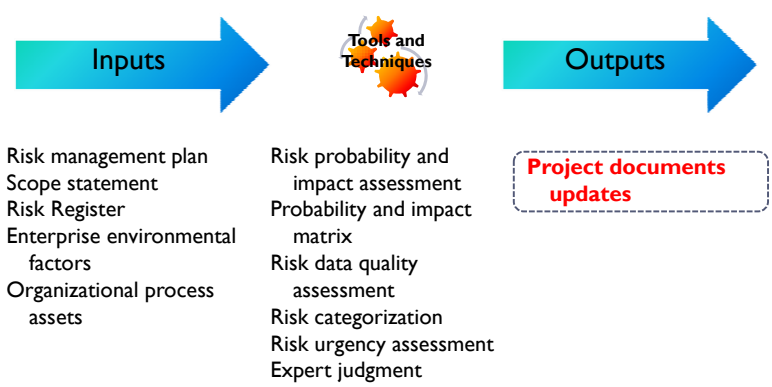
The risk register becomes a key planning tool for the project. Understand that although a risk identifies only the *probability* of an event occurring, the possibility of the event is deemed to be real, true and requires assistance in monitoring.

The risk register example shown above contains a description of the risk, it's probability, its impact in dollars, a category of risk, the triggering event that indicates the risk is about to occur, the risk response strategy, the risk owner, the date the risk was identified, a due date for resolution and most importantly, the risk's priority. Also understand this key point about risks in the risk register:

Any risk with a probability percentage of 90% or greater is no longer a risk, it's an issue!

In other words, your risk just became an issue (now an issue in the issue log that needs to be dealt with in proactive terms.

Perform Qualitative Risk Analysis



The process of qualitative risk analysis focuses on prioritizing risks for further analysis or action and identifying the high priority risks. The only output to the qualitative risk analysis process is updates to the project documents. To perform these updates, we use a battery of tools and techniques to help us perform qualitative risk analysis.

An example of a qualitative risk assessment matrix appears below:

QUALITATIVE RISK ASSESSMENT MATRIX			
Risk Description	**Business Impact**	**Probability of Occurrence**	**Risk Score**
	Probability	As a percent	As a Percent
Lead Architect Leaves	.2	.15	3%
Technology does not work as planned	.15	.05	.75%
Timeline underestimated	..90	.75	67.5%
Vendor delivers 1 month late	.75	.50	37.5 %

Qualitative Risk Assessment Matrix

The qualitative risk assessment matrix offers a summary level of the potential impact of the risk, based on approximate percentages. Notice that this matrix shows general percentages that are not tied to specific dollar amounts or timelines. Another way of showing a qualitative impact is to rank the probabilities as high, medium or low:

Risk	Impact	Likelihood
Shipments are delayed	High	Low
Long lead times for hardware	Medium	Medium
Resource unavailability	Medium	Low
Rework issues	Low	High

Project Documents Updates

The project risk register and assumption log are updated. Partial List of Risk Register Updates include:

- Ranking and prioritization of project risks
- Grouping risks by categories

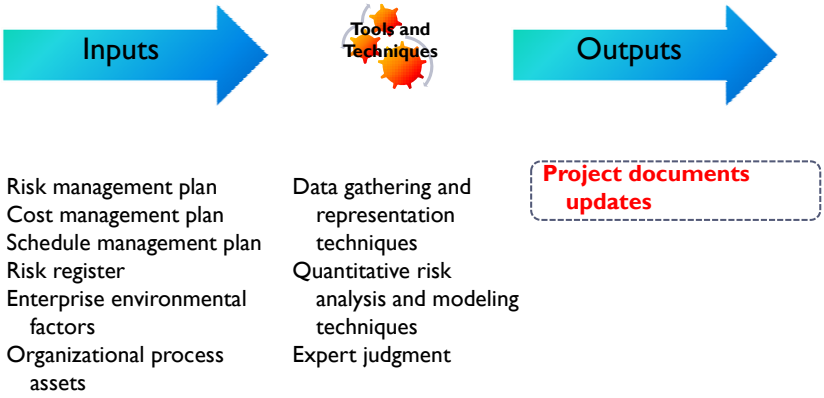
- Risks requiring near-term response
- Risks requiring additional analysis and response
- Low priority risks to monitor
- Look for trends in results – regression analysis or trend charts

Risk register updates will generally include the outcome of risk assessments, risk audits, and periodic risk reviews. This can include identification of new risk events or updates to risk probability, risk impact, risk priority and risk response plans.

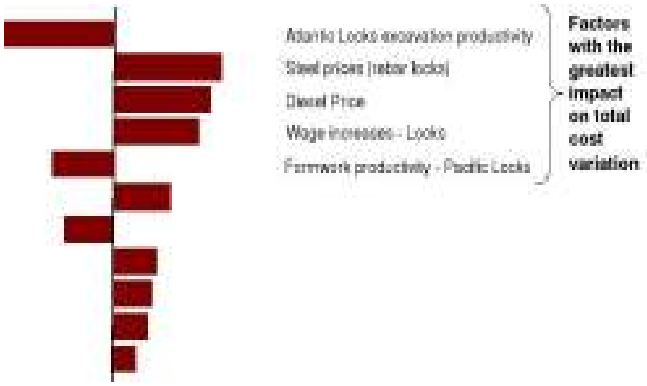
An important use of the risk register is to view the actual outcomes of the project risks and risk responses against anticipated risks. This data can help project managers plan for risk as the project moves forward.

For the Exam: Risk Register updates are an output of Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses and Monitor & Control Risks.

Perform Quantitative Risk Analysis



Quantitative risk analysis involves the numerical quantification and measurement of the effects of identified risks on the project. It frequently involves the use of sophisticated mathematical modeling techniques to create forecasts and trend analysis.



One of the more common analysis and modeling techniques is the sensitivity analysis, which is used to identify the risks with the largest potential impact on the project. The tornado diagram is frequently used to display the sensitivity analysis. The example shown is from the US Department of Transportation.[42]

[42]http://international.fhwa.dot.gov/riskassess/images/figure_17.cfm

Failure Modes Effects Analysis (FMEA)

Potential
Failure Mode and Effects Analysis
(Design FMEA)

Item	Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Potential Cause(s) / Mechanism(s) of Failure	Current Design Controls Prevention	Occurrence	Current Detection Design Controls		Detection	R.P.N.
								Cause	Failure Mode		
Name,	Requirements of function being analyzed	Manner in which systemcould fail:	Effects of failure as perceived by customers.		List every potential cause and/or failure mechanism:	List prevention activities		List Causes	List detection activities		0

FMEA: Failure Modes Effects Analysis. The FMEA is useful for manufactured product or where risk may be undetectable:

- Utilizes three measures: 1) Severity, 2) Occurrence, 3) Detectability to produce the Risk Priority Number (RPN) : The higher the RPN, the greater the risk
- This is also referenced as a 'non-proprietary' approach to quality management in the Project Quality Management chapter (Chapter 8)

A key aspect of the failure modes and effects analysis, or FMEA, is that it uses three measures to determine the Risk Priority Number:

- **Severity** of the risk - represented on a numeric scale from 1 to 10, 1 representing no effect, to 10 representing a high hazard (unsafe without warning)
- **Probability** of occurrence – 1 representing the current probability of less than .0007%, to 10 representing a probability of 20% (almost continuous failure) or greater
- **Detectability** of the risk – 1 representing a risk that is highly detectable, to 10 representing a risk that is completely undetectable (failure without warning)

The three numbers are multiplied together to produce the RPN (Risk Priority Number)

This risk register type is particularly effective for manufactured products or for software products in which the software controls mechanical devices that could potentially cause serious injury or loss of life if the software (and therefore the device itself) were to fail.

While the FMEA is initially described in the Quality Management knowledge area as a 'non-proprietary' quality management approach, it was invented by the US Army in 1949 and was designed to assess high risk elements:

"Each potential failure is ranked by the severity of its effect in order that appropriate corrective actions may be taken to *eliminate or control the high risk items*"[43]

Expected Value/ Expected Monetary Value

Expected value or Expected Monetary Value (EMV) is computed by multiplying the probability of an event by its impact. Examples appear below:

Risk #	Probability	Impact	Expected value
1	30%	-$20,000	- $6,000
2	25%	28 Days	7 days
3	11%	-$95,000	-$10,450
4	40%	-$38,000	-$15,200
5	20%	+$40,000	+$8,000

Example #5 is an example of an opportunity: There is a 20% chance of saving $40K which results in a potential EMV savings of $8K. Notice that the impact values can be expressed in time or dollars.

QUANTITATIVE RISK ASSESSMENT MATRIX			
Risk Description	Business Impact	Probability of Occurance	Expected Monetary Value (EMV)
(	In Dollars ($)	As a percent	in Dollars ($)
Lead Architect Leaves	$ 50,000.00	15%	$ 7,500.00
Technology does not work as planned	$ 250,000.00	5%	$ 12,500.00
Timeline underestimated	$ 150,000.00	25%	$ 37,500.00
Vendor delivers 1 month late	$ 75,000.00	20%	$ 15,000.00
			$ -
			$ -
			$ -
			$ -
			$ -
			$ -
			$ -
		Total Risk	$ 72,500.00

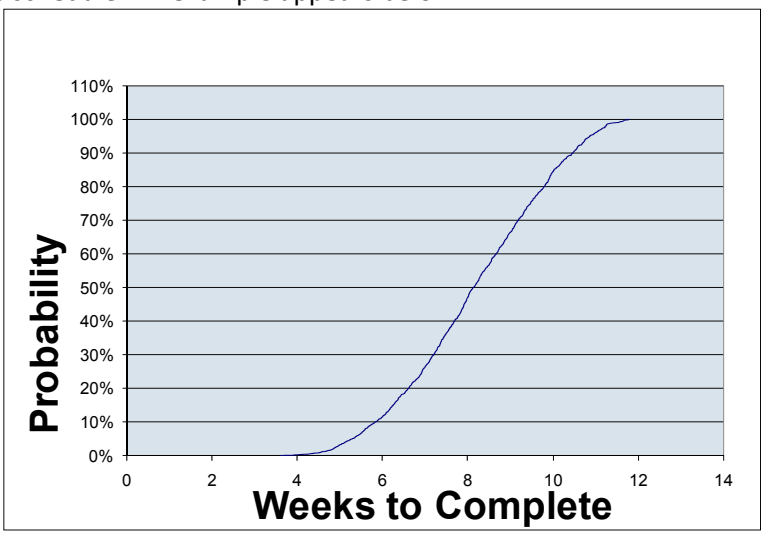
[43]MIL-STD-1629A, Procedures for Performing a Failure Modes and Criticality Effects Analysis" November 1980,p7

Monte Carlo Analysis

Monte Carlo analysis is a mathematical modeling technique requiring the use of statistical analysis tools to render the model. The graphic below demonstrates what is called a cumulative distribution, otherwise known as an 'S' curve.

The Monte Carlo analysis can use PERT or triangular distributions to model data. Whereas the PERT estimate uses a single optimistic, most likely, and pessimistic estimate to derive a weighted average, the Monte Carlo analysis can use hundreds or even thousands of data points that can be combined into an overall model.

The graphic above utilized the PERT estimate coupled with a random variable to produce a thousand data points. The data points were then graphed in the chart you see below. The Monte Carlo can be run for budget as well as schedule. An example appears below:



Decision Tree Analysis

The decision tree analysis is another form of EMV that is used for more complex decision making in which there are multiple decisions possible and complex uncertainties. The decision tree utilizes two type of branching:

- _____: illuminates a possible path forward based on the decision made by the business
- _____: illuminates the probability of success based on certain conditions

The example below demonstrates a build or buy decision scenario.

The decision branches:

- Buy the product for $85K
- Build the product in-house for $200K

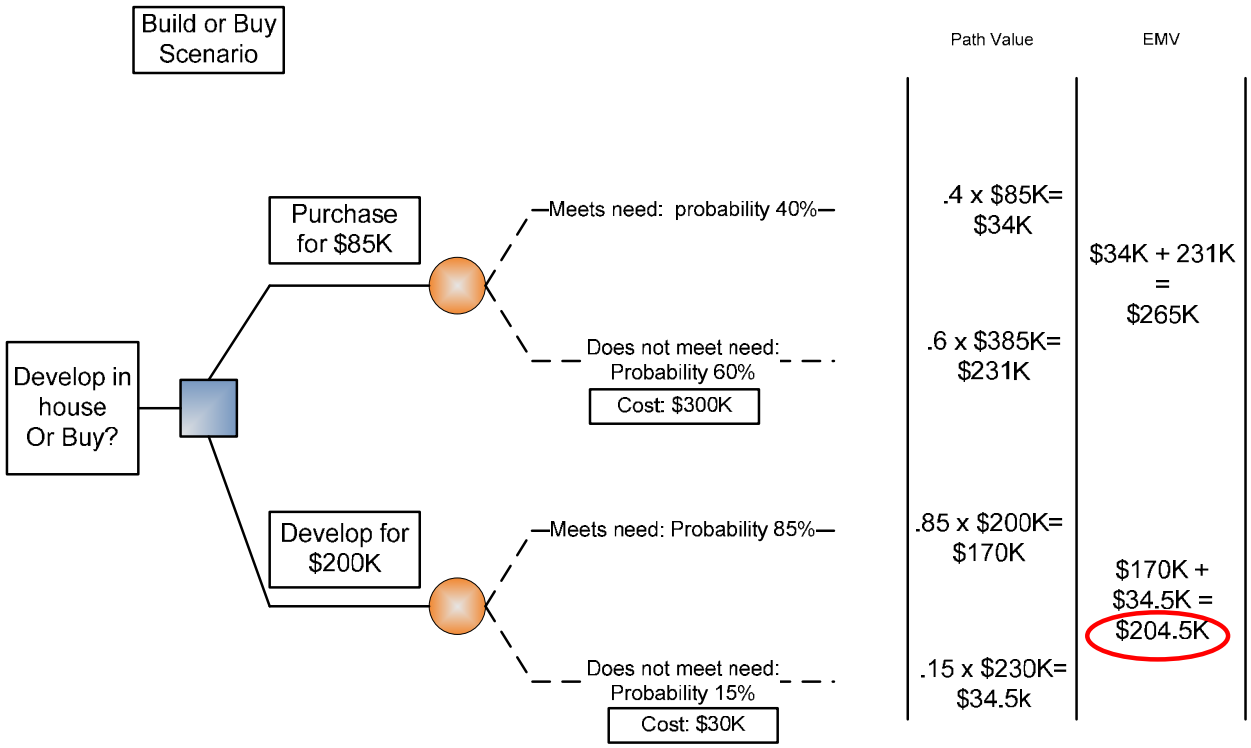
The uncertainty branches for the 'buy' scenario:

- The product meets the need (40% probability)

- The product does not meet the need (60% probability)

The uncertainty branches for the 'build' scenario:

- The product meets the need (85% probability)
- The product does not meet the need (15% probability)



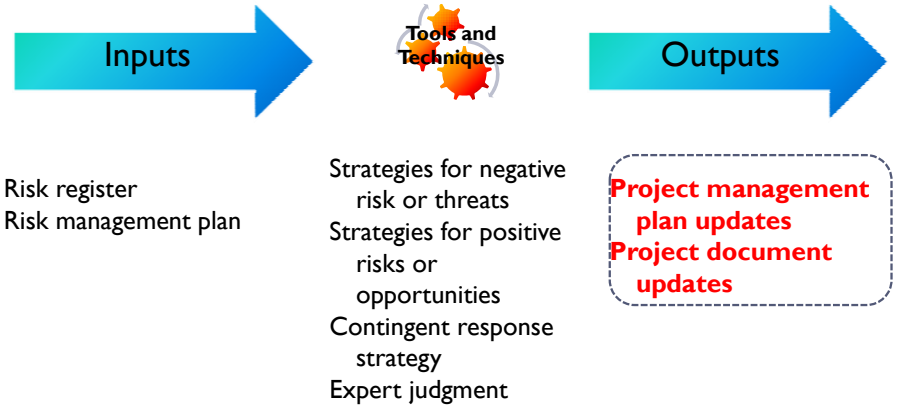
Notice that for each 'uncertainty' path, the same EMV calculation is performed as it was before in previous examples: Impact in dollars times the probability. Each calculation produces a 'path value' as shown in the first column entitled; Path Value. The probability percentages can be derived via a PERT estimate or expert judgment.

Finally, the uncertainty path values for each decision branch are added together to produce the EMV as shown in the far right column. For the scenario above we are looking for the lowest cost option. In this case the decision tree shows that the 'develop in-house' scenario offers the lowest cost: $204.5K.

Project documents updates may include the following:

- Probabilistic analysis of the project
- Probability of hitting time and cost goals
- Prioritized list of risks

Plan Risk Responses



After risks are identified and evaluated from a qualitative and quantitative perspective, we can plan our responses to risk, and either to enhance opportunities, or reduce threats for the project.

There are a number of risk response strategies that can be employed on a project, however, all of the responses fall into the following basic categories:

- Implementing actions to prevent the risk from occurring
- Implementing actions in response to a risk occurrence
- Implementing actions to mitigate or reduce the risk occurrence
- Implementing actions to promote opportunities
- Implementing fallback or contingent responses, in the event risk response plans do not work

Risk Response Strategies

For the exam, understand there are two fundamental types of risks; negative risks and positive risks (otherwise known as opportunities).

<u>Examples of Risk Strategies – Negative Risks</u>

- _____ – Elimination of the potential threat. For example, you are dealing with a vendor and there is the threat of a potential major strike. Your avoidance strategy would be to switch vendors to an organization that does not have unions at all.
- _____– This involves shifting some or all of the negative impact of a threat, along with the ownership of the response, to a third party. Examples include purchasing insurance, performance bonds, warranties, or other forms of guarantee.
- _____ –this involves a reduction in the probability or impact of the risk. Designing fault tolerance into a system is a risk mitigation strategy. Instead of shouldering the full cost of the development of a new high risk product, you find three or four partners who can share the expense of development. In case of failure, your exposure to loss has been cut by 75-80%
- **Accept –** Acceptance means that you cannot eliminate, transfer, or mitigate a threat, and there is no other suitable response strategy. You can actively or passively accept the threat:

- Passive acceptance means you take no action and deal with the risk if it occurs
- Active acceptance commonly means you have set aside contingency reserves to deal with any potential risks

Examples of Risk Strategies – Positive Risks

- _____– is used when the organization wants to ensure an opportunity is realized. Saving funds by using existing equipment or facilities is an exploit strategy.
- _____ – occurs when the organization transfers ownership of the opportunity, in part or altogether to a third party to ensure the opportunity occurs. Engaging a sub-contractor with specialized skill sets not available in your organization can help you capture an opportunity that may have been out of reach otherwise.
- _____– used to increase the impact or probability of an opportunity. Ending a project early by using highly experienced resources, or utilizing specific schedule compression techniques, is an enhancement opportunity.
- **Accept –** willing to take advantage of an opportunity without actively pursuing it.

Quick Quiz: You will need to know and understand the risk response strategies listed above. Look at the table below and see if you can quickly identify what type of risk response strategy is being employed in each situation:

Risk Description	Response Strategy?
There is a risk your lead architect may leave the project before her job is completed. As a result you cross-trained one of the developers to handle lead architect responsibility.	
The database for your software project is expected to run into multiple terabytes. After consulting with the infrastructure team you discover there are terabytes of available storage in the data center that can be secured at a much lower cost than purchasing new equipment.	
An out-of-state vendor on your project has expressed concerns about meeting delivery due dates. You engage a local vendor that can easily meet the delivery dates without issue.	
Staffing up for customer service on your project will take too long and be too expensive. You identify a vendor that will exceed your customer service requirements and will pay penalties if their service falls below stated quality levels.	
In your RFP response you identify a potential partner that will increase the likelihood you will secure a contract and achieve the opportunity	
You're running a product launch outdoors on the California coast. You can't afford rain on the date. You contact a tent company to erect tent that will hold up to a thousand guests in the event of rain.	
Your client stated that you can obtain incentive fees by turning in daily status reports (DSR). Your lead developer created a small DSR application that can be beamed to every consultant's smart phone that helps to automate the DSR process and help to ensure compliance.	

Contingency Plans

Contingency plans are developed for a specific risk. Contingency plans are generally developed when you have accepted a risk and now have developed a plan 'A' as a contingent response. These plans are executed only under predefined conditions, and when there is sufficient warning to implement the plan.

Fallback plans (plan 'B') are implemented when a contingent response is not effective.

Residual and Secondary Risks

Residual risks are identified as risks that remain after a risk response strategy was implemented. It is possible that residual risks can be identified in the risk planning process, in which case they are subject to contingency and fallback planning.

For example, if you know that certain key personnel on the project might leave before the project is over, your risk response strategy many include required cross-training of other lower level resources. There is a potential residual risk that even with cross-training, the lower level resources might not perform to the level expected. In this event, you may have identified a contingent or fallback plan to address the residual risk.

A secondary risk is a risk that results from implementing a risk response strategy. Secondary risks can be identified in the planning process, or they might occur as a result of discovery.

For example, you implemented a risk avoidance strategy by replacing an unreliable vendor with a highly dependable vendor on a project. However, unknown to you at the time, the dependable vendor was in negotiations to be bought out by a larger company. The secondary risk with the dependable vendor may include elements such as unexpected price changes, changes in resource availability, or a complete change in the business model.

Contingency and Management Reserve

Contingency risk reserve handles 'known unknowns':

- Risks have been quantified
- Risk category has been determined

Management reserve handles unknown risks i.e. 'unknown unknowns':

- Assessment of overall project uncertainty or project unknowns is needed
- Risk occurrences are usually described as 'discovery'

Exam Tip:

Contingency reserves, aka money allocated for known risks (or known 'unknowns'), are part of the ***cost baseline*** of the project.

Contingency reserves plus management reserves (money allocated for unknown risks) are part of the ***project budget*** of the project.

Risk Register Updates

The risk register is completed at this point and can include:

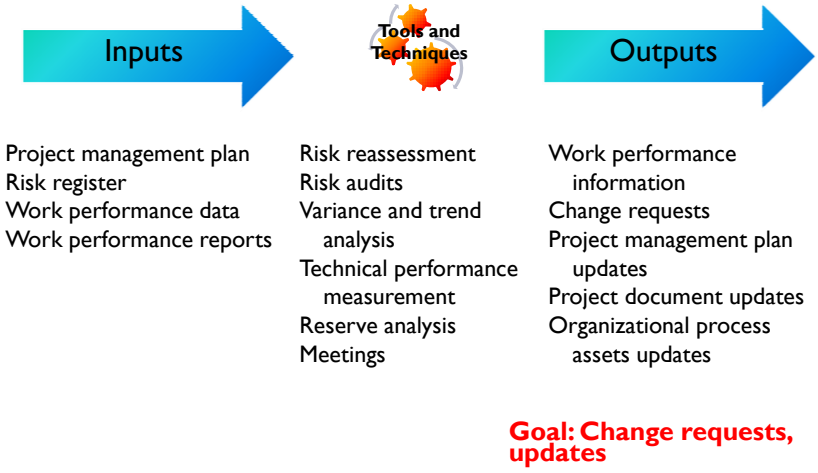
- Identified risks and descriptions
- Triggers
- Response strategy
- Specific actions taken if risk occurs
- Responsible party or owner
- Results from qualitative and quantitative risk analysis process
- Primary and secondary responses for each risk
- Residual risks that are expected to remain
- Risk budget
- Contingency and fallback plans
- Contingency reserves for time and cost

The risk register is designed to be written to a level of detail that corresponds with the priority ranking of the risk and its associated response. Frequently, the lower level, low priority risks are placed on a 'watch list' for periodic review and monitoring. The listing above is a partial listing of elements that can be included in the risk register.

Exam Tip: Know the following for the exam

Risk Register Updates (Outputs)	
Qualitative Risk Analysis	**Quantitative Risk Analysis**
Risk ranking	Probabilistic analysis of project
Group risks by category	Probability of meeting cost/time objectives
Risks needing special attention	Prioritized list of quantified risks
Risks needing near term responses	Trends in quantitative risk analysis results
Watchlists of low priority risks	
Trends in qualitative risk analysis results	

Control Risks



As in other monitor and controlling activities, it is assumed you have performed all the necessary elements to identify and quantify project risk, and have created the necessary strategies to respond to risk on the project. *For the exam, it is assumed that the project has a lower risk profile as a result of your risk and project management planning activities*.

Part of the process of monitoring and controlling risks is to perform risk reassessments of the project on a regular basis:

- You are utilizing variance and trend analysis to see if the risk elements changed and if assumptions are still valid
- Are risk procedures being followed or do they need updating?
- Have lower level, low priority risks become high priority risks?
- Have certain risks been addressed, and be considered closed on the risk log?
- Do contingency or management reserves need to be adjusted?

The exam assumes that you are doing these things throughout the project. Other risk monitoring and controlling elements are listed on the following pages.

Risk Audits and Reviews

In most large organizations, there are individuals who specialize in risk auditing and conducting risk reviews. You would do well to learn as much as you can from these individuals about project risk - it will help you do a better job of identifying risks and planning risk responses. Usually, risk audits are periodically scheduled throughout the project. They are typically conducted by people outside of your immediate organization. Why do you think that is so?

There are several reasons why auditors are not part of the project team:

- Provides for an objective review of risks
- Provides a fresh pair of eyes to review risk elements from a different perspective
- Can help identify risks not considered by the team

- Risk reassessment or risk reviews
  - Periodic and scheduled
  - Should occur to determine if any risk priorities or ratings have changed
- Risk audits
  - Carried out throughout project life
  - Typically performed by experts outside project team

Additional Risk Tools

Variance and Trend analysis compares planned results to the actual results. Variance tools such as earned value analysis can be used for monitoring overall project performance. As a result, potential forecasts of deviation at the project's completion from cost and schedule targets are possible.

Technical Performance Measurement compares technical accomplishments during project execution to the project management plan schedule of technical achievement. Quantifiable measurements are taken and compared against actual results.

Reserve Analysis compares the amount of contingency reserves remaining to the amount of risk remaining at any time in the project.

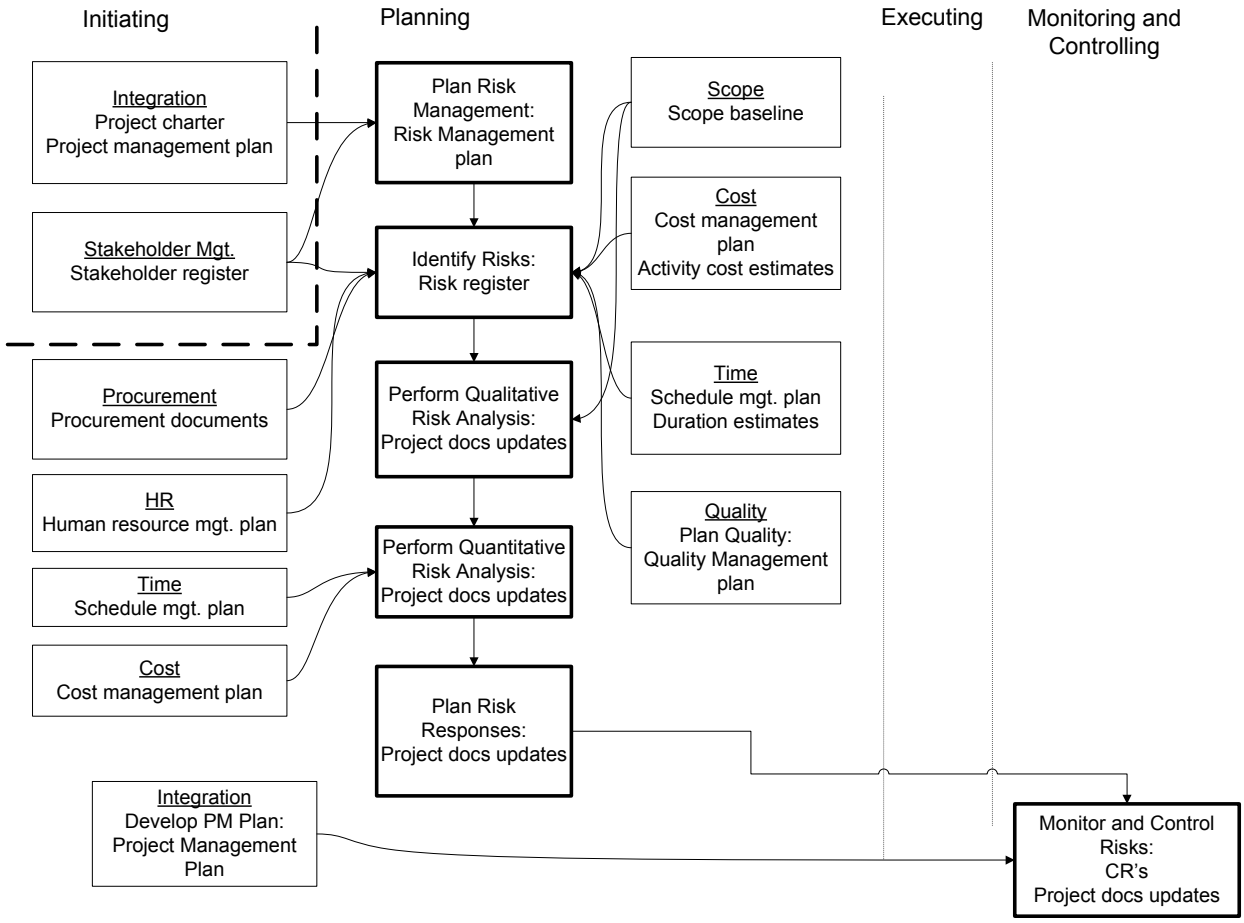
Exam Tip: reserve analysis and the funds set aside for contingencies apply *only* to the specific risks on the project for which they were set aside.

Workarounds

Workarounds are usually employed when no contingency plan exists, and are generally executed 'on-the-fly' to address some unplanned event. The result of implementing a workaround can be the identification of an undiscovered risk for which the contingency and fallback planning can now be addressed.

