Project Quality Management

Project Skills

Team FME

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Preface

This eBook describes the process of quality management in projects. It includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.

You will learn:

- Why quality management is treated as a distinct knowledge area
- How to identify quality requirements and set standards
- How to perform quality assurance
- How to monitor and control quality
- How to tell when a project is out of control

The Free Management eBooks 'Project Skills' series are structured around the ten key knowledge areas of project management detailed in the 'Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide)—Fifth Edition, Project Management Institute Inc., 2013'. ISBN-13: 978-1935589679.

The eBooks in this series follow the structure of the PMBOK® Guide because it represents a tried and tested framework. We have tried to ensure full alignment of our eBooks with the Guide by using the numbering convention as well as the naming convention.

If you need more detailed explanation of a particular subject then you can simply refer to the related chapter and paragraph number in the PMBOK® Guide. Remember, many of the generic project management methodologies available refer to the PMBOK® Guide as a basic framework.

A knowledge of the PMBOK® processes will go a long way towards giving you an understanding of almost any project management methodology that your organization may use.

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About this Knowledge Area

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

It implements the quality management system through policy and procedures with continuous process improvement activities conducted throughout, as appropriate.

Process	Project Phase	Key Deliverables
8.1 Plan Quality Management	**Planning**	Quality Management Plan, Quality Metrics
8.2 Perform Quality Assurance	**Execution**	Change Requests
8.3 Control Quality	**Monitoring and Controlling**	Quality control Measurements

Quality management, like every other aspect of the project management, should be proactive. Limiting the quality management to detecting defects is reactive.

You should plan the quality and prepare an environment that does not create defects, instead of finding and repairing defects.

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Introduction

Many people who are new to project management find it strange that quality is treated as a separate area. Surely, quality should be present in every aspect of the project. This way of thinking begs the question, why is quality treated as something that can be managed separately? To answer this, we need to define exactly what we mean by 'quality' and who gets to decide what this definition is.

In some situations a quality standard might be obvious, for example a computer system used by customer service staff must be able to deal with peak loads. In this case, a quality standard could specify that when one hundred staff are inputting data at the same time, the system response time must still be less than two seconds.

However quality is not always quite so easy to define; consider the design of the computer interface to capture customer data.

> ***The software engineer responsible for the design might consider conformance to industry standards to be a sign of quality.***
>
> ***The user might consider it more important that the design matches the interfaces that they already use.***
>
> ***In this example, it is more important that the users will be able to work more efficiently than that the design conforms to some theoretical external standard.***

In fact, it should always be the end user who decides what counts as quality rather than the people doing the work. Although this can be complicated when a project has a number of users who have different priorities.

In the example we have been using, it may be important for customer service staff who deal with billing to see a summary of the past two years of payment history on the 'home'

screen whereas staff who deal with complaints might prefer to see the complaint history. Focusing too much on one group of users may compromise the others and leave them dissatisfied. This illustrates one reason why a system to manage quality is required.

There are six possible reasons why quality standards might not be met despite everyone on the project team doing their best to deliver the project as specified.

1. The users were not asked to specify their requirements in sufficient detail
2. Not all of the user groups were asked
3. The requirements were not understood
4. They were understood but could not be achieved
5. The quality requirements changed during the project
6. The quality requirements were exceeded

The first five points are easily understandable, but the last one needs some explanation. If quality requirements have been exceeded then someone somewhere has done more work than has been planned for in that part of the project.

This work needs to be paid for, in either time or money and this has not been budgeted for. Because there is a lag when comparing actual progress against planned progress and for money actually spent against the budget, this is not usually obvious at the time.

> ***The result of exceeding the quality plan is that sooner or later either more money needs to found or the scope of the project needs to be reduced. Neither of these things is acceptable.***

The purpose of quality management is to make sure that the project meets the needs for which it was created. To do this it needs to take account of the reasons above why it might not. It needs to ensure that:

1. Users are asked to specify their requirements in sufficient detail
2. Requirements are fully documented
3. All stakeholders agree to them
4. There is a recognized process to deal with any changes
5. There is a process for monitoring and controlling quality

Modern quality management complements project management and both disciplines recognize the importance of:

- **Customer Satisfaction**—this involves understanding, evaluating, defining, and managing expectations so that customer requirements are met. This requires a combination of conformance to requirements, to ensure the project produces what it was created to produce, and fitness for use (the product or service must satisfy real needs).
- **Prevention Over Inspection**—one of the fundamental tenets of modern quality management states that quality is planned, designed, and built in rather than inspected in. The cost of preventing mistakes is generally much less than the cost of correcting them when they are found by inspection.

- **Continuous Improvement**—the plan-do-check-act cycle is the basis for quality improvement. This is described in detail in the 'Project Process Groups' eBook, which can be downloaded free from this website.
- **Management Responsibility**—success requires the participation of all members of the project team, but remains the responsibility of management to provide the resources needed to succeed.

The PMBOK® Project Quality Management Processes

There are three Project Quality Management processes:

8.1 Plan Quality Management
8.2 Perform Quality Assurance
8.3 Control Quality

These are dealt with in detail in the following chapters of this eBook.

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8.1 Plan Quality Management

This process is about deciding what quality means for this particular project and its deliverables. This information makes up the quality plan, which is part of the project plan. Planning for quality is no different from planning for any other task.

It aims to produce a description of what the quality requirements are and how they are going to be achieved. As well as providing a definition of quality the quality plan also acts as a communication tool to engage key stakeholders in the quality management process.

A quality plan can be as simple or as detailed as warranted by the project. The plan below is short and simple but it makes it clear to everyone on the project what is expected in terms of quality.

The PMBOK® defines this process as follows:

> ***'Plan Quality is the process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance.***
>
> ***Quality planning should be performed in parallel with the other project planning processes.***

For example,

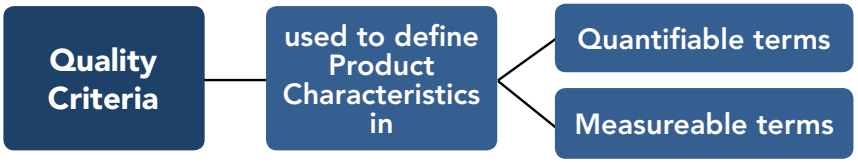
> ***Proposed changes in the product to meet identified quality standards may require cost or schedule adjustments and a detailed risk analysis of the impact to plans.'***

In practice, quality planning is inseparable from general planning because quality criteria are required as part of the product descriptions. That is, they need to be thought about when a deliverable is being specified rather than 'added on' afterwards.

Imagine a project to produce a brochure for a new Smartphone.

> ***One of the selling points of this new Smartphone model is that it is extremely rugged.***
>
> ***The photographs in the brochure need to show the phone being used in various outdoor environments like construction sites and oilrigs.***
>
> ***The quality criteria for these photographs might specify that the phone must be clearly identifiable in each photo with the brand name visible.***

In another project one of the final deliverables is a hand held device for scanning barcodes. Quality criteria for this physical product would include things like operational distances from the object being scanned, light levels, acceptable error rates, etc.



Quality criteria should always be used to define the characteristics of a product in terms that are quantifiable and measurable. The criteria effectively define 'quality' and are used as a benchmark against which to measure the finished product.

