MASTER OF COMPUTER SCIENCE/
MASTER OF SCIENCE IN COMPUTER SCIENCE

MCS4204- Software Project Management

Topic 6: Project Quality Management

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

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Project Quality Management

- Includes processes incorporating the **organization's quality policy** regarding planning, managing, and controlling project and **product quality requirements** in order to meet stakeholders' objectives.
- **Supports continuous process improvement activities.**
- is concerned with ensuring that the s/w;
  - meets the needs of the users
  - will perform efficiently and reliably
  - will be delivered on time and within the budget
- Formalizing quality management is especially important for large or long-lifetime projects

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Organizational-Level and Project-Level QM

Organizational-Level

- Establish **a framework of organisational processes and standards** that will lead to high-quality software.
- Define the software **development process to be used** and **standards** that should be applied to the software and related documentation (e.g. SRS, SDS and code).

Project-Level

- Prepare a **quality plan** (quality goals, processes and standards) for the project.
- Apply the **quality processes**
- check whether the planned **processes have been followed**, and
- Ensure that the project **outputs meet the defined project standards**.

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Project Quality Management

1. **Plan Quality Management**—identify the quality requirements.
2. **Manage/Assure Quality**—Introduce quality assurance processes, procedures and standards. Manage the quality processes by preparing tests and evaluation instruments.
3. **Control Quality**—Verify that the quality requirements are met. Compare the work results with the quality requirements to ensure the result is acceptable

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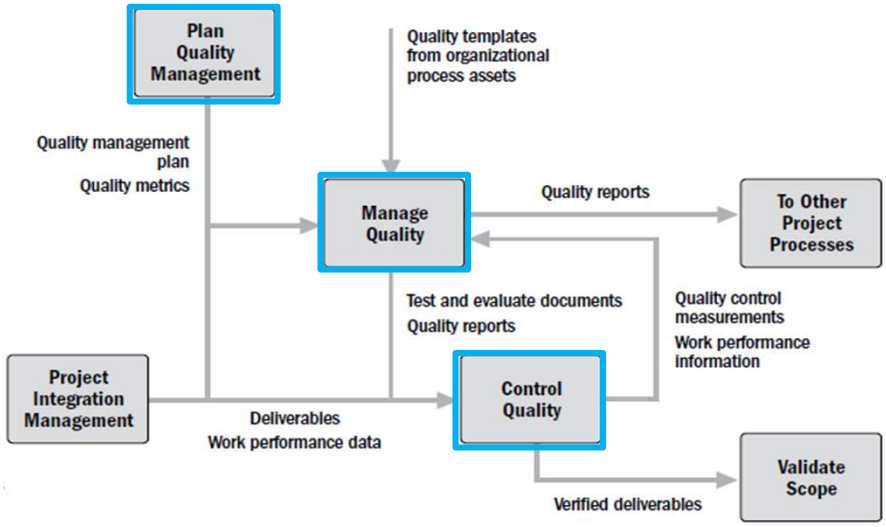
Project Quality Management Interrelations



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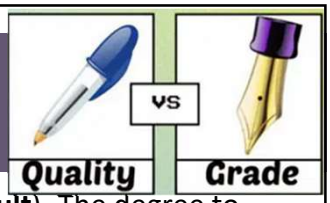
Quality and Grade



- **Quality (of delivered performance or result**)- The degree to which a set of inherent characteristics **fulfils the requirements and and satisfies user needs** (A high-quality product has no defects).
- **Grade** - A category label assigned to deliverables having the same **functional use** and technical characteristics (The number of features or scope).
- The project manager and the team are responsible for delivering the final product at the required levels of both quality and grade.
- Failure to meet quality requirements is always a problem. But a low-grade product may not be a problem if it is of high quality.

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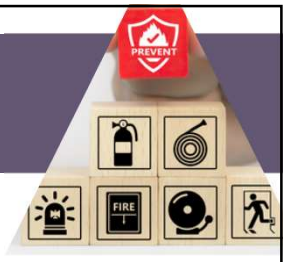
Prevention and Inspection



- Prevention -keeping errors out of the **process**
- Inspection - keeping errors out of the **hands of the customer**
- Prevention is preferred over inspection- Design quality into deliverables

- The cost of preventing mistakes is generally much less than the cost of correcting mistakes when they are found by inspection or during usage.