Project Risk Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Risk Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

This section discussed risk management, including:

- The benefit of using a risk breakdown structure
- Information gathering techniques: brainstorming, Delphi technique, interviewing, root cause identification, and SWOT analysis
- Importance and components of the risk register
- Using decision trees and Monte Carlo simulation to assess the quantitative impact of each risk item
- Deciding on the best risk response strategy: avoid, transfer, mitigate, exploit, share, enhance, or accept risk events
- The purpose of risk response audits

Risk Process Check

Match the process to its description:

___Plan risk management

___Identify risks

___Perform qualitative risk analysis

___Perform quantitative risk analysis

___Plan risk responses

___Control risks

A. The process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact

B. The process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating the risk process for effectiveness throughout the project

C. The process of developing actions and options to enhance opportunities and to reduce threats to project objectives

D The process of defining how to conduct risk management activities for the project

E. The process of determining which risks may affect the project and documenting their characteristics

F Process of numerically analyzing the effects of identified risks on overall project objectives

Chapter Eleven Memory Check

1. The risk categories in a project management plan can be graphically represented with a tool called a _____
2. The five Planning steps in Risk Management are, in order: _____, _____, _____, _____, and _____
3. The tool that is used to determine where the organization's strengths and weaknesses play against each other is called a _____ grid
4. A risk register that measures probability, impact, and detectability is known as a _____
5. A decision tool that is best used when the participants could become contentious is known as the _____
6. A reactive method of problem detection and solving in which the analysis is performed ***after*** an event has occurred is called a _____
7. A repository for all known risks on a project that identifies risk responses and owners is called a _____
8. Multiplying the Impact of an event in dollars times its probability is called the _____
9. Three types of responses to negative risks are known as_____, _____, and_____
10. A decision tool that illuminates a possible path forward based on a decision made by the business and the probability of success of each decision path is called a _____
11. The types of responses to positive risks are known as _____, _____, and _____
12. The risk response plan that is used when the risk has been accepted is called a _____ plan
13. A minor risk that remains after the risk response strategy has been implemented is called a _____ risk, whereas a risk that occurs as the result of implementing a risk response strategy is called a _____ risk
14. A _____is developed when a selected risk strategy is not fully effective or if risk has a high impact
15. _____are used to provide funding for the 'unknown' unknowns of a project – while _____ are used to handle the known unknowns
16. An unplanned response to risk when no contingency plan exists is called a _____
17. A risk response that is used for both positive and negative risks is called _____
18. A statistical modeling tool used to create cumulative distributions and what-if scenarios is called a _____
19. A risk information gathering technique that collects as many ideas as possible is called _____
20. A document that describes how you will manage and plan your risk responses is called a _____

Chapter 11 Test

1. The tool that lists the categories and subcategories of risk on a project is known as a:
    a. Risk breakdown structure
    b. Quantitative risk analysis matrix
    c. Probability and impact matrix
    d. Stakeholder tolerance matrix

2. An assumptions analysis is used to:
    a. Identify historical information for risk analysis
    b. Identify root causes
    c. Assess the validity of risk assumptions
    d. Assess the effectiveness of potential risk responses

3. The project manager overhears two stakeholders discussing the current project. Each stakeholder is discussing the risk impacts of the project on each of their departments. The first stakeholder states that the project will have impact on her department, but states that the team has effective strategies for dealing with it. The second stakeholder is voicing great concern because it may cause them to double their workload. They are looking to acquire additional headcount to meet the need but the company just implemented a hiring freeze (!) At this point, the second stakeholder does not know how serious the impact on her department will be. At the next stakeholder meeting, what will you *most likely* discuss with the stakeholders?
    a. Stakeholder register
    b. Stakeholder risk tolerances
    c. Risk management plan
    d. Risk avoidance strategies

4. What is the purpose of a root cause analysis?
    a. To find defects in a product or process
    b. To identify problem resolutions for difficult issues
    c. To identify the individual(s) responsible for the failure
    d. To find the ultimate precipitating event that caused the failure

5. A series of stakeholder meetings were called to address the needs of stakeholders for the upcoming project. A list of 150 requirements was drawn up. After reviewing the list and developing a high level estimate, the PM reported back to the stakeholder group that due to the budget limitations on the project, it would be possible to deliver 75 of these requirements. A new meeting was called to cull the list from 150 to 75. The stakeholders, all PhD's, were going through the list, when there was serious contention about a group of requirements. The disagreement escalated to a shouting match, and several stakeholders left the meeting infuriated. What risk tool would have *best* prevented this situation?
    a. Brainstorming
    b. SWOT analysis
    c. Delphi Technique
    d. Nominal Group technique

6. All of the following are key risk register components with the *exception* of:
    a. Identification of the risk trigger
    b. The risk owner
    c. Who identified the risk
    d. The risk response strategy

7. A unique aspect of the quantitative risk analysis process is that PMI recommends that quantitative risk analysis:
    a. Should be performed in conjunction with quality assurance
    b. Should be repeated after Plan Risk Responses to determine if project risk has decreased
    c. Can be used in place of Perform Qualitative Risk Analysis
    d. Can be used to make unknown risks, visible to the project team

8. What is the expected monetary value (EMV)?
    a. The potential cost/benefit of a risk, positive or negative
    b. What the project ROI will be
    c. The amount of the risk contingency budget
    d. The cost baseline minus the risk contingency

9. Your project is completed and is ready to roll into maintenance and support mode. You are weighing the risk of having the internal organization handle support; or contracting an external company that has guaranteed 99.9% response time within an hour for all support issues. There are financial penalties for the external company if it does not meet its guaranteed response time. You decide on the external vendor. This risk response strategy is known as?
    a. Accept
    b. Transfer
    c. Exploit
    d. Mitigate

10. The risk register has been reviewed for completeness at this point in time. Risks have been prioritized based upon urgency and potential impact. As the team was working on the project, an event occurred that was not identified in the risk register. Since something needed to be done to handle the emergency, the technical team implemented a temporary fix until the issue could be discussed and a permanent resolution installed. This is best described as a:
    a. Secondary risk response
    b. A workaround risk response
    c. A residual risk response
    d. A contingency risk response

11. Your risk register is reviewed by an external team every two weeks so that 'fresh eyes' are looking at all potential risks. One of the risk response strategies to a specific risk is met with some skepticism by one of the assessors. "You may need to develop an additional response strategy in case this one creates additional problems for you." What kind of risk is she referring to?
    a. Secondary risk
    b. Fallback plan
    c. Residual risk
    d. Workaround

12. You are developing a revolutionary new product for the telecom industry. It is a switching product that provides voice, video and data over the same pipeline, but uses a technology that has never been tried before. The potential return on investment for this product is $5 billion. Your estimated development costs are $150 million. If you go it alone, there is a 65% chance that you will succeed. You also decide to look into developing the product with a partner that has specific experience with this new technology. With a partner, there is an 85% chance that you will succeed, but development costs in this case are $250 million, of which the partner is carrying $50 million. Because you are shouldering 80% development costs, you decide to split the ROI with 80% going to you and 20% going to the partner if the project succeeds. What is the best EMV scenario from your organization's point of view?
    a. Build the solution alone for $3.25 billion in potential return

b. Build with a partner with a $4.25 billion in potential return
c. Build with a partner with a $3.37 billion in potential return
d. Build the solution alone for $3.35 billion in potential return

13. Risk register updates typically include the following *except*:
    a. Trends in risk analysis results
    b. Probability of achieving cost and time objectives
    c. Risk management reserves
    d. Prioritized risk ranking

14. The impact of risk and the probability of experiencing a risk event are *best* described in?
    a. Probability and impact matrix
    b. Risk Management Plan
    c. Risk Register
    d. Random Access Matrix

15. The process of determining which risks have the *most* potential impact on the project is known as a?
    a. Risk probability and impact assessment
    b. Risk data quality assessment
    c. Sensitivity analysis
    d. Expert judgment

16. You are managing a project in which measurement accuracy is of paramount importance. Which of the following would have the *largest impact* to decrease the risk of obtaining inaccurate measurements?
    a. Secure resources with the most experience in measurements
    b. Make sure the measurements are taken at the same time of day
    c. Have the QA team audit the process
    d. Have the resources take measurements against previously measured elements that have established, verified results

17. You are managing a large project team of over 75 people. This computes to a minimum of 2775 potential lines of communication between all the team members. As the project manager, what is your *largest* risk concern?
    a. Crashing the e-mail system
    b. Controlling the communication hierarchy
    c. Shielding potentially embarrassing communications from senior executive staff
    d. Ensuring communications are clear

18. Your project has implemented several risk response strategies along the way. While the risk response strategies have generally worked, the project manager wants to explicitly evaluate the success of those risk response strategies. The tool that would *best* help the project manager make this determination is:
    a. Risk analysis
    b. Trend Analysis
    c. Quantitative analysis
    d. Variance analysis

19. You have just experienced a risk trigger on your project. What type of risk response *usually* occurs when a risk is triggered?
    a. Mitigation response
    b. Contingency response
    c. Avoidance Response
    d. Workaround response

20. Who owns the resolution of any given risk on the project?
    a. The team
    b. The sponsor
    c. The PM
    d. It depends on the specific risk response being utilized

21. All the answers below are reasons for performing risk management *except*?
    a. Reduce the impact of threats
    b. Ensure the occurrence of opportunities
    c. Elimination of issues
    d. Planning for known and unknown events

22. Your team has done a good job of implementing a risk response strategy for the current project. One of the risk triggers was activated and you implemented the appropriate risk response strategy for that risk. What occurred, however, was that an additional risk was realized as a result of implementing the documented risk response strategy. This type of risk is called:
    a. Residual Risk
    b. Tertiary Risk
    c. Unanticipated Risk
    d. Secondary Risk

23. The *main* purpose of a risk audit is to:
    a. Assess the thoroughness of the PM's risk management plan
    b. Reassess current risks listed in the risk register
    c. Examine and document the effectiveness of risk responses and the risk management process
    d. Evaluate variances and trends in project risks

24. Several risks have occurred on your recent project. You and your team implemented the appropriate risk response strategies with great success. What is the *next* thing the project manager should do?
    a. Inform senior management of the team's successful risk response
    b. Perform a risk reserve analysis
    c. Update the stakeholder management plan
    d. Update the risk register

25. Your newest 2 year project has a large number of technical developers on it – 175 to be exact. The organization didn't consider where they were going to put these people once the project started; the assumption was that 95% of the staff would come from internal departments where the developers already had a home. However, this project required skills not possessed by the performing organization and a hundred developers were coming in from the outside as consultants or additional headcount. Senior management realized they would have to rent a small building and outfit it for an additional 100 developers at a cost of $20,000 per month to the project, plus $50,000 in initial setup charges. At the next stakeholder meeting, one of the stakeholders informed the project manager that they had a warehouse that was practically empty that could be easily converted to use as a development center. In this case, set-up charges would only cost $40,000, and the project would save $20,000 a month. This type of risk strategy is called?
    a. Avoid
    b. Enhance
    c. Exploit
    d. Transfer

26. A major deliverable on the current project was approved by the stakeholders and released for initial trials to the user community. One week into the trial, an event occurred which crashed the entire system. Investigation revealed that there was no control put in place to tell them when the database in the process was going to reach capacity. The technical team installed an advance warning system as a risk trigger, but the same thing happened two weeks later. What did the project manager *probably fail* to do that would have avoided this situation?
    a. A proper defect identification
    b. A root cause analysis
    c. A process analysis
    d. Threat of punitive action for another failure

27. The implementation of a contingency plan or workaround *sometimes* results in a:
    a. Change request
    b. Risk ranking adjustment
    c. Secondary risk
    d. Risk audit

28. Recommended corrective and preventive actions are:
    a. Outputs of Monitor and Control Risks
    b. Tools and techniques of Plan Risk Responses
    c. Inputs to Perform Quantitative Risk Analysis
    d. Outputs of Perform Qualitative Risk Analysis

29. What three elements does an FMEA risk matrix evaluate?
    a. Probability, Impact and Detectability
    b. Cost, Likelihood and Urgency
    c. Impact, Cause, and Remediation
    d. Impact, Probability and Responsibility

30. The process of defining objective, quantifiable measures of actual results against targeted values is a tool and technique known as:
    a. Variance and trend analysis
    b. Technical performance measurement
    c. Quantitative risk analysis
    d. Assumptions analysis

31. The definition of a risk is best described as:
    a. Some positive or negative impact that will occur on a project
    b. Something negative that will occur on a project
    c. Something that may have a positive or negative impact on a project
    d. An evaluation of threats on a project

32. If there are an unusually high number of risks on a project, which the following is *most likely* true?
    a. The project manager did not assemble an effective project management plan
    b. The funds in the risk reserve will be proportionately higher
    c. The organization will cancel the project
    d. It will be more difficult to manage the project

33. Are risks handled differently in a contract environment than they are on an internal project?
    a. There is essentially no difference – the same risk strategies for positive and negative risks are considered

b. More controls are needed in a contract environment due to the complexity of managing risk in the contract environment
c. Risks in a contract environment require more input from the legal team
d. The project manager has less to do with risks in a contract environment because those risks are managed by the contract administrator

34. In prioritizing risks in your project's risk log, which risk element has the highest priority?
    a. Urgency
    b. Probability
    c. Impact
    d. Ownership

35. You are managing a project in which there is a significant risk that is on the critical path of the project timeline. You have had several meetings with the risk manager and have had numerous discussions with the project team about this risk. The risk deals with a key software complement that is responsible for the automation of a crucial process flow on the project. You have discussed crashing and fast tracking options the project. You have also discussed various risk strategies such as transference, mitigation, and active acceptance utilizing either or both of a contingency and a fallback plan. Which solution would offer the least risk?
    a. Hire a vendor that can handle the software problem and will pay penalties if they fail
    b. Set up a fail-safe mitigation strategy in the event that the risk is realized
    c. Establish a manual process and remove the software from the critical path
    d. Crash the timeline by adding high-end resource to the critical path. Expenses increase but the on-time delivery is almost guaranteed

Chapter 11 Test – Answers

1. A – This is the definition of an RBS. *PMBOK® Guide*, 5th edition, p. 317
2. C – Assesses the validity of assumptions as they apply to the project. *PMBOK® Guide*, 5th edition, p. 325
3. B – In this instance, the stakeholders are discussing their tolerance for risk. The first stakeholder can deal with it well, while a second stakeholder will have real difficulty. The risk register (A) is a risk repository for all risks; the risk management plan (C) focuses on how risk will be managed and audited, and a risk avoidance strategy (D) is a specific risk response may not be possible.
4. D – Root cause analysis identifies the precipitating event that caused the failure. Frequently organizations focus on the point of failure to address their corrective activities. The point of failure is simply a symptom of the real problem that started much further upstream. The point of the root cause analysis is not to fix the symptom, but to find the cause and eliminate it.
5. C – With the Delphi technique, participants remain anonymous to each other so that they can simply focus on the facts without having to deal with the emotional components of the problem.
6. C – Who identified the risk is not an important part of the risk register
7. B – Quantitative risk analysis should be repeated after plan risk responses to determine if the project risk has decreased.
8. A – The expected monetary value (EMV) outlines the potential cost of a negative risk or the potential benefit of a positive risk.
9. B – You have transferred the risk to a third party. If they do not meet their service-level agreements, there are financial penalties levied against the performing organization
10. B – A workaround is defined as a response to a negative risk that was not part of original risk planning. It is usually a solution developed "on-the-fly" until a permanent solution can be derived
11. A – In this case, the fact that the risk response may create 'additional problems for you' defines the secondary risk
12. C – This is a decision tree question. The decision branch for going it alone computes as follows: 65% of $5 billion = $3.25 billion. 35% of $150 million = $52.5 million. The EMV equals 65% of the ROI minus 35% of the potential failure costs, or $3.25 billion - $52.5 million = $3,197,500,000. The decision branch for sharing the development with a partner computes as follows: 85% of $5 billion = $4.25 billion. 15% of the $250 million development costs = $37.5 million. $4.25 billion - $37.5 million = $4,212,500,000. Your share of the ROI is 80% of the $4.212,500,000 or $3.37 Billion. All in all, developing with a partner gets you a higher return on investment
13. C – Risk registers typically do not include management reserve amounts.
14. A – This is best described as a probability and impact matrix. *PMBOK® Guide*, 5th edition p. 331
15. C – The question is the definition of a sensitivity analysis. *PMBOK® Guide,*5th edition, p. 338
16. D – The only approach mentioned here that will determine your measurement accuracy is to have the technical team take measurements against elements that already have a known result. In other words, have the team measure something that is already producing a consistent and accurate result to see if the team gets the same result.
17. B – Three of the answers are, to a degree, *somewhat* correct. However, controlling the communication hierarchy is the only answer that will enable you to control the complexity of communications on the project
18. D – The tool that is used to explicitly evaluate the success of risk response strategies is called a variance analysis. *PMBOK® Guide*, 5th edition, p.352
19. B – The contingency response is the most common in this case
20. D – Once again, three of the answers are somewhat correct depending on the situation however, the best answer is it really depends on the specific risk response as to who owns the risk.
21. C – Issues are not addressed in risk management – issues are not risks, they are *FACTS*
22. D– This is the definition of a secondary risk
23. C – The risk audit evaluates the effectiveness of risk responses and of the risk management process overall

24. D – Update the risk register to keep it current. Answers B and C would probably be done as a follow-up. Answer A is immaterial
25. C – This scenario is essentially an exploit strategy; you are exploiting existing facilities at a cost reduction saving the organization $480,000 in rent
26. B – The team addressed the symptom, but did not discover the root cause. The project manager's best play here would have been to initiate a root cause analysis
27. A – A change request. *PMBOK® Guide*, 5th edition, p. 353
28. A – They are outputs of Monitor and Control Risks. *PMBOK® Guide*, 5th edition, p. 312
29. A – The FMEA calculates the probability, impact and detectability of a potential risk event
30. B – The technical performance measurement is a tool and technique of monitor and control risks. *PMBOK® Guide*, 5th edition, p. 312
31. C – A risk is the *potential* for an event, *not* a certainty. If it is a certainty, it becomes an issue.
32. B – The only thing you can say for sure in this answer set is that the amount of your risk reserve will be considerably larger. Answer C may occur after the risks are evaluated and answer D may be also true. There is no evidence to support answer A
33. A – A risk assessment is a risk assessment. Some of the risks on the contract may be different than the risks you're dealing with on the project internally, but other than that, you go through the same process in identifying and managing risks. Answers B, C, and D may potentially all be true depending upon how the contract is being managed
34. A – Urgent elements on a risk log always get top priority
35. C - Taking the risk off the critical path essentially avoids the risk and makes it a non-issue. While a manual process may be more expensive in the short term, it will give the development team time to solve the software issues and eventually automate the process.

Chapter 12 : Project Procurement Management

Section Topics:

- Plan Procurements
- Conduct Procurements
- Control Procurements
- Close Procurements

Section Objectives

With this section, you will be able to:

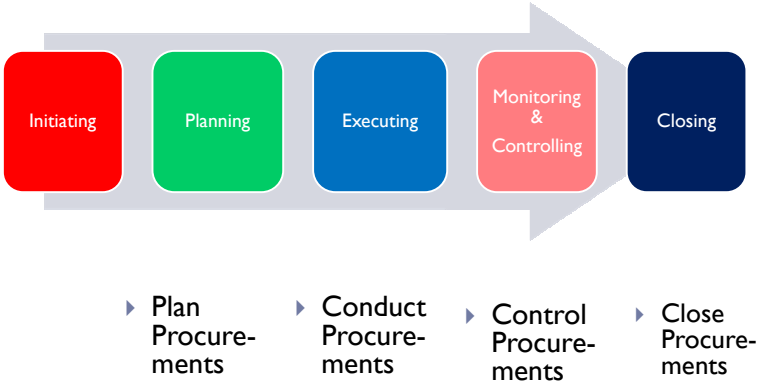
- List the required elements of a contract
- Describe the various types of contracts
- List the types of procurement documents
- Define various legal terms to know for the exam
- Calculate PTA – Point of Total Assumption
- List various negotiation tactics
- List contract closeout activities

Project Procurement Management Process Summary

The high level Project Procurement Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
	-Procurement management plan -Procurement SOW -Make-or-buy decisions	-Selected sellers -Agreements	CR's	Closed procurements

Project Procurement Management



The procurement process formalizes how organizations obtain goods and services from outside the organization. As a result, process can involve make or buy decisions, securing expertise not available within the organization, potential lease decisions, and the best type of contract to use when obtaining goods or services.

This can include the use of local sourcing or off-shore teams. If the resources are within the United States, the local, state and federal laws and regulations governing business transactions apply. In the case of obtaining off-shore procurements, understand the local laws and customs that are at work in these locales. What is illegal in the United States may be ethical (and expected) in another country.

Understand that the procurement activity involves the creation of a 'Procurement Statement of Work' (SOW). This is a legal document subject to legal reviews – breaches of contract may be addressed in the US court system. The seller is legally bound to what is contained in the contract SOW, and no more. Therefore, when establishing a contract SOW, it is in the best interests of the purchaser/buyer to make the document as detailed and accurate as possible, to avoid misunderstandings and misinterpretations that can lead to legal disputes.

There are usually specialized parts of the organization that deal with procurement activities regularly and that have developed significant expertise in these areas. If you have never dealt with these areas as a project manager, this aspect of the exam may prove to be more difficult than some of the other areas. Pay particular attention to the details in this chapter.

Procurement for the *Exam*

Unless stated otherwise, assume you are the buyer/purchaser of goods and/or services for your organization. The contract will include *terms and conditions* that specify what the seller is to deliver to the buyer, and it is the project team's responsibility to insure that procurements meet the explicit needs of the project.

On exam questions, sellers may be identified as prime contractors, sub-contractors, vendors, service providers or suppliers, and the seller is external to the project team. It is also assumed that the contract between the buyer and seller is a formal written agreement. To summarize:

- Questions are from the ***buyer's perspective unless the question states otherwise***
- Seller is offering goods or services
- Buyer is buying goods or services
- Contract outlines terms of agreement between buyer and seller

Required Contract Elements

All contracts between the seller and the buyer must contain the following elements:

- The **offer** describes the product or service the seller may offer the buyer.
- The **acceptance** is performed from the buyer's point of view - it describes the explicit criteria under which the buyer will accept the product or service delivered by the seller
- **Capacity** means that the seller has the physical and/or financial capabilities to deliver the product or service according to the specifications in the contract
- **Consideration** is what the seller will receive for performing the work of producing the product or service for the buyer. This is can be in the form of direct monetary compensation to the seller or some other form of compensation.
- **Legal purpose** means that the contract must be legal under US state, federal, or local laws. You cannot draw up a contract to commit a murder that would legally be supported in the courts of the United States. That is explicitly *not* a legal purpose

Project Manager's Role in Procurement

For the exam, you need to understand what role the project manager plays in the procurement process - there will be questions on the exam that will test your understanding of this critical role. Make sure you understand the following:

1. It is best if the project manager is assigned to the project before the contract is signed. There is a strong risk that the deliverables or the completion dates for the project may be jeopardized if the contract is signed without any regard to what is needed for the project.
2. Review your understanding of contract terms and conditions, so that there is no ambiguity when dealing with the contract.
3. Ensure you have input to tailor the contract to the needs of the project as the contract is being written.
4. Identify risks in a contract that may impact project deliverables or timelines.
5. Make sure the project schedule can be adjusted to include enough time for the completion of the procurement process.
6. Make sure you have access to procurement personnel to fully understand the procurement process for the project.
7. Make sure you are also involved in contract negotiations to help protect the relationship with the seller.

Centralized/Decentralized Contracting

- May be on the exam (not defined in PMBOK®)

Centralized:

Advantages	Disadvantages
Higher Expertise levels	Multiple projects
Continuous improvement	Difficulties for PM to obtain help
Standardized practices	
Defined career path	

Decentralized:

Advantages	Disadvantages
PM easier access to contract expertise	No home department for the procurement manager
Procurement manager more loyalty to project	Harder to maintain high level of contracting expertise
	Duplication of effort
	Little standardization
	No career path

There are two types of contracting mentioned on the exam that are not defined in the *PMBOK® Guide,*5th edition at all: centralized contracting and decentralized contracting. This will let you know how the procurement department is organized, and what authority the procurement manager has in executing a contract.

In a centralized environment:

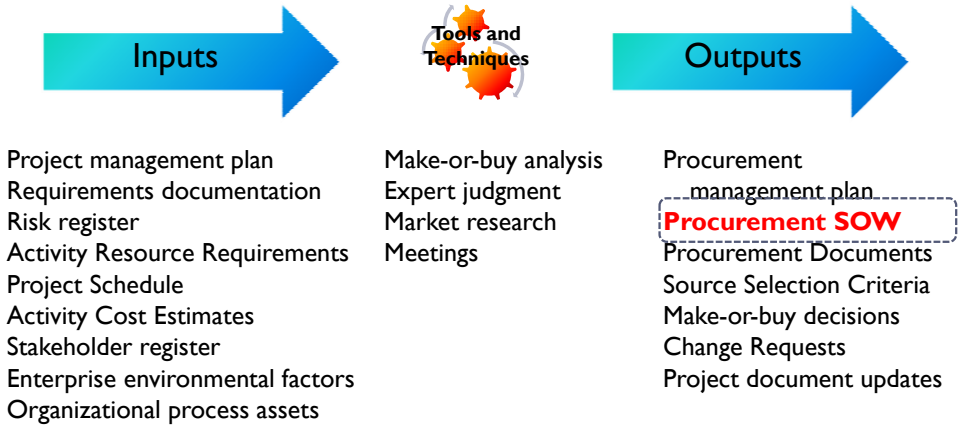
- The procurement manager may manage many contracts
- The general advantages support procurement managers with higher levels of expertise, as well as standardized company practices and clearly defined career paths in the procurement area.

- General disadvantages can include difficulties in obtaining contract expertise for your project, as well as the lack of a dedicated procurement resource for the project.[44]

In a decentralized environment:

- The procurement may be assigned specifically to the contract and may directly report to the project manager.
- General advantages are that the project manager has easier access to contracting expertise, and the procurement manager has more loyalty to the project.
- Disadvantages can include lack of contracting expertise, duplication of effort, no clearly defined career path for procurement personnel, or a duplication of effort.[45]

Plan Procurement Management



This process focuses on determining whether or not to obtain products and services from outside the organization, and to identify explicitly what is needed. This will frequently be identified as a 'make or buy' decision.

- The schedule requirements of the procurement activities must be coordinated with the needs of the project so that the goods or services procured occur in a timely fashion.
- Risk considerations are reviewed with each make or buy decision – what are the risks the organization is taking by either doing the work in-house, or contracting a vendor to perform work or deliver a product?

Teaming agreements or joint ventures are an important input to the Plan Procurement process. They are legal contractual agreements between two or more parties that define the buyer-seller relationship, and only last for the duration of the agreement. These agreements are usually arranged to pursue a new business opportunity or to synergistically optimize the strengths of each organization to produce a better product.

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[44] "Encyclopedia of Production and Manufacturing Management", Paul Swimidass, Kluwer Academic Publishers 1999, p. 606

[45] "Decentralization, Hierarchies, and Incentives: A Mechanism Design Perspective", DilipMookherjee, *Journal of Economic Literature*, Vol. 44, No. 2 (Jun., 2006), pp. 367-390

Perform Make or Buy Analysis

Costs are evaluated on Make/Buy decisions as well as:

- In-house expertise
- Facility availability
- Resource Availability
- And other considerations

As an output of Plan Procurements, specific *procurement documents* are created to solicit proposals from sellers. These documents vary depending on the type of contract being used, and generally fall into the following categories:

- RFP or Request for Proposal
- IFB or Invitation for Bid
- RFQ or Request for Quote
- RFI or Request for Information
- Tender Notice
- Invitation for Negotiation
- Seller Initial Response

As part of the 'buy' analysis, the contract type determines the sharing of risk between the buyer and seller while the terms and conditions specify the degree of risk assumed by both parties.

Buying or leasing may also be possibility because elements that involve trade secrets, product innovations or require strict controls may be better left in-house.

There are any number of considerations in performing a make or buy analysis for your organization. You may be asking yourself; do we have the required skill sets for the work(?), can our facilities handle the type of work that needs to be performed (?), if we job out the work, are there trade secrets we might potentially expose to competitors (?).

Other considerations can include, funding, availability of resources, mitigation of risk, potential partnering agreements and others. This information can be documented in formal organizational process assets, which may include templates using specific software tools that are able to perform a weighted analysis of the decision factors.

Procurement Management Plan

The procurement management plan specifies how a project will acquire goods and services from outside the organization. This includes everything from the development of procurement documents to the close of the contract. The procurement management plan typically includes but is not limited to the following:

- Contract type
- Risk management issues

- Need for independent estimates
- Actions that are under the project management team's control
- Coordinating procurement activities with other project activities
- Constraints and assumptions
- Addressing long lead times
- Addressing a make or buy decisions and linking them to estimate activity resources and develop schedule process
- Setting schedule dates for contract deliverables
- Requirements for performance bonds or insurance contracts
- Establish direction provided to the sellers on developing a WBS
- Form and format for the procurement statement of work
- Identification of pre-qualified sellers
- Metrics used to manage contracts and evaluate sellers

Procurement Statement of Work

The procurement statement of work is a document subject to legal review that is legally binding on both parties - the seller and the buyer - the provisions of which can be a redressed in US courts of law, should there be a contract dispute or any cardinal breach in the contract.

On large contracts, the procurement statement of work can run upwards of thousands of pages (!)

There are three fundamental procurement statements of work types which are detailed in the bullet points below:

- _____ – defines the level of performance required in the final product or service without specifying how the work should be done or the product's design characteristics e.g. this compound hunting bow will deliver a shaft to within 1 inch target at a range of 100 yards requiring a pull strength of no greater than 8 pounds.
- _____– describes specific functions the product needs to perform while in operation e.g. the vehicle will warn the driver when the speed limit has been exceeded and will allow all four wheels to turn when parallel parking.
- _____ – in which the vendor builds to a specific design specification e.g. the vendor machines component parts based on blueprint specs.

Contract Types and Risk Assessment

There are three basic types of contracts with variants of each type. The three types, including their variants are listed below:

Fixed Price (FP)

Advantages for Buyer

- Greatest risk to the vendor - they are on the hook to deliver
- Implemented when the product or process is well known
- You don't have time or resources to audit invoices
- SOW is detailed and specific, as are the product specifications
- You are buying "Just do it!"

Disadvantages for buyer

- The vendor's profit margin is unknown to the buyer
- Can be exposed to excessive change orders if the seller's profit margins are threatened or if the seller 'low-balled' the original contract offer
- Constitutes more effort on the buyer's part to create an explicit statement of work

Variants of the FP include:

1. FFP (Firm Fixed Price)
2. FPIF (Fixed Price Incentive Fee). Financial incentives are tied to superior performance from the seller, i.e. additional monies can be won for delivering the project ahead of schedule or for outstanding technical performance
3. FPEA or FP-EPA (Fixed Price with Economic Adjustment or Economic Price Adjustment). For a contract that spans multiple years, economic adjustment can take the form of pre-defined adjustments due to increased price for commodities over time, inflation or other changed conditions
4. PO (Purchase Order). Usually a fixed-price contract for off-the-shelf goods or service. Built-in price discounts can be applied depending on the volume of the purchase. These prices are usually published in the seller's catalog or website.

Cost Reimbursable (CR) Also called "Cost Plus"

Advantages for Buyer:

- Can be lower cost than a fixed-price vehicle
- Implemented when outcome may *not* be clear
- You are buying 'expertise' – specifications may not be known
- Procurement statement of work may be simplified

Disadvantages for Buyer:

- Greatest risk to buyer
- The seller has little incentive to control costs
- More effort is required to audit seller invoices to keep control of costs
- Because you are purchasing expertise, the total cost may be unknown at the beginning of the procurement

Variants of the CR contract include:

1. CPFF (Cost Plus Fixed Fee). The vendor is reimbursed for all allowable costs – the fixed fee is usually calculated as a percentage of the original costs
2. CPIF (Cost Plus Incentive Fee). The vendor is reimbursed for all allowable costs – an incentive fee can be applied based on the vendor's performance on the contract. In some instances there can be a sharing ratio; i.e. the vendor can receive additional monies for performance and the buyer may receive a discount if the vendor's costs are under the contracted amount
3. CPAF (Cost Plus Award Fee). The vendor is reimbursed for all allowable costs – the vendor can receive an award fee based on subjective criteria that are broadly defined in the contract. The actual fee is determined at the whim of the buyer.
4. CPPC (Cost Plus Percentage of Costs) Illegal for contracts with the US Government
5. Cost Contract – The seller does not receive a profit – usually set up with not-for-profit organizations
6. Best Efforts – obligates the seller to utilize their best attempts to accomplish the goal of the project, particularly when there is uncertainty about the ability to meet the goal

Time and Materials (T&M)

Advantages to Buyer:

- Usually set up with known costs and a 'not to exceed' amount
- A unit price type of contract - usually quick and simple to create
- Contract duration is generally short-term

Disadvantages to Buyer:

- Seller's profit is built into each billable hour - thus there is no incentive to control costs
- The buyer must constantly monitor the work being done on the project

Time and materials contracts are generally used for staff augmentation projects in which resources are contracted into the organization on a temporary basis. T&M type contracts can be useful for quick proof-of-concept type projects, or where the purchasing organization is implementing a 'try-before-you-buy' scenario.

Quick Quiz: what type of contract would best be suited for the following scenarios?

Scenario	Contract Type
You need two PL/SQL developers and a UNIX admin to supplement your staff for three months on an ongoing project	
You need a detailed and explicit procurement statement of work	
You do not have the in-house expertise to build the needed product and you need the job done very well	
You've just priced 35 laptops at CDW - the price looks reasonable and you're ready to purchase	
Since the contract is long-term, the vendor has concerns regarding inflationary issues or unexpected changes in the business environment	
You engaged a not-for-profit organization to perform the work	
The vendor does not guarantee the results of the project regarding budget, timeline, or risk	

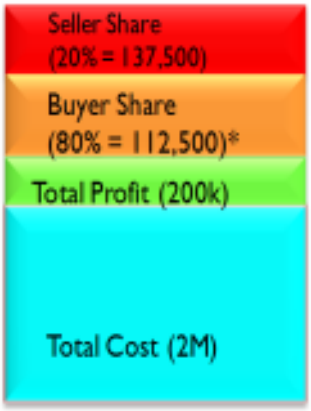
Point of Total Assumption

The point of total assumption is used in certain fixed-price contracts or fixed-price incentive fee contracts, and is used in the event that there is a cost overrun on the project. The point of total assumption is the point at which the seller assumes all additional costs for delivering a product of the project.

For a cost reimbursable contract, the Point of Total Assumption does not exist, since the buyer agrees to cover all costs – *unless* – an incentive arrangement with similar components, called a Fixed Price Incentive Fee (FPIF) contract, sometimes is used.

A typical example of a point of total assumption calculation appears below.

Fixed Price Plus Incentive – PTA



Ceiling 2.45M

PTA 2.3125M

Cost + Profit
e.g. original total price to buyer

Target Cost e.g. original total cost w/o profit

- The Point of Total Assumption (PTA) - the point at which the seller assumes all additional costs:
  - Seller assumes 100% of costs
  - PTA = ((Ceiling Price - Total Price) / Buyer's Share Ratio)) + Target Cost
- For example, assume:
  - Total Cost (Target Cost): 2,000,000
  - Total Profit: 200,000
  - Total Price: 2,200,000
  - Ceiling Price: 2,450,000
  - Share Ratio: 80% buyer–20% seller for overruns, 50%–50% for under runs
  - PTA = ((2,450,000 – 2,200,000)/ 0.80) + 2,000,000 = 2,312,500

Brain Dump!

The 'total cost' , 'estimated cost', or 'target cost' (the three terms are synonymous), represents the contracted cost without the profit.

The 'total profit' is the profit on the project.
The 'total price' equals the total cost plus the total profit.
The 'ceiling price' is the highest price the buyer will pay for the product or service.
The 'sharing ratio' represents the buyer share of the cost overrun.
The PTA formula: PTA = $\frac{\text{(ceiling price - total price)}}{\text{Buyer's share ratio}}$ + Target Cost

Question: what is the point of total assumption for a contract with a total cost of $1.2 million, a profit of $160,000, a buyer's share ratio of 70% and a ceiling price of $1.5 million?

($1,500,000 - $1,360,000)/.70 + $1,200,000 = $1,400,000)

Unit Price and Time & Materials Contracts

Here is some additional information on unit price and time & materials contracts, (T&M).

With a unit price contract vehicle, the customer pays a fixed sum for each completed unit of work. The total payment to the contractor is based on the actual quantities multiplied by the respective quoted unit prices. Where the unit cost is not clear to the buyer, vendors may submit bids for the work. Therefore, the final price used to determine the lowest bid is based on the lump sum price: the quoted unit price multiplied by the quantity needed.

