Project Management: Lecture 7
Project Quality Management

The Importance of Project Quality Management

- People seem to accept systems being down occasionally or needing to reboot their PCs
- But quality is very important in many IT projects
- IT projects today develop mission-critical systems that are used in life-and-death situations.
- Ex: aircraft navigation system, components in medical equipment

What Went Wrong?

- In 1986, two hospital patients died after receiving fatal doses of radiation from a Therac 25 machine after a software problem caused the machine to ignore calibration data
- In August 2008, the Privacy Rights Clearinghouse stated that more than 236 million data records of U.S. residents have been exposed due to security breaches since January 2005
- In March 2018, Facebook data breach which created a big stir around the privacy of the users.

What is Project Quality

- The International Organization for Standardization (ISO) defines **quality** as "the degree to which a set of inherent characteristics fulfils requirements" (ISO9000:2000)

- Other experts define quality based on:
  - **Conformance to requirements**: The project's processes and products meet written specifications
  - **Fitness for use:** A product can be used as it was intended

What is Project Quality Management

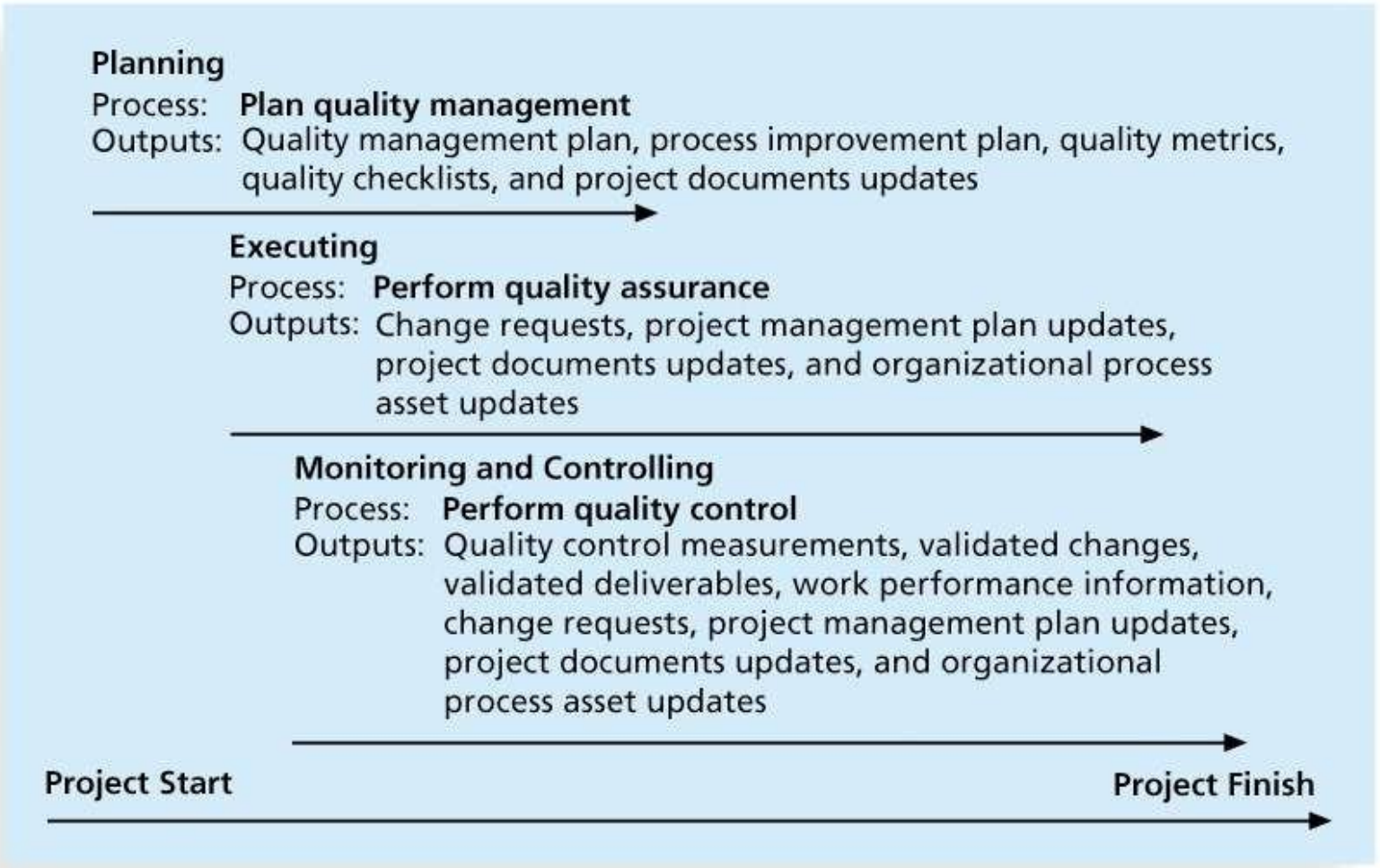
- **Project quality management** ensures that the project will satisfy the needs for which it was undertaken

