



Project Quality Management

What is Quality?

“ the degree to which a set of inherent characteristics fulfill requirements”



Key Concepts

Quality vs. Grade (degree of functionality)

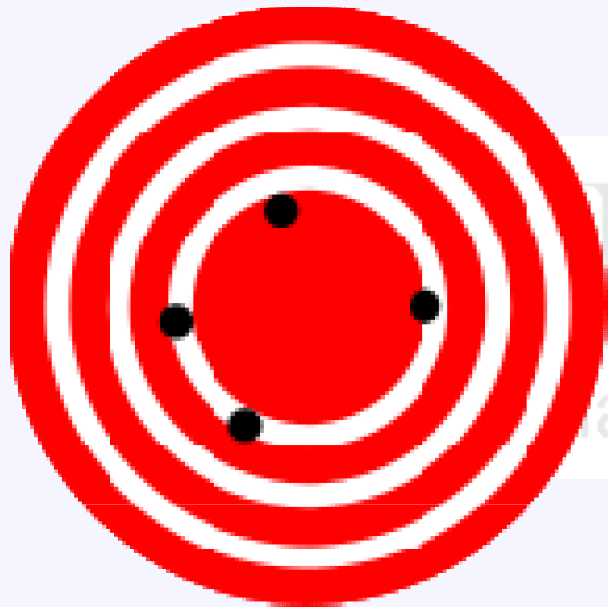
- Grade is a category assigned to products or services having the same functional use but different technical characteristics.
- A camera with lots of functions is high grade and a camera which takes bad pictures is low quality
- Low Quality is always a problem; low grade may not be.

Precision vs. Accuracy

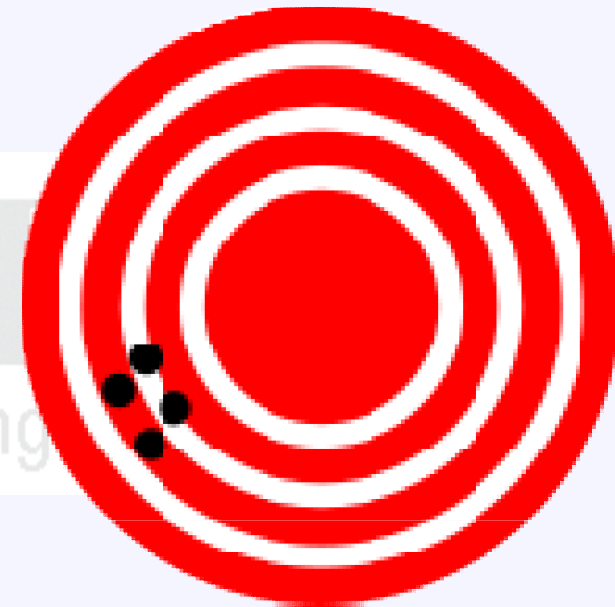
Precision and Accuracy are not equivalent.

- Precision is consistency that the value of repeated measurements are clustered and have little scatter.
- Accuracy is correctness that the measured value is very close to the true value.
- Precise measurements are not necessarily accurate. A Very accurate measurement is not necessarily precise.
- The Project Management Team must determine how much accuracy or precision or both are required.

Precision vs. Accuracy



High accuracy, but low precision



High precision, but low accuracy

Key Concepts

➤ Modern Quality Management Focus

- ❖ Customer Satisfaction – Understanding, evaluating, defining and managing expectations so that customer requirements are met.
- ❖ Conformance to requirements – Ensure that project produces what it was created to produce
- ❖ Fitness for use – The product must satisfy real needs
- ❖ Prevention over inspection – Quality is planned, designed and built in and not inspected in. Inspections generally produce rework, cost and customer complaints.
- ❖ Continuous improvement – Plan-Do-Check-Act cycle (Defined by Shewhart and modified by Deming)
- ❖ Management Responsibility – Management shall provide necessary resources to complete quality activities

Quality Theorists

- ✔ Three people are responsible for rise of the quality management movement & theories behind the cost of quality.
 - ✔ **Philip B. Crosby**
 - ✔ Zero defects practice (Do it right in the first time) (Prevention)
 - ✔ **Joseph M. Juran**
 - ✔ Fitness for use (Stakeholders or customers expectations are met or exceeded.)
 - ✔ **W. Edwards Deming**
 - ✔ 85% of cost of quality is a management problem.

- ✔ Kaizen approach
 - ✔ Quality technique from Japan. (Continuous improvement)
 - ✔ Improve the quality of people first. Then quality of products or service.

Project Quality Management

- The Project Quality Management processes include the following:
 - ❖ Plan Quality
 - ❖ Perform Quality Assurance
 - ❖ Perform Quality Control

8.1 Plan Quality

- Quality requirements are identified (normally from Stakeholders), quality standards the project work and products shall follow are identified (includes external standards and a plan how the project will comply with these requirements are prepared.
- Plan quality produces a plan (and done prior to start of work)
- Checklists, procedures, manuals etc are prepared here.

8.1 Plan Quality

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Scope Baseline 2. Stakeholder Register 3. Cost performance baseline 4. Schedule baseline 5. Risk Register 6. Enterprise environmental factors 7. Organizational process assets 	<ol style="list-style-type: none"> 1. Cost-benefit analysis 2. Cost of quality 3. Control charts 4. Benchmarking 5. Design of experiments 6. Statistical sampling 7. Flowcharting 8. Proprietary quality management methodologies 9. Additional quality planning tools 	<ol style="list-style-type: none"> 1. Quality management plan 2. Quality metrics 3. Quality checklists 4. Process improvement plan 5. Project document updates

8.1 Plan Quality : Tools & Techniques

1. Cost Benefits Analysis:

- ❖ Benefit of meeting quality requirements and costs of meeting quality requirements are analyzed.
- The primary benefit of meeting quality requirements is less rework, which means higher productivity, lower costs, and increased stakeholder's satisfaction.
- The primary cost of meeting quality requirements is the expense associated with project quality management activities.