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Five levels of increasingly effective quality management

1. **Let the customer find the defects**. This can lead to warranty issues, recalls, loss of reputation, and rework costs.
2. **Detect and correct the defects** before the deliverables are sent to the customer. This incurs appraisal costs and internal failure costs.
3. **Use quality assurance to examine and correct the process itself** and not just special defects.
4. **Incorporate quality into the planning and designing** of the project and product.
5. **Create a culture throughout the organization** that is aware and committed to quality in processes and products.

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Role of Quality Management Team

- **Independent team** – not part of the S/W development team
- **Take an objective view** of the quality of the software
- **Report on the software quality** without being influenced by software development issues.
- **Have organisation-wide responsibility** for quality management
- **Report to management above the project manager level**
- **Ensures that the organisational goals of quality are not influenced** by the short-term budget and schedule considerations.

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Plan Quality Management

Inputs	Tools & Techniques	Outputs
.1 Project charter .2 Project management plan • Requirements management plan • Risk management plan • Stakeholder engagement plan • Scope baseline .3 Project documents • Assumption log • Requirements documentation • Requirements traceability matrix • Risk register • Stakeholder register .4 Enterprise environmental factors .5 Organizational process assets	.1 Expert judgment .2 Data gathering • Benchmarking • Brainstorming • Interviews .3 Data analysis • Cost-benefit analysis • Cost of quality .4 Decision making • Multicriteria decision analysis .5 Data representation • Flowcharts • Logical data model • Matrix diagrams • Mind mapping .6 Test and inspection planning .7 Meetings	.1 Quality management plan .2 Quality metrics .3 Project management plan updates • Risk management plan • Scope baseline .4 Project documents updates • Lessons learned register • Requirements traceability matrix • Risk register • Stakeholder register

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Data gathering: Benchmarking

- Involves comparing actual or planned project practices or the project's quality standards to those of comparable projects.
- Aims to;
  - identify best practices,
  - generate ideas for improvement, and
  - provide a basis for measuring performance.
- Benchmarked projects may exist within the performing organization or outside of it. Also, it can be within the same application area or another application area.

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Cost of Non-Conformance and Conformance

Cost of Conformance

Prevention Costs
(Build a quality product)
- Training
- Document processes
- Equipment
- Time to do it right

Appraisal Costs
(Assess the quality)
- Testing
- Destructive testing loss
- Inspections

Money spent during the project **to avoid failures**

Cost of Nonconformance

Internal Failure Costs
(Failures found by the project)
- Rework
- Scrap (cost at which it can be sold)

External Failure Costs
(Failures found by the customer)
- Liabilities
- Warranty work
- Lost business

Money spent during and after the project **because of failures**

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Cost of Quality

- Refers to the total cost of the conformance and the non-conformance work that should be done as a compensatory effort.
- Total investment in
  - preventing nonconformance to requirements,
  - appraising the product or service for conformance to requirements (evaluating, measuring, auditing, and testing), and
  - failing to meet requirements (rework) -
    - Failure costs (Cost of Poor Quality)
      - Internal costs -found by the project team
      - External costs -found by the customer/client

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Cost of Quality

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Components of Quality Management Plan

- Quality standards that will be used by the project
- Quality objectives of the project
- Quality roles and responsibilities
- Project deliverables and processes subject to quality review
- Quality control and quality management activities planned for the project
- Quality tools that will be used for the project and
- Major procedures relevant to the project, such as dealing with nonconformance, corrective actions procedures, and continuous improvement procedures.

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Manage Quality (Quality Assurance)

Inputs

.1 Project management plan
- Quality management plan

.2 Project documents
- Lessons learned register
- Quality control measurements
- Quality metrics
- Risk report

.3 Organizational process assets

Tools & Techniques

.1 Data gathering
- Checklists

.2 Data analysis
- Alternatives analysis
- Document analysis
- Process analysis
- Root cause analysis

.3 Decision making
- Multicriteria decision analysis

.4 Data representation
- Affinity diagrams
- Cause-and-effect diagrams
- Flowcharts
- Histograms
- Matrix diagrams
- Scatter diagrams

.5 Audits
.6 Design for X
.7 Problem solving
.8 Quality improvement methods

Outputs

.1 Quality reports
.2 Test and evaluation documents
.3 Change requests
.4 Project management plan updates
- Quality management plan
- Scope baseline
- Schedule baseline
- Cost baseline

.5 Project documents updates
- Issue log
- Lessons learned register
- Risk register

