Project Management Professional (PMP®) Exam

Study Notes

PROJECT QUALITY MANAGEMENT

STUDY NOTES

Reference Material to study:

- A Guide to the Project Management Body of Knowledge (PMBOK), Chapter 8 (2000 edition)
- Quality Management for Projects and Programs, Ireland, Lewis R., 1991
- PMP Exam Guide, 4th Edition, by Knapp, W. Brent, PMP, 2004, Chapter 7

What to Study?

- The PMBOK phases of Project Quality Management: Quality Planning, Quality Assurance, and Quality Control (Be familiar with Inputs, Tools and Techniques, and Outputs for each phase)
- Know the difference between quality and grade.
- Know the difference between Quality Control and Quality Assurance
- Project characteristics and attributes (Ireland, Chapter II)
- Cost of Quality (Ireland, Chapter IV)
- Statistical Concepts and Quality Tools (Ireland, Chapter V)
- Cost Trade-offs
- Know the difference between the ISO 9001 Certification and the Malcolm Baldrige Award.
- Know the difference between the Deming, Juran, and Crosby Management approaches
- Pareto and Fishbone diagrams

Key Definitions

Control	The process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.
Control Charts	A graphic display of the results, over time and against established control limits, of a process. The charts are used to determine if the process is in control or in need of adjustment.
Corrective Action	Changes made to bring expected future performance of the project in line with the plan.
Cost of Conformance	The cost of conforming to Specifications, Planning, Training, Control, Validation, Test, and Audits.
Cost of Nonconformance	The cost of not conforming is Scrap, Rework, Additional Work, Warranty, Complaint Handling, Product Recall, and Expediting.
Cost of Quality	The cost incurred to ensure quality. Includes quality planning, quality control, quality assurance, and rework.
Grade	A category or rank used to distinguish items that have the same functional use (e.g., “hammer”), but do not share the same requirements for quality (e.g., different hammers may be built to withstand varying degrees of force)
Monitoring	The capture, analysis, and reporting of project performance, usually as compared to plan.
Monte Carlo Analysis	A technique that performs a project simulation many times to calculate a distribution of likely results.
Pareto Diagram	A histogram ordered by frequency of occurrence that shows how many results were generated by each identified cause.
Pareto’s Law	A supposition that states that a relatively small number of causes will typically produce a large majority of the problems or defects. Commonly referred to as the 80/20 principle in which 80% of the problems can be attributed to 20% of the causes.
Performance Reporting	Collecting and disseminating information about project performance to help access project progress. Includes status reporting, progress measurement, and forecasting.
Project Quality Management	The processes required to ensure that the project will satisfy the needs for which it was undertaken. Modern quality management complements modern project management in that both recognize the importance of customer satisfaction and prevention over inspection.
Quality	The totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs.
Quality Assurance (QA)	1) The process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards. 2) The organizational unit that is assigned responsibility for quality assurance.

Project Quality Management

Project quality management includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It also includes all activities of the overall management function that determine the quality policy, objectives, and responsibilities and implements these by means such as quality planning, quality assurance, quality control, and quality improvement within the quality system.

Project quality management must address both the management of the project and the product or service of the project. Failure to meet quality requirements in either dimension can have serious negative consequences for the project stakeholders. For example:

- Meeting customer requirements by overworking the project team may produce negative consequences in the form of increased employee attrition.
- Meeting project schedule objectives by rushing planned quality inspections may produce negative consequences when errors go undetected.

Modern quality management complements project management. For example, both disciplines recognize the importance of:

1. Customer satisfaction understanding, managing, and influencing needs so that customer expectations are met. This requires a combination of conformance to requirements and fitness for use. (the product/service must satisfy real needs)
2. Prevention over inspection - the cost of preventing mistakes is always much less than the cost of correcting the mistakes, as revealed by inspection.
3. Management responsibility - success requires the participation of all members of the team, but it remains the responsibility of management to provide the resources needed to succeed.
4. Processes within phases - the repeated plan-do-check-act cycle described by Deming and others is highly similar to the Project Management Processes. (Described in Chapter 3 of the PMBOK Guide.)

Quality

Quality is the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs. Stated and implied needs are the inputs to developing project requirements. Should not be confused with grade. Grade is a category or rank given to entities having the same functional use but different technical characteristics. Low quality is always a problem; low grade may not be. For example:

- A software product may be of high quality (very few defects, a readable user's manual) but of low grade meaning it has a limited number of features.
- Or, a software product may be of low quality but of high grade meaning it has many defects but lots of customer features.