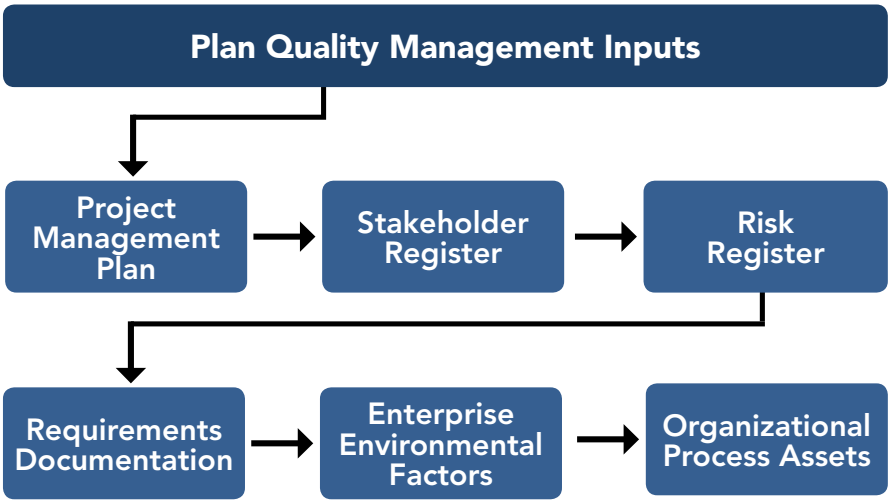
They should be detailed in the related product description and should be established by considering what the important characteristics of a product are in satisfying the need that it addresses.

Inputs	Tools & Techniques	Outputs
Project Management Plan	Cost-Benefit Analysis	Quality Management Plan
Stakeholder Register	Cost of Quality	Process Improvement Plan
Risk Register	Seven Basic Quality Tools	Quality Metrics
Requirements Documentation	Benchmarking	Quality Checklists
Enterprise Environmental Factors	Design of Experiments	Project Documents Updates
Organizational Process Assets	Statistical Sampling	
	Additional Quality Planning Tools	
	Meetings	

The quality criteria of a project should always be stated objectively, subjective statements like 'quick response' or 'maintainable' are unsatisfactory because they can't be measured. The inputs, tools and techniques, and outputs of this process are summarized in the table above.

8.1.1 Plan Quality Management: Inputs

This process requires the following inputs:



8.1.1.1 Project Management Plan

The scope statement contains the project description, major project deliverables, and acceptance criteria. This is an important input to the quality planning process because if something is out of scope than there is no need to worry about its quality.

For example,

> ***If the aim of the project was to deliver a prototype then it may be safe to ignore some 'official' standards because the product is not going to be used outside of the organization.***

This is often the case when the aim of the project is concerned with prototyping or proving a concept rather than producing a marketable product or an IT system that is going to be used operationally. In these cases the scope document can be used to justify why certain 'standards' are not being met.

The product scope description will often contain details of technical issues and other concerns that can affect quality planning. The definition of acceptance criteria can significantly increase or decrease project costs and quality costs. Satisfying all acceptance criteria implies the needs of the customer have been met.

The Cost Performance Baseline specifies what costs will be incurred and when. This matters because most projects will not receive their funding as a lump sum at the beginning but will be financed according to a monthly or quarterly budget. It is described in detail in the 'Project Cost Management' eBook available free from the online library of this website www.free-management-ebooks.com .

The Schedule Baseline is a specific version of the project schedule developed from the schedule network analysis. It is accepted and approved by the project management team as the schedule baseline with baseline start dates and baseline finish dates. It is a component of the project management plan. It is described in detail in the 'Project Time Management' eBook available free from the online library of this website www.free-management-ebooks.com .

8.1.1.2 Stakeholder Register

This document identifies stakeholders with a particular interest in, or impact on, quality. It is an important input because it helps to ensure that all of the relevant stakeholders are consulted including the people who will actually do the work.

Projects often run into trouble because the technical people who are actually going to do the work have not been properly consulted about what is and is not achievable. This is quite common in IT projects when the project sponsor has little understanding of how the underlying system will work and whose expectations may be based on a combination of the software vendors exaggerated claims and the fact that many IT managers often don't really understand the technical side of the business.

8.1.1.3 Risk Register

This contains information on threats and opportunities that may impact quality requirements. It is described in detail in the 'Project Risk Management' eBook available free from the online library of this website www.free-management-ebooks.com .

Meeting quality requirements poses risk to the project. For this reason, the risk register will identify quality-related risks and in particular, those relating to customer acceptance.

8.1.1.4 Requirements Documentation

This captures the stakeholder's quality requirements, among other things. These are used to help plan how quality control will be implemented on the project.

8.1.1.5 Enterprise Environmental Factors

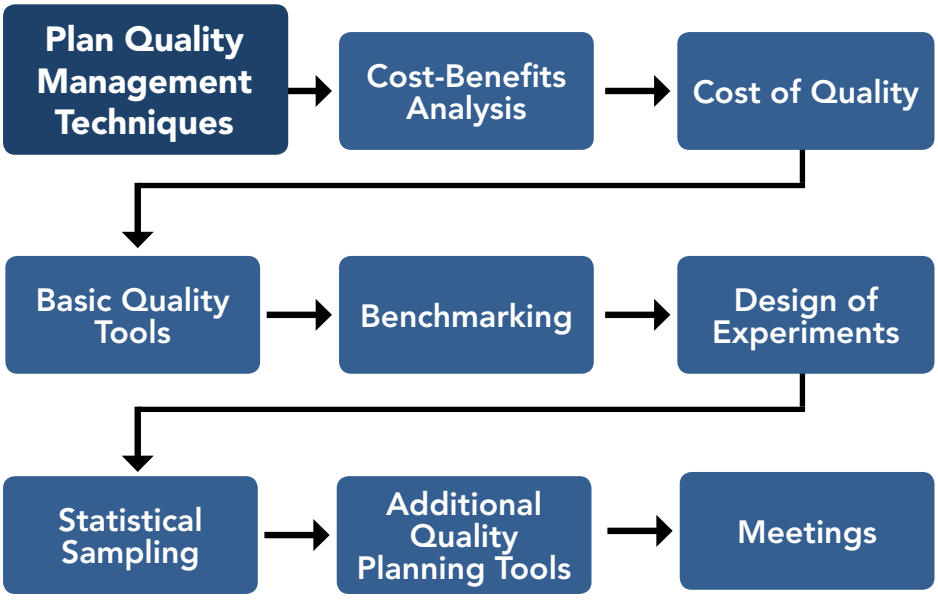
These include any special features of the project's environment that may affect project quality for example, governmental agency regulations, rules, standards, and guidelines specific to the application area.

8.1.1.6 Organizational Process Assets

The quality policy of the organization can be adopted 'as is' for use by the project. If it lacks a formal quality policy, or if the project involves multiple performing organizations, the project management team will need to develop a quality policy for the project. Regardless of the origin of the quality policy, the project management team must ensure that the project stakeholders are fully aware of the policy used for the project through the appropriate distribution of information.

8.1.2 Plan Quality Management: Tools and Techniques

The PMBOK® lists several tools and techniques that can be used in the quality planning process. It is very unlikely that any individual project manager would be expected to be skilled in using all of them.



A better approach would be to have an appreciation of what each one involves and then to select the those that best suit the project and delegate the work to project team members who have expertise in that technique.

