Chapter 8: Project Quality Management

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Learning Objectives

- Understand the importance of *project quality management* for information technology (IT) products and services
- Define project quality management and understand how *quality relates to various aspects of IT projects*
- Describe *quality management planning* and how quality and scope management are related
- Discuss the importance of *quality assurance*
- Explain the main outputs of the *quality control* process

Learning Objectives

- Understand the tools and techniques for quality control, such as the *Seven Basic Tools of Quality*, statistical sampling, Six Sigma, and testing
- Summarize the contributions of *noteworthy quality experts* to modern quality management
- Describe how leadership, the cost of quality, organizational influences, expectations, cultural differences, and *maturity models* relate to improving quality in IT projects
- Discuss how software can assist in project quality management

Opening case

一家大型医疗器械公司刚雇佣了一个资深顾问Scott来帮助解决公司新开发的行政信息系统(EIS)存在的质量问题。EIS是由公司内部程序员、分析员以及公司的几位行政官员共同开发的。许多行政管理人员也被EIS所吸引，EIS能够使他们便捷地按照产品、国家、医院和销售代理商分类对各种医疗仪器的销售情况进行跟踪。EIS系统在行政部门获得成功测试后，公司决定把EIS系统推广应用到各个管理层。

不幸的是，在经过几个月的运行之后，新的EIS产生了许多质量问题。人们抱怨他们不能进入系统。这个系统一个月出好几次故障，响应速度也在变慢。用户在几秒钟之内得不到所需信息。有几个人总忘记如何输入密码进入系统，因而增加了向服务台打电话求助的次数。有人抱怨系统中有些报告输出的信息不一致。EIS的行政负责人希望这些问题能够快速准确的解决，所以他决定从公司外部雇佣一名质量专家。据他了解，这位专家有类似项目的经验。Scott的工作将是领导由来自医疗仪器公司和他的咨询公司的人员共同组成的工作小组，识别并解决EIS中存在的质量问题，编制一项计划以防止质量问题。

Opening case

1. What quality problems exist in the EIS system?

2. What should be done about the above problems?

3. How does a project team know whether their project has delivered a high-quality product?

4. If you were Scott, what kind of quality plan (assurance and control) would you prepare to prevent quality problems in future it projects?

Main Contents

1. The importance of project quality management
2. What is project quality management ?
3. Planning quality management
4. Performing quality assurance
5. Controlling quality
6. Tools and techniques for quality control
7. Modern quality management
8. Improving IT project quality

1. The importance of project quality management

- How do you think the quality of the software that you mostly use ?

- How about the progressiveness of the technologies utilized by motor industry, construction industry, and IT industry ? And which products of the above industries have the highest quality ? Why?

2. What is project quality management ?

Quality:

- The 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 fulfills requirements. (ISO9000: 2000)
- *conformance to requirements* and *fitness for use*
  - ✓ **conformance to requirements:** the projects processes and products meet written specifications.
  - ✓ **fitness for use:** a product can be used as it was intended.

2. What is project quality management ?

The purpose of project quality management is to ensure that the project will ***satisfy the needs*** for which it was undertaken.

- *The customer ultimately decides if quality is acceptable.*
- A basic criterion of modern **quality** management is "***quality is planned, not checked***."
- **Quality responsibility:**

➢ *Top management:* responsible for the quality of the organization

➢ *Project Manager:* responsible for the overall quality of the project

➢ *Individual employees:* responsible for the quality of their work

Quality management — 3 main processes

Planning
Process: Plan quality management
Outputs: Quality management plan, process improvement plan, quality metrics, quality checklists, and project documents updates

Executing
Process: Performing quality assurance
Outputs: Change requests, project management plan updates, project documents updates, and organizational process asset updates

Monitoring and controlling
Process: Perform quality control
Outputs: Quality control measurements, validated changes, validated deliverables, work performance information, change requests, project management plan updates, project documents updates, organizational process asset updates

Project start **Project finish**

3. Planning quality management

Planning quality management: Identifying which ***quality standards*** are relevant to the project and how to satisfy them.

Inputs: Organizational policies related to quality,

Scope statement and product description,

Related standards and regulations

Tools and techniques: Design of experiments

Outputs: Quality management plan, Quality checklists,

Quality metrics, Process improvement plan,

Project documents updates

3. Planning quality management

Quality management planning implies the ability to anticipate situations and prepare actions to bring about the desired outcome.

- Identify relevant quality standards
- Design quality into the products of the project
- Plan a process that ensures the appropriate outcome

Correcting actions for ensuring quality in a format

3. Planning quality management

Metric is a standard of measurement.

Quality metric is dedicated to describing the project or product attributes and how the quality control process will verify the degree of compliance

- Completion rate
- Cost performance
- Failure rate
- Daily defect quantity
- Total downtime per month
- Number of code line errors
- Customer satisfaction score
- Test coverage

3. Planning quality management

•**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.

4. Performing quality assurance

Performing quality assurance: Periodically evaluating overall ***project performance*** to ensure the project will satisfy the relevant quality standards.

Quality assurance(QA) includes all of the activities related to satisfying the relevant quality standards for a project, and to continuously improving the quality.

Two popular concepts in quality assurance, one is **continuous improvement** and the other is **lean.**

4. Performing quality assurance

Inputs: quality management plan, process improvement plan, quality metrics, quality control measurements, project documents

Tools and techniques: design of experiment, benchmarking, fishbone, quality audit

Outputs: Change requests

Project management plan updates,

Project documents updates

Organizational process asset updates

4. Performing quality assurance

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

5. Controlling quality

Performing quality control: Monitoring ***specific project results*** to ensure that they comply with the relevant quality standards