The T&M contract is generally used when the scope of work is not known, or when the buyer is attempting to acquire information about a particular product or service. For example, the buyer may need a help desk function on certain hardware or software purchases, but may not know at what level these purchases need to be supported. The buyer may initiate a three or six month T&M contract for the support of these elements. After three or six months, the data collected to support these hardware and software components will help the buyer identify needed support levels, so that they may eventually create a fixed-price contract.

To summarize:

Unit Price:

- Customer pays a fixed sum for each completed unit of work
- In construction contracts, "unit price bidding is used in projects for which the quantity of materials or the amount of labor involved in some key tasks is…uncertain."[46]

T & M:

- A cross between fixed price and cost reimbursable contracts
- PMI states: "T&M contracts can also resemble fixed, unit price arrangements when certain parameters are specified in the contract"[47] e.g. an hourly charge or a per item charge
- Usually where the scope of work is not known or for short term services

Standard Procurement Documents

There are three basic types of procurement documents associated with the contract type:

- The request for proposal (RFP) is usually used on a cost reimbursable vehicle. This is a situation where the buyer is purchasing expertise, and is usually looking for a Functional or Performance type, statement of work.
- The invitation for bid (IFB) or request for bid (RFB) contract is customarily associated with a fixed-price contract vehicle. This is a situation where the buyer is purchasing a product or service that is well understood. The statement of work is commonly, design specification based.
- The request for quote (RFQ) is primarily utilized with a time and materials vehicle and can use any of the previously mentioned of SOW types, depending on the needs the contract.

A graphic summary appears below:

Document Type	Contract Vehicle	SOW Type
RFP – request for Proposal	Cost Reimbursable	Functional/ Performance
IFB (Invitation for Bid) or RFB (Request for Bid)	Fixed Price	Design
RFQ (Request for Quote)	T&M	Functional/Performance/ Design

[46] *Project Management for Construction,* Chris Hendrickson, Prentice Hall, 1989.

[47] *PMBOK®Guide*5th edition, p. 324

Additional Terms

There are numerous terms and conditions, in addition to the terms we have already covered, that you need to be familiar with for the exam:

- **Agent** - authorized representatives from both the buyer's and seller's side
- **Assignment** - one party can assign its contracted rights or obligations to another
- **Cancellation**:
    - **For Convenience** - purchaser cancels the contract due to changing business conditions or changing direction. The buyers pay for all work up until the point of the cancellation - it is a 'no harm, no foul' situation
    - **For Cause** - this occurs when there has been a *cardinal breach/material breach* or *default* of the contract terms by either party. This leaves either party open to legal action by the other party and may result in liquidated damages. The party responding to the breach must do so timely, formally and in writing. If the breach is not addressed immediately, the aggrieved party may lose its right to take action on the breach later. A *cardinal breach* is identified as so serious that it may not be possible to for the seller to complete the terms of the contract
- **Confidentiality** - certain information relating to the contract must be kept confidential. Failing to do so may result in a breach or default on the contract.
- **Escrow** - can be used as a contract provision if the purchaser has concerns about the viability or survivability of the seller. For software development projects, code may be placed in escrow in the event that the seller goes out of business and the buyer needs access to the code to continue its operations. This can be used specifically in situations where the seller does not want to give up its intellectual property rights for developed product.
- **Force majeure** - a standard disclaimer used in a contract that refers to 'Acts of God'. It describes a situation in which neither the seller nor the purchaser, can be held accountable or responsible for the events
- **Indemnification or Liability** - defines who is responsible for injury, damage, or accidents
- **Intellectual Property** - defines who owns any patents, designs, trademarks, copyrights, or product that was developed during the course of the contract
- **LOI** – Letter of intent. The buyer states they intend to hire the seller. This is not legally binding.
- **Ownership** - who will own the items that were used in the development of any deliverables that were part of the contract?
- **Payments** - this can include scheduled payments, late payments or fees, or withholding payments for cause, such as an inaccurate invoice.
- **Privity**-The prime contractor can use sub-contractors. Since the sub is contracted to the Prime and not to the buyer, the buyer has no contractual control over the sub.
- **Retainage** - specific payment amounts withheld from each payment to ensure delivery of the final product - usually in the 5-10% range.
- **Risk of Loss** - divides the risk of loss between the parties, should goods or services become lost or destroyed during contract execution.
- **Termination** - stopping work before it is complete
- **Time is of the essence** - this means that delivery dates are contractually binding, and that the procurement activity is fundamentally time constrained. In this case, delay can be considered a cardinal breach of contract.

- **Waivers** - these are contract statements specifying that rights under the contract may not be waived unless agreed to by both parties. As the project manager, make sure that you do not intentionally or unintentionally give up a right in the contract.
- **Work made for hire** - identifies all contracted work as owned by the purchaser

Non-Competitive Forms of Procurement

It is important to understand certain types of noncompetitive forms of procurement for the exam. There are reasons why this may occur; for example, a seller may be best in class, or may even be the only provider of a specific product or service.

A **sole source** provider is the only provider for the product or service available. One example of a sole-source provider is the W. R. Gore Co. They make a polymer used in hundreds of products in the United States. You can only get this polymer through a licensing arrangement with W R. Gore Co.

A **single source** provider is a preferred vendor, usually one that does an exemplary job and provides a high level of service for the particular product or service. The Toyota Corporation typically engages single source providers - vendors with whom they seek to form a long-term relationship - that deliver high quality, low prices, and very short turnaround times.

Source/Vendor Evaluation Criteria

Key vendor evaluation criteria include, but are not limited to, the following:

- Risk - what is the risk contained in the statement of work and how will the seller mitigate risk?
- Understanding of Need - does the seller's proposal address the procurement statement of work effectively?
- Life-Cycle Cost - this addresses the 'total cost of ownership' aspects of the project. What is the overall cost of the project, based on the purchase price plus all operations and maintenance costs?
- Technical Capability - does the seller have the technical skills to deliver the product of the project?
- Management Approach - does the seller's management approach make sense to the buyer? Do the organization's culture and process assets contribute to the delivery of a successful project?
- Technical Approach - will the seller's proposed methods, procedures, techniques, solutions, and services meet the requirements of the procurement?

Conduct Procurements

Inputs	Tools and Techniques	Outputs
Procurement Management Plan	Bidder conferences	Selected sellers
Procurement Documents	Proposal evaluation techniques	**Agreements**
Source selection criteria	Independent estimates	Resource calendars
Seller proposals	Expert judgment	Change requests
Project documents	Advertising	Project management plan updates
Make or buy decision	Analytical techniques	Project document updates
Procurement SOW	Procurement negotiations	
Organizational process assets		

This is the process of identifying qualified sellers that can actually perform the work, delivering the appropriate procurement documents to the sellers, and soliciting a response from the sellers so the selection of a seller can be completed.

In many instances, buyers will create an approved vendors list; vendors that they have identified as producing quality work with whom they have formed ongoing relationships. In many instances, a Master Services Agreement is set up that addresses the administrative details of performing projects, so that vendors on this approved vendor list can focus on the work at hand.

For situations in which there is not an approved vendor that can supply the skill set, or provide the product in question, the buyer may advertise in trade publications or newspapers in an attempt to identify a potential seller.

The Conduct Procurements process usually involves a formal weighting and/or evaluation process to assess the elements of the buyer's request against seller capabilities and responses. This way all potential seller responses can be ranked and evaluated by criteria in prioritized sequence. The ultimate purpose of this activity is to select a seller.

Bidder Conferences

This is a key tool and technique in conducting procurements. A bidder's conference invites all bidders to a Q&A session in which bidders can ask clarifying questions regarding the buyer's RFP. This is done to ensure that all bidders have a clear understanding of the business and technical requirements of the project. It also ensures that all bidder questions are funneled through the buyer's single point of contact, so that it will be clear that no bidder is receiving preferential treatment. Not asking questions through the buyer's single point of contact is usually grounds for disqualification from responding to the buyer's RFP.

The bidder conference process allows the other bidders to hear questions from all other bidders and the buyer's response to each of those questions. Because some sellers feel that asking questions in front of potential competitors may reveal their technical approach to a problem, bidders are usually very careful to ask questions in a manner that does not reveal their technical approach to the RFP.

Qualified Sellers Lists

Maintaining a list of qualified sellers, or approved vendors, has distinct benefits for the buyer:

- Familiarity with the seller's management structure
- Understanding of the seller's technical capabilities
- Clear understanding of methods, procedures and standards utilized by the seller
- Quality of deliverables is well known and understood
- May serve as a yardstick by which to measure other potential vendors
- Set up of a 'master services agreement' establishes an administrative foundation for managing procurement activities with specified vendors. Once set up, the basic 'rules of engagement' for all procurements with the vendor are already defined.

Review Seller Proposals

There are a number of tools that are used to evaluate seller proposals. Outside of the look and feel of the proposal, quantitative methods are used to calculate specific metrics that measure the seller's ability to satisfy the proposal criteria. Some of these tools include:

- **Weighting Systems** - essentially a grid listing all the proposal criteria and assigning a numeric weight each of the criteria. Each seller is then scored on a scale of 1-10 against each of the proposal criteria. The criteria, multiplied times the seller score, equals the seller's total score for that criterion. Total scores for all the criteria are added up for each seller, and highest score wins.
- **Independent Estimates** - the buyer hires an external auditor to evaluate seller estimates.
- **Screening Systems** - usually a prequalification tool that is used to screen out nonqualified vendors. This can include a list of 'showstopper' criteria the seller must achieve to be considered for the contract.
- **Sellers Ratings Systems** - a repository of past performance evaluations of the seller. This can give the buyer an idea of how the seller may perform on the current proposal, if accepted.
- **Expert Judgment**–the seller's proposal may be evaluated by multidisciplinary teams, such as a cost review team, a technology review team, and a legal review team.

Contract Negotiations and Tactics

When engaged in negotiations with a vendor, there are a number of negotiation tactics that can be employed. You may see reference to any one of these tactics on the exam. Become familiar with the terms and their meanings.

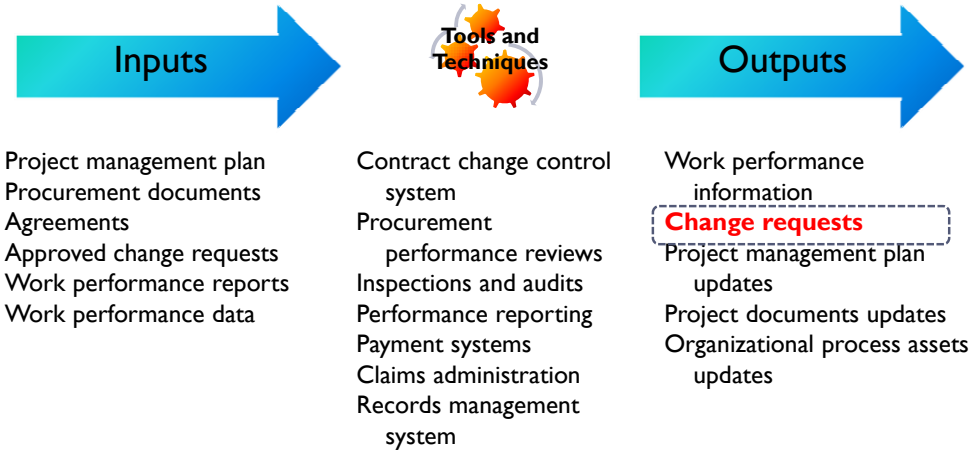
- **Fait Accompli** - Standard contract terms that are nonnegotiable. (In reality, *anything* in the contract is negotiable although your adversary will never admit it).
- **Deadline**–A set deadline by which the other person has to decide or act. Make it clear that this is the time by which they must do what you want them to do. As the deadline approaches, increase the emotional pressure, talking more about what will happen if the deadline is missed. This may include threatening actions or vague and disturbing hints.
- **Good guy /bad guy** - One person acts in an aggressive and pushy way, making unreasonable demands and requiring compliance. The other person then acts in a kind and friendly way, asking nicely -- and getting compliance.
- **Missing man** - The person who can actually make the decision is missing from the negotiation. The negotiator can then negotiate for a lower price or more favorable terms which they claim they can agree to.
- **Limited authority** - Refusing to give in on items because you have not been given authority to do what is being requested.
- **Fair and reasonable** - You can engage the other person by asking them 'what is fair'. You can also bring something into the negotiation that is, by definition, fair. You can also reject criteria from the adversary on the grounds that it is not fair.
- **Unreasonable** - Stating that the other side is making unreasonable demands of you in the negotiation.
- **Delay** - Stretching out the negotiation, especially at critical moments.
- **Attack** - A direct attack on your integrity, trustworthiness, competence, or other such bullying bombast designed to force compliance out of you.

Agreements

An agreement can be referred to as an understanding, contract, subcontract, or a purchase order. Regardless of what it is called, the agreement or contract is a legally binding document subject to remediation in courts of law. Typically, the components of the agreement document will include but are not limited to the following:

statement of work (deliverables)	schedule baseline
performance reporting	period of performance
roles and responsibilities	sellers place of performance
Pricing	payment terms
place of delivery	inspection and acceptance criteria
Warranty	product support
limitation of liability	Fees and retainers
Penalties	Incentives
insurance and performance bonds	subordinate subcontractor approvals
change request handling	termination clauses and alternative dispute resolution mechanisms

Control Procurements



This process focuses on managing and monitoring the contract, the relationship with the seller, and making changes and/or corrections as necessary. One very important part of the Control Procurements process is the execution of performance reviews, as well as inspections and audits of delivered product. The project management team must be sensitive to legal implications when administering any aspect of the procurement process.

One of the key tools in the Control Procurements process deals with potential disagreements between the buyer and the seller. There may be changes or disputes that need to be addressed in a claims administration process. Claims are documented and monitored throughout the contract life cycle and are executed in accordance with the specifics of the contract. If the parties cannot resolve a claim, it may have to be handled in accordance with an alternative dispute resolution (ADR), facilitated by a third party.

Contract Administration

On the exam some very tricky questions can be asked about contract administration. Make sure you understand the PM's role for managing each type of contract, and the pitfalls of managing each type:

Fixed Price

- Look out for excessive change orders - it may be an indication that the seller's profit is being impacted.
- Audit the sellers work to ensure that scope and quality are not being impacted. The seller may try to cut corners in order to bring in the contract at a fixed price without impacting their profit margin. Bait and switch is a typical tactic here; for example, on a construction project the seller might swap out a stainless steel electrical conduit for PVC without making the buyer aware of it.
- Review the statement of work to ensure that the scope is clearly understood by both parties.

Cost Reimbursable

- All invoices need to be audited - ensure that the work is being performed corresponds to the resources performing the work.
- Look out for additional charges that were not part of the original plan.
- If specific resources with specific skill sets have been contracted, ensure they are not replaced with lower cost, less experienced resources for the same price.
- Ensure that all charges are specifically applicable to your project.
- Ensure deliverables meet their expected milestone dates. Tie payments in the contract to delivered milestones.

Time and Materials

- Ensure that hours are not padded.
- Keep the project to a fixed length.
- Require that deliverables are defined and met by specific milestone dates.

Contract Change Control System

"A contract change control system defines the process by which procurements can be modified."[48]Change control in a contract is essentially handled in a similar fashion to how it is handled for your project, but there are significant differences. Change control in a procurement environment is more complicated than it is on your project for the following reasons:

- Both the buyer and the seller have different reasons for why they want to or do not want to implement a change. There may be conflict in this area: the seller may submit a change that the buyer sees no reason to implement.
- The buyer usually has less visibility into the seller's internal processes and, therefore, the reason for changes may not be as evident to the buyer.
- Organizational cultures may get in the way and increase complexity between the buyer and the seller when attempting to implement changes.
- If changes are necessary, it must be clearly spelled out in the contract *who* in your organization has the authority to approve them; it is generally *not* the project manager.

Change steps:

- Analyze impact of change.
- Follow change procedures specified in contract.
- Any changes to a contract must be formally made.

The project manager must know who has authority to make changes to the contract.

[48]*PMBOK® Guide*, 5th edition, p. 338

Contract Monitoring

Understand that when you monitor the contract in the administer procurement process, you are using some of the following project processes:

- **Direct and Manage Project Work** to authorize the seller's work
- **Performance Reporting** so that you can monitor the cost, schedule, and scope of the contract as well as the sellers technical performance
- **Control Quality** to validate the quality of the seller's deliverables. This requires inspections and audits of the sellers processes
- **Perform Integrated Change Control** to ensure that changes are approved by those authorized to make such approvals, and that the appropriate stakeholders are notified of such changes. This requires the use of a formal change control system
- **Monitor and Control Risks** - so that risks can be mitigated or eliminated

A records management system is also needed so that the project manager can manage the contract and procurement documentation. This record management system is considered part of the project management information system (PMIS), which is considered an Enterprise Environmental Factor.

Ensure payments to the vendor are made according to contracted Terms and Conditions.

The PM is also responsible for ensuring that procurement documentation is updated as a result of monitoring activities.

Buyer-conducted performance reviews:

- Identify performance success and failures
- Identify progress against the contract SOW
- Quantify seller's ability (or not) to perform work

Inspections and audits:

- Identify weaknesses in seller's processes or deliverables

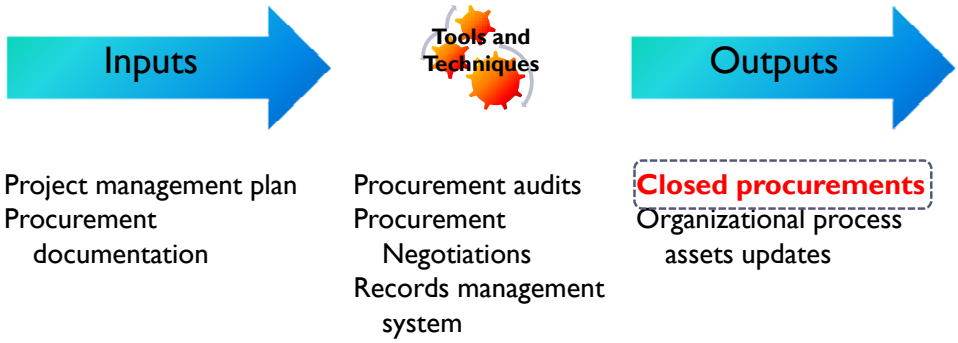
Performance reporting:

- Determine how effectively seller is performing to the contract

Claims administration:

- Settle disputes regarding compensation for changes

Close Procurements



Closing the procurement activity means the work on the contract has been completed, final audits and verification of deliverables have been accepted, that all claims are finalized and closed and all outstanding bills, including retainage, have been paid.

Procurements can be closed one of two ways:

- Completion of the contract
- Termination of the contract

Understand that: ***procurements are always closed prior to administrative closure of the project or project phase.***

On a large project, there can be multiple closures of procurement activities. Whatever phase of your project that you are in, the procurement activity that ends within that phase is closed *before* administrative closure of the phase.

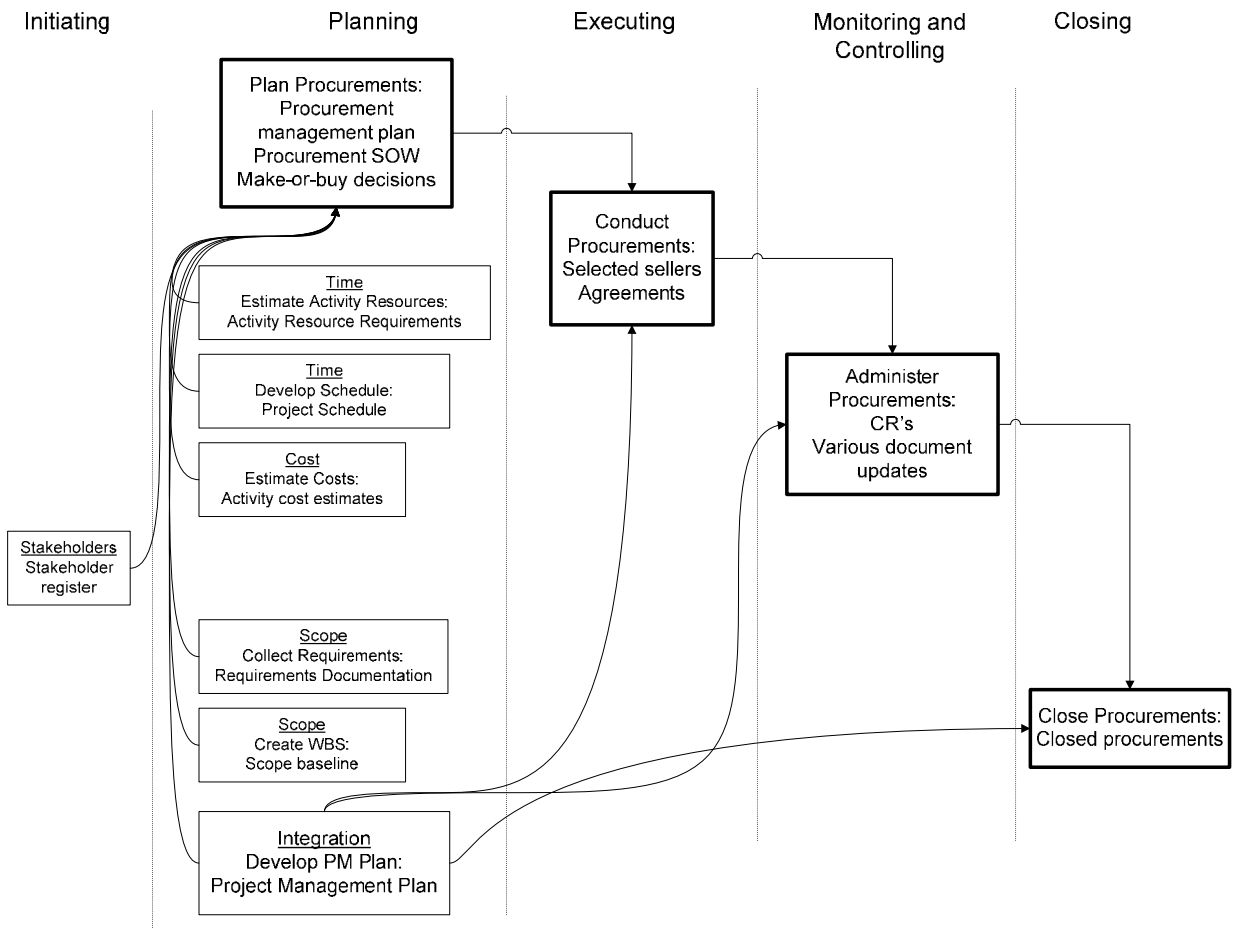
Closure Activities

Closing a procurement in a project includes all of the following:

- Final settlement of all claims and invoices
- Procurement audit
- Final contract performance reporting
- Product verification
- Procurement contract file and updates
- Lessons learned

Project Procurement Management: Key Process Interactions

The key inputs from the other Knowledge Areas to Project Procurement Management processes are shown below. *Know these process interactions for the exam.*



In Summary…

For procurement management, the covered elements included:

- The types of contracts and the risks associated with each
- When each type of procurement document is used
- The difference between single source and sole source
- Bidder conferences
- Good guy/bad guy, deadline, missing man, limited authority, delay, unreasonable, attacks, and other negotiation tactics
- How change control is different in a contracted environment
- Contract closure activities and when they are done

Procurement Process Check

Match the process to its description:

___Plan procurement management

___Conduct procurements

___Control procurements

___Close procurements

A. The process of completing each project procurement

B. The process of managing procurement relationships, monitoring contract performance, and making changes and corrections as appropriate

C. The process of documenting project procurement decisions, specifying the approach, and identifying potential sellers

D. The process of obtaining seller responses, selecting the seller, and awarding a contract

Chapter Twelve Memory Check

1. Several disadvantages of _____contracting is that the procurement lead may be working on multiple projects, so it may be difficult for the PM to obtain help
2. The five elements of a contract are ____, _____, _____, _____, and _____ _____
3. One of the key tools in the Plan Procurements process that analyzes whether to do the work in house versus having a third party provide the product or service is called a ____-__-___ analysis
4. Some advantages of _____ contracting are that the PM has easier access to procurement expertise and that the procurement manager has more loyalty to the project
5. The three fundamental procurement statements of work types are; _____, _____, and _____
6. Two forms of non-competitive procurement are called _____, and _____
7. A non-legally binding document in which the buyer states they intend to hire the seller is called a _____
8. Another term for a teaming agreement is called a _____
9. The three basic forms of contract are _____ _____, _____, and _____
10. The concept of _____ addresses the total cost of ownership of a product or service
11. The key outputs of the Conduct Procurements process is the _____and _____
12. The prime contractor can use sub-contractors. Since the sub is contracted to the prime and not to the buyer, the buyer has no contractual control over the sub. This is called _____
13. The _____ occurs on fixed price incentive fee contracts in which the seller assumes all additional costs for delivering a product of the project
14. The RFP is best used for a _____contract, while the IFB or RFB is best used for a _____contract
15. The key output of the Plan Procurements process is the _____ _____
16. A _____invites all bidders to a Q&A session in which bidders can ask clarifying questions regarding the buyers RFP
17. A _____establishes minimum criteria to eliminate non-qualified vendors
18. Fait Accompli, deadline, missing man and limited authority are all examples of _____ tactics
19. A _____is usually implemented as a grid that lists all the proposal criteria, and assigns a numeric weight to each of the criteria
20. _____ closure always occurs before _____ closure when completing a project or project phase
21. Force majeure, assignment, escrow, time is of the essence, retainage and confidentiality are all contract elements generally grouped in a category called _____
22. A key output of the Control Procurements process is _____
23. A contract_____system defines the process by which procurements can be modified
24. Technical Capability, management approach and technical approach are some of the elements that are assessed in _____criteria

Chapter 12 Test

1. The contract does not specify how overcharges from the vendor should be handled on a Cost Reimbursable contract. The buyer receives an invoice from the vendor that has questionable charges. The buyer should:
    a. Pay the invoice
    b. Initiate a claim against the vendor via the claims administration process
    c. Consult the legal team for remediation options
    d. Cancel the contract for convenience

2. You have engaged a sole source vendor to procure a critical product for your organization that is needed for your own product line. The vendor submits a contract which is reviewed by your legal team. While most of the provisions are agreeable, there are several questionable provisions that are clearly illegal and unenforceable in the state where the contract will be signed. The vendor has informed you that they will not provide the product or sign the contract without those questionable provisions included. The procurement of this product is critical to the survivability of your business, and time is of the essence. The vendor thinks they have your organization 'over a barrel'. Aside from the questionable provisions in the contract, everything else in the contract is acceptable. As the buyer, your *best* option moving forward is to:
    a. Initiate a legal action against the vendor for attempting to break the law
    b. Point out that the questionable provisions are unenforceable in the state, and offer to sign the contract immediately if the provisions are removed or modified to be legal
    c. Find a competing vendor that will provide an equivalent product
    d. Sign the contract – you've got them over the barrel if the questionable provisions are legally unenforceable

3. Which of the following are *not* advantages in a centralized contracting environment?
    a. Access to contracting expertise
    b. Procurement manager has more loyalty to the project
    c. Standardized practices
    d. Defined career path

4. All of the following are required contract elements except:
    a. Consideration
    b. An offer
    c. Capacity
    d. Alternatives

5. Which of the following occurs in the Conduct Procurement process?
    a. Contract change control
    b. Make-or-buy decisions
    c. Bidder conferences
    d. Source selection criteria

6. Your organization needs some specialized equipment for the next project. The project is anticipated to last one year. Salvage rate on the equipment is 25 cents on the dollar. When the project is done, you will have no use for the equipment. When performing a rent-or-buy analysis for this piece of equipment, the following facts are established: the equipment price is $28,000. The rental price is $3000/month for the first four months followed by $2000/month thereafter. What is your *best* option?
    a. Either option is viable – for one year, the rental price equals the purchase price
    b. If the project ends early, it will be less expensive to rent
    c. If the project is late, it will less expensive to buy

d. Unless the project is guaranteed to end 4 months early, buy the equipment

7. The contract specifies that payments are to be made when deliverables are received by the buyer. All of the following regarding the procurement statement of work (SOW) are true *except*:
    a. Changes must be documented as formal written elements
    b. Non-delivery of any component of the procurement SOW is subject to legal remediation
    c. The SOW can be developed by both the buyer and the seller
    d. Payments can be withheld in the event that the customer is not satisfied with the deliverable

8. Withholding a portion of a vendor's payment in order to guarantee delivery of the final product is called:
    a. Withholding
    b. Retainage
    c. Escrow
    d. Assignment

9. You are managing a contract in which you will not have much time to audit invoices. What is the best form of contract to choose under these conditions?
    a. Time and Materials (T&M)
    b. Fixed Price
    c. Cost Plus Incentive Fee (CPIF)
    d. Best Efforts

10. You are negotiating specific contract terms with a purchaser of your organization's flagship product. As the negotiations progress, a number of terms have already been hammered out, and the negotiation session looks to be proceeding well. Your final price comes to $1.25 million for the product and associated services. The customer's negotiator then says the following; "I am only allowed to spend up to $1 million on this product. If you're willing to offer it at that price, we can move forward, otherwise we will have to reconvene this session in two weeks". The negotiation tactic being employed at this point is described as:
    a. Missing Man
    b. Delay
    c. Limited authority
    d. Deadline

11. When do contract negotiations occur on a project?
    a. Control Procurements
    b. Plan Procurements
    c. Conduct Procurements
    d. SOW evaluation

12. The buyer has established a CPFF vehicle for the current procurement activity. What is the buyer *most* concerned about?
    a. Risk
    b. Cost
    c. Specifications
    d. Vendor expertise

13. What is the seller's *biggest* benefit for arranging a T&M contract with a potential buyer?
    a. The seller's profit is unknown to the buyer
    b. Profit is built into every hour of work
    c. Project scope is usually small and easy to manage
    d. The TM vehicle can usually become a cost reimbursable contract

14. You have set up a cost reimbursable contract with your vendor on your organization's newest project. The most appropriate procurement document for a cost plus contract is:
    a. IFB
    b. RFQ
    c. RFB
    d. RFP

15. Your company makes a product that a potential buyer is very interested in. After several discussions, the potential buyer issues a letter of intent to purchase the product within the next two months. Your company president takes this letter of intent (LOI) to the local commercial bank in the hopes of obtaining a short-term loan to purchase the necessary equipment to deliver on this potentially lucrative contract. The bank turns him down flat, even though the seller's finances are in good order. Why do you think this is the case?
    a. Issues with the buyer's reputation
    b. The LOI is not a legal document
    c. The LOI does not contain enough money to cover the loan
    d. The seller has not reached the minimum funding limits for loans of this type

16. What is not a tool and technique of Control Procurements?
    a. Negotiated settlements
    b. Payment systems
    c. Performance Reporting
    d. Claims administration

17. The RFP is:
    a. A tool and technique of the Conduct Procurements process
    b. An output of the Plan Procurements process
    c. An input to Control Procurements process
    d. A tool and technique of the Plan Procurements process

18. Contract terms and conditions:
    a. Cannot be modified
    b. Formalizes degree of risk assumed between the buyer and seller
    c. Identifies the type of contract being used for the engagement and specifies the reasons for its use
    d. Are outlined in the buyers RFP

19. The project manager can perform all the following functions in a procurement *except*:
    a. Be the lead negotiator in a procurement
    b. Have authority to authorize changes to the procurement
    c. Help to clarify and finalize the contract terms and conditions
    d. Take a lead role in auditing the seller's work product

20. The structured review of the procurement process from Plan Procurements through Control Procurements is known as a:
    a. Structure procurement review
    b. Records review
    c. Procurement audit
    d. Procurement verification and validation

21. The PM has been authorized by the contract administrator in your organization to handle specific, low impact changes in the contract should the need arise. The vendor on this particular procurement has

indicated a need for a major change in the current specification. You discuss the change with the vendor, verbally agree to it, and implement the change via the standard internal change control process. At an invoice audit several months later, the purchasing organization refuses to pay for the work that was entered in the change system. What has the project manager *forgotten* to do in this instance?

a. Consult the technical team prior to implementing the change
b. Implement a formal written change to the contract
c. Verify that the change was within the project manager's responsibility from the contract administrator
d. Update the configuration documents on the project

22. What costs are the *most important* costs that need to be considered when making a purchase decision for a product or service?
    a. All development costs
    b. The purchase price
    c. The life-cycle costs
    d. The purchase price + failure costs

23. You are thinking of purchasing a software product from a relatively young organization - they have been in business less than two years. This is a cutting edge financial product that would put you at least 18 months ahead of all competitors in your market space. However, your concern is that if you purchase software from them, there is a possibility that they may go out of business and you would lose the investment in the software. You ask the company to outright purchase the software code, but the company has rejected this as an option. What is your *best* option moving forward if the company's survivability is an issue?
    a. Contract it as a work made for hire
    b. Set up a code escrow arrangement
    c. Offer to buy the company
    d. Look for viable alternatives

24. The vendor is *primarily* concerned with which of the following on a fixed-price contract vehicle?
    a. Capacity
    b. Price
    c. Audits
    d. Risk

25. All of the following are usually true when dealing with a single source supplier with the possible *exception* of:
    a. You are getting the best price
    b. You have a well established relationship with the seller
    c. You are getting exactly what you need from the seller
    d. The procurement process is simplified

26. Your organization has made you the single point of contact for the bidder conference your organization is sponsoring. Each vendor has been notified in writing that any breach in the bidder conference protocol will result in disqualification from bidding on this RFP. While in the process of collecting questions from the vendors for the bidder's conference, you discover that one of the vendors knows your senior vice president of sales, and has contacted him for some inside information about the bidding process. As the designated single point of contact for your organization, what is the *next* thing you should do?
    a. Contact your senior management about the breach in protocol by the vendor in question
    b. Issue the vendor a *stern* warning that this breach will not be tolerated a second time
    c. Contact the VP of sales and instruct him to sever all contact with the vendor
    d. Disqualify the vendor from participation in the bidding process

