

Session-5 software quality Assurance

Dr. Bharati Wukkadada

SOFTWARE QUALITY ASSURANCE

ing, definition, explanation

index

- ▶ Verification and validation
- ▶ SQA plans
- ▶ Software quality frameworks
- ▶ ISO 9000 models
- ▶ SEI-CMM model
- ▶ Six Sigma

<https://www.youtube.com/watch?v=tj2LwVZ6NX4>

Watch first



If you want buy something
???

Online or offline



Not Assure No Purchase



- ▶ Then u will buy the goods when the equality is good



so we know the benefits of the quality assurance

What is SQA?

Software Quality assurance is simply a way to assure quality in the software.

Where to use SQA?

Software quality assurance is a process which works parallel to development of software.

How SQA is beneficial

- SQA Produce High Quality Software and those are beneficial.
- High quality application means short development time.
- High quality application saves time and cost.
- Better reliability and no maintenance for long time.
- High quality commercial software increase market share of company.

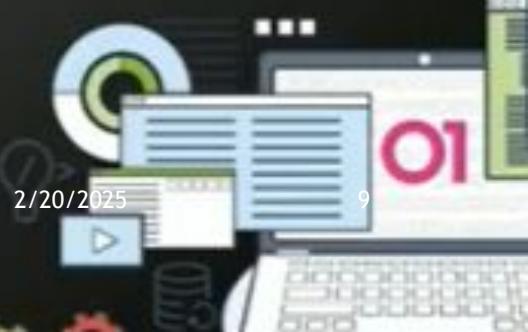
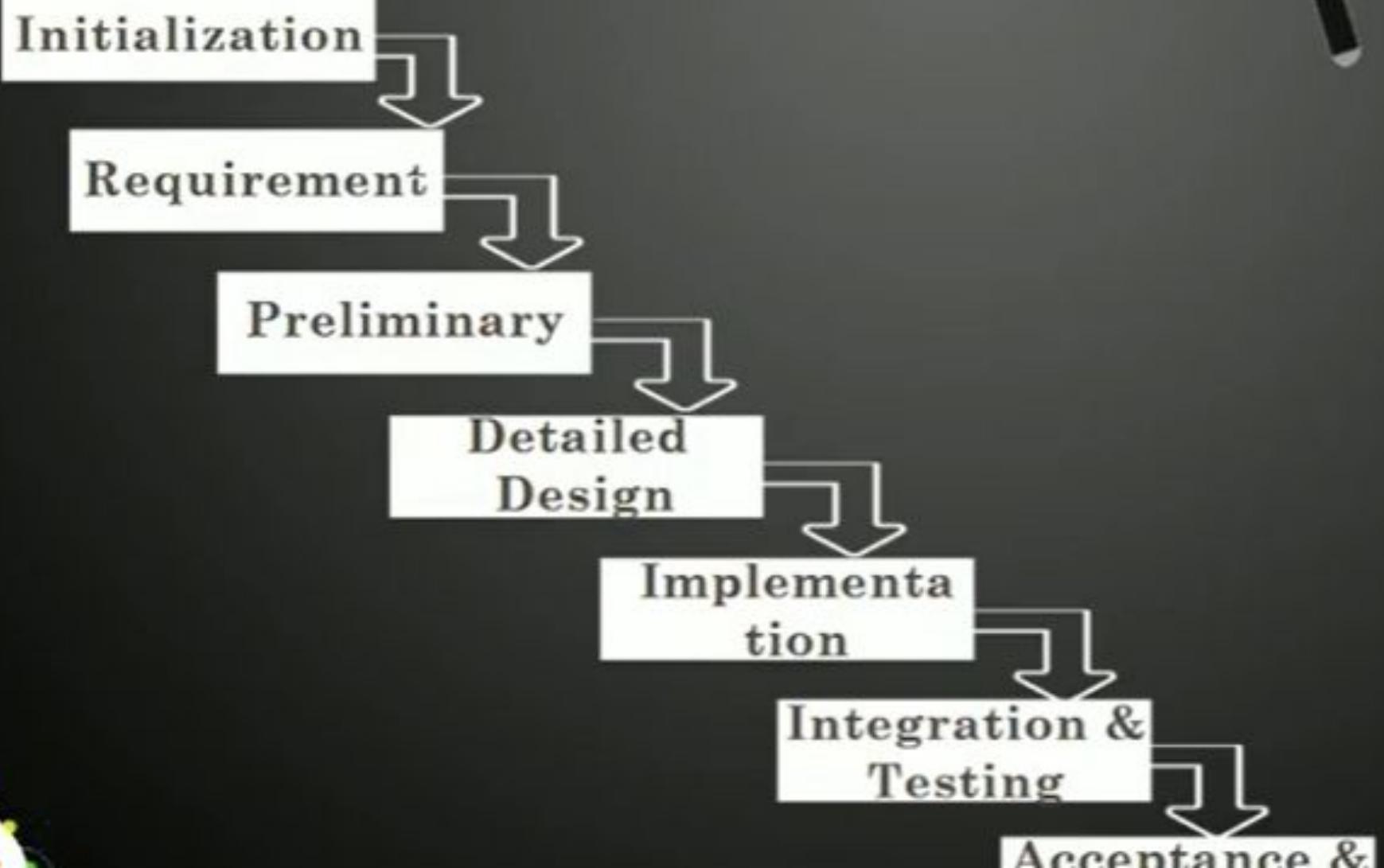
Activities of SQA