Quality Planning (8.1) (Process Group: Planning)

Quality planning is the process of identifying which quality standards are relevant to the project and determining how to satisfy them. One of the key facilitating processes during project planning, meaning it should be performed regularly and in parallel with other project planning processes. For example:

- The changes in the project product/service required to meet identified quality standards may require cost or schedule adjustments.
- The desired product/service quality may require a detailed risk analysis of an identified risk source.

Quality should be planned in, not inspected in.

Inputs include: Quality policy, scope statement, product description, standards and regulations, and other process outputs.

- Quality policy - the quality policy is the overall intentions and direction of an organization with regard to quality, as formally expressed by top management. When a formal quality policy is not available, or in the case of joint ventures involving multiple performing organizations, the project management team will need to develop a quality policy for the project. Regardless of origin, the project management team is responsible for ensuring that the project stakeholders are fully aware of the quality policy.
- Other process outputs: outputs from other knowledge areas that should be considered as part of quality planning. For example, procurement planning may identify contractor quality requirements.

Methods used during quality planning include: benefit/cost analysis, benchmarking, flowcharting, and design of experiments.

- Benefit/cost analysis - must consider benefit/cost tradeoffs during quality planning.
- The primary benefit of meeting quality requirements is less rework which translates to higher productivity, lower costs, and increased stakeholder satisfaction. The primary cost of meeting quality requirements is the expense associated with project quality management activities. The benefits of the quality management discipline outweigh the costs.
- Benchmarking - involves comparing actual or planned project practices to those of other projects (either within the performing organization or external) to generate ideas for improvement and to provide a standard by which to measure performance.
- Flowcharting - a technique which creates a diagram that displays how various elements of a system relate. Can assist the project team with anticipating what and where quality problems may occur and with developing approaches for addressing the problems. Flowcharts commonly used in quality management include:
    - Cause-and-effect diagrams: illustrate how various factors may be linked to potential problems or effects. (also referred to as Ishikawa or fishbone diagrams)
    - System or process flow charts: show how various elements of a system interrelate.
- Design of experiments - a statistical method that helps identify which factors might influence specific variables. Is applied most frequently to the product of the project (e.g., automotive designers may wish to determine which combination of suspension and tires will produce the most desirable ride characteristics at a reasonable cost.) Can also be applied to project management issues such as cost and schedule tradeoffs. Example: senior engineers will cost more than junior engineers but will usually complete the assignment in less time. An appropriately designed experiment which computes project costs and duration for various combinations of senior and junior engineers will often yield an optimal solution from a relatively limited number of cases.

Cost of Quality

Cost of quality refers to the total cost of all efforts to achieve product/service quality. It includes all work to ensure conformance to requirements as well as all work resulting from nonconformance to requirements. Three types of incurred costs: prevention, appraisal, and failure where failure is broken down into internal and external costs.

Quality Management Plan

The quality management plan describes how the project management team will implement its quality policy. In ISO 9000 terminology, it should describe the project quality system: the organizational structure, responsibilities, procedures, processes, and resources needed to implement quality management. It also provides input to the overall project plan and must address quality control, quality assurance, and quality improvement for the project. The quality management plan may be formal or informal, highly detailed or broadly framed, depending on the requirements of the project.

Operational definitions

Operational definitions describe in very specific terms what something is and how it is measured by the quality control process. (Also called metrics in some application areas.)

Checklists

Checklists are usually a list of specific items that are used to verify that a set of required steps has been performed. They may be simple or complex and usually phrased as imperatives ("Do this!") or interrogatories ("Have you done this?"). Standardized in many organizations for frequently performed tasks. Available from professional associations or commercial service providers in some application areas.

Inputs to other processes: The quality planning process may identify a need for further activity in another area.

Outputs include: Quality Management Plan, operational definitions, checklists, and inputs to other processes.

Quality Assurance (8.2) (Process Group: Executing)

Quality assurance is the process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards. Quality assurance should be performed throughout the project. Often, although not always, provided by a Quality Assurance Department or similarly titled organization.

Internal quality assurance: assurance is provided to the project management team and to the management team of the performing organization.

