

CSIT214/CSIT883
IT Project Management



Quality management

Project management framework (review)

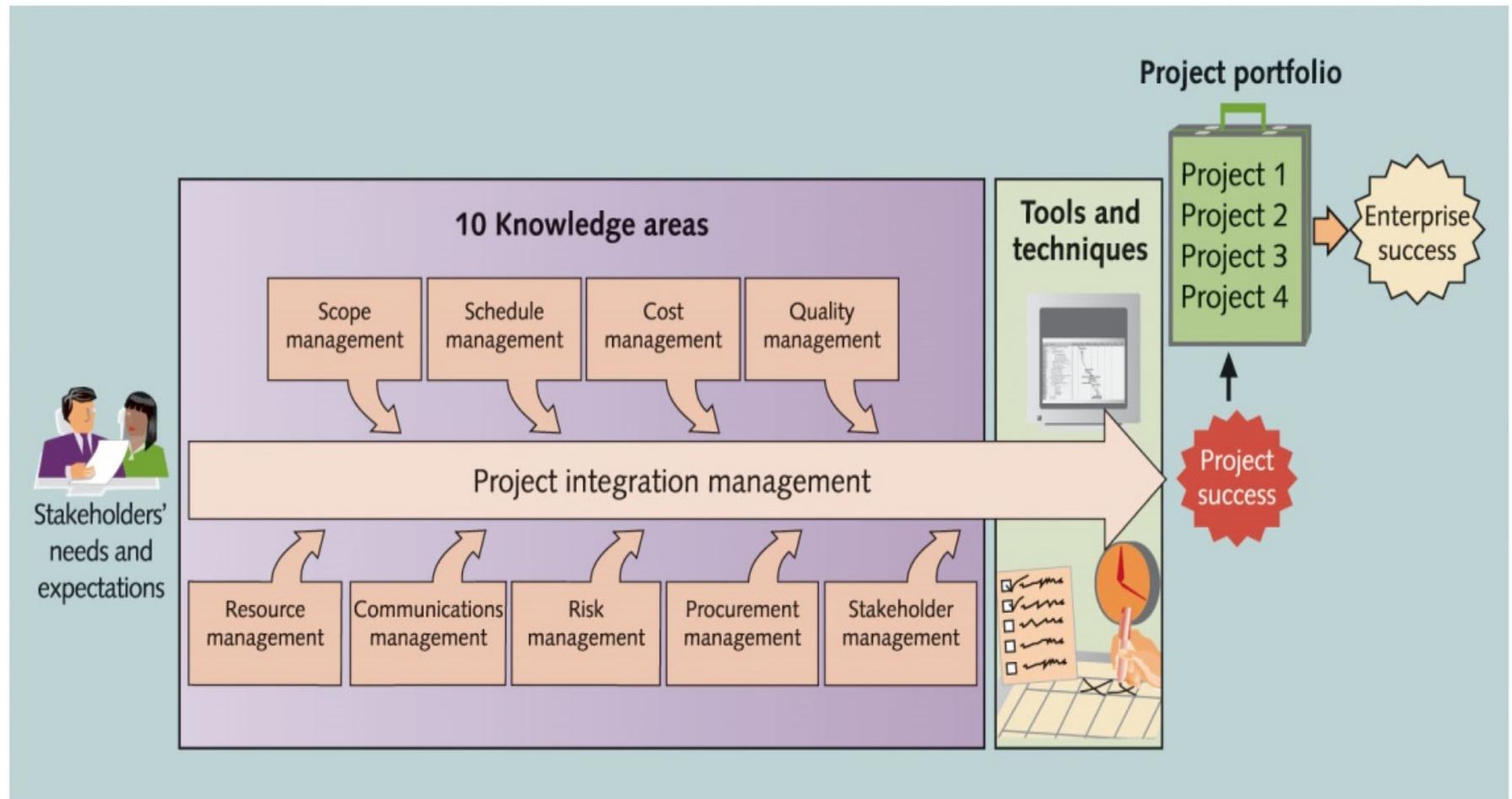


FIGURE 1-2 Project management framework

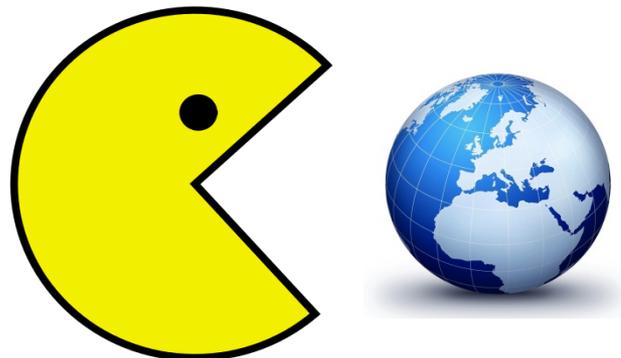
“Software eats the World”

- *“We are in the middle of a dramatic and broad technological and economic shift in which software companies are poised to take over large swathes of the economy”*

(Marc Andreessen, “Why Software is Eating the World”,
The Wall Street Journal,

<http://online.wsj.com/article/SB10001424053111903480904576512250915629460.html>)

- More and more major businesses and industries are being run on software and delivered online services.



“Software eats the World” (cont.)

Good news for us

Hurray!



But “*With great power there must also come great responsibility*” ...



Low-quality software costs jobs ...

<https://www.youtube.com/watch?v=7BKNnpJfWII>



knight capital software glitch costs



<https://money.cnn.com> › [knight-expensive-computer-bug](#) ⋮

[Is Knight's \\$440 million glitch the costliest computer bug ever?](#)

9 Aug 2012 — **Knight Capital's computer bug cost** the firm \$440 million, making it one of history's most expensive software glitches.

<https://dealbook.nytimes.com> › [2012/08/02](#) › [knight-ca...](#) ⋮