1. prepare on SQA plan for project
2. participate in development of the project's software process description
3. review the current s/w engg activities to verify the compliance with defined s/w process
4. audit the designed s/w work products to verify the compliance [**according**] with those defined as part of s/w process
5. ensures that there are no deviations in s/w work
6. records any noncompliance and reports to senior manager

Compliance is the state of being in accordance with established guidelines or specifications, or the process



SQA Life Cycle





Software Quality Assurance



Software Quality Assurance

Software Quality Assurance (SQA) is a set of activities for ensuring quality in software engineering processes. It ensures that developed software meets and complies with the defined or standardized quality specifications. SQA is an ongoing process within the Software Development Life Cycle (SDLC) that routinely checks the developed software to ensure it meets the desired quality measures.

SQA practices are implemented in most types of software development, regardless of the underlying software development model being used. SQA incorporates and implements software testing methodologies to test the software. Rather than checking for quality after completion, SQA processes test for quality in each phase of development, until the software is complete. With SQA, the software development process moves into the next phase only once the current/previous phase complies with the required quality standards. SQA generally works on one or more industry standards that help in building software quality guidelines and implementation strategies.

It includes the following activities –

- Process definition and implementation
- Auditing
- Training

Processes could be –

- Software Development Methodology
- Project Management
- Configuration Management
- Requirements Development/Management
- Estimation
- Software Design
- Testing, etc.

Once the processes have been defined and implemented, Quality Assurance has the following responsibilities –

- Identify the weaknesses in the processes
- Correct those weaknesses to continually improve the process

Components of SQA

An SQA system always combines a wide range of SQA components. These components can be classified into the following six classes –

Pre-project components

This assures that the project commitments have been clearly defined considering the resources required, the schedule and budget; and the development and quality plans have been correctly determined.

Components of project life cycle activities assessment

The project life cycle is composed of two stages: the development life cycle stage and the operation–maintenance stage.

The development life cycle stage components detect design and programming errors. Its components are divided into the following sub-classes: Reviews, Expert opinions, and Software testing.

The SQA components used during the operation–maintenance phase include specialized maintenance components as well as development life cycle components, which are applied mainly for functionality to improve the maintenance tasks.

Components of infrastructure error prevention and improvement

The main objective of these components, which is applied throughout the entire organization, is to eliminate or at least reduce the rate of errors, based on the organization's accumulated SQA experience.

Components of software quality management

This class of components deal with several goals, such as the control of development and maintenance activities, and the introduction of early managerial support actions that mainly prevent or minimize schedule and budget failures and their outcomes.

Components of standardization, certification, and SQA system assessment

These components implement international professional and managerial standards within the organization. The main objectives of this class are utilization of international professional knowledge, improvement of coordination of the organizational quality systems with other organizations, and assessment of the achievements of quality systems according to a common scale. The various standards may be classified into two main groups: quality management standards and project process standards.

Organizing for SQA – the human components

The SQA organizational base includes managers, testing personnel, the SQA unit and the persons interested in software quality such as SQA trustees, SQA committee members, and SQA forum members. Their main objectives are to initiate and support the implementation of SQA components, detect deviations from SQA procedures and methodology, and suggest improvements.

What are SQA, SQP, SQC, and SQM?

SQA includes all 4 elements...

1. **Software Quality Assurance** – establishment of network of organizational procedures and standards leading to high-quality software
2. **Software Quality Planning** – selection of appropriate procedures and standards from this framework and adaptation of these to specific software project
3. **Software Quality Control** – definition and enactment of processes that ensure that project quality procedures and standards are being followed by the software development team
4. **Software Quality Metrics** – collecting and analyzing quality data to predict and control quality of the software product being developed

METRIC: a system or standard of measurement:

Software metrics

Software quality metrics are a subset of software metrics that focus on the quality aspects of the product, process, and project. These are more closely associated with process and product metrics than with project metrics.