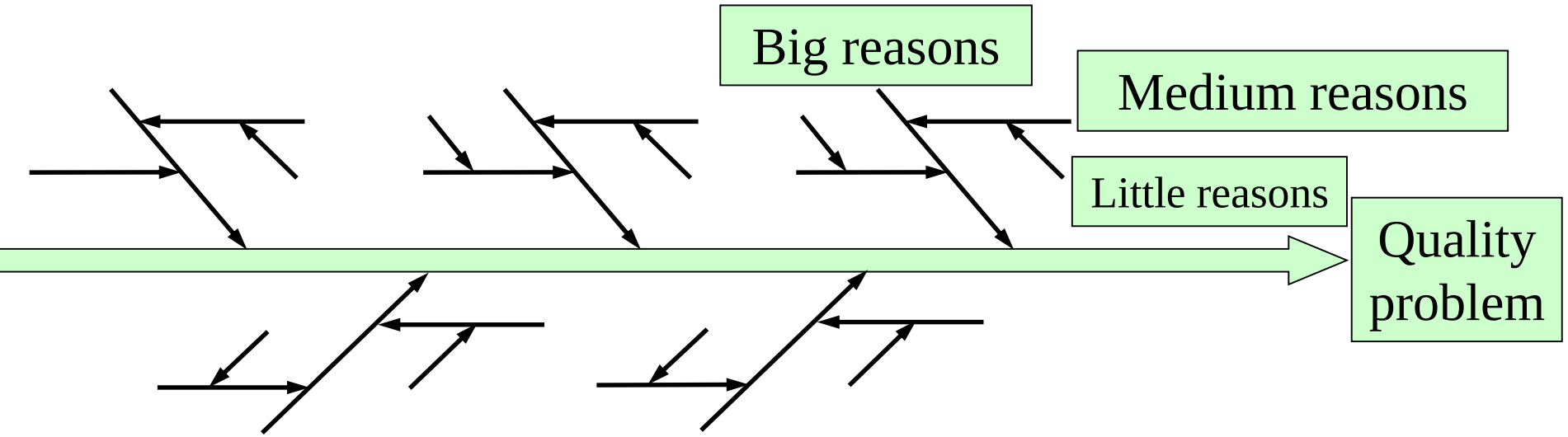
Quality control intends to improve quality.

Outputs :

- acceptance decision
- rework
- process adjustments

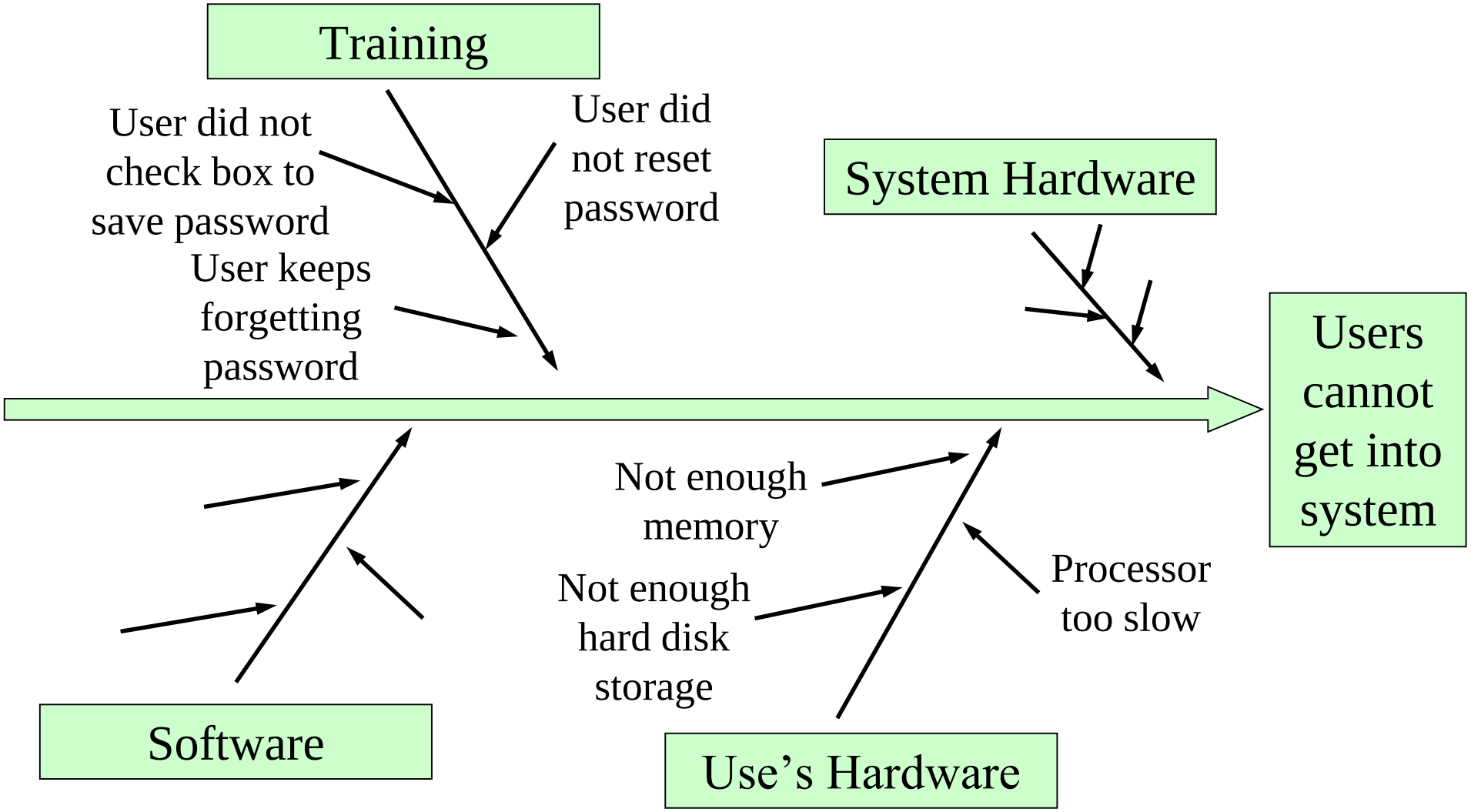
6. Tools and techniques for quality control

