Chapter 8:
Project Quality Management

Learning Objectives

Develop	Develop a justification for project quality management and its importance in achieving project success for information technology (IT) products and services
Define	Define project quality management and understand how quality relates to various aspects of IT projects
Describe	Describe quality management planning and how quality and scope management are related
Discuss	Discuss the importance of managing quality and quality assurance
Explain	Explain the main outputs of the quality control process
List and describe	List and describe the tools and techniques for quality control, such as the Basic Tools of Quality, statistical sampling, Six Sigma, and testing
Summarize	Summarize the contributions of noteworthy quality experts to modern quality management
Describe	Describe how leadership, the cost of quality, organizational influences, expectations, cultural differences, and maturity models relate to improving quality in IT projects
Discuss	Discuss how software can assist in project quality management
Discuss	Discuss considerations for agile/adaptive environments

What Is Quality?

The International Organization for Standardization (ISO) defines quality as the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs

Other experts define quality based on

conformance to requirements: meeting written specifications

fitness for use: ensuring a product can be used as it was intended

What Is Project Quality Management?

- International Organization for Standardization (ISO) definition of quality
  - "Totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs" (ISO8042:1994)
  - "The degree to which a set of inherent characteristics fulfils requirements" (ISO9000:2000)
- Other definitions of quality
  - Conformance to requirements
    - Project's processes and products meet written specifications
  - Fitness for use
    - Product can be used as it was intended
- Project quality management ensures the project will satisfy the needs for which it was undertaken
- Project quality management processes
  - Planning quality management: identifying which quality standards are relevant to the project and how to satisfy them; a metric is a standard of measurement
  - Managing quality: translating the quality management plan into executable quality activities
  - Controlling quality: monitoring specific project results to ensure they comply with the relevant quality standards

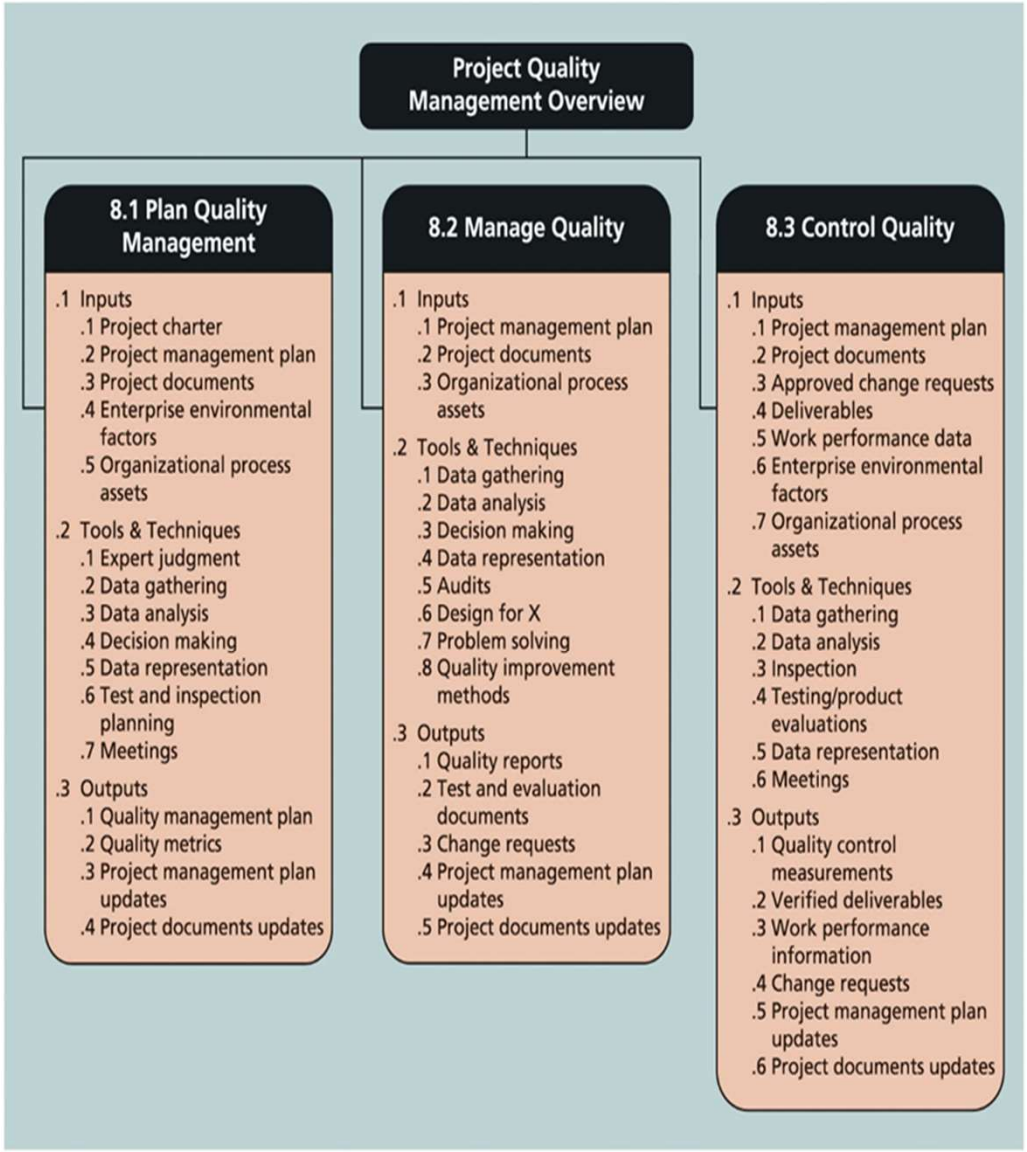


FIGURE 8-1 Project quality management overview

Project Quality Management Processes

Quality planning: identifying which quality standards are relevant to the project and how to satisfy them