Software quality metrics can be further divided into three categories –

- Product quality metrics
- In-process quality metrics
- Maintenance quality metrics

Software metrics can be classified into three categories –

• **Product metrics** – Describes the characteristics of the product such as size, complexity, design features, performance, and quality level.

• **Process metrics** – These characteristics can be used to improve the development and maintenance activities of the software.

• **Project metrics** – This metrics describe the project characteristics and execution. Examples include the number of software developers, the staffing pattern over the life cycle of the software, cost, schedule, and productivity.

Some metrics belong to multiple categories. For example, the in-process quality metrics of a project are both process metrics and project metrics.

Quality Concepts - 1

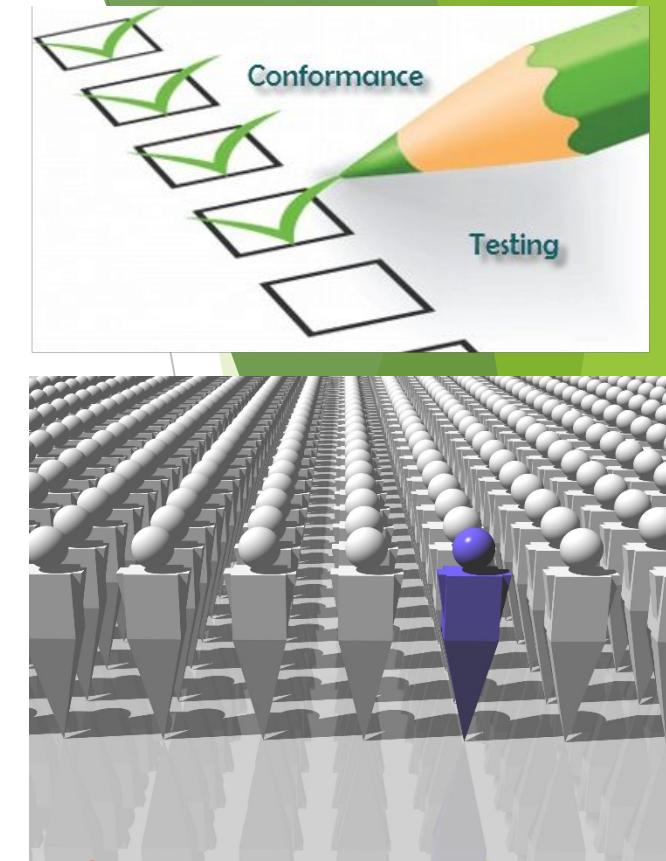
- ▶ Variation control is the heart of quality control
- ▶ Software engineers strive to control the
 - ▶ process applied
 - ▶ resources expended
 - ▶ end product quality attributes
- ▶ Quality of design
 - ▶ refers to characteristics designers specify for the end product to be constructed

Quality Concepts - 2

- ▶ Quality of conformance
 - ▶ degree to which design specifications are followed in manufacturing the product
- ▶ Quality control
 - ▶ series of inspections, reviews, and tests used to ensure conformance of a work product to its specifications
- ▶ Quality assurance
 - ▶ auditing and reporting procedures used to provide management with data needed to make proactive decisions

Conformance is how well something, such as a product, service or a system, meets a specified standard and may refer more specifically to: **Conformance** testing, testing to determine whether a product or system meets some specified standard.

quality assurance is a means and practice of monitoring the software engineering processes and methods used in a project to ensure proper quality of the software. It may include ensuring conformance to standards or models, such as ISO/IEC 9126 (now superseded by ISO 25010), SPICE or CMMI.
It focuses more on the software process rather than the software work products.
Quality Assurance makes sure the Test Manager is doing the right things in the right way.



Quality Costs

- ▶ **Prevention costs**
 - ▶ quality planning, formal technical reviews, test equipment, training
- ▶ **Appraisal costs [REVIEW /EVALUATION]**
 - ▶ in-process and inter-process inspection, equipment standardization and maintenance, testing
- ▶ **Failure costs**
 - ▶ rework, repair, failure mode analysis
- ▶ **External failure costs**
 - ▶ complaint resolution, product return and replacement, help line support, warranty [contract]work

SOFTWARE TESTING AND QUALITY ASSURANCE

TESTING SERVICES

Functional Testing

Integration Testing

Performance Testing

Acceptance Testing

Web-based Testing

Mobile Testing

QUALITY ASSURANCE

Test Plans/Cases

Risk-Based Testing

Test Automation

Test Data Management

Industry-Specific Testing

Agile Testing

QUALITY MANAGEMENT

Managed QA Team

Quality Center
of Excellence

Strategy & Governance

Onsite Advisory/
Assignment

Shared QA
Outcomes/Ownership

COVERING THE QUALITY CONTINUUM

Software Quality Assurance(SQA): Plan, Audit & Review



Please conduct the Test Manager review or Quality Assurance. This is good evidence to prove quality of our work



what

what is the Test Management Reviews & Audit?



why

why do we need the SQA in Test Management process?