External quality assurance: assurance is provided to the customer and others not actively involved in the work of the project.

Inputs include: Quality Management Plan, results of quality control measurements, and operational definitions.

- Results of quality control measurements - records of quality control testing and measurement in a format for comparison and analysis.

Methods used include: quality planning tools and techniques and quality audits.

- Quality planning tools and techniques - includes benefit/cost analysis, benchmarking, flowcharting, checklists, etc.
- Quality audits - are a structured review of other quality management activities. The objective of a quality audit is to identify lessons learned that can improve performance of this project or of other projects within the performing organization. These audits may be scheduled or random; may be carried out by trained in-house auditors or by third parties such as quality system registration agencies.

Outputs include: quality improvement includes taking action to increase the effectiveness and efficiency of the project to provide added benefits to the project stakeholders. In most cases will require preparation of change requests or taking corrective action and will be handled according to the procedures for integrated change control.

Quality Control (8.3) (Process Group: Controlling)

Quality control is the process of monitoring specific project results to determine if the results comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance. It should be performed throughout the project. Project results include both product results such as deliverables and project management results such as cost and schedule performance.

Often, although not always, provided by a Quality Control Department or similarly titled organization. Project management team should have a working knowledge of statistical quality control, especially sampling and probability, to help evaluate quality control outputs. The team may find it useful to know the differences between:

- **Prevention:** keeping errors out of the process, versus, Inspection: keeping errors out of the hands of the customer.
- **Attribute sampling:** the result either conforms or it does not, versus, Variables sampling: the result is rated on a continuous scale that measure that degree of conformity.
- **Special causes:** unusual events, versus,
- **Random causes:** normal process variation.
- **Tolerances:** the result is acceptable if it falls within the range specified by the tolerance, versus, Control limits: the process is in control if the result falls within the control limits. Note: Result can be within the control limits of a process but out of tolerance.

Inputs include: work results (both process and product results), Quality Management Plan, operational definitions, and checklists.

Methods used during quality control include: inspection, control charts, pareto diagrams, statistical sampling, flowcharting, and trend analysis.

- **Inspection:** Includes activities such as measuring, examining, and testing undertaken to determine whether results conform to requirements. May be conducted at any level (e.g., the results of a single activity may be inspected or the final project product). May be called reviews, product reviews, audits, and walkthroughs. Note: in some application areas these terms have narrow and specific meanings.
- **Control charts:** Graphic displays of the results over time of a process. Used to determine if the process is “in control” (e.g., are differences in the results attributed to random variations or unusual events whose causes must be identified and corrected?) Although most frequently used to track repetitive activities such as manufacturing lots, control charts may be used to monitor any type of output variable. Examples: cost and schedule variances, volume and frequency of scope changes, errors in project documents, etc.
- **Pareto diagrams:** Histograms ordered by frequency of occurrence that display how many results were generated by type or category of an identifiable cause. Rank ordering is used to guide corrective action with the assumption that the project team should take action to fix the problems that are causing the greatest number of defects, first. Are conceptually related to Pareto’s Law which holds that a relatively small number of causes will typically produce a large majority of the problems or defects. This is commonly referred to as the 80/20 principle where 80% of the

problems are due to 20% of the causes.

- **Statistical sampling:** Involves choosing a population of interest for inspection. (e.g., selecting ten engineering drawings at random from a list of seventy-five). Appropriate sampling can often reduce the cost of quality control. In some application areas, the project management team must be familiar with a variety of sampling techniques.
- **Trend analysis:** Uses mathematical techniques to forecast future outcomes based on historical results. Often used to monitor technical performance (how many errors or defects have been identified, how many remain uncorrected) as well as cost and schedule performance (how many activities per period were completed with significant variances.)

Outputs include: quality improvement, acceptance decisions, rework, completed checklists, and process adjustments.

- **Acceptance decisions:** Decisions to either accept or reject the inspected items. Rejected items may require rework.
- **Rework:** Action taken to bring a defective or nonconforming item into compliance with requirements or specifications. Rework, especially unanticipated, is a frequent cause of project overruns in most application areas. The project team should make every reasonable effort to minimize rework.
- **Process adjustments:** Immediate corrective or preventive action as a result of quality control measurements. In some cases, the process adjustment may need to be handled according to procedures for integrated change control.