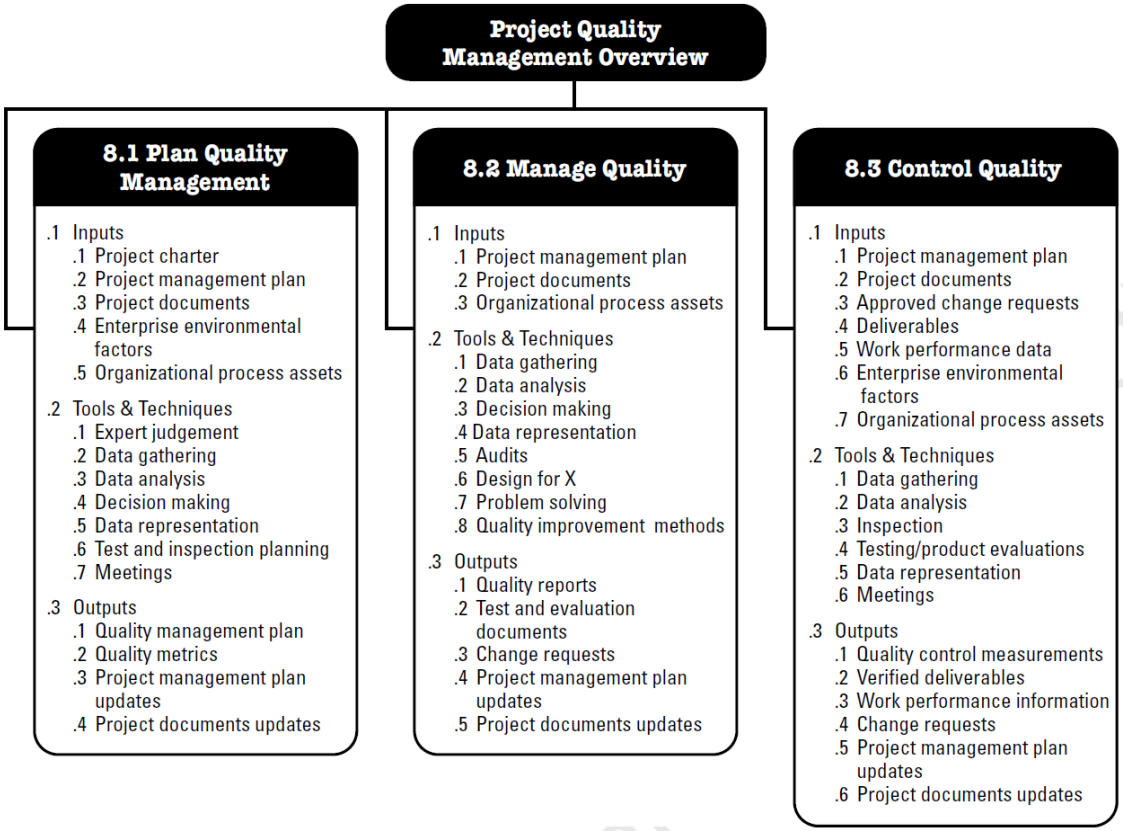
- Processes include:

  - **Planning quality management**: Identifying which quality standards are relevant to the project and how to satisfy them; a **metric** is a standard of measurement
  - **Performing quality assurance**: Periodically evaluating overall project performance to ensure the project will satisfy the relevant quality standards
  - **Performing quality control**: Monitoring specific project results to ensure that they comply with the relevant quality standards

Source: PMBOK Guide- Sixth Edition, Project Management Institute, Inc(2017)

Project Quality Management Summary





Project Quality Management Overview

Source: PMBOK Guide- Sixth Edition, Project Management Institute, Inc(2017)

Step 1: Planning Quality

- Implies the ability to anticipate situations and prepare actions to bring about the desired outcome
- Important to prevent defects by:
  - Selecting proper materials
  - Training and indoctrinating people in quality
  - Planning a process that ensures the appropriate outcome

Scope Aspects of IT Projects

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

Who's Responsible for the Quality of Projects?

- Project managers are ultimately responsible for quality management on their projects
- Several organizations and references can help project managers and their teams understand quality
  - International Organization for Standardization (www.iso.org)
  - IEEE (www.ieee.org)

Step 2: Manage Quality
Performing Quality Assurance

- **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** 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

Step 3: Controlling Quality

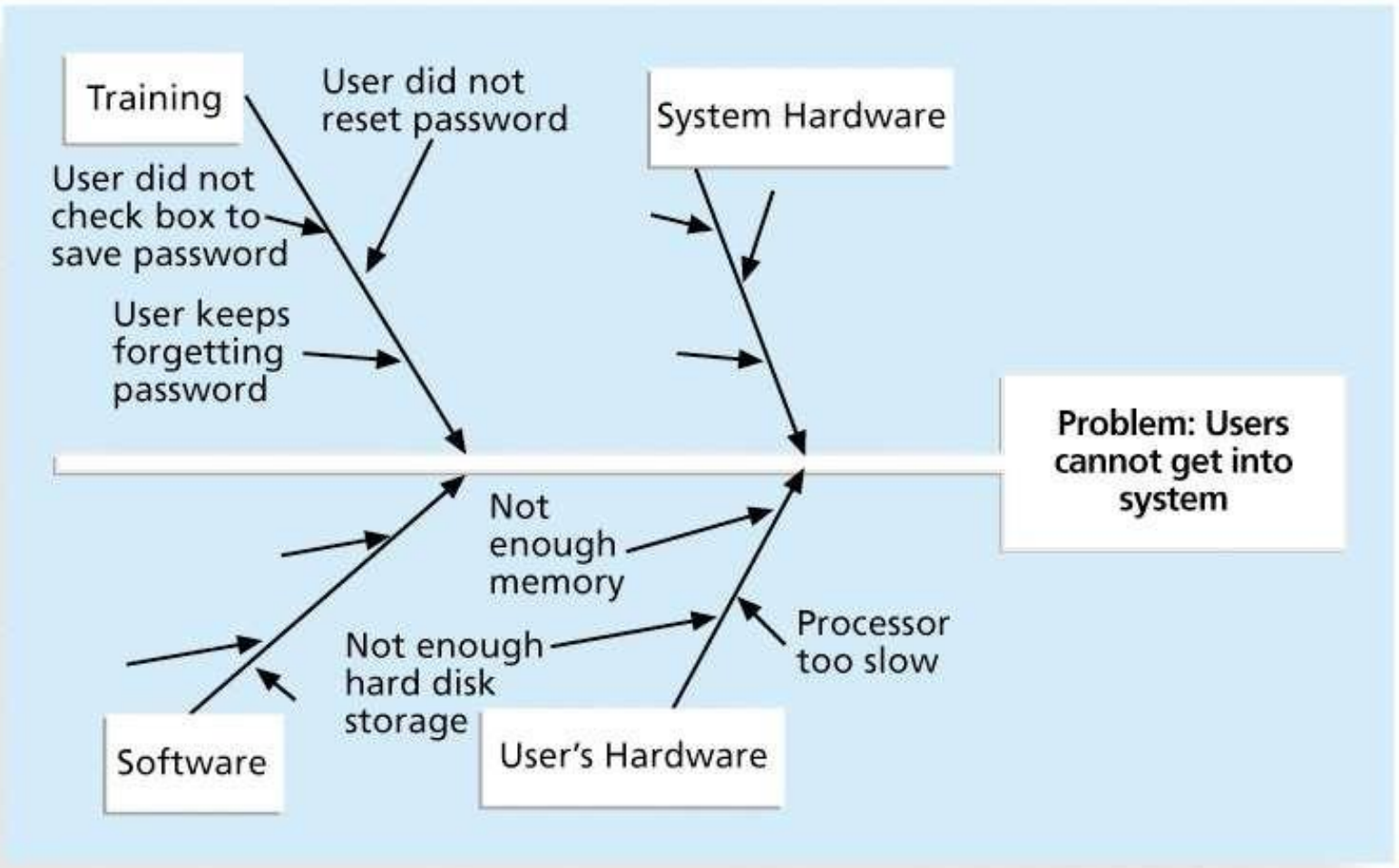
- The main outputs of quality control are:
  - Acceptance decisions
  - Rework
  - Process adjustments

