V Skills

Skills for a secure future

# Certified Performance Manager
# Sample Material

## V-Skills Certifications

**A Government of India**
**&**
**Government of NCT Delhi Initiative**

V-Skills

Skills for a secure future

# 1. CONCEPT OF PROJECT QUALITY

## 1.1. Definitions of Quality and Grade

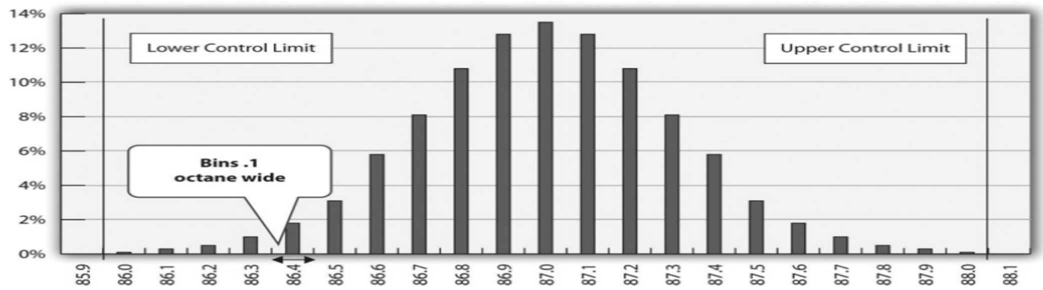
Quality is a relative term, which means that something is of high or low quality compared to what it is required to be. According to the International Organization for Standardization (ISO), quality is "the degree to which a set of inherent characteristics fulfill requirements". International Organization for Standardization, Quality Management Systems Fundamentals and Vocabulary, in Project Management Institute The quality is determined by how well something meets the requirements of its grade.

Determining how well products meet grade requirements is done by taking measurements and then interpreting those measurements. Statistics—the mathematical interpretation of numerical data—is useful when interpreting large numbers of measurements and is used to determine how well the product meets a specification when the same product is made repeatedly. Measurements made on samples of the product must be between control limits— the upper and lower extremes of allowable variation—and it is up to management to design a process that will consistently produce products between those limits.

If a process is designed to produce a product of a certain size or other measured characteristic, it is impossible to control all the small factors that can cause the product to differ slightly from the desired measurement. Some of these factors will produce products that have measurements that are larger than desired and some will have the opposite effect. If several random factors are affecting the process, they tend to offset each other most of the time and the most common results are near the middle of the range. This idea is called the central limit theorem.

If the range of possible measurement values is divided equally into subdivisions called bins, the measurements can be sorted, and the number of measurements that fall into each bin can be counted. The result is a frequency distribution that shows how many measurements fall into each bin. If the effects that are causing the differences are random and tend to offset each other, the frequency distribution is called a normal distribution, which resembles the shape of a bell with edges that flare out. The edges of a theoretical normal distribution curve get very close to zero but do not reach zero.

If the measurements of product samples are distributed equally above and below the center of the distribution as they are in Figure 1.1 "Normal Distribution of Measurements of Gasoline Samples", the average of those measurements is also the center value that is called the mean and is represented in formulas by the lowercase Greek letter μ.



The amount of difference of the measurements from the central value is called the sample standard deviation or just the standard deviation. The first step in calculating the standard deviation is subtracting each measurement from the central value and then squaring that difference. The next step is to sum these squared values and divide by the number of values minus one. The last step is to take the square root. The result can be thought of as an average difference. Mathematicians represent the standard deviation with the lowercase Greek letter σ (pronounced sigma). If all the elements of a group are measured, it is called the standard deviation of the population and the second step does not use a minus one.

For normal distributions, about 68.3 percent of the measurements fall within one standard deviation on either side of the mean. This is a useful rule of thumb for analyzing some types of data. If the variation between measurements is caused by random factors that result in a normal distribution and someone tells you the mean and the standard deviation, you know that a little over two thirds of the measurements are within a standard deviation on either side of the mean. Because of the shape of the curve, the number of measurements within two standard deviations is 95.4 percent, and the number of measurements within three standard deviations is 99.7 percent. For example, if someone said the average (mean) height for adult men in the United States is 5 feet 10 inches (70 inches) and the standard deviation is about 3 inches, you would know that 68 percent of the men in the United States are between five feet seven inches (67 inches) and six feet one inch (73 inches) in height. You would also know that about 95 percent of the adult men in the United States were between five feet four inches and six feet four inches tall, and that almost all of them (99.7 percent) are between five feet one inches and six feet seven inches tall. These figures are referred to as the 689599.7 rule.