Definition of Quality (from Ireland book)

Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs. Some goals of quality programs include:

- Fitness for use. (Is the product or service capable of being used?)
- Fitness for purpose. (Does the product or service meet its intended purpose?)
- Customer satisfaction. (Does the product or service meet the customer's expectations?)
- Conformance to the requirements. (Does the product or service conform to the requirements?)

Quality Movements

ISO (International Organization for Standardization) - A worldwide federation of national standard bodies. The work of preparing international standards is done by ISO technical committees. ISO 9001 and ISO 9004 are a set of complementary standards with a focus on quality. ISO 9001 specifies requirements for a quality management system that can be used for internal application, ISO certification, or for contractual purposes.

ISO 9004 provides guidance on a wider range of objectives of a quality management system than ISO 9001. It emphasizes the continual improvement of an organization's overall performance, efficiency, and effectiveness. Used in organizations whose top management wishes to move beyond the requirements of ISO 9001 in pursuit of continual improvement. ISO 9004 is not used for ISO certification or contractual purposes.

Requirements are centered around a methodology called Plan, Do, Check, Act (PDCA)

- Plan: Establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies.
- Do: Implement the processes.

- Check: Monitor and measure processes and product against policies, objectives, and requirements for the product and report the results.
- Act: Take actions to continually improve process performance.

Deming Prize (Overseas) - Administered by the Union of Japanese Scientists and Engineers (JUSE). Awarded to overseas companies that demonstrate a superior quality program.

Checklist includes: organization's policy, structure, education, collection, dissemination, and use of information, analysis of problems, establishment and use of standards, management system, quality assurance, effects, and future plans.

Deming's 4 step cycle for improvement: Plan, Do, Check, Act

Deming's major points for implementing quality

1. Participative approach
2. Adopt new philosophy
3. Cease mass inspection
4. End awards based on price
5. Improve production and service
6. Institute leadership
7. Eliminate numerical quotas
8. Education and training
9. Encourage craftsmanship

Malcolm Baldrige - The Malcolm Baldrige National Quality Improvement Act was established in Aug. 20, 1987. Purpose of the act was to promote quality awareness; to recognize quality achievements of U.S. companies, and to publicize successful quality strategies. Covers the following seven categories:

1. Leadership
2. Information and Analysis
3. Strategic Quality Planning
4. Human Resources
5. Quality Assurance
6. Results
7. Customer Satisfaction

Department of Defense: Total Quality Management (TQM)

- Quality is key to maintain level of readiness
- Quality is vital to our defense, requires a commitment by all personnel
- Quality is a key element of competition

Juran

- Attitude breakthrough
- Identify vital new projects
- Knowledge breakthrough
- Conduct the analysis
- Institute change
- Overcome resistance and institute controls

Philip Crosby (ITT): Quality is Free
Four absolutes of quality management:

1. Quality is conformance to requirements.
2. The system of quality is prevention.
3. The performance standard is zero defects
4. The measurement of quality is the price of nonconformance.

Fourteen steps to improving quality.

1. Management commitment
2. Quality improvement team
3. Measurement
4. Cost of quality
5. Quality awareness
6. Corrective action
7. Zero defects planning
8. Employee education
9. Zero defects day
10. Goal setting
11. Error cause removal
12. Recognition
13. Quality councils
14. Do it over again

Quality Concepts

- **Zero Defects** – implies that there is no tolerance for errors within the system. The goal of all processes is to avoid defects in the product or service. Similar to six sigma: almost zero defects
- **The Customer is the Next Person in the Process** - the internal organization has a system that ensures the product or service is transferred to the next person in the process in a complete and correct manner. The product or service being built is transferred to another internal party only after it meets all the specifications and all actions at the current work station. Avoids incorrectly assembled components and poor workmanship.
- **Do the Right Thing Right the First Time (DTRTRTFT)** - implies that it is easier and less costly to do the work right the first time than it is to do it the second time. Entails the training of personnel to ensure sufficient skills and tools to correctly complete the work.
- **Continuous Improvement Process (CIP)** (From Japanese word, Kaizen) - a concept which recognizes that the world is constantly changing and any process that is satisfactory today may well be unsatisfactory tomorrow. A sustained, gradual change to improve the situation.
- Differs from innovation -- does not make a sudden jump to a plateau where it matures over time.