27. What is the primary difference between a Weighting system and a Screening system?
    a. Weighting systems favor specific vendors, while screening systems are used to screen out non-MBE vendors
    b. Weighting systems evaluate the seller's financial capacity, while screening systems evaluate the seller's technical capacity
    c. Weighting systems evaluate the seller's ability to deliver the contract terms, while Screening systems weed out unqualified vendors
    d. The systems are essentially the same – these are two terms for the same process

28. Change Control in a Contract environment is:
    a. Less complicated than in your project environment
    b. More complicated than in your project environment
    c. The complexities are equal internally or with a contract
    d. Discouraged, as it usually represents scope creep

29. Which of the following would usually play the *most important* part in your decision to outsource work for your organization or retain it for execution internally?
    a. Proprietary processes or trade secrets
    b. Vendor expertise
    c. Possibility of a Sarbanes-Oxley required audit
    d. Cost

30. You are managing a procurement using a FPIF contract vehicle. What is the total point of assumption for the seller if the ceiling price is $2.1 million, total cost is $1.7 million, total price is $1.85 million and the buyers share ratio is 70%?
    a. $2,057,101
    b. $2,057,143
    c. $2,050,020
    d. $1,985,000

31. Your vendor completed some work on the current procurement that was not built to specification. The breach is serious enough that filing a simple claim via the claims administration process outlined in the contract will not address the issue. The legal team has gotten involved and has demanded that the vendor correct the problem. The vendor is saying what's done is done, and it is too late to make a correction. The project manager should recommend:
    a. Taking the vendor to court to force them to comply with the contract
    b. Cancelling the contract for convenience
    c. Cancelling the contract for cause and then take legal action to force compliance or obtain liquidated damages
    d. Ignoring the breach and move on

32. You've been negotiating with the buyer for several days to come to contract terms on the sale of your new product. The final details have been hammered out and you have come to an agreement on contract terms and conditions. All that remains is to finalize the contract, obtain signatures and prepare to begin the work. Just as the negotiations are completing, the negotiator from the buyer side informs you that the person that can ultimately make the decision was unavoidably called away to deal with an internal emergency and the negotiating team lead cannot complete the deal. The signing will have to be delayed three days until the senior executive returns. This type of negotiation tactic is called:
    a. Delay
    b. Missing man

c. Fait accompli
d. Limited authority

33. You have procured services from a general contractor on your current project. Because you need to keep track of some of the details of this work, a number of the general contractor's resources are working on-site at your organization's facility. For specific aspects of this work, the general contractor has brought in a subcontractor to fulfill certain details of the contract. You approached one of the subcontracted resources and asked them to do something. They ignored you. Incensed, you approach the project manager for the general contractor and ask why your requests are being ignored. The general contractor's project manager explains that the subcontractor is not contracted to your organization. What type of contract relationships does this describe?
    a. Non-disclosure
    b. Non-compete
    c. Privity
    d. Fait Accompli

34. You discover that a manager for your company is engaged in a kickback scheme with a vendor on a government contract. Saying something to senior management might jeopardize your employment. What do you do?
    a. Inform senior management of the illegal activity
    b. Speak to the manager offline – let him know what you found out and give him 48 hours to correct the situation
    c. Turn in the vendor for illegal activity, but protect the manager in your organization
    d. Nothing. With the current economy, you may not find another job for six months – if at all. Otherwise, you may be branded as a whistleblower

35. You are on a flight heading for a bidder's conference to deliver a presentation to the buyer which will outline your response to the buyer's RFP. You overhear two people in the row in front of you discussing their bid strategy for a contract and realize that they are competing vendors for the same RFP. What do you do?
    a. Put on earphones so that you cannot hear them
    b. Move out of earshot to a different section of the plane
    c. Say nothing but take careful notes – this will give your organization a clear advantage at the bidder's conference
    d. Inform the vendors that you are a competitor

Chapter 12 Test – Answers

1. A – Read this question carefully. It does not state that there was an overcharge, only that some of the charges were 'questionable'. In the absence of specific contract language about overcharges, the invoice must be paid
2. B – This is a somewhat tricky question and it must be read carefully. Answer A does not help you if time is of the essence - litigations and additional negotiations can take quite a long time. Answer C may or may not be possible and will also take considerable additional time. Answer D would probably work, legally, but may not support the idea of 'protecting the relationship with the seller'. However, it might become your 'fallback' option if B does not work. The best option, Answer B, is to point out the legal problems with the contract and appeal to the vendor's reason. Point out that if it comes down to legal wrangling or a court case, the illegality of the specific contract provisions will be exposed and deemed unenforceable in a court of law. (Most contracts will contain a phrase that states that if any provision of the contract is deemed unenforceable in a court of law, the remaining provisions are still in force.)
3. B – The Procurement manager is not loyal to your specific project but may be administering many procurements
4. D – Alternatives are not a required contract element
5. C – The bidder conference is a tool and technique of Conduct Procurements. *PMBOK® Guide*, 5th edition, p.356
6. D – Did you forget the salvage costs of the equipment? That brings the cost of the purchase down to $21,000. Four months @ $3K = $12,000. Eight months @ $2K = 16,000. Total = $28,000, minus salvage of 25 cents on the dollar or $7,000 to sell the equipment. $28,000 - $7,000 = $21,000. If the project goes 8 months your rental costs are $20,000 – in this case it is cheaper to rent. At nine months, the rental costs are $22,000 – in this case it is cheaper to buy the equipment
7. D – The contract terms do not specify customer satisfaction as a contract term
8. B – This is known as retainage
9. B – This is one of the buyer advantages in a firm fixed-price contract
10. C – This is an example of the limited authority ploy
11. C – Procurement negotiations occur in the Conduct Procurements process. *PMBOK® Guide,*5th edition, p. 356
12. A – For a cost plus contract vehicle, the biggest concern is Risk from the buyer's perspective
13. B – the vendor's profit is built into every hour of work delivered
14. D – For a CR or cost plus contract, the most appropriate procurement document is the RFP
15. B – The letter of intent is not a legal document and does not obligate the buyer to follow through
16. A – Negotiated Settlements. *PMBOK® Guide,*5th edition, p. 356
17. B – It is one of the Procurement Documents which is an output of the Plan Procurements process. *PMBOK® Guide*, 5th edition, p. 368
18. B – Formalizes the degree of risk between the buyer and the seller. 'A' is incorrect, 'C' is established in the procurement management plan and 'D' is also incorrect. PMBOK® Guide, 5th edition, p. 377
19. A – The PM cannot be the lead negotiator in procurements. *PMBOK® Guide*, 5th edition, p. 377
20. C – This is the definition of a procurement audit. *PMBOK® Guide*, 5th edition, p. 388
21. B–The contract is the final arbiter of what gets paid, not your internal change control system. Only a formal written change to the contract, specifying who has the authority to make the change, is legally binding.
22. C – Life-cycle costs are the inclusive costs that include purchase price, maintenance and support and warranty costs. This is your ultimate cost for the product or service
23. B – A code escrow arrangement will protect the seller and the buyer. If the seller goes out of business, the buyer will have access to the code for continuing support of the product. Otherwise the code stays in escrow
24. D – The biggest issue for the vendor on an FP contract is risk
25. A – The probability is that you may not get the best/lowest price

26. D – If the rules of the procurement are not followed to the letter, other competing vendors may get the message that the bid process is rigged. Your organization may have great difficulty finding qualified sellers if it becomes known that there are issues with the bid process. Answers A and C may be the next thing you do after disqualifying the vendor. Answer B is not an option
27. C – Weighting systems evaluate vendors on specific buyer criteria and rank their potential performance accordingly. Screening systems are used to weed out potentially unqualified sellers
28. B – Change control is more complex in a contract environment due to the potential lack of visibility into the vendor's internal processes
29. A – Proprietary processes or trade secrets would make any business think twice about outsourcing any work that would impact the organization's competitive position. Answers B and D may follow as close seconds. Answer C is a red herring
30. B – As per the PTA formula: ($2,100,000 - $1,850,000)/.7 + $1,700,000 = $2,057,143
31. C – The question describes a cardinal breach in the contract. The best option is to cancel for cause (this will send a message to other potential vendors that you do not tolerate cardinal contract breaches) and take legal action to either force the vendor to do its job, or obtain monetary damages so that the buyer can implement a fix without incurring additional cost
32. B – This describes the classic 'missing man' scenario
33. C – The Privity relationship means that any sub-contractor doing work for the prime contractor is responsible to whomever directly contracted for their services – in the case the prime contractor
34. A – Always do the right thing without consideration for your personal benefit
35. D – Inform the vendor you are a competitor. It speaks most highly to your ethics and the ethics of your organization. Answers A and B might leave the question of your ethics open to discussion. Answer C is 180 degrees incorrect

Chapter 13 : **Project Stakeholder Management**

Section Topics:

- Identify Stakeholders
- Plan Stakeholder Management
- Manage Stakeholder Engagement
- Control Stakeholder Engagement

Section Objectives:

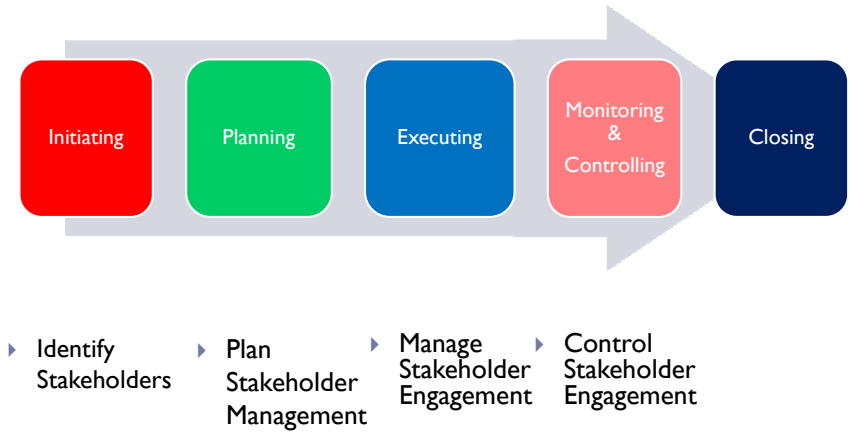
- Perform a stakeholder analysis
- Create a stakeholder register and a stakeholder engagement matrix
- Develop a stakeholder management plan
- Implement stakeholder communication methods
- Manage and control the stakeholder engagement

Project Stakeholder Management Process Summary

The high level Project Stakeholder Management output elements, by Process Group are:

Initiating	Planning	Executing	Monitoring and Controlling	Closing
-Stakeholder register	-Stakeholder management plan	-Issue log -CR's	-Work performance info -CR's	

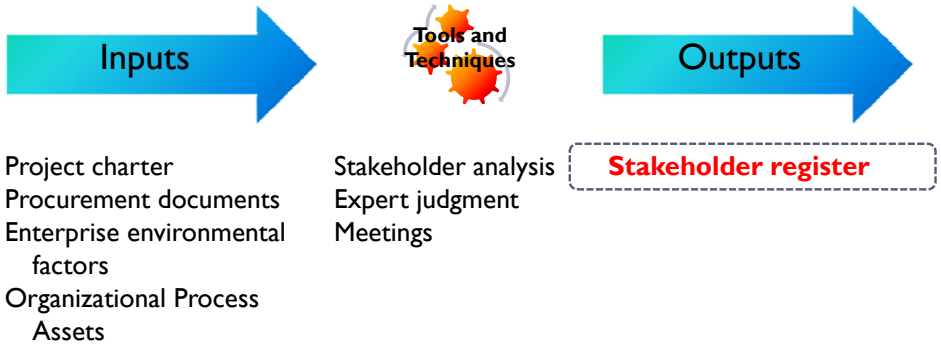
Project Stakeholder Management



Project stakeholder management focuses on the processes required to identify the people, groups, or organizations that can either impact or be impacted by the project. Some of these processes include the following:

- Analyzing stakeholder expectations and their impact on the project
- Developing appropriate management strategies for engaging stakeholders
- Implementing continuous communications with stakeholders to understand needs and expectations
- Fostering stakeholder engagement in the project for decisions and activities
- Focusing on stakeholder satisfaction as a key project objective

Identify Stakeholders



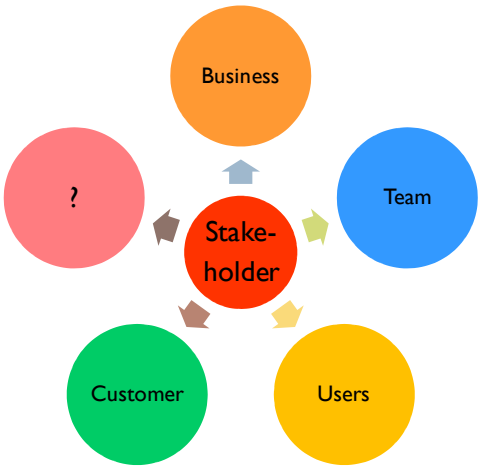
Identify Stakeholders is the process of identifying all individuals or organizations that can be positively or negatively impacted by the project, and documenting their influence, impact, interest, and involvement on project success.

This is a key area in the project management process, as many projects fail due to a lack of complete stakeholder identification.

Most projects will have a large number of stakeholders, and it is a project manager's job to identify stakeholders and understand the impact of the project on their specific business areas. In this respect, the project manager's job amounts to a relationship management function.

The key output of this process is to create a stakeholder register which identifies in great detail, everything about the stakeholders on the project.

Stakeholder Analysis



Identify *all* stakeholders

Identify potential impact or support stakeholder may have on/for the project

Assess stakeholder 'hot buttons' for potential project impacts and identify mitigation strategies

Since identifying stakeholders occurs in the initiating process group, understand that you are identifying stakeholders while you are also developing the project charter.

For the exam, stakeholder analysis fundamentally involves three steps:

1. Identify all potential stakeholders and document all relevant information, such as influence level, project interest level, specific skill set and business knowledge, their role on the project, their operational department and their decision-making authority.
2. Identify the impact level the stakeholder has on your project, either positive or negative, and define useful strategies to deal with issues or concerns. Power grids are an effective graphical tool to identify stakeholder influence (see next page).
3. Assess how key stakeholders may respond to specific situations (i.e. determine stakeholder 'hot buttons'), and develop approaches to influence or enhance their support of the project.

   EXAM TIP: Know the three "I's" of Stakeholders: Interest, Importance and Influence

For Example, this can all be represented in a Stakeholder Analysis Matrix:

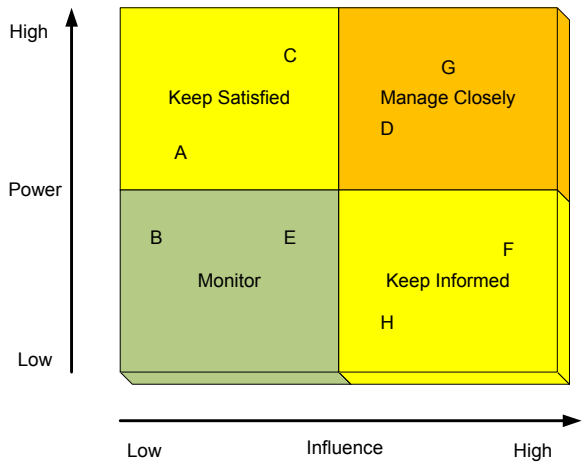
Stakeholder	Stakeholder Interest	Impact Assessment	Support Strategy

Power/Interest Grid

Multiple models are used to classify stakeholder Power/interest/influence:

- Power/interest: Grouping stakeholders based on authority (Power) and interest
- Power/Influence: Grouping stakeholders based on authority and influence (Involvement)
- Influence/Impact: Grouping stakeholders based on influence and project impact (ability to effect change)
- Salience Model: Grouping based on power to influence, urgency (immediate need for attention) and legitimacy (appropriate involvement)

A Power/Interest grid is a useful graphical tool to identify stakeholder influence on a project. A variant called a **power/influence grid** appears below:



This grid identifies two vectors: power and influence. In this case, Power means that the stakeholder can stop your project 'dead in the water' if dissatisfied with the results. Influence, in this case, means that the stakeholder can influence the direction of your project and influence change on the project as well. When Power and Influence are both low, the project manager needs to monitor the situation regularly. When dealing with a stakeholder whose power and influence are both high, the project manager should maintain constant communication with that stakeholder to ensure the project is proceeding to the stakeholder's satisfaction, and that issues are addressed in immediately.

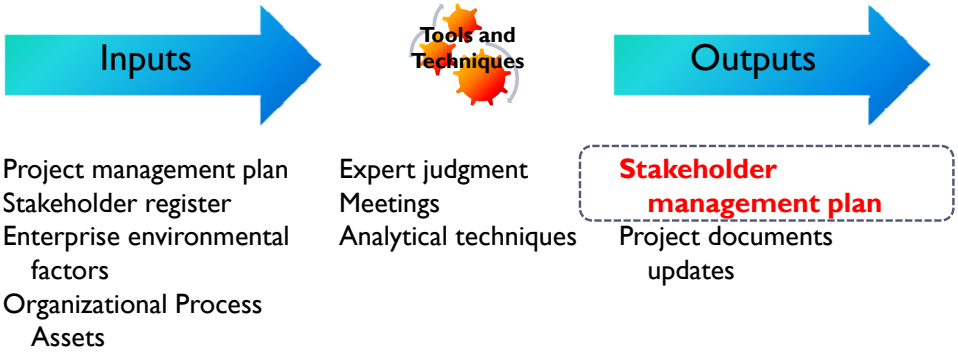
Stakeholder Register

Stakeholder Register										
Project:				Start Date:						
Name	Position	Location	Role on Project	Contact Data	Key Requirements	Major Expectations	Classification: I - Internal E - External	Impact: S - Supporter N - Neutral R - Resistant	Impact/ Influence Level 1-10	Comments
Joe	Director	Los Angeles	Software Development Lead	813-555-1234	Resources must be dedicated	Collaboration and adequate testing	I	S	3/5	

An example of a stakeholder register, shown above, includes all information about the stakeholder, including their power, impact, and influence level on the project. The register can also include information about whether they generally support the Project, are neutral about the project, or have issues with the project that need to be addressed. A brief example is shown above, for display purposes only. The list of elements in the register can include, but are not limited to, the following elements:

- Name
- Formal Position
- Location
- Role on Project
- Contact Information
- Preferred communication method
- Key Project Requirements
- Project Expectations
- Stakeholder Classification
- Stakeholder Influence
- Stakeholder Impact
- Senior Management Direct Report
- Significant Issues or Constraints
- Additional Information

Plan Stakeholder Management



Plan stakeholder management involves developing appropriate management strategies to engage stakeholders throughout the project lifecycle. To do so effectively the project manager has to perform analysis of stakeholder needs, interests, and potential impact on the project's success. Planning stakeholder management addresses stakeholders who might view the project as a positive or as a significant negative.

Analytical Techniques

A key analysis technique is to compare the current engagement level of all stakeholders to the desired level of engagement required for a successful project completion. The engagement level of stakeholders is usually classified as follows:

- Unaware: unaware of the project or its potential impacts
- Resistant: aware of the project impacts and resistance to change
- Neutral: aware of the project and neither supports nor resists the project objectives
- Supportive: aware of the project and supportive of change
- Leading: aware of the project and actively engaged in ensuring project success

A key tool used to perform this analysis is known as the Stakeholder Engagement Assessment Matrix, an example of which is shown below:

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Bob	C			D	
Carol			C		D
Ted		C		D	
Alice				C,D	
Joe			C	D	

'C' indicates the current level of support.
'D' indicates the desired level of support.

The project manager's objective is to move stakeholders from the 'C' state to the 'D' state.

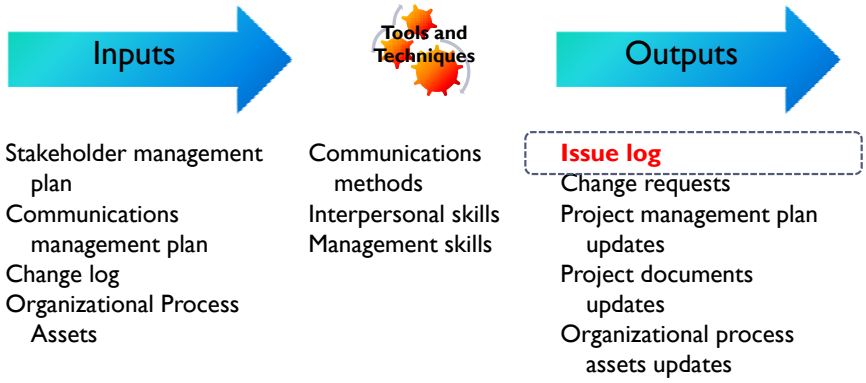
Stakeholder Management Plan

What if you're dealing with stakeholders who view your project as a significant negative, causing them to do extra work, or at worst, impact the livelihood of the people in their department? If you don't have a strategy for dealing with stakeholders who may be less than enthusiastic about the project, your project may experience significant roadblocks or outright resistance from stakeholders.
Therefore it is critical to find out which stakeholders may be negatively impacted by your project from the beginning and identify strategies for removing obstacles for stakeholders and gaining their support.

The stakeholder management plan will typically contain the following elements:

- Current and desired engagement levels of stakeholders
- Scope and impact of change to stakeholders
- Interrelationships and overlaps between stakeholders
- Stakeholder communication requirements for the current phase of the project
- Format, content, level of detail, and language of information to be distributed to stakeholders
- Timeframe and frequency of distribution of information to stakeholders
- Method for refining and updating the stakeholder management plan

Manage Stakeholder Engagement



The manage stakeholder engagement process enables the project manager to increase support for the project while minimizing resistance from stakeholders. Thus, the project manager is able to increase the chances of achieving a successful project.

Interpersonal and Management Skills

From the point of view of the project manager, one of the critical aspects that will drive the success of the project manager on any project is the project manager's interpersonal skills and management skills. Aligning stakeholders to the goal of the project, and getting them on your side, is a key element in making any project successful. In order to do this, the following management and interpersonal skills are used throughout the project:

- **Interpersonal skills**
  - Build trust with your stakeholders and project team members
  - Resolve conflict for the positive outcome of the project
  - Use active listening techniques to capture needed information
  - Help stakeholder overcome their fears of and resistance to change

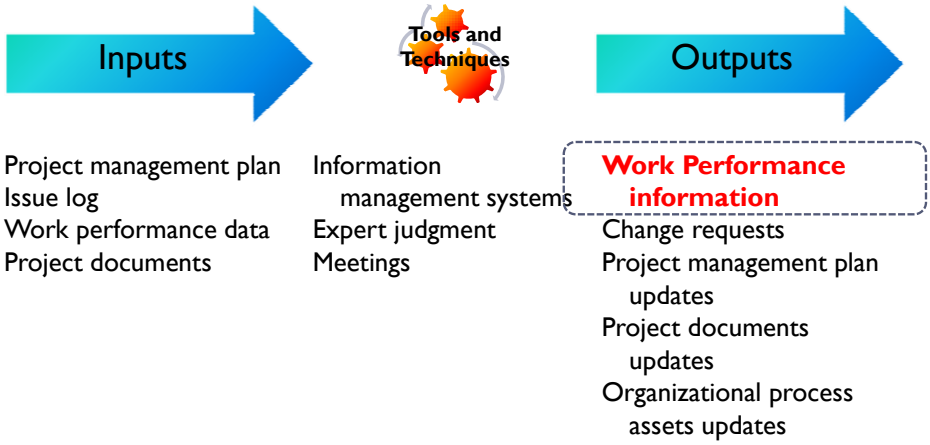
- **Management Skills**
  - Strong presentation and public speaking skills are key to communicating the goals and needs of the project
  - Negotiating skills, especially for needed resources, are a major asset
  - The ability to communicate clearly and effectively via the written word is a key skill for all project managers

Issue Logs

Issues Log								
Project				Project #				
Project manager				Sponsor				
Project artifacts				Updated				
ID	Issue Description	Project Impact	Action Plan/Resolution	Owner	Importan	Date Entered	Date to Review	Date Resolved
1								
2								
3								

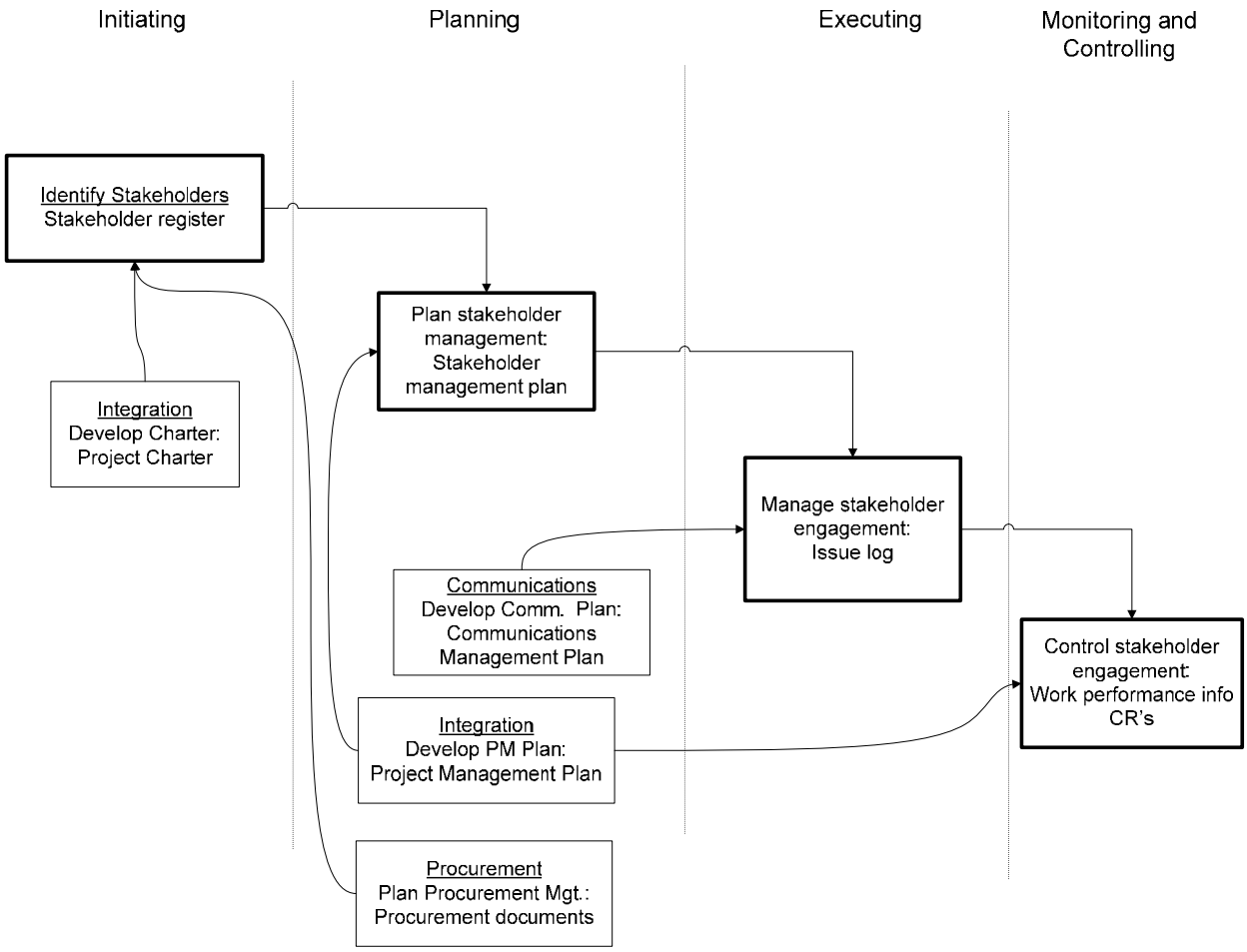
The issue log or action item log is a key tool used by the project manager to identify issues, define the impact, priority and urgency of the issues, assign ownership of those issues, and established due dates for resolution. It is the project manager's responsibility to create and track issues on the project with the goal of bringing them to a successful resolution, or escalating them to senior management if the issues fall outside the project manager’s area of authority.

Control Stakeholder Engagement



Controlling the stakeholder engagement involves the processes of monitoring overall stakeholder relationships and adjusting strategies and plans for engaging stakeholders in the project. Performed correctly, the process will maintain or increase the efficiency and effectiveness of stakeholder engagement activities as the project evolves.