Cause-and-effect diagrams



6. Tools and techniques for quality control

Cause-and-effect diagrams

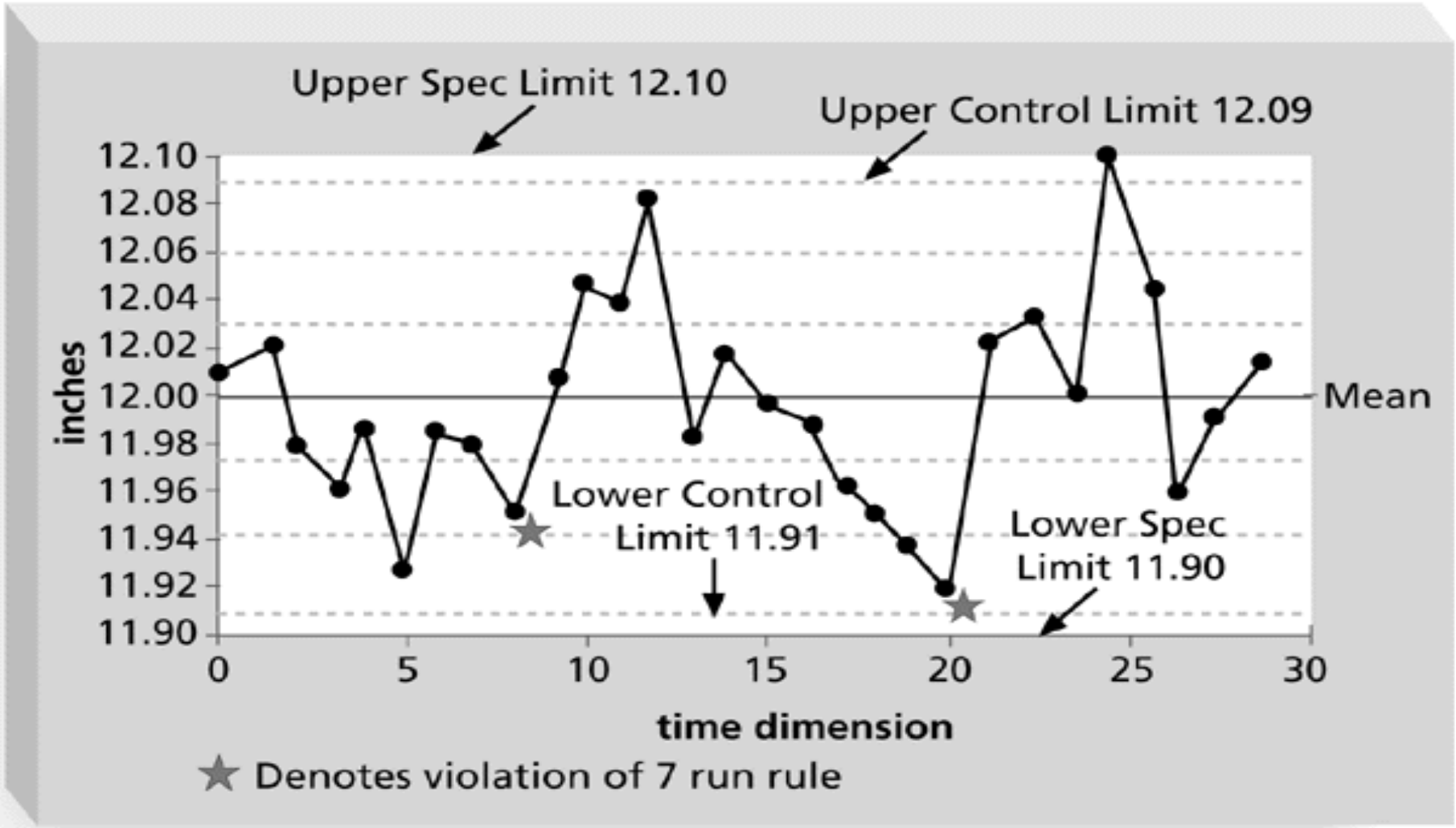


6. Tools and techniques for quality control

- 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

6. Tools and techniques for quality control

Control chart

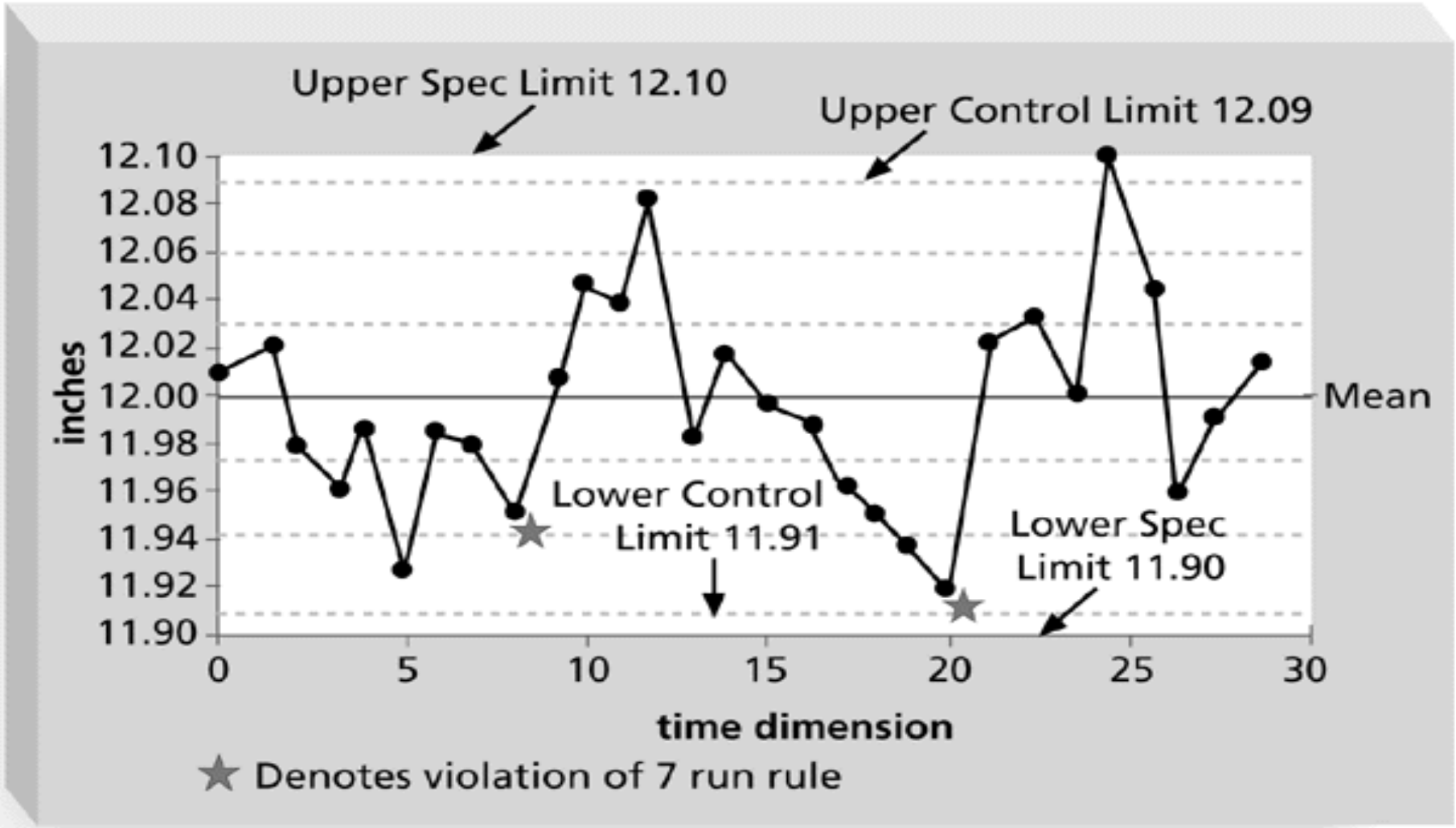


6. Tools and techniques for quality control

- 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

6. Tools and techniques for quality control

Control chart



6. Tools and techniques for quality control

A **checksheet** is used to collect and analyze data

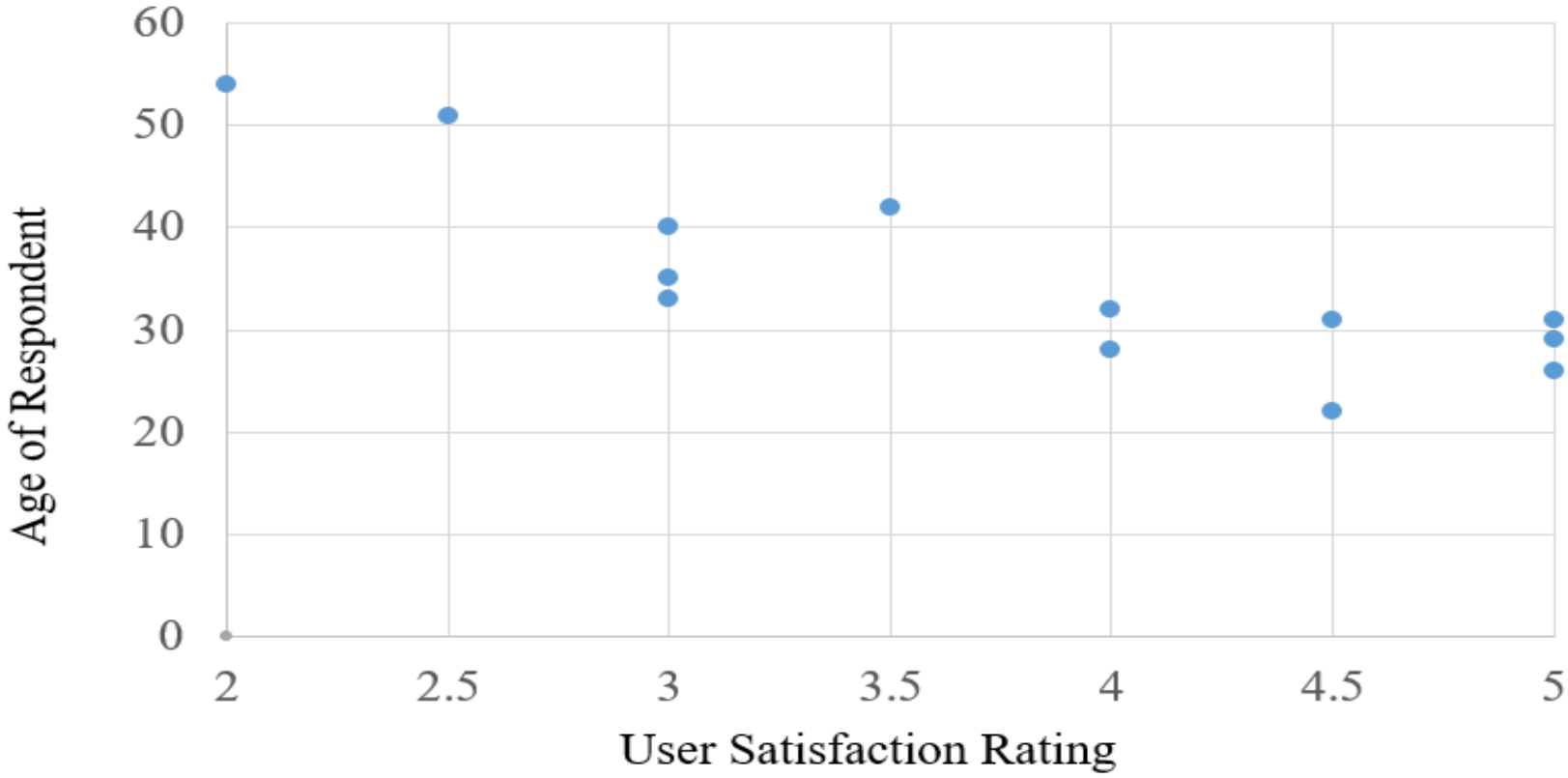
