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For the Project Management Professional[®]

Your Key to PMP Certification and Understanding the PMBOK® Fourth Edition

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CHAPTER 8: QUALITY MANAGEMENT



Keywords

- □ Accuracy
- □ Affinity diagram
- \Box Attribute sampling
- □ Brainstorming
- □ Benchmarking
- □ Cause and effect diagram
- \Box Common cause
- □ Continuous improvement
- \Box Control chart
- \Box Control limits
- \Box Cost of quality
- □ Cost-benefit analysis
- \Box Crosby
- □ Deming
- □ Design of experiments
- □ Flowchart
- \Box Force field analysis
- □ Grade
- □ Histogram
- □ Inspection
- □ Ishikawa
- □ ISO 9000
- □ Juran
- □ Marginal analysis
- □ Matrix diagram
- \Box Mutually exclusive

- □ Nominal group technique
- \Box Pareto chart
- \Box Precision
- \Box Prevention
- \Box Process analysis
- □ Process improvement plan
- □ Quality
- \Box Quality assurance
- \Box Quality audits
- \Box Quality baseline
- \Box Quality checklists
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- □ Quality management plan
- \Box Quality metrics
- \Box Rule of Seven
- □ Run chart
- □ Scatter diagram
- \Box Shewhart
- □ Six Sigma
- \Box Special cause
- \Box Standard deviation
- \Box Statistical sampling
- □ Statistically independent
- \Box Tolerances
- □ Total Quality Management
- □ Variable sampling

CHAPTER 8: QUALITY MANAGEMENT



Project Quality Management is comprised of three processes:

- Plan Quality: Establish and plan for meeting project quality requirements.
- **Perform Quality Assurance:** Ensure the project is meeting the requirements established in the project quality management plan.
- **Perform Quality Control:** Make sure the deliverables are meeting their quality requirements.

Activities performed in the project quality management processes ensure the project's product, service, or result meets the requirements for which the project was undertaken, the expectations of the customer, and that the project's activities are efficiently executed. Because a project is only one component of larger endeavors, quality management has to stretch beyond the project's boundaries, so project quality management is concerned not just on the deliverables the project is creating but on the management of the project itself and of the processes used by the activities performed within the project. While product quality improvement efforts primarily benefit the customer through lower product costs, benefits from process improvements are reaped by the performing organization both within and outside the project through better work processes.



Quality management and project quality management complement each other in that they both stress:

- **Customer satisfaction:** Quality is all about meeting the expectations and requirements of the customer and stakeholders and creating a product that fulfills those needs and is fit for its intended use.
- **Prevention:** Quality is achieved by planning, designing, and building it into a product or process from the inception.
- Management responsibility: It's up to the project team to ensure the success of quality efforts but it is up to organizational management to provide the financial resources needed for quality efforts to succeed.
- **Continuous improvement:** Quality and process improvement relies on the ongoing plan-docheck-act cycle.

Quality overview

But before we can jump into these processes and what they do, we need to first make sure we understand just what *quality* and *grade* refer to. **Quality** is "the degree to which a set of inherent characteristics fulfill requirements"¹ while **grade** is "a category assigned to products or services having the same functional use but different technical characteristics."²

We generally think of quality as embodying a superior property, such as this brand of laundry detergent is better quality than another brand. But grade is separate from quality, and the two are often mistakenly confused. Grade is largely determined by characteristics while quality is based on meeting expectations, so we can have a low-grade product that is high quality or vice-versa a high-grade product that is low quality.

Because quality is based solely on fulfilling a customer's explicit and implicit requirements, different customers will have a different view of what quality is. For example, if we have only \$10 to spend on a bouquet of flowers then our expectations are probably in the neighborhood of a lower grade of flowers, such as a bouquet of daisies. But on the other hand, if we're willing to spend \$100 then we're probably The blunt reality of business is that basic customer satisfaction is no longer adequate for businesses to remain successful. Basic satisfaction simply means that they might use your services in the future --unless a better offer comes up. Satisfaction is little more than the absence of dissatisfaction, and there's no glory in just squeaking by.³

Craig Cochran, author of *Customer Satisfaction: Tools, Techniques* and Formulas for Success and The Continual Improvement Process.

going into the flower shop looking for high-grade flowers like long-stemmed roses. Let's imagine that we bought both, but after only one day the roses faded and began to droop; however, the daisies lasted for a whole week. We probably expected the roses to last longer than a day, so they failed to live up to our quality expectations while the daisies exceeded our expectations. So the lower grade product was high quality, and the higher grade product failed our expectations, and so was of lower quality.

The difference between grade and quality is important because it's the responsibility of the project management team in collaboration with the stakeholders to determine what the required levels of both will be and then developing a plan for quality that ensures those requirements are met while ending up with a product, service, or result that is fit for the customer's intended use.

Quality pioneers

Crosby

Phillip B. Crosby was a businessman and author who wrote 12 books on quality. His first book in 1979, Quality Is Free, was widely read and popular in the 1980s. His book included DIRFT (do it right the first time) and four major principles:

- quality is "conformance to requirements"
- the system of quality is prevention
- the performance standard is zero defects
- the measurement of quality is the price of nonconformance

Feigenbaum

Armand V. Feigenbaum wrote the 1951 book, Quality Control: Principles, Practice, and Administration. He was the first to write about quality costs as the costs of prevention, appraisal, and internal and external failure.⁵

Deming

William Edwards Deming developed new sampling techniques while working on the 1940 U.S. census. He was later involved in the 1951 Japanese Census, and it was in Japan that he began to train engineers, managers, and scholars in statistical process control and quality concepts.

Deming's primary message to Japanese companies was that improving quality will reduce expenses while increasing productivity and market share.⁴ In the post-WWII environment, Japanese industry eagerly adopted Deming's processes. The quality of Japanese products drastically improved over the decades, and by the late 1970s U.S. companies sought Deming out to help them turn around their own quality problems.

Ishikawa

Kaoru Ishikawa pioneered quality management processes at the Kawasaki shipyards in Japan. He's best known for the cause-and-effect diagram that bears his name (Ishikawa diagram), but his contributions to quality management also include involving senior management in quality efforts and showing the importance of the seven basic quality tools. Ishikawa also expanded Deming's Plan-Do-Check-Act Cycle into six elements⁶:



Juran

Joseph Juran was one of the most enthusiastic advocates of quality. His 1951 handbook Quality Control Handbook excited many post-World War II Japanese companies. In 1954 Juran met with many Japanese companies and started courses in quality management.

While Deming was seen as focusing more on statistical quality control, Juran focused on training managers for quality. He's often seen as introducing the human element into quality management, and he developed the "Juran trilogy," which is a management approach consisting of three processes: planning, control, and improvement.⁷

Shewhart

Walter A. Shewhart was a statistician and is referred to as the father of statistical quality control⁸. Shewhart introduced the concept of modern process quality control while working with Western Electric to improve the reliability of Bell Telephone's transmission systems.⁹

Taguchi

Gen'ich Taguchi was a statistician who worked with Walter A. Shewhart in the mid-1950s. Taguchi concentrated on quantifying losses from process variations, and he introduced a number of innovations used in design of experiments (DOE).