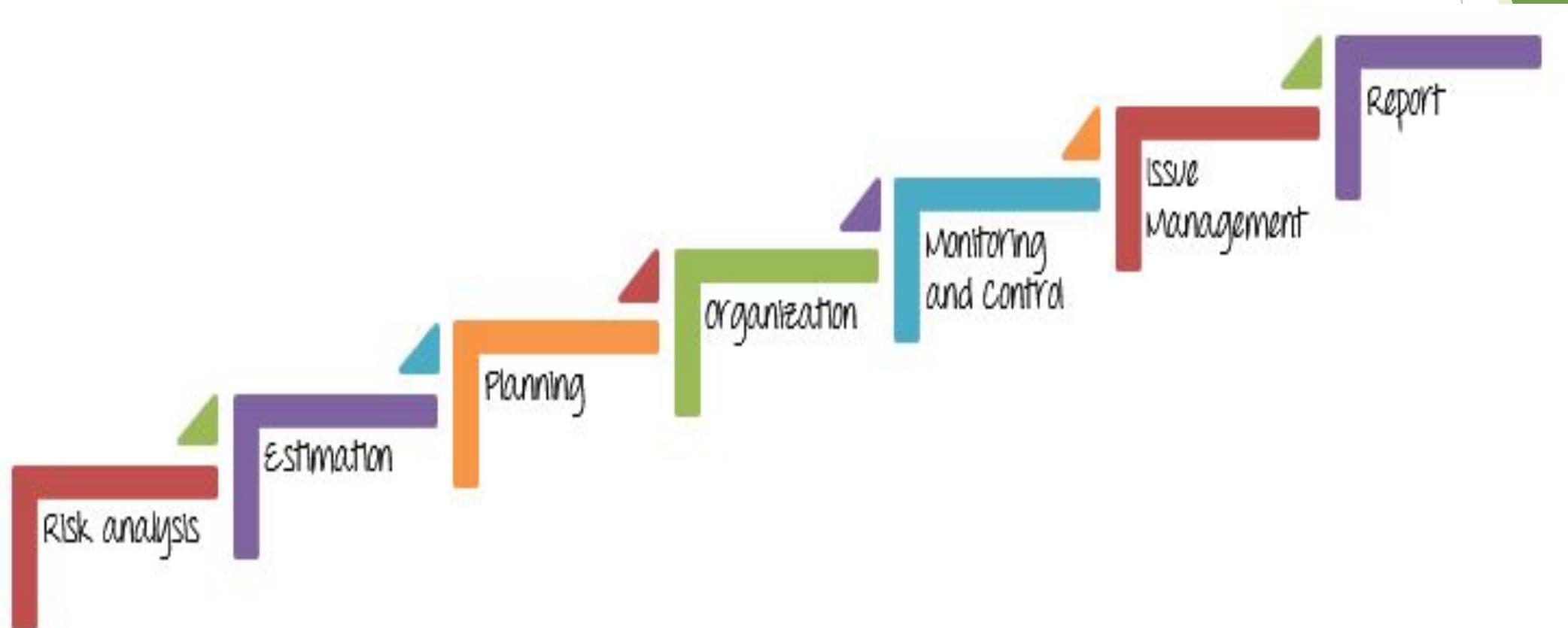
How

How to implement the quality assurance?

What is the Test Management Reviews & Audit?

- ▶ Management Review is also known as Software Quality Assurance or (SQA).
- ▶ It **focuses more on the software process rather than the software work products.**
- ▶ Quality Assurance **makes sure the Test Manager is doing the right things in the right way.**

Why do we need SQA in Test Management process?



- ▶ **Test Manager** at the highest position in the project team.
- ▶ **Who will review your tasks and check the project management activities are executed to the highest possible standard.**
- ▶ Well, SQA auditor.
- ▶ **the Management Board □ SQA Auditor check**

Benefits of SQA are -



Monitoring and improving the process



Make sure that the standards and procedures are followed



Preventing the quality problems from occurring



Quality Assurance

SERVICE: a system or organization that provides the public with something that it needs; the job that an organization does