- There are Seven Basic Tools of Quality that help in performing quality control

Cause-and-effect-diagrams

- Cause-and-effect diagrams trace complaints about quality problems back to the responsible production operations
- They help you find the root cause of a problem
- Also known as fishbone or Ishikawa diagrams
- Can also use the 5 whys technique where you repeated ask the question “Why” (five is a good rule of thumb) to peel away the layers of symptoms that can lead to the root cause

Sample Cause-and-effect-diagrams



Quality Control Charts

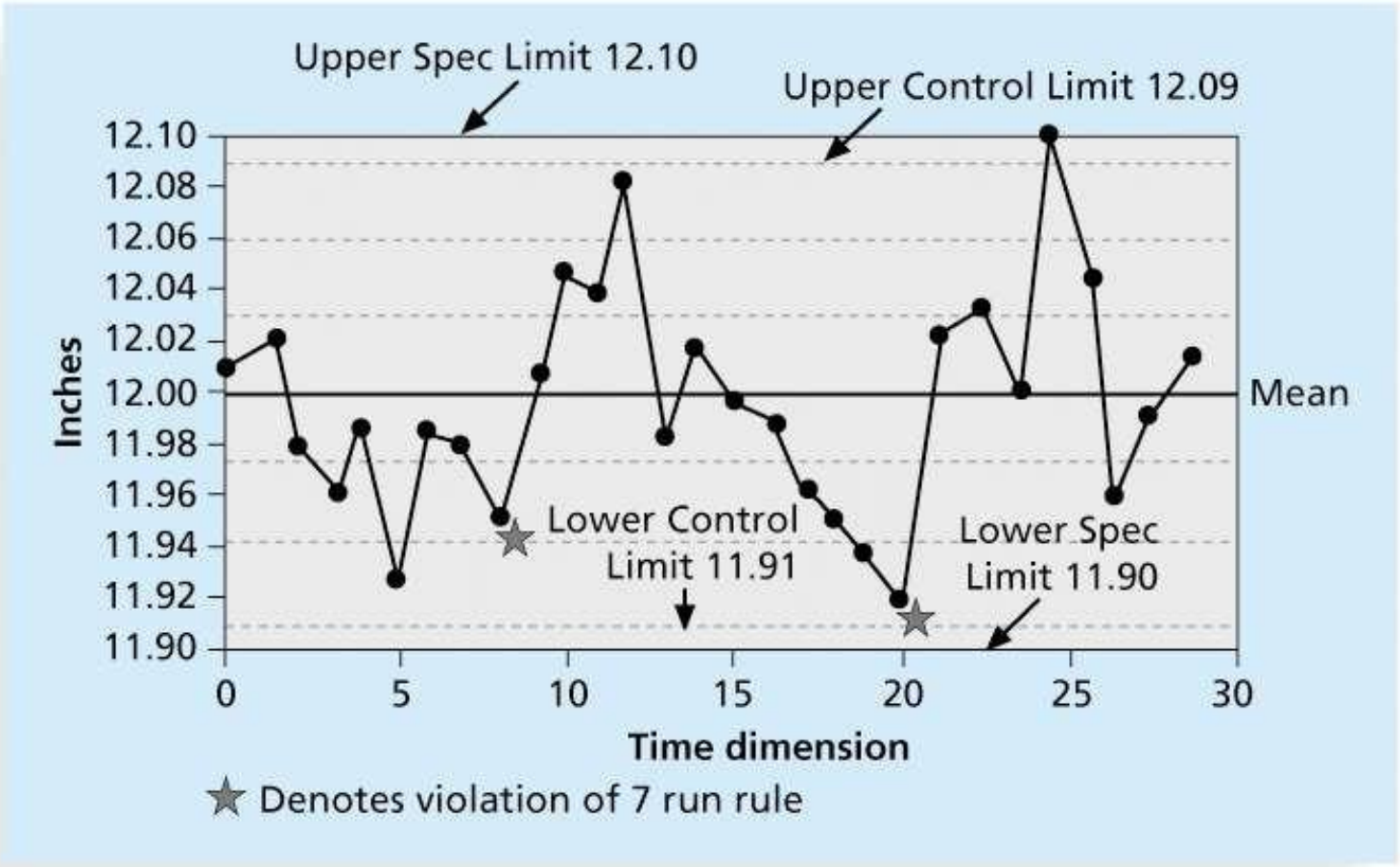
- A **control chart** is a graphic display of data that illustrates the results of a process over time
- The main use of control charts is to prevent defects, rather than to detect or reject them
- Quality control charts allow you to determine whether a process is in control or out of control
  - When a process is in control, any variations in the results of the process are created by random events; processes that are in control do not need to be adjusted
  - When a process is out of control, variations in the results of the process are caused by non-random events; you need to identify the causes of those non-random events and adjust the process to correct or eliminate them

