

# LECTURE 1

## WIF3002 SOFTWARE PROCESS AND QUALITY





## AT THE END OF THIS LECTURE

- Students should be able to
  - Define the fundamental concepts of software quality, software process and software process improvement

# WHAT IS SOFTWARE?

- Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system.
- [IEEE]

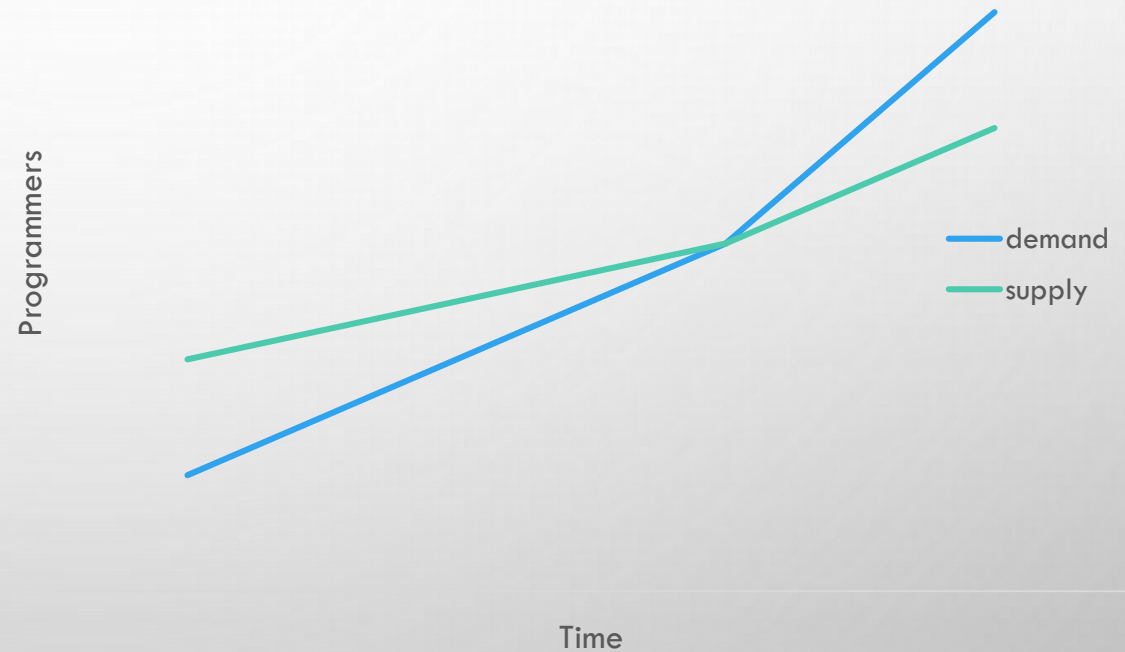


# DIFFERENCES BETWEEN SOFTWARE AND OTHER PRODUCTS

1. Product complexity
  2. Product visibility
  3. Product development process
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# "SOFTWARE CRISIS"

- Term coined by DoD years ago
- Problem today: complexity of problems addressed by software has outpaced improvements in software creation process