[Knight Capital Says Trading Glitch Cost It \\$440 Million](#)

2 Aug 2012 — Errant trades from the **Knight Capital** Group began hitting the New York Stock Exchange almost as soon as the opening bell rang on Wednesday.

<https://finance.yahoo.com> › [blogs](#) › [breakout](#) › [knight-...](#) ⋮

[Knight Capital's Software Glitch Costs it \\$440 Million - Yahoo ...](#)

2 Aug 2012 — Financial services company Knight Capital Group (KCG) has seen its stock price ... **Knight Capital's Software Glitch Costs** it \$440 Million.

<https://www.bugsnag.com> › [blog](#) › [bug-day-460m-loss](#) ⋮

[The Worst Computer Bugs in History: Losing \\$460m in 45 ...](#)

14 Sept 2017 — Ultimately, **Knight Capital** was fined an additional \$12 million by the Securities Exchange Commission, due to various violations of financial ...

Low-quality software costs money ...

On the 4th June 1996 at 1233 GMT (UTC) the European Space Agency launched a new rocket, **Ariane 5**, on its maiden unmanned flight,

https://www.youtube.com/watch?v=PK_yguLapgA

“It took the European Space Agency **10 years** and **\$7 billion** to produce **Ariane 5**, a giant rocket capable of hurling a pair of three-ton satellites into orbit with each launch and intended to give Europe overwhelming supremacy in the commercial space business.