It is sometimes called a tally sheet or checklist, depending on its format

System Complaints								
Source	Day							
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
Email	III	IIII	I	II	I		I	12
Text	VII	IIII	VI	III	IIII	II	III	29
Phone call	I	II	I	I	II	I		8
Total	11	10	8	6	7	3	4	49

This information might be useful in improving the process for handling complaints

6. Tools and techniques for quality control

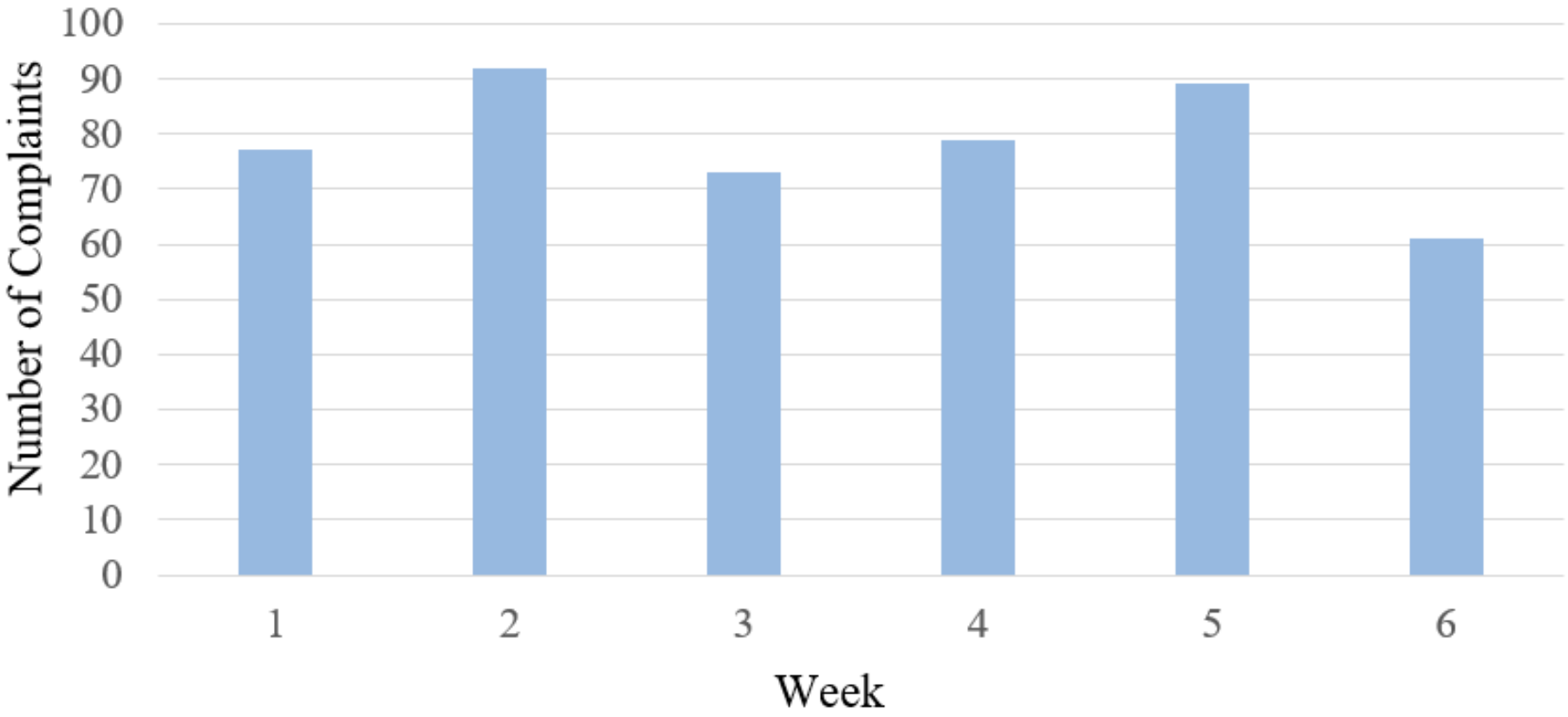
A **scatter diagram** helps to show if there is a relationship between two variables. The closer data points are to a diagonal line, the more closely the two variables are related.