## 1.2. Features

Quality is the degree to which a product or service fulfills requirements and provides value for its price.

Statistics is the mathematical interpretation of numerical data, and several statistical terms are used in quality control. Control limits are the boundaries of acceptable variation.

If random factors cause variation, they will tend to cancel each other out—the central limit theorem. The central point in the distribution is the mean, which is represented by the Greek letter mu, μ. If you choose intervals called bins and count the number of samples that fall into each interval, the result is a frequency distribution. If you chart the distribution and the factors that cause variation are random, the frequency distribution is a normal distribution, which looks bell shaped.

The center of the normal distribution is called the mean, and the average variation is calculated in a special way that finds the average of the squares of the differences between samples and the mean and then takes the square root. This average difference is called the standard deviation, which is represented by the Greek letter sigma, σ. About 68 percent of the samples are within one standard deviation, 95.4 percent are within two, and 99.7 percent are within three.

## 1.3. Development of Quality as a Competitive Advantage

Quality management is an approach to work that has become increasingly important as global cooperation and competition have increased. A review of the history of quality management explains why it is so important to companies and why clients often require projects to document their processes to satisfy quality standards.

### Statistical Control before World War II

Prior to the late 1700s, products such as firearms and clocks were made as individual works where the parts were adjusted to each other so they could work together. If a part broke, a new one had to be made by hand to fit. In 1790 in France, Honoré Blanc demonstrated that he could make musket parts so nearly identical that a musket could be assembled from bins of parts chosen at random. Ken Alder, "Innovation and Amnesia - Engineering Rationality and the Fate of Interchangeable Parts Manufacturing in France," Technology and Culture. The practice of making parts to a high level of accuracy in their dimensions and finishes made the parts interchangeable. The use of interchangeable parts became the founding principle of assembly line manufacturing to produce all manner of goods from sewing machines to automobiles. The manufacturers of firearms and weapons were often the leaders in improving quality because reliable and safe operation of weapons and their rapid repair is a matter of life and death.

### Statistical Control in the United States during World War II

During World War II, factories were converted from manufacturing consumer goods to weapons. War plants had to make large numbers of parts as fast as possible while doing it safely for the workers and for the service members who used them. Important improvements in quality control (QC)—the management of production standards through statistical interpretation of random product measurements, which emphasizes consistency and accuracy—were made during this period. Shewhart recognized that real processes seldom behaved like theoretical random distributions and tended to change with time. He separated causes of variation into two categories - chance cause and assignable cause. Chance causes could be ignored if they did not cause too much variation, and trying to eliminate them often made the problem worse, but assignable causes could be fixed. To help distinguish between variations caused by random events and trends that indicated assignable causes, Shewhart introduced the control chart, which is also known as a type of run chart because data are collected while the process is running. A control chart has time on the bottom axis and a plot of sample measurements. The mean, upper control limit, lower control limit, and warning lines that are two sigma from the mean are indicated by horizontal lines.

In brief, they are as follows -

Create constancy of purpose toward improvement of product and service. Adopt a new philosophy. We are in a new economic age. Western management must awaken to the challenge, learn their responsibilities, and take on leadership for a change.

Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place. End the practice of awarding business on the basis of price tag. Instead, minimize cost. Move toward a single supplier for any one item, on a long term relationship of loyalty and trust.

Improve constantly and forever the system of production and service to improve quality and productivity and thus constantly decrease costs. Institute training on the job.

Institute leadership the aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.

Drive out fear, so that everyone may work effectively for the company. Break down barriers between departments.

Eliminate slogans, exhortations, and targets for the workforce asking for zero defects and new levels of productivity.

Eliminate work standards (quotas) on the factory floor. Substitute leadership.

Remove barriers that rob the hourly worker of his right to pride of workmanship.

Institute a vigorous program of education and self improvement. Put everybody in the company to work to accomplish the transformation. The transformation is everybody‘s job.

## Trade and International Standards

Trade between countries increased as countries recovered from WWII and began producing consumer goods. In 1948, the General Agreement on Tariffs and Trade (GATT) established the rules for international trade in the postwar world. Through years of negotiations based on GATT, the World Trade Organization (WTO) was created in 1995. The WTO is a negotiating forum where governments can discuss ways to help trade flow as freely as possible.

Increases in trade forced companies to improve the quality of their products to compete for clients and to exchange parts reliably between companies that used parts suppliers. To assist in developing standards for quality that would be the same between countries, an organization of 158 national standards groups formed the International Organization for Standardization (ISO), which is headquartered in Switzerland. For example, a company might require a parts supplier to meet certain ISO standards if it wants to bid on contracts. There are thousands of ISO standards, and they are grouped by their numbers.

