# 7.3: Qualitative Monitoring

It's not enough to make sure you get a project done on time and under budget. You need to be sure you make the right product to suit your stakeholders' needs. Quality means making sure that you build what you said you would and that you do it as efficiently as you can. And that means trying not to make too many mistakes and always keeping your project working toward the goal of creating the right product.

Everybody "knows" what quality is. However, the way the word is used in everyday life is a little different from how it is used in project management. Just like the triple constraint (scope, cost, and schedule), you manage the quality of a project by setting goals and taking measurements. That's why you must understand the quality levels your stakeholders believe are acceptable, and ensure that your project meets those targets, just like it needs to meet their budget and schedule goals.

Customer satisfaction is about making sure that the people who are paying for the end product are happy with what they get. When the team gathers requirements for the specification, they try to write down all of the things that the customers want in the product so that they know how to make them happy. Some requirements can be left unstated. Those are the ones that are implied by the customer's explicit needs. For example, some requirements are just common sense (e.g., a product that people hold can't be made from toxic chemicals that may kill them). It might not be stated, but it's definitely a requirement.

"Fitness to use" is about making sure that the product you build has the best design possible to fit the customer's needs. Which would you choose: a product that is beautifully designed, well constructed, solidly built, and all-around pleasant to look at but does not do what you need or a product that does what you want despite being ugly and hard to use? You'll always choose the product that fits your needs, even if it's seriously limited. That's why it's important that the product both does what it is supposed to do and does it well. For example, you could pound in a nail with a screwdriver, but a hammer is a better fit for the job.

Conformance to requirements is the core of both customer satisfaction and fitness to use and is a measure of how well your product does what you intend. Above all, your product needs to do what you wrote down in your requirements document. Your requirements should take into account what will satisfy your customer and the best design possible for the job. That means conforming to both stated and implied requirements.

In the end, your product's quality is judged by whether you built what you said you would build.

Quality planning focuses on taking all of the information available to you at the beginning of the project and figuring out how you will measure quality and prevent defects. Your company should have a quality policy that states how it measures quality across the organization. You should make sure your project follows the company policy and any government rules or regulations on how to plan quality for your project.

You need to plan which activities you will use to measure the quality of the project's product. And you'll need to think about the cost of all the quality-related activities you want to do. Then you'll need to set some guidelines for what you will measure against. Finally, you'll need to design the tests you will run when the product is ready to be tested.

## Quality and Grade

According to the International Organization for Standardization (ISO), **quality** is "the degree to which a set of inherent characteristics fulfill requirements." The requirements of a product or process can be categorized or given a grade that will provide a basis for comparison. The quality is determined by how well something meets the requirements of its grade.

For most people, the term quality also implies good value—getting your money's worth. For example, even low-grade products should still work as expected, be safe to use, and last a reasonable amount of time. Consider the following examples.

**✔ Example: Quality of Gasoline Grades**

Petroleum refiners provide gasoline in several different grades based on the octane rating because higher octane ratings are suitable for higher compression engines. Gasoline must not be contaminated with dirt or water, and the actual performance of the fuel must be close to its octane rating. A shipment of low-grade gasoline graded as 87 octane that is free of water or other contaminants would be of high quality, while a shipment of high-grade 93 octane gas that is contaminated with dirt would be of low quality.

## Statistics

Determining how well products meet grade requirements is done by taking measurements and then interpreting those measurements. **Statistics**—the mathematical interpretation of numerical data—are useful when interpreting large numbers of measurements and are 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 within 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.

Instructional designers often use statistics to determine the quality of their course designs. Student assessments are one way in which instructional designers are able to tell whether learning occurs within the control limits.

### Example: Setting Control Limits

A petroleum refinery produces large quantities of fuel in several grades. Samples of the fuels are extracted and measured at regular intervals. If a fuel is supposed to have an 87-octane performance, samples of the fuel should produce test results that are close to that value. Many of the samples will have scores that are different from 87. The differences are due to random factors that are difficult or expensive to control. Most of the samples should be close to the 87 rating and none of them should be too far off. The manufacturer has grades of 85 and 89, so they decided that none of the samples of the 87-octane fuel should be less than 86 or higher than 88.

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 affect the process, they tend to offset each other, and the most common results are near the middle of the range; this phenomenon 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.

### Example: Normal Distribution

A refinery's quality control manager measures many samples of 87 octane gasoline, sorts the measurements by their octane rating into bins that are 0.1 octane wide, and then counts the number of measurements in each bin. Then she creates a frequency distribution chart of the data, as shown in Figure 7.4.