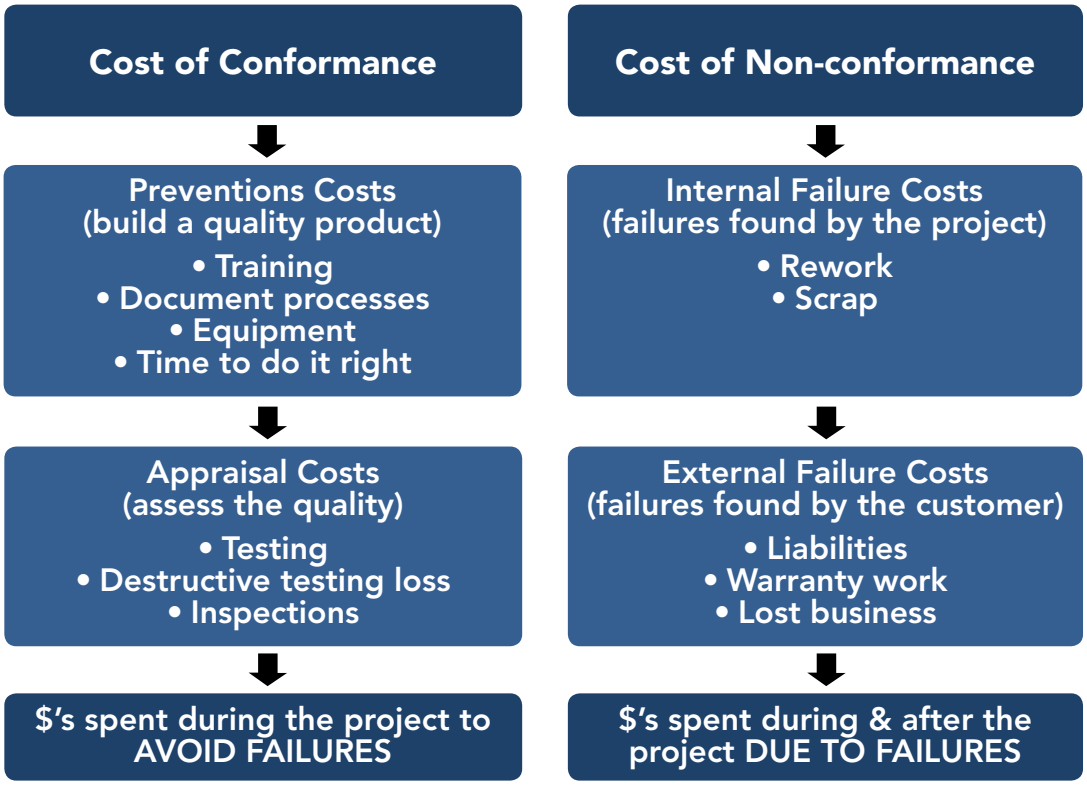
8.1.2.1 Cost-Benefit Analysis

This is by far the most important decision making tool and involves nothing more than common sense and judgment based on experience. All quality management activities have a related cost and that cost must be justified in terms of benefit to the project sponsor and the organization as a whole.

No activities should be performed that would equal or cost more than the expected benefits. It should show that the level of quality is viable from a cost perspective and justify its inclusion in the quality plan.

8.1.2.2 Cost of Quality

This includes all costs incurred over the life of the product and looks at the costs of conformance to quality standards and the costs of nonconformance.



For example, the proposed quality standard for the production of a metal pressing might mandate a tolerance of 1mm. In other words the finished part can be up to 1mm bigger or smaller than the specification.

> ***The costs of conformance include both the prevention and appraisal costs incurred in conforming to this standard (Training, equipment, additional time, testing and inspections).***
>
> ***The costs of nonconformance include internal and external costs that would be incurred if this quality standard were not achieved. These would include the costs of reworking or scrapping the failed parts (internal cost) and the costs associated with sending out parts that were unacceptable to the customer.***

Project decisions can impact operational costs of quality as a result of product returns, warranty claims, and recall campaigns. Therefore, due to the temporary nature of a project, the sponsoring organization may choose to invest in product quality improvement, especially defect prevention and appraisal, to reduce the external cost of quality.

8.1.2.3 Seven Basic Quality Tools

Most of the tools and techniques described here are based on statistical analysis and are most appropriate where the project deliverables are products that can be measured in some way.

For example,

> ***If parts are being produced on a production line then it will be straightforward to measure dimensions, tolerances, failure rates, etc.***

However, many project deliverables are not like this and it is not possible to collect this type of data. For example,

> ***Anything that provides a user 'experience' can be difficult to measure in this way.***

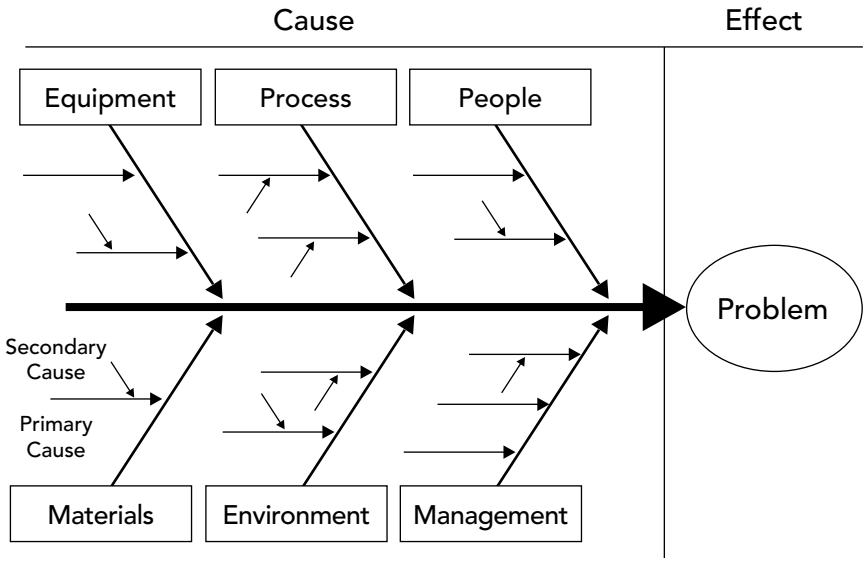
The best approach is to be aware of what tools and techniques exist and to select those that are appropriate for the project you are working on. It may even be possible to adapt some of them in order to provide useful data about quality even if you are not making a product that can easily be measured.

One other point is that unless you are taking the PMBOK® exams, you do not really need to understand these techniques at a practitioner level. As a project manager, your job is to oversee the whole project and call on specific expertise as needed, you should not be expected to 'do' everything yourself.

1. Cause and Effect Diagrams

Also called Ishikawa diagrams or fishbone diagrams, they illustrate how various factors might be linked to potential problems or effects. Factors are usually grouped into major categories as shown:

- **People**—Anyone involved with the process
- **Methods**—How the process is performed and the specific requirements for doing it, such as policies, procedures, rules, regulations and laws
- **Machines**—Any equipment, computers, tools, etc. required to accomplish the job
- **Materials**—Raw materials, parts, pens, paper, etc. used to produce the final product
- **Measurements**—Data generated from the process that are used to evaluate its quality
- **Environment**—The conditions, such as location, time, temperature, and culture in which the process operates



This is not a statistical technique and is therefore applicable to almost all types of project. It does have its critics precisely because is not quantitative and requires a lot of subjective analysis and judgment.

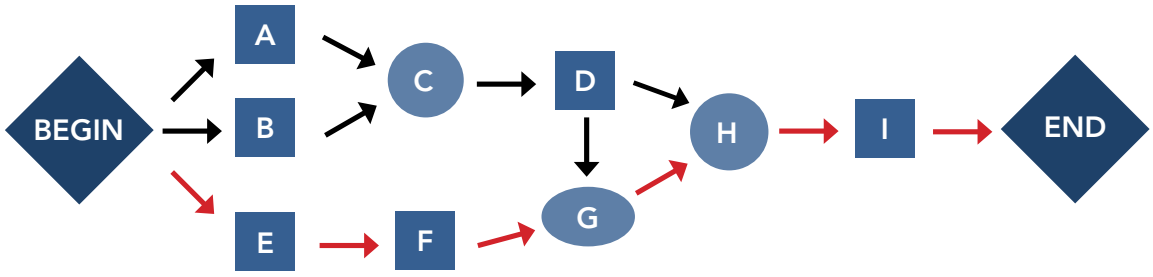
It's strengths are that it can help you to make sense of a situation where there are a lot of variables that are interacting with each other, none of which are quantifiable. It is also a powerful visual tool when you are trying to explain your analysis to others.