All it took to explode that rocket less than a minute into its maiden voyage last June, scattering fiery rubble across the mangrove swamps of French Guiana, was a **small computer program** trying to stuff a 64-bit number into a 16-bit space”

Low-quality software costs lives



WIKIPEDIA
The Free Encyclopedia

[Main page](#)
[Contents](#)
[Current events](#)
[Random article](#)
[About Wikipedia](#)
[Contact us](#)
[Donate](#)

Contribute

[Help](#)
[Learn to edit](#)
[Community portal](#)
[Recent changes](#)
[Upload file](#)

Tools

[What links here](#)
[Related changes](#)
[Special pages](#)
[Permanent link](#)
[Page information](#)
[Cite this page](#)
[Wikidata item](#)

[Print/export](#)

Not logged in [Talk](#) [Contributions](#) [Create account](#) [Log in](#)

Article [Talk](#)

Read

[Edit](#)

[View history](#)



Therac-25

From Wikipedia, the free encyclopedia

The **Therac-25** was a computer-controlled [radiation therapy](#) machine produced by [Atomic Energy of Canada Limited](#) (AECL) in 1982 after the Therac-6 and Therac-20 units (the earlier units had been produced in partnership with [CGR of France](#)).

It was involved in at least six accidents between 1985 and 1987, in which patients were given massive [overdoses of radiation](#).^{[1]:425} Because of [concurrent programming errors](#) (also known as race conditions), it sometimes gave its patients radiation doses that were hundreds of times greater than normal, resulting in death or serious injury.^[2] These accidents highlighted the dangers of software [control](#) of safety-critical systems, and they have become a standard case study in [health informatics](#) and [software engineering](#). Additionally, the overconfidence of the engineers^{[1]:428} and lack of proper [due diligence](#) to resolve reported [software bugs](#) are highlighted as an extreme case where the engineers' overconfidence in their initial work and failure to believe the end users' claims caused drastic repercussions.

Contents [\[hide\]](#)

- [Design](#)
- [Problem description](#)
- [Root causes](#)
- [See also](#)
- [Notes](#)
- [Further reading](#)

Design [\[edit\]](#)

The machine offered two modes of [radiation therapy](#).^[3]

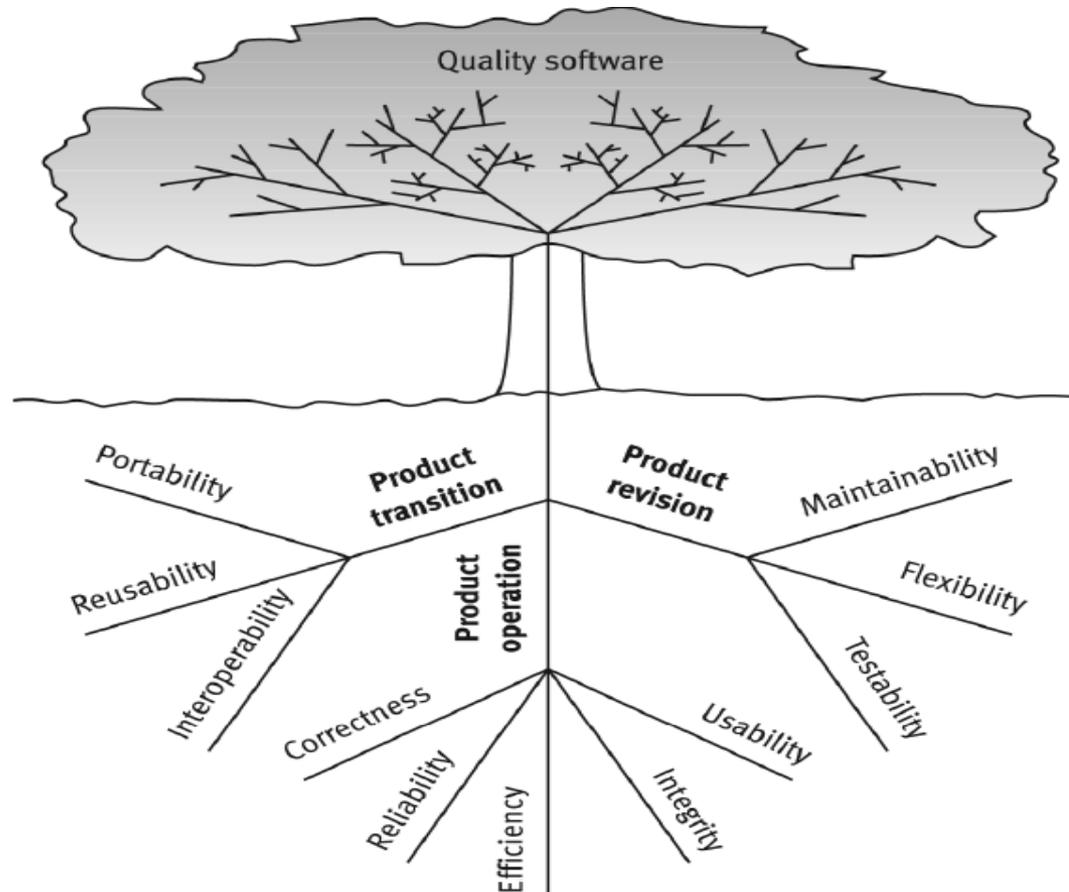
- Direct [electron-beam therapy](#), in which a narrow, low-current beam of high-energy (5 [MeV](#) to 25 MeV) electrons was scanned over the treatment area by magnets;
- [Megavolt X-ray](#) (or photon) therapy, which delivered a fixed-width beam of [X-rays](#), produced by colliding a narrow beam of 25 MeV electrons with a [tungsten](#) target, then passing the emitted