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Tools of quality

1. Cause-and-effect diagram
2. Check sheet
3. Control chart
4. Histogram
5. Pareto chart
6. Scatter diagram
7. Flow chart / Run chart

https://marketingskull.com/define-flow-chart-control-chart-run-chart-pareto-diagram-histogram/

https://www.projectcubicle.com/pareto-chart-pareto-analysis/

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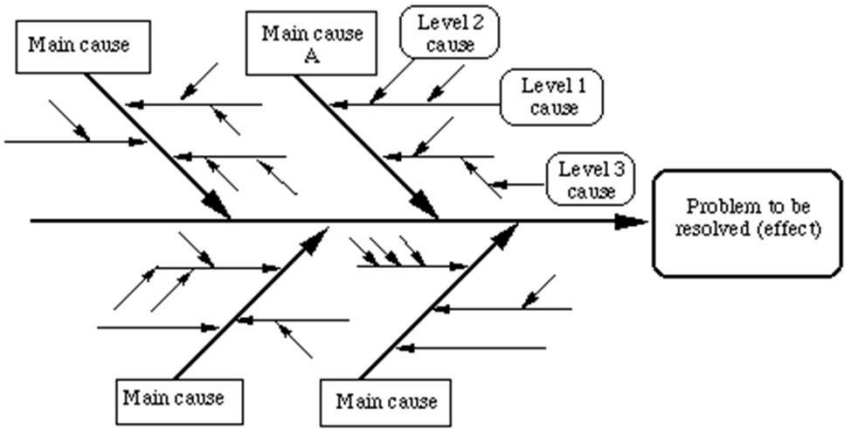
Cause-and-effect diagram



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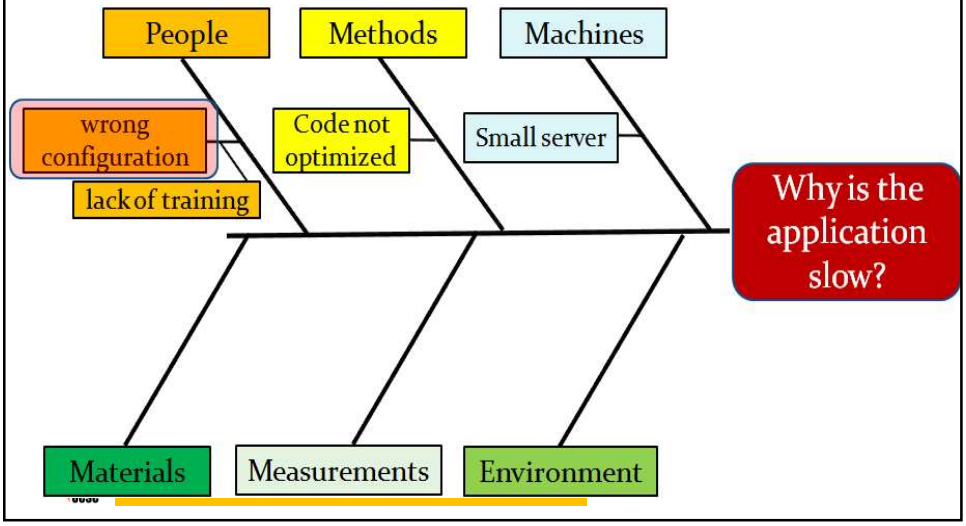
Example: Cause-and-effect diagram



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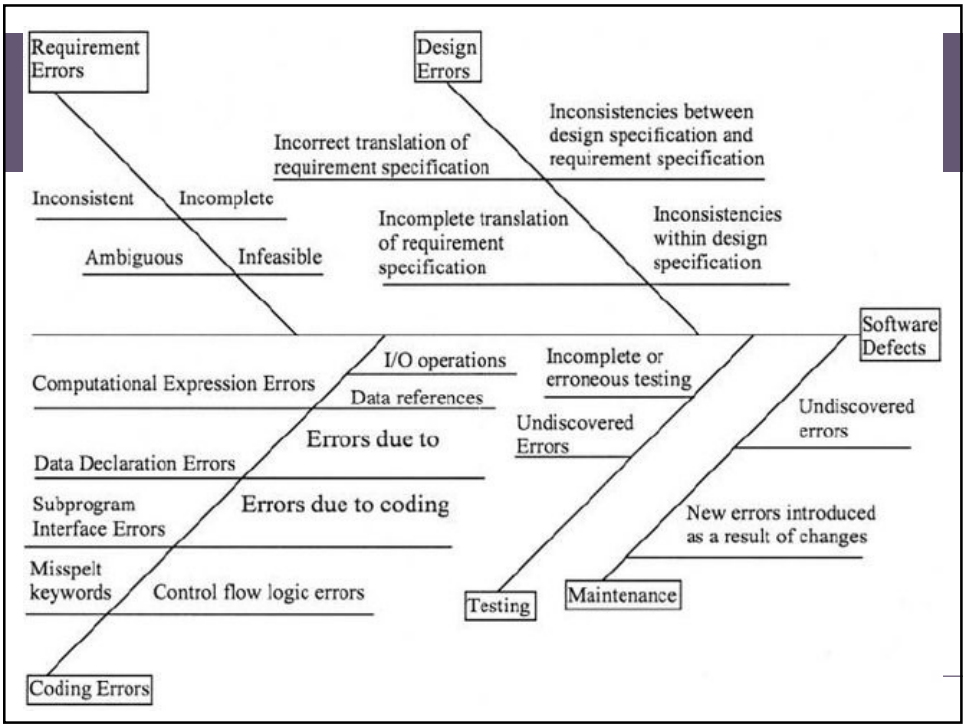