Project Stakeholder Management: Key Process Interactions



In Summary…

- The creation and maintenance of a stakeholder register
- Stakeholder management plan
- Stakeholder management strategy
- Power/influence/impact grids
- Stakeholder engagement matrix
- Managing the stakeholder engagement
- Controlling the stakeholder engagement

Stakeholder Process Check

Match the process to its description:

___Identify stakeholders

___Plan stakeholder management

___Manage stakeholder engagement

___Control stakeholder engagement

A. The process of developing appropriate management strategies to effectively engage stakeholders throughout the project lifecycle, based on the analysis of their needs, interests, and potential impact on project success

B. The process of monitoring overall project stakeholder relationships and adjusting strategies and plans for engaging stakeholders

C. The process of identifying the people, groups, or organizations that could impact or be impacted by a decision, activity, or outcome of the project

D. The process of communicating and working with stakeholders to meet their needs or expectations, address issues as they occur, and foster appropriate stakeholder engagement in project activities

Chapter 13 Memory check

1. The three 'I's' of stakeholders are _____, _____, and _____.
2. The key and only output of the identify Stakeholders process is _____ _____.
3. Stakeholder engagement levels are _____, _____, _____, _____, and _____.
4. Stakeholder current and desired level of engagement can be captured in a _____ _____ _____ _____.
5. Control stakeholder engagement has as the key output_____ _____ _____.
6. Classes of stakeholder that include power, urgency and legitimacy is described in something called the _____ _____.
7. A key output of Manage Stakeholder Engagement process is _____ _____.
8. Interpersonal skills and management skills are both _____ _____ _____ of _____ _____ _____.
9. The key tool and technique of Identify Stakeholders is_____ _____.
10. The process of monitoring overall stakeholder relationships is called _____ _____ _____.
11. _____ is the process of identifying all individuals or organizations that can be positively or negatively impacted by the project
12. Identifying all potential stakeholders, their potential impact on the project and assessing how key stakeholders may respond to specific situations is called _____
13. The _____ includes all information about the stakeholder, including his/her power, impact, and influence level on the project

Chapter 13 Test

1. The implementation of which of the following processes decreases the risk of project failure?
    a. Manage stakeholder engagement
    b. Control stakeholder engagement
    c. Plan stakeholder management
    d. Develop stakeholder engagement

2. The five levels of stakeholder engagement are...?
    a. Oblivious, opposed, neutral, proactive, driving
    b. Unaware, opposed, neutral, supportive, driving
    c. Oblivious, resistant, neutral, supportive, leading
    d. Unaware, resistant, neutral, supportive, leading

3. Plan stakeholder management is fundamentally concerned with all the following except...?
    a. Developing strategies to effectively engage stakeholders throughout the project
    b. Development of the stakeholder register
    c. Development of the stakeholder management plan
    d. Identifying how the project will affect stakeholders

4. You are engaged in gathering information from stakeholders regarding whose interests should be taken into account throughout the project. This is called:
    a. Identify stakeholders
    b. Stakeholder analysis
    c. Expert judgment
    d. Plan stakeholder management

5. Which of the following is not included in the Stakeholder Management Plan?
    a. Project lifecycle
    b. Communications requirements
    c. Impact of scope changes to stakeholders
    d. Stakeholder management strategy

6. Most projects will have a _____ number of stakeholders.
    a. Resistant
    b. Supportive
    c. Diverse
    d. Unknown

7. Which of the following is not an input to the Control Stakeholder Engagement process?
    a. Project management plan
    b. Issue log
    c. Project documents
    d. work performance information

8. The ability of stakeholders to influence the project is typically highest at the _____ stages.
    a. Planning
    b. Initial
    c. Executing
    d. Design

9. The three 'I's' of stakeholders are...?
    a. Independence, influence and inquiry
    b. Importance, inquiry and influence
    c. Interest, influence and importance
    d. Influence, inquiry and importance

10. A stakeholder is...?
    a. Anyone who is involved in the project
    b. Anyone positively or negatively impacted by the project
    c. Anyone who can influence the direction of the project
    d. Anyone who can impact/be impacted positively or negatively by the project

11. Your project is well underway, and the project management plan as well as subsidiary plans have been baselined and work is proceeding apace. A key project stakeholder has just approached you with a problem: a requirement was missed by the business in the requirements gathering process and they want it inserted into the project plan without having to go through the formal change request process. They would consider it a huge favor if you did so and would be willing to reciprocate at some later date. What should you do next?
    a. Talk to the stakeholder's manager about the stakeholder's request for a breach in the formal corporate change management process
    b. Since the stakeholder has key resources on the project, it may pay off in the long run to agree to the stakeholder's request
    c. Perform an impact assessment on the requested change and submit to the CCB for approval
    d. Agree to the request only if the stakeholder is willing to remove a less important feature of equal effort so as not to impact the costs or the timeline on the project

12. Expert judgment is a tool and technique of all of the following processes except…?
    a. Identify stakeholders
    b. Plan stakeholder management
    c. Manage stakeholder engagement
    d. Control stakeholder engagement

13. The stakeholder analysis matrix is part of …?
    a. Part of the Stakeholder Management Strategy - an output of identify stakeholders
    b. An output of Plan Communications
    c. Part of the stakeholder register
    a. Part of Performance Reporting

14. Describing stakeholders based on their power (ability to impose will), urgency (need for immediate attention), and legitimacy (their involvement), describes what type of grid or model?
    a. Power/Influence grid
    b. Salience Model
    c. Influence/Impact grid
    a. Power model

15. Which of the following best describes Plan Stakeholder Management process?
    a. Creation and maintenance of relationships between the project team and stakeholders
    b. Preventing negative stakeholders from derailing the project
    c. Striking a balance between stakeholder needs and project needs
    d. Focuses on from the creation of the stakeholder management strategy

16. The key benefit of the Manage Stakeholder Engagement process can be summarized best in which of the following statements?
    a. It focuses on communicating and working with stakeholders
    b. It is focused on reducing negative stakeholder influence
    c. It allows the PM to increase support and minimize resistance
    d. It delivers the stakeholder management plan

17. Maintaining or increasing the efficiency and effectiveness of stakeholder engagement activities is a key benefit of which process?
    a. Identify stakeholders
    b. Control Stakeholder engagement
    c. Manage Stakeholder Engagement
    d. Plan Stakeholder Management

18. Regarding the Stakeholders Engagement Assessment Matrix, what do the letters 'C' and 'D' represent?
    a. Correct; direct
    b. Confirmed; denied
    c. Collaborate; disengaged
    d. Current; desired

19. What is a key tool and technique of the Manage Stakeholder Engagement process?
    a. Decision making skills
    b. Problem solving skills
    c. Interpersonal skills
    d. Conflict resolution skills

20. It is about midway through your current project and some of your stakeholders have informed you that their needs have changed on the project. As a result, you will need to adjust your strategy and plans for engaging stakeholders for the remainder of the project. What process are you in?
    a. Control Stakeholder Engagement
    b. Plan Stakeholder Management
    c. Manage Stakeholder Engagement
    d. Identify Stakeholders

21. You are evaluating your stakeholders on the current project. There is one stakeholder in particular who keeps calling you to make sure that he will be updated regularly on the project -sometimes that means on a daily basis! After speaking with the stakeholder, you discover that there are no resources from their organization participating in the project, nor are they part of the executive steering committee. Where on the power/interest grid does this stakeholder go?
    a. Manage closely
    b. Keep satisfied
    c. Monitor
    d. Keep informed

Chapter 13 - Test Answers

1. A - Manage stakeholder engagement decreases risk of project failure. *PMBOK® Guide*, 5th edition, p. 406
2. D - The correct selection is: Unaware, Resistant, Neutral, Supporting, Leading. *PMBOK® Guide*, 5th edition, p. 402
3. B - The stakeholder register is created in the Identify Stakeholders process. *PMBOK® Guide*, 5th edition, p. 398
4. B - This is called a stakeholder analysis , *PMBOK® Guide*, 5th edition, p. 395
5. A - The project lifecycle is selected and defined in the project management plan. *PMBOK® Guide*, 5th edition, p. 400
6. C - A diverse number of stakeholders. . *PMBOK® Guide*, 5th edition, p. 394
7. D - Work performance information is an *output* of control stakeholder engagement. . *PMBOK® Guide*, 5th edition, p. 413
8. B - the initial stages. *PMBOK® Guide*, 5th edition, p. 406
9. C - Interest, influence and importance
10. D - Anyone who can impact/be impacted positively or negatively by the project. *PMBOK® Guide*, 5th edition, p. 391
11. C - This is an ethics question dressed up as a stakeholder management question. What happens next is an impact assessment. Under the mandatory Responsibility section: "We inform ourselves and uphold the policies, rules, regulations and laws that govern our work..."
12. C - Expert judgment is not a tool and technique of Mange Stakeholder Engagement. *PMBOK® Guide*, 5th edition, p. 398
13. C – It is part of the stakeholder register, which is an output of Identify Stakeholders. *PMBOK® Guide*, 5th edition, p. 396
14. B – This exactly describes the Salience model. *PMBOK® Guide*, 5th edition, p. 396
15. A - stakeholder management is about the creation and maintenance of relationships between the project team and stakeholders. Under specific circumstances, answers B and C may be partially or. Answer D is incorrect: what is created as the stakeholder management plan, not the stakeholder management strategy. *PMBOK® Guide*, 5th edition, p. 400
16. C - It allows the project manager to increase support and minimize resistance from stakeholders. While answers A and B are partially correct, they do not describe the key benefit of the process. Answer D is wrong: the stakeholder management plan is created in the previous process - Plan Stakeholder Management. *PMBOK® Guide*, 5th edition, p. 404
17. B -Maintaining or increasing the efficiency and effectiveness of stakeholder engagement activities is a key benefit of Control Stakeholder Engagement. *PMBOK® Guide*, 5th edition, p. 409
18. D - Current; desired. *PMBOK® Guide*, 5th edition, p. 403
19. C - Interpersonal skills. *PMBOK® Guide*, 5th edition, p. 404
20. A - adjusting strategies and plans for engaging stakeholders. *PMBOK® Guide*, 5th edition, p. 409
21. D – Since the stakeholder does not have any resources from her organization that are actually working on the project, their influence is minimal. This indicates low power but high interest – therefore you want to keep this stakeholder informed

Chapter 14 : Professional and Social Responsibility

Section Topics:

- Overview of Professional and Social Responsibility
- The Meaning of Professional and Social Responsibility
- Recurring Themes

The PMI Code of Ethics and Professional Conduct

If you are an applicant to become a PMP®, or you already have become a PMP®, you are required to adhere to the PMI Code of Ethics and Professional Conduct.

A complete version of the PMI Code of Ethics and Professional Conduct can be found in the Project Management Professional (PMP®) Credential Handbook. We will review the high-level requirements over the next several pages.

The Code of Ethics – Four Areas

The code is basically broken down into four distinct areas:

1. Responsibility
2. Respect
3. Fairness
4. Honesty

You will be expected to answer between 17-25 questions regarding Professional and Social Responsibility for the exam (or between 8 -12 % of the test).

NOTE: The PMI Code of Ethics and Professional Conduct are not contained in the PMBOK® Guide, 5th edition®. While there is not a separate category for the PMI Code of Ethics and Professional Conduct on the PMP exam, there may be test questions addressing ethics.

The following attribution applies to pages 13-4 through 13-7 of this manual:

PMP Credential Handbook ©2009, Project Management Institute, Inc. pp 32-37

Responsibility

Aspirational Standards

2.2.1- We make decisions and take actions based on the best interests of society, public safety, and the environment.
2.2.2 -We accept only those assignments that are consistent with our background, experience, skills, and qualifications.
2.2.3 -We fulfill the commitments that we undertake – we do what we say we will do.
2.2.4 -When we make errors or omissions, we take ownership and make corrections promptly. When we discover errors or omissions caused by others, we communicate them to the appropriate body as soon as they are discovered. We accept accountability for any issues resulting from our errors or omissions and any resulting consequences.
2.2.5 -We protect proprietary or confidential information that has been entrusted to us.
2.2.6 -We uphold this Code and hold each other accountable to it.

Mandatory Standards

2.3.1 - We inform ourselves and uphold the policies, rules, regulations and laws that govern our work, professional, and volunteer activities.
2.3.2 - We report unethical or illegal conduct to appropriate management and, if necessary, to those affected by the conduct.
2.3.3 - We bring violations of this Code to the attention of the appropriate body for resolution.
2.3.4 - We only file ethics complaints when they are substantiated by facts.
2.3.5 - We pursue disciplinary action against an individual who retaliates against a person raising ethics concerns.

In summary:

Aspirational Standards

- Decisions and actions based on best interests of society, public safety and the environment
- Accept assignments consistent with our background, experience, skills and qualifications

Mandatory Standards

- Uphold rules, regulations and laws
- Report illegal activity or unethical conduct
- Report code violations to the appropriate body
- File ethics complaints only when substantiated by fact

Respect

Aspirational Standards

3.2.1 We inform ourselves about the norms and customs of others and avoid engaging in behaviors they might consider disrespectful.
3.2.2 We listen to others' points of view, seeking to understand them.
3.2.3 We approach directly those persons with whom we have a conflict or disagreement.
3.2.4 We conduct ourselves in a professional manner, even when it is not reciprocated.

Mandatory Standards

3.3.1 We negotiate in good faith.
3.3.2 We do not exercise the power of our expertise or position to influence the decisions or actions of others in order to benefit personally at their expense.
3.3.3 We do not act in an abusive manner toward others.
3.3.4 We respect the property rights of others.

In summary:

Aspirational Standards

- Be informed of norms and customs of others
- Listen to others points of view
- Directly engage those with whom we disagree or have conflict
- Conduct ourselves in a professional manner

Mandatory Standards

- Negotiate in good faith
- We do not influence others for personal benefit
- We do not act in an abusive manner to others
- We respect the property rights of others

Fairness

Aspirational Standards

4.2.1 We demonstrate transparency in our decision-making process.
4.2.2 We constantly reexamine our impartiality and objectivity, taking corrective action as appropriate.
4.2.3 We provide equal access to information to those who are authorized to have that information.
4.2.4 We make opportunities equally available to qualified candidates.

Mandatory Standards

4.3.1 We proactively and fully disclose any real or potential conflicts of interest to the appropriate stakeholders.
4.3.2 When we realize that we have a real or potential conflict of interest, we refrain from engaging in the decision-making process or otherwise attempting to influence outcomes, unless or until: we have made full disclosure to the affected stakeholders; we have an approved mitigation plan; and we have obtained the consent of the stakeholders to proceed.
4.3.3 We do not hire or fire, reward or punish, or award or deny contracts based on personal considerations, including but not limited to, favoritism, nepotism, or bribery.
4.3.4 We do not discriminate against others based on, but not limited to, gender, race, age, religion, disability, nationality, or sexual orientation.
4.3.5 We apply the rules of the organization (employer, Project Management Institute, or other group) without favoritism or prejudice.

In summary:

Aspirational Standards

- Exhibit transparency in our decision making process
- Constantly re-examine our own impartiality
- Provide equal access to information for those authorized
- Make opportunities equally available to qualified candidates

Mandatory Standards

- Disclose conflicts of interest (CI)
- Recuse oneself from any decision in which there is a CI

- Report code violations to the appropriate body
- We do not hire/fire based on personal considerations
- We do not discriminate based on race, gender, religion, etc
- We apply organizational rules without favoritism or prejudice

Honesty

Aspirational Standards

5.2.1 - We earnestly seek to understand the truth.
5.2.2 - We are truthful in our communications and in our conduct.
5.2.3 - We provide accurate information in a timely manner.
5.2.4 - We make commitments and promises, implied or explicit, in good faith.
5.2.5 - We strive to create an environment in which others feel safe

Mandatory Standards

5.3.1 - We do not engage in or condone behavior that is designed to deceive others, including but not limited to, making misleading or false statements, stating half-truths, providing information out of context or withholding information that, if known, would render our statements as misleading or incomplete.
5.3.2 - We do not engage in dishonest behavior with the intention of personal gain or at the expense of another. *

* PMP® Credential Handbook, © 2009 Project Management Institute, Inc – updated March 2009

In summary:

Aspirational Standards

- We seek to understand the truth
- We are truthful in communications and conduct
- We provide accurate information in a timely manner
- We make commitments and promises in good faith
- We create a safe environment so that others feel safe in telling the truth

Mandatory Standards

- We do not engage in deceptive behavior
- We do not engage in dishonest behavior

Contribute to the PM Body of Knowledge

- Sharing lessons learned
- Coaching other project managers
- Educating stakeholders on PM principles
- Becoming an active member of PMI
- Participating in research
- Writing PM articles

Not only is contributing to the Project management body of knowledge a good thing for project management in general, but it will also help you to obtain PDUs necessary to maintain your credential.

Each time you attend a PMI meeting, deliver a keynote speech on project management, do a presentation for your local PMI chapter, teach a course on project management, write an article for a professional journal on project management, or write a book on project management, you will not only be contributing to the knowledge base of project management, but you will also earn PDUs for these activities.

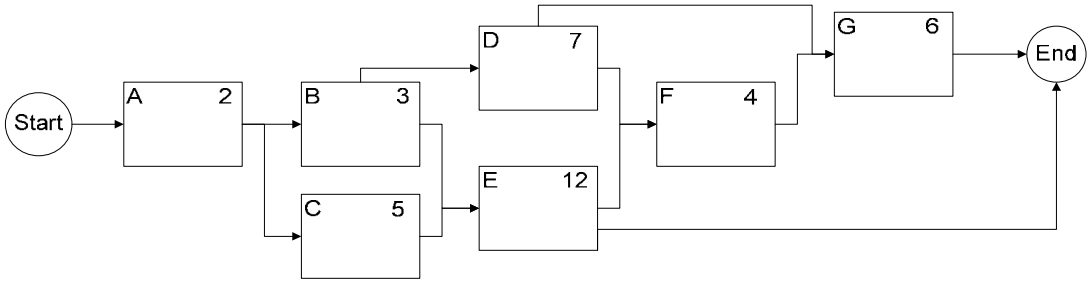
Chapter 15 : **Exercise Answers**

PDM Exercise Answers

Exercise #1:

Activity	Predecessor	Duration
Start		-
A	Start	2
B	A	3
C	A	5
D	B	7
E	B,C	12
F	D,E	4
G	D,F	6
End	E,G	-

PDM:



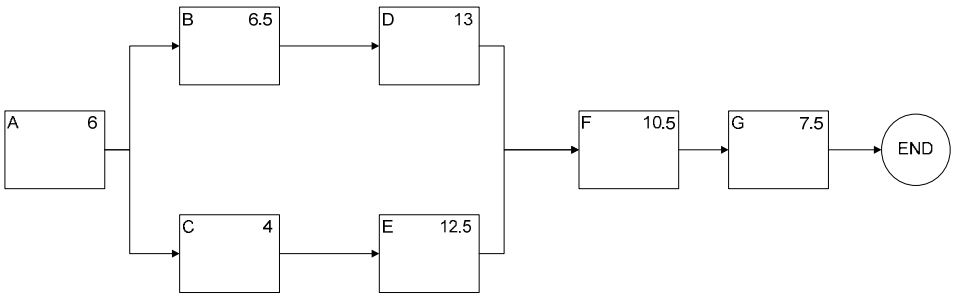
Answers:

1. What is the critical path? **A-C-E-F-G**
2. Where is the float or slack, if any? **Activities B and D have a combined float of 7**
3. The customer needs the schedule brought in seven weeks sooner. You discuss options with the customer and decide to reduce activity 'E' by seven weeks. How does this affect critical path? **You have 2 critical paths: A-B-D-F-G and A-C-E-F-G**
4. Starting with the original schedule, activity 'B' experiences major discovery and, as a result, changes to seven weeks. How does this impact critical path, if at all? **CP increases by 2**

Exercise #2:

Activity	Optimistic	Most Likely	Pessimistic	Predecessor	Computed PERT
A	3	5	13	None	6
B	4	6	11	A	6.5
C	2	4	6	A	4
D	8	12	22	B	13
E	7	12	20	C	12.5
F	6	10	17	D, E	10.5
G	3	6	18	F	7.5
End				G	

Computed PERT for each activity is shown in the grid above.

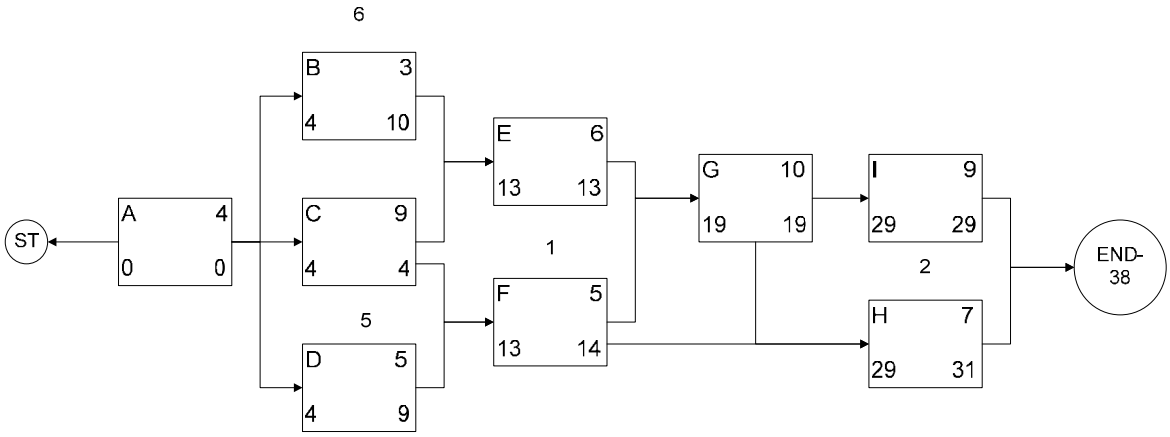


Question answers:

1. Compute the critical path: **A-B-D-F-G = 43.5 WEEKS**
2. Risk on activity E sharply increases 21 weeks due to a major discovery. Which part of the PERT estimate does this impact and what is the impact on the critical path? **It changes the pessimistic estimate from 20 to 41. Recomputed PERT for activity E is now 16. Critical path is now A-C-E-F-G = 44 WEEKS.**

<u>Exercise #3:</u>

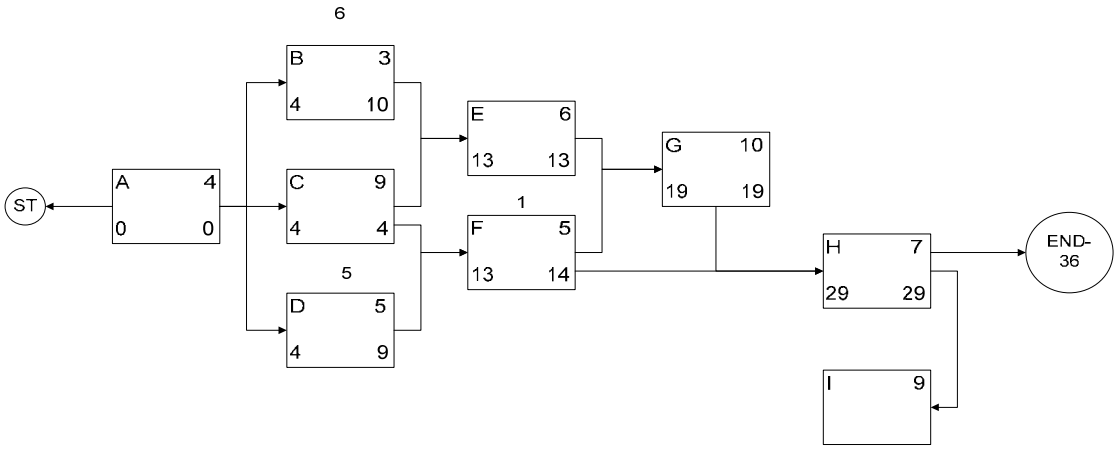
Activity	Predecessor	Duration
Start		-
A	Start	4
B	A	3
C	A	9
D	A	5
E	B,C	6
F	C,D	5
G	E,F	10
H	F,G	7
I	G	9
End	H,I	



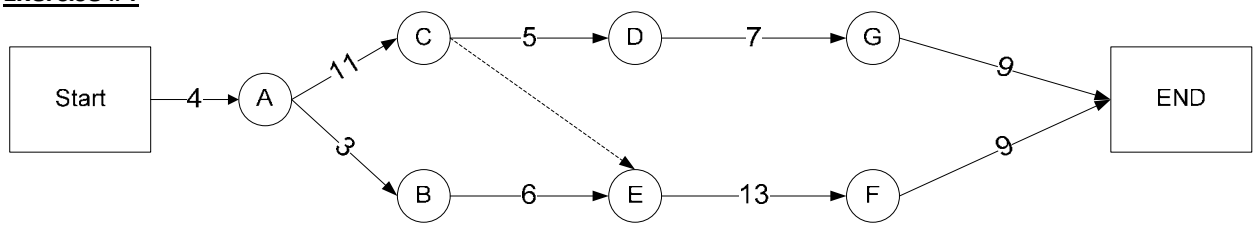
Answers:

1. What is the critical path? **A-C-E-G-I**

2. What is the near-critical path? **A-C-F-G-I and A-C-E-G-H**
3. If the customer wanted to reduce schedule by 4 weeks, what would be the resulting float? **Negative 4 weeks**
4. What would happen if activities 'H' and 'I' change to a finish-to-finish relationship and the predecessor relationship between activity 'I' and 'G' is eliminated? **Activity 'I' is no longer on the critical path and the critical path is now A-C-E-G-H with a duration of 36.**



Exercise #4



Answers:

1. What is the critical path? Start-**A-C-E-F-End**
2. What is the near-critical path? **Start-A-C-D-G-End**
3. If the customer wanted to reduce G-End by 2 weeks, what would the critical path be? **No Change**
4. What would be the simplest way to reduce the schedule by 4 weeks? **Eliminate Activity Start-A**

Earned Value Exercise Answers

Exercise #1:
You are managing a small construction project. The vendor was hired to install an intricate parquet floor in nine sections. Each section is supposed to take one week to complete at a cost of $750/section. Assume spending continues at the current rate.
At this point in time, you are 4 weeks into the project and you have the following information:

- Expenditures to date: $3250
- Sections completed: 4.5

Fill in the following grid with your answers:

Value	Formula/Calculation	Answer	What it Means
PV	4 * $750	$3000	Planned expenditures by this point in time
EV	4.5 * $750	$3375	Work accomplished after 4 weeks
AC	Given	$3250	Expenditures
BAC	9* $750	$6750	
CV	EV-AC	+ $125	We are under budget by $125
SV	EV – PV	+ $375	We are ahead of schedule
CPI	EV/AC	1.04	Achieving $1.04 in value for every dollar spent
SPI	EV/PV	1.125	We are 12.5% ahead of schedule
ETC	EAC - AC	$3240	Remaining expenditures
EAC	BAC/CPI	$6490	Forecast of actual budget for the project
VAC	BAC-EAC	+$260	We finish $260 under budget
TCPI	(BAC-EV)/(BAC-AC)	.964	The remaining work divided by the funds available. i.e. we have less work than the funds available to do it

Exercise #2:
Your current project is running with the following indicators:

- CPI = 1.07
- SPI = 1.1
- AC = $22,500

You are 4 weeks into a 12 week project, and some of the financial data is missing. Spending will continue at the budgeted rate – no BAC variance.
Given the information above, compute:

- EV = $24,075
- PV = $21,886
- BAC = $65,659
- ETC = $41,584
- EAC = $64,084
- VAC = +$1575
- TCPI for BAC = .963

We need EV to get the remaining answers.
CPI = EV / AC Thus 1.07 = EV / $22,500. Solving for EV, we get EV = 1.07 * $22,500 or $24,075
SPI = EV / PV or 1.1 = $24,075/PV . Solving for PV we get PV = $24,075/1.1 = $21,886
Since we are 4 weeks into a 12 week project, we are 1/3 complete. Thus BAC = 3* PV or $65,659
With no BAC variances, the EAC formula is AC +BAC –EV = $22,500 + $65,659 - $24,075 = $64,084
ETC = EAC – AC = $64,084 – 22, 500 = $41,584
VAC = BAC-EAC = $65,659 – 64,084 = +$1575
TCPI = (BAC – EV)/ (BAC-AC)

Exercise #3 -PERT and standard deviation rounded to the nearest dollar:

Deliverable	Optimistic	Most likely	Pessimistic	PERT	Std. Deviation
Component 1	$5000	$10000	$15000	$10000	$1667
Component 2	$3000	$7000	$14000	$7500	$1833
Component 3	$20000	$35000	$80000	$40000	$10000
Component 4	$15000	$30000	$63000	$33000	$8000
Totals:	$43000	$82000	$172000	$90500	

Questions:

1. What is the PERT estimate for the project – rounded to the nearest dollar?**$90,500**
2. Which component estimate is least precise? **Component 3: highest STD deviation.**
3. What is the budget range to a 95% confidence factor?**$47.5K to $133.5K**

Chapter 16 : **Pre-Test**

Pre-Test

1. All of the following are included in the PMB (Performance Measurement Baseline) with the exception of…?
    a. Sunk costs
    b. Planned value
    c. Expected monetary value
    d. Actual costs

2. The schedule development process includes which of the following?
    a. Scheduling method, master scheduler, HR management plan
    b. Scheduling method, PM plan, master scheduler
    c. Scheduling master, activity list, Cost Performance Baseline
    d. Scheduling method, scheduling tool, schedule model

3. Projects risk management, according to PMI, _____.
    a. Is an optional activity
    b. Is not an optional activity
    c. Depends on historical information
    d. Is performed by a team external to the project

4. Project estimates are derived from a number of sources and are continually refined throughout the duration of the project. Which of the following is not part of project estimating?
    a. Contingency reserves
    b. Expert judgment
    c. Industry standard databases
    d. Historical data

5. Project configuration management (PCM), when applied correctly to the life of a configuration item, provides visibility and control of the configured item's performance, function and physical attributes. This occurs throughout the lifetime of the project and often goes beyond project boundaries. Which of the following is a *key* PCM function?
    a. Reactively responding to changes in the product configuration
    b. Controlling changes to approved baselines
    c. Addressing issues in the project management plan
    d. A repository for product defects

6. A control account is used in the earned value process and is most accurately defined as _____.
    a. A management control point that is one level above a work package
    b. A management control point that that accounts for all budgeted costs, contingency reserves and management reserves
    c. A management control point that that accounts for all budgeted costs, minus contingency reserves and management reserves
    d. A management control point where all actual costs, scope and schedule are compared to earned value for performance measurement

7. You need to temporarily increase headcount on your project for work packages in which the discrete effort is not yet known. The best form of contract would be..?
    a. Fixed Price
    b. T&M
    c. Cost plus
    d. Fixed price – EPA

8. When computing the point of total assumption (PTA) on a fixed price contract, what is meant by "total price"?
    a. The ceiling price of the contract
    b. Costs minus profit
    c. Costs plus profit
    d. The ceiling price minus the buyer's share ratio

9. You just completed an important meeting with senior executives for a review of your current project. You just sent out your meeting notes to the project team. Meeting notes are considered what type of communication?
    a. Informal written
    b. Formal written
    c. Formal reviewed
    d. Informal reviewed

10. You have just witnessed a manager threaten a subordinate with demotion or transfer to another department because the subordinate was about to report to senior management on a conflict of interest issue within his department. PMI considers this _____.
    a. Well within the authority of the manager
    b. A violation of the mandatory, responsibility section of the *PMI code of Ethics and Professional Conduct*
    c. A violation of the aspirational, responsibility section of the *PMI code of Ethics and Professional Conduct*
    d. A violation of the discretionary, responsibility section of the *PMI code of Ethics and Professional Conduct*

11. Performing resource leveling with a tool like MS Project frequently results in…?
    a. An extended project timeline
    b. A reduced project timeline
    c. A schedule that is using human resources at higher than their 100% allocation levels
    d. The elimination of unneeded scope elements

12. Your boss thinks that his direct reports are lazy, not too bright, must be bullied in order to get them to do their jobs and thinks that they are overpaid. What leadership trait does this describe?
    a. Theory Z
    b. Theory Y
    c. Theory Q
    d. Theory X

13. The news has stated that there is a 20% probability that you may experience tornadoes in your area today. You just heard a tornado siren, which now changes the tornado probability occurrence to 90%. What kind of probability does this describe?
    a. Logical probability
    b. Conditional probability
    c. Indirect probability
    d. Direct probability

14. The BAC for your one year project was estimated at $1.2M. Assuming an equal monthly expenditure rate, what is the PV after 9 months?
    a. $600K
    b. $800K
    c. $900K
    d. $1M

15. You are in the process of identifying stakeholders for your current procurement activity. Where does general information about the project stakeholder's legitimacy, urgency and power reside?
    a. Procurement management plan
    b. Responsibility assignment matrix
    c. Salience grid
    d. Stakeholder register

16. A risk is…?
    a. A function of stakeholder tolerances
    b. A negative impact on the project
    c. A result of poor planning
    d. Always in the future

17. You are working out the details of a contract with your customer. As your discussions continue, one of the contract elements involves the potential of damage due to an earthquake. The customer insists that they should be indemnified against potential damage from the possibility of such an event. You counter that no one can predict such an event which is beyond anyone's control, and will have the possibility entered into the contract as:
    a. Fait acompli
    b. Force majure
    c. Quid pro quo
    d. Isto pensitaris

18. What would be used to evaluate the performance of a team member on your project?
    a. Team performance assessment
    b. Project performance appraisal
    c. 360° review
    d. Annual review

19. Two stakeholders are in violent disagreement regarding some of the key deliverables on the project you are managing. Each has spoken to you privately about their concerns and each has stated that they think the other stakeholder is 'making things up' to gain an advantage. What is your *best* course of action at this point?
    a. Report to senior management that there is a potential ethics violation by the two stakeholders
    b. Engage each of the stakeholder's managers and state that both stakeholders are conducting themselves in an unprofessional manner
    c. Let the stakeholders work out their differences. Inform them that their behavior may delay the project end date, which you will report in your status reviews to the project sponsor.
    d. Confront the issue with both stakeholders directly and attempt to help facilitate a resolution

20. There are an unusual number of change requests (CRs) being issued by a few stakeholders on your telecom project. Upon examination, you discover that the CRs are the result of an almost incomprehensible call-flow diagram that the stakeholders are having trouble understanding. What is the next thing you should do as the project manager regarding the call-flow?
    a. Implement a CR for a defect repair
    b. Implement a CR for a preventive action
    c. Implement a CR for a risk mitigation
    d. Implement a CR for a corrective action

21. A root cause analysis is _____
    a. A reactive process
    b. A proactive process
    c. A predictive process
    d. A synergistic process

22. You are thinking about applying to sit for the PMP examination. At this point PMI states that _____.
    a. You are subject to the *PMI Code of Ethics and Professional Conduct*
    b. You are conditionally subject to the *PMI Code of Ethics and Professional Conduct*
    c. You are not subject to the *PMI Code of Ethics and Professional Conduct*
    d. The *PMI Code of Ethics and Professional Conduct* applies only to those who are PMPs and members of PMI

23. You have utilized a form of project planning that details the immediate work in great detail and creates rough estimates for work that may not occur for a few months. This method of planning is called _____.
    a. Progressive response
    b. Incremental elaboration
    c. Rolling wave
    d. "Snowball" planning

24. The LS (Late Start) for a project activity is 53, and the LF (Late Finish) is 42. From a schedule perspective, this means one of the following:
    a. You are ahead of schedule
    b. You are behind schedule
    c. Your project contains negative float
    d. Both B and C

25. A trigger on a risk log item has been activated. As the project manager what is the next thing you should do?
    a. Notify stakeholders
    b. Notify senior management
    c. Implement the prescribed contingency response
    d. Immediately make an entry in the issue log

26. You have spent some time cultivating a relationship with a vendor to help them produce the highest quality product at the lowest possible price. They have done such a good job that they have become the primary source for this product. The type of relationship described here is known as _____.
    a. Prime vendor
    b. Single source
    c. Preferred vendor
    d. Sole source

27. You are thinking of investing $10M on a project with a potential of a $250M return on investment. There is an 80% probability the project will be successful. You have also determined that if the product works you will capture 75% of your market. What is the expected monetary value of this scenario?
    a. $198M
    b. $200M
    c. $250M
    d. $148.5M

28. You have facilitated a meeting between several stakeholders on your current project. Unfortunately the stakeholders are still at odds on several key points. You have recommended a compromise on the key issues that the stakeholders say they can 'live with'. What may be a problem with this approach?
    a. The stakeholders may be dissembling
    b. Some stakeholders may still harbor resentment on the 'solution'
    c. There is no problem; sometimes compromise is your only option
    d. The stakeholders may feel they have all lost something

29. The SPI = .97 while the CPI = 1.02. What does this tell you about your project?
    a. You are ahead of schedule and over budget
    b. You are ahead of schedule and under budget
    c. You are behind schedule and under budget
    d. You are behind schedule and over budget

30. Your organization is starting up a high visibility project for which you are the PM. All of the following are performed with the exception of_____.
    a. Acquiring the project team
    b. Identifying stakeholders
    c. Creating the project charter
    d. Developing the business case

31. Use the following grid for the next three questions. All durations in weeks. How long is the critical path?

Activity	Predecessor	Duration
A	-	4
B	A	3
C	A	11
D	B	7
E	C, D	6
F	C,E	7

    a. 27
    b. 25
    c. 22
    d. 28

32. If we shorten activity D by 3 weeks, what is the change in the length of the critical path?
    a. No change
    b. Shorter by three weeks
    c. Longer by three weeks
    d. There are 2 critical paths of the same length

33. Due to discovery, Activity B changes to 6 weeks. What is the change, if any, in the length of the critical path?
    a. No change
    b. Longer by three weeks
    c. Longer by 2 weeks
    d. Longer by one week

34. The SWOT grid is a tool used in _____.
    a. Risk planning
    b. Scope planning
    c. Quality planning
    d. Schedule planning

35. A process that originated in Japan that is used to help capture the 'voice of the customer' is called…?
    a. Kai-zen
    b. Poka Yoke
    c. Gemba
    d. Muda

36. The project requirements as well as the project work activities are captured in the _____.
    a. Requirements documents
    b. Scope management plan
    c. The Performance Measurement Baseline
    d. The scope statement

37. At the halfway point, the project has been assessed at being 5% ahead of schedule but 7% over budget. What report specifically is used to derive this information?
    a. Trend report
    b. Variance report
    c. Progress report
    d. Status report