Quality assurance: evaluating overall project performance to ensure the project will satisfy the relevant quality standards

Quality control: monitoring specific project results to ensure that they comply with the relevant quality standards while identifying ways to improve overall quality

Quality Planning

It is important to design in quality and communicate important factors that directly contribute to meeting the customer’s requirements

Design of experiments helps identify which variables have the most influence on the overall outcome of a process

Many scope aspects of IT projects affect quality like functionality, features, system outputs, performance, reliability, and maintainability

Planning Quality Management

Implies the ability to anticipate situations and prepare actions to bring about the desired outcome

Defect prevention methods

- Selecting proper materials
- Training and indoctrinating people in quality
- Planning a process that ensures the appropriate outcome

Scope aspects of IT projects

- **Functionality:** degree to which a system performs its intended function
- Features: system's special characteristics that appeal to users
- System outputs: screens and reports the system generates
- Performance addresses: how well a product or service performs the customer's intended use
- Reliability: ability of a product or service to perform as expected under normal conditions

All project stakeholders must work together to balance the quality, scope, time, and cost dimensions of the project

Project managers are ultimately responsible for quality management on their projects

Managing Quality

Quality assurance includes all the activities related to satisfying the relevant quality standards for a project

Another goal of quality assurance is continuous quality improvement

Benchmarking can be used to generate ideas for quality improvements

Quality audits help identify lessons learned that can improve performance on current or future projects

Managing Quality

- Quality assurance includes all the activities related to satisfying the relevant quality standards for a project
  - Another goal is continuous quality improvement
  - Kaizen is the Japanese word for improvement or change for the better
  - Lean involves evaluating processes to maximize customer value while minimizing waste
  - Benchmarking generates ideas for quality improvements by comparing specific project practices or product characteristics to those of other projects or products within or outside the performing organization
  - A quality audit is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects

What Went Right?

Kanban uses five core properties

- Visual workflow
- Limit work-in-process
- Measure and manage flow
- Make process policies explicit
- Use models to recognize improvement opportunities

Application of Kanban is different for every team

Kanban is an Agile management method built on a philosophy of continuous improvement, where work items are “pulled” from a product excess into a stable flow of work.

Quality Control

The main outputs of quality control are

- acceptance decisions
- rework
- process adjustments

Some tools and techniques include

- Pareto analysis
- statistical sampling
- Six Sigma
- quality control charts

Tools and Techniques for Quality Control (1 of 9)

- Basic tools of quality that help in performing quality control
  - Cause-and-effect diagrams
  - Control chart
  - Checksheet
  - Scatter diagram
  - Histogram
  - Pareto chart
  - Flowcharts/run charts

Tools and Techniques for Quality Control (2 of 9)