8.1 Plan Quality : Tools & Techniques

2. Cost of Quality (COQ):

- Cost of quality refers to all efforts related to quality activities throughout the product life cycle. This include cost of conformance and cost of non conformance.
- For project point of view, Cost of Quality is primarily the Cost associated with doing the activities related to Quality Planning, Quality Assurance, Quality Control and internal failure cost. However for an organization cost of quality may include external failure cost.
- Due to temporary nature of project, organizations may choose to invest in product quality, especially quality improvements, defects prevention and appraisal, to reduce external cost of quality.

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
- Inspection

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

Cost of Non Conformance

Internal Failure Costs

(Failures found by the project)

- Rework
- Scrap

External Failure Costs

(Failures found by the customer)

- Testing
- Destructive testing loss
- Inspection

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

8.1 Plan Quality : Tools & Techniques

3. Control Chart

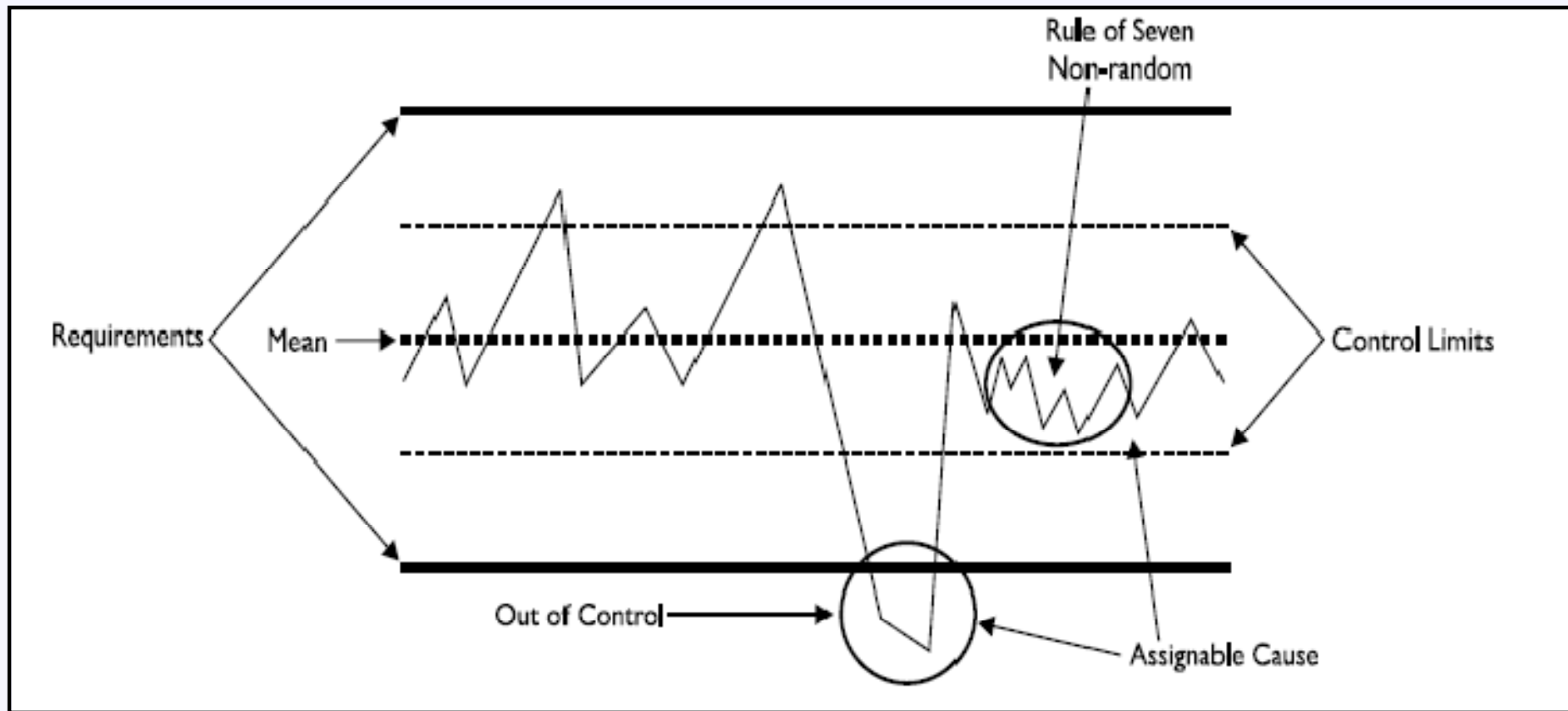
Purpose: It determines whether or not a process is stable or has predictable performance.

- ❖ It is a graphic display of the interaction of the process variables within acceptable limits
- ❖ When a process is outside acceptable limits the process should be adjusted.
- ❖ The upper control limits and lower control limits are usually set at +/- 3 sigma (i.e. standard deviation)
- ❖ In project, control chart can be used for monitoring of cost and time.

8.1 Plan Quality : Tools & Techniques

- To draw a control chart, upper and lower control limits are identified. Normally control limits are determined by organizations policies
- **Specification limit** – are normally drawn from contract or customer requirement. It may be stringent than control limits
- **Mean** represent the average of control limits or specification limits
- **Out of control** – A process is considered out of control if
 - A data point falls out of control limits
 - Breaks the rule of seven
- **Rule of seven** – Is a rule of thumb or heuristic. A consecutive seven data points one single side of mean is considered out of control, even though the data points are within control limits.
- **Assignable cause / Special Cause Variation** – is a data point that requires investigation (either out of control limits or breaks rule of seven)

8.1 Plan Quality : Tools & Techniques



8.1 Plan Quality : Tools & Techniques

4. Benchmarking

- It compares actual or planned project practices to those projects to generate ideas for improvement and to provide a basis by which to measure performance.
- These other projects can be within the performing organization or outside of it, and can be within the same or in another application area.

8.1 Plan Quality : Tools & Techniques

5. Design of Experiments (DOE)

- It helps identify which variables have the most influence on the overall outcome of a process
- It provides a statistical framework for systematically changing the entire important factors one at a time rather than each at a time.
- Automotive designers use this technique to determine which combination of suspension and tires will produce the most desirable ride characteristics at a reasonable cost.