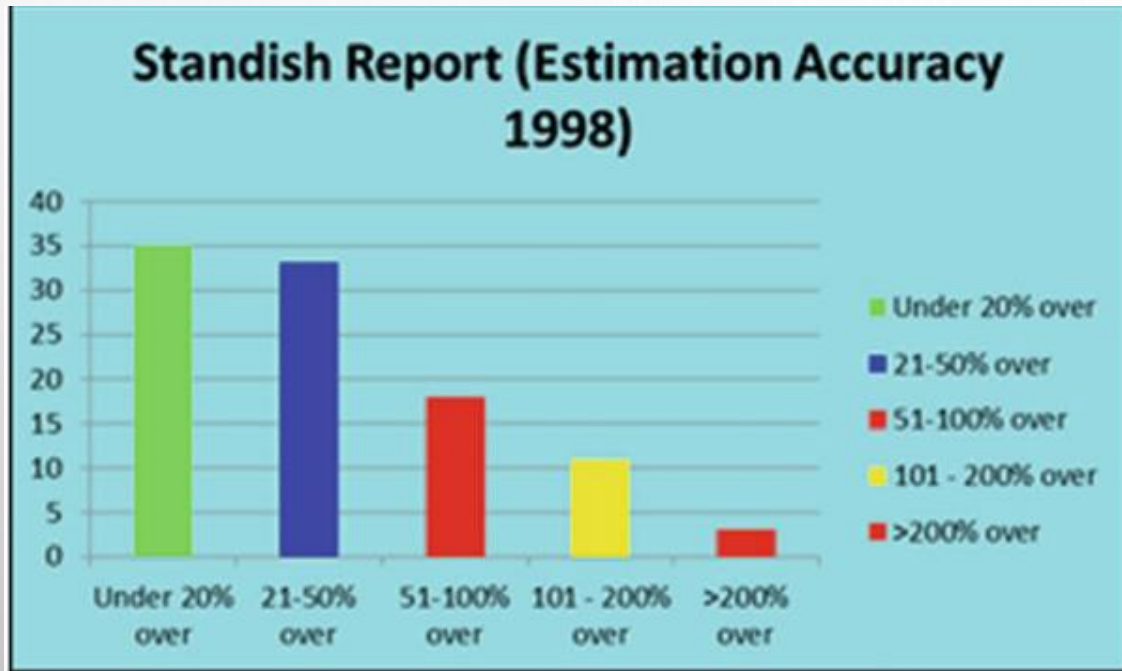


# THE BIG QUESTION

- Q: How do we assure quality?
  - A: We have a good **process**.
- 



# THE SOFTWARE ENGINEERING CHALLENGE



Standish research – Project cost estimation accuracy in 1998

- the challenge in software engineering is to deliver high-quality software on time to customers.
- **project management** and estimating project cost, effort and schedule accurately are software engineering challenges
- **risk management** is a key part of project management
- It is essential that **requirements** are properly managed as changing requirements may have a negative effect on the project

# HISTORY OF SOFTWARE FAILURES

- Y2K - huge costs to correct the software
- ARIANE 5 failure - 1996 caused major embarrassment and damage to the credibility of the European Space Agency (ESA) - the loss of a valuable communications satellite
- INTEL microprocessor mathematical bug back in 1994 - negative perception of a company





# WHAT IS QUALITY?

- Popular views about quality:
- quality related to luxury, class and taste
- quality is related to quality of life.
- I know about quality when I see the product.



# PRESSMAN'S DEFINITION OF "SOFTWARE QUALITY"

- Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

# IEEE DEFINITION OF "SOFTWARE QUALITY"

1. The degree to which a system, component, or process meets specified requirements.
2. The degree to which a system, component, or process meets customer or user needs or expectations.

# ROLE OF CUSTOMER

- Customers don't buy products, they buy assurances that their expectations with the products would met.
- You also, can only sell assurances – in other words, quality.
- Customer is in absolute position to judge the quality