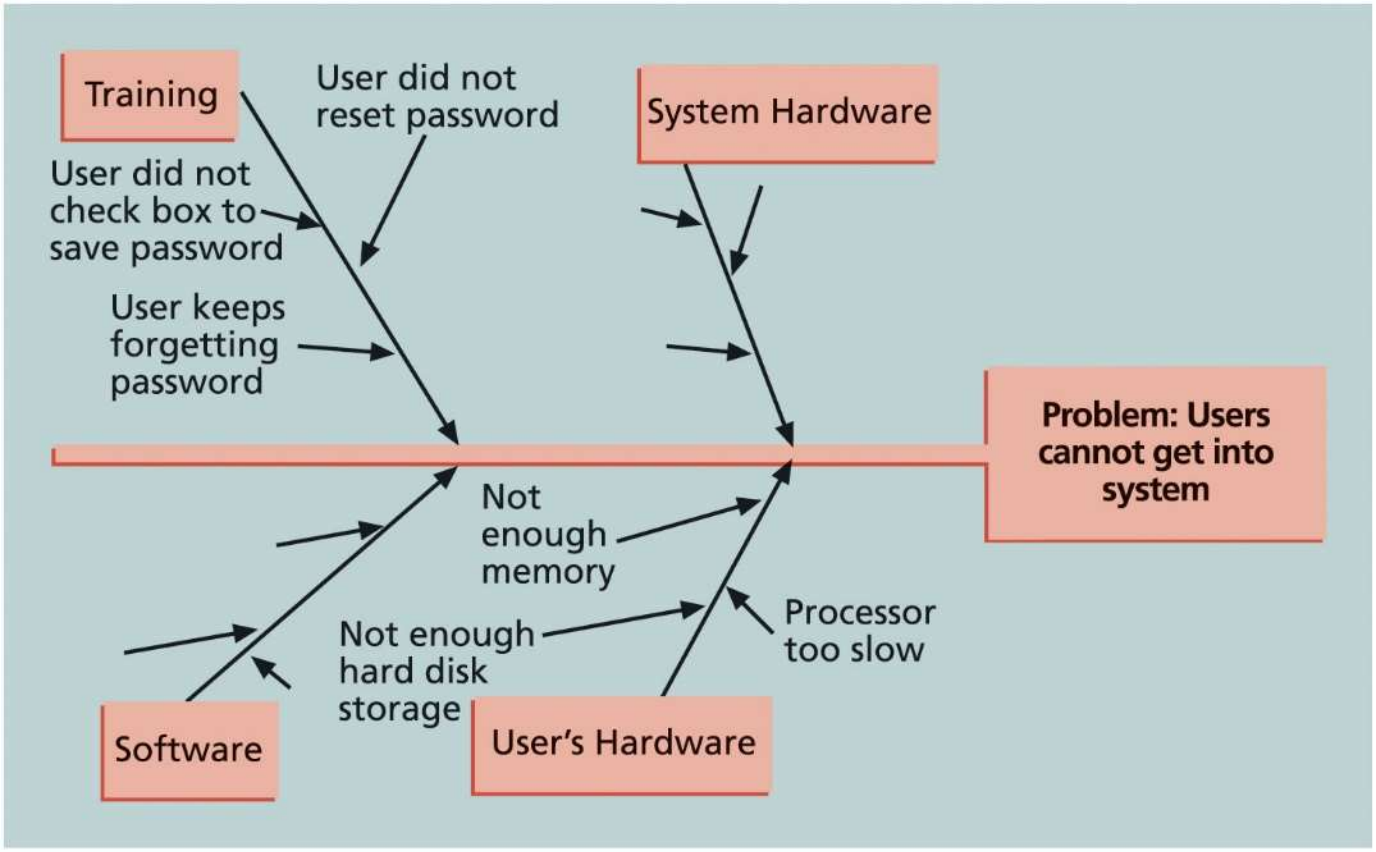


FIGURE 8-2 Sample cause-and-effect diagram

Cause-and-effect diagrams is a graphic tool used to explore and display the possible causes of a certain effect.

Tools and Techniques for Quality Control (3 of 9)