The Seven Run Rule

- You can use quality control charts and the seven run rule to look for patterns in data

- The **seven run rule** states that if seven data points in a row are all below the mean, above the mean, or are all increasing or decreasing, then the process needs to be examined for non-random problems

Sample quality control chart



Checksheet

- A checksheet is used to collect and analyze data
- It is sometimes called a tally sheet or checklist, depending on its format
- In the example below, most complaints arrive via text message, and there are more complaints on Monday and Tuesday than on other days of the week
- This information might be useful in improving the process for handling complaints

Sample Checksheet

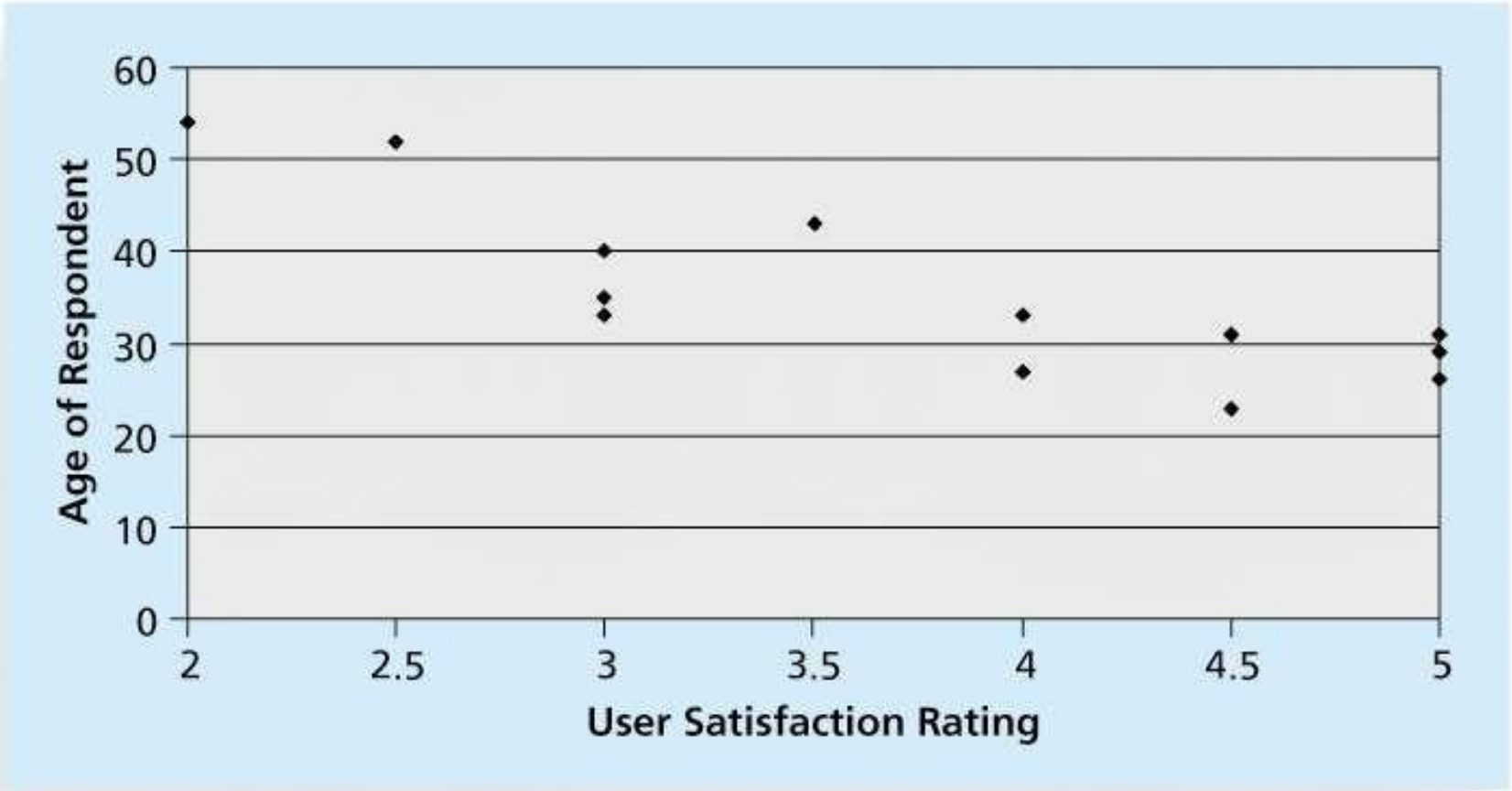
System Complaints

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

Scatter Diagram

- A **scatter diagram** helps to show if there is a relationship between two variables
- The closer data points are to a diagonal line, the more closely the two variables are related