# WHAT IS SOFTWARE QUALITY?

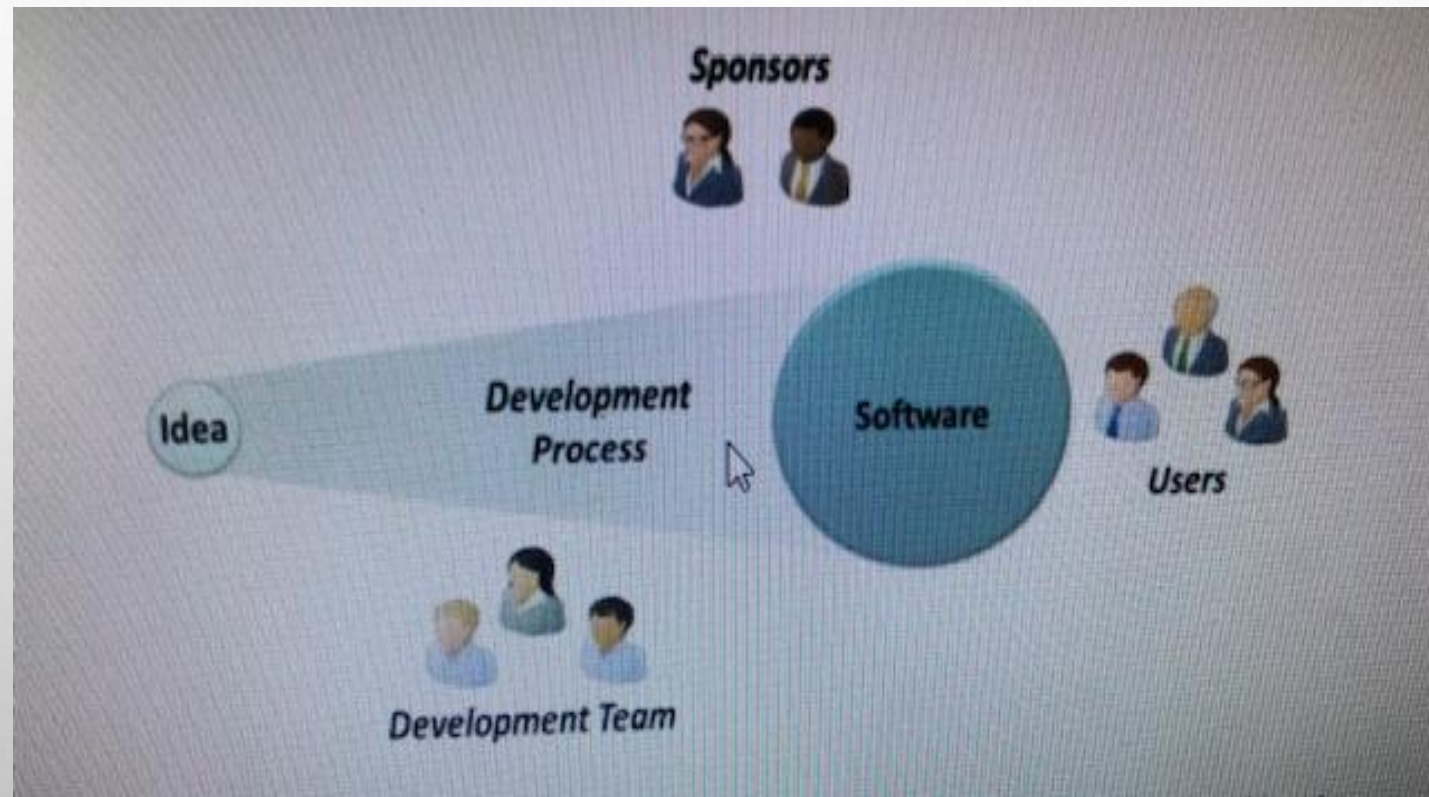
- Philip Crosby where quality is defined as “conformance to the requirements”
- does not take the intrinsic difference in quality of products into account in judging the quality of the product
- Juran defines quality as “fitness for use”
- this is a better definition, although it does not provide a mechanism to judge better quality when two products are equally fit to be used.