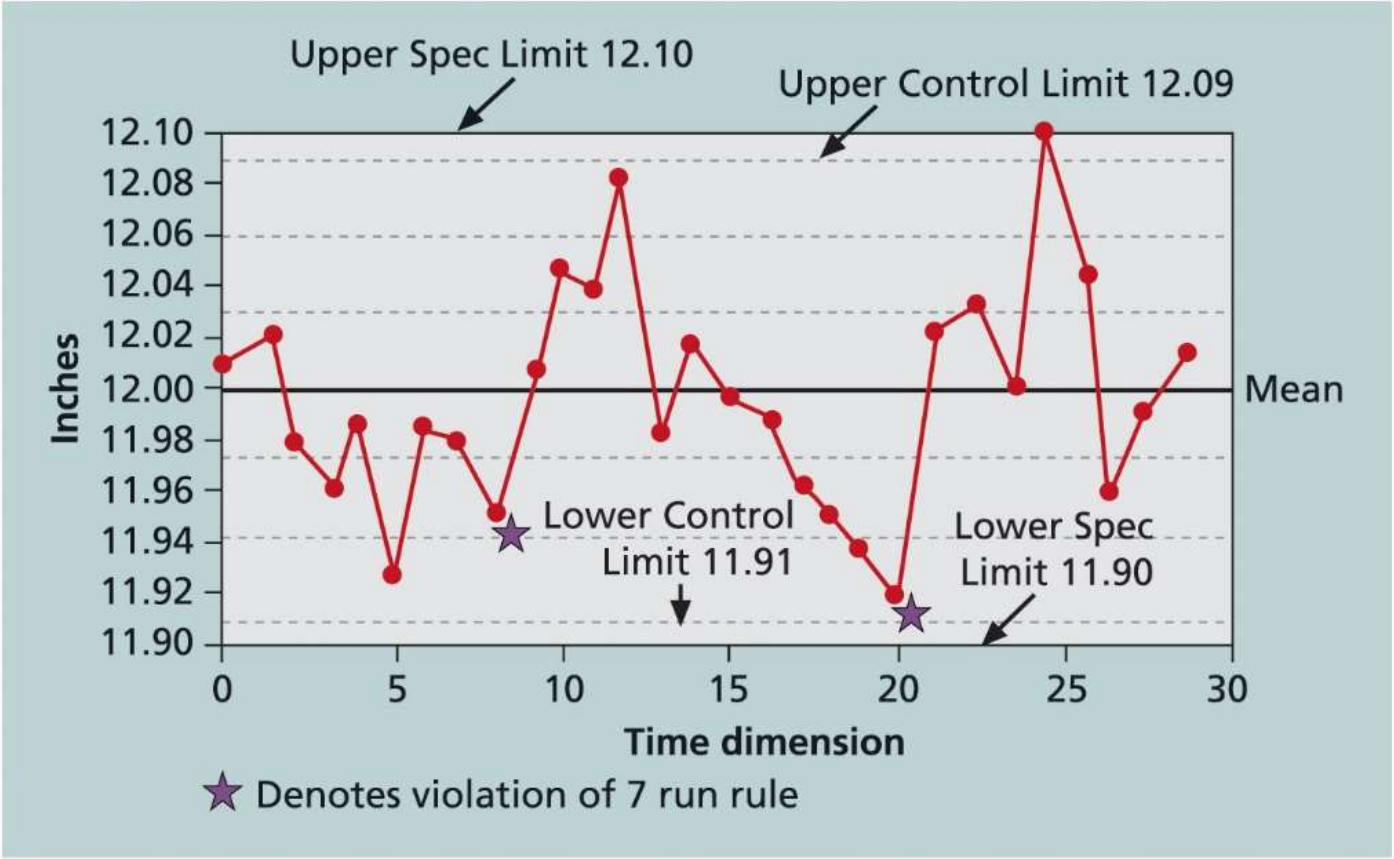


FIGURE 8-3 Sample control chart

Statistical Process Control Charts (SPCC) are tools used to determine if a process is in a state of statistical control, or how much variation exists in a process.

Tools and Techniques for Quality Control (4 of 9)

System Complaints

Source	Day							
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
E-mail	|||	||||	|	||	|		|	12
Text	𝍸 ||	||||	𝍸 |	|||	||||	||	|||	29
Phone call	|	||	|	|	||	|		8
Total	**11**	**10**	**8**	**6**	**7**	**3**	**4**	**49**

FIGURE 8-4 Sample checksheet

Tools and Techniques for Quality Control (5 of 9)

FIGURE 8-5 Sample scatter diagram

Check sheet is a form (document) used to collect data in real time at the location where the data is generated.

Tools and Techniques for Quality Control (6 of 9)

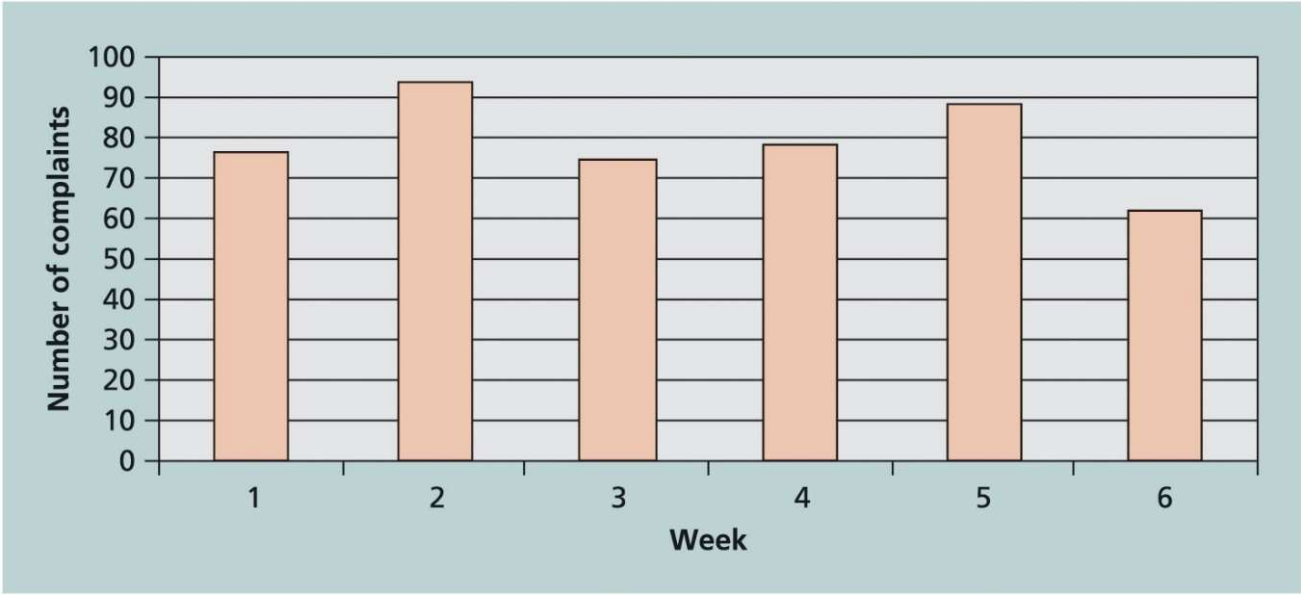


FIGURE 8-6 Sample histogram

Histogram is a bar graph-like representation of data that buckets a range of classes into columns along the horizontal x-axis.