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File Testing Checklist - (Sample Checklist)

Sr.	Check Point / Defect Statement	Check Mark (√) the Appropriate Column	
		Yes	N/A
01	Is a condition available for testing each file?		
02	Is a condition available for testing each file's interface with each module?		
03	Are test conditions available for validating each job control condition?		
04	Is a condition available for validating that the correct version of each file will be used?		
05	Is a condition available for testing that records placed on a file will be returned intact?		
06	Are conditions available for validating that each file is properly closed after the last record is processed for that file?		
07	Are conditions available for validating that each record type can be processed from beginning to end of the system intact?		
08	Are conditions available for validating that all records entered are processed through the system?		
09	Are conditions available for validating that files that are mounted but not used are properly closed at the end of processing?		
10	Are test conditions available for creating a file for which no prior records exist?		
11	Is a condition available for validating the correct closing of a file when all records on the file have been deleted?		
12	Are conditions available for validating the correctness of all the job control statements?		

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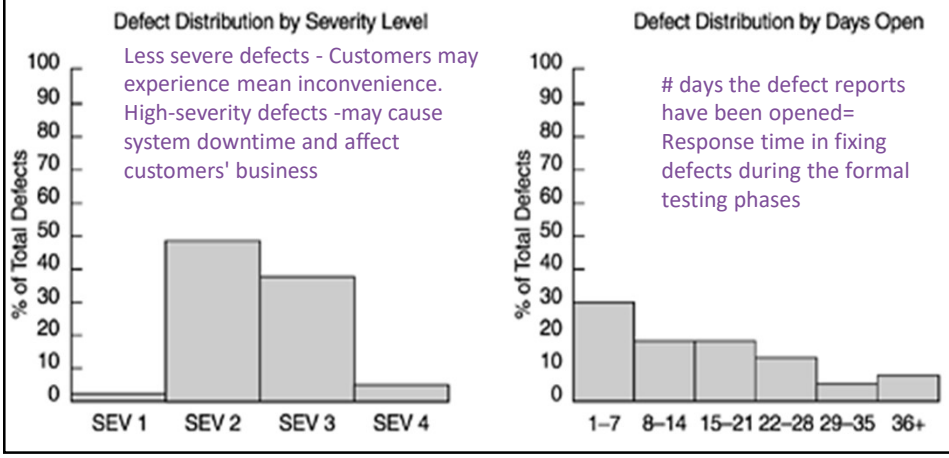
Histogram

- A special form of bar chart used to describe the central tendency, dispersion, and shape of a statistical distribution.



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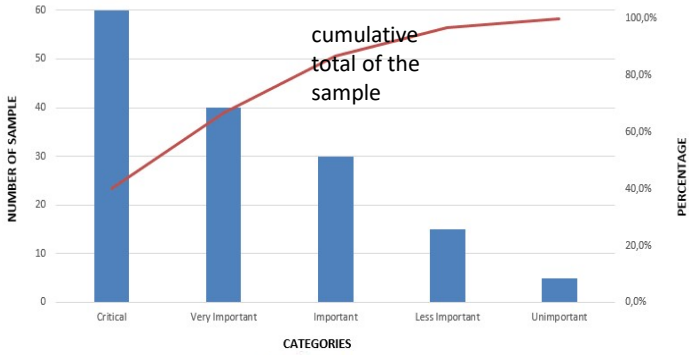
Pareto Charts

- Indicates the frequency of defects, as well as their cumulative impact.
- Useful to find the defects to prioritize in order to observe the greatest overall improvement.



80/20 principle: For many events, roughly 80% of the effects come from 20% of the causes.