Focuses on 11 principles:

1. Constancy of purpose
2. Commitment to quality
3. Customer focus and involvement
4. Process orientation
5. Continuous improvement
6. System-centered management
7. Investment in knowledge
8. Investment in teamwork
9. Conservation of human resources
10. Total involvement
11. Perpetual commitment

Rather than manage the output of the project, the focus is on managing the total process and subprocesses. The process is held constant only after it has been proven capable of the work. Hence, the product naturally meets the requirements.

Continuous Improvement Process (CIP) Steps

1. Define and standardize processes (and subprocesses).
2. Assess process performance.
3. Improve processes.
4. Measure progress.

Project Characteristics/Attributes that Bear on Quality

- Producibility (technology required) - ability of a product or service to be produced within the existing technology, human resources, skills, knowledge, and materials at a cost compatible with market expectations. Producibility is one of the most critical aspects of developing any new product.
- Usability (effort expended to use) - the ability of a product to perform its intended function for the specified user under the prescribed conditions. Usability is determined by examining performance, function and condition of a product.
- Reliability (Mean-Time-Between-Failure: MTBF) - the degree to which a unit of equipment performs its intended function under specified conditions for a specified period of time. Computed by 2 methods of Mean-Time-Between-Failure (MTBF):
    1. Predicted MTBF: based on a mathematical computation of a component failure using a tree diagram to determine sequential failure aspects of the component rated periods. Least desirable method because it cannot account for environmental variations that can degrade components to lower rates.
    2. Actual MTBF: base of field collected data to compute the failures under realistic operating conditions to find the average time between failure. The actual reliability will seldom be the same as the predicted reliability.
- Maintainability (Mean-Time-To-Repair: MTTR) - the ability of a unit to be restored within a specified time to its performance capability under the environmental operating conditions within a specified, average period of time.
- Availability (Probability of performance) - the probability of a product being capable of performing a required function under the specified conditions when called upon. The key parts of availability are reliability and maintainability.
- Operability (Expected conditional use) - the ability of a product to be operated by human resources for specified periods of time under given conditions without significant degradation of the output.

- Flexibility (Expected variable use) - the ability of a product to be used for different purposes at different capacities and under different conditions.

- Social Acceptability (Environment and safety) - the degree of compatibility between the characteristics of a product or service and the prevailing values and expectations of the relevant society. The degree to which a public accepts a product for use.
- Affordability (Return for quality required) - the ability to develop, acquire, operate, maintain, and dispose of a product over its life. The cost of each phase of ownership has a different value based on such items as design, manufacture, maintainability, reliability, and use. There must be a balance between the initial cost of a product and the operation and maintenance costs. For example: a $30,000 automobile with maintenance costs of 20 cents per mile may be considered more affordable than a $100,000 automobile with maintenance costs of 1 cent per mile or a $5,000 automobile with maintenance costs of $2 per mile.

Cost of Quality (from Quality Management by Ireland)

Cost of quality is the total price of all efforts to achieve product or service quality. This includes all work to build a product or service that conforms to the requirements as well as all work resulting from nonconformance to the requirements.

Quality programs also have costs that are not apparent. The general categories of additional direct costs include:

- Cost to build right the first time
- Training programs
- Statistical Process Control (SPC) Costs

Cost of a quality system is often viewed as a negative cost because errors in work have been traditionally accepted as a cost of doing business.

Cost of Conformance

- Planning
- Training and indoctrination
- Process control
- Field testing
- Product design validation
- Process validation
- Test and evaluation
- Inspection/Quality audits
- Maintenance and calibration

Cost of Nonconformance

- Scrap / Rework
- Expediting
- Additional material or inventory
- Warranty repairs or service
- Complaint handling
- Liability judgments
- Product recalls / Product corrective actions

Cost of Non-Quality

- Cost of non-quality is estimated to be 12-20% of sales versus the “should cost” of 3-5% of sales for a quality program.
- Waste of time and materials
- Rework of poor quality products and additional material for rework
- Delays in schedule
- Product and service image
- Corporate image

Major Cost Categories of Quality

- **Prevention Cost** - cost to plan and execute a project so that it will be error-free.
- **Appraisal Cost** - cost of evaluating the processes and the outputs of the processes to ensure the product is error-free.
- **Internal Failure Cost** - cost incurred to correct an identified defect before the customer receives the product.
- **External Failure Cost** - cost incurred due to errors detected by the customer. This includes warranty cost, field service personnel training cost, complaint handling, and future business losses.
- **Measurement and Test Equipment** - capital cost of equipment used to perform prevention and appraisal activities.