Questions of the day



- ❑ What do you think defining the quality of a software?
- ❑ How do we deliver a high-quality software?

Characteristics of software quality



McCall's Quality Factor Tree

ISO 9126

- ❑ ISO 9126 “Software engineering — Product quality” is an international standard for the evaluation of software quality.
- ❑ Attributes of software product quality
 - External qualities: reflect the external view of software held by users.
 - Internal qualities: reflect the developers’ view of the software.

ISO 9126 (external) software qualities

functionality	does it satisfy user needs?
reliability	can the software maintain its level of performance?
usability	how easy is it to use?
efficiency	relates to the physical resources used during execution
maintainability	relates to the effort needed to make changes to the software
portability	how easy can it be moved to a new environment?

Sub-characteristics of **Functionality**

- Suitability
 - Providing an appropriate set of functions for specified tasks and user objectives.
- Accuracy
 - Providing the correct or agreed results.
- Interoperability
 - ability of software to interact with other software components
- Security
 - Protect information and data and control access to the system.

Sub-characteristics of **Reliability**

□ Maturity

- frequency of failure due to faults

□ Fault-tolerance

- maintain a specified level of performance and recover the data directly affected in the case of a failure.

□ Recoverability

- re-establish a specified level of performance and recover the data directly affected in the case of a failure.

Sub-characteristics of **Usability**

- Understandability
 - easy to understand?
- Learnability
 - easy to learn?
- Operability
 - easy to use?
- Attractiveness
 - capability of the software product to be attractive to the user

Sub-characteristics of **Efficiency**

- Time behaviour
 - e.g. response time
- Resource utilization
 - e.g. memory usage

Sub-characteristics of **Maintainability**

- Analysability
 - identify the cause of a failure or parts to be modified.
- Changeability
 - how easy is software to change?
- Stability
 - avoid unexpected effects from modifications of the software.
- Testability
 - The capability of the software product to enable modified software to be validated.