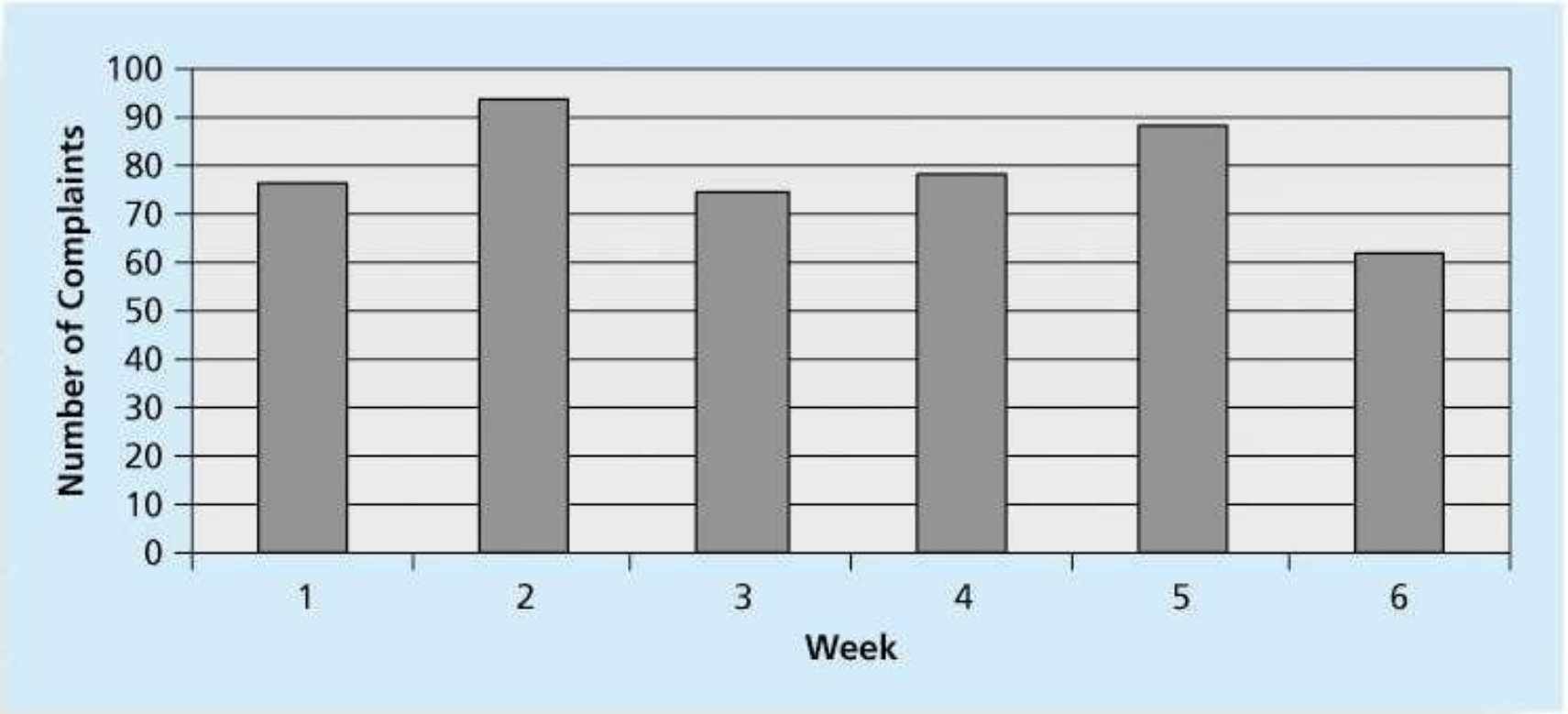
Sample Scatter diagram



Histograms

- A **histogram** is a bar graph of a distribution of variables
- Each bar represents an attribute or characteristic of a problem or situation, and the height of the bar represents its frequency