Categories contributing to 80% of the problems are often referred to as the 'vital few' whereas the others are labelled the 'useful many'

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Example: Pareto Charts

https://asq.org/quality-resources/pareto

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80/20 Rule

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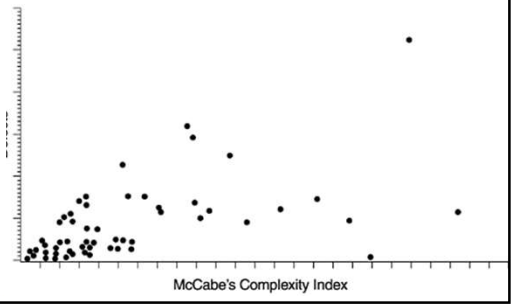
Scatter diagram

- An efficient communication tool
- Can check the degree of relationship between the data in the form of pairs.
  - Find the direction (positive, negative, or no relationship) and the degree of relationship (correlation coefficient between +1 and -1)

E.g An analysis of program complexity and the number of defects found:
+ve correlation: Can use program complexity to predict defect level.
Reduce the program complexity to reduce the chance for defects and make programs easier to maintain



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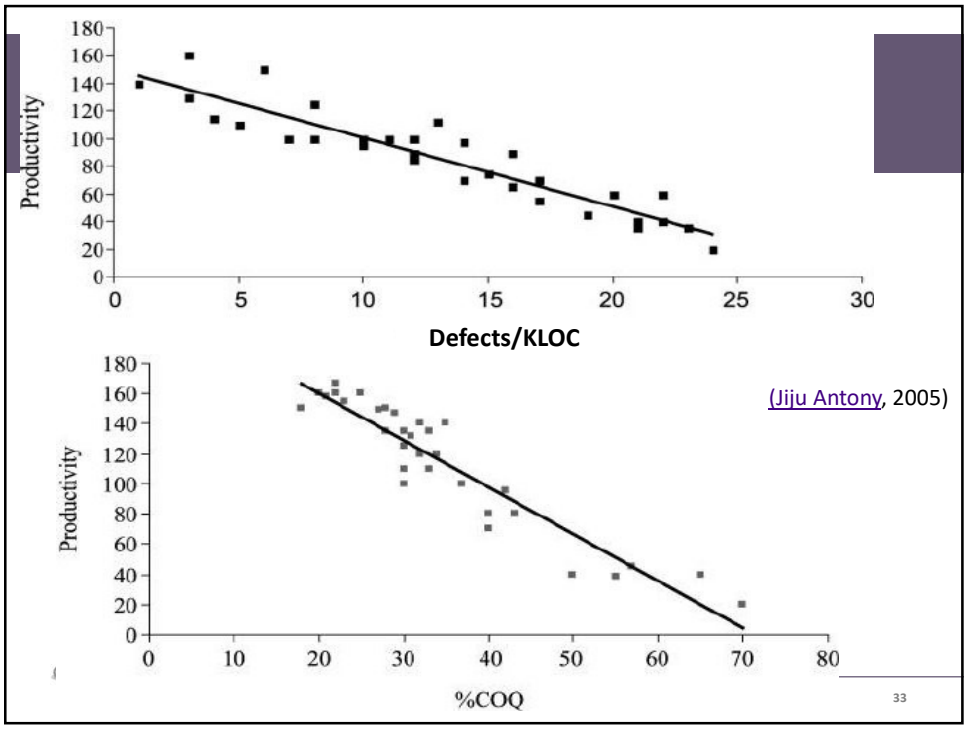

(Jiju Antony, 2005)

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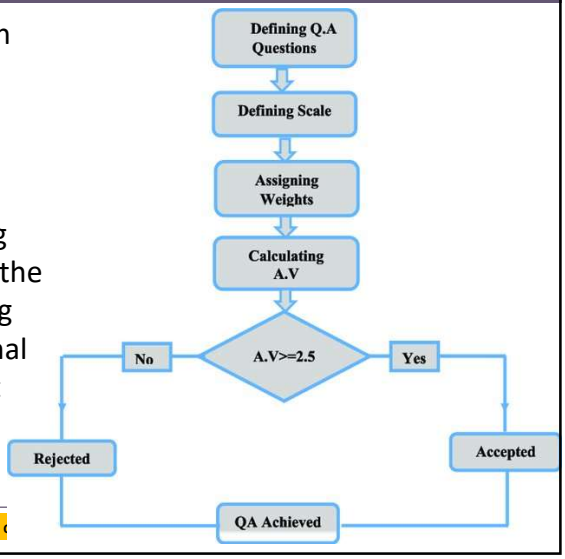
Flow chart

- A graphical representation of a process showing the relationships among the process steps.
- It shows the activities, decision points, branching loops, parallel paths, and the overall order of processing by mapping the operational details of procedures that exist within a horizontal value chain.