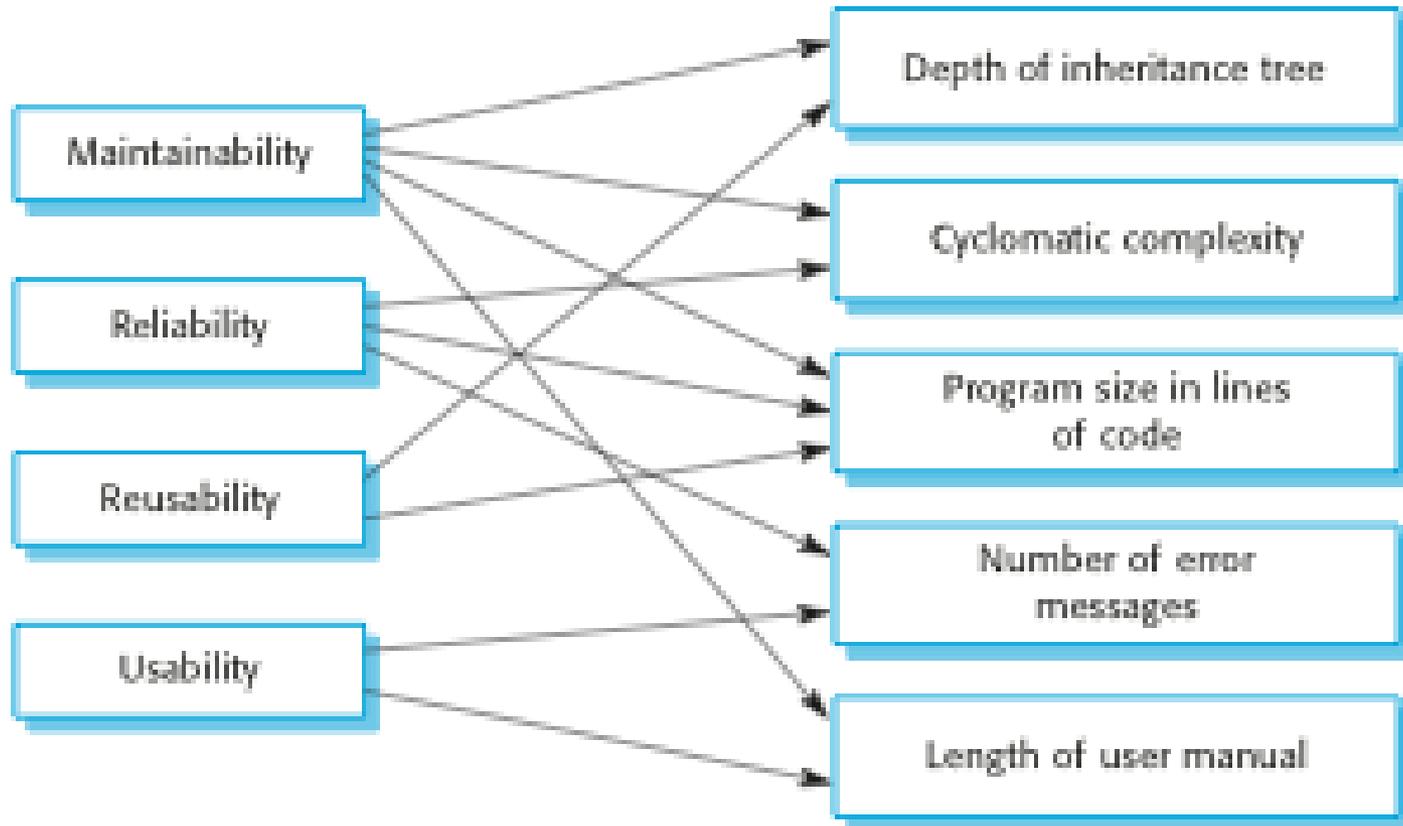
Sub-characteristics of **portability**

- Adaptability
 - adapted for different specified environments
- Installability
 - installed in a specified environment
- Co-existence
 - Capability of co-existing with other independent software products in a common environment sharing common resources.
- Replaceability
 - to be used in place of another specified software product for the same purpose in the same environment.

Relationships between internal and external quality

External quality attributes

Internal attributes



Using ISO 9126 quality standards

- Judge the importance of each quality for the application
 - for example, safety critical systems - *reliability* very important
 - real-time systems - *efficiency* important
- Select relevant external measurements within ISO 9126 framework for these qualities, for example
 - for reliability
 - Availability: the percentage of a particular time interval that a system is usable.
 - Mean-time between failures: the total service time divided by the number of failures
 - response-time for efficiency

Using ISO 9126 quality standards

- map measurement onto ratings scale to show degree of user satisfaction – for example response time

response (secs)	rating
<2	Exceeds requirement
2-5	Target range
6-10	Minimally acceptable
>10	Unacceptable

Pen and paper exercise

The new tutor management system has been installed, and is normally available to users from 8:00am until 6:00pm from Monday to Friday.