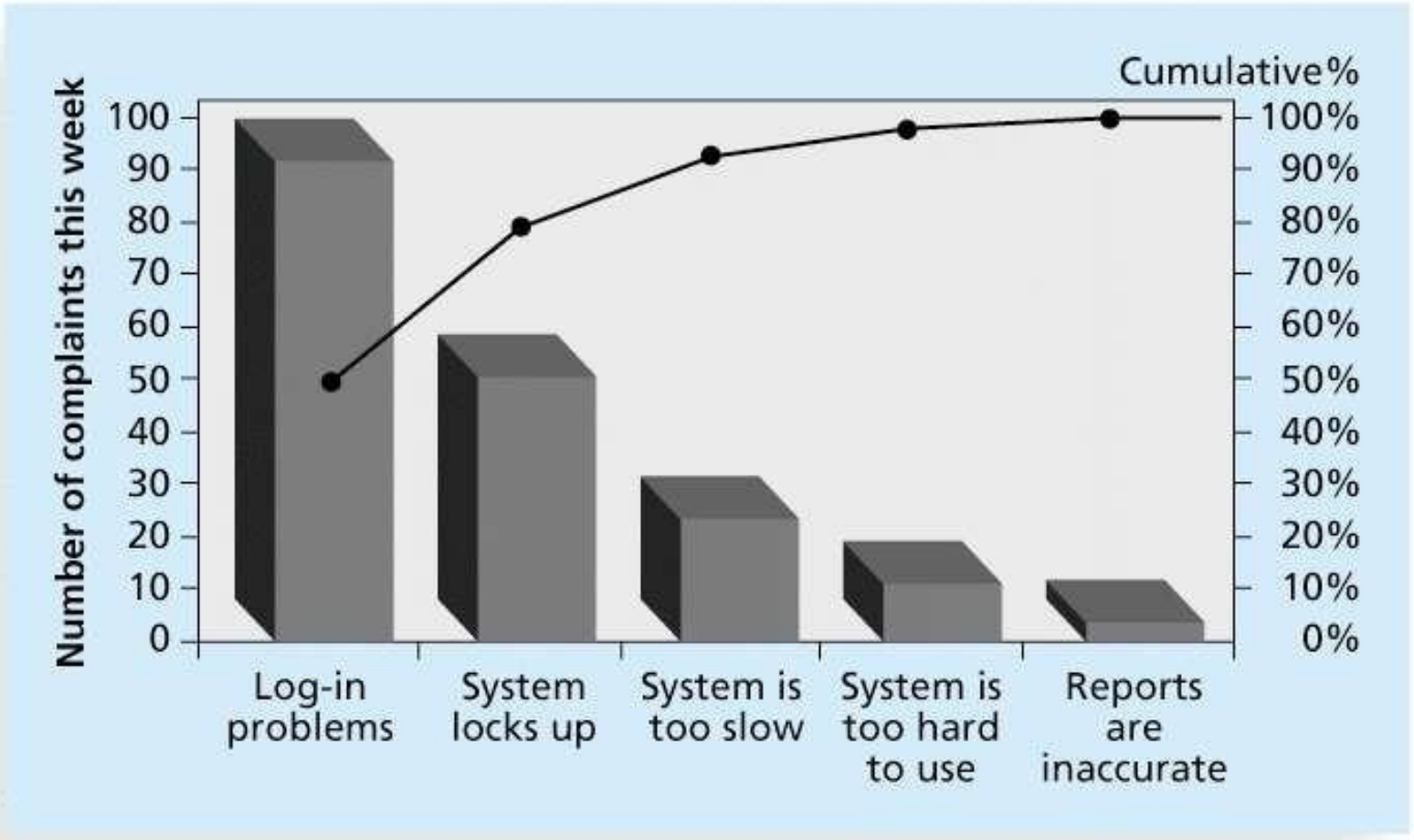
Sample Histogram



Pareto Charts

- A **Pareto chart** is a histogram that can help you identify and prioritize problem areas
- **Pareto analysis** is also called the 80-20 rule, meaning that 80 percent of problems are often due to 20 percent of the causes

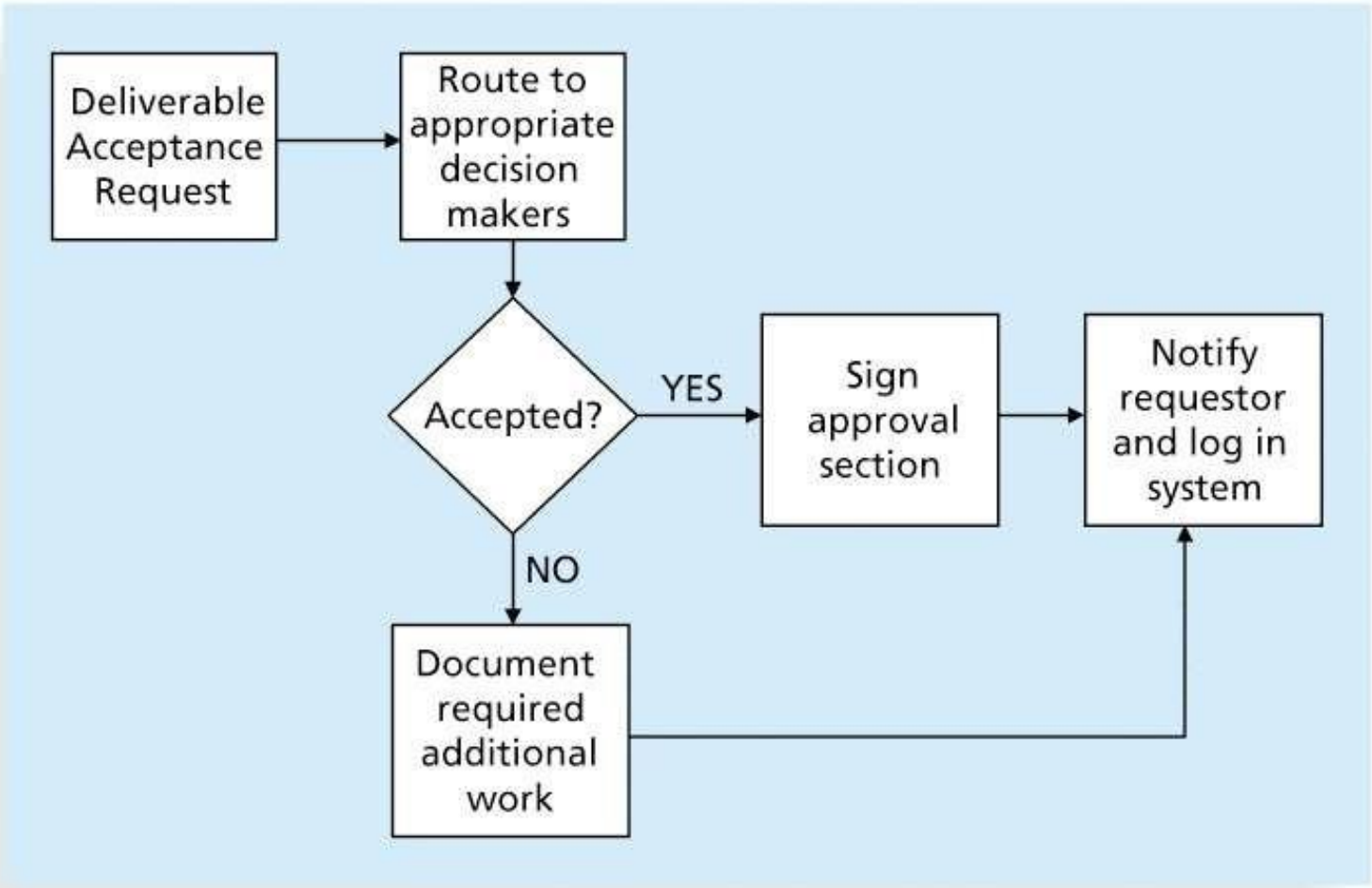
Sample Pareto Chart



Flow Charts

- Flowcharts are graphic displays of the logic and flow of processes that help you analyze how problems occur and how processes can be improved
- They show activities, decision points, and the order of how information is processed