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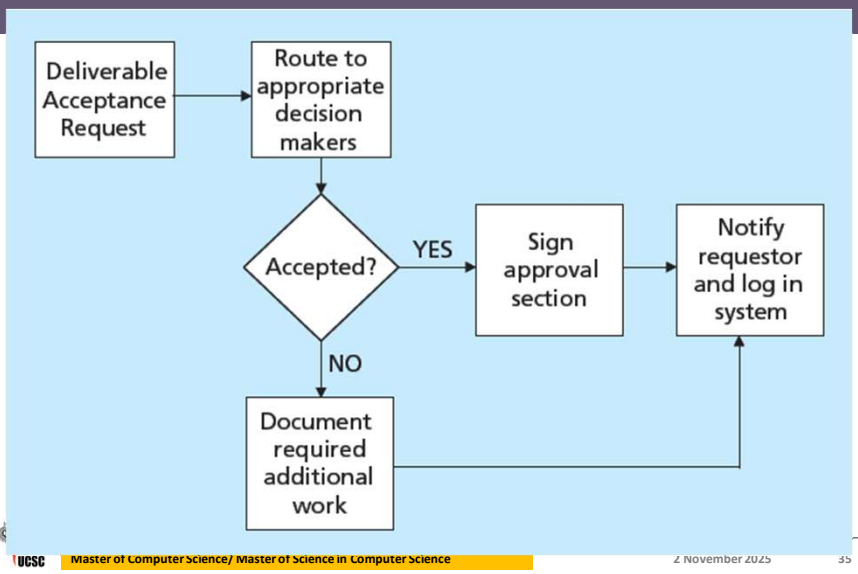
Example: Flow chart



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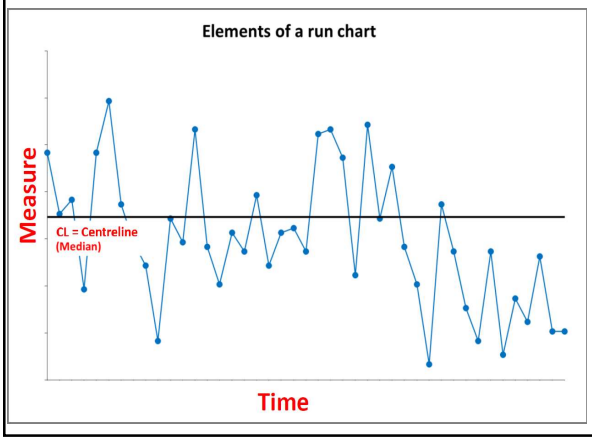
Run chart

- One of the most useful tools in quality improvement to determine that a change has occurred



- Monitor the performance of one or more processes over time to detect trends, shifts or cycles.
- Compare a performance measure before and after the solution implementation to measure its impact.
- Focus attention on truly vital changes in the process.
- Assess whether improved performance has been sustained.

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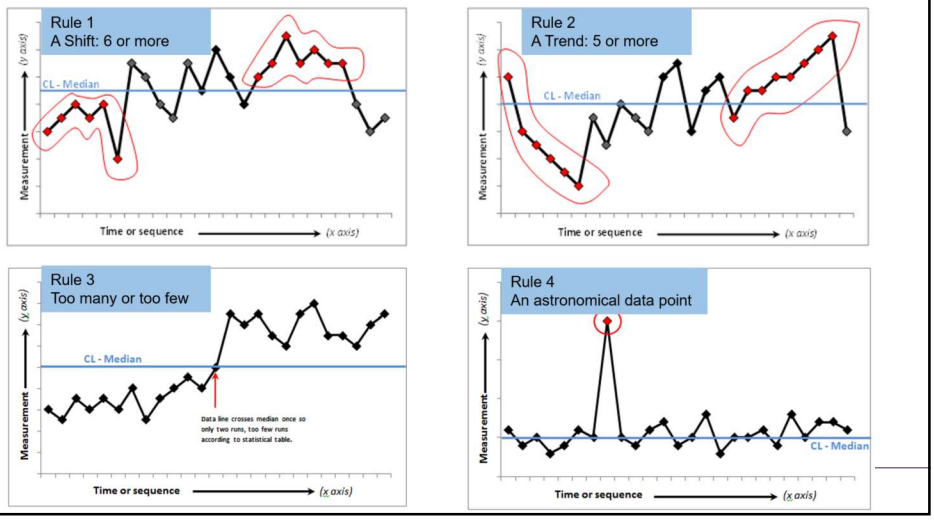
Non-random rules for Run charts