6. Tools and techniques for quality control

A **histogram** is a bar graph of a distribution of variables

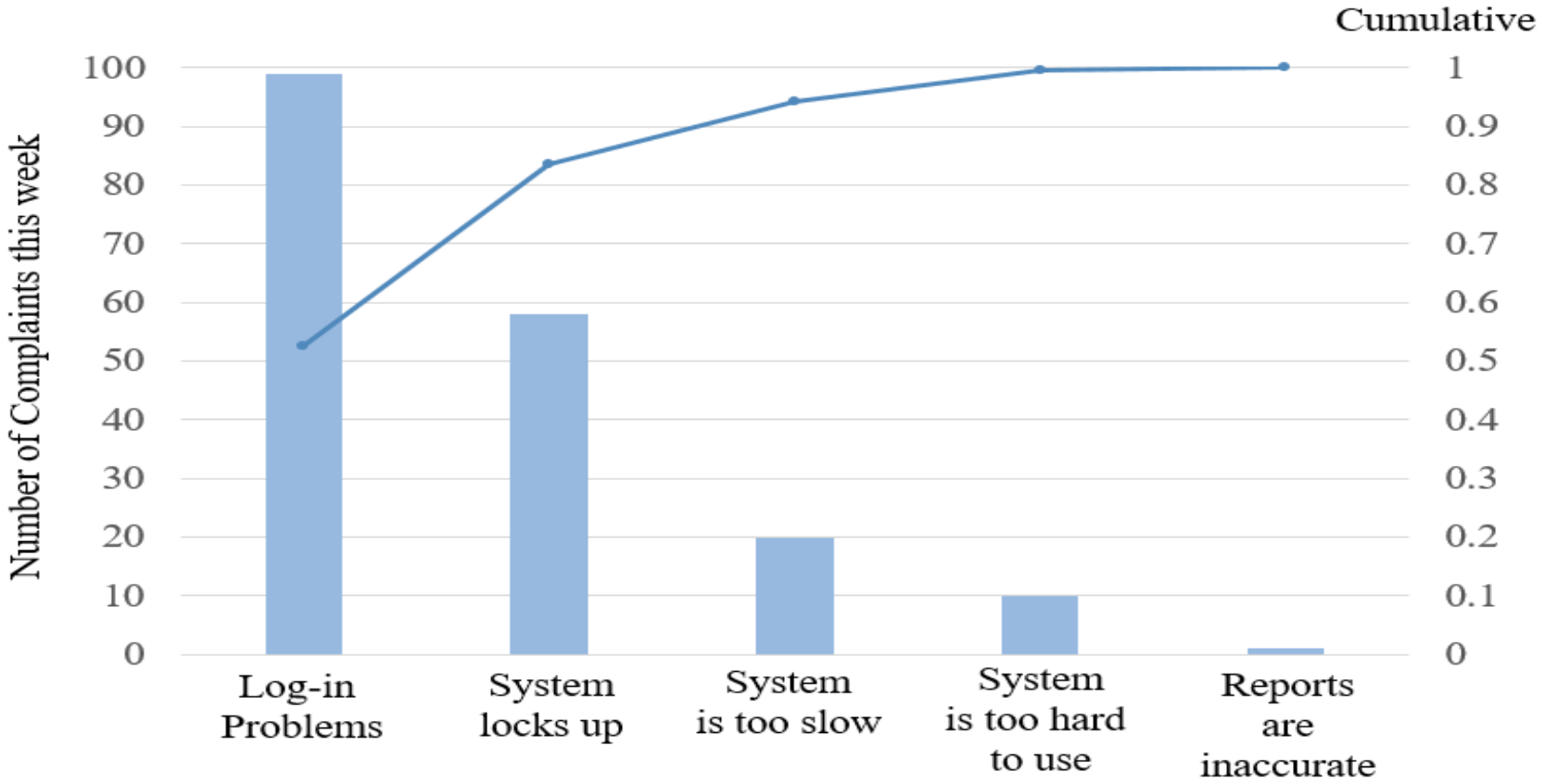
Each bar represents an attribute or characteristic of a problem or situation, and the height of the bar represents its frequency



6. Tools and techniques for quality control

A **Pareto chart** is a histogram that can help you identify and prioritize problem areas