2. Flowcharts

This is a graphical representation of a process showing the relationships among process steps. There are many styles, but all process flowcharts show

- Activities,
- Decision points, and the
- Order of processing.

Flowcharting can help the project team anticipate quality problems that might occur and this awareness can result in the development of test procedures or approaches for dealing with them.



A flowchart is common type of chart that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows.

There are many different types of flowcharts, and each type has its own repertoire of boxes and notational conventions. The two most common types of boxes in a flowchart are:

- Processing step (usually called activity) is denoted as a rectangular box
- Decision is usually denoted as a diamond

Flowcharts are used in designing and documenting complex processes. Like other types of diagram, they help visualize what is going on and thereby help the viewer to understand a process, and perhaps also find flaws, bottlenecks, and other less-obvious features within it.

3. Checksheets

These are also known as tally sheets and may be used as a checklist when gathering data.

Motor Assembly Check Sheet

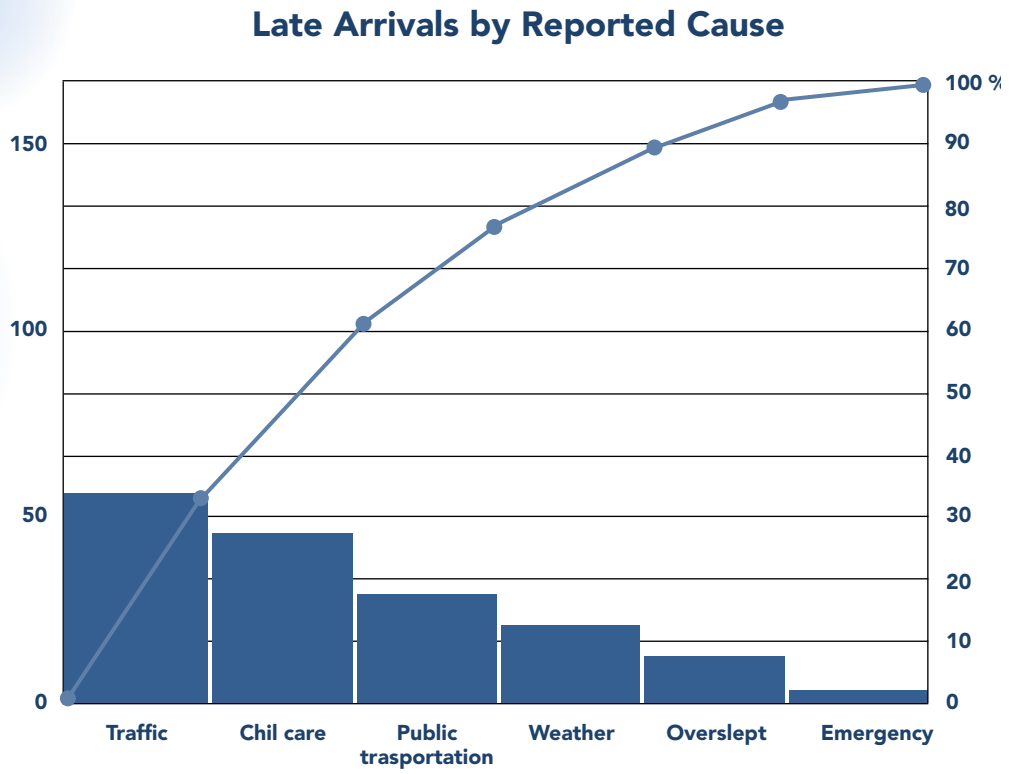
Name of Data Recorder: Lester B. Rapp
Location: Rochester, New York
Data Collection Dates: 1/17 - 1/23

Defect Types/ Event Occurence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Supplied parts rusted		||||||||	|||||	||||	||			20
Mislaigned weld			|||			||		5
Improper test procedure								0
Wrong part issued		|		||				3
Film on parts								0
Voids in casting				||||	||			6
Incorrect dimensions						||		2
Adhesive failure								0
Masking insufficient					|			1
Spray failure			|||||					5
Total		**10**	**13**	**10**	**5**	**4**		

They are used to organize facts in a manner that will facilitate the effective collection of useful data about a potential quality problem and are especially useful for gathering attributes data while performing inspections to identify defects.

4. Pareto Diagram

This is a special type of histogram where the values being plotted are arranged in descending order. The graph is accompanied by a line graph that shows the cumulative totals of each category.



- Left vertical axis shows the frequency of occurrence, cost or other important unit of measure.
- Right vertical axis is the cumulative percentage of the total.

In quality control, the Pareto chart often represents the most common sources of defects, the highest occurring type of defect, or the most frequent reasons for customer complaints, etc. The Pareto chart was developed to illustrate the 80-20 Rule, which states that 80 percent of the problems stem from 20 percent of the various causes.

5. Histogram

This is a vertical bar chart showing how often a particular variable state occurred, with the height of each column representing the relative frequency. Histograms are useful when presenting project data to stakeholders as they can give a clear indication of which problems are the most important to tackle.

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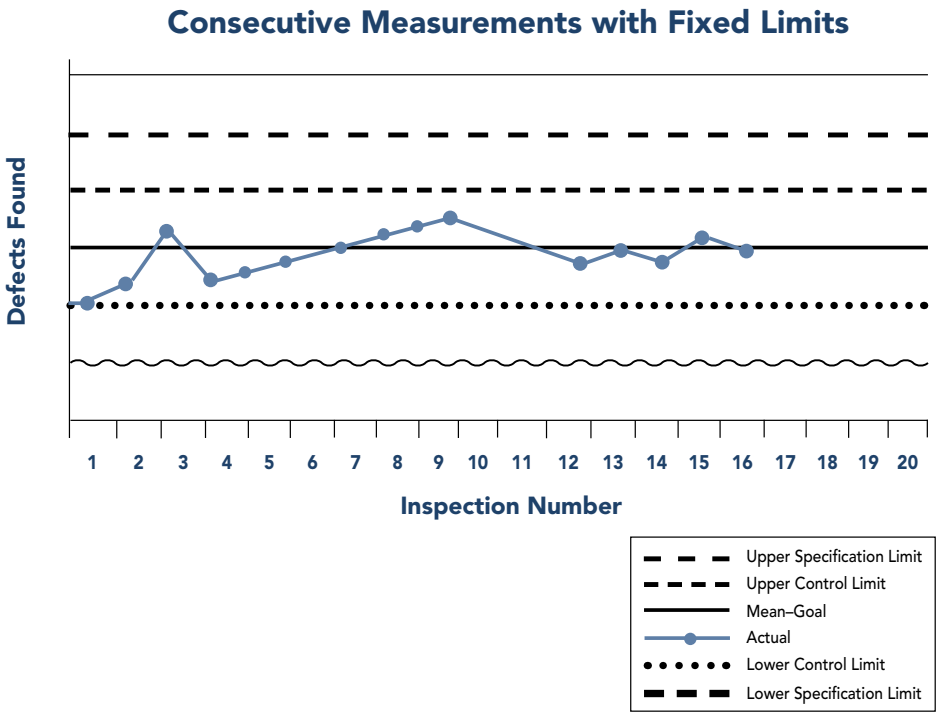
6. Control Charts

These answer the question:

> ***'Is this process variance within acceptable limits?'***

The pattern of data points on a control chart may reveal random fluctuating values, sudden process jumps, or a gradual trend in increased variation. By monitoring the output of a process over time, a control chart can help assess whether the application of process changes resulted in the desired improvements.