Pareto Analysis

Pareto analysis involves identifying the vital few contributors that account for the most quality problems in a system

Also called the 80-20 rule, meaning that 80% of problems are often due to 20% of the causes

Pareto diagrams are histograms that help identify and prioritize problem areas

Tools and Techniques for Quality Control (8 of 9)

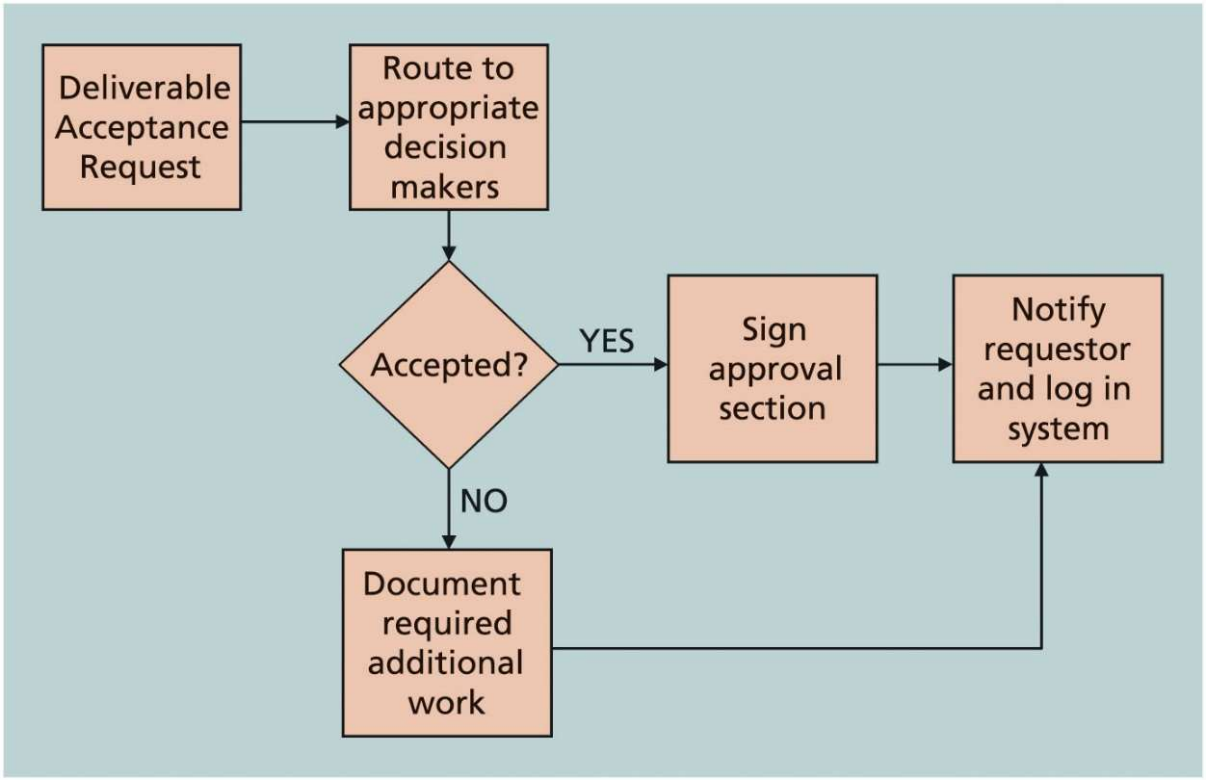


FIGURE 8-8 Sample flowchart

A flowchart is a type of diagram that represents a workflow or process. A flowchart can also be defined as a diagrammatic representation of an algorithm, a step-by-step approach to solving a task.

Tools and Techniques for Quality Control (9 of 9)