Quality management and process improvement approaches

The PMBOK project quality processes are compatible with other quality management approaches. It's necessary for the project team to have a general understanding of different quality management approaches for a couple of reasons. The first is because when projects are performed for external customers, the customer may require project quality management to align with its own organizational practices. The second is that when a performing organization doesn't have a formal quality management methodology or there are multiple methodologies in place because several organizations are involved in the project, it's up to the project team to develop their own quality policy for the project.

Total Quality Management (TQM)

Overview: TQM embeds awareness of and participation in quality activities throughout all of an organization's processes and its business, management, and culture. TQM aims to provide increased customer satisfaction at ever lower costs.

History: Armand Fiegenbaum introduced the concept of Total Quality Control in his 1951 book, *Quality Control: Principles, Practice, and Administration.* Over time, Fiegenbaum's idea evolved through the efforts of W. Edwards Deming, Joseph Juran, Phillip B. Crosby, and Kaoru Ishikawa into Total Quality Management.

...TQM is not some passing fad; many companies which could benefit have yet to give the plan a real trial. Some proponents of TQM may only be making half-hearted efforts or doing what could best be described as PQM, or "Partial Quality Management."⁹

Daiv Russell, management and marketing consultant with Envision Consulting.

TQM continues to evolve and is embedded in other management practices.

Philosophy:

Five basic principles involved in TQM

- 1. Management commitment
- 2. Employee empowerment
- 3. Fact-based decision-making
- 4. Continuous improvement
- 5. Customer focus

Main TQM Elements

- Deming's Plan-Do-Check-Act Cycle drives the TQM process.
- Quality must be managed.
- Everyone is a customer to someone, and is a supplier to somebody.
- Processes, not people, are the problem.
- Everyone within an organization is responsible for quality.
- Problems must be prevented and not just fixed.
- Quality improvements must be continuous.
- Quality goals are based on requirements and can't be compromised.
- Life-cycle costs are what should be considered and not front-end costs.
- Management must lead and support quality efforts.

Six Sigma

Overview: Six Sigma focuses on continuous efforts to remove the causes of defects and variances within processes. Efforts are driven by quantifiable and measureable results and passionate leadership. In Six Sigma, a *defect* is anything that can lead to customer dissatisfaction. Six Sigma is also inspired by Deming's Plan-Do-Check-Act Cycle.

...we require all our IT people to be trained in Six Sigma and to be Six Sigma green belts...If you think about what IT people do in our model, they are project leads and business analysts. Six Sigma is about leading projects, doing analysis and process improvement.¹⁰

Gail Farnsley, CIO, Cummins

History: Six Sigma was first conceived and

formulated by Bill Smith at Motorola.¹¹ Though originally used in the manufacturing sector, Six Sigma is used in all types of businesses.

Philosophy: There are two core methods of Six Sigma. One for improving existing processes or products and a second for creating new processes or products.



ISO 9000

Overview: The International Standards Organization developed the ISO 9000 to help make sure that companies follow their own proscribed processes.

The ISO 9000 standard can be used by any company or industry. What we collectively refer to as ISO 9000 actually contains three quality standards: ISO 9000:2005, ISO 9001:2000, and ISO 9004:2000. ISO certification (e.g., ISO 9001) is not a guarantee in itself of compliance to quality processes.

History: The first ISO 9000 version was completed in 1987 and has undergone several revisions.

Philosophy: The ISO 9000 standard has eight principles:

- Customer focus
- Leadership
- Involvement of people
- Process-based approach

...many organizations like to think of themselves as unique. So how does ISO 9001:2000 allow for the diversity...The answer is that ISO 9001:2000 lays down what requirements your quality system must meet, but does not dictate how they should be met in any particular organization. This leaves great scope and flexibility for implementation in different business sectors and business cultures, as well as in different national cultures.¹²

International Standards Organization, ISO 9000 Essentials

- System approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial supplier relationships

Failure Mode and Effect Analysis (FMEA)

Overview: Failure mode and effect analysis looks for potential or actual defects in a process or product and studies their consequences.

History: FMEA was originally used in the military in the 1940s, used by NASA in the 1960s, and by Ford Motor Company in the 1970s¹³. The updated FMEA procedures published in the MIL-STD-1629A document are those generally accepted in both military and commercial industries.

Philosophy: FMEA starts with a process diagram and a thorough analysis. Actual or potential failures are then identified and their severity, number of occurrences, and how likely they are to be detected are logged onto a matrix. Failures are then ranked by risk, and actions are identified to mitigate or prevent failures and improve early detection.

Quality Function Deployment (QFD)

Overview: QFD aims to link the needs of the customer with all production components, such as design, development, engineering and manufacturing. Quality Function Deployment uses elements of systems thinking, psychology, and epistemology to uncover explicit and unspoken customer needs and identifying business opportunities.

History: QFD was started by professors Shigeru Mizuno and Yoji Akao in Japan in the 1960s¹⁴. Though originally developed for manufacturing industries, QFD was adopted by in the 1980s by other industries, including software development and service industries.



Philosophy: In very general terms, QFD follows four phases to develop a house of quality. The HOQ is matrix that represents the relationships between items in the matrix, and includes "rooms," such as customer requirements, technical requirements, and targets.

Capability Maturity Model Integration (CMMI[®])

Overview: CMMI[®] provides a framework that focuses on improving business processes by establishing best practices and then appraising those organizations on a maturity level from one to five. A higher maturity level indicates that an organization's practices are more likely to be efficient and quality-focused.

History: CMMI[®] was developed by a consortium of experts from Carnegie Mellon University, industry, and the U.S. government. There are currently three CMMI models that have been released between 2006 and 2009.

Philosophy: Organizations undergo appraisals to determine their CMMI compliance and be awarded a maturity level rating.



- 1. Initial: The procedures for managing the process are reactive in nature rather than proactive.
- 2. Managed: The process is managed through isolated projects or similar efforts.
- 3. Defined: The process is tailored towards organizational needs rather than just being focused on isolated projectized objectives.
- 4. Quantitatively Managed: The process is aggressively measured and controlled.
- 5. Optimizing: There are concerted and ongoing efforts focused on improving the process.

Organizational quality

There is not a single best quality methodology that applies to all organizations, and each company will have its own unique approach based on its priorities, culture, industry, and environment. And just like a project management methodology, it doesn't simply spring up overnight. It takes the commitment of senior management and ongoing efforts by everyone to reach a high quality management maturity level. Each organization will be at different maturity stages, which impacts what organizational processes and procedures the project team can draw from in developing its project quality policy.

