Project Quality Management
Quality Management

All the activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.
Quality Management

Key Terms

➢ Project Quality Management must address the management of the project & product.

➢ Quality - “the degree to which a set of inherent characteristics fulfill requirements.” (American Society for Quality, 2000)

➢ Gold Plating – Giving the customer extra functionality, adds no value to the project; PMI argues against gold plating.

➢ Marginal Analysis – Finding the point where the cost of the incremental improvement in quality equals the value of the improvement.
Quality Management

- International Organization for Standardization (ISO)
- Total Quality Management (TQM)
- Six Sigma
- Kaizen
- Quality vs. Grade
- Precision vs. Accuracy
- PDCA
Quality Management

Thought Leaders

- **W.E. Deming:** (PDCA), Quality = results of work efforts / total costs
- **J.M. Juran:** quality planning, control & improvement. People are cause. Fitness for Use
- **P. Crosby:** Quality is Free, 0 Defects Conforming to Rqmts, Doing It Right the First Time" (DIRFT)
- **K. Ishikawa:** Cause-Effect (Fishbone) Diagram, Design Statistics, introduced quality circles
- **G. Taguchi:** Quality as part of the Design, not Inspection, Taguchi Method.
Quality Management

8.1 Plan Quality

- Identifying which quality standards are relevant to the project, and determining how to satisfy them.
- Performed in parallel with other planning processes.
- Quality is planned, designed, and built in, not inspected in.
Quality Management

8.1 Plan Quality Management

**Inputs**
1. Project charter
2. Project management plan
3. Project documents
4. Enterprise environmental factors
5. Organizational process assets

**Tools & Techniques**
1. Expert judgment
2. Data gathering
3. Data analysis
4. Decision making
5. Data representation
6. Test and inspection planning
7. Meetings

**Outputs**
1. Quality management plan
2. Quality metrics
3. Project management plan updates
4. Project documents updates
<table>
<thead>
<tr>
<th>Conformance</th>
<th>Nonconformance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention</td>
<td>Scrap</td>
</tr>
<tr>
<td>Appraisal</td>
<td>Rework</td>
</tr>
<tr>
<td>Auditing</td>
<td>Expediting</td>
</tr>
<tr>
<td>Testing</td>
<td>Warranty Service</td>
</tr>
<tr>
<td>Controlling</td>
<td>Recalls</td>
</tr>
</tbody>
</table>

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## Quality Management

### Flowcharts

<table>
<thead>
<tr>
<th>Shape</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flowline</td>
<td>Shows the process order of operations. Arrows are added if the flow is not the standard top to bottom, or left to right.</td>
</tr>
<tr>
<td></td>
<td>Terminal</td>
<td>A terminal is the beginning or ending of a program or subprocess. A term typically includes the word “Start” or “End,” or may indicate where it is.</td>
</tr>
<tr>
<td></td>
<td>Decision</td>
<td>A decision is a conditional operation where one of two paths is taken. The operation originally a yes/no or true/false question.</td>
</tr>
<tr>
<td></td>
<td>Input/Output</td>
<td>This is the input or output of data. For example, it can be returning data or input/program.</td>
</tr>
<tr>
<td></td>
<td>Annotation</td>
<td>An annotation provides additional information about a step in the process. It is represented as an open rectangle with a bold or solid line connecting it to the corresponding step in the flowchart.</td>
</tr>
<tr>
<td></td>
<td>Predefined Process</td>
<td>A predefined process is one that is defined elsewhere. It is represented by a rectangle with double-dashed vertical edges.</td>
</tr>
<tr>
<td></td>
<td>On-Page Connector</td>
<td>An on-page connector replaces long or confusing lines in a flowchart with a small circle with a letter inside.</td>
</tr>
<tr>
<td></td>
<td>Off-Page Connector</td>
<td>An off-page connector is used when the input is on another page. It is represented by a home plate-shaped pentagon.</td>
</tr>
</tbody>
</table>

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Quality Management

SIPOC

- Sometimes called COPIS.
- Tool that summarizes the inputs and outputs of one or more processes in table form.
- Acronym SIPOC stands for suppliers, inputs, process, outputs, and customers which form the columns of the table.
- First used in TQM programs.
- Used today in Six Sigma and Lean manufacturing.
Quality Management

SIPOC Steps

1. Create an area that will allow the team to post additions to the SIPOC diagram. This could be a transparency (to be projected by an overhead) made of the provided template, flip charts with headings (S-I-P-O-C) written on each, or headings written on post-it notes posted to a wall.

2. Begin with the process. Map it in four to five high level steps.

3. Identify the outputs of this process.

4. Identify the customers that will receive the outputs of this process.

5. Identify the inputs required for the process to function properly.

6. Identify the suppliers of the inputs that are required by the process.

7. Optional: Identify the preliminary requirements of the customers. This will be verified during a later step of the Six Sigma measurement phase.

8. Discuss with project sponsor, Champion, and other involved stakeholders for verification.
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SIPOC

Supplier

Process

Customer

Requirements & Feedback Loop

Requirements & Feedback Loop

Requirements List

Measurements List

Requirements List

Measurements List

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A logical data model is also referred to as a logical schema.