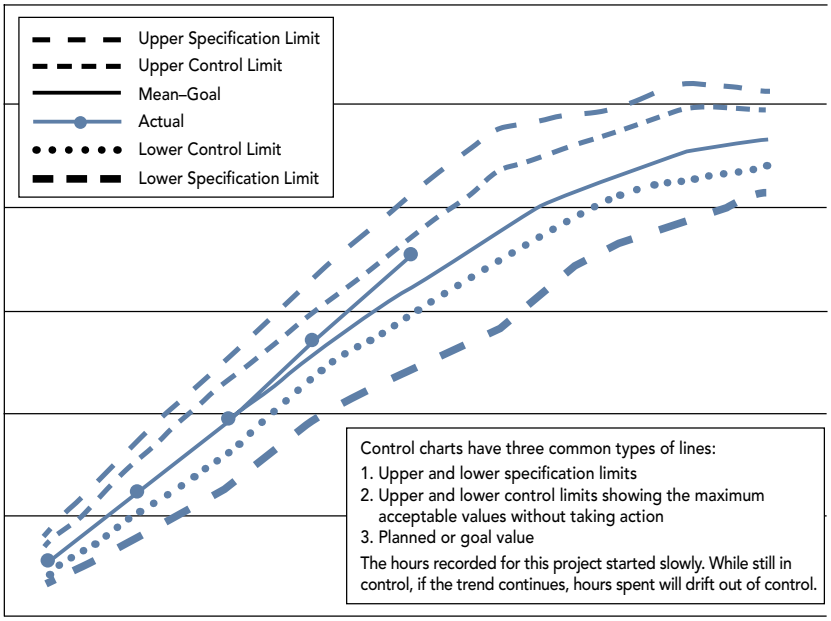


When a process is within acceptable limits it is in control and does not need to be adjusted. Conversely, when a process is outside acceptable limits, the process should be adjusted.

> ***Seven consecutive points above or below the central line indicate a process that is out of control.***

The upper control limit and lower control limit are usually set at (plus or minus) three Sigma, where one Sigma is one standard deviation.

Sample Control Chart



Although used most frequently to track repetitive activities required for producing manufactured lots, control charts may also be used to monitor cost and schedule variances, volume, and frequency of scope changes, or other management results to help determine if the project management processes are in control.

7. Scatter Diagram

These use Cartesian coordinates to display values for two variables for a set of data. The data is displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis.

A scatter diagram can suggest various kinds of correlations between variables with a certain confidence level. Correlations may be:

- Positive (rising)—If the pattern of dots slopes from lower left to upper right, it suggests a positive correlation between the variables being studied.
- Negative (falling)—If the pattern of dots slopes from upper left to lower right, it suggests a negative correlation.
- Null (uncorrelated).

A line of best fit can be drawn in order to study the correlation between the variables. One of the most powerful aspects of a scatter diagram is its ability to show nonlinear relationships between variables.

8.2.1.4 Benchmarking

This is simply a quality standard reference that is used for the current project. This may be a benchmark used within the performing organization, or one that is used across a specific industry. It involves comparing actual or planned project practices to those of comparable projects to identify best practices, generate ideas for improvement, and provide a basis for measuring performance.

The value of using this technique is to compare the current project's quality standards with those of other similar projects.

8.1.2.5 Design of Experiments

This is a statistical method for identifying which factors may influence specific variables of a product or process under development or in production.

8.1.2.6 Statistical Sampling

This involves choosing part of a population of interest for inspection. Sample frequency and sizes should be determined so the cost of quality (described above) will include the number of tests, expected scrap, etc. In some application areas it may be necessary for the project management team to be familiar with a variety of sampling techniques in order to chose the most appropriate one.

8.1.6.7 Additional Quality Planning Tools

Other quality planning tools are often used to better define the quality requirements and plan effective quality management activities. These include:

- Brainstorming,
- Affinity diagrams,
- Force field analysis,
- Nominal group techniques,
- Matrix diagrams, and
- Prioritization matrices.

As with proprietary quality management methodologies, if your organization uses these tools then you can expect that the relevant expertise will be made available to you.

8.1.6.8 Meetings

These involve people who are responsible for quality management including the project manager, the project sponsor, selected project team members, selected stakeholders, anyone with responsibility for any of the quality management processes, and others as needed.

Collective decision-making is very important area of project management that the PM-BOK® does not go into any detail about but which can make or break this part of the project. Almost all of the processes that for part of project time management will involve meetings between the project manager, the team and other stakeholders in order to make decisions about the activity definitions and associated estimates. How well these meetings are conducted will have a major impact on how smoothly the project runs.

If you feel as though your project meetings could be improved then you can download the 'Meeting Skills' eBooks from our free online library www.free-management-ebooks.com. These free eBooks cover all aspects of meetings including how to set an agenda that will ensure that the meeting achieves it's aims and how to chair a meeting so that it is as productive as possible.

8.1.3 Plan Quality Management: Outputs

This process will create the following outputs shown in the diagram.

8.1.3.1 Quality Management Plan

This describes how the project management team will implement the quality policy and is a component of the project management plan. The degree of formality and level of detail is determined by the requirements of the project but it should include:

- The quality objectives for the project
- A list of the standards, tools and techniques used
- A statement of how quality will be measured

8.1.3.2 Process Improvement Plan

This is a form of lessons learned and is part of the project management plan. It lays out exactly how quality activities will be refined, streamlined, and improved both for this, and future projects.

8.1.3.3 Quality Metrics

A quality metric describes, in very specific terms, a project or product attribute and how the quality control process will measure it. Since the success of the project depends upon it meeting the quality metrics, they must be measurable in some way.

8.1.3.4 Quality Checklists

This is a structured tool, usually component-specific, used to verify that a set of required steps has been performed. Many organizations have standardized checklists available to ensure consistency in frequently performed tasks.

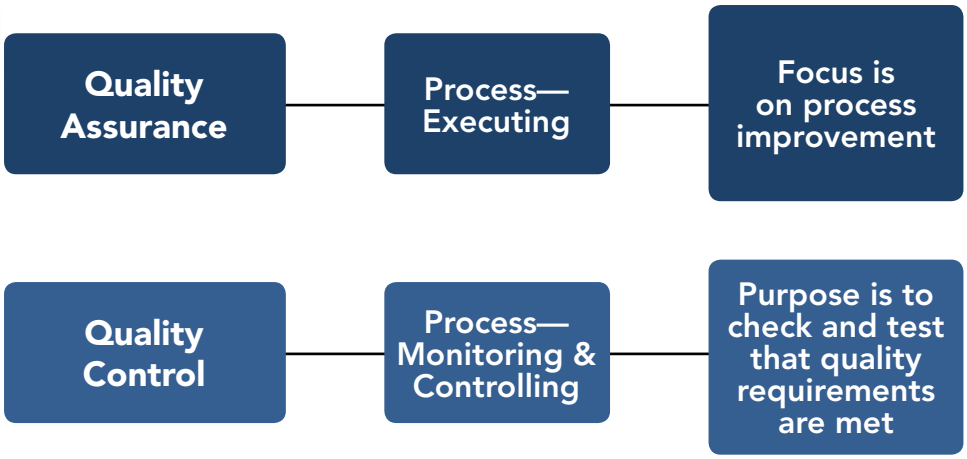
In some application areas, checklists are also available from professional associations or commercial service providers.

8.1.3.5 Project Document Updates

This usually means the specified quality standards.

8.2 Perform Quality Assurance

There is a lot of confusion about quality assurance and quality control. The difference is that quality assurance is part of the executing process and is concerned with making sure that the quality objectives are met. It is focused on process improvement.