Many mature quality management organizations will have a **quality management system** (QMS), which is the set of quality policies, procedures, and processes, that is thoroughly integrated into the development, production, manufacture, and service of its products. A QMS is a required element of ISO certification.

Certainty	Quality Management	QMS, organizational philosophy and culture built on quality, employee involvement, quality teams
Wisdom	Quality Assurance	Quality systems,measurements, quality processes, audits, large-scale process improvement efforts, formal quality department or focused teams
Enlightenment	Quality Control	Prevention and inspection efforts combined into formal QC, emphasis on prevention of nonconformance issues among many business units
Awakening	Prevention	Efforts are more focused on prevention activities than on inspection activities; awareness and cooperation among business units
Uncertainty	Inspection	Detection of nonconformance after it's occurred, focus is on correction of nonconformance and less on prevention

In his 1979 book, *Quality is Free*, Phillip Crosby used the Quality Management Maturity Grid (QMMG) to show the traits and characteristics of organizations as they proceed from a low to a high maturity level. In the accompanying illustration, the QMMG levels are shown side-by-side with the main efforts in project quality management. In Crosby's model, companies proceed from a level of uncertainty (not knowing that quality problems exist) to a level of certainty (knowing not just that quality problems exist but what causes them).

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CHAPTER 8: QUALITY MANAGEMENT



This process is performed by the project management team, and it's done in parallel with other project planning processes because the underlying approach is that quality is planned, designed, and built into the project and not something that is added on later.

The Plan Quality process results in:

- quality metrics
- quality checklists
- the project quality baseline
- the process improvement plan
- the project quality management plan.

Quality metrics are the specific quality goals the project must meet and how the quality control processes will confirm compliance. Quality metrics can include any type of applicable measurement, including defect rates, bug rates, failure rates, up-time, reliability, and coverage area.

Quality checklists are documents that outline the key steps that must be performed as part of quality control. Checklists are "to-do" lists that ensure that everything is performed and in the correct order. The quality checklists that will be used later during the quality control process are developed here.

The **project quality baseline** is the agreed upon level of quality requirements the project must meet. It's the quality objectives of the project and the subsequent plan for achieving those objectives. In other words, the quality baseline is the current project quality management plan which itself reflects all approved changes affecting quality.

Process improvement plan

The **process improvement plan** is integral to quality management's focus on continual improvement, and it details the steps that will be taken to analyze the project processes and eliminate waste and improve the efficiency of processes. This is accomplished by streamlining processes and eliminating non-value added activities, which will occur during the Perform Quality Assurance process.

Continuous improvement:

- benefits the customer by providing a more cost efficient project deliverable
- benefits the project by facilitating more productive processes
- benefits the project team by reducing inefficient activities thus allowing the team members to focus on value-added efforts

The common assumption is that continuous improvement is small scale and that innovation is discontinuous and large scale. Yet there is no logical reason to associate the term *innovation* with large-scale discontinuous change...Put more bluntly, there is plenty of innovation that occurs in the course of continuous improvement.¹⁵

Robert Cole, University of California-Berkley

 benefits the performing organization beyond the project life cycle through lower costs and a better use of resources. Processes are interrelated sets of activities involving people, systems, and information, whose purpose is to achieve some kind of result. Processes drive all business functions, from manufacturing a product to back-office functions like accounts payable, and the great number of processes involved in a project precludes each and every one from being fully analyzed. The project team needs to establish the logic behind what processes will be fully analyzed.

The process improvement plan will include:

Process characteristics and boundaries:

A description of the process.

What the policies are behind the process (what its purpose is, when it's to be performed, and why it's needed).

The roles involved in the process, including the process owner and process stakeholders.

The starting and ending points of the process.

The information or data it requires.

The process inputs and outputs.

The activities involved in the process

Its relationships or dependencies to other processes.

Process configuration:

A visual rendering, such as a flowchart, process map, or activity diagram, of the process illustrating all major systems, components, relationships, and process interfaces.

Process metrics:

The measurements that will be performed against the process. Compiling measurements against a process can often be tedious and difficult, so whenever possible it's best to incorporate some automatic means of measurement collection within the process.

Process improvement goals:

The specific goals for process improvements, including what the targets will be and how will they be measured.

Quality management plan

The quality management plan is part of the project management plan, and the quality activities in it are executed during the Perform Quality Assurance process. The **quality management plan** establishes the project's quality policy and describes how the project team will implement that policy through continual improvement activities, quality assurance activities, and quality control activities. The performing organization's quality policy is the foundation upon which the project's quality management plan is built. The project scope statement provides the deliverable requirements, and since quality is about fulfilling the customer's requirements, the scope statement and stakeholder register are the source for those needs and expectations.

Organizations with a mature quality management approach will likely have a quality department that can provide assistance to the project management team. But there are two common challenges the project management team may face when beginning quality planning. The first is that the performing organization may not have quality policy, and the second situation is when there are several organizations involved in project activities and each has its own quality policy. In either of these situations, it's up to the project management team to draft an agreeable quality policy for the project. This means that the project management team needs to have a good knowledge of overall quality management and its application to the type of project being undertaken. When no organizational quality policy exists, developing a project quality policy can take some time, but the extra effort can also benefit subsequent projects by providing a growing library of templates that they can draw from.

Once drafted the quality management plan undergoes some approval process. The acceptance of the quality management plan establishes the **quality baseline** for the project. This baseline is what level of quality the project and its product, service, or result will meet. The project's size, scope, complexity, and application area are some factors that determine how extensive and formal the approval needs to be. On some projects this may involve only the project management team while on others the customer, stakeholder, and company management might be involved.

Quality planning tools

Quality planning tools help to determine both the content of and activities that will be taken while implementing the process improvement and project quality management plans. These tools also have many uses beyond quality and can be used for product analysis, process analysis, alternatives identification, and risk analysis.



Cost of quality

Quality involves costs, and the **cost of quality** quantifies this cost. The cost of quality has two main components –the cost of conforming to quality requirements and the cost of not conforming to quality requirements.

Cost of Good Quality (cost of conformance)

- Prevention Costs
- Quality management activities, such as training and process documentation, and checklist development.

Appraisal Costs

- Quality assurance activities, like appraisals and audits
- Quality control activities, like testing and inspections.

A widely used and accepted rule of thumb in the construction industry suggests that a quality problem costing \$100 to fix in the field would cost only \$10 to fix if discovered during design and cost just \$1 to have been prevented in the first place.¹⁶

Richard Smith, Is An Ounce of Prevention Really Worth a Pound of Cure

Cost of Poor Quality (cost of nonconformance) Internal Failure Costs

 Failures found by the project team, including the costs related to rejects, rework, delays, shortages, scrap, and other inefficiencies.

External Failure Costs

 Failures found by the customer, including costs related to warranties, returns, lost sales, and lost good will



Cost of Nonconformance

Many conformance costs are easy to measure since they can be tracked and quantified, but much of the costs of nonconformance can be difficult to determine, such as lost sales or a tarnished reputation due to poor quality.