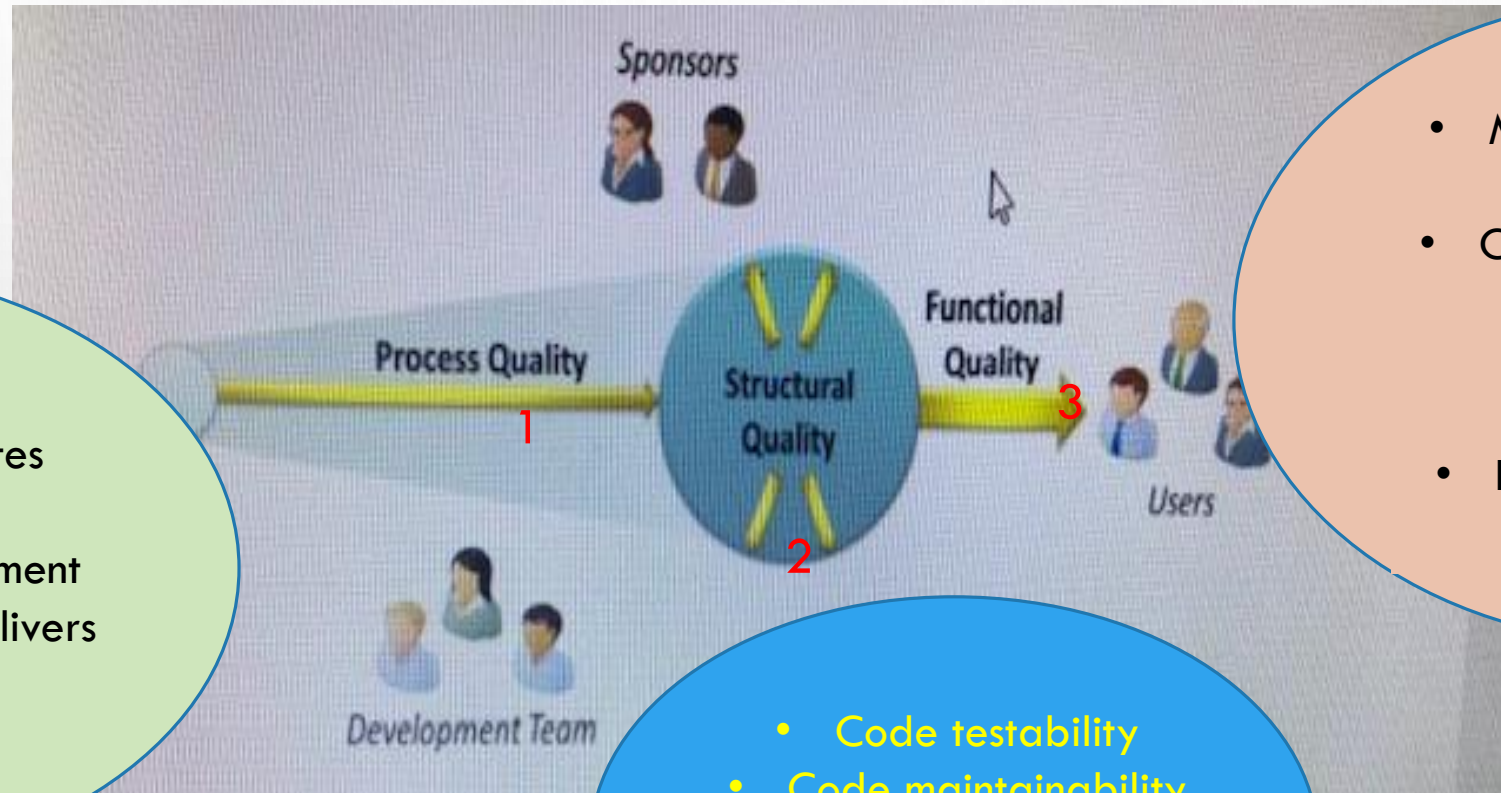
# ISO 9126-QUALITY CHARACTERISTICS

Characteristic	Description
Functionality	The extent to which the required functionality is available in the software.
Reliability	The extent to which the software is reliable.
Usability	The extent to which the users of the software judge it to be easy to use.
Efficiency	This characteristic indicates the efficiency of the software
Maintainability	The extent to which the software product is easy to modify and maintain.
Portability	The ease of transferring the software to a different environment.