Over a four week period, the system was unavailable for one whole day because of problems with a disk drive and was not available on two other days until 10:00am because of problems with overnight batch processing runs.

What are the availability and the mean time between failures of the software system?

Pen and paper exercise

The following is an excerpt from a report generated from a help-desk logging system.

Assess the maintainability of module AA247 from the point of view of:

- the user management;
- the developer management.

*Assume that the **mean effort to repair** and the **mean elapsed time to repair** for a software with high maintainability is **4 hours** and **7 days** respectively.*

Module	Date fault reported	Fault corrected	Effort (hours)
AA247	1.4.2004	2.4.2004	5
AA247	10.4.2004	5.5.2004	4
AA247	12.4.2004	5.5.2004	3
AA247	6.5.2004	7.5.2004	2

How to deliver high-quality software?

- Testing it hard?
 - Testing can only tackle **known unknowns**.
 - If you don't know what you're testing for, you are not, by definition, conducting tests.
- Software by its very nature is subject to **unknown unknowns**.
 - A software (e.g. its functionalities, behaviour, environment, etc.) constantly changes.

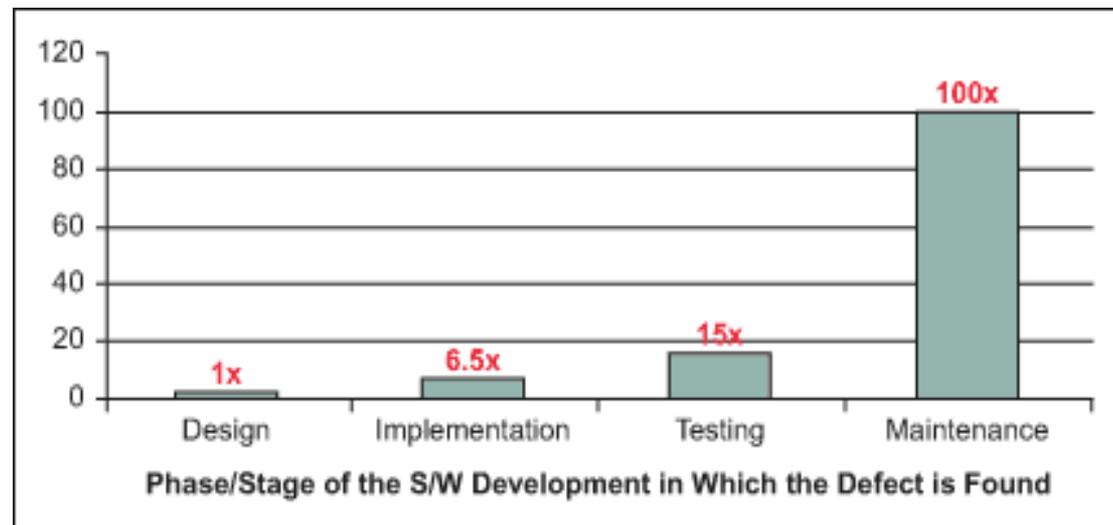
Product vs. Process Quality Management

- The quality measurements described earlier are related to products.
 - It is difficult to use them to measure the quality of a product when it is not completed yet.
 - What is an alternative approach to ensure quality in software?
- ⇒ Process Quality Management

Quality of a product is heavily dependent on quality of the process which produces it.

Process Quality Management

- ❑ The system development process comprises a number of (sub-)activities .
- ❑ Errors can enter the process at any stage.
- ❑ Errors not removed at early stages become more expensive to correct at later stages.



Process Quality Management (cont.)