Cost-benefit analysis

As it relates to quality, **cost-benefit analysis** helps to determine the appropriate trade-off between quality and the cost to achieve that level of quality. The goal of meeting the quality requirements is to reduce costs through less rework and higher productivity, but there are costs associated with meeting the quality requirements, and what we want to find is the agreeable level between quality requirements and the costs associated with meeting those requirements. And just as we avoided gold-plating the scope, we likewise

want to avoid gold-plating the quality requirements. Exceeding the customer's quality requirements results in quality costs incurred by the project that provide no real benefit to the customer.

Another purpose of cost-benefit analysis is related to continual improvement. As we strive for improving products and processes, we don't want to exceed a point beyond which the costs of the improvements aren't offset by the anticipated increase in revenue (sales or profits). This type of analysis is called **marginal analysis**.



Benchmarking

Benchmarking compares similar processes between different organizations, helping to generate ideas for

improvement and to provide a measurement basis by helping the organization determine what the "standard" is. Benchmarking can also help process reengineering by introducing new approaches to existing processes.

Technique:

• Identify the process, problem or issue to be addressed.

To benchmark effectively, it isn't always necessary to find a similar company or one within the same industry. "It's a matter of understanding that even companies or industries that are different can have similar core processes or common characteristics."¹⁷

Brian Andes, Director of Business Process Improvement, Tenneco, Inc.

- Benchmarking doesn't have to be formal to be effective --it can be as simple as sharing practices with others through a PMI chapter meeting.
- Find other companies that have a similar process, including researching public information on what companies have a reputation for "best in breed."
- Approach personnel from those companies --share the current process and ask them how they handle it. If applicable, survey trade group members (such as through newsgroups, user groups, or online community forums).
- Incorporate the new ideas learned and brainstorm to develop a new strategy for the process, problem, or issue.
- Implement the new process or practice, and follow up by measuring the results and adjusting the process as needed.

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Brainstorming

Brainstorming is a general term applied to a large number of different techniques in which group members spontaneously share ideas, often to find alternative approaches and solutions to problems. To get a better pool of ideas to choose from, brainstorming sessions should include a diverse group because a mix of participants with different backgrounds, experiences, and skills.

Technique:

A facilitator poses an objective to the group. The facilitator wants to encourage participants to think broadly about the problem and not focus too narrowly on ideas or solutions, and during the first part of the session, there shouldn't be any evaluation or criticism of any ideas mentioned. The facilitator should record all suggestions. After sufficient time has elapsed, the group turns towards categorizing, combining, and refining the list, and then analyzing the revised list of ideas. Eventually the suggestions will be narrowed down further and prioritized, ending up with an action plan.

Statistical sampling

Statistical sampling is a general term that applies to many different statistical techniques that look at a subset of a population in order to determine a measurement sampling. Depending upon the industry or project area, significant knowledge about probability and statistical techniques may be required by the project team.

Control charts

A **control chart** is a type of run chart that is used to determine whether a process is in control or out of control. A run chart is a line graph that displays measurements taken over time, and with the addition of upper and lower control limits, the chart shows at what points in time measurements exceeded thresholds, which aids in finding the root causes of anomalies.



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Design of experiments

Traditional experimentation usually involves changing one factor at a time and then analyzing the result. But that is time consuming and it doesn't take into account the interplay that may be going on between multiple factors. **Design of experiments** is a statistical method that can help make processes and products more efficient by mathematically simulating changes all at once to the variables affecting the process. The results can then be viewed to see how the changed factors not only influence the end result but how the factors relate to each other.

Flowcharting

A **flowchart** is a graphical representation of a process. There are a lot of different flowcharting approaches, but they all

show the sequencing of activities, relationships, branches, and decision points in a process.



Flowcharts help everyone to better understand a process by seeing it broken up into small, step-by-step components.

Affinity diagrams

An affinity diagram helps people address complex issues through brainstorming and data categorization. Affinity diagrams can be used to generate ideas, find identify issues. and relationships between factors contributing to an issue. Once categories are established, the affinity diagram can be used to prioritize items and develop an action plan.



How can we improve team performance?

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Technique:

- Identify the topic, problem, or issue.
- Choose a group facilitator.
- Brainstorm to generate ideas, potential solutions, or contributing factors.
- Sort the items into similar categories without too much initial thought.
- As themes begin to emerge, create "header" categories that establish the unifying relationships between items in the columns.
- Continue finding ideas and categorizing them until ideas are exhausted and the columns are grouped into categories agreed upon by the group.
- Construct the final affinity diagram.

Force field analysis



Developed by social psychologist Kurt Lewin¹⁸, **force field analysis** aids in visualizing the pro and con forces involved in an issue or situation. The premise behind this technique is that a situation is held in equilibrium by two sets of opposing forces. *Driving forces* are those striving for change, and *restraining forces* are those desiring the status quo. A situation can change only when the strength of the driving forces exceeds the restraining forces. By concentrating on the core factors giving strength to the restraining forces, the desired change can proceed.

Nominal group technique

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Driving Forces

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Nominal group technique (NGT) is a brainstorming derivative developed by Van de Ven and Delbecq¹⁹ that involves not only group brainstorming but individualized brainstorming. It's useful for new groups where the members aren't yet familiar with each other, the issue is controversial, or there are group members who are more vocal than others. NGT starts out with each individual privately generating ideas which are then discussed with the group.

Technique:

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- Choose a group facilitator.
- Make sure the topic or issue is clearly understood.
- Allow several minutes for the group members to privately write down as many ideas as possible.

- Taking turns, each individual states his or her ideas to the group. At this point there is no discussion from the group on the idea. The idea presented can be from the person's list or a new one he or she just thought of.
- As ideas are presented, the facilitator writes the ideas down on a common list that's visible to all.
- Keep this up until all ideas are exhausted.
- Each idea is then discussed by the group. Wording may be changed or ideas stricken from the list if all of the group members agree. The facilitator needs to keep the discussion relevant, healthy, and objective during this step.
- From the modified list, the ideas are prioritized by some form of secret balloting.
- The items with the highest votes can then be used for further prioritization or as action items.

Matrices

Matrices are rows and columns of data, typically thought of as spreadsheets. Matrices are versatile tools that help analysis, decision-making, and prioritization. A **matrix diagram** shows relationships between factors, causes, and objectives and a **prioritization matrix** provides a way of scoring or ranking actions.