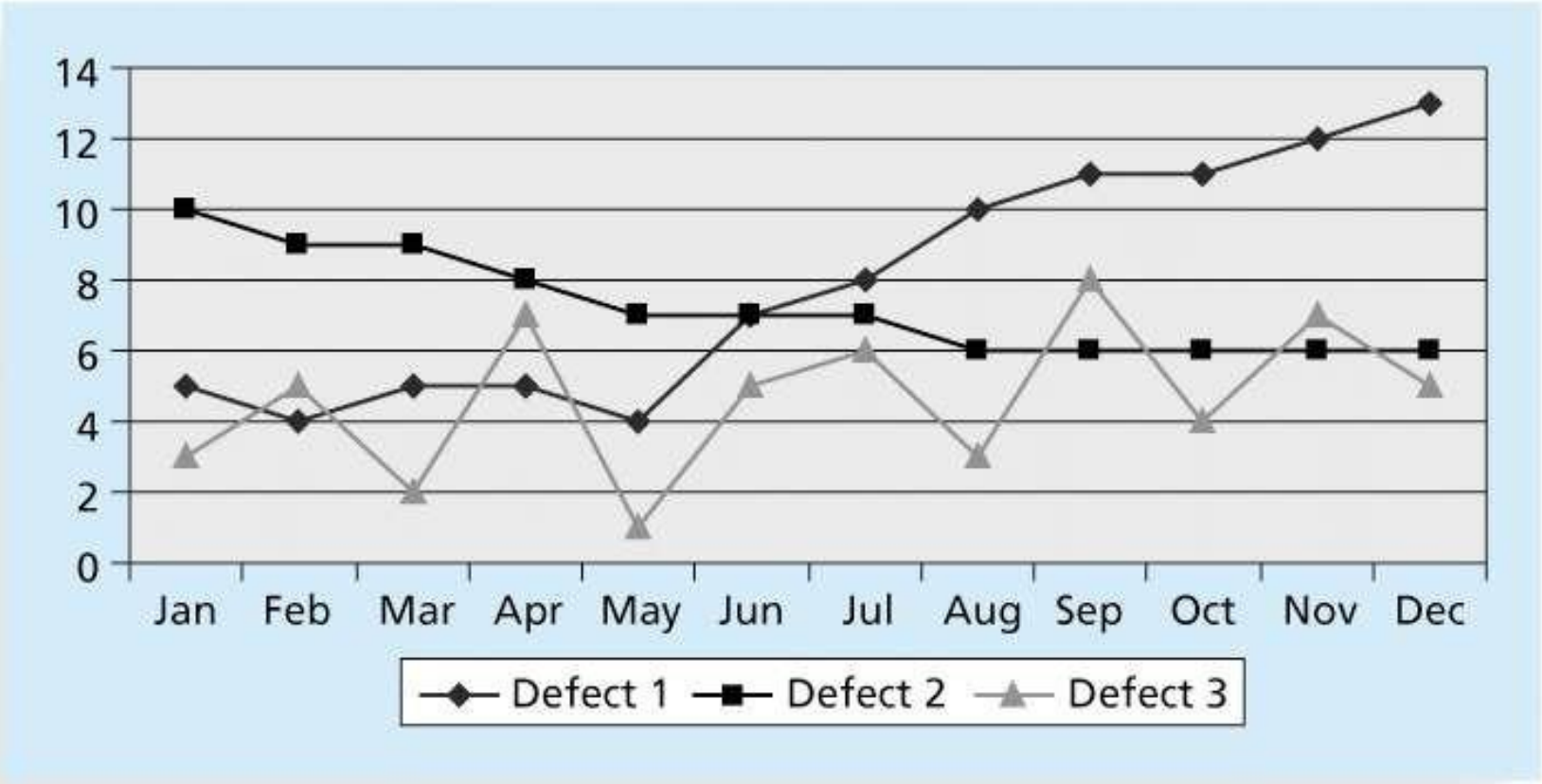
Sample Flowchart



Run Charts

- In addition to flowcharts, run charts are also used for stratification, a technique that shows data from a variety of sources to see if a pattern emerges
- A **run chart** displays the history and pattern of variation of a process over time.
- You can use run charts to perform trend analysis and forecast future outcomes based on historical results

Sample Run Charts



Statistical Sampling

- **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:

    Sample size = .25 X (certainty factor/acceptable error)^2
  - Be sure to consult with an expert when using statistical analysis

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

Six Sigma

- **Six Sigma** is "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"*

*Pande, Peter S., Robert P. Neuman, and Roland R. Cavanagh, *The Six Sigma Way*, New York: McGraw-Hill, 2000, p. xi.

Basic Information on Six Sigma

- The target for perfection is the achievement of no more than **3.4 defects per million opportunities**
- The principles can apply to a wide variety of processes
- Six Sigma projects normally follow a five-phase improvement process called DMAIC

DMAIC

- DMAIC is a systematic, closed-loop process for continued improvement that is scientific and fact based
- DMAIC stands for:
  - **D**efine: Define the problem/opportunity, process, and customer requirements
  - **M**easure: Define measures, then collect, compile, and display data
  - **A**nalyze: Scrutinize process details to find improvement opportunities
  - **I**mprove: Generate solutions and ideas for improving the problem
  - **C**ontrol: Track and verify the stability of the improvements and the predictability of the solution

How is Six Sigma Quality Control Unique?