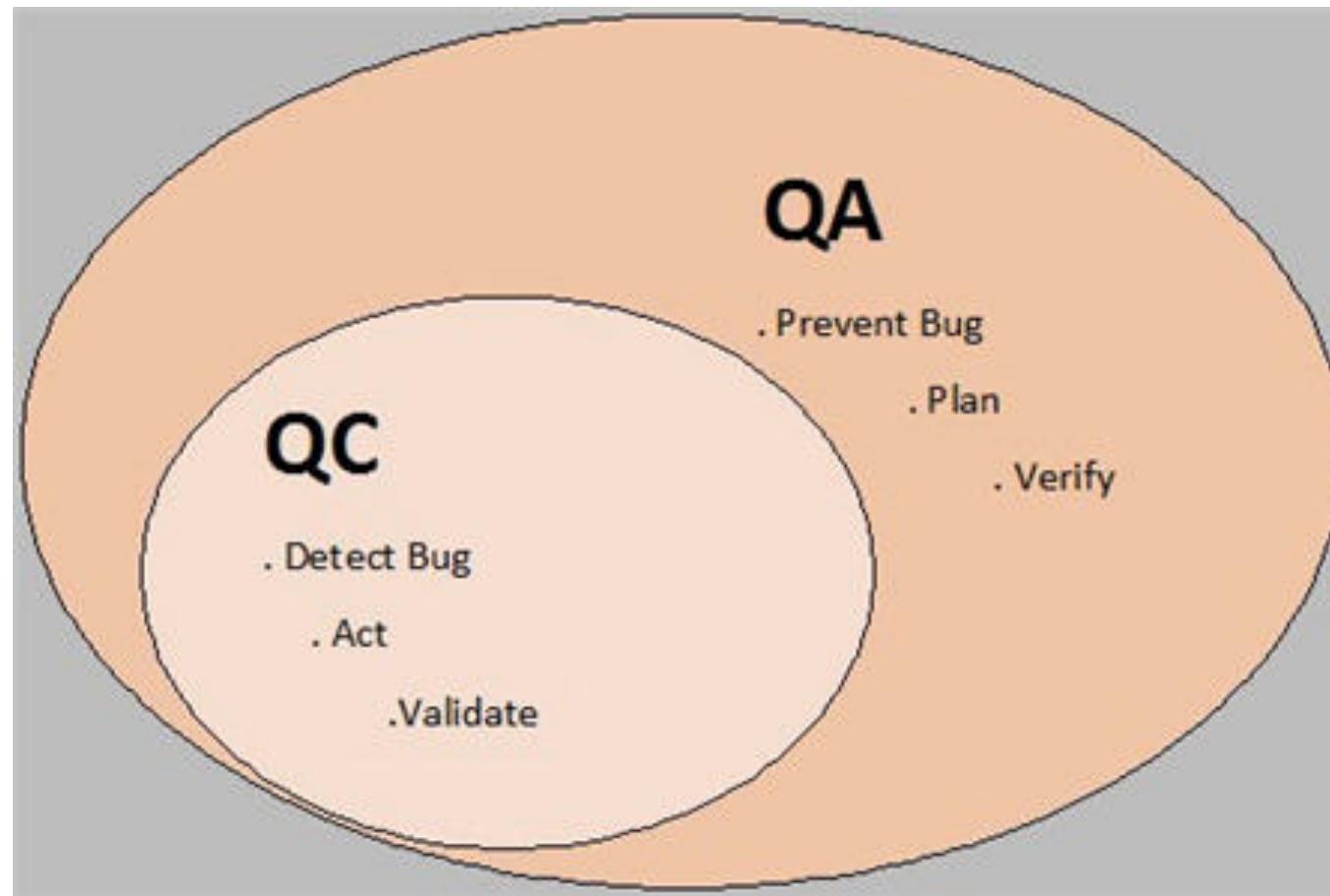
EFFICIENCY: signifies a peak level of performance that uses the least amount of inputs to achieve the highest amount of output. ... It minimizes the waste of resources such as physical materials, energy, and time while accomplishing the desired output

QUALITY: how good or bad something is · a characteristic or feature that something has

RELIABILITY: is defined as the probability that a product, system, or service will perform its intended function adequately for a specified period of time, or will operate in a defined environment without failure.



Quality in every aspect begins with the mind



PRINCIPLES OF QUALITY ASSURANCE

- Customer focus
- Leadership
- Involvement of people
- Process approach
- System approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial supplier relationship



Quality Assurance Criteria:

- ▶ correctness
- ▶ efficiency
- ▶ flexibility
- ▶ integrity
- ▶ interoperability
- ▶ maintainability
- ▶ portability
- ▶ reliability
- ▶ reusability
- ▶ testability
- ▶ usability

highlights

Software Quality Assurance

Overview

- This chapter provides an introduction for software quality assurance (SQA). SQA is the concern of every software engineer to reduce cost and improve product time-to-market. A Software Quality Assurance Plan is not merely another name for a test plan, though test plans are included in an SQA plan. SQA activities are performed on every software project. Use of metrics is an important part of developing a strategy to improve the quality of both software processes and work products.