8.1 Process decomposition Tools & Techniques 1. Cost-benefit analysis 6. Statistical sampling 2. Cost of quality 7. Flowcharting 8. Proprietary quality management 3. Control charts 8. Proprietary quality methodologies 9. Additional quality planning 4. Benchmarking 5. Design of experiments 5.3 11.2 Identify Risks Create WBS Inputs Outputs 10.1 Identify Stakeholders 1. Scope baseline 8.2 Perform Quality Assurance 8.3 Perform Quality Control 2. Stakeholder register 8.1 7.2 Determine PLAN 3. Cost performance baseline Budget 8.3 Perform QUALITY 4. Schedule baseline Quality Control 6.5 Develop Schedule 5. Risk register 4. Process improvement plan 5. Project document updates 6. Enterprise environmental factors 8.1 Plan Quality 11.2 Identify Risks 7. Organizational process assets

<u>Inputs</u>

□ Scope baseline

The scope baseline is the approved project scope statement, WBS, and WBS dictionary. The baseline incorporates all approved changes. It's very important for quality planning because it describes the acceptance criteria, and includes other details that may directly impact quality and grade levels, such as technical specifications of materials.

□ Stakeholder register

The stakeholder register identifies all project stakeholders and contains attributes such as the person's name, title, position, project interest, expectations, and influence. Meeting customer and stakeholder expectations is necessary for quality.

□ Schedule baseline

The schedule baseline is the approved project schedule. It has the start and finish dates for all project activities, which impact quality requirements.

□ Risk register

The risk register is a comprehensive list of all threats and opportunities the project faces. It also contains supplementary data about each risk, including its impact, probability, risk response, budget, risk owner, and contingency and fallback plans. Risks likely impact the project's quality requirements.

Enterprise environmental factors

Factors outside the project boundaries that affect quality planning can include regulations and industry standards and guidelines.

□ Organizational process assets

The project's quality policy is directly related to the organization's quality policy, and may include the quality methods of other organizations, such as the customer. Policies, procedures, and templates may also be available for the project team. Lessons learned and historical information from past projects is also considered during quality planning.

Tools and Techniques

□ Cost-benefit analysis

Cost-benefit analysis: Cost-benefit analysis helps determine the appropriate trade-off between quality and the cost to achieve that level of quality.

□ Cost of quality

The cost of quality quantifies the cost of adhering to the expected level of quality in the deliverables. It is a time and financial determination based on the needed level of quality the deliverable must meet.

□ Control charts

Control charts are types of run charts that are used to determine whether processes are in control or out of control by comparing measurements taken over time.

□ Benchmarking

Benchmarking compares processes between different organizations, helping to generate ideas for improvement and to provide a measurement basis by helping the organization determine what the "standard" is.

Design of experiments

Design of experiments is a statistical method that can help make processes and products more efficient by mathematically simulating changes all at once to the variables affecting the process.

8

□ Statistical sampling

Statistical sampling is a general term that applies to a number of different and industry-specific techniques that look at a subset of a population in order to determine a measurement sampling.

□ Flowcharting

Flowcharts are graphical representations of a process, showing sequential activities, branches, and decision points within the process.

□ Proprietary quality management methodologies

These include specific methodologies like Six Sigma, Lean, Quality Function Deployment, and CMMI[®] among many others.

□ Additional quality planning tools

Additional tools, such as brainstorming, affinity diagrams, force field analysis, matrix diagrams, and nominal group techniques, help to define the project's quality requirements and plan for the project's quality management activities.

Outputs

□ Quality management plan

The quality management plan is a component of the project management plan. The quality management plan details the quality policy of the project, including how the project management team will address quality assurance, quality control, and continuous improvement for the project.

□ Quality metrics

Quality metrics are the specific quality goals the project must meet and how the quality control processes will confirm compliance. Quality metrics can include any type of applicable measurement, including defect rates, bug rates, failure rates, up-time, reliability, and coverage area.

□ Quality checklists

Quality checklists are documents that outline the key steps that must be performed as part of quality control. Checklists are to-do lists that ensure that everything is performed and in the correct order.

□ Process improvement plan

The process improvement plan is a subsidiary plan of the project management plan. It describes how processes will be analyzed to find and remove non-value added activities.

□ Project document updates

Documents that are likely to be updated during the Plan Quality process include the stakeholder register and the responsibility assignment matrix for quality activities.

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The **Perform Quality Assurance** process executes the quality management plan and the process improvement plan, and by doing so ensures that the project's quality processes are aligned with the plans. The premise behind quality assurance is that if the quality of the project processes are improved then the quality of the deliverables will be subsequently improved. The performing organization and project team reap the benefits gained by process improvements and the customer benefits through lower-costs and deliverables more likely to meet its need.



Thus quality assurance is focused on the processes and not the quality of the deliverables. This is important for us to remember: quality assurance is concerned with *quality processes* while quality control is concerned with *quality deliverables*. Another way for us to remember this is that Perform Quality Assurance is an executing process while Perform Quality Control is a monitoring and control process.

Since QA relies on the quality management plan, its activities can't begin until the quality planning processes are well underway. Quality assurance activities are performed by the project management team, but in organizations with an established quality policy, QA activities may be overseen by personnel from another business unit that's responsible for the organization's quality policy.

Work performance information and quality control measurements are used in the quality assurance process to look for prevention and process improvements opportunities. Any process changes or process improvements uncovered by QA activities will result in change requests or requested corrective actions, which if approved might result in updates to the quality management plan, process improvement plan, and to the project quality baseline.

Process analysis

Process analysis is a generalized tool categorization that involves techniques which examine the project's processes, looking for any non-value added activities (inefficiencies). Process analysis techniques implement the continuous improvement plan. Exactly what techniques are used depends upon the type of process, but the techniques used to reengineer processes will be the same ones used to develop the process improvement plan (section 8.1), and will also include data collection and its subsequent analysis.

Quality audits

Quality audits ensure that the project is complying with its own quality policy. If it helps, we can think of quality audits as having a similar purpose to financial or accounting audits. Both are independent reviews to determine whether appropriate controls, policies, processes, and procedures are being followed. Quality audits are best performed by people from outside the project. Audits can result in recommended improvements to bring the project in better compliance with quality policies. For organizations with a quality management system, the audit also determines the effectiveness of the QMS.

Since auditing is primarily about interviewing and collecting data, the project team can expect a lot of questions and requests for documentation during a quality audit. We need to keep in mind that an audit is not about pointing out personal faults but is instead about making sure the processes and procedures are appropriately linked to the quality policy and are having the intended benefits.

Quality audits may be very broad or focused only on specific items. Audits are sometimes called vertical or horizontal audits. A vertical audit focuses on a particular function or single process while a horizontal audit follows a complete process from start to end, usually through several functional areas within the project or organization.



Quality audits can also be required for contractual or regulatory obligations, and in those cases the party to perform the audit is usually specified in the contract or regulation. In other cases quality audits may be performed by a consultant or a member of the performing organization's quality department, or the customer may also perform quality audits of

It isn't always just massive failures that we need to worry about. It's the near misses that should really keep us up at night. Quality audits are needed to find the causes of the near disasters that were averted, which very often are not known outside of a few people. the project. But in organizations without a quality department or people formally trained in quality management, the project management team will need to fill this role. While this destroys the independent nature of an audit, it's much better for this process to be performed as objectively as possible by the project management team than for it not to be performed at all.