38. The specific approach that is used to identify less costly methods for achieving the same results is known as…?
    a. Alternatives analysis
    b. Make-or-buy analysis
    c. Bargain hunting
    d. Value engineering

39. On any project the BCR (benefit cost ratio) should be _____.
    a. Greater than 1
    b. Used in project planning
    c. Equal to the ROI
    d. None of the above

40. Internal policies and standards, financial databases, templates and historical information all fall under a category defined by PMI as…?
    a. Enterprise environmental factors
    b. Organizational process assets
    c. Tools and techniques
    d. All of the above

41. You are taking statistical measurements of a component in a product to insure the manufacturing process is stable, predictable and repeatable. What process category do these measurements fall under?
    a. Quality assurance
    b. Quality planning
    c. Quality control
    d. B and C

42. What is the broad definition of the 'point of total assumption'?
    a. The point at which the customer accepts delivery and responsibility of the product of the project
    b. The point at which a project risk becomes an issue
    c. The point on a fixed price contract where the seller pays for all contract overages
    d. The point at which the performing organization assumes responsibility for all project deliverables

43. In simplest terms, the EAC (Estimate at completion) for your project is simply a/an_____.
    a. Original budget
    b. Forecast
    c. Amount need to complete the project
    d. Definition of earned value

44. Which of the following is not part of the Project Management Life Cycle?
    a. Verifying
    b. Planning
    c. Executing
    d. Initiating

45. The pessimistic estimate for project completion is 60 weeks; the optimistic completion estimate is 36 weeks. With a most likely completion of 48 weeks, what is the estimate for the possible range of completion to a 95% confidence level?
    a. Between 42 and 54 weeks
    b. Between 38 and 58 weeks
    c. Between 45 and 51 weeks
    d. Between 40 and 56 weeks

46. All of the following define responsibilities of the project sponsor with the exception of_____.
    a. Protecting the project from outside influences
    b. Accepting the product of the project
    c. Taking action on performance reports
    d. Signing off on the project charter

47. When communicating a message to a recipient, the Shannon-Weaver model does not specify which of the following elements?
    a. Encoding
    b. Decoding
    c. Feedback
    d. Translation

48. At the midpoint in your project, the PV = $25000, the AC = $30000 and the EV = $28000. From a project perspective this means that…?
    a. You are over budget and ahead of schedule
    b. You are over budget and behind schedule
    c. You are under budget and ahead of schedule
    d. You are under budget and behind schedule

49. A developer was performing some coding activities on a work package and discovered that a chronic problem in the software could be fixed with little effort – an additional 3 hours at most. He initiates the fix and surprises you at the next team meeting with this wonderful news. As the project manager, what is the next thing you should do?
    a. Complement the developer's initiative and back it up with a reward
    b. Reprimand the developer for not clearing it with you first
    c. Ask him to roll back the 'fix', as what he did is a form of scope creep
    d. Inform the developer's manager of his insubordination

50. All of the following can be used to create a network diagram using the critical path method with the exception of _____.
    a. PDM (Precedence Diagramming Method)
    b. ADM (Arrow Diagramming Method)
    c. CCPM (Critical Chain Project Management)
    d. HDM (Hierarchical Diagramming Method)

Pre-test Answers

1. C – Expected monetary value (EMV) is the result of a quantitative risk analysis and is not part of the PMB. It can be part of contingency reserves, which are not considered when computing earned value. *PMBOK® Guide*, 5th edition, p. 206
2. D - The schedule development process requires a scheduling method, scheduling tool, and a schedule model. *Practice Standard for Scheduling,* PMI, 2007, pp 1-2
3. B – Risk management is not optional. "It is essential to successful project management". *Practice Standard for Project Risk Management,* PMI, 2009, p. 4
4. A – Contingency reserves are created to address 'known unknowns' and are a function of the risk assessment process. They are not included in earned value calculations and are not part of the budget estimate.
5. B – A key function of the configuration management process is to control changes to approved project baselines. *PMBOK® Guide*, 5th edition, pp. 96-97
6. D – A control account is most accurately defined as a management control point where all actual costs, scope and schedule are compared to earned value for performance measurement. *Practice Standard for Earned Value Management,* PMI, 2005, p.49.
7. B – The T & M – time and materials – contract is best suited for short term projects needs in which the actual effort may be unknown or needs to be determined.
8. C – Total price equals the project costs plus the profit margin.
9. B – Meeting notes are considered a formal written form of communication. Formal reviewed and informal reviewed are made-up terms.
10. B - The scenario represents a mandatory responsibility in the PMI Code of ethics: "We pursue disciplinary action against an individual who retaliates against a person raising ethics concerns."Answer A is wrong under any circumstance and answer D is made-up.
11. A – Resource leveling levels out the workload so that resources can function at a sustainable pace. This will typically take 10/12/14 hour workdays down to a standard 8 hour day, which extends the project timeline. The process helps to avoid team burn-out.
12. D – This describes the Theory X manager. Theory Q is made-up.
13. B – This scenario describes conditional probability i.e. the probability of an event occurring is either increased or decreased based on some additional condition: "The probability that a tornado will occur is generally less than the probability that a tornado will occur given that I just heard a tornado warning siren".
14. C – By straight calculation: Budget burn rate is $100K/month. After 9 months, $900K of budget should have been expended.
15. C – The salience model describes the three elements described in the question. *PMBOK® Guide*, 5th edition, p. 396
16. D – A risk is always in the future. It defines a potential event with a specific probability. *PMBOK® Guide*, 5th edition, p. 310.
17. B – A force majeure is an 'act of God' in contract terms.
18. B – A project performance appraisal is used to evaluate individual performance on a project team and is a tool and technique of Manage Project Team. *PMBOK® Guide*, 5th edition, p. 282.
19. D – Confronting the issue is what PMI states is the most effective method for addressing problems on a project.
20. D – Issuing a CR for a corrective action – fixing the call flow diagram – will be the most effective method for putting the project back on track and preventing excessive CRs.
21. A – A root cause analysis is always reactive in nature in that it occurs after an event has occurred.
22. C – You are not subject to the code if you are only thinking about applying to take the PMP exam.
23. C – This is the classic definition of rolling wave planning. *PMBOK® Guide*, 5th edition, p. 560.
24. D – Both answers B and C are correct. The scenario validates the idea that the project is behind schedule *because* it contains negative float.
25. C – A risk log will contain a trigger and the prescribed contingency response as well as a fallback response.
26. B – This is a classic definition of a single source vendor: the buyer prefers to only do business with them.

27. A – The scenario describes a simple decision tree: 80% of $250M minus 20% of $10M or $200M - $2M = $198M. The 75% market share statement is a red herring.
28. D – The potential of the compromise process results frequently in what is described as a 'lose-lose' scenario: no walks away happy with the result and feels as though they have, instead, given up something important.
29. C – An SPI< 1 means you are behind schedule: A CPI > 1 means you are under budget.
30. A – Acquiring the project team is not an initiating project activity but an Executing project activity. *PMBOK® Guide*, 5th edition, p. 257.
31. D – The critical path consists of activities A-C-E-F for a total of 28 weeks
32. A – No change: activity D is not on the critical path
33. C – Changing the duration of activity B to 6 changes the critical path to A-B-D-E-F for a total of 30 weeks
34. A – The SWOT grid is a risk identification tool and part of the Planning process. *PMBOK® Guide*, 5th edition, p. 326.
35. C – Gemba is an observation technique that observes how the customer gets work done and how they will actually use your product or service; it is part of QFD, a Scope Management tool.
36. D – The project scope statement subsumes the requirements and the work required to create the deliverables. *PMBOK® Guide*, 5th edition, p. 123.
37. B – The variance report compares where the project now stands to the planned baselines and identifies any performance gaps, either positive or negative. Progress reports identify accomplishments to date. Trend reports Identify performance changes over time. Status report identifies the current status of the project.
38. D – The approach is called value engineering. Developed at GE in WWII to find effective alternatives due to material scarcity or cost.
39. A – A BCR of greater than 1 means that the benefits received from the project exceed the costs.
40. B – These elements are all organizational process assets. *PMBOK® Guide*, 5th edition, pp 32-33.
41. C – Statistical measurements are performed using Quality Planning and Quality Control tools. *PMBOK® Guide*, 5th edition, p. 238.
42. C – The point of total assumption is used on certain types of fixed price contracts to insure that the seller will take responsibility for contract overages beyond a specified point.
43. B – The EAC – estimate at completion – is a forecast of how much the project will actually cost. *PMBOK® Guide*, 5th edition, p.220.
44. A – 'Verifying' is not a defined process group in the Project Management Life Cycle
45. D – By straight PERT calculation. SD = (Pessimistic – Optimistic)/6 or (60-36)/6 = 4. A 95% confidence factor equates to 2 SD (standard deviations) from the most likely estimate (48). With an SD = 4, this equates to 48 – 8 to 48 + 8, or 40 weeks to 56 weeks.
46. C – The project manager with input from the project team is responsible for reviewing and taking action on performance reports
47. D – Translation is not included as a component in the Shannon-Weaver, sender receiver model. *PMBOK® Guide*, 5th edition, p. 294.
48. A – You are over budget and ahead of schedule: SPI = EV/PV or $28K/ $25K = 1.12 (ahead of schedule). CPI = EV/AC or $28K/$30K = .93 (over budget)
49. C – What the developer did is called 'gold plating'; delivering a feature that was not requested by the customer. It is a form of scope creep.
50. D – The 'hierarchical' diagramming method is a made up term.

Chapter 17 : **Post-Test**

Instructions:

Set aside 4 hours for the exam. ***DO NOT REFER TO THE MANUAL OR NOTES WHILE TESTING.***

Set a timer to run, even if you take breaks.

If your score on the post-test is 80% or better, you are ready to sit for the exam.

Post-Test

1. The process of developing management strategies to engage stakeholders throughout the project is called?
    a. Control stakeholder engagement
    b. Manage stakeholder engagement
    c. Identify stakeholders
    d. Plan stakeholder management

2. Which of the following statements is true regarding the five process groups of the project management life cycle?
    a. the process groups are project phases
    b. the planning, executing, and monitoring and controlling process groups overlap and are iterative
    c. the project life cycle and the project management life cycle are identical
    d. initiating only occurs once in the project life cycle

3. All of the following statements about earned value are correct *except* which of the following?
    a. Earned value shows us the value of the work accomplished at a certain point in time
    b. Earned value is computed from the basis of estimates
    c. Earned value is always the first operator in equations computing schedule or cost variance
    d. Earned value calculations are the most accurate when there is historical data and processes are well understood

4. Philip J. Crosby, the author of *Quality Is Free*, was known for promoting the following idea in quality circles:
    a. Kaizen
    b. Loss function
    c. Just in time
    d. Zero defects

Activity	Duration
Start-A	7
A-B	5
A-C	12
B-D	3
C-E	2
C-D	0
E-G	2
D-F	4
D-G	5
F-End	3
G-End	4

Use the grid above for the next 3 questions – all durations in weeks

5. What is the duration of the critical path?
    a. 28
    b. 26
    c. 24
    d. 22

6. Activity E-G is cut by 3 weeks – what is the resulting change in the critical path duration?
    a. 1 week
    b. 0 weeks
    c. 2 weeks
    d. 3 weeks

7. If activity C-D is eliminated, what is the duration of the resulting critical path?
    a. 27
    b. 26
    c. 24
    d. 22

8. When holding contract discussions with a vendor during procurement activities, a fait accompli is a type of:
    a. Contract type
    b. Force majeure
    c. Negotiation tactic
    d. Contract term and condition

9. The two basic standards that define the PMI Code of Ethics and Professional Conduct are:
    a. Government and industry
    b. Anticipated and required
    c. Aspirational and mandatory
    d. Intended and compulsory

10. The first major component in your project is about to be released to customer. The customer has asked for a meeting with you and the technical team to review the correctness of the component. This can *best* be described as:
    a. Validate Scope
    b. Validate deliverables
    c. Quality audit
    d. Variance analysis

11. A member of your team has been having difficulty on the project - they appear distracted and unfocused on the work. You've requested a meeting with this individual in order to assess the situation. The *best* type of communication to use in this instance is:
    a. formal written
    b. informal verbal
    c. informal written
    d. formal verbal

12. The Acquire Project Team process occurs during which of the project management life cycle process groups?
    a. Executing
    b. Planning
    c. Initiating
    d. Monitoring and controlling

13. You were brought in to replace the former project manager by senior management after project had started, and the project team has started planning activities. They had initiated planning activities and invited you to one of their planning sessions; a JAD session with the technical team and the stakeholders. At the meeting, several of the stakeholders are having a major disagreement about the goals of the project and where funding is coming from. What did management *probably* forget to do?
    a. Create a project management plan

b. Create a scope management plan
c. Create a requirements traceability matrix
d. Create a charter

14. We need some financial information. We are half-way complete with a six month project. SPI = 1.07, AC = $36,000, PV=$30,000. What is the cost variance of the project?
    a. -$3900
    b. -$6000
    c. -$3852
    d. $3900

15. You are attempting to obtain information regarding schedule variances on your project. Some stakeholders told you the project will take 15 weeks. The technical team has stated that the stakeholders are using 'creative accounting' to come up with this estimate. The technical team has estimated that the project will take 25 weeks. At an impromptu meeting with some longtime employees of the company, they state that the stakeholders and the technical team are imagining things. The project will really take 60 weeks! You consult with the PMO and they recommend that you take all the estimates and process them using a PERT analysis. While this is an accepted estimating method, what *might* be the biggest issue with using this approach?
    a. It only works with projects two years or longer
    b. It is only a point estimate - you need to use it with Monte Carlo modeling to demonstrate confidence factors at various points of time
    c. It relies too much on expert judgment
    d. The triangular distribution is more accurate

16. Several members of your project team are discussing how to address a specific risk on the project. One of the project's vendors has created a product that is key to the solution being delivered by the project, however, there is some question about the company's viability for the long term. Senior management wants to buy the product as a work made for hire, but the vendor has refused to make the product available as a 'buyout'. One of the team members recommends taking the product design and placing it in escrow. This way, if the vendor's company does not survive, the customer will have access to the design, so they can continue to update the product of the project over time. The risk strategy being employed is known as:
    a. Mitigation
    b. Avoidance
    c. Transfer
    d. Exploit

17. You are attempting to determine the escalation path in your organization in the event that certain project issues occur that are beyond your authority level to resolve. Which of the following would be most useful in defining this information?
    a. WBS
    b. RBS (risk breakdown structure)
    c. OBS
    d. RACI grid

18. Your team has just completed a major deliverable for your current project and the customer is now evaluating the result. To perform this evaluation, the customer brought in some end users who worked the product through its various features to see if it was as useful and easy to use as the customer had specified. In quality terms, what were they determining for the product?
    a. Requirements traceability
    b. Fitness for use
    c. Quality assurance
    d. Quality control

19. You are managing a team of 50 developers. As a result of a dramatic increase of scope on the project, another 23 developers were added to the team. What are the total lines of communications as a result of the increase in team size?
    a. 2628
    b. 1403
    c. 1404
    d. 2701

20. During planning, you are assessing your stakeholder's needed participation levels for the project. What tool will you most likely use to perform the assessment?
    a. Expert judgment
    b. Stakeholder analysis
    c. Engagement assessment matrix
    d. Stakeholder management strategy

21. You are working for an organization that requires that all employees be present at work during normal business hours, and will only allow work-at-home under extraordinary circumstances. The company's CFO has also made it clear that he frowns on the use of comp time if company resources have been expending a more than 40 hours per week to complete project work. "If people have to burn more than 40 hours to get their jobs done, that's their problem, not mine", he was overheard saying to another executive. Therefore, to receive comp time, one must make a formal submission in writing to the Executive Management Board. One of your project team members has been putting in some very long hours on the current project; 60 hours a week for the last three weeks. The resource is exhausted and has asked you for two days of comp time for some much needed R&R to 'recharge'. What should you do *first* in this situation?
    a. Give the comp time to the resource and socialize with management later
    b. Help the team member submit the request to the Executive Management Board and use your influence to help expedite the process
    c. Tell the resource that this is clearly against company policy and refuse to offer the comp time
    d. Recommended that the resource find employment with an organization that understands why burnout hurts the organization

22. You have just created a network diagram for your current project and have determined that a number of the activities can be run in parallel. This can be accomplished through the use of overlapping finish-to-start relationships, or the use of parallel start-to-start relationships. What is the name of this particular schedule compression technique?
    a. Crashing
    b. GERT
    c. Critical chain compression
    d. fast tracking

23. Integrated change control occurs in which of the project management life cycle process groups?
    a. Closing
    b. Monitoring and controlling
    c. Executing
    d. Planning

24. In which phase of the procurement process will you obtain a signed contract?
    a. Control Procurements
    b. plan procurements
    c. conduct procurements
    d. close procurements

25. Which of the following statements is true about project ethics?

a. Ethics are situational, depending on where you are doing business
b. Ethics are immutable: they are the same no matter where you go
c. PMI enforces Aspirational standards as part of the PMI Code of Ethics and Professional Conduct
d. If a PMP® observes unethical behavior by another PMP® on a project, they are required to first speak with the resource committing the unethical behavior before reporting them to senior management

26. The requirements traceability matrix is:
    a. A tool and technique of Collect Requirements
    b. Part of the Requirements Management Plan
    c. An optional requirements document
    d. A table that links requirements to their origin

27. Your project team has been working very long hours (almost near burnout) to ensure that the quality requirements on the project have been met. This can result in…?
    a. A project that meets all customer quality requirements
    b. An increase in profits
    c. A loss in product grade
    d. Errors and/or rework

28. You have just taken over a troubled project from the previous project manager. At your first meeting with the project team, several of the technical resources are complaining that it has never been made clear what their specific responsibilities are for this project. In all likelihood, the previous project manager *probably* forgot to create...?
    a. An OBS
    b. An RBS
    c. A RAM
    d. A WBS

29. Your current project is composed of stakeholders have conflicting needs and wants regarding the major deliverables on the project. What is the role of project governance in this situation?
    a. Executive control over the project
    b. Alignment of the project with stakeholder needs
    c. A process that prevents unnecessary changes or unneeded scope additions to the project
    d. Ensures that organizational policies are being followed for the duration of the project

30. You have assembled a PERT analysis to estimate costs on a large multiyear project. When the forecast is completed, the numbers appear as follows: Optimistic = $10,400,000; A calculated Most Likely = $22 million; Pessimistic = $47 million. With a 95% confidence factor, what is the budgetary range for this project?
    a. $8.8 million to $38.2million
    b. $9.8 million to $34.2Million
    c. $0 million to $46,440.000
    d. $15.9 million to $28.1 million

31. You have assembled a project team so you can start creating a project schedule for your newest project. You have identified the activities, assigned durations for the activities, identified the resources needed to perform the activities, and placed all the activities in the proper sequence. What is the *next* thing you need to do?

    a. risk identification
    b. create schedule management plan
    c. update the project scope statement
    d. develop schedule

32. The project sponsor has asked for a meeting to identify risks on the current project. You have assembled the key technical project leads and stakeholders to review potential risks on the project. One of the technical team leads identifies a risk on the project that would be a high negative impact of the project, if it were to occur. One of the stakeholders turns to you and says, "I thought you assembled a team that could get the job done! Why am I hearing all this doom and gloom?" You describe to the stakeholder why an assessment of risk on the project is important and how it ultimately benefits the project. The stakeholder responds that this is an unnecessary and wasteful expenditure of project funds and fails to see why it is beneficial. What is the *best* answer you can give to the stakeholder?
    a. The risk assessment is mandated by senior management. While you may not see the value in it, we are required to do it
    b. The risk assessment not only assesses negative outcomes and ways we can avoid them, but also assesses potential positive outcomes and describes how we can achieve the benefits
    c. The reason we do risk assessments can be best described in terms that came from the noted philosopher George Santayana: "Those who cannot remember the past are condemned to repeat it." Performing a risk assessment is the best method we have derived to date that prevents us from repeating past mistakes
    d. The expenditure in performing a risk assessment is small compared to the benefits we receive

33. You are observing a Junior Project manager interact with a stakeholder. The Junior Project manager asks the stakeholder some questions about the project. As the stakeholder is answering, the Junior Project manager, eager to show that he is capable and qualified, anticipates the stakeholder's answers and states those words to the stakeholder before the stakeholder can actually say them. After a few minutes the project manager notices that the stakeholder seems a bit put-off by this behavior and starts to respond in terse sentences or one-word answers. After the interview, the Junior Project manager comes up to you and says, "Well, that seemed to go pretty well. What did you think?" What is the *best* advice you can give this Junior Project manager?
    a. Review the sender-receiver model
    b. Review tools and techniques of Manage Stakeholder Expectations
    c. Work on your management skills
    d. Practice active listening

34. What is the difference between quality and grade?
    a. Any product that exhibits high quality is, by definition, also high-grade
    b. Quality addresses the fulfillment of requirements by the deliverable, while grade addresses the physical characteristics of the deliverable
    c. Quality is defined by the customer; grade is defined by the technical team
    d. Quality is the only meaningful characteristic; grade is meaningless

35. Managing stakeholder expectations and Manage Communications:
    a. Both occur in the Executing process group
    b. Both occur in the Monitoring and Controlling process group
    c. Manage Communications occurs in the executing process group; managing stakeholder expectations occurs in the monitoring and controlling process group
    d. Manage Communications occurs in the monitoring controlling process group; managing stakeholder expectations occurs in the executing process group

36. As an experienced project manager, you realize that the process of correctly outlining the scope at the beginning of the project is critical to project success. One of the techniques that you have used successfully in the past is something called capturing the 'voice of the customer'. This technique is used in which of the following processes?
    a. JAD sessions
    b. Brainstorming

c. QFD
d. The Delphi technique

37. Two of your key stakeholders are having an intense discussion about the value of using EVA (earned value and analysis) on the project. One of the stakeholders thinks that earned value analysis is a very beneficial tool, while the other thinks it's a complete waste of time. Upon querying the two stakeholders, you discover that the first stakeholder has been working on projects in which there is ample historical value and historical precedent, while the second stakeholder usually works on projects that have high levels of uncertainty, risk and/or complete unknowns. What is the *best* answer you can give them about using EVA?
    a. EVA is a waste of time
    b. EVA is useful provided you understand the intricacies of the process
    c. EVA is best used on construction projects, but has little value in other industries
    d. EVA is fairly accurate when assessing projects that have ample historical data, but more problematic with projects that have little historical data

38. You are working with your organization to create repeatable, predictable quality processes that can be used from project to project. You want to ensure that the correct processes, procedures and measurements are being utilized, along with the proper level of sign-off. What kind of activity are you engaged in?
    a. Quality assurance
    b. Quality control
    c. Quality audit
    d. None of the above

39. You're planning to deliver a presentation regarding your current project to high-level executives in your organization. To quickly get the point across to these executives, what tool would you use that would *most likely* display your accomplishments to date?
    a. bar chart
    b. milestone chart
    c. status report
    d. issue log

40. You're managing a project in which you will not have time to audit invoices. What would be the best type of contract vehicle to use in this instance?
    a. time and materials
    b. cost reimbursable
    c. fixed-price
    d. best efforts

41. You are managing a project in which there are several opportunities to improve the product of the project. After evaluating these opportunities, you discover the following: one of the options will allow you to finish on time, with a 10% increase in budget, but will deliver exactly what the customer wants; the second option will deliver exactly what the customer wants with a 10% increase in budget, but it will take six months longer (and also provide you with an additional six months of employment); the third option will allow you to finish ahead of schedule and under budget by scaling back the deliverable by 10%. What would you recommend to the customer?
    a. You need the work; recommend option 2
    b. You attempt to persuade the customer to go with option 1 – it delivers the complete scope within the range of a definitive estimate
    c. You push for option 3, but attempt to persuade the customer to extend your contract to manage the transition to maintenance and support
    d. You state option 3 is the best approach; industry data shows that up to 45% of requested features are never used by the customer

42. Defining scope involves:
    a. A detailed description of the product of the project
    b. A detailed description of the work needed to complete the project
    c. A detailed description of both the product and the project
    d. A detailed description of the product, the project, and the risks associated with Project

43. The reason that we manage stakeholder expectations on a project includes all of the following *except*:
    a. To help ensure project success
    b. To identify corrective or preventive actions
    c. To identify and remove troublesome stakeholders from project influence
    d. To identify potential change requests in the product or the project

44. Two members of your technical team are having an intense disagreement about how to proceed with the technical solution for the project. They approach for some guidance on how to resolve the disagreement. As the project manager, what is the *best* advice you can give them?
    a. Listen to both sides of the question and make the decision
    b. Recommend they attempt to come to an agreement - if that is not possible, attempt to facilitate a resolution using a collaborative approach
    c. Recommend they attempt to come to an agreement - if that is not possible, escalate to senior management for disciplinary action
    d. Immediately engage senior management to function as arbiters in the disagreement

45. You have completed the project charter and the project management plan and are now well into project execution. All of the following are key outputs of Direct and Manage Project Work with the *exception* of:
    a. work performance information
    b. deliverables
    c. change requests
    d. organizational process assets

46. Contingency reserves are:
    a. Are part of the project cost baseline
    b. Must be included in earned value calculations
    c. Are used to identify 'unknown unknowns' in the risk register
    d. Are based on funding requirements

All durations are in weeks. Use this grid for the next three questions

Activity	Predecessor	Duration
Start	-	-
A	Start	4
B	A	7
C	A	3
D	A	9
E	C,D	6
F	B, E	11
G	D,F	7
H	F	5
End	G,H	-

47. What is the critical path?
    a. Start -A-C-E-F-H-End
    b. Start -A-B-F-G-End
    c. Start -A-D-E-F-G-End
    d. Start -A-D-E-F-H-End

48. Activity D. is reduced from nine weeks to three weeks. What is the resulting critical path?
    a. No change
    b. The critical path reduces by three weeks
    c. There are two critical paths
    d. It cannot be determined

49. Based on the original diagram, the customer insists on a 9-week schedule reduction without a change in the critical path. Where does the network diagram stand at this point?
    a. You can Reduce activity G by seven weeks, and activity A by two weeks to meet the customer demand
    b. It is not possible to remove 9 weeks from the schedule
    c. Reduce Activity F by 9 weeks to meet customer demand
    d. The network has a negative float of 9 weeks

50. You have just completed a review of the current deliverable that was handed off to the customer. While the customer was basically satisfied with the deliverable, there are some changes to the spec that the customer wants made that they claim were part of the original contract. In reviewing the original contract, the procurement manager determines that the original customer specification was ambiguous and was subject to a very wide interpretation. The customer states that prior discussions with the head of your technical team addressed the concern, and that they expected the changes to be made. The procurement manager states that the technical lead had no authority to make such changes without clearing it with him first. The customer is now furious and prepares to initiate a claim against your company (the vendor) through the procurement claims administration system. What *best describes* the current situation?
    a. The vendor failed to do a good job of requirements elaboration
    b. While the customer may be upset, a formal written change to the contract is the only acceptable form of contract change. If the change isn't written down, it is only hearsay
    c. The procurement manager should have reviewed who has authority to make changes to the contract with the project manager
    d. Situations like this *cannot* be avoided, they are typical on 95% of all contracts

51. You have been approached by a junior project manager with a question about creating a WBS for the current project. After listening to the junior project manager's question, you state that they need to establish a solid scope baseline for the project. The scope of baseline consists of?
    a. WBS, project management plan, scope statement
    b. WBS, WBS dictionary, scope statement
    c. WBS, statement of work, WBS dictionary
    d. WBS, scope statement, resource breakdown structure

52. You are evaluating several candidates for the upcoming high-visibility project in your organization. The first PM candidate is someone whom you have worked with previously, who is capable and who you like personally. The second PM is very experienced and has more skill sets needed for the position but has never worked in this area. The third PM candidate is new to the company but comes highly recommended by a Sr. VP in your division. Who would you select for the position?
    a. Candidate #1 – always go with people who you know personally
    b. Candidate #2 – go with the most qualified candidate
    c. Candidate #3 – the Sr. VP may have a say in your next assignment and it is best to please him
    d. Discuss the options with the head of your PMO and make the decision based upon their recommendation

53. Your organization is highly risk averse. The PERT estimate for the project in weeks is Optimistic=14, Most Likely=26, Pessimistic=38. If a 95% confidence factor is required for the schedule estimate, how long could this project take to complete?

a. 38
b. 36
c. 34
d. 30

54. Your current project is progressing well and you are regularly communicating with stakeholders regarding their needs and expectations. What tools will you most likely use to aid this process?
    a. Interpersonal and management skills
    b. Meetings
    c. Stakeholder analysis
    d. Expert judgment

55. A make or buy analysis:
    a. Is an output of Conduct Procurements
    b. Is a tool & technique of Plan Procurements
    c. Occurs in the Executing process group
    d. Is a tool & technique of Conduct Procurements

56. You are managing a project that is engaged in a major procurement activity. Senior management has asked that you take part in the vendor evaluation process to help determine the best candidate for the procurement. As the vendor proposals are returned, you discover that one of the vendors is a former employer and their proposal manager was a former colleague of yours at that company. What is your *best* course of action?
    a. Try to help the vendor as much as possible – they do outstanding work and your current company could benefit from their expertise
    b. Do nothing to aid the vendor or dissuade your company from choosing them – let them win the contract on their own merits
    c. Disclose to your senior management a potential conflict of interest
    d. Schedule vacation time while the vendor is being evaluated so there is no appearance of impropriety on your part

57. The WBS Dictionary:
    a. Shows cross functional dependencies between activities
    b. Is part of the Resource Breakdown Structure
    c. Is an input to Develop Schedule
    d. Is created by the customer

58. When you are describing stakeholders based on their power to impose their will, urgency of need for immediate attention and the legitimacy of their project involvement, this is described as the:
    a. Salience model
    b. Stakeholder Analysis Matrix
    c. Sender-receiver model
    d. Maslow Hierarchy model

59. The project started 10 months ago by your organization was urgent out of the gate. Management stated that the team had to 'hit the ground running', and the team was working a punishing schedule from the start. The project completed and despite the very aggressive time line, it was on time, within 5% of budget and gave the company what it needed to stay competitive. At the completion of the project, the Sr. VP gave a short speech to the organization stating, "See what we can do when we put our minds to it?! Now let's keep up the good work!!" Within two months of the project's completion, over 75% of the project team quit and move on to other jobs in different companies, taking all the acquired knowledge developed on the project with them. What could have been done to *best* avoid the mass exodus?
    a. Lock the employees in to a non-disclose/non-compete contract

b. Stock options
c. Implementation of a formal recognition/rewards process
d. Giving the team more control over project decisions including comp time

60. What are the primary differences between iterative and adaptive lifecycles?
    a. Iterative cycles are plan driven; adaptive lifecycles are change driven
    b. Both lifecycles are essentially the same
    c. Iterative lifecycles can be subsumed within adaptive lifecycle approaches
    d. With iterative approaches, the length of the iteration can change; with adaptive approaches the lifecycles are short and fixed (usually 2 to 4 weeks)

61. The project team is evaluating a vendor solution. While the upfront costs of purchase and installation are understood, the team is asking the vendor about what the costs of the product will be for its useable lifetime, i.e. maintenance, support, etc. After evaluating several internal solutions, the team decides to go with the vendor's product and completes the purchase. Six months down the road, the team has uncovered significant issues with the product that are requiring significant financial outlays in support and enhancements. They are wondering whether they should go with another solution. What do you *not* consider in your decision process?
    a. Cross-collateralization
    b. Depreciation
    c. Sunk Costs
    d. Adjusted Present Value

62. Which project phase type would be *best* used for a project that addresses uncertainties, high risk, and is subject to rapidly changing user needs or environments?
    a. Sequential
    b. Overlapping
    c. Iterative
    d. Adaptive

63. Your team has just completed its risk evaluation for the current project. The risks have been prioritized with input from the key stakeholders, and you have just submitted the risk log to senior management for comment. One of the risks had a 90% probability of occurrence and the executive vice-president questioned the team's judgment in this area. What is the *most likely* reason for this criticism?
    a. Any risk with a 90% probability should have generated an alarm
    b. The 'risk' is actually an issue
    c. A better risk mitigation strategy should have been employed to reduce the likelihood of the risk
    d. The team is obviously 'making this up'

64. You have completed the human resource plan for the project, negotiated for the best resources and created the project staff assignments. What do you do next?
    a. Manage the project team
    b. Create a RACI matrix
    c. Create the resource histogram
    d. Develop the project team

65. Your team has uncovered some issues that impact the quality of the product. Which of the following costs have the greatest impact on the cost of quality?
    a. Inspection costs
    b. Rework
    c. Prevention costs
    d. Measurement costs

66. Which of the following scheduling methods focuses on activity durations?
    a. PERT
    b. Critical path method
    c. Critical chain method
    d. Agile technique

67. Your project will culminate in an event to launch a new product. The launch will occur outdoors on the Palisade cliffs overlooking the Pacific Ocean, north of San Francisco. Since the event will cost over $1million, you want to make sure this goes off without a hitch and contact Lloyds of London to insure you against rain on the date of the event. Lloyds respectfully declines to take on the policy. One of your colleagues puts you in touch with a company that makes unique tents. The tent can comfortably hold well over a thousand people but allows the top to be open to let the sun in. In the event of rain, it can quickly be closed within 30 seconds. What risk strategy are you using here?
    a. Accept
    b. Avoid
    c. Transfer
    d. Share

68. There can be many conflicts on a project. Which of the following, for the most part, represents the greatest source of conflict on a project?
    a. Budget
    b. Personalities
    c. Schedule
    d. Scope