The ISO 9000 group of standards relate to quality -

ISO 9000 Fundamentals and vocabulary for this group of quality standards
ISO 9001 Standards for evaluating the quality management processes in an organization it has five parts -

- ✓ Overall requirements for the quality management system and documentation
- ✓ Management responsibility, focus, policy, planning and objectives
- ✓ Resource management and allocation
- ✓ Product realization and process management
- ✓ Measurement, monitoring, analysis, and improvement

ISO 9004 Ways to extend benefits of ISO 9001 to employees, owners, suppliers, partners, and society in general. It is a guide for top management for overall quality improvement.

ISO 9011 Guidance for auditing a quality system

Recommended steps for implementing a quality management system (QMS) are as follows -

- ✓ Fully engage top management.
- ✓ Identify key processes and the interactions needed to meet quality objectives.
- ✓ Implement and manage the QMS and its processes.
- ✓ Build your ISO 9001based QMS.
- ✓ Implement the system, train company staff, and verify effective operation of your processes.

Manage your QMS—focus on client satisfaction, strive for continual improvement. If necessary, seek third party certification and registration of the QMS, or alternatively, issue a self declaration of conformity. International Organization for Standardization, Quality Management Systems

## 1.4. Relevance of Quality Programs to Project Quality

### Introduction

Project quality refers to two distinct aspects of the project. Project quality can refer to the quality of the product or service delivered by the project. Does the end product meet client specifications? For example, does a software development project develop a program that performs to the client‘s requirements? A software program that performs the basic work functions but does not integrate with existing software would not be considered a quality product, as long as the client specified that the software must interface with existing software.

Project quality can also refer to managing the project efficiently and effectively. Almost any client specification can be met if the project manager has unlimited time and resources. Recall that high quality means meeting the requirements for a particular grade while providing value. Meeting project deliverables within the time and resource constraints is also a measure of project quality. Developing a project execution plan that matches the complexity level of the project is the most critical aspect in developing a project plan that meets project specifications within the time frame and at the lowest costs. These two aspects of project quality have similarities and differences to quality as applied to parent organizations.

### Similarities

All successful quality programs have (1) a requirement for commitment to quality by all the employees and their partners and (2) an emphasis on error prevention and client satisfaction. To comply with TQM, Six Sigma, ISO, or other quality standards required by the client or by the project management firm, the project manager must engage in quality programs and provide documents that specifically comply with the quality standards in use. For example, a project is typically required to follow the parent organization‘s work processes related to procurement and document management. Any project processes that interface with the organization‘s quality processes will be required to meet the quality standards of the organization.

If a large project involves repetitive processes such as welding or pouring concrete, statistical processes control methods can be used to maintain the quality of the product. These processes control methods are similar to those used by process managers in the manufacturing environment. The intent is for the work of the project to meet design specifications. The welding tools and equipment must be sufficient to perform the welds established in the welding specifications, and the welds must be tested, usually by an independent tester, to assure the end product meets the design specifications. The civil engineers design a concrete pour to meet certain criteria that will support a structure. The criteria, detailed in the design specifications, provide the parameters that the construction crew must meet when pouring the concrete. On large projects, which sometimes have thousands of welds and hundreds of yards of concrete to pour, the use of quality control tools and methods are critical to meeting design specifications

### Differences

Because projects are temporary, spotting trends in samples produced by repetitive processes is not as important as considering quality in the planning of the project. Instead, the project manager must be able to provide documentation that demonstrates that the correct processes are in place to prevent quality failures.

The cost of quality (COQ) must be considered in the scope document and the project budget. If the group or company that is providing the project management is separate from the client, the project budget will bear the cost of prevention while the client will reap the rewards of avoiding the costs of failure. If senior management does not recognize the benefit to the organization of reducing cost of failure by spending more on prevention during the project, the project manager can be placed in the position of producing a product or service that he or she knows could be of higher quality.

If the cost of quality is not specifically considered and approved by senior management in the scope of the project, quality might be sacrificed during the project to meet budget goals.

Some separation of responsibility for quality is necessary. For example, if a project is undertaken to build a facility that makes something, it is important to distinguish between the quality of the work done by the project team and the quality of the items produced after the project is over. The client provides specifications for the facility that should result in production of quality products. It is the client‘s responsibility to provide appropriate project requirements that will result in a facility that can produce quality products. It is the project manager‘s responsibility to meet the project requirements. The project manager must focus on meeting requirements for project activities, but as part of the quality team, opportunities to improve the quality of the final product should be discussed with the client. If the final products fail to meet quality standards, someone will be blamed for the failure. It could be the project manager, even if he or she met all the requirements of the project specified by the client.