<u>Inputs</u>

□ Project management plan

The quality management plan and the process improvement plan are key to quality assurance.

□ Quality metrics

Quality metrics are the specific quality goals the project must meet and how the quality control processes will confirm compliance. Quality metrics can include any type of applicable measurement, including defect rates, bug rates, failure rates, up-time, reliability, and coverage area.

□ Work performance information

Work performance information is any data that can be considered related to the work which produces the project deliverables. Examples are schedule and progress status information, budget and cost status, quality status, estimates to complete, resource utilization information, and lessons learned.

Quality control measurements

The measurements from quality control activities are used in QA to evaluate and analyze the effectiveness of the project's quality policy.

8

Tools and Techniques

□ Plan Quality and Perform Quality Control tools and techniques

Any of the tools from the Plan Quality (8.1) and Perform Quality Control (8.3) processes are also useful as part of performing quality assurance.

Quality audits

Quality audits are independent reviews to determine whether appropriate controls, policies, processes, and procedures are being followed for quality management. Audits ensure that the project is complying with its own quality policy.

□ Process analysis

Process analysis is a generalized tool categorization that involves techniques which examine the project's processes, looking for any non-value added activities (inefficiencies). Process analysis techniques implement the continuous improvement plan.

Outputs

□ Organizational process assets updates

Quality assurance activities can result in updates to organizational quality standards.

□ Change requests

Quality assurance can result in recommended improvements, which are treated as changes and coordinated through integrated change control for review.

□ Project management plan updates

Quality assurance activities and approved changes relating to quality can impact several components of the project management plan, including the quality management plan, schedule management plan, and cost management plan.

□ Project document updates

Audits, training materials, checklists, and process documentation are usually impacted by quality assurance activities.

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There are only a handful of project management processes that have deliverables as their outputs, and it's sometimes easy to confuse their different purposes. While the Verify Scope and Perform Quality Control processes both examine the deliverables, quality control ensures that the deliverables meet the *quality* requirements while scope verification ensures that the deliverables meet the *scope* requirements.



The deliverables, quality checklists, quality metrics, and the quality management plan are the main inputs to the quality control process. QC also makes sure that defects have been brought back into quality compliance. Defects are treated as change requests through integrated change control and the deliverables are re-validated through Perform Quality Control, and if the defect repair is successful then the change control system serves as the notification that the correction is completed.

Quality control processes occur throughout the project from its early stages all the way to the end --as long as project processes are executing there will always be corresponding quality control processes. QC activities are usually performed by trained personnel from the performing organization's Quality Control Department, but the project team will need to fill this role if no quality control personnel exist.

Quality control terminology

The project team will need to have a general understanding of statistical quality control and terminology so that they can work with and properly evaluate the quality control outputs.



Prevention

Prevention keeps non-compliance issues from happening in the first place. While it's good to catch a defect before it gets into the hands of the customer, it's even better to prevent the defect from occurring at all. Prevention of errors is always preferable to reliance on inspection, and this philosophy is the basis of

the PMBOK's project quality management and of quality management in general. Prevention activities involve looking at processes for factors that can potentially lead to defects, and when defects detected. are determining the root causes so that those factors can be mitigated. Unfortunately, not all defects can be definitively

One approach to determining the root cause of a problem is to keep asking "why" at least five times:

1. Why did the concrete crack? Because the mix wasn't right.

- 2. Why wasn't the mix right? Because it came from a different supplier.
- 3. Why was a different supplier used? *Because it was a rush order*.

4. Why was it a rush order? Because the order wasn't on the daily schedule.

5. Why wasn't the order on the daily schedule? *Because the order had been misplaced.*

prevented, but we still need to investigate and understand the reasons for the failure.

8

Inspection

Inspection activities are the testing, measurement, review, and examination of the deliverable to determine whether it's in compliance with the quality requirements. The inspection methods used will differ depending upon the deliverable types. For example, the inspection methods employed against software will be different than those performed for a medical device. Inspection is meant to keep the defect out of the hands of the customer, and when non-compliance issues are found, the root cause is determined so that it can be prevented in the future.

Accuracy and precision

Accuracy describes how close a measurement is to its true value while **precision** describes how repeatable the measure is and how many significant digits it's measured in. Though we often use the two terms interchangeably, in the scientific and statistical realms, they describe different characteristics because a measurement can be accurate and precise, precise but not accurate, or accurate but not precise.

To help us understand their difference, let's assume that we've taken measurements of our body temperature at different intervals throughout the day using two types of oral thermometers –one is a regular analog thermometer and the second is a digital thermometer. If we're healthy, our body temperature is 98.7 F (37.0 C), so this is our measurement baseline. Here are our measurements:

	1 st Reading	2 nd Reading	3 rd Reading	4 th Reading	5 th Reading
Analog	98.7	98.7	99.7	98.8	98.7
Digital	98.743	98.735	98.712	98.760	98.684

All the measurements from our digital thermometer are clustered very close together, so they are precise as are our 1st, 2nd, 4th, and 5th measurements from the analog thermometer. However, the third reading from the analog thermometer is not precise since it's outside the cluster of all the other readings. Our third measurement from the analog thermometer looks to be an anomaly since it's a full degree off from the digital reading. Either we misread the analog thermometer or the procedure we used to take the measurement was flawed, but that temperature reading is inaccurate.

Tolerances

Tolerances are the acceptable variations in limits, such as a fluorescent light bulb should burn between 4000 and 5000 continuous hours. They define the maximum variations from a nominal value that are acceptable because they will have a negligible effect on the quality level.

Special and common causes

A **special cause** is an unusual event outside of the process that leads to a measurable change in the process (such as an increase in production downtime). Though unusual, *special causes* are considered preventable. For example, a backup generator failed to start up during a power failure. The failure of the backup generator can be prevented in the future through regular mechanical maintenance and operational tests.

A **common cause** is a normal event within the process that leads to a measurable change in the process (such as an increase in production downtime). Common causes result in rare, but tolerable variations. Even if it were possible to remove all possible common causes from a process, the effort to do so would usually be cost prohibitive. Common causes are thus generally considered as non-preventable and accepted as part of the process.

For example, let's imagine that about one screw out of every 50,000 from a supplier is misthreaded. When a manufacturing process encounters one of these misthreaded screws, it causes a jam in the machine which must be manually removed. The jam would result in a measurable change in the process (seen as decrease in production), but since it would be cost prohibitive to have all screws individually inspected before they were used in the manufacturing process this is considered an unpreventable cause.

Control limits



Sampling

Statistical sampling is a broad term that involves choosing random, representative samples for testing rather than testing each individual deliverable. There are many different sampling techniques that can apply to different disciplines, industries, and deliverables. The main key for this technique is to make sure that the sample collected is representative of the whole population. When properly sampled, this method takes less time that measuring the whole population.