Opportunities for Reducing Cost

- Just-in-Time - concept of zero inventory in a manufacturing plant. Reduces cost of storing and moving parts; cost of inventory; cost of parts damaged through handling, etc.
- Product Life Cycle Cost - concept of reducing overall product life cycle cost by linking the cost areas of the product life cycle (R&D, acquisition, and operations and maintenance) and considering each one’s cost implications for the other.
- Product Maturity - Identifying, documenting, and correcting failures early helps products achieve stability earlier in the life cycle. (see Ireland, IV-9)

Statistical Quality Control

Method used to measure variability in a product for evaluation and corrective actions. Normal Distribution Curve or Bell Curve

Six standard deviations (+/-3 Sigma) encompass 99.73% of area
Four standard deviations (+/- 2 Sigma) encompass 95.46% of area
Two standard deviations (+/- 1 Sigma) encompass 68.26% of area

Sigma = Standard Deviation

Quality Control Systems

Process Control Charts - Statistical techniques used for monitoring and evaluating variations in a process. Identifies the allowable range of variation for a particular product characteristic by specifying the upper and lower bounds for the allowable variation. Upper Control Limit (UCL), Lower Control Limit (LCL), process average: the mean of the averages for the samples taken over a long period of time.

Visual patterns indicating out-of-control state or a condition that requires attention:

1. Outliers: a sample point outside the control limits (also referred to as out-of-control)
2. Hugging control limit: a series (run) of points that are close to a control limit. Requires correction to prevent data points from going outside the control limit. Rule of Thumb: Considered abnormal if two of three, three of seven, or four of ten data points fall within the outer one-third of the chart.
3. Cycle: A repeating pattern of points.
4. Trend: A series of consecutive points which reflect a steadily increasing or decreasing pattern. Rule of Thumb: Considered abnormal when seven or more consecutive data points reflect a steadily increasing or decreasing pattern.
5. Run: A series of 7 or more consecutive points (observations) fall on the same side of the average (mean) (Ireland V-6, V-7) Rule of Thumb: Considered abnormal if seven consecutive points, ten of eleven, or twelve of fourteen data points are above or below the process average.

Acceptance Sampling - Used when expensive and time-consuming to test 100%. Random sampling may be used to check the characteristics and attributes of a given lot of goods. Determines whether or not the lot conforms to the specifications or standards necessary to support the overall project requirements. Inspection and test standards must be established to ensure that procedures are adequate to determine whether a lot is conforming or nonconforming to specifications. Standards must also be set for qualification of the sampled lot. Important to select a sample size that will provide sufficient information about the larger lot of goods without costing a great deal of money. Must determine in advance the number of allowable defects before the lot is rejected.

Quality Management Tools

- Histograms - Shows frequency of occurrence of items within a range of activity. Can be used to organize data collected for measurements done on a product or process.
- Pareto Diagram - Ranks defects in order of frequency of occurrence to depict 100% of the defects. (Displayed as a histogram). Defects with most frequent occurrence should be targeted for corrective action. 80-20 rule: 80% of problems are found in 20% of the work. Does not account for severity of the defects.
- Cause and Effect Diagrams (fishbone diagrams or Ishikawa diagrams) - Analyzes the inputs to a process to identify the causes of errors. Generally consists of 8 major inputs to a quality process to permit the characterization of each input.
- Scatter diagrams - Used to determine the relationship between two or more pieces of corresponding data. The data are plotted on an “X-Y” chart to determine correlation (highly positive, positive, no correlation, negative, and highly negative)

Other Tools – Graphs, Check sheets (tic sheets) and check lists, and Flowcharts

Quality and People in Project Management

Management defines type and amount of work. Management is 85% responsible for quality. The employee can only assume responsibility for meeting the requirements of completing the work when the employee:

- Knows what’s expected to meet the specifications
- Knows how to perform the functions to meet the specifications
- Has adequate tools to perform the function
- Is able to measure the performance during the process
- Is able to adjust the process to match the desired outcome

Project quality team consists of:

- Senior Management
- Project Manager
- Project Staff
- Customer
- Vendors, suppliers, and contractors
- Regulatory Agencies

Project Manager has the ultimate responsibility for Quality Control and Quality Assurance. Customer sets the requirement for acceptable quality level.