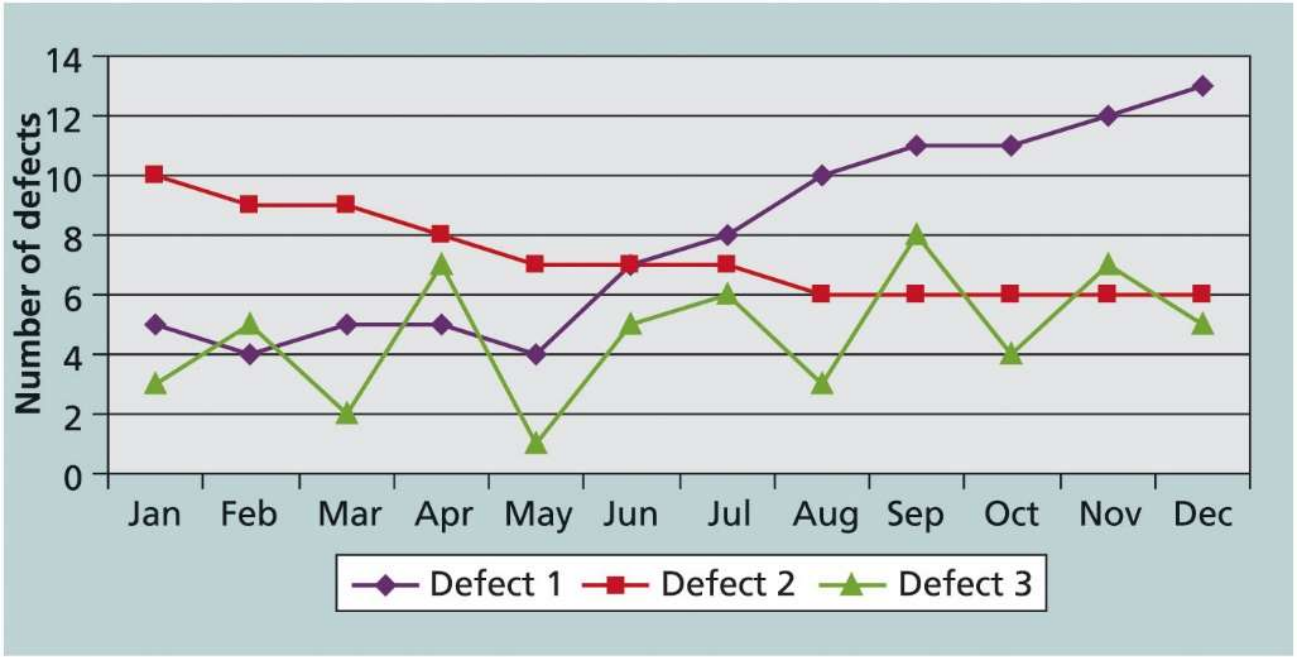


FIGURE 8-9 Sample run chart

A run chart, also known as a run-sequence plot is a graph that displays observed data in a time sequence. Often, the data displayed represent some aspect of the output or performance of a manufacturing or other business process.

Statistical Sampling and Standard Deviation

Statistical sampling involves choosing part of a population of interest for inspection

The size of a sample depends on how representative you want the sample to be

Sample size formula

= .25 x (certainty Factor/acceptable error)^2

Desired Certainty	Certainty Factor
95%	1.960
90%	1.645
80%	1.281

95% certainty: Sample size = 0.25 x $(1.960/.05)^2 = 384$

90% certainty: Sample size = 0.25 x $(1.645/.10)^2 = 68$

80% certainty: Sample size = 0.25 x $(1.281/.20)^2 = 10$

Six Sigma

The *Six Sigma is defined as*

- A comprehensive and flexible system for achieving, sustaining, and maximizing business success.
- Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes."

DMAIC is a systematic, closed-loop process for continued improvement that is scientific, and fact based

- **Define**: define the problem/opportunity, process, and customer requirements
- **Measure**: define measures, then collect, compile, and display data
- **Analyze**: scrutinize process details to find improvement opportunities
- **Improve**: generate solutions and ideas for improving the problem
- **Control**: track and verify the stability of the improvements and the predictability of the solution

How is Six Sigma Quality Control Unique?

Six Sigma is a quality management methodology used to help businesses improve current processes, products, or services by discovering and eliminating defects. The goal is to streamline quality control in manufacturing or business processes so there is little to no variance throughout.

Six Sigma principles that help organizations improve their competitiveness and bottom-line results

Requires an organization-wide commitment	Training follows the “belt” system	Organizations have the ability and willingness to adopt contrary objectives, such as reducing errors and getting things done faster	An operating philosophy that is customer focused and strives to drive out waste, raise levels of quality, and improve financial performance at breakthrough levels

Six Sigma and Project Selection and Management

Project selection should be based on objective data and be quantifiable. It depends on the maturity of your organization. A good Six Sigma project should align with the organization's strategic goals and solve customers' issues or concerns.

What makes a project a potential Six Sigma project?

Must be a quality problem or gap between the current and desired performance

Project should not have a clearly understood problem

Solution should not be predetermined, and an optimal solution should not be apparent

Six Sigma and Statistics (1 of 2)

- Sigma means standard deviation
  - Standard deviation measures how much variation exists in a distribution of data; a key factor in determining the acceptable number of defective units found in a population
  - Six Sigma projects strive for no more than 3.4 defects per million opportunities
- Six Sigma uses a conversion table
  - Yield represents the number of units handled correctly through the process steps
  - A defect is any instance where the product or service fails to meet customer requirements
    - There can be several opportunities to have a defect
- Six nines of quality is a measure of quality control equal to one fault in one million opportunities
  - In the telecommunications industry, it means 99.9999 percent service availability or *30 seconds of down time a year*