It is a data model of a specific problem domain that is expressed independently of any specific named database product or storage technology.

It focuses on the foundational data structure and its elements such as relational tables, columns, object-oriented classes and/or XML tags.

It represents the abstract structure of a domain of information.

A logical data model is most often used in business process seeking to capture the important aspects of the organization and how they relate to one another.

The logical data model is the basis for the physical data model.

It is sometimes used as a synonym for a domain model, but the two are not the same. A domain model is more focused on capturing the concepts in the problem domain rather than the structure of the data associated with that domain.
<table>
<thead>
<tr>
<th>Conceptual Data Model</th>
<th>Logical Data Model</th>
<th>Physical Data Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes high-level data constructs</td>
<td>Includes entities (table), attributes (columns/fields) and relationships (keys)</td>
<td>Includes tables, columns, keys, data types, validation rules, database triggers, stored procedures, domains, and access constraints.</td>
</tr>
<tr>
<td>Non-technical names, so that executives and managers at all levels can understand the data basis of architectural description</td>
<td>Uses business names for entities and attributes</td>
<td>Uses more defined and less generic specific names for tables and columns, such as abbreviated column names, limited by the database management system (DBMS) and any company defined standards.</td>
</tr>
<tr>
<td>Uses general high-level data constructs from which architectural descriptions are created in non-technical terms.</td>
<td>Is independent of technology (platform, DBMS)</td>
<td>Includes primary keys and indices for fast data access.</td>
</tr>
<tr>
<td>May not be normalized.</td>
<td>Is normalized to forth normal form (4NF)</td>
<td>May be de-normalized to meet performance requirements based on the nature of the database. If the nature of the database is online transaction processing (OLTP) or operational data store (ODS) it is usually not de-normalized. De-normalization is common in data warehouses.</td>
</tr>
<tr>
<td>Represented in the DIV-1 viewpoint (DoDAF V2.0)</td>
<td>Represented in the DIV-2 Viewpoint (DoDAF V2.0), and OV-7 View (DoDAF V1.5)</td>
<td>Represented in the DIV-3 Viewpoint (DoDAF V2.0), and SV-11 View (DoDAF V1.5)</td>
</tr>
</tbody>
</table>

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Matrix Diagrams

- Also called a matrix chart.
- Used to show the relationship between two, three or four groups of information.
- Six possible shapes to the matrix: L, T, Y, X, C, and roof-shaped depending on how many variables or groups are being compared.

<table>
<thead>
<tr>
<th>Shape</th>
<th># of Groups</th>
<th>What the Matrix Shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-Shaped</td>
<td>2 Groups</td>
<td>A &lt;-&gt; B (or A &lt;-&gt; A)</td>
</tr>
<tr>
<td>T-Shaped</td>
<td>3 Groups</td>
<td>B &lt;-&gt; A &lt;-&gt; C but NOT B &lt;-&gt; C</td>
</tr>
<tr>
<td>Y-Shaped</td>
<td>3 Groups</td>
<td>A &lt;-&gt; B &lt;-&gt; C &lt;-&gt; A</td>
</tr>
<tr>
<td>C-Shaped</td>
<td>3 Groups</td>
<td>All three simultaneously (3-D)</td>
</tr>
<tr>
<td>X-Shaped</td>
<td>4 Groups</td>
<td>A &lt;-&gt; B &lt;-&gt; C &lt;-&gt; D &lt;-&gt; A but not A &lt;-&gt; C or B &lt;-&gt; D</td>
</tr>
<tr>
<td>Roof-shaped</td>
<td>1 Group</td>
<td>A &lt;-&gt; A when also A &lt;-&gt; B in L or T</td>
</tr>
</tbody>
</table>
Quality Management
Matrix Diagram Symbols

- Strong relationship
- Moderate relationship
- Weak or potential relationship
- Supplier
- Customer
- Doer
- Owner

Positive relationship
Neutral relationship
Negative relationship

Item on left influences item at top
Item at top influences item on left.

The arrows usually are placed next to another symbol indicating the strength of the relationship
Quality Management
Sample Matrix Diagrams

<table>
<thead>
<tr>
<th>Measure #1</th>
<th>Customer A</th>
<th>Customer B</th>
<th>Customer C</th>
<th>Customer D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure #2</td>
<td>15</td>
<td>22</td>
<td>19</td>
<td>12</td>
</tr>
<tr>
<td>Measure #3</td>
<td>95</td>
<td>105</td>
<td>125</td>
<td>97</td>
</tr>
<tr>
<td>Measure #4</td>
<td>29</td>
<td>36</td>
<td>27</td>
<td>56</td>
</tr>
</tbody>
</table>

L-Shaped Matrix

Y-Shaped Matrix
Quality Management

Test Driven Development (TDD)

- Tests are written **BEFORE** the code.
- A Unit Test is a test of a small, functional piece of code.
- Unit Tests are given priority in TDD.
- Unit tests make it...
  - Easier to find bugs.
  - Easier to maintain the code, but not test maintainability or test readability.
  - Easier to have full code coverage.
  - Easier to design & develop code.
  - Easier to deliver early & often.
  - Easier to track performance.
Quality Management