Quality control, on the other hand, is part of the monitoring and controlling process and is concerned with checking (by means of measuring and testing) that the quality requirements are being met.

The PMBOK® defines quality assurance as:

> *'The application of planned, systematic quality activities to ensure that the project will employ all processes needed to meet requirements.'*

This process also provides an umbrella for continuous process improvement, which is an iterative means for improving the quality of all processes so as to reduce waste and eliminate activities that do not add value.

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The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Quality Management Plan	Quality Management & Control Tools	Change Requests
Process Improvement Plan	Quality Audits	Project Management Plan Updates
Quality Metrics	Process Analysis	Project Documents Updates
Quality Control Measurements		Organizational Process Assets Updates
Project Documents		

8.2.1 Perform Quality Assurance: Inputs

This process requires the following inputs:

8.2.1.1 Quality Management Plan

This plan contains the following information that is used to assure quality. It describes how quality assurance will be performed within the project.

8.2.1.2 Process Improvement Plan

This plan details the steps for analyzing processes to identify activities that enhance their value.

8.2.1.3 Quality Metrics

As described in the previous process, a quality metric describes, in very specific terms, a project or product attribute and how the quality control process will measure it.

8.2.1.4 Quality Control Measurements

These are the results of the quality control activities described later. They are used to analyze and evaluate the organization's quality standards and processes.

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8.2.1.5 Project Documents

These may influence quality assurance work and should be monitored within the context of a system for configuration management.

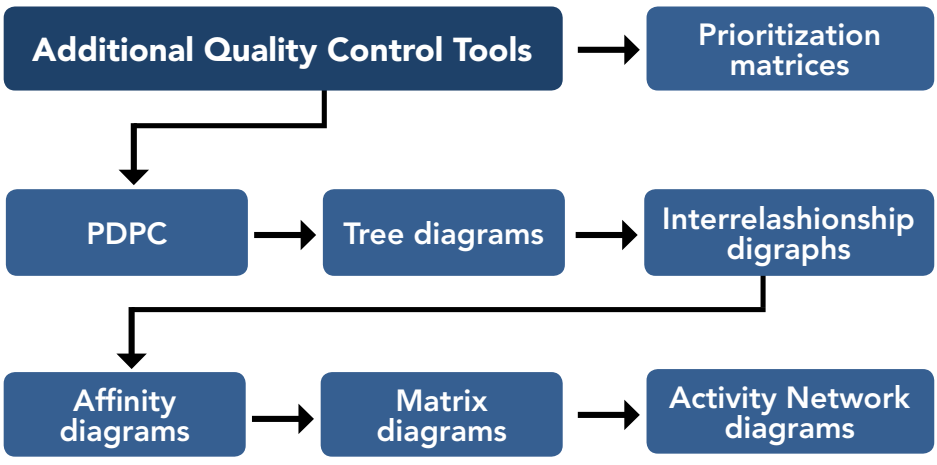
8.2.2 Perform Quality Assurance: Tools and Techniques

There are three tools and techniques that can be used.

- Quality management and control tools
- Quality Audit
- Process Analysis

8.2.2.1 Quality Management and Control Tools

The tools and techniques from the other two processes in this knowledge area can also be used in this process. In addition, other tools that are available are shown in the diagram below.



Affinity diagrams

The affinity diagram is similar to mind-mapping techniques in that they are used to generate ideas that can be linked to form organized patterns of thought about a problem.

Using the affinity diagram to give structure to the decomposition of scope may enhance the creation of the WBS.

Process decision program charts (PDPC)

These charts are used to understand a goal in relation to the steps for getting to the goal. The PDPC is useful as a method for contingency planning because it aids teams in anticipating intermediate steps that could derail achievement of the goal.

Interrelationship digraphs.

The interrelationship digraphs provide a process for creative problem solving in moderately complex scenarios that possess intertwined logical relationships for up to 50 relevant items.

The interrelationship digraph may be developed from data generated in other tools such as the affinity diagram, the tree diagram, or the fishbone diagram.

Tree diagrams

Tree or systematic diagrams may be used to represent decomposition hierarchies such as the:

- WBS (work breakdown structure),
- RBS (risk breakdown structure), &
- OBS (organizational breakdown structure).

In project management, tree diagrams are useful in visualizing the parent-to-child relationships in any decomposition hierarchy that uses a systematic set of rules that define a nesting relationship.

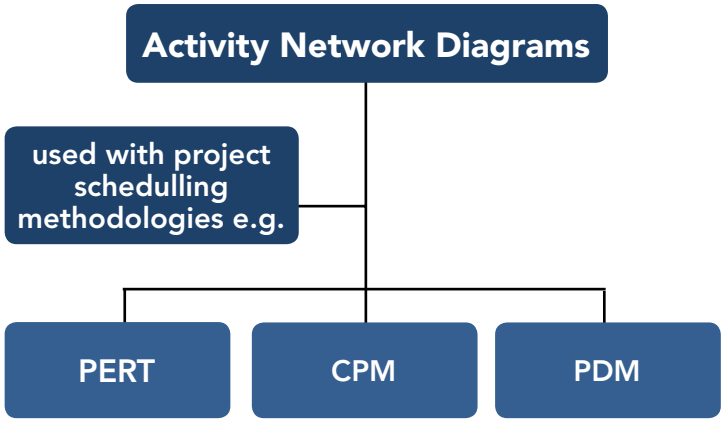
Tree diagrams can be depicted horizontally (such as a risk breakdown structure) or vertically (such as a team hierarchy or OBS). Because tree diagrams permit the creation of nested branches that terminate into a single decision point, they are useful as decision trees for establishing an expected value for a limited number of dependent relationships that have been diagramed systematically.

Prioritization matrices

These are used to identify the key issues and the suitable alternatives to be prioritized as a set of decisions for implementation. Criteria are prioritized and weighted before being applied to all available alternatives to obtain a mathematical score that ranks the options.

Activity network diagrams

In the past Activity network diagrams have been known as 'arrow diagrams'. They include both the AOA (Activity on Arrow) and, most commonly used, AON (Activity on Node) formats of a network diagram.



Activity network diagrams are used with project scheduling methodologies such as program evaluation and review technique (PERT), critical path method (CPM), and precedence diagramming method (PDM).

Matrix diagrams

A quality management and control tool used to perform data analysis within the organizational structure created in the matrix.

The matrix diagram seeks to show the strength of relationships between factors, causes, and objectives that exist between the rows and columns that form the matrix.

8.2.2.2 Quality Audits

This is a structured, independent review to determine whether project activities comply with organizational and project policies, processes, and procedures. The words 'independent' and 'audit' are open to interpretation depending on the requirements of the particular project.

There is no need to use external auditors or to make the process particularly formal or bureaucratic provided that the information fed back from the process is credible to both the project team (who are doing the work) and the sponsor (who is paying for it).

The audit should:

- Identify where the best practices being implemented
- Identify where they are not being used
- Share best practices proven in similar projects
- Help the project team to implement them
- Assure the project sponsor that work is being done in line with accepted best practices

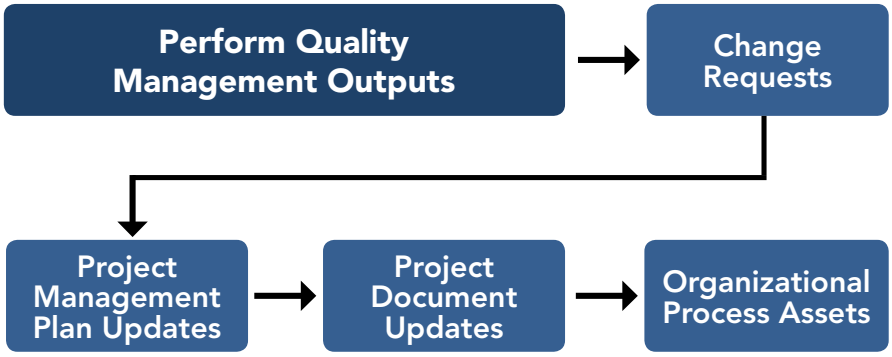
This process should result in a reduced cost of quality and an increase in sponsor or customer acceptance of the project's product. Quality audits can be carried out whenever necessary for either the whole project or a part of it.