- evidence of a non-random signal of change



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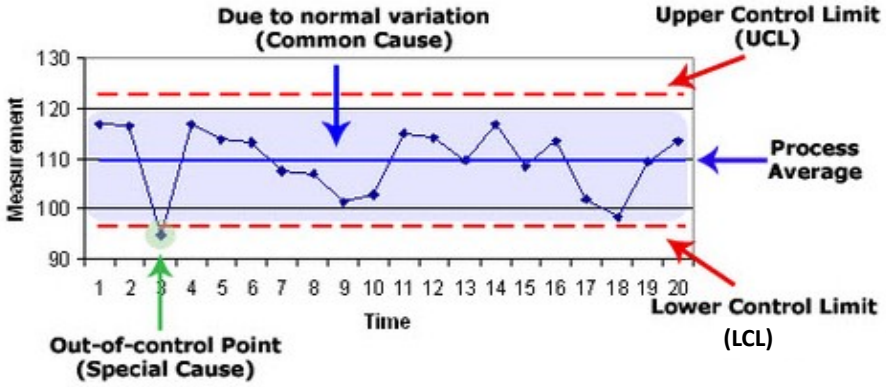
Control Chart

- A random distribution of points within the limits implies a stable process.
  - ✓ identify the important causes of variation common to all the points.
- If the distribution is not random, then the process is unstable.
  - ✓ Take action to understand what could be contributing to the special causes of variation.



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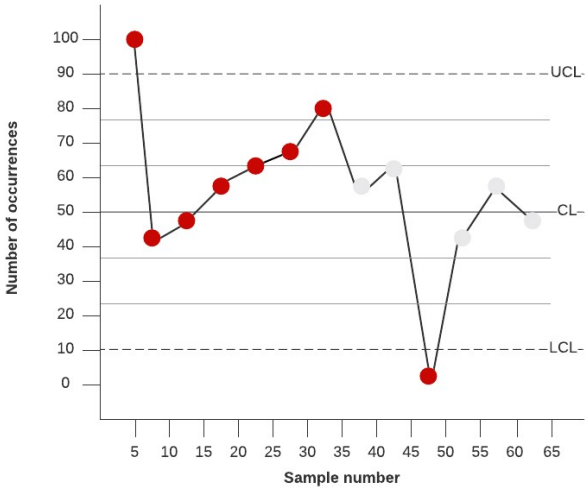

Control chart

-can provide more information and insight into the nature and sources of variation in a process than run charts
-center line represents the average of the measurement that is being tracked.

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Manage Quality Tools and Techniques: Quality Audit

- A structured, independent process used to determine if project activities comply with organizational and project policies, processes, and procedures.
- Usually conducted by a team external to the project (e.g. Organization's internal audit department, PMO, or by an auditor external to the organization).
- Aims to;
  - Identify all good and best practices being implemented;
  - Identify all nonconformity, gaps, and shortcomings;
  - Share good practices introduced or implemented in similar projects
  - Proactively offer assistance in a positive manner to improve the implementation of processes to help raise team productivity
  - Highlight contributions of each audit in the lessons learned repository of the organization.

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Design for Excellence (DfX)

- A set of technical guidelines that may be applied during the design of a product for the optimization of a specific aspect of the design.
- DfX can control or even improve the product's final characteristics. The X in DfX can be different aspects of product development, such as reliability, deployment, assembly, manufacturing, cost, service, usability, safety, and quality.
- Using the DfX may result in cost reduction, quality improvement, better performance, and customer satisfaction.

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Traditional Engineering vs DFX

Traditional Engineering Design	Designing for Excellence (DFx)
Address issues after the design phase	Address issues at early design stage
Many iterations of a product	Goal is to limit iterations (get it right the first time)
Use of many tools	Select use of an efficient set of standardized tools
Considers functional requirements	Considers the product life cycle requirements
Less team based (less involvement from manufacturing, suppliers and customers)	Team based (more collaboration, supplier involvement, project management)

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Problem Solving

- Effective and systematic problem solving is a fundamental element in quality assurance and quality improvement.
- Elements of problem-solving methods
  - Defining the problem,
  - Identifying the root cause,
  - Generating possible solutions,
  - Choosing the best solution,
  - Implementing the solution, and
  - Verifying solution effectiveness.