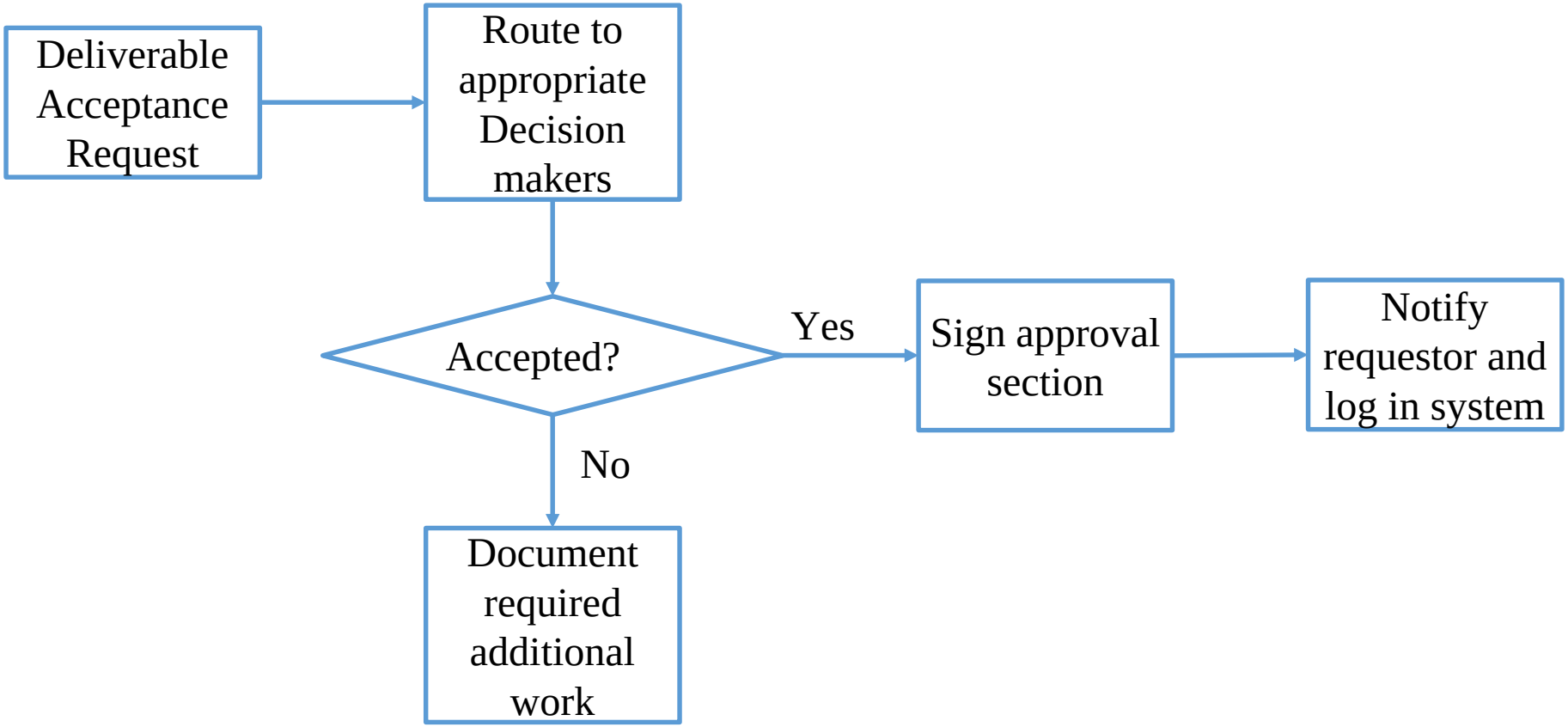
Pareto analysis is also called the 80-20 rule, meaning that 80 percent of problems are often due to 20 percent of the causes



6. Tools and techniques for quality control

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



6. Tools and techniques for quality control

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

6. Tools and techniques for quality control

- **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:

$$\text{Sample size} = 0.25 * (\text{certainty factor}/\text{acceptable error})^2$$

- Be sure to consult with an expert when using statistical analysis

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

6. Tools and techniques for quality control

Six sigma is a comprehensive and flexible system for achieving, sustaining and maximizing business success. Its target for perfection is the achievement of *no more than 3.4 defects, errors, or mistakes per million opportunities.*

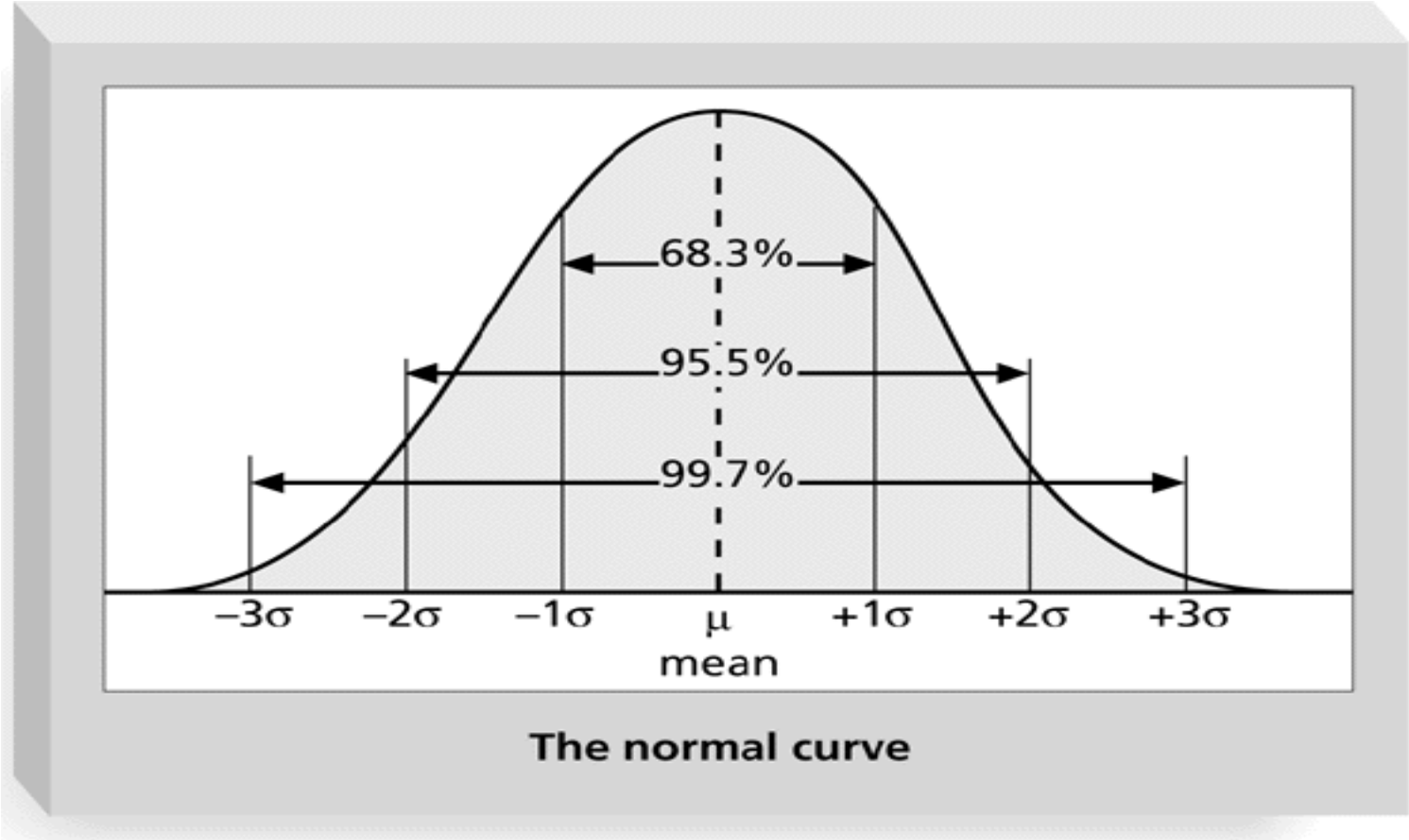
The term ***sigma*** means standard deviation

Standard deviation measures how much variation exists in a distribution of data

Standard deviation is a key factor in determining the acceptable number of defective units found in a population.