# ASSESSING QUALITY MEANS MEASURING VALUE



# DEFINING SOFTWARE QUALITY: THREE ASPECTS



- Meeting delivery dates
  - Meeting budgets
- A repeatable development process that reliably delivers quality software

- Meeting the specified requirements.
- Creating software that has few defects
  - Good enough performance
- Ease of learning and ease of use

- Code testability
- Code maintainability
- Code understandability
  - Code efficiency
  - Code security

# SOFTWARE QUALITY CONTROL

- Concerned with activities to ensure that the end product satisfies the functional and non-functional requirements and is fit for purpose
  - Software inspection
  - Software testing
  - Verification
  - Validation
- Support for tracking the status of the process
- refactoring, static code testing, dynamic code testing



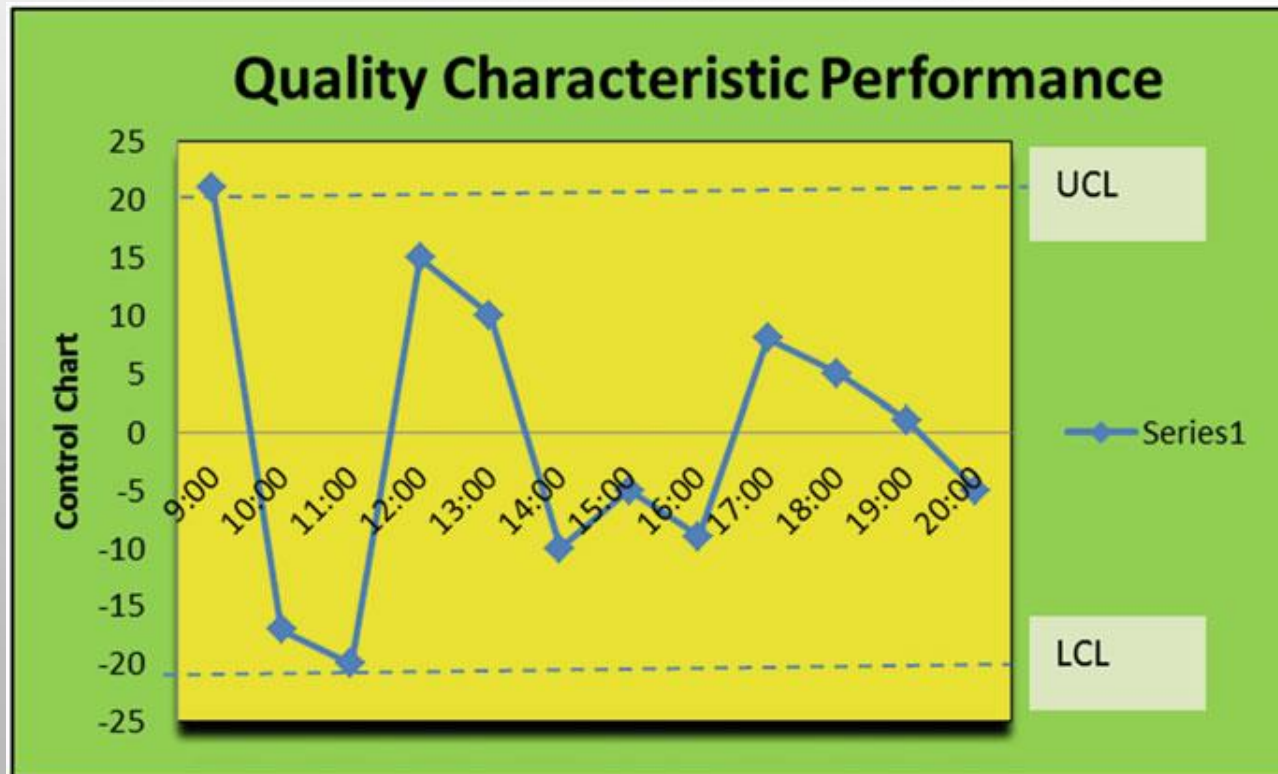
# SOFTWARE QUALITY PIONEERS

- Walter Shewhart,
  - W. Edwards Deming,
  - Joseph Juran,
  - Philip Crosby
  - Watts Humphrey
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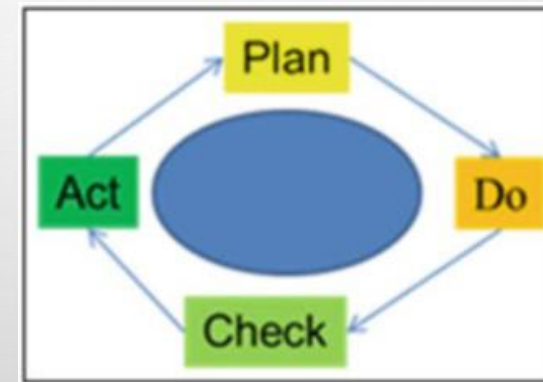


# WALTER SHEWHART

- Walter Shewhart was a statistician at AT&T Bell laboratories
- Founder of statistical process control (SPC), in monitoring and controlling a process
- Shewhart argued that **quality and productivity improve** as **process variability is reduced**.



The Shewhart model is a systematic approach to problem solving and process control.



Shewhart's ideas were later applied to the Capability Maturity Model (CMM)

# Shewhart Cycle

Step	Description