8.1 Plan Quality : Tools & Techniques

6. Statistical Sampling

- ❖ It is used to **choose part of a population of interest for inspection**
- ❖ A sample selected according to statistical calculation is tested / checked rather than all products.
- ❖ Sample frequency and sizes shall be determined during plan quality process.

8.1 Plan Quality : Tools & Techniques

7. Flowcharting :

- A flowchart is a graphical representation of a process showing the relationships among the process steps.
- All flow charts will have activities, decision points and order of processing.



8.1 Plan Quality : Tools & Techniques

8. Proprietary Quality Management Methodologies :

- These include Six Sigma, Lean Six Sigma, Quality Function Deployment , CMMI, etc
- Recommend further reading

8.1 Plan Quality : Tools & Techniques

9. Additional Quality Planning Tools

- **Brainstorming**
- **Affinity diagram**
- **Force field analysis**
- **Nominal group techniques**
- **Matrix diagrams**
- **Prioritization matrices**

8.1 Plan Quality : Outputs

1. Quality Management Plan:

- It describes how the project management team will implement the performing organization's quality policy.
- ❖ The quality management plan is a component or a subsidiary plan of the project management plan
- ❖ The quality management plan provides inputs to the overall project management plan and must address quality control (QC), quality assurance (QA) and continuous process improvement for the project.

8.1 Plan Quality :Outputs

2. Quality Metrics

- ❖ A metric is an operational definition that describes, in very specific terms, what something is and how the quality control process measures it.
- ❖ A measurement is an actual value and matrices defines the tolerances
- ❖ A product can be accepted with +/- 5% variation
- ❖ Cost can exceed 10% of estimated values.
- ❖ Metrics will define statistical sampling requirements which are used in QA & QC processes

8.1 Plan Quality :Outputs

3. Quality Checklists:

- ❖ A checklist is a structured tool to verify that a set of required steps has been performed
- ❖ It may be simple or complex phrased as imperatives (do this) or Interrogatories (Have you done this) in which process you may ask it
- ❖ Quality checklists are used in QC process but prepared here.

8.1 Plan Quality :Outputs

4. Process improvement plan:

- It details the step for analyzing processes that will facilitate the identification of waste and non-value added activities and thus increasing customer satisfaction
 - ❖ Process boundaries: start and end of processes, their inputs and outputs, data required, if any and the owners and stakeholders of processes
 - ❖ Process configuration: A flowchart of processes to facilitate analysis with interfaces identified.
 - ❖ Process metrics: Maintain control over status of process
 - ❖ Targets for improved performance: Guides the process improvement activities

8.1 Plan Quality :Outputs

5. Project Document Updates :

➤ Project documents that may get updated include, but are not limited to :

1. Stakeholder register
2. Responsibility Assignment Matrix

8.2 Perform Quality Assurance

- Perform Quality assurance is the process of auditing the quality requirements and results from quality control measurements to ensure that appropriate quality standards and operations definitions are met.
- Another goal of quality assurance is continuous quality improvement
- Normally done by a third party



8.2 Perform Quality Assurance

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan 2. Quality metrics 3. Work performance information 4. Quality control measurements 	<ol style="list-style-type: none"> 1. Plan Quality and perform quality control tools and techniques 2. Quality audits 3. Process analysis 	<ol style="list-style-type: none"> 1. Organizational process assets (updates) 2. Change requests 3. Project management plan (updates) 4. Project Document Updates

8.2 Perform Quality Assurance: Tools & Techniques

1. The T & T for quality planning also can be used for QA Activities.
2. Quality Audits: It is structured, **independent review** to determine whether project activities comply with org. & project policies, processes and procedures.
3. Policies and procedures are set in the Quality planning stage and here auditing is carried out to confirm that project quality activities are confirming to this.

8.2 Perform Quality Assurance: Tools & Techniques

3. Process Analysis: : Main goal of quality assurance is continuous quality improvement , hence process analysis is done

- ❖ It follows the steps outlined in the process improvement plan to the identified improvements.
- ❖ It examines problems experienced, constraints experienced, and non- value-added activities identified during process operation.
- ❖ It includes root cause analysis to create preventive action for similar problems.

4. Quality control Tools & Techniques

- ❖ Described later

8.2 Perform Quality Assurance: Outputs

1. Organizational process assets (updates)
2. Change Requests
3. Project Management Plan Updates
4. Project Document Updates :

Documents that might get updated include , but are not limited to :

- Quality audit reports
- Training plans
- Process documentation

8.3 Perform Quality Control

- QC involves monitoring specific project results to determine:
 - ❖ Whether they comply with relevant quality standards
 - ❖ Identifying ways to eliminate causes of unsatisfactory results.
- QC should be performed throughout the project
- Project results include deliverables and PM results, such as cost and schedule performance
- QC is often performed by a quality control Dept.

Some Quality Control Terms

- **Marginal Analysis**
 - Optimal quality is reached at the point where the incremental revenue from improvement equals the incremental cost to secure it.
- **Prevention**
 - Keeping errors out of the process.
- **Inspection**
 - Catching errors when they have occurred.
- **Attribute Sampling**
 - Is the color (attribute) blue (acceptable) or red (unacceptable) ?
- **Variable Sampling**
 - How blue is it on the blueness scale ?

Some Quality Control Terms

- **Special Causes (Assignable Causes)**
 - Unusual events that probably merit investigation.
- **Random Causes (Common Causes)**
 - Normal process variation – probably doesn't merit investigation.
- **Tolerances**
 - The result is acceptable if it falls within the range specified by the tolerance.
- **Control limits**
 - The process is in control if the result falls within the control limits.