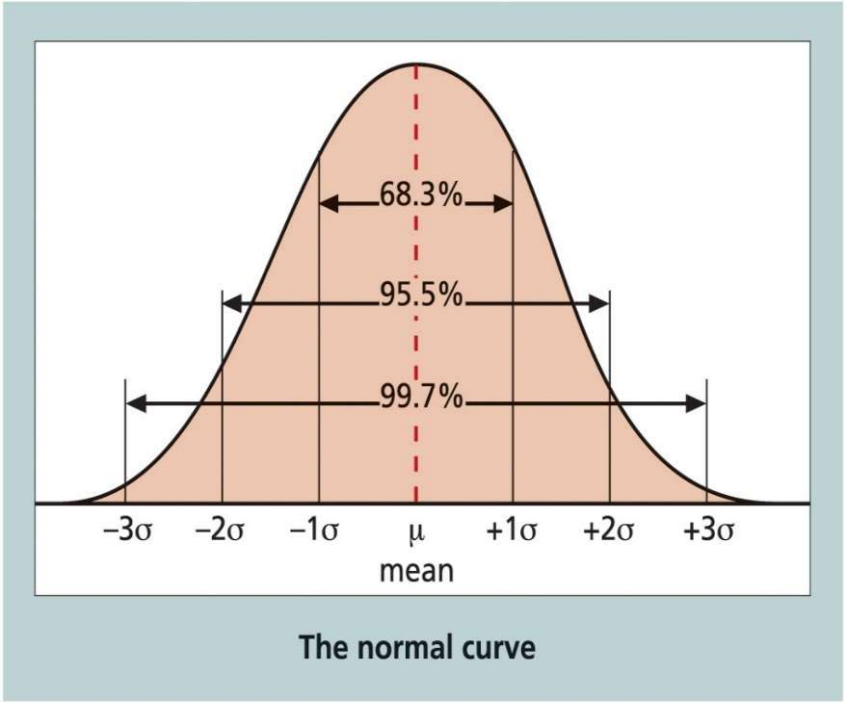


FIGURE 8-10 Normal distribution and standard deviation

Six Sigma and Statistics (2 of 2)

Specification Range (in ± Sigmas)	Percent of Population within Range	Defective Units per Billion
1	68.27	317,300,000
2	95.45	45,400,000
3	99.73	2,700,000
4	99.9937	63,000
5	99.999943	57
6	99.9999998	2

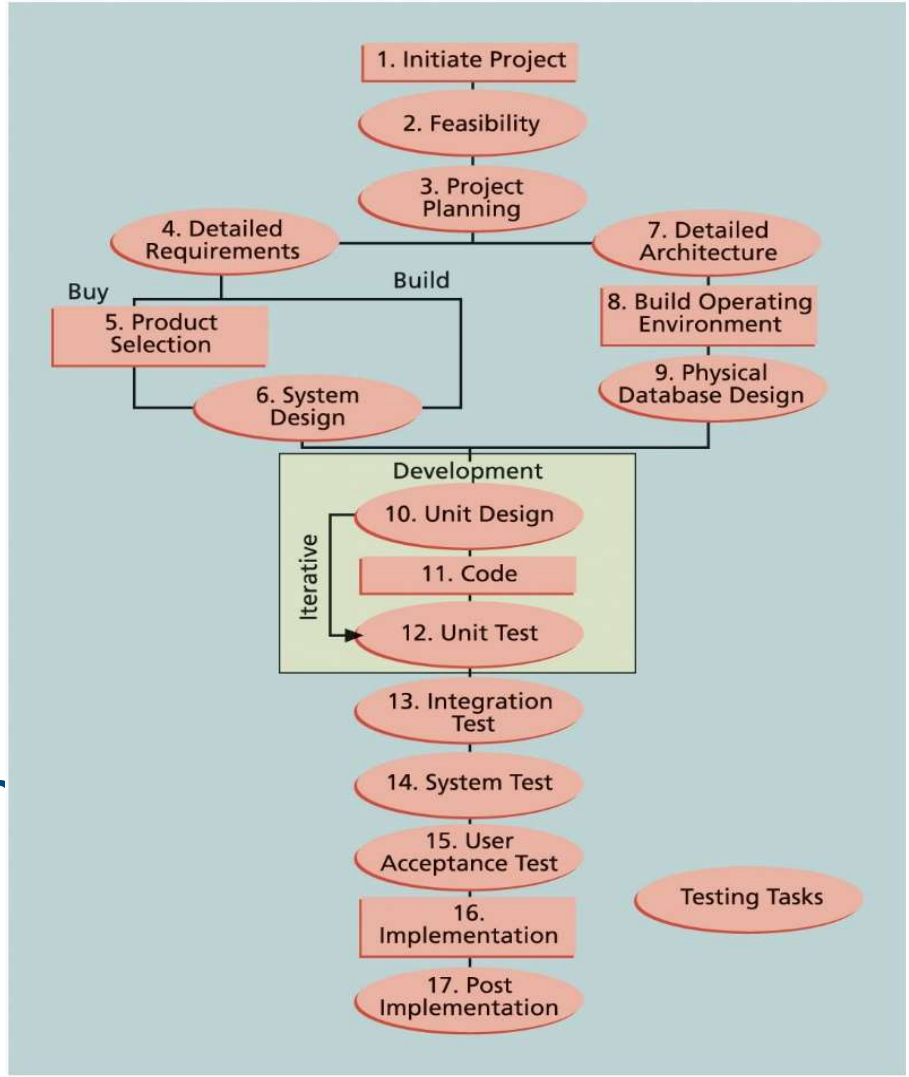
Table 8-2 Sigma and defective units

Sigma	Yield	Defects per Million Opportunities (DPMO)
1	31.0%	690,000
2	69.2%	308,000
3	93.3%	66,800
4	99.4%	6,210
5	99.97%	230
6	99.99966%	3.4

Table 8-3 Six Sigma conversion table

Testing (1 of 2)

- Many IT professionals think of testing as a stage that comes near the end of IT product development
  - Testing needs to be done during almost every phase of the systems development life cycle, not just before the organization ships or hands over a product to the customer



Source: Hollstadt & Associates, Inc.