Plan	This step <b>identifies</b> an improvement opportunity and outlines the problem or process that will be addressed. Select the problem to be addressed. Describe current process. Identify the possible causes of the problem. Find the root cause of problems. Develop an action plan to correct the root cause.
Do	This step involves <b>carrying out</b> the improvements and it may involve a pilot of the proposed changes to the process.
Check	This step involves <b>checking the results</b> obtained against the expected results to determine their effectiveness.
Act	This step includes the <b>analysis of the results</b> to adjust process performance to achieve the desired results.

# W. EDWARDS DEMING

- Improving quality
  - costs will decrease due to less rework of defective products, and
  - productivity will increase as less time is spent in reworking.
- Deming argued that it is not sufficient for everyone in the organization to be Doing one's best
- His approach helps an organization to produce high-quality products. It includes:
  - Constancy of purpose
  - Quality built into the product
  - Continuous improvement culture
- 14 steps

# THE “FIVE DEADLY DISEASES

Emphasis on  
short term  
profit

a company should aim to become the world's most efficient provider of product/service. Profits will then follow

Evaluation of  
performance

Deming is against annual performance appraisal and rating

Excessive  
measur-  
ment

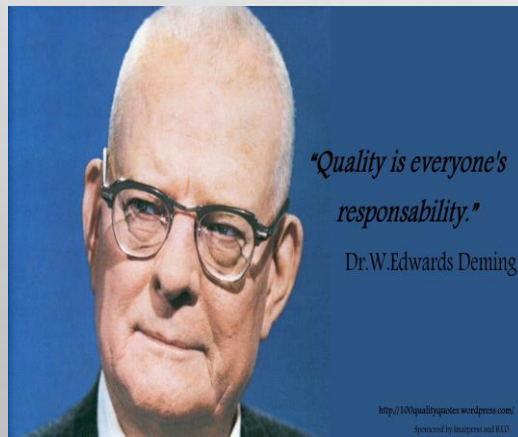
excessive management by measurement

Lack of  
constancy of  
purpose

management is too focused on short term thinking rather than long-term improvements.

Mobility of  
management

mobility of management frequently has a negative impact on quality.