8.3 Perform Quality Control

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Project management plan 2. Quality metrics 3. Quality checklists 4. Organizational process assets 5. Work performance measurements 6. Approved change requests 7. deliverables 	<ol style="list-style-type: none"> 1. Cause and effect diagram 2. Control charts 3. Flowcharting 4. Histogram 5. Pareto chart 6. Run chart 7. Scatter diagram 8. Statistical sampling 9. inspection 10. Approved change requests review 	<ol style="list-style-type: none"> 1. Quality control measurements 2. Validated changes 3. Organizational process assets (updates) 4. Validated deliverables 5. Project management plan (updates) 6. Change Requests 7. Project Document Updates

8.3 Perform Quality Control Tools & Techniques

1. Cause and effect diagram
2. Control Charts
3. Flowcharting
4. Histogram
5. Pareto chart
6. Run Chart
7. Scatter Diagram
8. Statistical Sampling
9. Inspection
10. Approved change requests review

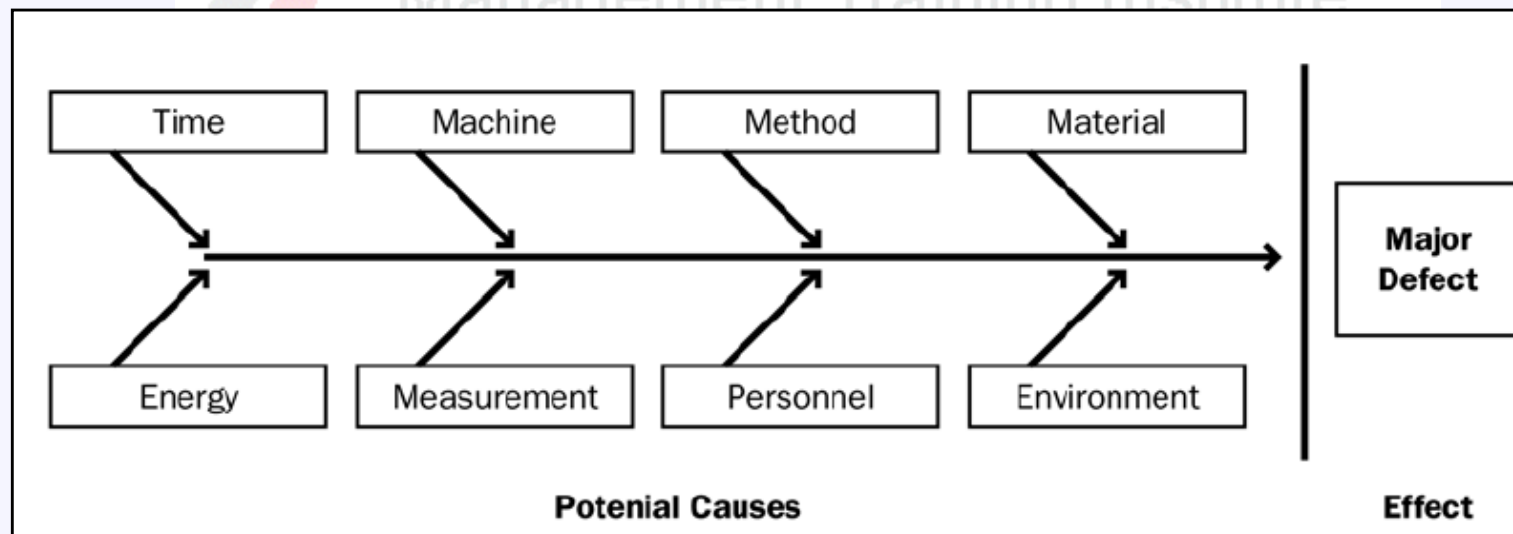
The first seven of these are known as the Seven Basic Tools of Quality

8.3 Perform Quality Control Tools & Techniques

1. Cause and Effect Diagram. Also called Ishikawa diagrams or fishbone diagrams.

➤ Purpose

It illustrates how various factors might be linked to potential problems or effects.



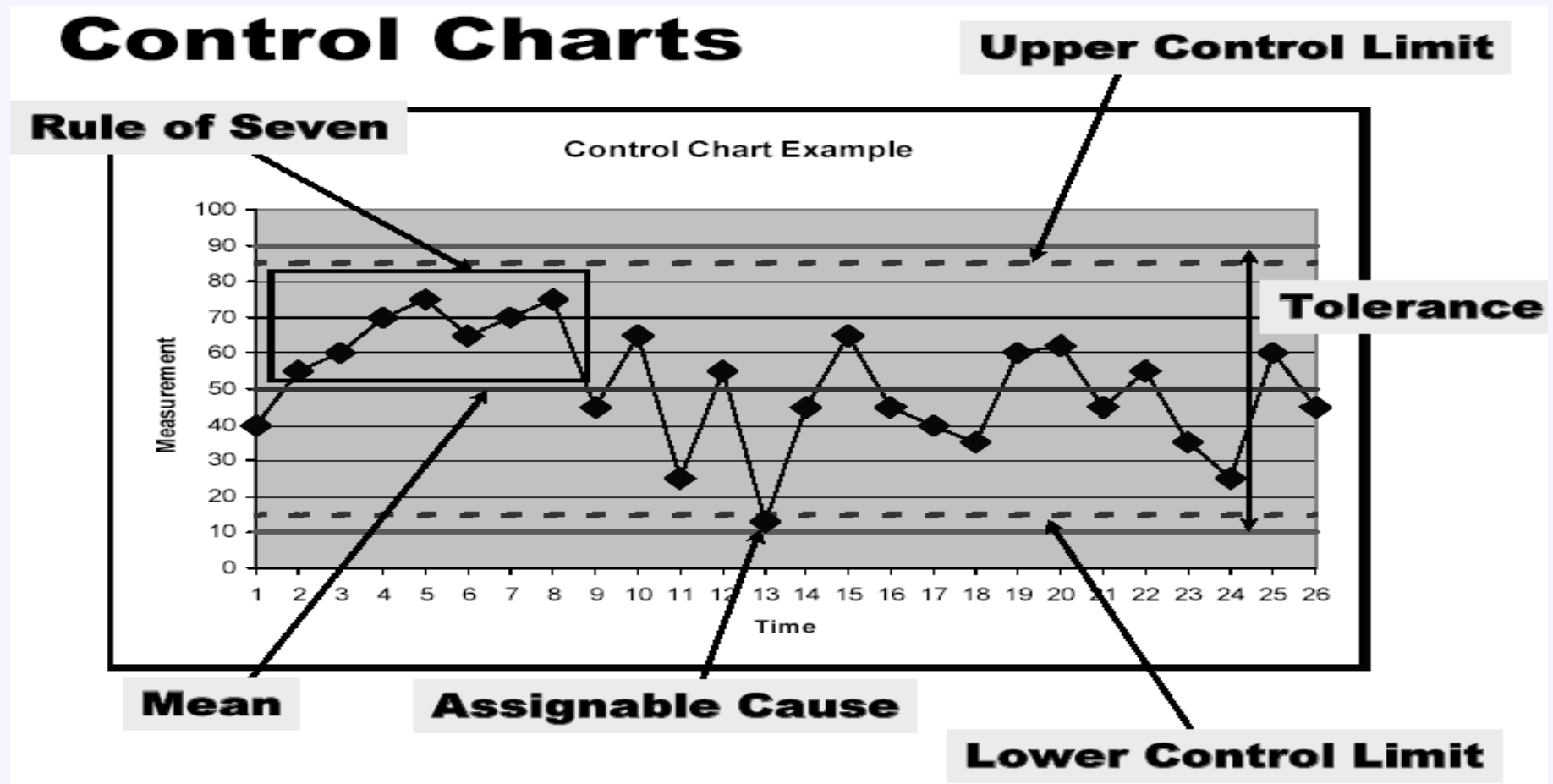
8.3 Perform Quality Control Tools & Techniques