1. Red
2. Green
3. Refactor

TDD

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Test Driven Development (TDD)

- Must be able to make it fail. No code can be written without a failing test. This means we actually run the tests to ensure the failure state before writing any code.
- Running the test to prove failure is a fundamental difference of TDD.
- Make it work. Code must be as simple as possible. The code must ONLY pass that new test for which it was designed.
- Make it better. This means you must refactor.
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Acceptance Test-Driven Development

- Also called ATDD
- Moves testing focus from code to business requirements.
- Tests created before coding.
- Might use functional test framework such as FIT (Framework for Integrated Testing) or FitNesse
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Acceptance Test-Driven Development

➢ Four stages:
  – Discuss the requirements – during planning meeting ask acceptance criteria.
  – Distill tests in a framework-friendly format
  – Develop the code and hook up the tests
  – Demo through exploratory testing

➢ Regardless of method team must think about how the system will be tested before coding.
Refactoring

- Refactoring – Process of changing existing code to improve the way it functions.

- In XP you are not afraid of refactoring.

- Refactoring is part of your regular work & not a separate task.
Types of Refactoring

- **Yuck** – You look at code and it works, but is unsatisfactory. This is about making small improvements.
- **The Not Understood** – Code that you look at and cannot understand what it is doing. You must make code easier to understand.
- **New Insights** – When new functionality needs to be added, or you learn something.
Types of Refactoring

- Planned Refactoring – Actually adding refactoring to your project plan as a deliverable.
  - M. Fowler says it should hardly ever be done, because it represents a failure of the team to do the refactoring in small enough pieces to be constant.
  - Planned refactoring almost always requires justification.
  - Is evidence that you are not doing enough of the other types of refactoring.
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Types of Refactoring

➢ **Long Term Refactoring** – Trying to get closer to some large future goal. Get some vision of where you want things to be in the future.
  – Must be done gradually.
  – Does not require significant planning.
  – The essence is doing small steps.
Quality Management

8.2 Manage Quality

- Answers the question are we following the right standards. e.g. if we follow these standards what will the results be?

- Provides an umbrella for Continuous Improvement . . .

- Completed during execution.
Quality Management

8.2 Manage Quality

**Inputs**
1. Project management plan
2. Project documents
3. Organizational process assets

**Tools & Techniques**
1. Data gathering
2. Data analysis
3. Decision making
4. Data representation
5. Audits
6. Design for X
7. Problem solving
8. Quality improvement methods

**Outputs**
1. Quality reports
2. Test and evaluation documents
3. Change requests
4. Project management plan updates
5. Project documents updates
Quality Management

Root Cause Analysis

➤ A Root Cause is - if removing the item from the problem-fault sequence prevents the final undesirable outcome from occurring then the item is considered a root cause.

➤ A Causal Factor - Removing a causal factor can benefit the outcome, but it does not prevent its recurrence with certainty.
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Root Cause Analysis

- Define and properly describe the event or problem.
- Establish a timeline from the normal situation until the failure.
- Distinguish between root causes and causal factors.
- The team then focuses on problem prediction to determine when the problem will happen next and what must happen to prevent future occurrence.
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Affinity Diagrams

- An affinity diagram is one of the “Seven Management and Planning Tools”.
- Created by Jiro Kawakita in the 1960s.
- Sometimes referred to as the KJ Method.
- Used to sort a large number of ideas created during brainstorming based on their natural relationships for review and analysis.
Quality Management

Affinity Diagrams Steps

1. Record each idea on card or Post Its™.
2. Look for ideas that seem related.
3. Sort the cards into groups until all the cards have been used.
4. Once the cards are sorted create clusters or subgroups for easier analysis.
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Affinity Diagrams
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Cause and Effect Diagram
(Ishikawa or fishbone Diagram)

Potential Causes

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Scatter Diagram

Scatterplot of MPG vs weight

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- **In Control** – When ‘in control’ a process should not be adjusted.
- **Specification Limits** – Customer expectations or contract requirements.

What is ‘out of control’?
What is the ‘rule of 7’?
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Pareto Diagrams

Reasons for lateness

- Traffic
- Child care
- Public Transport
- Weather
- Overslept
- Emergency

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**Design For X**

1. Design for “excellence” also known as DFX.
2. Term used in the engineering world
3. The X serves as a placeholder for different design objectives.
4. Common substitutes for x include assembly (DfA), cost (DfC), logistics (DfL), manufacturability (DfM), reliability (DfR), serviceability and/or repairability (DfS).
5. Making square pegs and round holes.
6. Using fewer components.
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Problem Solving

- Thomas J. D'Zurilla defined problem solving as a “cognitive–affective–behavioral process through which an individual (or group) attempts to identify, discover, or invent effective means of coping with problems encountered in every day living”.
- Problem solving is used when products or processes fail, so corrective action can be taken to prevent further failures.
- Used when a potential problem can be predicted and analyzed, and mitigation applied so the problem never actually occurs.
- Problem solving techniques include: GROW model, How to Solve It, OODA loop, PDCA, Rapid Problem Resolution, failure mode effects and many others.
Quality Management

**Benchmarking**

- Used for process and product improvement.
- Can be done within the organization or with other organizations that have similar processes.
- Can disrupt a project if improperly done.
Quality Management

Design of Experiments (DOE)

➢ Statistical method used to identify which factors may influence specific variables in a process.