6. Tools and techniques for quality control

Six Sigma projects strive for no more than *3.4 defects per million opportunities*, yet this number is confusing to many statisticians



The normal curve

6. Tools and techniques for quality control

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

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

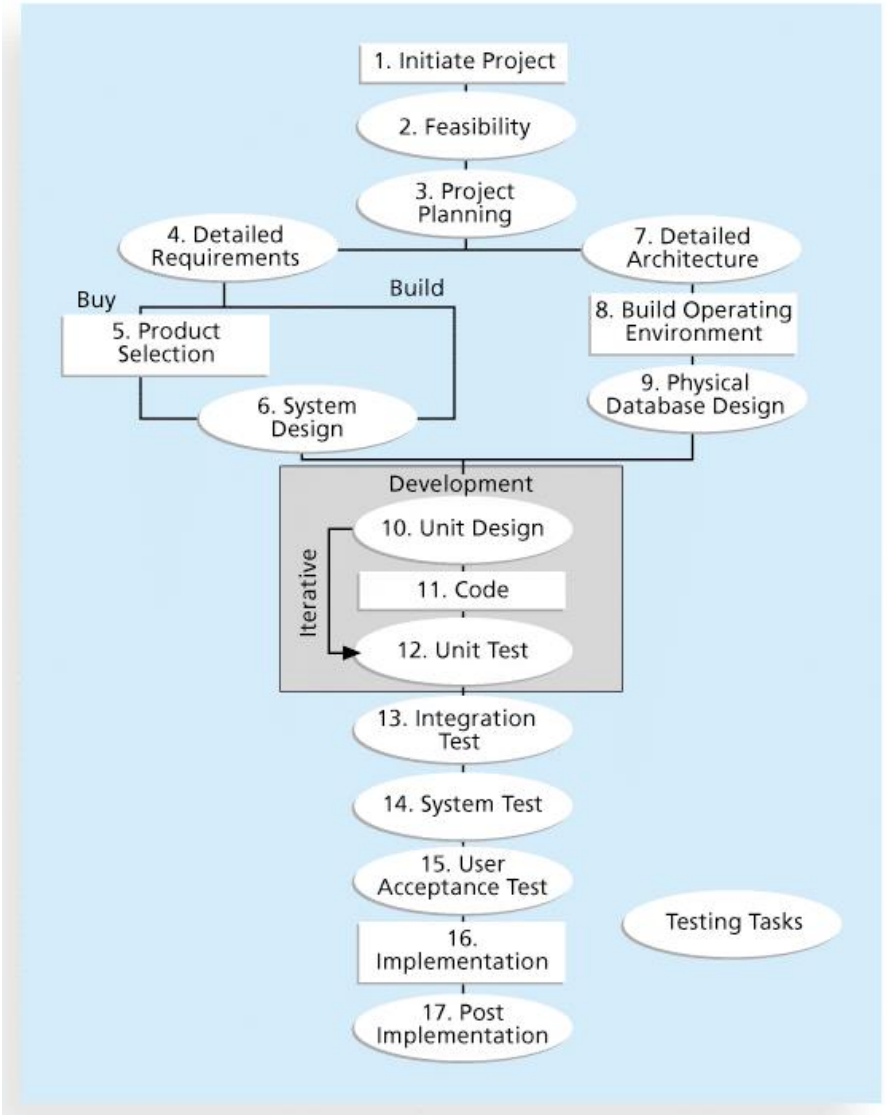
6. Tools and techniques for quality control

- **DMAIC(**Define 、 Measure 、 Analyze 、 Improve 、 Control) – **DMADV**(Define、Measure、Analyze、Design、Verify)
- **Six 9s of quality** is a measure of quality control equal to 1 fault in 1 million opportunities.
- In the telecommunications industry, it means *99.9999* percent service availability or *30 seconds of down time a year*.
- This level of quality has also been stated as the target goal for the number of errors in a communications circuit, system failures, or errors in lines of code.

6. Tools and techniques for quality control

Testing

- **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.



6. Tools and techniques for quality control

- 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

7. 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,
- Feigenbaum

7. Modern quality management

- **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 *fishbone diagrams.*
- **Taguchi** developed methods for optimizing the process of engineering experimentation.
- **Feigenbaum** developed the concept of total quality control.

7. Modern quality management

Malcolm Baldrige Award

- The **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

7. Modern quality management

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

8. Improving IT 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***

i. Software Quality Function Deployment (SQFD) model

ii. Capability Maturity Model Integration (CMMI) model

iii. Project Management Maturity Models

8. Improving IT project quality

Leadership

As Joseph M. Juran said in 1945, “It is most important that top management be quality-minded. In the absence of sincere manifestation of interest at the top, little will happen below”*

A large percentage of quality problems are associated with management, not technical issues.

*American Society for Quality (ASQ), *(www.asqc.org/about/history/juran.html*).