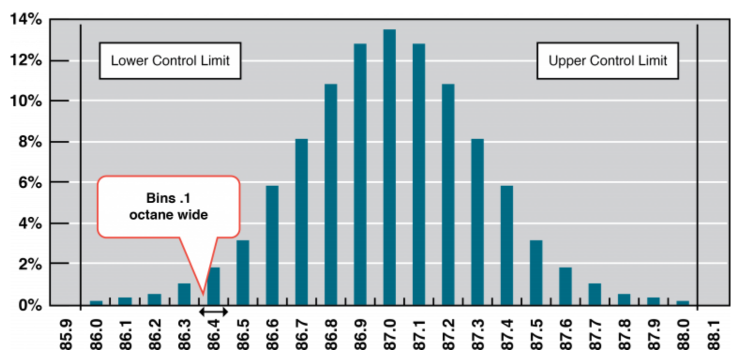


*Figure 7.4: Normal Distribution of Measurements*

It is common to take samples—randomly selected subsets from the total population—and measure and compare their qualities, since measuring the entire population would be cumbersome, if not impossible. If the sample measurements are distributed equally above and below the centre of the distribution as they are in Figure 10.1, the average of those measurements is also the centre value that is called the mean and is represented in formulas by the lowercase Greek letter μ (pronounced mu). 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 (mean) and then squaring that difference. (Recall from your mathematics courses that squaring a number is multiplying it by itself and that the result is always positive.) 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. (If you had used the usual method of taking an average, the positive and negative numbers would have summed to zero.) Mathematicians represent the standard deviation with the lowercase Greek letter (pronounced sigma). If all the elements of a group are measured, instead of just a sample, it is called the standard deviation of the population and in the second step, the sum of the squared values is divided by the total number of values.

Figure 8.2 shows that the most common measurements of octane rating are close to 87 and that the other measurements are distributed equally above and below 87. The shape of the distribution chart supports the central limit theorem's assumption that the factors that are affecting the octane rating are random and tend to offset each other, which is indicated by the symmetric shape. This distribution is a classic example of a normal distribution. The quality control manager notices that none of the measurements are above 88 or below 86 so they are within control limits, and she concludes that the process is working satisfactorily.

**Example: Standard Deviation of Gasoline Samples**

The refinery's quality control manager uses the standard deviation function in her spreadsheet program to find the standard deviation of the sample measurements and finds that for her data, the standard deviation is 0.3 octane. She marks the range on the frequency distribution chart to show the values that fall within one sigma (standard deviation) on either side of the mean (Figure 7.5).

For normal distributions, about 68.3% 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%, and the number of measurements within three standard deviations is 99.7%. For example, if someone said the average (mean) height for adult men in the United States is 178 cm (70 inches) and the standard deviation is about 8 cm (3 inches), you would know that 68% of the men in the United States are between 170 cm (67 inches) and 186 cm (73 inches) in height. You would also know that about 95% of adult men in the United States are between 162 cm (64 inches) and 194 cm (76 inches) tall and that almost all of them (99.7%) are between 154 cm (61 inches) and 202 cm (79 inches) tall. These figures are referred to as the 68-95-99.7 rule.

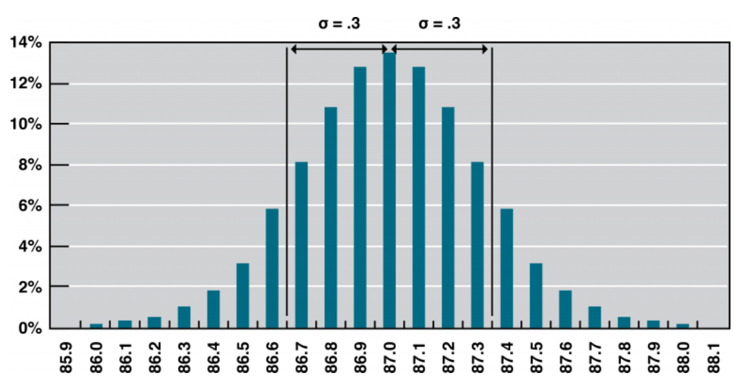


*Figure 7.5: One Sigma Range Most of the measurements are within 0.3 octane of 87*

Qualitative monitoring, as its name implies, involves measuring quality rather than quantity. In the context of project management, qualitative monitoring addresses the following questions:

- **Scope:** Is the team delivering on the intended scope in order to fulfill the project's objectives and organizational needs?
- **Quality:** Is the quality of the deliverables meeting stakeholder expectations?
- **Stakeholders:** Are stakeholders engaged?
- **Communications:** Are project communications effective?
- **Risks:** Are risks and opportunities being effectively managed by the team?
- **Resources:** Are resources being effectively managed and available as expected?
- **Procurement:** Are the expectations outlined in procurement contracts being adhered to by vendors?

- **Team Management:** Has the team become high-performing and are individual team members meeting performance expectations?