- Control Chart

As described earlier



8.3 Perform Quality Control: Tools & Techniques

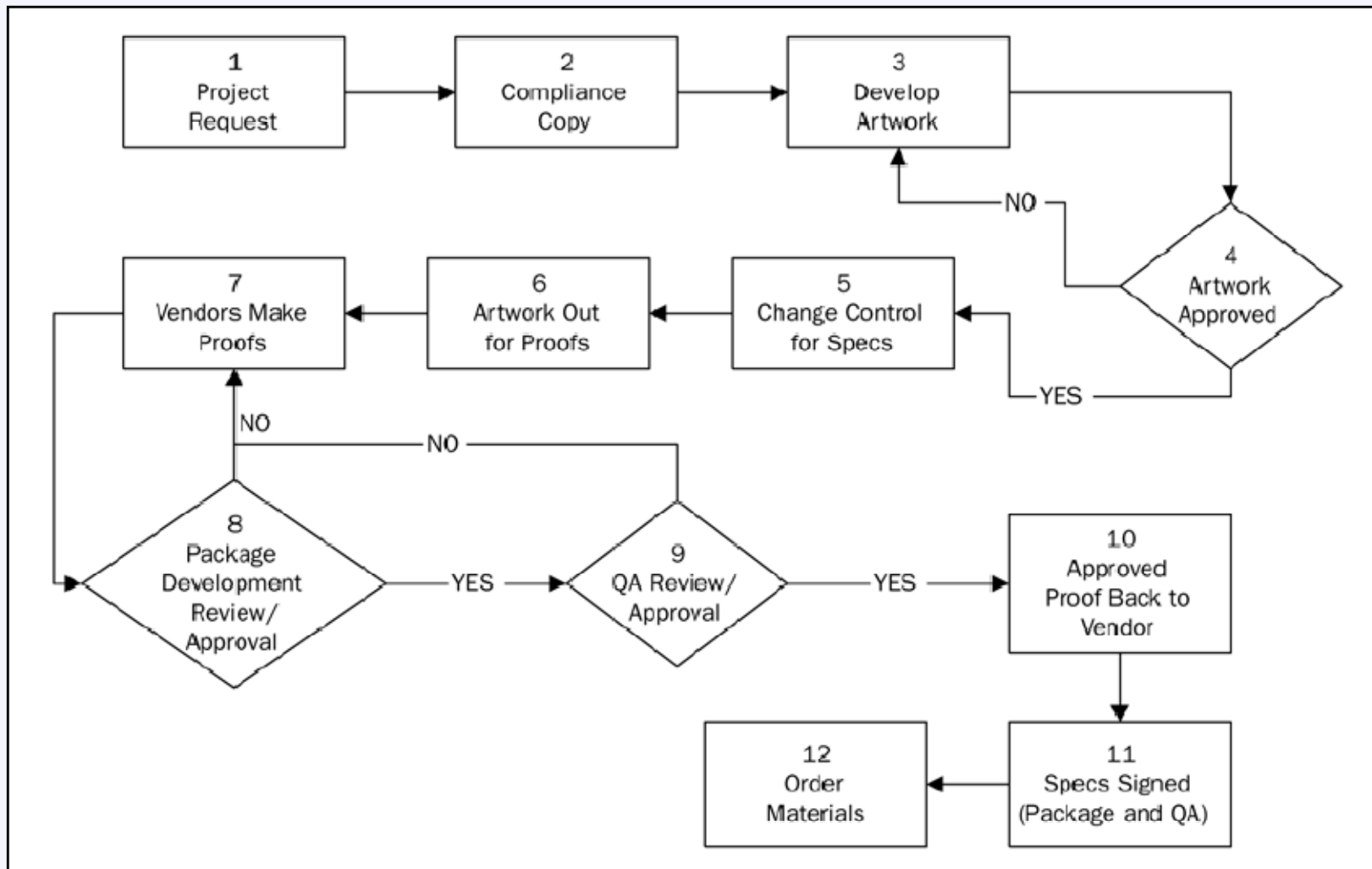


8.3 Perform Quality Control: Tools & Techniques

3. Flowcharting, It helps to analyze how problems occur

- ❖ A flowchart is a graphical representation of a process
- ❖ It shows how various elements of a system interrelated and the order of processing
- ❖ It helps the project team anticipate what and where quality problems might occur.