Quality Concepts

- Variation control is the heart of quality control (software engineers strive to control the process applied, resources expended, and end product quality attributes).
- Quality of design - refers to characteristics designers specify for the end product to be constructed
- Quality of conformance - degree to which design specifications are followed in manufacturing the product
- Quality control - series of inspections, reviews, and tests used to ensure conformance of a work product to its specifications
- Quality assurance - consists of the auditing and reporting procedures used to provide management with data needed to make proactive decisions

Cost of Quality

- Prevention costs - quality planning, formal technical reviews, test equipment, training
- Appraisal costs - in-process and inter-process inspection, equipment calibration and maintenance, testing
- Failure costs - rework, repair, failure mode analysis
- External failure costs - complaint resolution, product return and replacement, help line support, warranty work

Total Quality Management

- **Kaizen** - develop a process that is visible, repeatable, and measurable
- **Atarimae hinshitsu** - examine the intangibles that affect the process and work to optimize their impact on the process
- **Kansei** - examine the way the product is used by the customer with an eye to improving both the product and the development process
- **Miryokuteki hinshitsu** - observe product use in the market place to uncover new product applications and identify new products to develop

Software Quality Assurance

- Conformance to software requirements is the foundation from which software quality is measured.
- Specified standards are used to define the development criteria that are used to guide the manner in which software is engineered.
- Software must conform to implicit requirements (ease of use, maintainability, reliability, etc.) as well as its explicit requirements.

SQA Group Activities

- Prepare SQA plan for the project.
- Participate in the development of the project's software process description.
- Review software engineering activities to verify compliance with the defined software process.
- Audit designated software work products to verify compliance with those defined as part of the software process.
- Ensure that any deviations in software or work products are documented and handled according to a documented procedure.
- Record any evidence of noncompliance and reports them to management.

Software Reviews

- Purpose is to find defects (errors) before they are passed on to another software engineering activity or released to the customer.
- Software engineers (and others) **conduct formal technical reviews (FTR)** for software engineers.
- Using formal technical reviews (walkthroughs or inspections) is an effective means for improving software quality.

Formal Technical Reviews

- Involves 3 to 5 people (including reviewers)
- Advance preparation (no more than 2 hours per person) required
- Duration of review meeting should be less than 2 hours
- Focus of review is on a discrete work product
- Review leader organizes the review meeting at the producer's request
- Reviewers ask questions that enable the producer to discover his or her own error
(the product is under review not the producer)
- Producer of the work product walks the reviewers through the product
- Recorder writes down any significant issues raised during the review
- Reviewers decide to accept or reject the work product and whether to require additional reviews of product or not

Statistical Quality Assurance

- Information about software defects is collected and categorized
- Each defect is traced back to its cause
- Using the Pareto principle (80% of the defects can be traced to 20% of the causes) isolate the "vital few" defect causes
- Move to correct the problems that caused the defects

The Pareto Principle, also known as the **80/20 Rule**, **The Law of the Vital Few** and **The Principle of Factor Sparsity**, illustrates that **80% of effects arise from 20% of the causes –**

or in lamens terms – 20% of your actions/activities will account for 80% of your results/outcomes.

- **Software Reliability**
 - Defined as the probability of failure free operation of a computer program in a specified environment for a specified time period
 - Can be measured directly and estimated using historical and developmental data (unlike many other software quality factors)
 - Software reliability problems can usually be traced back to errors in design or implementation.
-
- **Software Safety**
 - Defined as a software quality assurance activity that focuses on identifying potential hazards that may cause a software system to fail.
 - Early identification of software hazards allows developers to specify design features to can eliminate or at least control the impact of potential hazards.{damage, harm or adverse}
 - Software reliability involves determining the likelihood that a failure will occur, while software safety examines the ways in which failures may result in conditions that can lead to a mishap.
-
- **Mistake-Proofing Software**
 - **Poka-yoke** devices are mechanisms that lead to the prevention of a potential quality problem before it occurs or to the rapid detection of a quality problem if one is introduced
 - Poka-yoke devices are simple, cheap, part of the engineering process, and are located near the process task where the mistakes occur
-
- **ISO Quality Standards**
 - Quality assurance systems are defined as the organizational **structure, responsibilities, procedures, processes, and resources** for implementing quality management.
 - ISO 9000 describes the quality elements that must be present for a quality assurance system to be compliant with the standard, but it does not describe how an organization should implement these elements.
 - ISO 9001 is the quality standard that contains 20 requirements that must be present in an effective software quality assurance system.