## Validating and Controlling Scope

The approach taken to monitor and control scope depends on the development methodology used. The predictive/waterfall approach involves a sequential definition of requirements and scope, which then leads to solution development. This approach is commonly utilized when the organization has a clear vision of the project's end outcome. Given this, monitoring and controlling scope occurs with the premise that significant scope changes are not expected. Validating scope involves formal acceptance of the completed project deliverables by the project sponsor and their assigned designates. Acceptance often requires deliverable reviews where the quality of the work is inspected before sign-off is provided. Changes may be required. These changes can be a result of poor quality (which leads to re-work) or new requirements intended to improve the organizational value of the project's outcomes. New requirements are carefully controlled. This is necessary because once solution development begins, the project's resources, timelines, and budget were all defined with a specific scope in mind. A scope change may mean those resources, timelines, and budgets are now insufficient to deliver on the increased scope. Controlling scope in this situation requires the project team to assess the impact of the new requirement on all the project's constraints. If necessary, the team will seek approval for additional funding, time, and/or resources to pursue the new requirement. Project leaders need to reserve judgment on scope changes until the impact and benefits are clearly understood. The term "scope creep" refers to the poorly controlled expansion of scope over time. This means that the scope expands, perhaps unintentionally, without an understanding of its impact on the project's other constraints, such as time and budget. Therefore, utilizing an integrated approach for change management is a critical success factor for projects using the predictive/waterfall approach.

Projects that follow an adaptive development methodology, such as agile, view scope change very differently. Scope definition, as well as solution development and testing, occur in an iterative or incremental fashion. As new requirements are identified, they are evaluated from a cost/complexity and benefit perspective, and if worth pursuing, they will be scheduled into a future iteration. A continuous improvement mindset encourages scope definition to occur in cycles.

## Controlling 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.

## Measurement Terminology

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. The plus and minus signs are written together, ±.

**✔ Example: Tolerance in Gasoline Production**

The petroleum refinery chose to set its control limits for 87-octane gasoline at 86 and 88-octane. The tolerance is 87 ± 1. 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.

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, if the cost of evaluating each screen as it is created in an online tutorial is greater than delivering the product and fixing any issues after the fact, then the COQ may be too high and the instructional designer will tolerate more defects in the design.

## Defining and Meeting Client Expectations

Clients provide specifications for the project that must be met for the project to be successful. Recall that meeting project specifications is one definition of 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 be invited only 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 those expectations.

Project surveys can capture how the client perceives the project performance and provide the project team with data that are useful in meeting client expectations. 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 improvement.

## Sources of Planning Information

Quality is about ensuring the expectations of the project sponsor have been met. This involves ensuring the expectations of the end-user community are well understood. High quality is achieved by planning for it (proactive) rather than by reacting to problems after they are identified (reactive).

Standards are chosen and processes are established to achieve those standards in the planning phase. Project quality focuses on the end deliverables that reflect the purpose of the project. The project leader is responsible for developing a quality management plan that defines the quality expectations and for ensuring the specifications and expectations are met. In the execution phase, the project team attempts to prevent quality issues from occurring with the use of quality management techniques, such as checklists, assessments, and lean six-sigma tools. Lean six-sigma tools are focused on creating efficient and effective processes that involve error-proofing methods.

### *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. The following represents the quality planning tools available to the project manager.

**Cost-benefit analysis** is looking at how much your quality activities will cost versus how much you will gain from doing them. The costs are easy to measure; the effort and resources it takes to do them are just like any other task on your schedule. Since quality activities don’t actually produce a product, it is sometimes harder for people to measure the benefit. The main benefits are less reworking, higher productivity and efficiency, and more satisfaction from both the team and the customer.

**Benchmarking** means using the results of quality planning on other projects to set goals for your own. You might find that the last project in your company had 20% fewer defects than the one before it. You should want to learn from a project like that and put into practice any of the ideas they used to make such a great improvement. Benchmarks can give you some reference points for judging your own project before you even start the work.

**Design of Experiments** is the list of all the kinds of tests you are going to run on your product. It might list all the kinds of test procedures you’ll do, the approaches you’ll take, and even the tests themselves. (In the software world, this is called test planning.)

**Cost of Quality** is what you get when you add up the cost of all the prevention and inspection activities you are going to do on your project. It doesn’t just include the testing. It includes any time spent writing standards, reviewing documents, meeting to analyze the root causes of defects, and reworking to fix the defects once they’re found by the team: in other words, absolutely everything you do to ensure quality on the project. Cost of quality can be a good number to check to determine whether your project is doing well or having trouble. Say your company tracks the cost of quality on all of its projects; then you could tell if you are spending more or less than has been spent on other projects to get your project up to quality standards.

**Control Charts** can be used to define acceptable limits. 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** can help in discovering problems. 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.