FIGURE 8-11 Testing tasks in the software development life cycle

Testing (2 of 2)

Types of tests

- Unit testing tests each individual component (often a program) to ensure it is as defect-free as possible
- Integration testing occurs between unit and system testing to test functionally grouped components
- System testing tests the entire system as one entity
- User acceptance testing is an independent test performed by end users prior to accepting the delivered system

Testing alone is not enough

- Watts S. Humphrey, a renowned expert on software quality, defines a software defect as anything that must be changed before delivery of the program

Testing does not sufficiently prevent software defects

- The number of ways to test a complex system is huge
- Users will continue to invent new ways to use a system that its developers never considered

Humphrey suggests that people rethink the software development process to provide no potential defects when you enter system testing

- Developers must be responsible for providing error-free code at each stage of testing

Modern Quality Management (1 of 2)

Modern quality management:

- Requires customer satisfaction
- Prefers prevention to inspection
- Recognizes management responsibility for quality

Noteworthy quality experts:

- Deming, Juran, Crosby, Ishikawa, Taguchi, and Feigenbaum

Quality experts

- Deming was famous for his work in rebuilding Japan and his 14 Points for Management
- Juran wrote the *Quality Control Handbook* and ten steps to quality improvement
- Crosby wrote *Quality is Free* and suggested that organizations strive for zero defects
- Ishikawa developed the concepts of quality circles and pioneered the use of cause-and-effect diagrams
- Taguchi developed methods for optimizing the process of engineering experimentation
- Feigenbaum developed the concept of total quality control
- https://www.qualitygurus.com/9-quality-gurus-and-their-contributions/

Modern Quality Management (2 of 2)

Malcolm Baldrige National Quality Award

- Originated in 1987 to recognize companies that have achieved a level of world-class competition through quality management
- Given by the President of the United States to U.S. businesses
- Three awards each year in different categories
  - Manufacturing
  - Service
  - Small business
  - Education and health care

ISO standards

- ISO 9000: a three-part, continuous cycle of planning, controlling, and documenting quality in an organization
- Provide minimum requirements needed for an organization to meet its quality certification standards
- Help ensure that projects create products or services that meet customer needs and expectations

Improving IT Project Quality

- Suggestions for improving quality for IT projects
- leadership
- A large percentage of quality problems are associated with management, not technical issues
  - Top management must take responsibility for creating, supporting, and promoting quality programs
- Leadership provides an environment conducive to producing quality
  - When every employee insists on producing high-quality products, then top management has done a good job of promoting the importance of quality
- Cost of conformance plus the cost of nonconformance
  - Conformance means delivering products that meet requirements and fitness for use
  - Cost of nonconformance means taking responsibility for failures or not meeting quality expectations
- Cost of Quality
  - Prevention cost: cost of planning and executing a project so it is error-free or within an acceptable error range
  - Appraisal cost: cost of evaluating processes and their outputs to ensure quality
  - Internal failure cost: cost incurred to correct an identified defect before the customer receives the product
  - External failure cost: cost that relates to all errors not detected and corrected before delivery to the customer
  - Measurement and test equipment costs: capital cost of equipment used to perform prevention and appraisal activities
- Provide a good workplace to enhance quality
- Work toward improving the organization's overall maturity level in software development and project management

Expectations and Cultural Differences in Quality

- Project managers must understand and manage stakeholder expectations
  - Expectations vary
    - Organization’s culture
    - Geographic regions

Advice for Young Professionals

Managing expectations is a critical skill

It’s important to understand other people’s expectations as well as your own

Too many people, including experienced project managers, make assumptions about expectations and get surprised when they do not match those of their stakeholders

Never be afraid to ask what is expected of you

Maturity Models

Frameworks for helping organizations improve their processes and systems

- Software Quality Function Deployment Model focuses on defining user requirements and planning software projects
- Capability Maturity Model Integration is a process improvement approach that provides organizations with the essential elements of effective processes

CMMI (Capability Maturity Model Integration)levels https://www.bmc.com/blogs/cmmi-capability-maturity-model-integration/

- Incomplete
- Performed
- Managed
- Defined
- Quantitatively Managed
- Optimizing

PMI released the Organizational Project Management Maturity Model (OPM3) in December 2003

- Organizational Project Management Maturity Model is to provide leadership a guideline of steps they can take to improve.

Best Practice

OPM3® example to illustrate a best practice, capability, outcome, and key performance indicator:

Best practice: establish internal project management communities

Capability: facilitate project management activities

Outcome: establish local initiatives

Key performance indicator: community addresses local issues

Using Software to Assist in Project Quality Management

Software can be used to assist with tools and techniques

Spreadsheet and charting software helps create diagrams

Statistical software packages help perform statistical analysis

Specialized software products help manage Six Sigma projects or create quality control charts

Considerations For Agile/Adaptive Environments

Agile methods can be used on all types of projects, not just software development

- Several projects use a hybrid approach where some deliverables are created using more traditional approaches

Quality is a very broad topic, and it is only one of the ten project management knowledge areas

- Project managers must focus on defining how quality relates to their specific projects and ensure that those projects satisfy the needs for which they were undertaken

Chapter Summary

- Quality is a serious issue
  - Project quality management includes planning quality management, performing quality assurance, and controlling quality
  - Many tools and techniques are related to project quality management
  - Many people made significant contributions to the development of modern quality management
  - There is much room for improvement in IT project quality
  - Several types of software are available to assist in project quality management