➢ Provides statistical framework to systematically change all the important factors in a system, instead of changing one at a time.
Quality Management

8.3 Control Quality

- Monitoring specific project results to determine whether they comply with relevant standards.
- Identifying ways to eliminate causes of unsatisfactory results.
- Quality standards include project processes and product goals.
Quality Management

8.3 Control Quality

**Inputs**
1. Project management plan
2. Project documents
3. Approved change requests
4. Deliverables
5. Work performance data
6. Enterprise environmental factors
7. Organizational process assets

**Tools & Techniques**
1. Data gathering
2. Data analysis
3. Inspection
4. Testing / product evaluation
5. Data representation
6. Meetings

**Outputs**
1. Quality control measurements
2. Verified deliverables
3. Work performance information
4. Change requests
5. Project management plan updates
6. Project documents updates
Quality Management

7 Basic Quality Tools

- Also known as 7QC Tools.
- Used within PDCA cycle to solve quality problems.
- They are:

<table>
<thead>
<tr>
<th>Cause-and-effect diagrams</th>
<th>Flowcharts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checksheets</td>
<td>Pareto diagrams</td>
</tr>
<tr>
<td>Histograms</td>
<td>Control charts</td>
</tr>
<tr>
<td>Scatter diagrams</td>
<td></td>
</tr>
</tbody>
</table>

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Check or Tally Sheets

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Blemish</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Scratch</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Dent</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Poor Fit</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

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Quality Management
Statistical Sampling Terms

- **Attribute** – A quality or characteristic of a thing.
- **Variable** – A quantity or function that may assume any given value or set of values.
- **Producer’s Risk** – (Alpha) chance of rejecting a good lot. Type I error.
- **Consumer’s Risk** – (Beta) chance of accepting a bad lot. Type II error.
- **Sampling Plan** – Sample size (n) and acceptance criteria (c).

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Statistical Terms

- **Mean** – Sum of the values divided by the count.
- **Median** – the middle value.
- **Mode** – the most commonly occurring value.
- **Standard Deviation:**

\[
\sqrt{\frac{\sum(x - \mu)^2}{n - 1}}
\]
Quality Management

Statistical Example

You have a sample with 5 cases with values of 1,2,3,4,5

The mean = Σ(values)/number of cases or 15/5 = 3

Variance and Standard Deviation

\[ (1-3)^2 + (2-3)^2 + (3-3)^2 + (4-3)^2 + (5-3)^2 = \]
\[ 4 + 1 + 0 + 1 + 4 = 10 \]
\[ 10 / (5-1) = 2.5 \text{ (variance)} \]

Square root of 2.5 = 1.58 (standard deviation)

\[ \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}} \]
Quality Management

Project Quality Management – Summary

- Three (3) processes.
- Assurance vs. Control.
- Principles advocated by Deming, Juran, Ishikawa, Crosby, Taguchi.
- Control Chart & rule of seven.
- PM & team have primary responsibility for conformance to standards.
Quality Management

Project Quality Management – Summary

➢ Importance of Continuous Improvement
➢ 7 basic quality tools
➢ Variable vs. Attribute sampling
➢ Gold Plating – not recommended
➢ Metrics
Questions and Answers
Review Questions:

1. A new software development project is in progress and the project manager is working with the quality assurance department. They want to improve everyone's confidence that the project will satisfy the quality standards. Which of the following do they need to have before they start this process?
   A. Completed checklists
   B. Quality management plan
   C. Rework
   D. Results of quality control measurements

2. A project manager and team from a firm that designs railroad equipment are tasked to design a machine to load stone onto railroad cars. The design allows for 2% spillage, amounting to over two tons of spilled rock per day. In which of the following does the project manager document quality control, quality management, and quality improvements for this project?
   A. Quality management plan
   B. Quality policy
   C. Control charts
   D. Project management plan

3. The project has had a major defect, and the project manager has involved the project team and process engineers in analyzing the situation. One of the group says that the real fault is the age of the equipment. Another says it is the lack of a material for the correct quality. To address the root of the problem, the project manager decides to use an Ishikawa diagram. Which of the following BEST describes the step of the quality management process in which the group is involved in this situation?
   A. Quality analysis
   B. Control quality
   C. Manage quality
   D. Plan quality management
4. You are a project manager for a major information systems project when someone from the quality department comes to see you about beginning a quality audit of your project. The team, already under pressure to complete the project as soon as possible, objects to the audit. You should explain to the team that the purpose of a quality audit is:
   A. Part of an ISO 9000 investigation.
   B. To check if customer is following its quality process.
   C. To identify lessons learned that can improve performance on the project.
   D. To check accuracy of costs submitted by the team.