69. The issues of post-project COQ (Cost of Quality) are the primary concern of... ?
    a. The project manager
    b. Program and portfolio management
    c. Functional management
    d. Senior executive management

70. What is the primary difference between the stakeholder register and the stakeholder analysis matrix?
    a. They are two terms for the same document
    b. The stakeholder register is a component of the stakeholder management strategy, whereas the stakeholder analysis matrix is not
    c. the stakeholder register assesses and classifies the stakeholder; the stakeholder analysis matrix identify strategies for gaining stakeholder support
    d. Answers B and C together

71. Your organization has decided to bring stakeholders together to identify key requirements for the current project. While a number of interviews have been conducted with stakeholders, and some focus groups have been used to identify stakeholder expectations, the organization feels that some type of workshop approach would be most appropriate to define the cross functional needs of the project stakeholders. Since this is a large software project that will take at least 18 months to complete, what type of tool would be *best* used in this situation?
    a. The Delphi technique
    b. Brainstorming
    c. Prototyping
    d. JAD sessions

72. Midway into your project, several stakeholders have gotten into a serious confrontation about the product of the project. The stakeholders are all in the finance area, and two stakeholders in particular have been constantly arguing about how certain forecasting features should work in the product. As the project

manager, you attempted to broker a solution by acting as an impartial facilitator to address the issue. After three meetings, you are no closer to a resolution than you were two weeks ago. The CPI=.87. The SPI=1.04. What is your *biggest* concern right now?

a. How to escalate the stakeholder issues to senior management
b. Cost overruns
c. Keeping the schedule on track
d. How the disagreement may ultimately impact scope

73. The Critical Chain scheduling process is being utilized on your current project. After the team had finished the workflow diagram, there was some concern that if one of the parallel development paths was late in delivery, it might impact the critical path. What would help prevent this situation?

a. Feeding buffer
b. Resource buffer
c. Project buffer
d. Schedule buffer

74. You have selected a vendor to provide products and services for your current project. Since this is a vendor you have never worked with before, you want to ensure that the deliverables are on time, and as required by the contract. While the contract stipulates that payments be made at regular intervals, it also stipulates that you are entitled to hold back a certain percentage of payment until each deliverable has been accepted by your company. This practice is known as:

a. Withhold-until-delivery
b. Monetary stipulation
c. Retainage
d. Financial confluence

75. One of the team members on your current project has just discovered that a director level resource has a conflict of interest regarding your current contract negotiations with an outside vendor: the director holds several thousand shares of stock in the vendor's company and is also part of the committee that determines who will be selected for the current contract. Your team member brought this to the attention of the director and was immediately threatened by the director with a demotion or possible firing if the resource brought this to the attention of senior management. Your team member approaches you, very upset and fearful that she may lose her job if she discloses this information to senior management. Over the next day or two, you verify that her information is correct in regards the director's stock ownership with the potential vendor. As a Senior Project manager and certified PMP®, what is your *next* step?

a. Engage the director in an informal meeting to discuss the potential negative outcome of his statement to the team member
b. Immediately inform HR and senior management with a request to pursue disciplinary action against the director
c. Tell your team member not to discuss this with anyone; then at the next executive staff meeting with the director present, raise the issue in front of the entire assembly
d. Offer to transfer the resource to a different department, out of reach of the specific director who threatened her

76. On the current project, you are dealing with a vendor that is having great difficulty assembling a test plan for the software they have committed to build for your project. In fact, they just shipped you a 30 page document that identifies many types of testing (e.g., White box testing, black box testing, smoke testing, integration testing, etc.), but doesn't really describe how they are going to test the software requirements. As the project manager, you review their process for collecting the requirements and find it to be haphazard and incomplete. What tool, technique or output would have *best* helped the vendor produce a viable test plan?

a. Facilitated workshops
b. Scope management plan
c. Requirements traceability matrix

d. Requirements management plan

77. You are managing a small program in which three project managers are reporting to you. Each project manager manages a team of seven people, and while the team members communicate to their own team members, they do not communicate to members of the other teams. Once a week, you hold a meeting with the three project managers to assess progress on their individual projects. How many lines of communications exist for this program?
    a. 300
    b. 279
    c. 69
    d. 90

78. When developing the human resource plan for your project, you have been very careful to identify the roles, their authority level, their responsibility level and the competency of the resources dedicated to your project. What is another key output that is part of the human resource plan?
    a. Activity resource requirements
    b. Staffing management plan
    c. Negotiation
    d. Pre-assignment

79. Project governance is a critical element of any project, especially in the area of...?
    a. Managing non co-located teams on different projects
    b. High cost projects
    c. Long lifecycle projects
    d. Complex and risky projects

80. The correct sequence in establishing the project schedule occurs as follows:
    a. define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule
    b. define activities, estimate activity resources, estimate activity durations, sequence activities, develop schedule
    c. define activities, estimate activity durations, estimate activity resources, sequence activities, develop schedule
    d. sequence activities, define activities, estimate activity resources, estimate activity durations, develop schedule

81. The external team selected to perform the risk assessment on your recently initiated project has revealed hidden sources of risk not initially identified by the project team. While the team finds this very valuable,some the project stakeholders have decried the expenditure of project funds on risk management as 'wasteful' and 'unnecessary'. What is the most correct response to this assertion?
    a. Risk management is optional
    b. Risk management costs are small compared to the benefit received
    c. Risk management is not optional
    d. Risk management is a preventive activity that helps the project succeed

82. The process of building trust, resolving conflict and overcoming resistance to change falls into the category of?
    a. Management skills
    b. Team building skills
    c. Negotiating skills
    d. Interpersonal skills

83. The ‘bathtub’ curve is utilized in quality processes to evaluate a product’s:

a. Defect frequency
b. Optimal warranty period
c. Failure mode
d. Process control limits

84. Several team members have been attempting to estimate how long it will take to complete the project, based on expert judgment and historical data. The optimistic estimate for the project is 26 weeks. The most likely estimate is 48 weeks. The pessimistic estimate is 74 weeks. Given that the organization is moderately risk tolerant - meaning that they have some tolerance for risk in the schedule - they have decided that slightly under a 70% confidence factor in the schedule will be adequate for estimation purposes. Which of the following represents the maximum amount of time that the project could take, based on this information?
    a. 56 weeks
    b. 56.7 weeks
    c. 59 weeks
    d. 59.7 weeks

85. Your project team, along with the company's risk expert, is evaluating risks on the current project. Risk #1 (the vendor solution fails) has a very high impact if it is realized. Risk #2 (the senior architect may leave for a better job) has a moderate impact if it is realized but requires action within the next four weeks. Risk #3 (a looming strike at your supplier's factory may delay needed equipment for the project up to four months) has a high impact if it is realized but requires immediate action. The team is focused on risk #1 because of its potentially harmful impact if realized, however, the risk expert is focused on risk #3. This is *probably* because:
    a. The company will never get such a good price from the equipment supplier again
    b. Fear of risk #1 on the project team's part is misplaced and overblown
    c. Neither risk #1 nor risk #2 are simultaneously urgent and important
    d. Risk #2 is unlikely

86. The project team is working in a 'tight matrix'. In terms of organizational structure, a tight matrix means that:
    a. The team reports to a single functional manager
    b. The team is co-located
    c. The team will not have jobs once the project ends
    d. The team reports to both a project manager and the functional manager

87. The project team is evaluating data on the last software run to determine if there are any problems. The following information was uncovered: all the data points exist within the process control limits of +/- 3 Sigma; at least seven consecutive data points trend upwards; at least eight consecutive data points are slightly below the mean. In terms of statistical process control, what does this mean?
    a. The data is in a state of statistical control
    b. The data is in a state of statistical control, however, it must be watched carefully for potential process shifts
    c. The data is within statistical control limits, but has failed the zone test – your data is not in statistical control
    d. The equipment was not properly calibrated when measurements were taken

88. The progress dashboard and issue resolution meeting have gone well. A number of issues have been addressed and action items assigned to various people. Some key stakeholders were not able to attend the meeting because they were on vacation; however when they returned and attended the next progress dashboard meeting, some of the action items caught them by surprise. What did the project manager *probably forget* to do?
    a. Send out an agenda
    b. Send out meeting minutes
    c. Update the stakeholder register
    d. Update the RACI grid

89. Questions containing the phrases, 'obtain customer sign off', 'review deliverables', and 'requirements validation' are all questions about:
    a. Requirements documentation
    b. Updating the scope baseline
    c. Work performance measurements
    d. Validating scope

90. You are sharing office space with several other project teams. Charges against your project, such as heat, light, and building security are all considered what kind of cost?
    a. Variable
    b. Indirect
    c. Direct
    d. Fixed

91. You have taken measurements of deliverables completed at the end of a manufacturing process. The UCL = 2.000" and the LCL = 1.990" . The first 10 measurements that have been entered into a statistical process chart were as follows: 1.996", 1.991", 1.993" 1.994", 1.996", 1.998", 2.000", 1.997". 1.997", 1.992". What does the data tell you?
    a. The process is in statistical control
    b. The process violates the zone test
    c. The process violates the Ishikawa test
    d. The process violates the FMEA test

92. The Identify Risks process is the first step in what leads to the creation of risk responses. What is a significant obstacle in this area?
    a. Stakeholder misunderstanding
    b. Identifying risk owners
    c. Management risk attitudes
    d. Objectivity

93. Because of the nature of the work on your current project, the project team and the project stakeholders have decided that a parametric estimating method would be the best for tracking project deliverables. All of the following are disadvantages of the parametric estimating method *except* which of the following?
    a. Historical information may not be available
    b. Parameters may not be quantifiable or scalable
    c. It is less accurate than an analogous estimate
    d. It can be more costly to produce

94. Your prime contractor completed work on a contract for your organization. After a final audit of the product, it was determined that the product complied with the customer specifications, and was delivered two weeks ahead of schedule and slightly under budget. Unfortunately, a number of the stakeholders in your organization are not satisfied with the product. They claim that the vendor did not correctly interpret the specifications and are dissatisfied with the result. What is your *next* step?
    a. Retain a percentage of the final payment and have the vendor address and correct the discrepancies
    b. Perform an impact assessment of what it would take to correct the stakeholder's issues and present the findings to senior management
    c. Close the contract – pay the final invoice
    d. Catalog all the elements that the stakeholders are dissatisfied with, and offer these elements as an enhancement request - essentially, create a small project to address the discrepancies

95. Your project shows a TCPI=1.06. In forecasting terms, what does this mean?

a. You have to produce $1.06 in efficiency for every dollar you spend through the end of the project
b. Your project is ahead of schedule and under budget
c. Your project will finish late, but on budget
d. You are achieving $1.06 in value for every dollar you spend to the end of the project

96. You are using a specialized or risk assessment matrix called an FMEA (Failure Modes Effects Analysis) to assess risk on your current project. You are evaluating a mechanical assembly, and your technical team has determined that certain aspects of this assembly can fail without warning. What aspect of the FMEA measurement does this address?
    a. Reliability
    b. Detectability
    c. Severity
    d. probability of occurrence

97. An approach that adjusts the activities of a schedule model so that resource requirements do not exceed resource limits is called...?
    a. Resource leveling
    b. Critical chain
    c. Resource smoothing
    d. Staffing management plan

98. Several members of the project team decided to put together a questionnaire to evaluate stakeholder priority of requirements for the current project. They used what is known as a 'Likert' scale, in which the users could evaluate the importance of requirements on a scale of 1 to 5: 5 meaning critical, 4 meaning important, 3 meaning moderately important, 2 meaning somewhat important, 1 meaning of low importance. The team spun up a numeric score based on the questionnaire and presented it to the project manager who looked at it and said, "I'm sorry but I can't accept this. The measurements don't make sense." Surprised, the team members asked why this was so. The project manager, who also had a background in statistics,*probably* told them the following:
    a. The questionnaire was misleading and tended to push respondents in a specific direction
    b. The Likert scale represents discrete/attribute data - you can't do math on those measurements
    c. The questionnaire was not offered to the entire stakeholder population
    d. Certain stakeholders with specific agendas might have deliberately tried to skew the results of the questionnaire

99. You are attempting to have an important conversation with your team members in a crowded lunchroom. Several times your team members asked you to repeat what you have said. In terms of the sender receiver model this represents?
    a. An encoding error
    b. A decoding error
    c. A noise issue
    d. A feedback issue

100. Your organization has a documented and automated change control method that programmatically tracks changes to the current system. One of your stakeholders has approached you with a 'desperately needed' change to the current system. Upon examination, you discover that the change, while increasing the convenience to the user, does not have the critical impact upon the system that the stakeholder had previously described. You communicate this back to the user and his response is, "Well, since this is a small change, how about we slip this in to the system *under the radar*." According to PMI, your *primary responsibility* in this situation is:
    a. To give the stakeholder what they request; fundamentally the customer is always right
    b. To prevent unnecessary changes to the project

c. To ensure that the change control process is followed, to perform the necessary impact assessment, and obtain formal approval
d. To reject the stakeholders request outright as a breach in change management protocol

101. Executive management has approached you about a project to monitor their sales of a recently launched product - the USB phone. They want you to be the project manager and bring the project in within six weeks. The first thing that you want to do is:
    a. create the project management plan
    b. estimate resources for the project
    c. have the sponsor create the project charter
    d. refuse the project because the timeline is not achievable

102. You are in the process of identifying interests, expectations, and identifying stakeholder relationships within your project. This involves the sifting of qualitative and quantitative information to determine whose interests need to be taken into account during project execution. This information is captured in?
    a. Stakeholder analysis
    b. Stakeholder register
    c. Project charter
    d. Stakeholder management plan

103. You're planning a new project to implement in the first RFID enabled luggage handling system at a large airport on the east coast. You have assembled some of the top experts in the business to vet potential approaches for implementing the project. Of course some of these experts are Ph.D.'s and have very different ideas on how to implement the solution. Sometimes the project meetings get somewhat contentious and as a result, you've been looking for a way to focus the team on simply getting things done. The best approach that you can use to collect everyone's input is:
    a. Pareto analysis
    b. The Delphi technique
    c. Balanced business scorecard
    d. Decision tree analysis

104. All the following are factors that affect the choice of a communications technology with the exception of...?
    a. Urgency
    b. Availability
    c. Risk
    d. Ease of use

105. The project manager has just completed the WBS for a new transportation project in the Houston area. She has reviewed the scope statement and is about to create a completed scope baseline. What is the final element she needs to complete the Scope Baseline?
    a. Human resources plan
    b. Project schedule
    c. Risk management plan
    d. WBS dictionary

106. The lowest level in a WBS is:
    a. Control account
    b. Work package
    c. Task breakdown
    d. Activity

107. The project manager has just reviewed the charter for the new software project, and the initial assessment shows that there will not be enough resources on the project to complete it by the required due date. Which of the following is the WORST option regarding the actions the PM should take to resolve the issue:
    a. Negotiate with line managers for more resources
    b. Escalate to the project sponsor and request a reduction in scope
    c. Transfer the risk to an outside vendor who will be responsible for on-time delivery
    d. Transfer resources from non-critical path items to bring the project in on time

108. Your project needs to be estimated at a 95% confidence factor. The current budget stands at $220,000. What is the range of the cost if the standard deviation on the project is $10,000:
    a. $200,000 to $240,000
    b. $197,500 to $238,500
    c. $205,000 to $235,000
    d. $188,600 to $217,453

109. Your project will be deemed successful when:
    a. Scope creep has been completely controlled
    b. The project sponsor is overjoyed with the result
    c. All key stakeholder expectations have been met
    d. The project has met the triple constraints at a Definitive Estimate level (-10% to plus 10%)

110. Your project team is scattered across the United States - you spend nine hours a day communicating with them all on a headset. A recent issue has emerged which has been identified as a complex problem on your project. The most appropriate form of communication in this case is:
    a. Informal written
    b. Formal verbal
    c. Formal written
    d. Informal verbal

111. You are managing a contract with a very recalcitrant vendor. They are doing a razor-sharp read of the statement of work, and if there is the slightest variance, they issue a change order to cover the cost. This is proving very frustrating, not only for you as a project manager, but for your entire organization. The contract is fixed price plus incentive fee. The highest risk on this contract falls to:
    a. The seller
    b. The buyer
    c. The project sponsor
    d. Senior management

112. The process of configuration management exists in two project management domains: the project domain and the product domain. All of the following exist in both domains with the exception of…?
    a. Status reports
    b. The configuration management plan
    c. Spare parts list
    d. Modification records

113. All of the following are components in the stakeholder management plan with the exception of…?
    a. Stakeholder communication requirements
    b. Information to be distributed to stakeholders
    c. Scope and impact of change to stakeholders
    d. Salience model

114. A change to one of the triple constraints of your project is requested. It appears that the timeline can be met, but the budget will increase beyond the limitations of the contingency reserve and the management reserves. Who can authorize a change in this instance?
    a. The project manager
    b. Senior management
    c. Project sponsor
    d. The customer

115. You have been brought in to save a failing project on a major upgrade to an enterprise CRM system. The previous project manager suffered a nervous breakdown and was hauled out of the building on a stretcher, babbling incoherently. However, he left careful records of the work he had done. You've ascertained the following facts:

    AC = $12,438
    EV = $9,321
    BAC = $42,000

    What is the estimate at completion (EAC) if current variances continue?
    a. $54,438
    b. $51,321
    c. $56,045
    d. Cannot be determined from the information provided

116. You are the Senior Project manager on a $50 million, high visibility project for a major insurance company. The project has been moving along with few issues - the performing organization has been doing an outstanding job. You have been asked to prepare a report for senior management showing the progress of the team. The best report to be used under these circumstances would be:
    a. Variance report
    b. Gantt chart
    c. Milestone report
    d. Critical Path analysis

117. Your project is running late. There have been a number of discovery issues that have pushed out the timeline - these elements were beyond anyone's control and not foreseen by the project team or senior management. Whose responsibility is it to solve this specific problem?
    a. Project manager
    b. Senior management
    c. Change Control Board
    d. Project sponsor

118. Quality assurance occurs in what process group of the project management life cycle?
    a. Initiating
    b. Monitoring and controlling
    c. Execution
    d. Planning

119. Your project has a cost performance Index (CPI) of 1.21 and a schedule performance Index (SPI) of 0.90. What this means is:
    a. Your project is achieving $.79 in value for every dollar that it spends, while you are slightly ahead of schedule
    b. Your project is late and over budget
    c. Your project is achieving $1.21 in value for every dollar it spends, and you are slightly behind schedule
    d. You are ahead of schedule and under budget

120. Disciplinary configuration management involves ensuring compliance with internal organizational CM disciplines. Project configuration management controls individual project artifacts. What term is used to describe the condition where the configuration management systems of the project interface with the disciplinary configuration management process?
    a. Socialization
    b. Reconciliation
    c. Harmonization
    d. Interoperability

121. You are the project manager of a complex technical project. As the project begins to unfold, the team members are coming to you for your opinion on certain technical matters. What kind of project management power is being demonstrated here?
    a. Referent
    b. Expert
    c. Reward
    d. Legitimate (formal)

122. You have been the project manager on Project Comet since its inception. A major part of the work has been contracted out to one of your most reliable vendors. You have discussed the particulars of the contract with your legal department and the legal team feels that you are qualified to handle various aspects of managing the contract. You might be called on to perform any of the following during Control Procurements *except:*
    a. Verify contract performance against the statement of work
    b. Amend the contract based on requested changes
    c. Authorize payouts to the seller based on completed milestones
    d. Be part of the contract negotiation with the seller

Use the following table for the next three questions:

Task	Duration	Predecessor
A	2	None
B	4	A
C	10	B
D	5	B
E	7	D
F	1	C, E

123. What type of network diagram will you create based on the information above?
    a. AOA (activity on arrow)
    b. PDM (precedence diagramming method)
    c. GERT (graphic evaluation and review technique)
    d. PCP (parallel critical path)

124. You've completed the network diagram based on the table above. Management promised the customer the project would be done in 15 weeks. Based on your calculations, which of the following is true:
    a. You have positive float of two weeks
    b. You have negative float of four weeks
    c. The project is on time and there is no cause for concern
    d. You are one week ahead of schedule

125. You have been asked to compress the schedule by three weeks. What is the s*implest* thing to do here?
    a. Reduce task “D” by three weeks
    b. reduce task "E" by three weeks
    c. reduce task "B” by three weeks

d. reduce task “C” by one week, reduce task “E” by three weeks

126. PMI’s Project Management Code of Ethics and Professional Conduct states that the project manager is responsible for everything *except* the following:
    a. Respect confidential, proprietary, and intellectual property
    b. Developing the project management plan according to the guidelines set down in the Project Management Body of Knowledge
    c. Ensure that there are no conflicts of interest that compromise the interests of the customer
    d. Accurately and honestly report all aspects of project progress

127. The project has been going smoothly, and you have been keeping track of all project risks on a regular basis. Unfortunately, when you arrived at work this morning, one of your key suppliers has informed you of potential delay of a key shipment. This could potentially set back your project several weeks. The reason for the delay - a union dispute with the trucking company threatens to shut down shipping operations for several weeks. You call your supplier and discuss some options. You both decide that it might be wise to engage a backup shipping company that can deliver in the event of a strike with the other firm. This is an example of:
    a. Risk avoidance
    b. Risk mitigation
    c. Risk transference
    d. Risk acceptance

128. All of the following are a cost of poor quality *except:*
    a. Defects
    b. Rework
    c. Corrective action
    d. Inspection

129. Enterprise environmental factors generally describe which one of the following:
    a. How your company implements projects
    b. Corporate culture
    c. Specific tools and techniques used in managing a project
    d. Factors that contribute to project failure

130. The project you have been working on has been plagued with setbacks and numerous change requests. You have dutifully tracked all the changes, entered them in the change management system and obtain the required customer signoff on each one. The project is due to be released in three days, and the business customer informs everyone in the business organization of the impending release of a new product. Within three hours, the business manager gets a panicked phone call from one of the business users, stating that the project will never work because the reporting function will fail. The *most likely* reason for this is because:
    a. The subject matter experts missed a requirement when originally scoping the project
    b. A key stakeholder was never contacted
    c. the project manager failed to effectively manage the stakeholders
    d. There were too many changes and wrong turns in the project to be able to manage the project effectively

131. You have just placed a request for 10,000 units from Widgets ‘R’ Us. The type of contract best used in this situation is:
    a. T&M -(time and materials)
    b. IFB -(invitation for bid)
    c. RFB -(request for bid)
    d. RFP – (request for proposal)

132. While the project is in full swing, several of the stakeholders get into a confrontation regarding which features need to be delivered first. A meeting between the stakeholders became contentious, voices were raised, arguments broke out and some of the meeting participants completely disengaged from participation in the meeting as a result. The PM, in an attempt to bring the meeting back under control, has attempted to defuse the confrontation by making this suggestion to the stakeholders: "Look, we've got conflicting priorities on this project. Rather than beat each other up about who's going to get what, let's focus on what each of us can live with and move on." The conflict resolution technique that the project manager is employing here is called:
    a. Withdrawing
    b. Confronting
    c. Compromise
    d. Forcing

133. There is some confusion on your project as you head into the planning phase. Several of the key stakeholders are not sure who should have control of the project. You have communicated with each of the stakeholders that you are the project manager and that the project control ultimately rests with you. But at the project kickoff meeting, several of the stakeholders are questioning why you are there and what qualifies you to be the project manager. What was omitted at the start of the project?
    a. The detailed scope statement
    b. The project charter
    c. The resource breakdown structure
    d. A sponsor

134. Your project is in full swing and you are monitoring overall stakeholder relationships for the project. Several of the stakeholders have been in almost violent contention about the goals of the project and you have regularly had to adjust strategies and plans for engaging stakeholders. What process are you in?
    a. Manage stakeholder engagement
    b. Identify stakeholders
    c. Control stakeholder engagement
    d. Plan stakeholder management

135. You are managing a project with a team of high performing individuals. This is one of the best teams with which you have ever worked and their performance and professionalism is second to none. In spite of their outstanding performance, a senior VP took exception to something one of the team members said and verbally abused him in front of the rest of the team. After the meeting, the individual expressed great concern and dismay at the abusive treatment. Shortly after, this team member's performance seemed to fall off, and this individual became somewhat disengaged from the activities of the project. The scenario outlined above is best described by which of the following:
    a. The Theory of Constraints
    b. Situational Continuum
    c. Hertzberg's Hygiene theory
    d. McGregor's theory X and theory Y

136. Which statement about the WBS is correct?
    a. The WBS shows dependencies between tasks
    b. It is a graphic representation of the project that allows for team buy in
    c. It is synonymous with a network diagram
    d. it is *never* a template

137. The term that is used to represent a complete set of concepts and activities that make up a professional field, project management field, or area of specialization is known as…?
    a. Knowledge area
    b. Process area
    c. Process group

d. Functional group

138. You have just joined a new organization that is fairly weak in its project management processes. After a month, you have determined that the company's project approach resembles a complete free-for-all. You are attempting to implement disciplined project processes, starting with the creation of a project charter and with helping management understand what their responsibilities are in supporting projects, companywide. At the kickoff meeting to the newest project, the project sponsor begins to tell the IT professionals how to do their jobs. (The sponsor is an ex-IT manager...) After the meeting, you speak with the sponsor off-line and coach him on his true responsibilities, which include all of the following *except:*
    a. Providing financial resources for the project
    b. Defining requirements
    c. Formal acceptance of the product of the project
    d. Protecting the project and the team from changing management priorities

139. You are evaluating two projects. You have received optimistic, most likely, and pessimistic timeline estimates for each project. Project "A" has a most likely estimate of 100 days with a standard deviation of 8 days. Project "B" has the most likely estimate of 105 days with a standard deviation of 6 days. Which of the following statements is true regarding the two projects:
    a. There is a likelihood that both projects may finish within 86 days
    b. The Monte Carlo estimate was used in evaluating both projects
    c. With a 95% confidence factor, the maximum amount of time to complete both projects will be less than 120 days
    d. Project "B" is riskier than project "A" because its most likely estimate is longer

140. One of the team members on your project team is what we call a "sniper". At team meetings, he will lean back in his chair and offer wisecracks and comedic putdowns any time other team members state anything with which he significantly disagrees. At the last meeting, you asked him the status of specific deliverables in the project management plan. He turned and looked at you incredulously, stating, "What deliverables are you talking about?" What is the most likely element that is missing at this point?
    a. A clear communication plan
    b. Work packages
    c. A human resources management plan that outlines disciplinary action for undisciplined team members
    d. A resource breakdown document explicitly defining job responsibilities for each member of the team

141. Calculate the point of total assumption (PTA) of a contract with the total cost of $180,000, a profit of $20,000, a buyer/seller sharing ratio of 70/30, and a ceiling price of $225,000.
    a. $225,000
    b. $198,452
    c. $215,714
    d. $187,958

142. You are evaluating the risk for a large program and have collected inputs from four project managers including risk assessment matrices, qualitative and quantitative analysis. You have just sorted the risks into their respective priorities. You want to model several potential scenarios to ascertain what may happen if certain risk mitigation strategies are employed. The *best* tool to use in this situation is:
    a. Statistical process control charts
    b. Pareto analysis
    c. Benefit cost ratio
    d. Monte Carlo analyses

143. Which of the following can help prevent scope creep?

a. PMIS
b. Work authorization system
c. Poka Yoke
d. WBS dictionary

144. Administrative closure can occur in any of the following except:
a. The completion of a project phase
b. The completion of a major project deliverable
c. The completion of the project
d. If the project is canceled in mid-execution

145. You are continuously monitoring the results of project deliverables as various phases of the project complete. However, you have reached a point where some problems have emerged as a result of scheduling conflicts and conflicting priorities. There are two specific work packages on the critical path that are giving you the most trouble. Work package "A" has an early start (ES) of 44 and a late start (LS) of 44. Work package "B" has an early start (ES) of 65 and a late start (LS) of 55. Which of the following statements is best description of the preceding situation?
a. A mistake was made in calculating the critical path of the network diagram
b. The total float of the project is negative at this point
c. There is a high risk the budget will be exceeded by at least 50%
d. Fast tracking the two work packages will solve the problem

146. You are engaged in collecting probability data regarding risk on your current project. One of your team members with extensive experience in statistics has recommended the use of the beta distribution in computing probabilities of risk on the project. The beta distribution is a type of…?
a. Statistical control chart
b. Continuous probability distribution
c. Autoregressive moving average
d. Qualitative analysis tool

147. You have two options in creating a software solution for your current project. You can either buy the software or build the software. If you buy the software for $100,000 there is a 40% chance it will meet your needs and an additional and $100,000 impact if it does not. If you build the software, there is an 80% chance it will meet your needs at a cost of $180,000 and an additional $100,000 impact if it does not. What is the least expensive choice and the expected monetary value?
a. Buy the software: EMV = $140,000
b. Build the software: EMV = $100,000
c. Buy the software: EMV = $160,000
d. Build the software: EMV = $164,000

148. What are the process steps in implementing a formal change request, in order?
a. Document the change, perform impact assessment, evaluate the need, submit to CCB for approval
b. Evaluate the need, perform impact assessment, document the change, submit to CCB for approval
c. Submit to CCB for approval, document the change, evaluate the need, perform impact assessment
d. Evaluate the need, submit to CCB for approval, document the change, perform impact assessment

149. management is responsible for 85% of what happens in the workplace, while the worker can contribute, at most, 15% to the end result of the product or process. What other concept is attributed to W. Edwards Deming?
a. Kaizen
b. Total quality control
c. The 14 points
d. Statistical process control

150. You are in the process of evaluating team members based on experience, ability, knowledge, skills, and attitude. What process are you in?
    a. Develop project team
    b. Acquire project team
    c. Manage project team
    d. Develop human resource plan

151. The concept of the situational continuum describes:
    a. Gradual self-actualization in a work environment as the resource increases their skills and capability
    b. Changes that occur as an employee moves from a theory Y environment to a theory X environment
    c. The business's commitment to the employee over time, so that the employee commits their efforts to the business
    d. Management gradually handing off decision responsibilities to a resource as the resource's maturity grows and develops

152. Which of the following statements is true?
    a. The scope of baseline consists of the WBS, the scope management plan, the WBS dictionary
    b. Scope verification occurs at the end of the Project
    c. Excessive inspections are a direct cost of poor quality
    d. All of the above are true

153. Your current project produces a series of manufactured pieces that come off an assembly line. The project team and the customer have determined that a pass/ fail scenario to determine which parts are acceptable will be a sufficient quality metric for the project. What kind of testing are you performing to determine the correctness of the manufactured product?
    a. Variable sampling
    b. Random sampling
    c. Stratified sampling
    d. Attribute sampling

154. The five levels of the CMMI model in order are:
    a. Initial, managed, quantitatively managed, defined, optimized
    b. Initial, quantitatively managed, defined, managed, optimized
    c. Initial, managed, defined, quantitatively managed, optimized
    d. Initial, reviewed, quantitatively managed, scoped, optimized

155. You are a project manager in the middle of project execution, and you have determined that the project will overrun its deadline by at least five weeks. The timeline overage has been due to circumstances that are beyond anyone's control and that are external to the project. The project sponsor has stated that absolutely no additional budget can be allocated to this project. Which of the following is the *best* thing to do to deliver the project on time:
    a. Negotiate with the sponsor to reduce scope
    b. Swap out high cost resources for lower-cost resources
    c. Fast track the project to compress the timeline
    d. Report the discrepancy to senior management for a decision on an alteration to the triple constraints

156. Process boundaries, process configuration, and process metrics, are all elements that are explicitly found in…?
    a. Project management plan
    b. Process improvement plan
    c. Quality management plan
    d. Defect management plan

157. As a project manager, the primary skill that you bring to a project is:
    a. Project leadership
    b. Communication skills
    c. Project management
    d. Negotiation skills

158. You have undergone an extensive review of the project risks on the newest, high visibility project for your company. In performing your risk assessment, you have identified a potential partner that will increase the likelihood that you will succeed on the project. This is an example of what type of risk response strategy?
    a. Transfer
    b. Share
    c. Exploit
    d. Mitigate

159. What is the most accurate statement concerning contingency plans on a project?
    a. Risk has been realized and a response implemented
    b. Designed to handle secondary risk on a project
    c. Designed to handle residual risk on a project
    d. The risk fallback plan has created additional risk that must be addressed

160. The concept of "legal purpose" on a contract specifically addresses:
    a. That the contracted organization has been legally organized according to US law
    b. That the buyer has entered into a legally binding arrangement for the purpose of obtaining goods and/or services from the seller
    c. The contract can only apply to the purchase of explicitly legal services or goods
    d. The seller has the legal capacity to perform the work

161. The requirements management plan includes all the following except?
    a. How requirements activities will be planned, tracked, and reported
    b. Configuration management activities
    c. Traceability structure
    d. Resources performing the work

162. On the current project, you have created a WBS to capture all the deliverables for the current work effort. What is being described here?
    a. The inclusionary rule
    b. The WBS rule
    c. The 100% rule
    d. Level of effort

163. Schedule variance on your current project is .93. You discuss it with the project team and it is decided that taking high-end resources off noncritical path activities and applying them to the critical path, along with running some project activities simultaneously, will bring the project back in line within 30 days. What approach was used by the project team to correct the current schedule deficiencies?
    a. Fast tracking
    b. Critical chain project management
    c. Crashing
    d. A and C

164. What is the difference between critical path and float?
    a. Critical path shows schedule flexibility; float does not
    b. The level of float drives the critical path duration
    c. Critical path and float are interchangeable terms

d. Critical path shows the shortest project duration possible, float identifies schedule flexibility