## 1.5. Planning and Controlling Project Quality

High quality is achieved by planning for it rather than by reacting to problems after they are identified. Standards are chosen and processes are put in place to achieve those standards.

During the execution phase of the project, services and products are sampled and measured to determine if the quality is within control limits for the requirements and to analyze causes for variations. This evaluation is often done by a separate quality control group, and knowledge of a few process measurement terms is necessary to understand their reports. Several of these terms are similar, and it is valuable to know the distinction between them.

The quality plan specifies the control limits of the product or process; the size of the range between those limits is the tolerance. Tolerances are often written as the mean value, plus or minus the tolerance.

Tools are selected that can measure the samples closely enough to determine if the measurements are within control limits and if they are showing a trend. Each measurement tool has its own tolerances. For example, if a machine is making rods whose diameters should be 10 mm ± 0.01 mm, you need a measuring device that can accommodate a rod that is 10 mm wide but can measure that width to a much smaller tolerance than 0.01 mm, such as 0.001 mm.

The choice of tolerance directly affects the cost of quality (COQ). In general, it costs more to produce and measure products that have small tolerances. The costs associated with making products with small tolerances for variation can be very high and not proportional to the gains. For example, it might double the manufacturing cost to improve a process from a 4 $\sigma$ to a 5 $\sigma$ (lower tolerances from 25 percent of control limits to 20 percent), which might only reduce the number of parts that are out of control from 4 per 100,000 to 6 per 10 million.

## Client Expectations

Clients provide specifications for the project that must be met for the project to be successful. Meeting project specifications is one definition of a project success. Clients often have expectations that are more difficult to capture in a written specification. For example, one client will want to be invited to every meeting of the project and will then select the ones that seem most relevant. Another client will want to only be invited to project meetings that need client input. Inviting this client to every meeting will cause unnecessary frustration. Listening to the client and developing an understanding of the expectations that are not easily captured in specifications is important to meeting the client‘s expectations.

Project surveys that capture how the client perceives the project performance provide the project team with data that is useful in meeting client expectation If the results of the surveys indicate that the client is not pleased with some aspect of the project, the project team has the opportunity to explore the reasons for this perception with the client and develop recovery plans. The survey can also help define what is going well and what needs improved.

## Sources of Planning Information

Planning for quality is part of the initial planning process. The early scope, budget, and schedule estimates are used to identify processes, services, or products where the expected grade and quality should be specified. Risk analysis is used to determine which of the risks the project faces could affect quality.

## Techniques

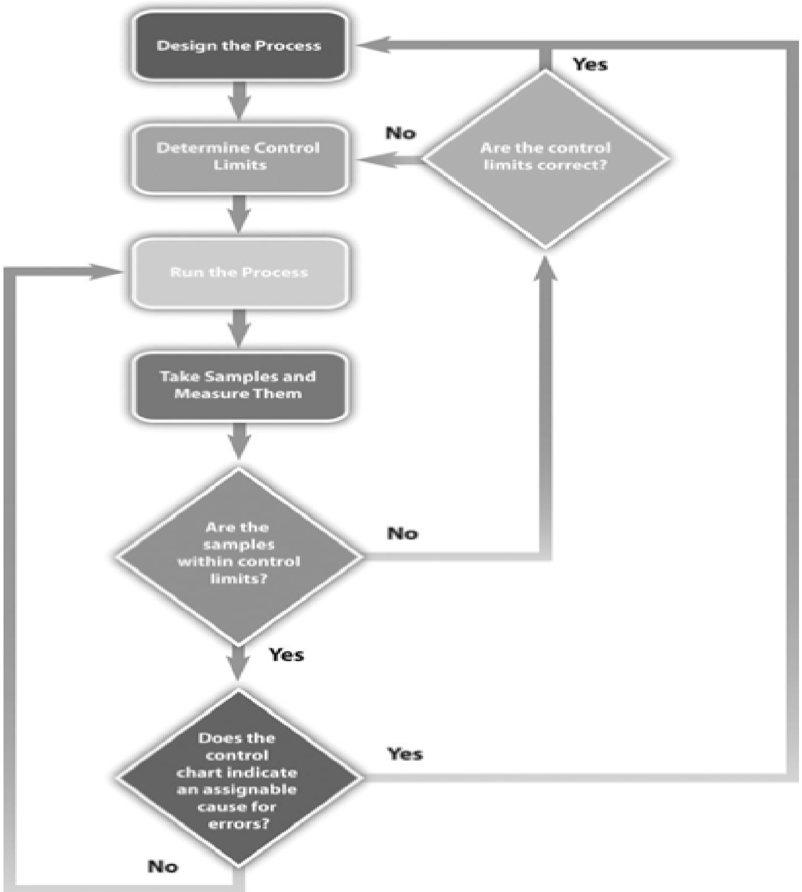
Several different tools and techniques are available for planning and controlling the quality of a project. The extent to which these tools are used is determined by the project complexity and the quality management program in use by the client.