5. The project has had a major defect, and the project manager has involved the project team in analyzing the situation. One of the group says that the real fault is the technology being used. Another says it is the age of the material. To address the root of the problem, the project manager decides to use a Control Chart. Which of the following BEST describes the step of the quality management process in which the group is involved in this situation?
   A. Analyze quality
   B. Control quality
   C. Manage quality
   D. Plan quality management

6. The project has had a major defect, and the project manager has involved the project team and process engineers in analyzing the situation. One of the group says that the real fault is using a new machine when an older machine was specified. Another says it is a change in subcomponent suppliers. To address the root of the problem, the project manager decides to use a cause and effect diagram. Which of the following BEST describes the step of the quality management process in which the group is involved in this situation?
   A. Perform quality analysis
   B. Control quality
   C. Manage quality
   D. Plan quality management

7. Which of the following is NOT a valid definition of project quality?
   A. The degree to which the project team meets customer expectations
   B. The degree to which a set of characteristics fulfill requirements
   C. The degree to which a product has no obvious defects
   D. Quality is something that both the project manager and project management team are responsible for delivering
8. Which of the following is the first process in quality management?
   A. Manage quality
   B. Control quality
   C. Plan quality management
   D. Perform quality definition

9. In which of the following processes do you ensure that the quality standards will allow the project to achieve its desired quality goals?
   A. Control quality
   B. Manage quality
   C. Plan quality management
   D. Perform quality definition

10. Which of the following is not an input to the quality planning process?
    A. Product scope baseline
    B. Risk register
    C. Enterprise environmental factors
    D. Organizational quality metrics

11. Which of the following is a tool and technique used in the plan quality management process?
    A. Project charter
    B. Process analysis
    C. Cause and Effect Diagrams
    D. Design of Experiments

12. What is the effect of a project product, service or result that meets customer requirements while being ahead of schedule and over budget?
    A. The project is successful.
    B. The project is significantly over budget.
    C. Project quality has been achieved.
    D. The project is behind schedule.
13. Which of the following statements best describes marginal analysis?
   A. The process of determining the point at which the value of incremental quality improvements will not equal the cost to attain them.
   B. The process of determining the point at which the value of incremental quality improvements equal the cost of those improvements.
   C. The process of determining the optimal quality standards for the project.
   D. The process for determining the optimal profitability based on the differentiation of the cost and pricing.

14. Sally is talking to a coworker and states she believes her boss is being unfair with her regarding her current project and the project's level of quality. Who owns final responsibility for project quality?
   A. Project resources
   B. Project sponsor
   C. Project manager
   D. The entire project team

15. Your project team is currently using Cost-Benefit Analysis. In which of the quality management processes are you in?
   A. Plan quality management
   B. Manage quality
   C. Control quality
   D. Integrated change control

16. You are a project manager leading a team that is currently using the cost of quality to evaluate the project. In which of the quality management processes are you in?
   A. Manage quality
   B. Control quality
   C. Develop project management plan
   D. Plan quality management

17. You are leading an engineering project. Your team is completing a quality audit. In which of the quality management processes are you in?
   A. Manage quality
   B. Quality planning
   C. Control quality
   D. Close project
18. Your project team is using control charts to determine the current quality status of your project. In what part of the quality management process are you in?
   A. Plan quality
   B. Control quality
   C. Manage quality
   D. Direct and manage project execution

19. You are the project manager on a project that has struggled with the quality of the deliverables throughout the entire project. Your boss, the Senior Vice President has come to you and stated that quality is the most important project constraint. On Monday morning you come into the office and find that another problem with quality has occurred. What is the best thing for you to do?
   A. Absorb a cost increase to fix the root cause of the problem.
   B. Fix the problem immediately.
   C. Cut project costs and allow the schedule to slip.
   D. Allow project risks to increase by allowing the schedule to slip.

20. You are a project manager leading a project that has an SPI 1.03 and a CPI 1.05. The ETC is $247,905. In a meeting you are conducting with your team to discuss the quality of the project one of your team members complains that the schedule is seriously compressed and you do not have time for the meeting. You have consistently rewarded your team according to the reward system you put in place and have a great team that has worked well together. Which of the following best explains why the complaining individual is wrong?
   A. Improved quality leads to increased productivity, decreased cost effectiveness, and increased technology risks.
   B. Improved quality leads to increased productivity, increased cost effectiveness, and decreased cost risk.
   C. Improved quality leads to increased productivity, increased cost effectiveness, and increased cost risk.
   D. Improved quality leads to increased productivity, decreased cost effectiveness, and decreased cost risk.

21. Quality attributes from the perspective of a project:
   A. Provide the basis for judging the project's success or failure.
   B. Determine how effectively the team supports the project.
   C. Are specified characteristics for which a product is designed and tested.
   D. Are objective criteria that must be met.
22. Which of the following best defines quality?
   A. Meeting and exceeding the customer's expectations.
   B. Conformance to management's objectives.
   C. Adding extras to keep the customer happy.
   D. The degree to which the project meets requirements.

23. You are a project manager working through some issues on your project. A member of your team suggests you make use of a Pareto diagram. Why might a Pareto diagram be helpful?
   A. Focus on the most critical issues to improve quality.
   B. Allow you to effectively brainstorm.
   C. Examine potential future outcomes.
   D. Determine if a process is out of control.