In the monitoring and control phase, the project team reviews the project deliverables to ensure they are ready for review and sign-off. Ideally, this review leads to deliverable acceptance. However, the team may encounter problems that they are unable to prevent. When this occurs, the team’s objective is to determine how to fix these problems. One of the most effective ways to address a problem is to begin by understanding its root cause(s). Cause-and-effect diagrams, which are also referred to as fishbone or Ishikawa diagrams, are very effective for this purpose.

## Monitoring Stakeholder Engagement

Project teams cannot control stakeholders. However, they can significantly influence their level of engagement. During the planning phase of a project, the stakeholder register is created which is an effective tool for keeping track of a project's stakeholders, their relative interest in the project, and their level of power/influence over the project's outcomes. The register provides an effective starting place for determining how to engage stakeholders according to their power and interest levels if a Power/Interest Grid is used.

During the monitoring and control phase, the project team looks for new stakeholders and monitors the engagement level of existing stakeholders. Engagement techniques will vary from one organization to another as their respective cultural norms and values influence how individuals work together. Some organizations prefer face-to-face interaction while others prefer the use of electronic messaging and project team websites. Whatever the methods are used to engage stakeholders, it is important to keep stakeholders informed of the project's progress and to find the right approaches for meaningfully involving stakeholders throughout the life of the project.

A project leader's interpersonal skills are critical in stakeholder management. Some stakeholders may have become unresponsive to the project team's requests. When this occurs, the project leader's relationship-building skills will be put to the test as they attempt to understand the stakeholder's actions. Conflict resolution skills, such as negotiating, are vital because stakeholders are very likely to have differing priorities, and successfully navigating these conflicts can be the difference between project success and project failure.

## Monitoring Communications

Communication is one of the most effective ways to keep team members and all other stakeholders engaged. In order for this communication to be effective, it must be developed and delivered in ways that consider stakeholder roles and communication preferences. During the planning phase, a communication plan would be created to guide the project team's communication efforts throughout the project. It is important for project leaders to proactively determine if the selected communication methods will be suitable for the key stakeholders. This is done by directly asking them and monitoring their responsiveness to the communication delivered. Another important way to determine if project stakeholders are well-informed is to pay careful attention to the questions they ask. Questions about project progress that have been addressed in recent project communications are a good sign that the communication techniques may not be effective for a particular stakeholder. When this occurs, it is time to revisit the communication plan and make the appropriate adjustments.

## Controlling Procurements

Monitoring procurement includes ensuring the vendors' performance meets the agreed-upon, often contractual, requirements. The complexity of the project determines the number and type of vendors procured. This, in turn, determines the nature of the monitored activities. For instance, projects that only require supplies to be purchased externally will have much simpler vendor management processes than projects that had to outsource the completion of some of the work to external consultants.

Key tools and techniques that may be used in procurement management include inspections, audits, formal change control methods, vendor-produced performance reports, payment systems, and contract administration.

## Monitoring Risks

Monitoring and controlling risks involves implementing a risk management plan. A key aspect of this plan is often the risk register, which helps the team keep track of the project risks, triggers (early warning signs), and risk responses. Risk responses can be implemented in any phase of the project as long as documentation is kept up to date.

Many project teams establish contingency plans and contingency funds to account for all types of risks (e.g., negative and positive risks, individual and overall project risks). When these risks materialize, the project team determines if the contingency plans and/or funds will address these risks and, if so, they will be implemented. If contingency plans/funds don't suffice, the project team must identify workarounds. Contingency plans and workarounds are then monitored to determine if they were effective. Additional corrective action may be required.

## Controlling Resources

Projects require human resources, physical resources, and services in order to produce the desired outcomes. During monitoring and controlling, the project leader assesses the effectiveness of all types of resources.

With respect to the project team, effective project managers continuously assess the performance of the team and its members. Effective coaching and mentoring skills are essential and can be the difference between project success and failure. In addition, a project leader must sometimes make the difficult decision to replace team members when they are not able to perform as expected or the ensuing conflicts cannot be resolved. Conflict management skills are important in this regard. Proactive conflict management requires the project leader to continuously monitor stress levels in the team in an attempt to anticipate the likelihood of rising conflict. Monitoring resource utilization levels in the project schedule and staying connected to project team members are also critical activities that the project leader must perform. Lastly, many projects require people with different skills at different times. Project leaders should be actively monitoring when these skills will be required and ensuring people join/transition off the project at the appropriate times.

The availability and effectiveness of physical resources are also closely monitored. In some instances, faulty or ineffective equipment has to be replaced. If the scope of the project changes, new equipment and technology may be required, which, in turn, may lead to additional work in procurement management.

Monitoring and controlling is about integrating all the teams while assuring that work is being completed at a steady rate to keep the project on track. This phase is vital to the overall success of the project. Thus, requiring additional, highly-skilled resources, is a key consideration during the planning phase.

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