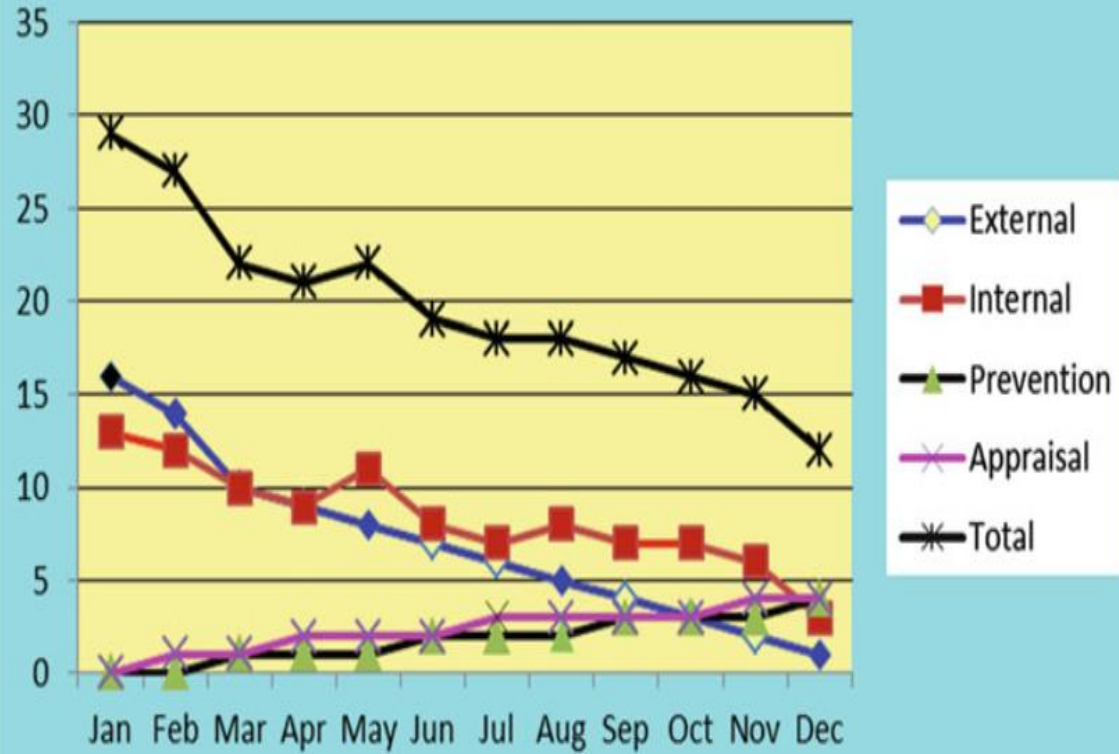


# Joseph Juran

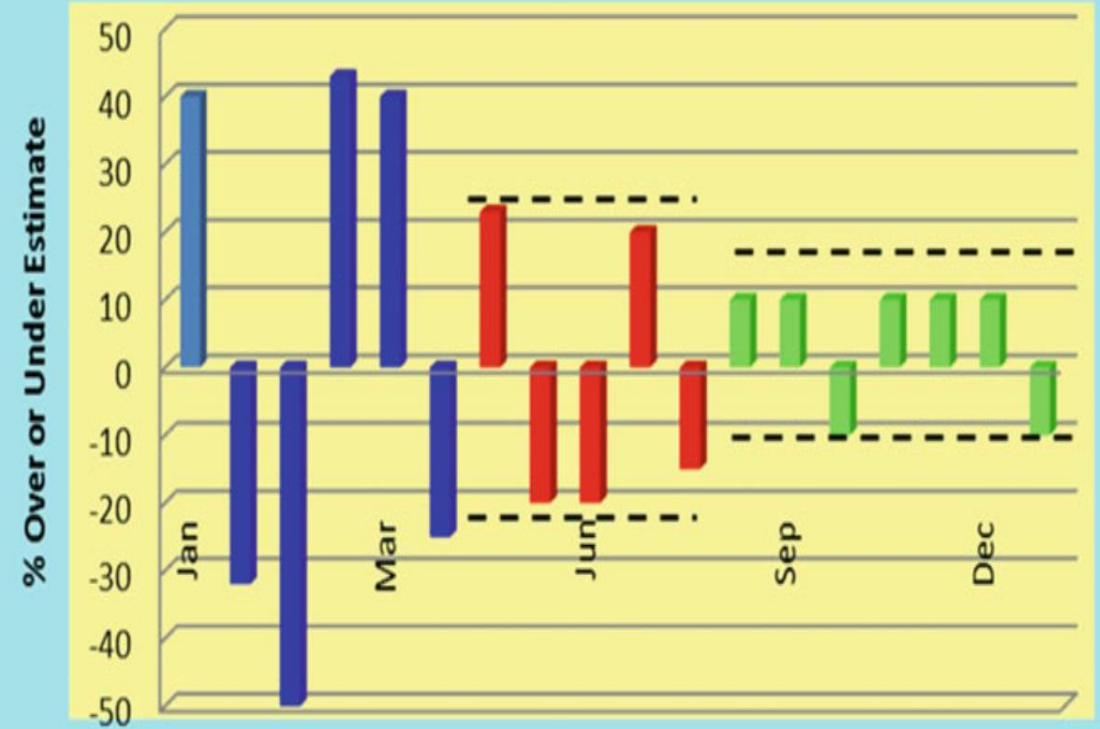
- He defined quality as “**fitness for use**”, and he argued that quality issues are the direct responsibility of management
- The trilogy of quality planning, control, and improvement is known as the “Juran trilogy” and usually described by a **cost of poor-quality** diagram
- Quality planning consists of setting quality goals, developing plans, and identifying resources to meet the goals.
- Quality control consists of evaluating performance, setting new goals, and taking action.
- Quality improvement consists of improving delivery, eliminating wastage and improving customer satisfaction