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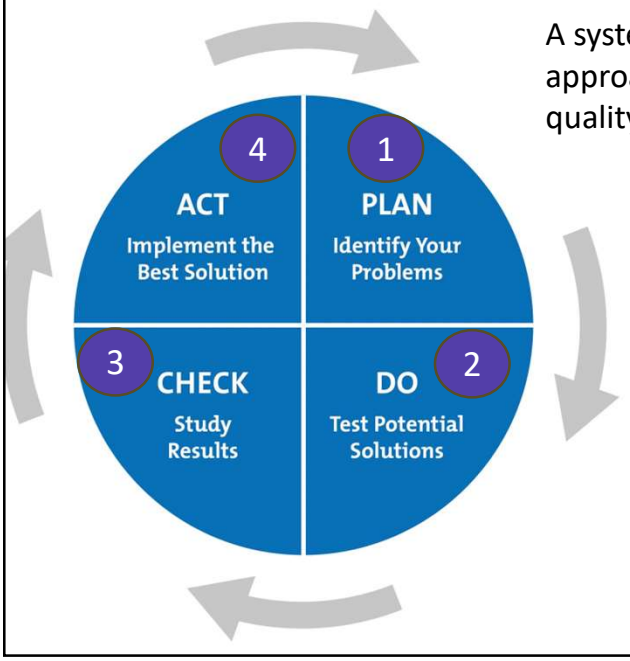
The Plan-Do-Check-Act Cycle



A systematic and structured approach for software quality improvement

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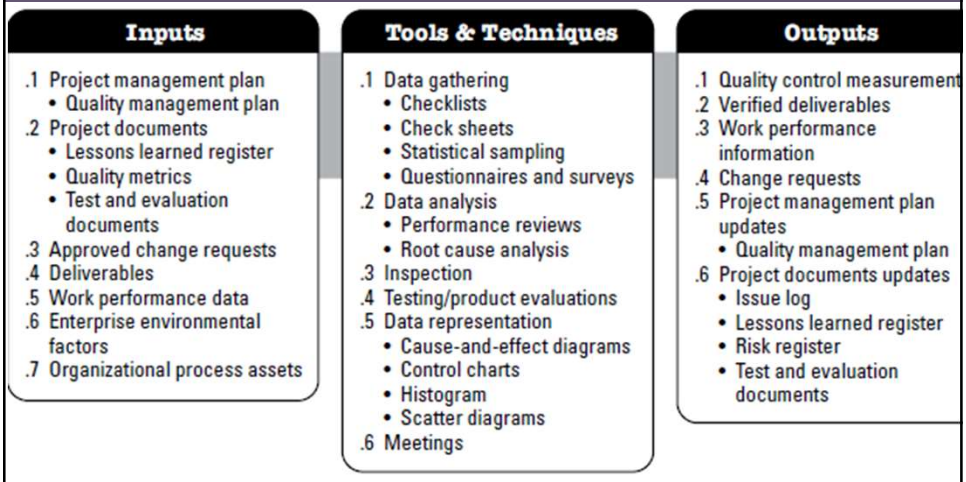
Control Quality



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Quality Control Process

- **Measures the completeness, compliance, and fitness for use** of a product or service prior to user acceptance and final delivery.
- **Measures all steps, attributes, and variables** used to verify conformance or compliance to the specifications stated during the planning stage.
- **Should be performed throughout** the project to formally demonstrate with reliable data, that the sponsor's/clients and/or user acceptance criteria have been met.
- **The level of effort to control quality and the degree of implementation may differ** between types of projects and methodologies used to develop the software.

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Project Quality Management: Review Exercise

1. What are the 3 main processes of Project QM?
2. What are the purposes and outcomes of each main PQM process?
3. Compare control charts and run charts

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System requirements

- Resource requirements – specify allowable costs
- Functional requirements –specify what system do
- Non-functional/quality requirements – specify how well the system operates
  - Quality factors (internal factors that the developers would be aware of and external factors defining the external view of the system held by users)
  - Quality in Use (e.g. effectiveness, productivity, safety and satisfaction).

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Software Specification and Evaluation Activities

- Development process: SDLC process
- Product quality management: Systematic examination of the product or computer system as part of quality assurance and quality control
- Product/Service supply: a contract with the acquirer for the supply of a system/product/ service under the terms of a contract
- Product/Service acquisition: including product selection and acceptance testing, when acquiring or procuring a system/product/service from a supplier
- Product maintenance: improvement of the product based on quality in use measures (e.g. effectiveness, productivity, safety and satisfaction).

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