165. All of the following are performed on a quality audit, except?
   a. Help raise team productivity
   b. Identify gaps and shortcomings
   c. Identify customer needs
   d. Identify best practices being implemented

166. The quality management plan includes all the following, except…?
   a. Quality assurance approaches
   b. Continuous process improvement approaches
   c. Cost of quality
   d. Quality control tools

167. There are three sequential processes in your current project on which the quality assurance team has taken measurements and delivered some final results on process efficiency to your team. The three processes yielded the following defect free percentages: 99.99%, 99.998%, 99.9%. How close is this to a Six Sigma level of defect free performance?
   a. 99.962 percent defect free
   b. 99.999 percent defect free
   c. 1 defect per ten thousand opportunities
   d. 99.888 percent defect free

168. The five elements of the sender-receiver model in order are …"
   a. Encode, transmit, feedback, medium, noise
   b. Encode, decode, feedback, filter, noise
   c. Encode, transmit, decode, acknowledge, feedback
   d. Encode, message, recode, medium and noise, acknowledge

169. What is the purpose in developing an RBS (risk breakdown structure)?
   a. The RBS can be used as a framework
   b. To remind stakeholders of the many sources of risks
   c. Useful in proactive risk management
   d. It provides a comprehensive process for systematically identifying risks

170. What is the best way focus a team on resolving project issues while injecting as little bias into the decision process as possible?
   a. Face-to-face interviewing
   b. Focus groups
   c. Webinars
   d. Delphi technique

171. You are the project manager on a construction project and are considering leasing and purchasing options for a very large earth mover. The equipment can be rented for $10,000 per day or purchased at a price of $575,000. In looking at your project schedule, you have estimated that you will use the equipment between 40 to 60 days. What type of cost would a lease represent?
   a. Fixed
   b. Variable
   c. Direct.
   d. Indirect

172. Understanding of need, life-cycle cost, technical capability, risk, and technical approach are all part of…?
   a. Risk responses

b. Contract components
c. Source selection criteria
d. Outputs of Conduct Procurements

173. Which of the following is the correct PERT formula?
a. (O + 4ML + P)/ 6
b. (O + ML + P)/3
c. +/- 3 sigma
d. (P – O)/6

174. All the following are inputs to Develop Human Resource Plan, except…?
a. Enterprise environmental factors
b. Project charter
c. Activity resource requirements
d. Organizational process assets

175. Reward power means that the project manager can issue rewards. Examples of rewards can include bonuses or comp time. PMI regards reward power as…?
a. One of the worst forms of authority
b. Unimportant
c. One of the best forms of authority
d. Subject to frequent misuse

176. You have been assisting the contracted vendor in the creation of the procurement statement of work for your current project. To show their appreciation for your assistance, their engagement manager has offered you season tickets for the local major league baseball franchise in your home city. What should you do?
a. You don't know your company's policy in this area; you tentatively accept the offer until you find out otherwise
b. Inform your senior management of the offer5.3.2.
c. Decline the offer; it violates the PMI Code of Ethics
d. Decline the offer but suggest the engagement manager contact the CEO

177. The staffing management plan can describe strategies for adherence to government regulations, union contracts and other policies. This element in the staffing management plan falls under the category of…?
a. Acquisition
b. Compliance
c. Training needs
d. Safety

178. If EAC is greater than BAC, which of the following is true?
a. It equates to TCPI
b. VAC will be negative
c. CPI will be greater than 1
d. BAC = AC + new ETC

179. You have created a number of planning packages for the current project. You have identified each control account relating to each planning package and you are just about to begin the work. What is the next step prior to the start of the work?
a. Convert the budgeted work items into work packages
b. Complete the budget at completion (BAC)
c. Assemble the activity list for each work package
d. Verify the planned value

180. You have contacted CDW to price an order for 100 laptop computers. What type of contract specifies the price per item?
   a. RFP (request for proposal)
   b. IFB (invitation for bid)
   c. RFQ (request for quote)
   d. Cost contract

181. The seller in a contract lifecycle is _____
   a. First a vendor, then a bidder, finally a selected source
   b. First a contractor, then a bidder, finally a selected source
   c. First an identified source, then a bidder, finally a selected source
   d. First a bidder, then a selected source, finally a vendor

182. On your current project, you and your team have developed a list of potential risks and prioritized them into the general categories of: high priority, medium priority, and low priority. What risk process have you just completed?
   a. Perform Quantitative Risk Analysis
   b. Perform Qualitative Risk Analysis
   c. Define risks
   d. Monitor and Control Risks

183. Vertical communication occurs either up and down through the organization's hierarchy. Where does horizontal communication mostly occur…?
   a. Between Subordinates
   b. Between the PM and the project sponsors
   c. Between the PM and functional managers
   d. Between Peers

184. You are managing a distributed team within the United States. As a consequence, you spend nine hours a day talking to people via telephone conversations. You just had a critical technical discussion with one of the senior developers on the project and attempted to hammer out details of the deliverable for over two hours on the phone. What percent of your message actually got through to the developer?
   a. 100%
   b. Slightly more than half
   c. Slightly less than half
   d. 7%

185. What is the most appropriate form of communication for team meetings and e-mails?
   a. Formal written
   b. Informal written
   c. Formal verbal
   d. Informal verbal

186. The key tool of Perform Quality Assurance is…?
   a. Work performance information
   b. Cost of quality
   c. Quality control measurements
   d. Quality audit

187. Regarding the scope management plan and the requirements management plan:
   a. the scope management plan is an input to the project management plan; the requirements management plan is a component of the project management plan

b. The scope and requirements management plans are inputs to the project management plan
c. The scope management plan and the requirements management plan are developed simultaneously with the project management plan
d. The scope and requirements management plans are outputs of the project management plan

188. You have been working on a high visibility project since its inception and are getting ready for a major presentation to senior management on the project's progress. Which is the best type of report to use for this purpose?
a. Milestone chart
b. Gantt chart
c. Bar chart
d. Network diagram

189. You are 6 months into a one year project, which is showing an SPI of 0.9. This translates to a schedule slippage of 2-3 weeks at this point. What should you do next?
a. Implement a temporary staff augmentation through your pre-approved vendor
b. Move more resources onto critical path activities
c. Perform a variance analysis and review potential options
d. Eliminate some project activities to bring the schedule back in line

190. You, the project team, and some key stakeholders have defined an agreed amount of variation on the project schedule that is allowed before some action needs to be taken. The amount of agreed variance is also called…?
a. Level of accuracy
b. Units of measure
c. Allowed variances
d. Control threshold

191. You have been working on the current project budget and have broken the costs down to the control account level in the WBS. This now serves as the total planned value for the entire project. This is called a....?
a. Performance measurement baseline
b. Cost budget
c. Distributed budget
d. Estimated budget

192. To understand the requirements for the product of your current project, you have conducted a systems analysis, a requirements analysis, a product breakdown and a value analysis. These activities define what is known as a…?
a. Product verification
b. Process analysis
c. Product analysis
d. Scope verification

193. All of the following are an input to Develop Project Charter, except…?
a. Project management plan
b. Business case
c. Enterprise environmental factors
d. Project statement of work

194. When is a project closed?
a. When the customer is satisfied with the result
b. When the project work is finalized or the project is terminated before completion

c. When senior management accepts the deliverables
d. When the project manager has released the resources

195. All the following are examples of enterprise environmental factors, except…?
a. Work authorization system
b. Change control procedures
c. Personnel administration
d. Project management information systems

196. You are a project manager on a dedicated project that demands 100% of your focus. The manager of one of your team members asks for your performance evaluation of the team member. What type of organizational structure are you working within?
a. Projectized
b. Matrixed
c. Functional
d. Processed

197. Which of these statements is true of the Initiation process group?
a. The project's probability of succeeding is high
b. Stakeholder influence on the project is high
c. Resources utilization is high
d. Risk is low

198. The project team and the key stakeholders have decided that the 'waterfall' approach to delivering the product will best suit the needs of the project. This lifecycle approach is also called…?
a. Iterative
b. Adaptive
c. Rolling wave
d. Predictive

199. Which statement is not true about Control Procurements?
a. It includes managing procurement relationships, monitoring contract performance, and making changes and corrections as needed
b. It is done by the buyer and the seller
c. It ensures that both parties meet the terms of the contract
d. It involves verification that all work and deliverables are acceptable

200. You are computing EAC for your project. In regards to the Deming-Shewhart cycle, what part of the cycle are you in?
a. Plan
b. Do
c. Check
d. Act

Post-Test answers

1. D – Plan stakeholder management. – *PMBOK® Guide*, 5th edition, p.391
2. B – *PMBOK® Guide*, 5th edition, pp 40-41
3. B – Earned value uses the basis of estimate as a starting point, but not to compute the EV. We need actual costs and the value of the work accomplished to compute EV.
4. D – Zero defects is ascribed to Phil Crosby

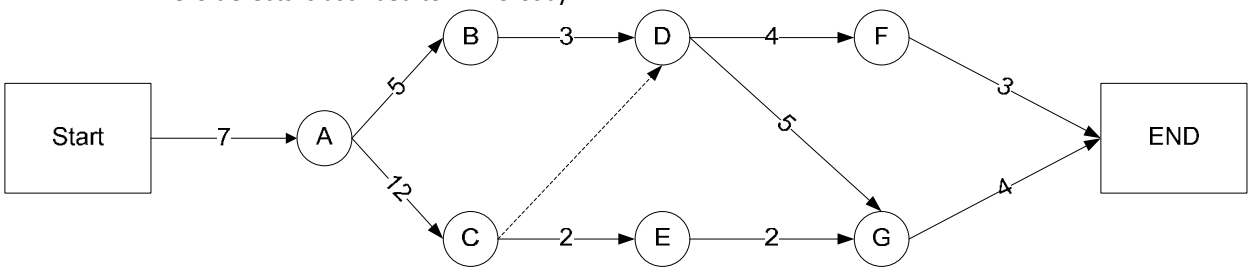


Diagram for the next 3 answers

5. A – 28. The path is Start-A-C-D-G-End
6. B – Critical path does not change. Activity E-G is not on the critical path
7. A – The new critical path is: Start-A-C-E-G-End
8. C – This negotiation tactic basically states that certain contract terms are non-negotiable
9. C – The standards are broken out into 2 categories: Aspirational standards and mandatory standards
10. B – *PMBOK® Guide*, 5th edition, p133
11. B – It is always best to begin with an informal conversation
12. A – *PMBOK® Guide*, 5th edition, p 61
13. D – Project goals and funding sources are outlined in the project charter
14. A - $3900. By straight calculation, you need to derive EV which is 1.07=EV/$30,000 or 1.07 * $30,000 = $32,100. CV = EV – AC or $32100-$36000 = -$3900
15. B – The PERT estimate is, by definition, a point estimate – a one shot deal. A model spinning up hundreds or thousands of possibilities will help construct a model of the schedule forecast
16. A – It mitigates the risk. It does not avoid the risk – it still might happen, and you have not transferred responsibility to another party. Exploit in this instance is a red herring
17. C – OBS: organizational breakdown structure. *PMBOK® Guide*, 5th edition, p 245
18. B – This defines Juran's concept of fitness for use
19. D – Don't forget the project manager!: 51+23=74. By straight calculation (74*73)/2= 2701
20. C – The stakeholder engagement assessment matrix explicitly identifies current and desired stakeholder engagement levels. *PMBOK® Guide*, 5th edition, pp 402-403.
21. C - While this may seem harsh, the PMI Code of Ethics and Professional Conduct offers the following mandatory standard: 4.3.5 "we apply the rules of the organization without favoritism or prejudice". You might then offer the resource help as outlined in answer B. Answer A violates the Code, and answer D might be a 'last resort' response.
22. D – This is the de facto definition of fast tracking
23. B – *PMBOK® Guide*, 5th edition, p 61
24. C – Conduct procurements. One of the key outputs of Conduct Procurements is Procurement Contract Award
25. A - What may be illegal in one country is a standard operating procedure and legal in another. PMI strongly recommends you understand the cultures and conventions of doing business in other countries, and do what is appropriate in that culture
26. D – *PMBOK® Guide*, 5th edition, p 118
27. D – Overworking a project team can result in employee attrition, errors, or rework. *PMBOK® Guide*, 5th edition, p 228
28. C – The creation of a RAM (responsibility assignment matrix) clearly shows who owns and is responsible for specific activities on the project: the 'single wringable neck' to grab.

29. C - Project governance concerns itself with the alignment of the project with stakeholder's needs and objectives. *PMBOK® Guide*, 5th edition, p 30
30. B – By straight calculation, the standard deviation = ($47 million - $10.4 million)/6 = $6.1 million. Subtracting two standard deviations from $22 million yields a low-end of $9.8 million. Adding two standard deviations to $22 million yields a high-end of $34.2 million
31. D - You have completed the first four steps necessary to ultimately develop the schedule
32. B – The risk assessment processes both potentially negative and positive outcomes. While answer A may be true, it does not address the stakeholder's concern, or obtain the stakeholders buy-in. C is only partially true. Answer D may or may not be true, depending on the situation
33. D – The Junior Project manager was trying to impress the stakeholder with his knowledge, when what he should have been doing is listening to the stakeholder and confirming what was said by the stakeholder
34. B – Quality is about conformance to requirements; grade references product characteristics. *PMBOK® Guide*, 5th edition p 228
35. A – Both are Executing processes. *PMBOK® Guide*, 5th edition p 61
36. C – QFD utilizes a seven step process in which the first step is capturing the voice of the customer
37. D – Earned value can be quite accurate when historical data is available, or data from commercially developed databases is available (such as the Cost Works guide available at the RS Means website for building construction projects).
38. A – This defines the quality assurance process. *PMBOK® Guide*, 5th edition, p. 242
39. B – The milestone chart would provide the best executive level summary over the other three choices
40. C – By definition, one of the benefits of using a fixed price contract is that close scrutiny of invoices is usually not required because the vendor is on the hook to deliver for a fixed price
41. D – This is an ethics question dressed up as an earned value question. Thus, option A is an ethical breach and out of the question. Option C is a variant on option A: you are still looking to extend your work at the customer's expense. The only answers left are options B and D. Of the two remaining options, which delivers the best value for the customer? Increasing the budget by 10%, or finishing early and under budget by eliminating unnecessary features in the product. One of the jobs of the project manager, according to PMI, is to protect the Project from unnecessary changes or the implementation of unnecessary features. This gives option D the edge.
42. C – Scope definition includes not only the scope of the product to be built, but the work necessary to deliver the product of the project
43. C – While your real-world experience might lead you to exclude this answer, managing stakeholder expectations is not about removing troublesome stakeholders from project influence
44. B – As the project manager, your first mandate is to let the team resolve their own internal conflicts. After that and if they approach you for help, offer to facilitate a resolution. Answer A is incorrect, as the PM is making the decision for the team. Answer C is incorrect; no disciplinary action is necessary, and answer D passes the buck
45. D – *PMBOK® Guide,* 5th edition p 84. OPA is an input to Direct and Manage Project Work
46. A – Part of the project cost baseline; *PMBOK® Guide*, 5th edition, p 206
47. C – Start-A-D-E-F-G-End
48. C – There are two critical paths
49. D – Note the question *doesn't* ask you what you would *do* about it. You have negative 9 weeks float
50. B – All contracts will contain verbiage stating who has the authority to make changes to the contract and that changes to the contract are only legally binding when those changes have been written and approved by both the customer and the vendor. Unfortunately, the customer does not have a leg to stand on in this situation. Answer A is a red herring; answer B might be something you do, not only with the project manager, but also with the entire team after you have experienced the problem. Answer D is pure misdirection
51. B – The scope baseline consists of the WBS, the WBS dictionary, and the scope statement
52. B – According to The PMI Code of Ethics and Professional Conduct, mandatory standard 4.3.3: "we do not hire or fire, reward or punish, or award or deny contracts based on personal considerations, including but not limited to, favoritism, nepotism, or bribery."

53. C – 34 weeks. By straight calculation; standard deviation= (38-14)/6= 4. Since we are looking at the high-end of the schedule, adding two standard deviations to the most likely estimate of 26 weeks yields a potential schedule of 34 weeks
54. A – The scenario describes what occurs in the Manage Stakeholder engagement process. Two of the tools used for this process include interpersonal and management skills. *PMBOK® Guide*, 5th edition, pp 407-408
55. B – Make-or-buy analysis. *PMBOK® Guide*, 5th edition, p 365
56. C – According to a PMI Code of Ethics and Professional Conduct, mandatory standard 4.3.1: "we proactively and fully disclose any real or potential conflicts of interest to the appropriate stakeholders"
57. A – One of the key features of the WBS dictionary is that it shows cross functional dependencies between activities
58. A – This is a description of the salience model: *PMBOK® Guide*, 5th edition, p 396
59. C – The implementation of a formal recognition/rewards process would have gone a long way to demonstrate to the employees that their service was valued and that the company stood behind that in terms of recognition and rewards
60. D – With iterative lifecycles, the length of an iteration can change from iteration to iteration. Adaptive lifecycles are usually short and fixed - from 2 to 4 weeks in length. *PMBOK® Guide*, 5th edition, pp 45-46
61. C – Sunk costs are not considered when evaluating whether to continue with a project or enhancements to a project
62. D –Adaptive. *PMBOK® Guide,* 5th edition, p 45
63. B – Any risk that evaluates at higher than a 70% level can be considered an issue rather than a risk
64. D – Develop the project team is the next step *PMBOK® Guide*, 5th edition, p 273
65. B – Rework is the highest cost. Inspection and measurement are essentially the same, and the next higher level of quality costs. The lowest cost of quality is prevention
66. A – The PERT technique focuses on activity duration. *Practice Standard for Scheduling*, PMI, 2011 pp. 15-16
67. A – Most would call this a mitigation strategy, but unfortunately that's not one of the options in the answer set. Of the four answers you're actually accepting the risk - you can't stop it from raining. Risk acceptance always includes one or several contingency plans. The use of a tent that can remain open in the event of sun and closed in the event of rain is a contingency plan.
68. C – Schedule conflicts are usually considered the number one source of conflicts on a project
69. B – "Escaped defects" that land in the customer's lap is a post- project COQ and the concern of program and portfolio management. *PMBOK® Guide*, 5th edition, p 229
70. C – Per the *PMBOK® Guide,*5th edition, pp 396, 398
71. D – For software projects, the JAD session is the most useful tool. *PMBOK® Guide*, 5th edition, p 107
72. B – The first part of the question is misdirection. With the CPI of .87, your biggest concern at this point is that you are only getting $.87 in value for every dollar you spend. Cost overruns loom large at this point
73. A – Per the *PMBOK® Guide,*5th edition, p 155
74. C – This the definition of retainage
75. B – You might be really itching to answer option C(!), or as a fallback, option A or D. However, as stated in the PMI Code of Ethics and Professional Conduct: mandatory standard 2.3.5. "We pursue disciplinary action against an individual who retaliates against a person raising ethics concerns".
76. C – Requirements traceability matrix would enable anyone creating a test plan to map test scenarios against specific requirements
77. D – The key to answering this question correctly is reading the question carefully: team members communicate only with members of their own team, but not across team boundaries. Therefore, you have three teams of eight people plus a PM meeting with three people. This works out to 28+28+28+6=90
78. B – The staffing management plan is subsumed within the human resource plan. *PMBOK® Guide,*5th edition, p 265
79. B – Yes – per the *PMBOK® Guide,*5th edition, p 74
80. A – The feeding buffer protects the critical chain. See the *PMBOK® Guide,*5th edition, p 143

81. C – Risk management is ***not*** optional. *Practice Standard for Project Risk Management*, PMI, 2009,p 4
82. D – The question describes interpersonal skills. *PMBOK® Guide,*5th edition, p 407
83. B – This question will probably qualify as something you've never seen before or have seen in any of the PMP® study guides. However, don't put it past PMI to put something like this on the test. A bathtub curve is used by organizations to find out at which point in a product life cycle the product will begin to fail due to wear and tear or other factors, (if it does not fail immediately after manufacture). It is when those failure modes start going past an acceptable percentage that the manufacturer places and end-of-life limit on their product warranty.
84. B – One must first compute the PERT estimate(O + 4/*ML +P)/6 = 48.7. Standard deviation = 8. A 70% confidence factor is about 1 SD, thus 48.7 + 8= 56.7
85. C – Risk #2 is both urgent and important
86. B – Tight matrix means the team is co-located
87. C – The process is out of control, even though the data points fall within the control limits of the chart
88. B – Meeting minutes would contain action items due for the next meeting. An agenda tells you what you will discuss. Stakeholder register defines wants and needs of the stakeholders. The RACI grid addresses predetermined project responsibilities
89. D –These phrases all address the process of verifying scope *PMBOK® Guide,*5th edition, p 133
90. B – These are examples of indirect charges to the project
91. B - The zone test has been violated: six data points in a row trending up or down.
92. D – Sources of bias should be exposed and addressed in this process*. Practice Standard for Project Risk Management*, PMI, 2009 p. 27
93. C – The analogous estimate is the least accurate estimate - the parametric estimate is usually more accurate than an analogous estimate
94. C – Close the contract and pay the final invoice. If the product has been delivered according to the written customer spec, and was delivered two weeks early and under budget, the performing organization has done an *outstanding* job
95. A – The To Complete Performance Index (TCPI) basically shows the amount of work remaining, expressed in dollars, divided by the budget available to do that work. If you have more work to do than the budget available to do it, you must produce a higher level of efficiency with the money you have left to achieve the goals of the project. In this case, I have to produce $1.06 in earned value efficiency for every dollar I spend
96. B – Failure without warning is a detectability issue; it means that a product can fail without any detectable indication that it is about to fail. This usually represents a recipe for disaster, even if the likelihood of the event (probability) is low
97. C – The scenario describes resource smoothing. *PMBOK® Guide,*5th edition, p 180
98. B – The Likert scale represents discrete/attribute data. While it gives general readings for critical, important, moderately important, etc., it does not specify a measurable distance between these readings. Anyone answering this questionnaire may have a completely different interpretation of the scale than any other person answering the questionnaire. Thus, mathematics cannot be performed on discrete/attribute data itself
99. C – The ambient noise level from the crowded, noisy lunchroom is what is obscuring the message
100. C – In this instance, your responsibility is to ensure the change control process is followed, documented, and that the proper impact assessments are performed. Answer A is flat-out incorrect; answer D might be considered confrontational from the user's perspective. Answer B might have been an option if the user had not asked you to slip the change in "under the radar"
101. C – The Charter is the first document created, which occurs in Initiation, prior to the project management plan or resource estimates, which occurs in planning
102. A -the stakeholder analysis is where this information is captured. *PMBOK® Guide,*5th edition, p 395
103. B - The Delphi technique is effectively used with experts whose differences of opinion can become extremely confrontational.
104. C - Risk is not one of the most important factors in choosing a communications technology. *PMBOK® Guide,*5th edition, pp 292-293
105. D – The WBS dictionary is the third piece of the scope baseline

106. B - Work package is the lowest level
107. C - Answers A, B, and D are all legitimate negotiation or schedule reduction techniques. There is no guarantee assigning the work to an outside vendor will produce the desired result
108. A - 95% confidence equals two standard deviations, which in turn equals $20,000. Subtracting or adding $20,000 to the budget of $220,000 yields the range $200000-$240000
109. C - This is the only possible answer. A and D address monitoring and controlling activities, B addresses only a single stakeholder
110. C - Addressing project issues requires formal written communications
111. A - On all fixed-price contracts the highest risk falls to the seller
112. A - The status report, issue logs, project plans, and schedule all exist exclusively in the project domain. *Practice Standard for Project Configuration Management*, PMI 2007, p. 6
113. D - The salience model is not a planning tool, but is a tool and technique of identify stakeholders. *PMBOK® Guide,*5th edition, p 396
114. B - Only senior management can authorize changes to the triple constraints
115. C - In this instance, EAC = BAC/CPI. You already have BAC ($42,000). CPI is computed by dividing EV/AC or $9,321/$12,438. This yields $42,000/ .749 = $56,045
116. C - Milestone reports are summary reports well-designed for reporting to senior management
117. A - It is the project manager's responsibility to resolve the issue. They can consult with anyone in answer B, C or D
118. C - Quality assurance is an executing process - quality control is a monitoring and controlling process
119. C - The CPI of 1.21 means you are under budget i.e. $1.21 in value for every dollar spent. An SPI of less than 1 means that you are behind schedule
120. C -Harmonization is the term that is used. *Practice Standard for Project Configuration Management*, PMI 2007, p. 9
121. B - Expert power defines someone who has strong knowledge in their area of expertise
122. D - Contract negotiation is part of the conduct procurements process, not the Control Procurements process D - This
123. B - By definition this diagram is a precedence diagram method (PDM)
124. B - The critical path is 19 weeks. Management has promised delivery in 15 weeks - thus the float is a negative 4 weeks
125. C – A and B have no affect on the critical path. D works but it involves coordinating two activities. C – reducing activity 'B' by three weeks, is the simplest solution
126. B – answer b has nothing to do with ethics
127. D - You are accepting the risk that the union might strike, and you have a backup plan. Avoiding the risk would mean dealing with a vendor that doesn't have shipping issues, like someone across the street. Mitigation would involve negotiating with the union to continue deliveries while contract talks were continuing -this would mitigate the possibility of a potential shipment delay. Risk Transfer would involve dumping your shipping company in place of one that guaranteed delivery.
128. D - Inspection is the only possible answer. A, B and C are all defined costs of poor quality
129. B – Corporate culture is one of the foundations of describing Enterprise Environmental Factors
130. B - When there is a late discovery that threatens the release of a project, it is almost always due to a key stakeholder that was never identified early in the project
131. A - This is a unit price or T&M contract
132. C - This defines a compromise situation. The issue is not addressed head-on (b), nor is anyone demanding a specific resolution (d), or simply dropping out of the conversation (a)
133. B - The project charter legitimizes the authority of the project manager
134. C - The question describes actions taken during the control stakeholder engagement process. *PMBOK® Guide,*5th edition, p 409
135. C - This is a classic case of Hertzberg's hygiene theory at work
136. B - A key use of the WBS is to allow for team buy-in.
137. A - the question describes the definition of a knowledge area. *PMBOK® Guide*, 5th edition, p 60
138. B - The sponsor is external to the project team and has nothing to do with defining requirements

139. C - A 95% confidence factor with project ‘A” brings it to 118 days. A 95% confidence factor with project ‘B’ brings it to 117 days. Both projects are less than 120 days. Answer ‘A’ doesn't work for project ‘B’. Answer B - there is no way to know if a Monte Carlo estimate was used. Answer D is not possible to determine given the information
140. B - The first part of the question is a complete red herring. If the resource doesn't know what his deliverables are, it is probably due to the fact that work packages were never defined. Answer A addresses how communications will occur. Answer C does not address the real issue – this is a ‘blame the employee’ answer. Answer D addresses job responsibilities, *not* explicit deliverables.
141. C - Simply plug the numbers into the formula for calculating PTA
142. D - The Monte Carlo is the best tool for performing ‘what if’ analyses
143. B - The work authorization system defines what gets done and when it gets done in the project. If it's not in there, it doesn't get done.
144. B - Answer B is a milestone event, not necessarily a reason for administrative closure. All the other answers are examples of when administrative closure will occur.
145. B - Answer B is the most correct. Work package ‘B’ has a float of -10 because its late start is 10 days sooner than its early start! The question does not ask what you would do about it, it asks what best describes the situation.
146. B - The beta distribution is a type of continuous probability distribution. *PMBOK® Guide,*5th edition, p 337
147. C - Buying the software costs $100,000. There is a 60% chance that you will incur $100,000 impact if the software does not meet needs. Total cost is: $100,000 + .6*$100,000 = $160,000. Building the software costs $180,000. There is a 20% chance that you will incur a $100,000 impact if the software does not meet your needs. Total cost is $180,000 + .2*$100,000 = $200,000. Thus the answer is C.
148. B –The correct sequence is: Evaluate the need, perform impact assessment, document the change, submit to CCB for approval
149. C –Deming was well known for the “14 Points for Management”.
150. B – The question defines elements of multi-criteria decision analysis, which is a part of the acquire project team process. *PMBOK® Guide*, 5th edition, pp 271-272
151. D -moving from a directing/telling approach to a delegation approach as the resource gains skill.
152. C - Excessive inspections are a direct cost of poor quality i.e. a nonconformance cost. *PMBOK® Guide*, 5th edition, p 235
153. D - An attribute or discrete sample is used in a pass/ fail scenario
154. C - Answer C outlines the correct levels in the CMMI model.
155. A – Answer B poses a risk in that lower cost resources may extend the timeline even longer. Answer C may not be possible in that there may not be activities that can occur simultaneously. Answer D shows the project manager abdicating his responsibility to a higher authority. The best answer is answer A.
156. B – The process boundaries, configuration, and metrics, are typically found in a process improvement plan. *PMBOK® Guide*, 5th edition, p 241
157. C - Your expertise is in project management. Answers A, B and D are all subsumed within the project management process.
158. B - Only answers B and C address positive risks. In this case answer B describes a ‘share’ scenario
159. A – Answer A defines the contingency plan scenario.
160. C – Answer C is the actual definition of ‘legal purpose’.
161. D – Resource activity requirements are defined in the Estimate Activity Resources process. *PMBOK Guide®*, 5th edition, pp. 110-111.
162. C – The rule is what is being described and is a core characteristic of the WBS*. The Practice Standard for Work Breakdown Structures*, PMI, 2006, p.8.
163. D – The scenario describes crashing (putting high end resources on critical path activities), and fast tracking (running activities in parallel), the correct answer is D. *PMBOK Guide®*, 5th edition, p. 181
164. D - *PMBOK Guide®*, 5th edition, pp. 155, 435, 451.
165. A -Assessing team productivity is not a quality audit function. *PMBOK Guide®*, 5th edition, p. 247.
166. C – The cost of quality is a tool and technique of the Plan Quality process. *PMBOK Guide®*, 5th edition, p. 195.

167. D – PMI defines Six Sigma accuracy as 99.999%. The question can be solved by applying the rolled throughput yield formula; multiplying 99.99% x 99.998% x 99.9% will yield a throughput of 99.888% defect free percent
168. C - Encode, transmit, decode, acknowledge, feedback. *PMBOK Guide®*, 5th edition, p. 293.
169. D – While all the answers are correct, answer D is most inclusive. *PMBOK Guide®*, 5th edition, p. 280.
170. D – "The Delphi technique helps reduce bias…"*PMBOK Guide®*, 5th edition, p. 324
171. A - Leased equipment represents a fixed cost for the project.
172. C - Source selection criteria – an output of Plan Procurements. *PMBOK Guide®*, 5th edition, p. 356.
173. A – The PERT formula is: [O (optimistic) + 4* ML (Most likely) + P (pessimistic)]/6. *PMBOK Guide®*, 5th edition, p. 150.
174. B – The charter is an output in the Initiating process group. *PMBOK Guide®*, 5th edition, p. 61.
175. C – PMI considers expert and reward power as the two best forms of project manager authority.
176. C - The PMI code of ethics states that the PM must not "…engage in dishonest behavior with the intention of personal gain or at the expense of another". From the PMP Credential Handbook®, p 36.
177. B – All answers are part of the staffing management plan, but the question specifically addresses compliance. *PMBOK Guide®*, 5th edition, p. 267.
178. B – The formula for variance at completion (VAC) is: VAC = BAC – EAC. Therefore if EAC is greater than BAC, variance will be negative.
179. A – Work and budget must be converted into one or more work packages. *Practice Standard for Earned Value Management, second edition,* PMI, 2011, p. 9.
180. C – This is a standard request for quote.
181. D - First bidder, then selected source, then vendor. *PMBOK Guide®*, 5th edition, p. 357
182. B – The question defines the actions taken in a qualitative risk analysis. *PMBOK Guide®*, 5th edition, p. 289.
183. D – Peer communications are horizontal in nature.
184. C - Slightly less than half: 7% words, 38% vocal inflection.
185. B – The most appropriate form of communication in this instance is informal written.
186. D - The quality audit. *PMBOK Guide®*, 5th edition, p. 247.
187. A – The scope management plan is an input to the PM plan; the requirements management plan is a component of the PM plan. *PMBOK Guide®*, 5th edition, pp 109-110
188. A – The milestone chart will summarize the major deliverables and progress points.
189. C – Before any action is taken, the cause of the variance needs to be identified.
190. D - This defines a control threshold. *PMBOK Guide®*, 5th edition, p. 148
191. C – This is the definition of a distributed budget. *Practice Standard for Earned Value Management*, 2nd ed, 2011, p. 8.
192. C – These are elements of a product analysis. *PMBOK Guide®*, 5th edition, p. 122.
193. A - *PMBOK Guide®*, 5th edition, p.66.
194. B – Answer B is most inclusive. Answers A and C may occur in the closure process. Answer D is usually the last step in closure activities. *PMBOK Guide®*, 5th edition, p. 99.
195. B - Change control procedures are an organizational process asset. *PMBOK Guide®*, 5th edition, p. 80.
196. A – This describes a matrixed organization in which the PM and functional manager share management responsibilities of resources.
197. B – At the start of a project, stakeholder influence is high as stakeholders can influence the direction and deliverables needed on the project.
198. D – The waterfall approach is a predictive process..*PMBOK Guide®*, 5th edition, p. 38.
199. D - D is a function of Close Procurements, not Control Procurements. *PMBOK Guide®*, 5th edition, p. 344.
200. C – Computing the EAC forecast is essentially part of the 'Check' process. You are checking the forecasted completion of your project to see if the project will complete within the performance baseline for time and budget.