## Cost of Quality



## Estimation Accuracy Improvements



# COST OF QUALITY CATEGORIES

Type of cost	Description
Cost external	This includes the cost of external failure and includes engineering repair, warranties, and a customer support function
Cost internal	This includes the internal failure cost and includes the cost of reworking and re-testing of any defects found internally.
Cost prevention	This includes the cost of maintaining a quality system to prevent the occurrence of problems, and includes the cost of software quality assurance, the cost of training
Cost appraisal	This includes the cost of verifying the conformance of a product to the requirements and includes the cost of provision of software inspections and testing processes.

# PHILIP CROSBY

- A key figure in the quality movement, and his quality improvement grid influenced the **capability maturity model (CMM)** developed by the Software Engineering Institute.
- His philosophy of doing things right the first time, i.e., The zero defects (ZD) program. Crosby's 14 step programme
- Quality is defined as “**conformance to the requirements**” and he argues that people have been conditioned to believe that error is inevitable
- He further argues that the term “Acceptable Quality Level” (AQL) is a commitment to produce **imperfect material**. Crosby notes that defects are due to two main reasons:
  - **lack of knowledge** or a **lack of attention of the individual**

# CROSBY'S MATURITY GRID (5 LEVELS )

Uncertainty	<b>Management has no understanding of quality</b> and is likely to blame quality problems on the quality department. Root causes of problems are not investigated, and there are few organized quality improvement activities.
Awakening	<b>Management is beginning to recognize that quality management</b> may be of value but is unwilling to devote time and money to it. Instead, <u>the emphasis is on appraisal rather than prevention</u> . Teams are set up to address major problems, but long-term solutions are rarely sought.
Enlightenment	<b>Management is learning more about quality and is becoming more supportive of quality improvement.</b> The quality department reports to senior management, and implementation of the 14 steps quality improvement program is underway. There is a culture of openness where problems are faced openly and resolved in an orderly way.
Wisdom	<b>Management is fully participating in the program, and fully understands the importance of quality management.</b> All functions within the organization are open to suggestions for improvement, and problems are identified earlier. Defect prevention is now part of the culture.
Certainty	<b>The whole organization is involved in continuous improvement</b>

# WATTS HUMPHREY

- American software engineer and vice president of technical development at IBM  
= Father of software quality
- Established the **software process programme** at the SEI, and this led to the development of the software **capability maturity model (CMM) and its successors** (CMMI model and the SCAMPI appraisal methodology)
- The CMM is a framework to help an organization to understand its current process maturity, and to prioritize improvements
- His later efforts to developing the **personal software process (PSP)** and the **team software process (TSP)**.