Reviews & Audits

Management reviews determine the status, progress made, problems, and solutions. Peer reviews determine whether proposed or completed work meets the requirements. Competency center reviews are used to validate documentation, studies, and proposed technical solutions to problems.

Fitness reviews and audits determine the fitness of a product or part of a project. (addresses specific issues).

The collection of quantitative data for statistical analysis is the basis for proactive management by FACT rather than by EXCEPTION. Management by exception lets errors and defects happen before management intervention.

Sample Questions

1. The process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards is called:
    a. Quality Assurance
    b. Quality Control
    c. Quality Planning
    d. Quality Review

2. The process of monitoring specific project results to determine if they comply with relevant quality standards is called:
    a. Quality Assurance
    b. Quality Control
    c. Quality Planning
    d. Quality Review

3. A histogram ordered by frequency of occurrence that shows how many results were generated by each identified cause is:
    a. Statistical Histogram
    b. Juran Histogram
    c. Fishbone Diagram
    d. Pareto Diagram

4. Tools and techniques used during the Quality Planning process include:
    a. Benefit/cost analysis
    b. Benchmarking
    c. Quality audits
    d. a and b

5. Top management's overall intentions and direction with regard to quality is formally expressed in the:
    a. Quality Plan
    b. Quality Statement
    c. Quality Policy
    d. TQM

6. Continuous improvement process is:
    a. Synonymous with innovation
    b. A sustained, gradual change
    c. A substantial change which matures over time
    d. The same as DTRTRTFT

7. The practice of ceasing mass inspections and ending awards based on price is credited to:
    a. Edward Deming
    b. Philip Crosby
    c. Juran
    d. Pareto

8. Which of the following are costs of quality?
    a. Product design and process validation
    b. Quality planning
    c. Scrap, rework, product recalls, and warranty repairs or service
    d. All the above

9. The concept of making a giant leap forward followed by a period of maturity is:
    a. Innovation
    b. Continuous improvement
    c. Just in time
    d. Paradigm

10. The concept that it is easier and less costly to do the work right the first time is called:
    a. Zero defects
    b. Continuous improvement
    c. DTRTRTFT
    d. The customer is the next person in the process

11. The ability of a product to be used for different purposes at different capacities and under different conditions determines its:
    a. Usability
    b. Flexibility
    c. Operability
    d. Availability

12. Which of the following is not considered a cost of nonconformance to quality?
    a. Scrap
    b. Rework
    c. Expediting
    d. Process control

13. Which of the following statements is false?
    a. The cost of quality is the total price of all efforts to achieve product or service quality.
    b. The cost of non-quality is all expenditures that waste time, motion, material or other valuable resources.
    c. Having an “acceptable quality level” such as an allowable defect rate is an example of a quality cost.
    d. Acceptance of the extra burden of non-quality costs as a “cost of doing business” can materially affect the profit of a project.

14. Which of the following statements regarding grade and quality is/are true?
    a. The terms are synonymous.
    b. Grade is a rank given to entities having the same functional use but different characteristics while quality refers to the characteristics of an entity that bear on its ability to satisfy stated or implied needs.
    c. Low quality and low grade are always considered problematic.
    d. B and C

15. A series of consecutive points on the same side of the average is called:
    a. A run
    b. A trend
    c. An outliner
    d. A cycle

16. Which of the following statements concerning acceptance sampling is true?
    a. Acceptance sampling is used when it is expensive and time-consuming to test the product 100%.
    b. Inspection and test standards must be established to ensure that procedures can adequately determine conformance and nonconformance.
    c. If the number of defects found in the sample exceeds the predetermined amount, the entire lot is rejected.
    d. All of the above are true

17. The philosophy that the majority of defects are caused by a small percentage of the identifiable problems can be contributed to:
    a. Edward Deming
    b. Philip Crosby
    c. Juran
    d. Pareto

18. A structured tool, usually industry or activity specific, used to verify that a set of required steps has been performed is called:
    a. Quality Policy
    b. Check list
    c. Trend analysis
    d. Pareto diagram

19. A tool that analyzes the inputs of a process to identify the causes of errors is called:
    a. Cause and effect diagram or Ishikawa diagram
    b. Scatter diagram
    c. Trend diagram
    d. Pareto diagram

20. The concept of zero inventory is called:
    a. Six sigma
    b. Continuous improvement
    c. Just in Time
    d. Zero defects

21. Design of experiments is a statistical technique that helps:
    a. Determine how various elements of a system interrelate
    b. Anticipate what and where quality problems might occur
    c. Identify which factors might influence specific variables
    d. Establish a standard by which to measure performance

22. Which of the following statements about the cost of quality is/are true?
    a. The costs of quality are mostly the direct responsibility of workers who are
    b. manufacturing the product.
    c. The cost of quality is the cost of conformance and non conformance to the
    d. requirements and specifications.