## Quality Management Methodology

The quality management methodology required by the client is used. The project manager must provide the documentation the client needs to prove compliance with their methodology. There are several different quality management methodologies, but they usually have characteristics that are similar to the ones described previously in the text.

## Flowcharting

Many processes are more complicated than a simple sequence of related events that include several different paths. A flowchart uses standard symbols to diagram a process that has branches or loops. Diamonds indicate decisions, and arrows indicate the direction of the flow of the process, as shown in Figure 1.2 "Flowchart of a Quality Control Process".




The process used to plan and assess quality can be described using flowcharts. They are useful for communicating processes that have logical branches that can be determined by simple yes or no questions. Flowcharting is also useful for discovering misunderstanding in project roles and responsibilities and communicating responsibility for work processes.

## Benchmarking

When products like shoes were made by hand, artisans would seek some degree of standardization by marking standard lengths for different parts of the product on their workbench. In modern management practice, if a particular method or product is a standard of quality, comparing your organization's quality plan to it is called benchmarking. If a product or service is similar to something that is done in another industry or by a competitor, the project planners can look at the best practices that are used by others and use them as a comparison.

## Cost to Benefit Analysis

Because the cost of prevention is more often part of the project budget, the case must be made for increasing the project budget to raise quality. Some quality management programs, like Six Sigma, require that expenditures for quality are justified using a cost to benefit analysis that is similar to calculating the cost of quality, except that it is a ratio of cost of increasing quality to the resulting benefit. A cost benefit analysis in some quality programs can take into account nonfinancial factors such as client loyalty and improvements to corporate image and the cost to benefit analysis takes the form of a written analysis rather than a simple numeric ratio. It is similar to determining the cost of quality (COQ).

## Design of Experiments

Measuring for quality of manufactured products or use of repetitive processes requires taking samples. Specialists in quality control design a test regimen that complies with statistical requirements to be sure that enough samples are taken to be reasonably confident that the analysis is reliable. In project management, the testing experiments are designed as part of the planning phase and then used to collect data during the execution phase.

## Control Charts

If some of the functions of a project are repetitive, statistical process controls can be used to identify trends and keep the processes within control limits. Part of the planning for controlling the quality of repetitive processes is to determine what the control limits are and how the process will be sampled.

## Cause and Effect Diagrams

When control charts indicate an assignable cause for a variation, it is not always easy to identify the cause of a problem. Discussions that are intended to discover the cause can be facilitated using a cause and effect or fishbone diagram where participants are encouraged to identify possible causes of a defect.

## Planning and Control Results

The quality plan is produced during the initiation phase. The methods, procedures, and logic are described to demonstrate a commitment to a project of high quality. The plan identifies the products or services that will be measured and how they will be measured and compared to benchmarks. A flowchart demonstrates the logic and pathways to improve the plan.

During the execution phase, data are collected by measuring samples according to the design Specified in the plan the data are charted and analyzed. If variations are due to assignable Causes, change requests are created.

## 1.6. Assuring Quality

The purpose of quality assurance is to create confidence that the quality plan and controls are working properly. To assure quality, time must be allocated to review the original quality plan and compare that plan to how quality is being created during the execution of the project.

**Process Analysis**

The flowcharts of quality processes are compared to the processes followed during actual operations. If the plan was not followed, the process is analyzed and corrective action taken. The corrective action could be to educate the people involved on how to follow the quality plan or to revise the plan.

The experiments that sample products and processes and collect data are examined to see if they are following statistically valid sampling techniques and that the measurement methods have small enough tolerances to detect variation within control limits.

Because projects are temporary, there are fewer opportunities to learn and improve within one project if it has a short duration, but even in short projects, the quality manager should have a way to learn from experience and change the process for the next project of a similar complexity profile.

**Quality Audit**

For additional confidence and assurance, an outside group can come in and review the quality procedures and accuracy of the data. This process is similar to a financial audit and is called a quality audit. The purpose of a quality audit is to compare the stated quality goals of the project against the actual practice and procedures that are used. It is not a certification of the quality of the products themselves.