3. Flowcharting

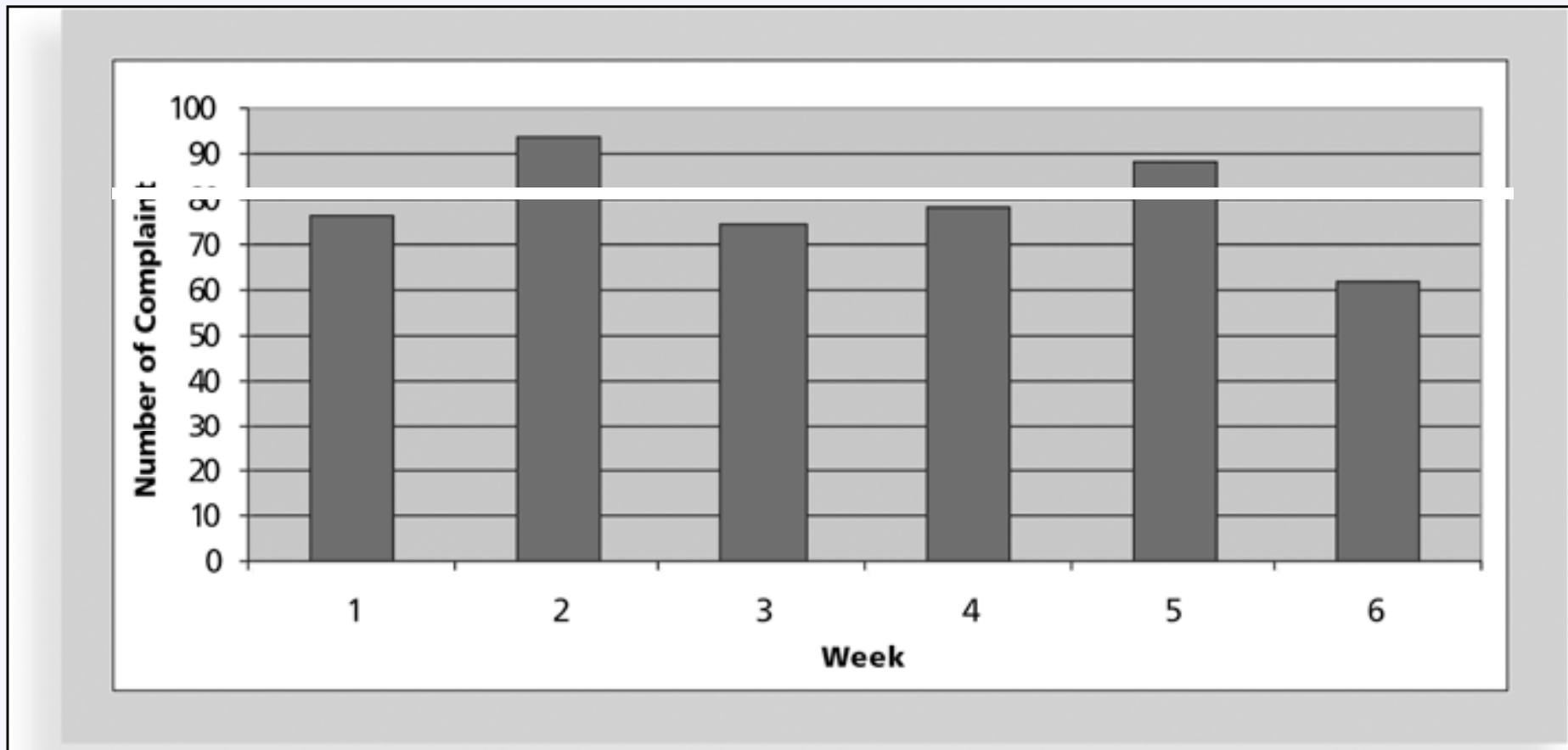


8.3 Perform Quality Control: Tools & Techniques

4. Histogram: it is a bar chart showing the distribution of variables

- ❖ Each column represents an attribute or characteristics of a problem or situation
- ❖ The height of each column represents the relative frequency of the characteristics
- ❖ Histogram helps identify the cause of the problem in a process by the shape and width of the distribution.