- ❑ **Errors** should therefore be **identified and removed** by careful examination of the deliverables of each activity before they are passed on to the next activity.
- ❑ One way of doing this is by having the following **process/activity requirements** for each step.

For each activity

□ Entry requirements

- these have to be in place before an activity can be started
- example: 'a comprehensive set of **test data** and **expected results** be prepared and independently reviewed against the system requirement before **testing** can commence'

For each activity, *define*

- Implementation requirements
 - these define how the activity is to be conducted
 - example 'whenever an error is found and corrected, **all test runs** must be completed, including those previously successfully passed'

For each activity, *define*

□ Exit requirements

- an activity will not be completed until these requirements have been met
- example: 'the **testing** phase is finished only when *all tests have been run in succession with no outstanding errors*'

Tools and Techniques for Quality Control

- The Seven Basic Tools of Quality
 - Cause-and-effect diagrams
 - Control chart
 - Checksheet
 - Scatter diagram
 - Histogram
 - Pareto chart
 - Flowcharts/run charts

Pareto chart

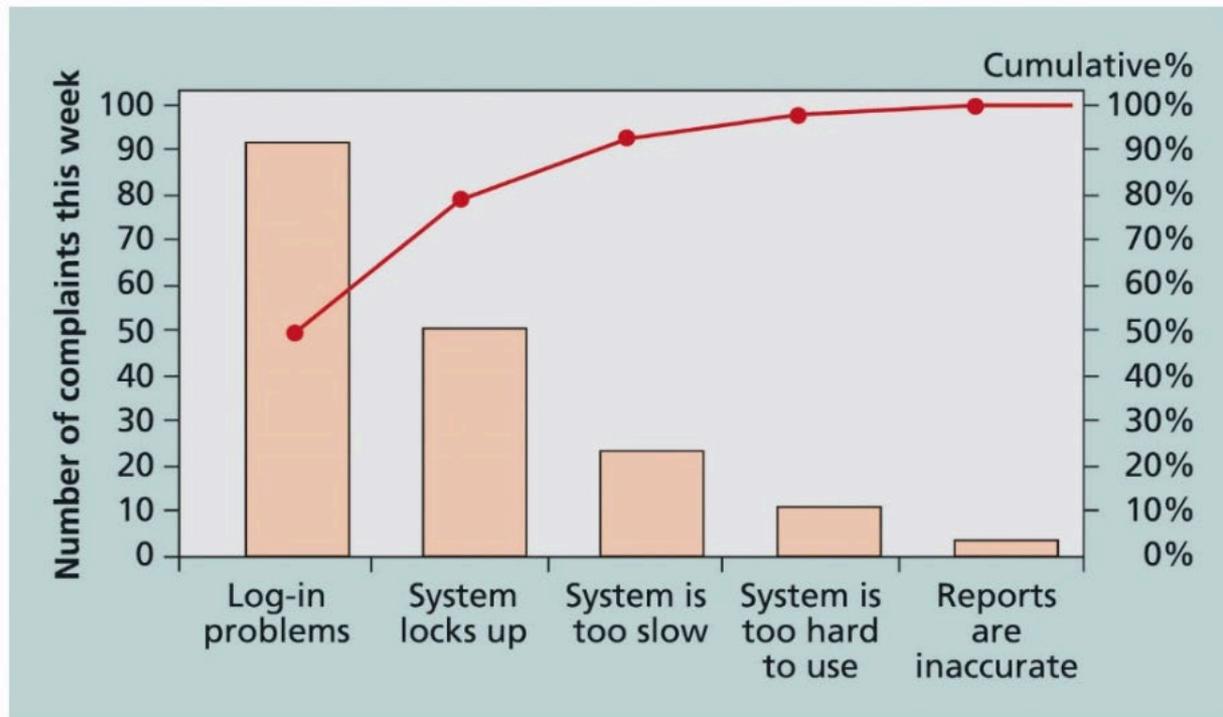


FIGURE 8-7 Sample Pareto chart