8. Improving IT project quality

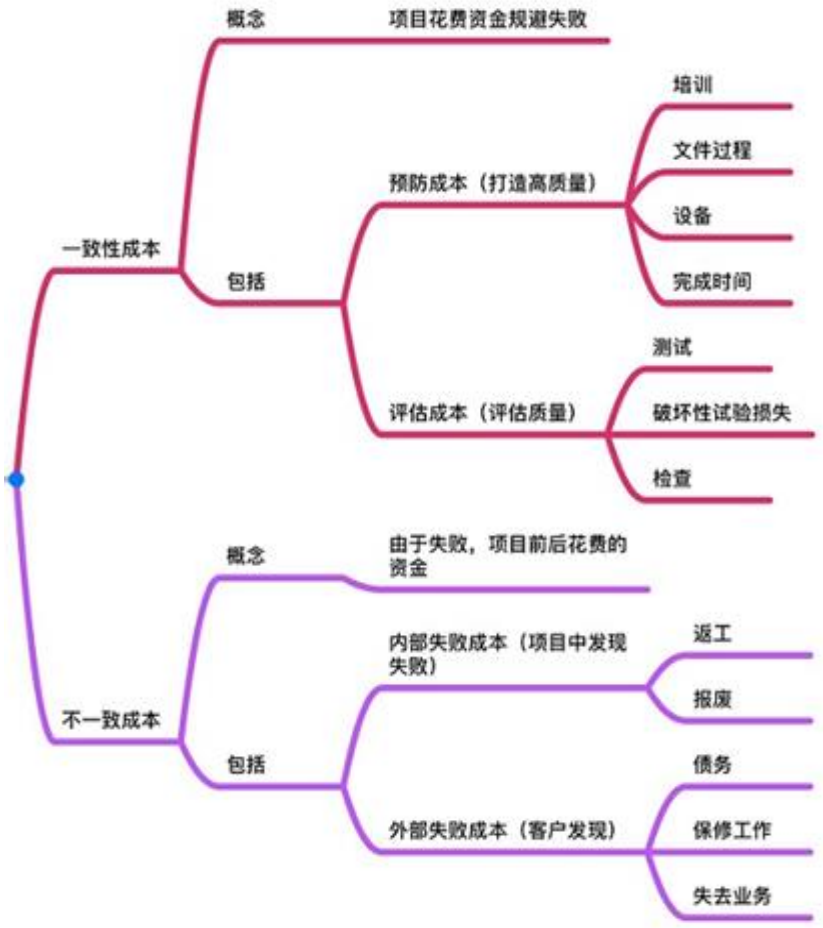
The Cost of Quality

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

IT industry tolerates lower or higher cost of nonconformance ?



8. Improving IT project quality

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.

8. Improving IT project quality

Follow ***maturity models:***

Maturity models are frameworks for helping organizations improve their processes and systems

Three popular maturity models:

i. Software Quality Function Deployment (SQFD) model

ii. Capability Maturity Model Integration (CMMI) model

iii. Project Management Maturity Models

8. Improving IT project quality

The Software Quality Function Deployment Model focuses on defining user requirements and planning software projects.

***Results**: measurable technical product specifications and their priorities.*

The Software Engineering Institute's **Capability Maturity Model Integration** is a process improvement approach that provides organizations with the essential elements of effective processes

8. Improving IT project quality

CMMI levels, from lowest to highest, are:

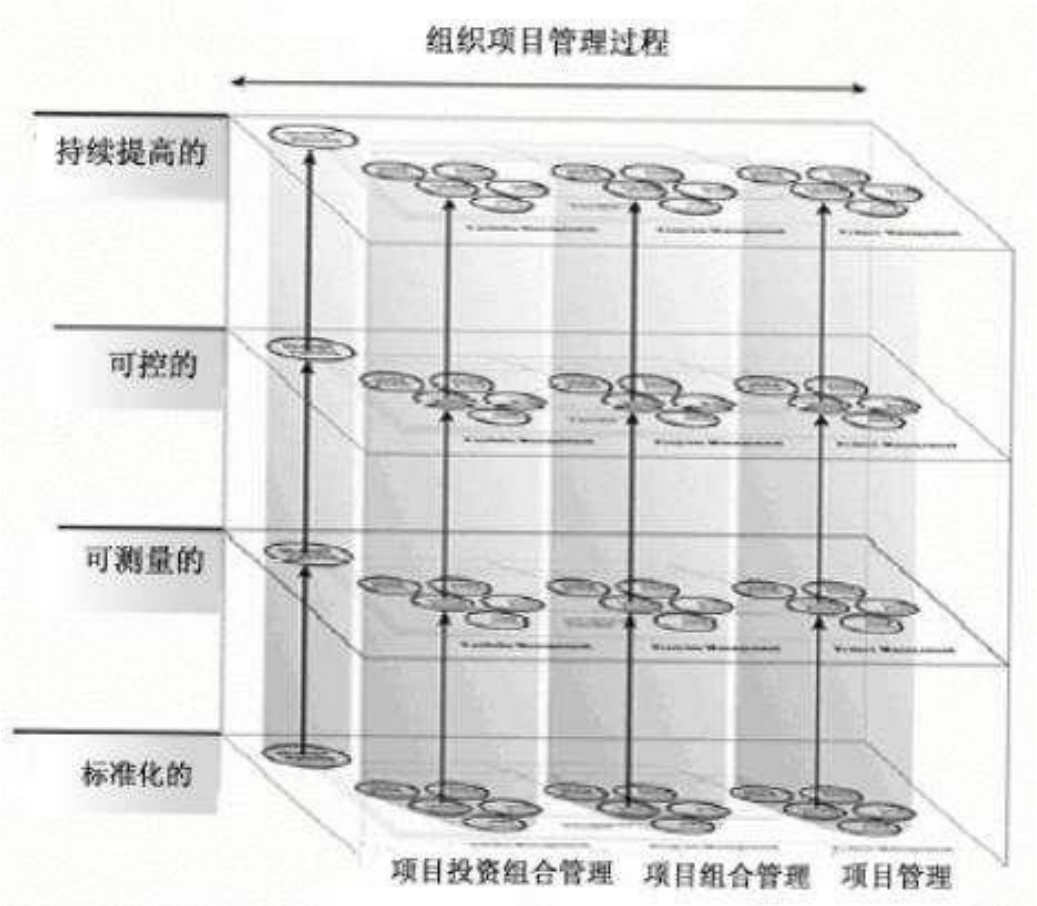
- **Incomplete**
- **Performed**
- **Managed**
- **Defined**
- **Quantitatively Managed**
- **Optimizing**

Companies may not get to bid on government projects unless they have a CMMI Level 3

8. Improving IT project quality

PMI's Maturity Model

- Addresses standards for excellence in project, program, and portfolio management best practices and explains the capabilities necessary to achieve those best practices



Chapter Summary

- **Project quality management** ensures that the project will satisfy the needs for which it was undertaken
- **Main processes include**: Plan quality、Perform quality assurance、Perform quality control
- **Tools and techniques for quality control**：Cause-and-effect diagrams、control chart 、Checksheet 、scatter diagram 、histogram 、Pareto chart、Flowcharts 、Statistical sampling 、Six sigma
- **Noteworthy quality experts include**: Deming、Juran、Crosby、Ishikawa、Taguchi、 Feigenbaum
- **Maturity models**：SQFD、CMMI、OPM3