24. As a project manager which of the following will a Control chart help you do?
   A. Focus on the most critical issues to improve quality.
   B. Determine if a process is functioning within set limits.
   C. Allow you to effectively brainstorm.
   D. Examine potential future outcomes.

25. You are a project manager trying to decide the best way to evaluate the quality of a manufactured product. Which of the following best explains why you choose not to test the entire population?
   A. It would create noise in the data.
   B. It would exclude other testing methods.
   C. It would take too long.
   D. It would show type II errors.

26. All of the following are examples of the cost of conformance except:
   A. Auditing
   B. Controlling
   C. Appraisal
   D. Expediting

27. All of the following are examples of the cost of nonconformance except:
   A. Expediting
   B. Warranty service
   C. Auditing
   D. Recalls
28. You are a project manager working on a large, highly visible project. Your most recent control chart shows seven consecutive points on one side of the mean. What should you do next?
   A. Find the cause of the change.
   B. Nothing. The project is not necessarily in trouble.
   C. Notify your sponsor that there is a problem.
   D. Adjust the chart to reflect the new mean.

29. You are a project manager leading a large project within your organization. Last week you were on vacation. Upon your return you discover the team added several deliverables to the project because they determined it would benefit the customer. What is wrong with this situation?
   A. The project manager was not present when the decision was made.
   B. Nothing, this is the best way to have a happy customer.
   C. Nothing. The team needed to keep moving in your absence.
   D. The team is gold plating.

30. You are working on creating a financial plan for your project. If you are planning on using JIT, how much inventory should you plan on maintaining?
   A. 0%
   B. 15%
   C. 25%
   D. 40%

31. When planning your project which would generally have the highest priority: schedule, cost or quality?
   A. Quality
   B. Schedule
   C. Cost
   D. It should be determined for each project.

32. You are a project sponsor with several projects falling within your authority. You are concerned about the accuracy of the performance reporting you have recently been receiving. Which of the following would best allow you to validate your concerns?
   A. Control charts
   B. Quality audits
   C. Monte Carlo analysis
   D. Logit analysis
33. You are leading a large manufacturing project for a new automobile. The current design allows for a 1.3% defect rate and expects to produce 1.2 million units. In which of the following would you document quality control, quality assurance, and quality improvements?
   A. The quality policy
   B. The project management plan
   C. The quality management plan
   D. Organizational processes and templates

34. You are a project manager leading a road construction project. The road is almost 80% complete according to your most recent EVMS report when a senior executive informs you that she is worried the project will not meet the quality standards. What should you do in this situation?
   A. Assure the executive that during the plan quality process it was determined that the project would meet the quality standards.
   B. Use EVMS to predict future results.
   C. Check the results from previous projects' quality management plans.
   D. Form a quality assurance team.

35. You are a project manager leading a small information technology project. You ask two members of your team to select tools and techniques to implement a quality assurance program that will be combined with existing quality control activities. Which of the following would you not expect to see in the program?
   A. Histograms
   B. Focus groups
   C. Quality audits
   D. Statistical sampling

36. You are the project manager on a major engineering project. You are working with the quality assurance department to make sure everyone has confidence that the project will satisfy the quality standards. Which of the following must you have before starting the process?
   A. Defined areas of concern
   B. Requested quality improvements
   C. Quality control measurements
   D. Rework
37. You have just taken over a project from another project manager. The project is currently in the execution process group. The previous project manager created a project budget, determined communications requirements, and went on to complete work packages. What should you do next?
   A. Complete the WBS.
   B. Complete the identify risk process.
   C. Complete the project according to the plan.
   D. Identify the quality standards.

38. You are a project coordinator leading an information technology project. Your project is facing major changes to its deliverables. If you are involved in determining which quality standards are relevant to the changes, you must also be involved in:
   A. Quality management
   B. Manage quality
   C. Plan quality management
   D. Control quality

39. You are the project manager for a large manufacturing project in the electronics industry. Your project has completed all of its deliverables. As you examine the lessons learned you conclude that the project has added five areas of performance and three areas of functionality. The customer has signed off on the delivery of the product of the project and is very happy with the results. What does this mean in terms of success of the project?
   A. The project was unsuccessful because it was gold plated.
   B. The project was successful because the team learned from the effort and the customer was satisfied.
   C. The project was an unqualified success.
   D. The project was unsuccessful because making the customer happy meant the team had to do more work.
40. You are a project coordinator on an information technology project within your organization. One of your team members comes to you and states that a completed work package does not meet the specified quality metric and that they do not believe it is possible to meet the metric. You gather the appropriate team members together to discuss the situation. Which process in the quality management knowledge area are you in?
   A. Monitoring and control
   B. Manage quality
   C. Control quality
   D. Project execution

41. Management assigns you to be the project manager of a project that crosses functional lines and is designed to operate at 6-sigma levels. The sponsor has given you cost and schedule requirements. Which of the following would not be an appropriate action on your part?
   A. Evaluating the project risks.
   B. Accepting the requirements.
   C. Creating a detailed estimate.
   D. Working with the team to come up with a project plan.