23. Quality control charts are used for the:
    a. Monitoring and subsequent evaluation of process variations
    b. Determination of which projects to kill
    c. Activity known as curve fitting or least squares
    d. Lot rejection ratio

24. A Pareto diagram is most useful for:
    a. Identifying nonconformity types
    b. Providing an evaluation of data at a single point in time
    c. Determining where to focus corrective action
    d. Accepting or rejecting a production lot

25. In ISO 9001 terminology, the quality management plan should do which of the following? (choose best answer)
    a. Describe the expected grade of the project product
    b. Describe the terms and conditions of the contract
    c. Describe the project quality system
    d. Describe the degree of acceptable nonconformance to quality

26. Quality Planning is:
    a. Identifying which quality standards are relevant to the project and determining how to satisfy them
    b. Preparing the design to the customer's specifications
    c. Monitoring the project results to decide if the outputs fulfill the requirements
    d. Determining the necessary quality sampling techniques

27. The continuous quality improvement process is a concept that states: (choose the best answer)
    a. The customer is the most important aspect of a quality product
    b. The work is continuously changing and that any procedure or process that is satisfactory today, will more than likely become unsatisfactory in the near future
    c. To succeed in business; it is important to retain customers and for them to have a willingness to repurchase
    d. The customer is driving the need to improve quality

28. The rule of seven:
    a. States that a batch should be rejected if there are seven consecutive rejects
    b. States that seven consecutive observations on one side of the mean indicates a batch should be rejected
    c. Means that a minimum sample size of seven should be taken
    d. States that seven consecutive observations on one side of the mean is highly improbable

29. Which of the following is a tool and technique used in quality assurance process?
    a. Design of experiments
    b. Continuous improvement
    c. Quality audits
    d. Inspections

30. Process Adjustments:
    a. Are actions taken to bring a conforming item into compliance
    b. Involve immediate corrective or preventive action as a result of quality control measurements
    c. Are reviews used to validate documentation, studies, and proposed technical solutions to problems
    d. Are acceptance plans and processes for making decisions

Answers

1. A, PMBOK Guide, pg. 95
2. B, PMBOK Guide, pg. 95
3. D, PMBOK Guide Glossary
4. D, PMBOK Guide, pg. 96 Quality audits are used during Quality Assurance
5. C, Ireland, pg. C-8
6. B, Ireland, pg. I-6
7. A
8. D, Ireland, pgs. IV-1 thru IV-2 The cost of quality includes all work to build a product or service that conforms to the requirements as well as all work resulting from nonconformance to the requirements.
9. A, Ireland, pg. I-6
10. C, Ireland, pg. I-5
11. B, Ireland, pg. II-4
12. D, Ireland, pg. IV-2, Process Control is a conformance cost.
13. C, Ireland, pgs. IV-2 and IV-11. Having an allowable defect rate is an example of the cost of non-quality. Any system or process that will accept defects adds cost to the product or service.
14. B, PMBOK Guide, pg. 96 Low quality is always a problem; however, low grade in itself is not necessarily a problem.
15. A, Ireland, pg. V-7
16. D, Ireland, pgs. V-7 thru V-8
17. D, Ireland, pg. C-6
18. B
19. A, Ireland, pg. V-11
20. C, Ireland, pg. IV-7
21. C, PMBOK Guide, pg. 99
22. B, Ireland pg. C-2
23. A, Ireland pg. V-3
24. C, PMBOK Guide, pg. 103
25. C, PMBOK Guide, pg. 99
26. A, PMBOK Guide, pg. 95
27. B, Ireland pg. I-6
28. D, Ireland pg. V-6. The probability of seven consecutive observations falling on one side of the mean is (0.5) ** 7 = .78%.
29. C, PMBOK Guide, pg. 96
30. B, PMBOK Guide, pg. 104

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