Attribute sampling of the deliverable results in it either passing if it conforms to requirements or failing if it does not, while variable sampling passes or fails based on an overall degree of conformity to the requirements. For example, a bicycle inner tube either holds air or it leaks, in which case that inner tube would fail through attribute sampling. Contrast that to a food manufacturing process in which a sample bag from an entire production run of batch of potato chips is tested for overall weight, crispness, taste, texture, and color. If the sample bag chosen is within tolerances for those characteristics then the entire batch passes.

Statistically independent and mutually exclusive

When the outcomes of processes have no relationship between each other, they are considered **statistically independent**. The errors in an order entry process won't have any correlation to the mechanical breakdowns of a truck in the transportation system.

When one choice excludes another, the choices are said to be **mutually exclusive**. Choosing to replace a metal-based product component with a plastic-based component negates any options that involve using an aluminum-based component.

Standard deviation and sigma values

Standard deviation is used to measure how data is organized, and it involves a formula that results in a mathematical description of how diverse the data is. Standard deviation is shown graphically as a bell curve, and it's used in quality for establishing quality levels and process control limits. For the PMP examination, we should know the basic standard deviation formula, the concept of standard deviation and what it's used for, and the four main sigma values for normally distributed data.

Standard deviation formula is the result of the optimistic estimate subtracted from the pessimistic estimate, divided by six:



Dark blue is less than one standard deviation from the mean. For the normal distribution, this accounts for 68.27 % of the set; while two standard deviations from the mean (medium and dark blue) account for 95.45 %; three standard deviations (light, medium, and dark blue) account for 99.73 %; and four standard deviations account for 99.994 %.

(Jeremy Kemp. (02.09.2005). Retrieved from http://en.wikipedia.org/wiki/Image:Standard_deviation_diagram.svg)

	Sigma Values
1σ	68.25%
2 σ	95.46%
3σ	99.73%
6σ	99.99%

(Pessimistic - Optimistic 6

Quality control tools Quality control tools Quality control control control control charts Control charts Flowcharts

Cause and effect diagrams

A **cause and effect diagram** shows what factors can be contributing to an issue or problem. It's also known as a fishbone diagram or an Ishikawa diagram (named after Kaoru Ishikawa).



Technique:

- Identify the problem or issue, and place it as the "head" of the fishbone.
- Pose the problem or issue as a question to the group and explore the contributing causes and factors.
- As broad categories become known evident, add them as side branches to the categories.
- As possible contributing factors within categories are found, add these as underlying branches beneath the categories.
- Further question the group on contributing factors because there may be more details and factors involved.
- When the diagram is completed, the group can use it to validate assumptions, prioritize actions to eliminate contributing factors, and develop an action plan.

Run charts

A **run chart** is a line graph that displays measurements over time. Run charts are sometimes also referred to as run-sequence plots. Run charts help to detect trends or changes in output, performance, or quality, and once a change is detected then they can also be used to help determine the exact timing of when the change occurred.



Control charts

A **control chart** is a type of run chart that is used to determine whether a process is *in control* or *out of control*. The control chart is also known as the Shewhart chart, named after Walter Shewart who first developed them in the 1920s. If a process is in control, the chart can be used to accurately determine



future performance.

Control charts use upper control limits (UCL) and lower control limits (LCL), which are collectively known as *natural process limits*. As data is collected on the run chart, if the measures fall within the upper and lower control limits then the process is considered to be in control. Measurements outside the

control limits mean the process is out of control and the cause needs to be found. An in control process doesn't imply neither an efficient nor a quality process. In fact, the **Rule of Seven** states that if there are seven consecutive measurements that fall on one side of the mean then there's an assignable cause that needs investigated because something has changed in the process. The rule of seven applies even if the measurements are still within the control limits.

Flowcharts

A **flowchart** graphically illustrates the steps, sequences, and decision points in a process. It can be helpful for defining the logic and flow in a new process, but it's also helpful to diagram existing processes to look for contention or relationships in the process.



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Histogram

A **histogram** is a column chart that shows a collection of measurements grouped into categories, and it helps identify trouble-spots. For example, a histogram could show the number of help desk support calls over a period of time grouped by the days of the week.



Parteto chart

A **Pareto chart** is a histogram chart showing the values in descending order. By illustrating the data in this manner, the chart can be used to hone in on the factors causing the biggest impact. The chart is named after Pareto's 80/20 rule, and in the case of a Pareto chart, it helps us find the 20% of the factors that are likely causing 80% of the problems.



Scatter diagram



A scatter diagram is a graph that uses Cartesian coordinates to display values for two variables. By viewing the plotted measurements for both variables, a relationship, if one exists, can be determined. For example, a scatter diagram that plots inclement weather as one variable and late deliveries as another variable might show that there's a relationship between bad weather and delivery delays.

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8.3 Process decomposition



<u>Inputs</u>

□ Project management plan

The quality management plan describes how quality control processes will be performed and what levels of quality must be met.

□ Quality metrics

Quality metrics are the specific quality goals the project must meet and how the quality control processes will confirm compliance. Quality metrics can include any type of applicable measurement, including defect rates, bug rates, failure rates, up-time, reliability, and coverage area.

□ Quality checklists

Quality checklists are documents that outline the key steps that must be performed as part of quality control. Checklists are "to-do" lists that ensure that everything is performed and in the correct order.

□ Work performance measurements

These are performance measurements that are communicated to stakeholders, and include items such as planned versus actual performance for the schedule, cost, and quality.

□ Approved change requests

Approved changes from integrated change control can impact quality control activities. Deliverables that initially fail quality control and need reworked are technically change requests, so those deliverables may also be resubmitted to quality control as an approved change request.

□ Deliverables

Quality control is performed against the deliverables.

□ Organizational process assets

The organization may have defect reporting or other procedures that must be followed.

Tools and Techniques

□ Cause and effect diagrams

A cause and effect diagram shows what factors can be contributing to an issue or problem. It's also known as a fishbone diagram or an Ishikawa diagram.

□ Control charts

A control chart is a type of run chart that is used to determine whether a process is in control or out of control. The control chart is also known as the Shewhart chart, named after Walter Shewart who first developed them in the 1920s. If a process is in control, the chart can be used to accurately determine future performance.

□ Flowcharting

A flowchart graphically illustrates the steps, sequences, and decision points in a process.

□ Histogram

A histogram is a column chart that shows a collection of measurements grouped into categories, and it helps identify trouble-spots.

□ Pareto chart

A Pareto chart is a histogram chart showing the values in descending order. By illustrating the data in this manner, the chart can be used to hone in on the factors causing the biggest impact.

□ Run chart

A run chart is a line graph that displays measurements over time. Run charts are sometimes also referred to as run-sequence plots, and they help to detect trends or changes in output, performance, or quality.