8.2.2.3 Process Analysis

This tool is used to review the quality process with the aim of ensuring that it works both efficiently and effectively.

8.2.3 Perform Quality Assurance: Outputs

This process will create the following outputs:



8.2.3.1 Change Requests

Quality improvement includes taking action to increase the effectiveness and/or efficiency of the policies, processes, and procedures of the performing organization. Change requests are created and used as input into the 4.5 Perform Integrated Change Control process (this is described in detail in the 'Project Integration Management', which is available from our free online library at www.free-management-ebooks.com).

Change requests can be used to take corrective action or preventive action or to perform defect repair.

8.2.3.2 Project Management Plan Updates

This includes updates to the quality, schedule, and cost management plans.

8.2.3.3 Project Document Updates

This usually involves an update to the quality audit reports, training plans and process documentation.

8.2.3.4 Organizational Process Assets Updates

This usually involves an update to the quality standards.

8.3 Perform Quality Control

The PMBOK® defines quality control as follows:

> ***'It involves monitoring specific project results to determine whether they comply with the relevant quality standards and identifying ways to eliminate the cause of unsatisfactory results.'***

In other words, it attempts to answer two questions:

1. Is the project meeting its quality requirements?
2. If not, how can this be addressed?

The project management team should have a working knowledge of statistical quality control, especially sampling and probability, to help evaluate quality control outputs.

Before looking at the process in detail, make sure you are familiar with the following terms:

- *Prevention*—keeping errors out of the process
- *Inspection*—keeping errors out of the hands of the customer
- *Attribute sampling*—the result either conforms or does not conform
- *Variables sampling*—the result is rated on a continuous scale that measures the degree of conformity
- *Tolerances*—specified range of acceptable results
- *Control limits*—thresholds, which indicate whether the process is out of control

- *Grade*—is a category assigned to products or services having the same functional use but different technical characteristics. While a quality level that fails to meet quality requirements is always a problem, low grade may not be.

  For example,

  A software product can be of high quality (no obvious defects, readable manual) and low grade (a limited number of features).

  The project manager and the project management team are responsible for managing the tradeoffs involved to deliver the required levels of both quality and grade.

- *Precision*—means the values of repeated measurements are clustered and have little scatter.
- *Accuracy*—the measured value is very close to the true value.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Project Management Plan	Seven Basic Quality Tools	Quality Control Measurements
Quality Metrics	Statistical Sampling	Validated Changes
Quality Checklists	Inspection	Verified Deliverables
Work Performance Data	Approved Change Requests Review	Work Performance Information
Approved Change Requests		Change Requests
Deliverables		Project Management Plan Updates
Project Documents		Project Documents Updates
Organizational Process Assets		Organizational Process Assets Updates

8.3.1 Perform Quality Control: Inputs

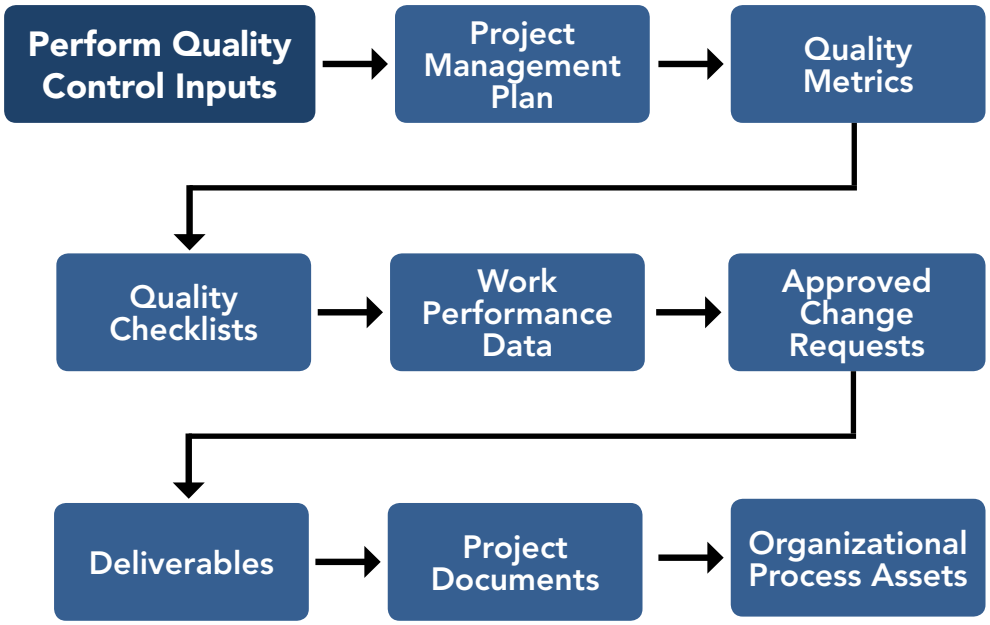
This process requires the following inputs:

8.3.1.1 Project Management Plan

This contains the quality management plan, which describes how quality control will be performed within the project.

8.3.1.2 Quality Metrics

As described in the Quality Planning process, a quality metric describes, in very specific terms, a project or product attribute and how the quality control process will measure it.



8.3.1.3 Quality Checklists

This is a structured tool, usually component-specific, used to verify that a set of required steps has been performed. Many organizations have standardized checklists available to ensure consistency in frequently performed tasks. In some application areas, checklists are also available from professional associations or commercial service providers.

8.3.1.4 Work Performance Data

These are used to produce project activity metrics to evaluate actual progress as compared to planned progress. They include:

- Planned vs. actual technical performance,
- Planned vs. actual schedule performance, and
- Planned vs. actual cost performance.

8.3.1.5 Approved Change Requests

A change control status update will indicate that some changes are approved and some are not. Approved change requests can include modifications such as defect repairs, revised work methods and revised schedule.

8.3.1.6 Deliverables

An approved deliverable is any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project.

8.3.1.7 Project Documents

These include agreements, quality audit reports, and change logs supported with corrective action plans, training plans and assessments of effectiveness. As well as process documentation such as those obtained using either the seven basic quality tools or the quality management and control tools.

8.3.1.8 Organizational Process Assets

The inputs in this section include:

- Quality standards and policies
- Standard work guidelines
- Issue and defect reporting procedures
- Communication policies.

8.3.2 Perform Quality Control: Tools and Techniques

There are four tools and techniques that can be used.

8.3.2.1 Seven Basic Quality Tools

These were described in detail in the section *8.1.2.3 Seven Basic Quality Tools*.

8.3.2.2 Statistical Sampling

This involves choosing part of a population of interest for inspection. Sample frequency and sizes should be determined so the cost of quality (described above) will include the number of tests, expected scrap, etc.

In some application areas it may be necessary for the project management team to be familiar with a variety of sampling techniques in order to chose the most appropriate one.

8.3.2.3 Inspection

This is the examination of a product to determine whether it conforms to documented standards. The results of an inspection generally include measurements and may be conducted at any level. For example,

- Results of a single activity can be inspected, or
- Final product of the project can be inspected.