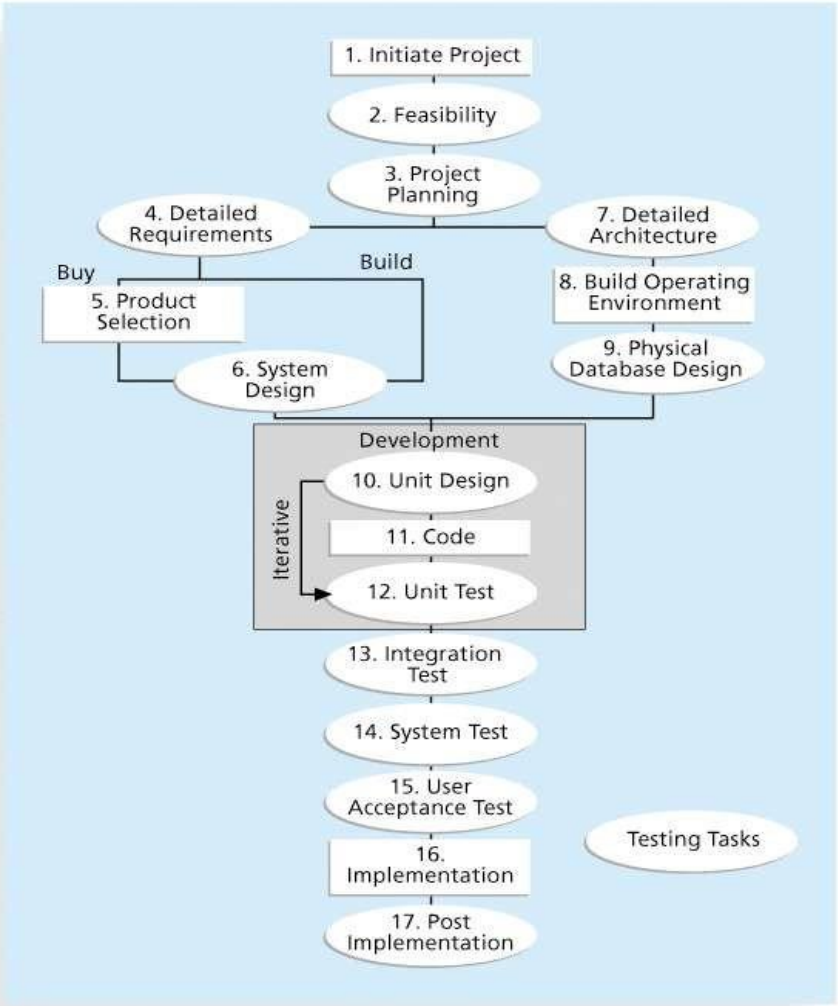
- It requires an organization-wide commitment.
- Training follows the “Belt” system
- Six Sigma organizations have the ability and willingness to adopt contrary objectives, such as reducing errors and getting things done faster
- It is an operating philosophy that is customer focused and strives to drive out waste, raise levels of quality, and improve financial performance at *breakthrough* levels

What Went Right?

- Motorola, Inc. pioneered the adoption of Six Sigma in the 1980s and saved about $14 billion
- Allied Signal/Honeywell saved more than $600 million a year by reducing the costs of reworking defects and improving aircraft engine design processes
- After implementing the solutions recommended by a Six Sigma team for Baptist St. Anthony's Hospital in Amarillo, Texas, the percent of delayed cases in the radiology department dropped from 79 percent to 33 percent, delays decreased by 22 percent, and the number of orders missing or needing clarification dropped to zero from 11 percent

Testing

- Many IT professionals think of testing as a stage that comes near the end of IT product development
- Testing should be done during almost every phase of the IT product development life cycle


1. Initiate Project
2. Feasibility
3. Project Planning
4. Detailed Requirements
7. Detailed Architecture
Buy
Build
5. Product Selection
8. Build Operating Environment
9. Physical Database Design
6. System Design
Development
10. Unit Design
Iterative
11. Code
12. Unit Test
13. Integration Test
14. System Test
15. User Acceptance Test
16. Implementation
17. Post Implementation
Testing Tasks

Type 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 because:
  - 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

- Modern quality management:
    - Requires customer satisfaction
    - Prefers prevention to inspection
    - Recognizes management responsibility for quality
- Noteworthy quality experts include Deming, Juran, Crosby, Ishikawa, Taguchi, and Feigenbaum

ISO Standards

- ISO 9000 is a quality system standard that:
  - Is a three-part, continuous cycle of planning, controlling, and documenting quality in an organization
  - Provides minimum requirements needed for an organization to meet its quality certification standards
  - Helps organizations around the world reduce costs and improve customer satisfaction
- See www.iso.org for more information

Improving Information Technology Project Quality

- Several suggestions for improving quality for IT projects include:
  - Establish leadership that promotes quality
  - Understand the cost of quality
  - Focus on organizational influences and workplace factors that affect quality
  - Follow maturity models

The Cost Of Quality

- The cost of quality is the 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
- A study reported that software bugs cost the U.S. economy $59.6 billion each year and that one third of the bugs could be eliminated by an improved testing infrastructure

Five Cost Categories Related To 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

Expectations and Cultural Differences in Quality

- Project managers must understand and manage stakeholder expectations.
- Expectations also vary by:
    - Organization's culture
    - Geographic regions

Maturity Models

- Maturity models are frameworks for helping organizations improve their processes and systems
    - The Software Quality Function Deployment Model focuses on defining user requirements and planning software projects
    - The Software Engineering Institute's Capability Maturity Model Integration is a process improvement approach that provides organizations with the essential elements of effective processes

CMMI Levels

- CMMI levels, from lowest to highest, are:
    - Incomplete
    - Performed
    - Managed
    - Defined
    - Quantitatively Managed
    - Optimizing
- Companies may not get to bid on government projects unless they have a CMMI Level 3

PMI's Maturity Model

- PMI released the Organizational Project Management Maturity Model (OPM3) in December 2003 and third edition was released in 2013
- Model is based on market research surveys sent to more than 30,000 project management professionals and incorporates 180 best practices and more than 2,400 capabilities, outcomes, and key performance indicators
- Addresses standards for excellence in project, program, and portfolio management best practices and explains the capabilities necessary to achieve those best practices

Thank you