□ Scatter diagram

A scatter diagram is a graph that uses Cartesian coordinates to display values for two variables. By viewing the plotted measurements for both variables, a relationship, if one exists, can be determined.

□ Statistical sampling

Statistical sampling is a broad term that involves choosing random, representative samples for testing rather than testing each individual deliverable.

□ Inspection

Inspection activities are the testing, measurement, review, and examination of the deliverable to determine whether it's in compliance with the quality requirements. The inspection methods used will differ depending upon the deliverable types.

□ Approved change request review

Deliverables that initially failed quality control are submitted to integrated change control as change requests. If approved for correction, this review ensures that the rework performed has been done as requested.

Outputs

Quality control measurements

These are the measurements and results from activities that make sure the deliverables meet the quality requirements.

□ Validated changes

Any approved changes (such as rework) are re-validated to make sure the change was implemented as requested.

□ Validated deliverables

Validated deliverables have been checked to ensure that they meet the quality requirements.

□ Organizational process assets updates

Lessons learned, completed checklists, root-cause analysis and other quality control activities result in updates to organizational process assets.

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Chapter summary

The Project Quality Management knowledge area includes the processes that make sure the deliverables meet the customer's requirements. Fully understanding both the explicit and implicit requirements are important because quality is based solely on fulfilling the customer's expectations. Another important facet of the quality approach is that the processes involved in the deliverables should be continually improved, which will result in a product of lower cost to the customer. PMI's approach to project quality is compatible with modern quality programs, including Six Sigma and Total Quality Management. The ISO 9000 standard helps companies establish a framework for their quality processes.

The Plan Quality process establishes the project quality management plan, the process improvement plan, quality checklists, and quality metrics. The organization's quality policy, if one exists, serves as the basis for the project quality management plan. The project scope statement and stakeholder register are needed during quality planning because they contain the expectations and specific acceptance criteria the deliverables must meet. The project management team will establish the quality, grade, tolerances, control limits, accuracy, and precision requirements. There are several tools and techniques that will assist during quality planning, and these include cost of quality, costbenefit analysis, benchmarking, design of experiments, affinity diagrams, force field analysis, nominal group technique, and matrix diagrams.

The Perform Quality Assurance process executes the quality management plan and the process improvement plan. Quality assurance activities are focused on the processes and not the deliverables. Measurements from the quality control process and work performance information are used to look for prevention opportunities and process improvements. Process analysis is a technique that looks for non-value added activities within processes, and quality audits are a means of making sure that the project is following the quality policy.

Perform Quality Control is concerned with making sure that the deliverables meet the quality requirements. Perform Quality Control results in validated deliverables. When a non-compliance issue is found, its root cause needs to be determined so that it can be prevented from happening again. Special causes are unusual events that are usually preventable, while common causes are normal events within the process that are usually not preventable. Sigma values are related to standard deviation the values for 1-, 2-, 3-, and 6- sigma are 68.25%, 95.46%, 99.73%, and 99.99%.

There are seven main tools of quality control. The cause and effect diagram looks like a fishbone, and it shows what factors are contributing to an issue or problem. The run chart is a line graph that displays measurements over time, and can help detect changes in a process. The control chart is a type of run chart that has upper and lower control limits, and it's used to determine whether a process is in control or out of control. Flowcharts graphically show the steps, sequences, and decision points in a process, and a histogram is a bar chart that shows categorized measurements. A Pareto chart is a bar chart showing the categorized measurements in descending order, so that the causes of the greatest problems can be addressed first. A scatter diagram can show if there's a relationship between two measurements.

Exam summary

- □ Quality is "the degree to which a set of inherent characteristics fulfill requirements."
- □ Quality management stresses prevention over inspection.
- □ The project management knowledge area relies heavily on Deming's Plan-Do-Check-Act cycle.
- □ Quality management is concerned both with deliverables and processes.
- □ Grade is a category assigned to products having the same functional characteristics but different technical characteristics.
- □ Continuous improvement, also known as Kaizen, stresses ongoing process improvement through incremental changes.
- □ ISO-9000 is a quality management framework that ensures companies follow their own quality policy.
- □ Total Quality Management (TQM) is an organizational quality approach that involves everyone being focused on quality.
- □ Six Sigma is an organizational quality approach that improves quality through an emphasis on quantifying and measuring.
- □ The Plan Quality process establishes the quality management plan and the process improvement plan.
- □ Accuracy, precision, quality and grade levels, metrics, and checklists are established in the Plan Quality process.
- □ The quality management plan is based on the organization's quality policy.
- □ It's up to the project management team to establish the project quality policy.
- □ The quality management plan describes the project's quality policy and how it will be implemented.
- □ Quality metrics are the specific goals and how they will be measured.
- □ The cost of quality includes the costs associated with good quality and poor quality.
- □ Design of experiments is a statistical method of identifying the optimum conditions for a product or process.
- □ Cost-benefit analysis ensures that the benefits of quality activities exceed the costs of quality activities.
- □ The Perform Quality Assurance process executes the project management plan and the continual improvement plan.
- □ Quality assurance looks at processes.
- \Box Process analysis is used to remove non-value added activities.
- □ Quality audits make sure that the project is complying with its own quality policy.
- □ The Perform Quality Assurance process relies on the project quality management plan and the process improvement plan.

- □ Quality control measurements, quality metrics, and work performance information is used by the Perform Quality Assurance process.
- □ The Perform Quality Control process ensures that the deliverables meet the quality requirements.
- □ Quality control is primarily concerned with the project's deliverables.
- □ Prevention of quality problems in the first place is always preferable.
- □ The deliverables, quality metrics, checklists, and quality management plan are the main inputs to the quality control process.
- □ Special causes are unusual events that can be prevented.
- \Box Common causes are normal events that can't be prevented.
- □ Attribute sampling results in either a pass or fail of the deliverable.
- □ Variable sampling uses a representative sample rather than looking at each unit.
- □ The 1-, 2-, 3-, and 6-sigma values in a normally distributed data set are: 68.25%, 95.46%, 99.73%, and 99.99%.
- □ The seven basic tools of quality are: cause and effect diagram; run chart; control chart; flowchart; histogram; Pareto chart; and scatter diagram.
- □ A cause and effect diagram is also known as a fishbone or Ishikawa diagram. It shows factors that are contributing to a problem or issue.
- □ A run chart displays measurements over time.
- □ A control chart shows measurements over time and has upper and lower control limits. It identifies whether a process is in control or out of control.
- □ The Rule of Seven says that if there are seven consecutive measurements on one side of the mean that there's an assignable cause that needs investigated.
- \Box A flowchart gives a graphical representation of all the steps in a process.
- \Box A histogram is a column chart.
- \Box A Pareto chart is a column chart that's grouped in descending order. It can be used to focus on the 20% of the issues causing 80% of the problems.
- □ A scatter diagram shows whether there's a relationship between two variables.