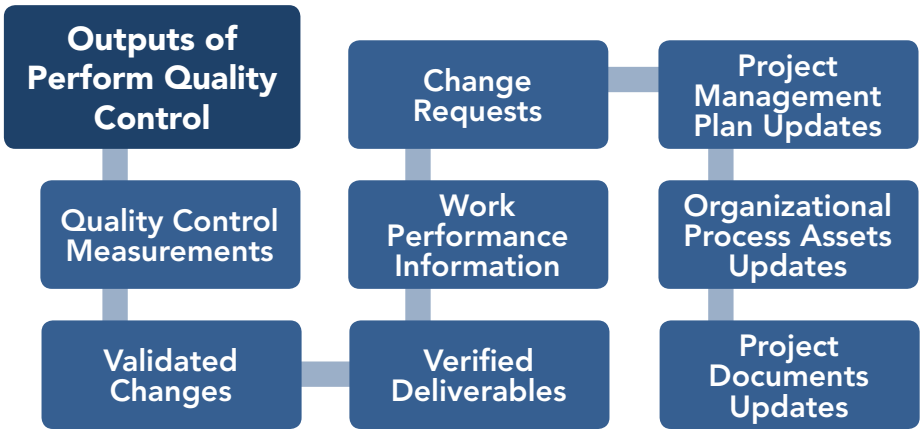
Inspections may be called reviews, peer reviews, audits, or walkthroughs.

8.3.2.4 Approved Change Requests Review

All approved change requests should be reviewed to verify that they were implemented as approved.

8.3.3 Perform Quality Control: Outputs

This process will create the following outputs:



8.3.3.1 Quality Control Measurements

These are the documented results of quality control activities in the format specified during quality planning.

8.3.3.2 Validated Changes

Any changed or repaired items are inspected and will be either accepted or rejected before notification of the decision is provided.

8.3.3.3 Verified Deliverables

The results of the execution quality control processes are validated deliverables.

8.3.3.4 Work Performance Information

This is the performance data collected from various controlling processes, analyzed in context and integrated based on relationships across areas.

8.3.3.5 Change Requests

If the recommended corrective or preventive actions or a defect repair requires a change to the project management plan, a change request should be initiated.

8.3.3.6 Project Management Plan Updates

These include the quality management plan and the process improvement plan.

8.3.3.7 Project Documents Updates

These project document updates include:

- Quality standards
- Agreements
- Quality audit reports and change logs supported with corrective action plans
- Training plans and assessments of effectiveness
- Process documentation, such as information obtained using the seven basic quality tools or the quality management and control tools.

8.3.3.8 Organizational Process Assets Updates

These include any completed checklists plus lessons learned documentation detailing the causes of variances and the reasoning behind the corrective action chosen.

Summary

One of the changes to the 5th Edition PMBOK® Guide is to make the quality management part of project management conform to the International Organization for Standardization quality standards.

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The ISO approach to quality management emphasizes the following concepts:

- Customer Satisfaction
- Prevention over Inspection
- Continuous Improvement
- Management Responsibility
- Cost of Quality

Customer Satisfaction

Quality means delivering the product so that its requirements meet the customer's expectations. However, the Project Management Institute does not endorse gold plating, or adding requirements that the customer did not request.

Prevention over Inspection

Inspection can reduce the probability of defects, but prevention through planning, designing, and building in quality can reduce that probability of defects for a lot less cost than through the inspection process.

Continuous Improvement

The Plan-Do-Check-Act cycle, which is the basis of the concept of continuous improvement, goes back to Deming. Total Quality Management, Six Sigma, Lean Six Sigma, and the Japanese Toyota Way are modern quality improvement initiatives that improve the quality of project management while improving the quality of the final deliverables.

Management Responsibility

Rather than thinking that quality is what job operators do on the factory floor, the modern concept of quality improvement initiatives mentioned in the last paragraph require the approval and active participation of management.

Cost of Quality

The cost of implementing quality standards is the cost of conformance.

To what level of standards should an organization aspire?

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This is where the Cost of Quality comes in. What is the cost of nonconformance, or what used to be called the cost of poor quality?

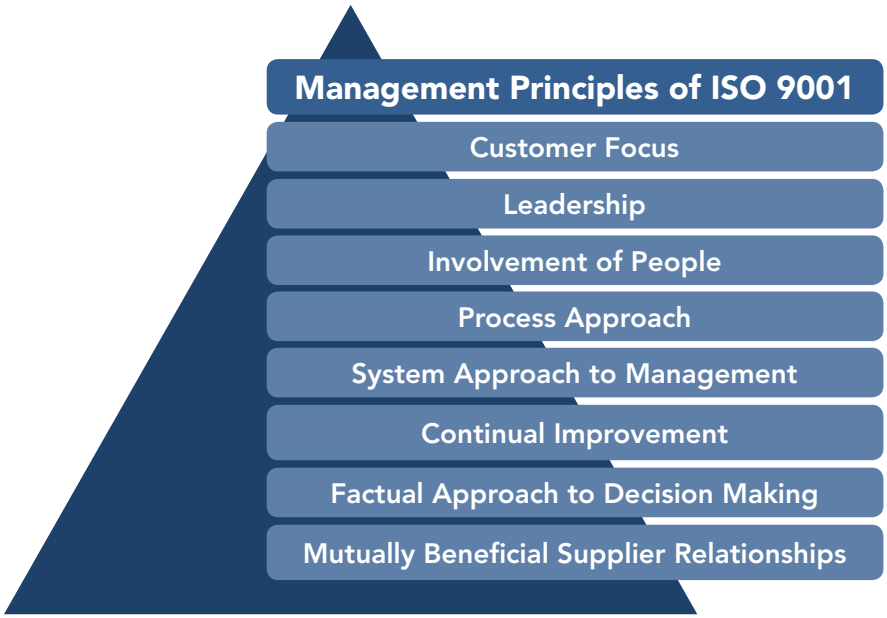
- If the defect is caught before the product gets shipped to the customer, this is an **internal cost of nonconformance**. It involves scrapping the part of reworking it so that it is in conformance with the quality standards.
- However, if the inspection process does not catch the defect, and it goes out to the customer, then the **costs could be in terms of the claims** the customer makes for replacement or repair under warranty, or product liability, if the customer or a third party is injured.

The Quality Management processes includes the following:

8.1 Plan Quality is the process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance.

8.2 Perform Quality Assurance is the process of auditing the quality requirements and the results from quality control measurements to ensure appropriate quality standards and operational definitions are used.

8.3 Perform Quality Control is the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes.



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The International Standard for Quality management (ISO 9001) adopts a number of management principles that can be used to guide organizations towards improved quality.

The principles include:

- **Customer focus**—Since the organizations depend on their customers, they should understand future needs as well as current ones. They also need to meet customer requirements and try to exceed their expectations where possible.

  An organization attains customer focus when all people in the organization know what customer requirements must be met to ensure that both the internal and external customers are satisfied.
- **Leadership**—Leaders of an organization establish unity of purpose and direction of it. They should go for creation and maintenance of such an internal environment, in which people can become fully involved in achieving the organization's quality objective.
- **Process approach**—The desired result can be achieved when activities and related resources are managed as processes.
- **System approach to management**—Identifying, understanding and managing all interrelated processes as a system that contributes to an organization's effectiveness and efficiency in achieving its quality objectives. Quality Control involves checking transformed and transforming resources in all stages of production process.
- **Continual improvement**—One of the permanent quality objectives of an organization should be the continual improvement of its overall performance.
- **Factual approach to decision making**—Effective decisions are always based on the data analysis and information.
- **Mutually beneficial supplier relationships**—Since an organization and its suppliers are interdependent, a mutually beneficial relationship between them increases the ability of both parties to add value.

If you want to know more about project management the eBooks in this skill set available from http://www.free-management-ebooks.com/skills-project.htm are:

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