Sample Histogram

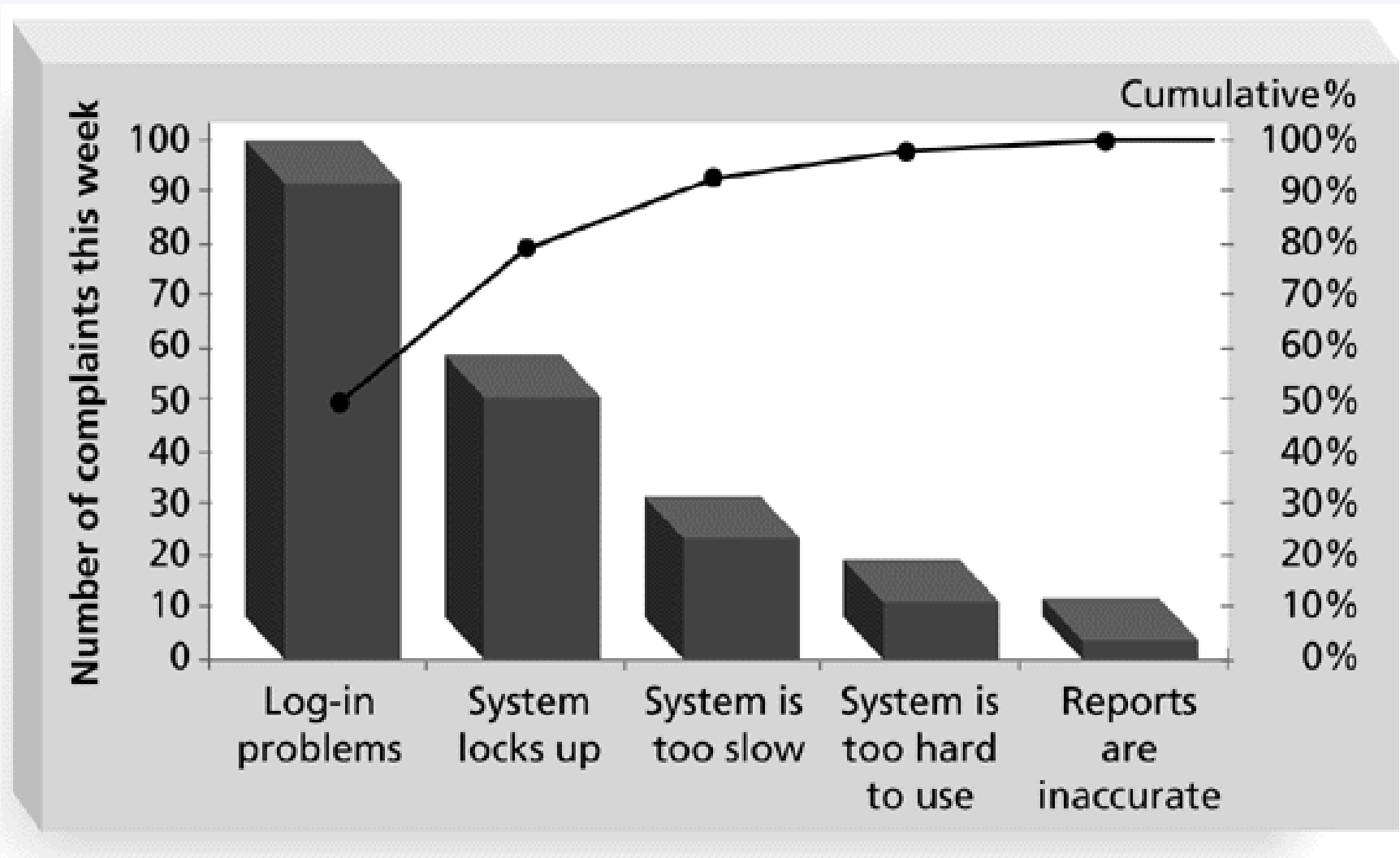


8.3 Perform Quality Control: Tools & Techniques

5. Pareto Chart (80/20 Principles)

- ❖ Pareto chart is a specific type of histogram ordered by frequency of occurrences
- ❖ A Pareto chart 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 Diagram



Pareto diagram

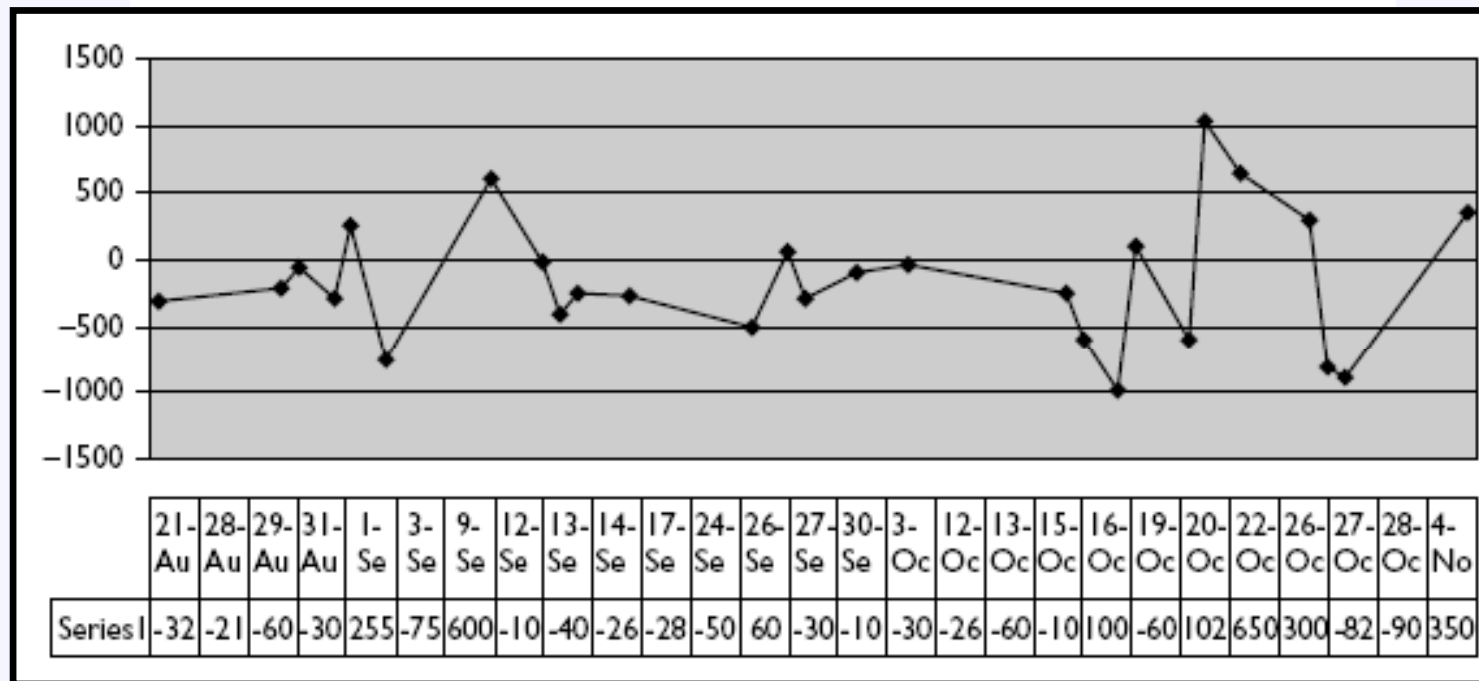
- Pareto diagram rank ordering is used to guide corrective actions
- The project team should take actions to fix the problems that are causing the greatest number of defects first.
- Pareto's Law "80/20 principle": a relatively small number of causes will typically produce a large majority of the problems or defects
- 80 percent of problems are due to 20 percent of the causes.