42. The project has had a major defect, and the project manager has involved the project team and process engineers in analyzing the situation. One of the group says that the real fault is the age of the equipment. Another says it is the lack of a material for the correct quality. To address the root of the problem, the project manager decides to use an Ishikawa diagram. Which of the following BEST describes the step of the quality management process in which the group is involved in this situation?
   A. Perform quality analysis
   B. Manage quality
   C. Control quality
   D. Plan quality management
43. An external stakeholder suggests to the project manager that the team does not have enough time to hold quality meetings when the schedule has been significantly compressed. The current CPI is 1.12 and the team has performed very well under adverse circumstances. Which of the following best explains why the stakeholder is wrong?
   A. Improved quality leads to increased productivity, increased cost effectiveness, and decreased cost risk.
   B. Improved quality leads to increased productivity, decreased cost effectiveness and increased cost risk.
   C. Increased quality leads to increased productivity, increased cost effectiveness, and increased cost risk.
   D. Improved quality leads to increased productivity, decreased cost effectiveness, and decreased cost risk.

44. You are leading a project to develop food packaging equipment. The current specifications call for less than one percent spillage per container. In which of the following do you document quality control, quality assurance, and quality improvements for the project?
   A. Quality management plan
   B. Quality policy
   C. Project documents
   D. Project management plan

45. As the project manager, you have created a plan for how the team will implement the quality policy. It addresses the organizational structure, responsibilities, procedures, and other information about plans for quality. If this plan changes during the project, which of the following plans will also change?
   A. Quality assurance plan
   B. Quality management plan
   C. Project management plan
   D. Quality control plan
46. You are in the middle of a major new facility construction project. The structural steel is in place and the heating conduits are going into place when a senior manager informs you that he is worried the project will not meet the quality standards. When should you do in this situation?

A. Assure senior management that during the plan quality process, it was determined that the project would meet the quality standards.

B. Analogously estimate future results.

C. Form a quality assurance team.

D. Check the results from the last quality management plan.
Answer Key:

1. D
   Answer D. To give the stakeholders confidence you first need to have information about where you are at. Your quality control measurements provide the information about where you are at in meeting the quality standards.

2. A
   Answer A. The Quality Management Plan contains all the information that documents how quality will be managed throughout the project.

3. B
   Answer B. At this point the team has already completed the planning steps and ensured that the plan will deliver the desired level of quality. The issue is making sure you are actually delivering against the plan.

4. C
   Answer C. Lessons learned are always key elements of any project as they allow continuous process improvement. Constantly getting better is key to PMI.

5. B
   Answer B. This is not a situation where you are planning for quality or making sure the plan would lead to the desired level of quality. You are in execution and trying to determine why you are not achieving the desired goals. This is control quality.

6. B
   Answer B. Don't be confused by the fact the project manager selected a cause and effect diagram (a poor choice for this situation). The correct answer is still control quality.

7. A
   Answer A. PMBOK Guide p. 274 - Quality should never be defined as meeting customer expectations. Quality is best defined as the ability to fulfill the project's stated requirements. This definition explains why requirements definition is so critical to project success.
8. C
Answer C. PMBOK Guide p. 272 - Like most defined processes in the PMBOK Guide, the first step is define what quality means for the project and the steps that will be used to achieve quality.

9. B
Answer B. PMBOK Guide p. 288 - Manage quality is the process where the project team uses systematic quality activities to ensure that the project will employ all the processes needed to meet requirements.

10. A
Answer A. The scope baseline includes both the project and the product. PMBOK Guide p. 277 - The inputs to the plan quality management process include:
  - .1 Project charter
  - .2 Project management plan
  - .3 Project documents
  - .4 Enterprise environmental factors
  - .5 Organizational process assets

11. D
Answer D. PMBOK Guide p. 277 - The tools and techniques used in plan quality management include:
  - .1 Expert judgment
  - .2 Data gathering
  - .3 Data analysis
  - .4 Decision making
  - .5 Data representation
  - .6 Test and inspection planning
  - .7 Meetings

12. C
Answer C. The only thing that can be stated definitively is that the project's quality level has been achieved. With the information provided you cannot be sure the project was successful as the project is over budget. However, you also cannot tell if the project is significantly over budget. The project is not behind schedule.
13. B
Answer B. Marginal analysis is an analytical process used in determining the point at which spending any more money to improve the project quality will exactly match the value of the improvements. It is a one for one exchange.

14. C
Answer C. PMBOK Guide p. 273-275 - The project management team and not the entire project team is ultimately responsible for the level of quality on a project. However, in this case the best answer is the project manager.

15. A

16. D
Answer D. PMBOK Guide p. 272 - Benchmarking is a tool and technique used in the plan quality management process.

17. A
Answer A. PMBOK Guide p. 288 - A quality audit is a tool or technique used in the perform quality assurance process.

18. B
Answer B. PMBOK Guide p. 304 - Control charts are one of several tools and techniques that make up the control quality process.

19. A
Answer A. The key phrase in the answers is "root cause". Only A fixes the root cause of the problem. B might only be a temporary solution. Neither C nor D provide a solution to the quality problem.