8.3 Perform Quality Control: Tools & Techniques

6. Run Chart

- It shows the history and pattern of variation.
- It is a line graph that shows data points plotted in the order in which they occur.
- It shows the trends in a process overtime variation overtime or declines or improvement in process overtime.
- Can be used to perform trend analysis to forecast future outcomes based on historical patterns

Run Chart



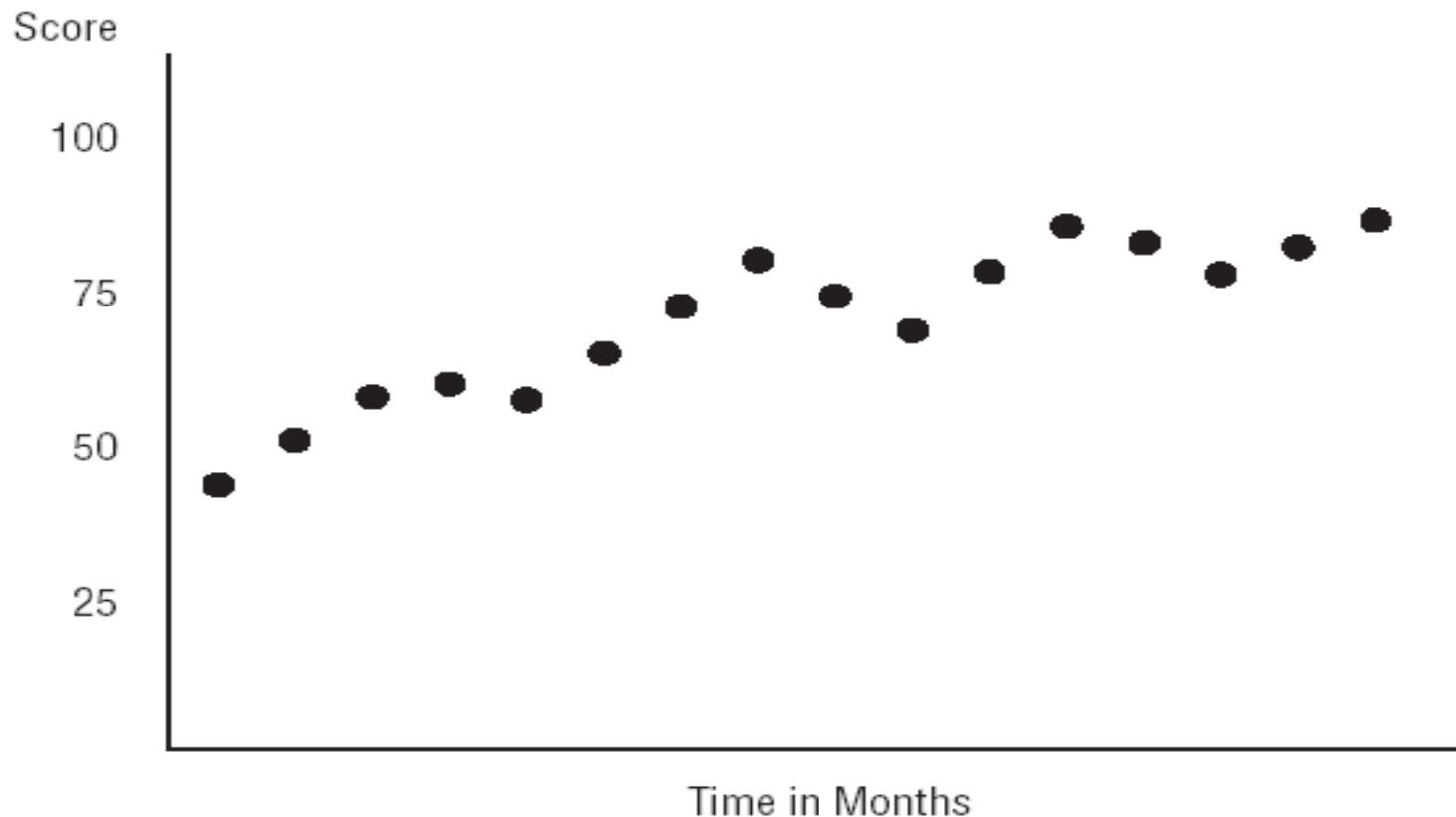
8.3 Perform Quality Control: Tools & Techniques

7. Scatter Diagram

- It allows the Quality team to study and identified the possible relationship between two variables.
- It shows the pattern of relationship between two variables.
- Dependent variables versus independent variables are plotted.
- The closer the points are to a diagonal line the more closely they are related.

8.3 Perform Quality Control: Tools & Techniques

Scatter diagram



8.3 Perform Quality Control: Tools & Techniques

8. Statistical Sampling

- ❖ As described before



8.3 Perform Quality Control: Tools & Techniques

9. Inspection

- ❖ Also called reviews, peer reviews, audits, and walk thorough
- ❖ It is the examination of a work product to determine whether it conforms to standards.
- ❖ Inspection includes measurements
- ❖ Inspections can be conducted at any level i.e. results of a single activity or the final product can be inspected
- ❖ Inspections are also used to validate defect repairs.

8.3 Perform Quality Control: Tools & Techniques

10. Approved Change Requests Review :

- All approved change requests should be reviewed to verify that they were implemented as approved



8.3 Perform Quality Control: Outputs

1. Quality control measurements

- These measurements are the result of the QC activities
- These measurements are fed back to the QA (section 8.2) to reevaluate and analyze the quality standards & processes

8.3 Perform Quality Control: Outputs

2. Validate Changes :

- Any changed or repaired items are inspected and will be either accepted or rejected before notification of the decision is provided .
- Rejected items may require rework

8.3 Perform Quality Control: Outputs

3. Organization process Assets (updates)

- Completed checklist: when checklist are used the completed checklist should become the part of the project's record
- Lessons learned documentation
- Lessons learned e.g. the causes of variances, the reasoning behind the corrective actions chosen... Should be documented so that they become the part of historical database for both this project and the performing organization.

8.3 Perform Quality Control: Outputs

4. Validated Deliverables

- ❖ QC aims to determine the correctness of deliverables
- ❖ The result of the execution quality control process are validated deliverables.

5. Project management plan (updates)



8.3 Perform Quality Control: Outputs

6. Change Requests :

- If the recommended corrective or preventive actions or a defect repair requires a change to the project management plan , a change request should be initiated in accordance with the defined Perform Integrated Change Control process

7. Project Document Updates :

- Project documents that may get updated include, but are not limited to : the quality standards