20. B
Answer B. This is a very long winded question, but is typical for the exam. Most of the question has little to do with coming up with the correct answer. Just remember from PMI's perspective improving the quality of the project will lead to lot of good stuff including decreasing the long term cost of the project, making the team more productive and reducing risks.
21. C
Answer C. PMBOK Guide p. 273-274 - This question is almost a straight definitional question. Quality is "the degree to which a set of inherent characteristics fulfill requirements."

22. D
Answer D. PMBOK Guide p. 273-274 - This question is almost a straight definitional question. Quality is "the degree to which a set of inherent characteristics fulfill requirements."

23. A
Answer A. PMBOK Guide p. 304 - A Pareto diagram is a type of histogram an is conceptually related to Pareto's law, which holds that a relatively small number of causes will typically produce a majority of the problems or defects.

24. B
Answer B. PMBOK Guide p. 304 - Control Charts are used to determine whether or not a process is stable or has predictable performance.

25. C
Answer C. PMBOK Guide p. 303 - The primary reason for not testing an entire population is that it can be extremely time consuming. For this reason sampling is often used.

26. D
Answer D. PMBOK Guide p. 283 - The costs of conformance include:
- Prevention
- Appraisal
- Planning
- Training
- Auditing
- Testing
- Controlling
27. C
   Answer C. PMBOK Guide p. 283 - The costs of nonconformance include:
   - Scrap
   - Rework
   - Expediting
   - Warranty service
   - Recalls
   - Failure

28. A
   Answer A. PMBOK Guide p. 304 - This is a trick question of sorts. Hopefully, the
   first thing you would do is notice the Rule of Seven was in play and you needed
to determine why you had 7 consecutive cases on one side of the mean.

29. D
   Answer D. Be careful in reading the question. Nothing gives you an indication
   that the customer actually approved the changes. Do not simply assume they
   have. The correct answer is the team is gold plating.

30. A
   Answer A. JIT refers to Just in Time inventory management. It is a technique
   where you attempt to carry no inventory and only have material arrive when
   needed. Therefore, 0% is the correct answer.

31. D
   Answer D. PMBOK Guide p. 294 - Don't get trapped because this is a quality
   question. The correct answer is always it depends and must be determined for
each project.

32. B
   Answer B. PMBOK Guide p. 294 - This question reflects the definition of a quality
   audit. It is a structured, independent review to determine whether project
   activities comply with organizational and project policies, processes, and
   procedures.

33. C
   Answer C. PMBOK Guide p. 277 - The quality management plan is where all
   aspects for how quality will be managed on the project are defined.
34. D
Answer D. The real question here is which option helps ensure you meet the appropriate quality standards. The only choice is forming a quality assurance team.

35. B
Answer B. PMBOK Guide p. 288 - This question is basically asking which item from the list is not a tool or technique from manage quality and control quality processes combined. The tools and techniques from control quality and manage quality combined include:
- Data gathering
- Data analysis
- Data representation
- Decision making
- Audits
- Design for X
- Problem solving
- Quality improvement methods
- Inspection
- Testing / product evaluations
- Meetings

36. C
Answer C. The key word in this question is must. The only one of the four items you must have is the quality control measurements. Everything else is optional.

37. D
Answer D. For some this is an easy question because it appears in the quality section. However, if you did not know which process group you were in would you have gotten it correct? Identifying the quality standards is the correct answer because no one has yet completed the planning process. The next step in that process calls for the creation of the quality standards, and then completing the identify risks process. The WBS is already done and you cannot execute the project until the planning is complete.

38. C
Answer C. Although quality planning usually occurs during project planning, sometimes you have to go back to planning from other processes to re-evaluate or make another decision.
39. A
Answer A. This question might be considered a trick by some, but it is not. The correct answer is the project was gold plated (you have no information that the customer approved the changes prior to implementation). So even though they were happy with the product of the project it was gold plated and that is bad. This is a situation with a great product and a failed project.

40. C
Answer C. Measuring is by definition part of the control quality process. Be careful here as the question is about the quality management knowledge area and not the project management process groups.

41. B
Answer B. As a project manager you should never simply accept requirements or anything else without understanding the implications of acceptance on the project.

42. C
Answer C. You have a standard you are trying to meet which takes both plan quality and manage quality out of the mix. Perform quality analysis is a made up process. Only control quality represents a process where you are measuring against targets and trying to analyze the variances.

43. A
Answer A. Improving the quality of the project improves the processes being used by the team. This will lead to improved productivity, increased cost effectiveness and decreased cost risk.

44. A
Answer A. Be very careful with this question. Two answers are technically correct. The quality management plan is part of the project management plan so both are technically correct, but the quality management plan is the best, most accurate answer.

45. C
Answer C. The plan described is the quality management plan. Since the quality management plan is included in the project management plan, changing the quality management plan will also change the project management plan.
Answer C. Assuring management that it was determined in planning that the project meet quality standards is not productive, since it does not solve the problem. An analogous estimate looks at the past history of other projects. This would not be appropriate to determine how the current project is going. The quality management plan does not provide results. A quality assurance team could help to determine whether the team is following the correct process to satisfy the relevant quality standards.