- ▶ **Poka-yoke** (ポカヨケ, [poka joke]) is a Japanese term that means "mistake-proofing" or "inadvertent error prevention". A **poka-yoke** is any mechanism in a process that helps an equipment operator avoid (yokeru) mistakes (**poka**).

Poka Yoke = Mistake-Proofing

Poka yoke strategies eliminate human error from your processes so that defects never get to customers, meaning that your processes are more productive and profitable.



- ▶ **SQA Plan**
- **Management section** - describes the place of SQA in the structure of the organization
- **Documentation section** - describes each work product produced as part of the software process
- **Standards, practices, and conventions section** - lists all applicable standards/practices applied during the software process and any metrics to be collected as part of the software engineering work
- **Reviews and audits section** - provides an overview of the approach used in the reviews and audits to be conducted during the project
- **Test section** - references the test plan and procedure document and defines test record keeping requirements
- **Problem reporting and corrective action section** - defines procedures for reporting, tracking, and resolving errors or defects, identifies organizational responsibilities for these activities
- **Other** - tools, SQA methods, change control, record keeping, training, and risk management



20-02-2025

40

- Software Quality Process Framework

Introduction – Software Quality Process Framework

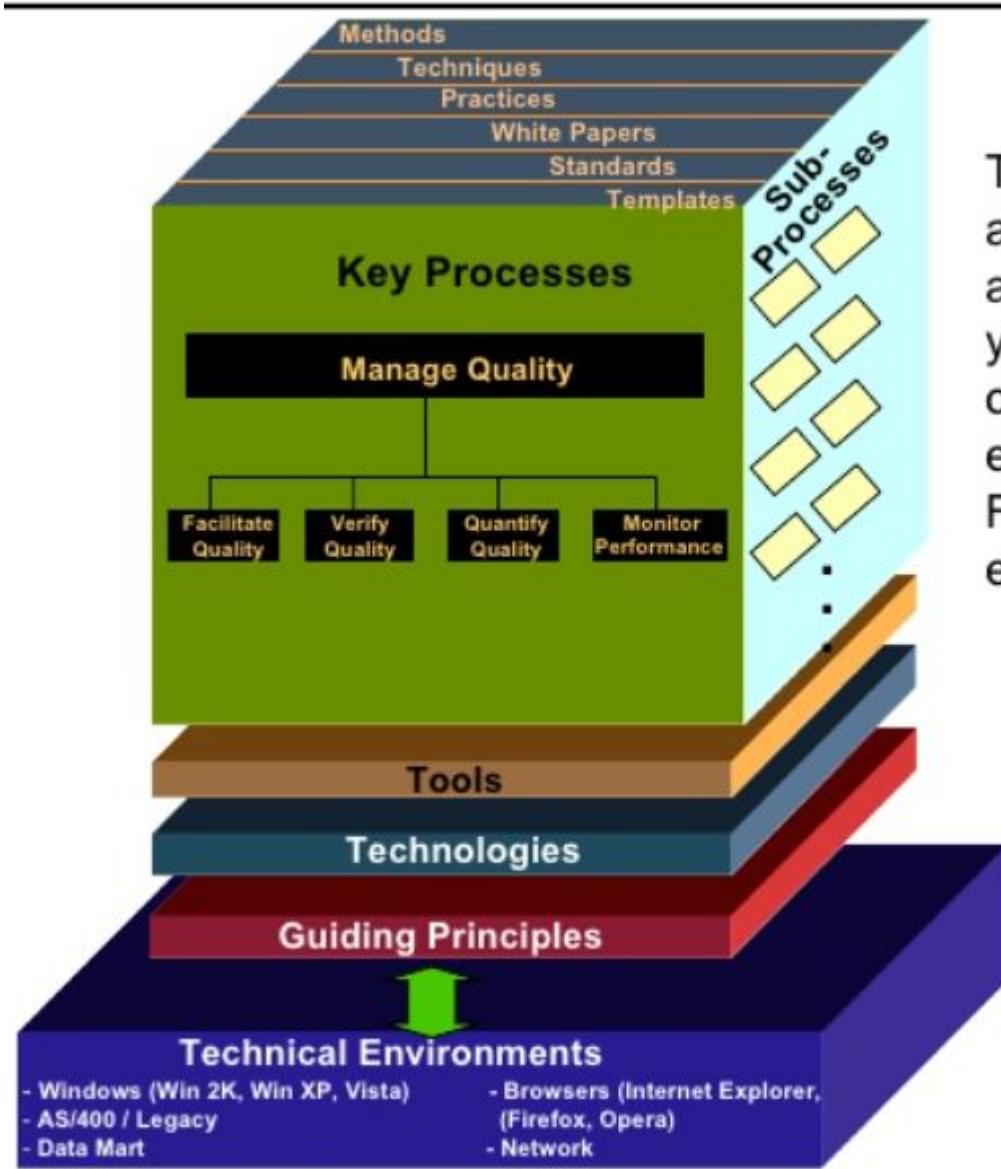
Process is oriented around key architectural principles:

- Must be practical and feasible
- Must support the ability to implement reliability, repeatability, predictability
- Must be designed for phased component implementation(s)
- Must have the capability of being improved over time
- Must be scalable across wide variety of industries / project types
- Must be independent of technology base at the highest level

Reliability is the overall consistency of a measure while

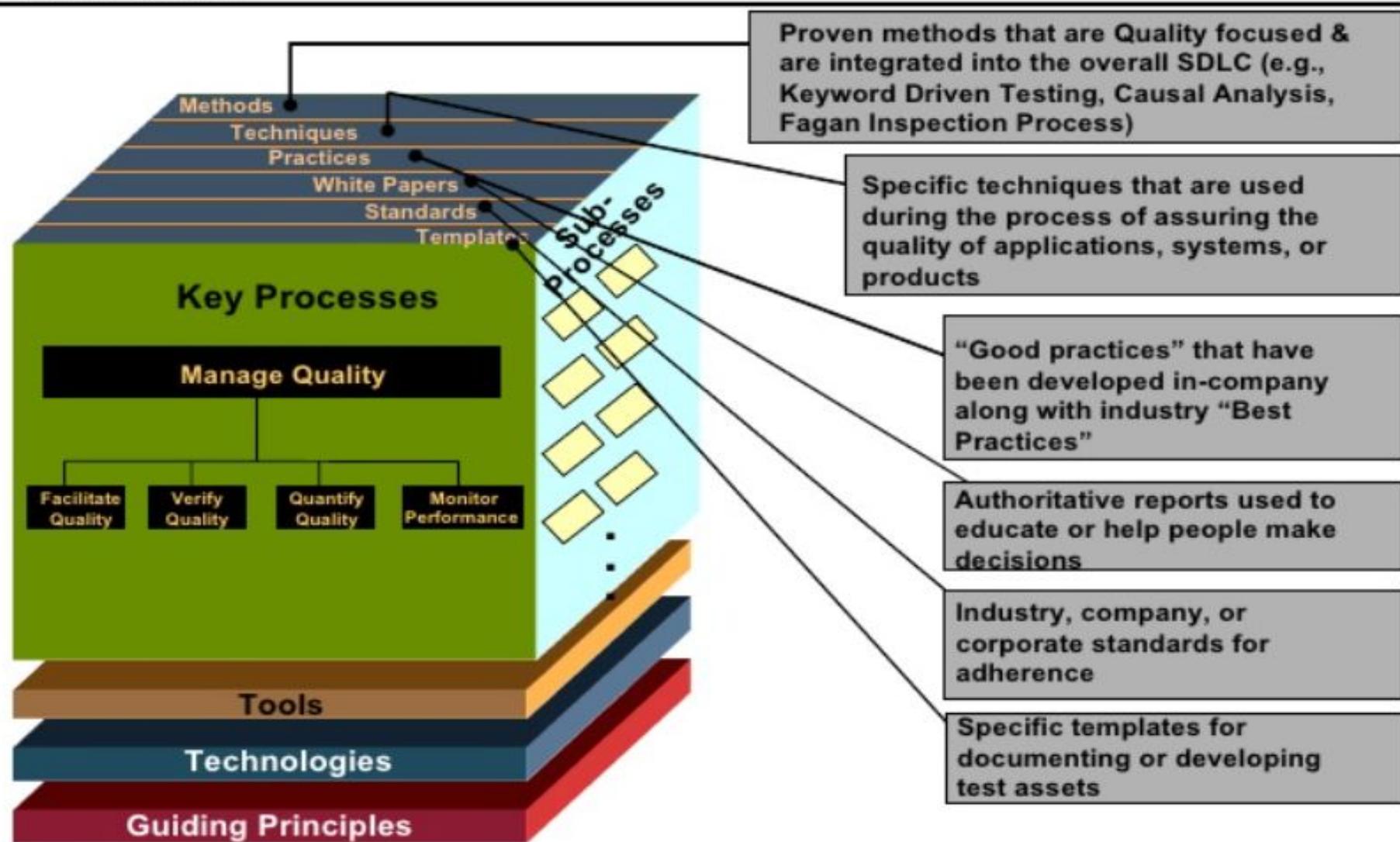
repeatability is the closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement.

Architectural relationships -software quality process Framework

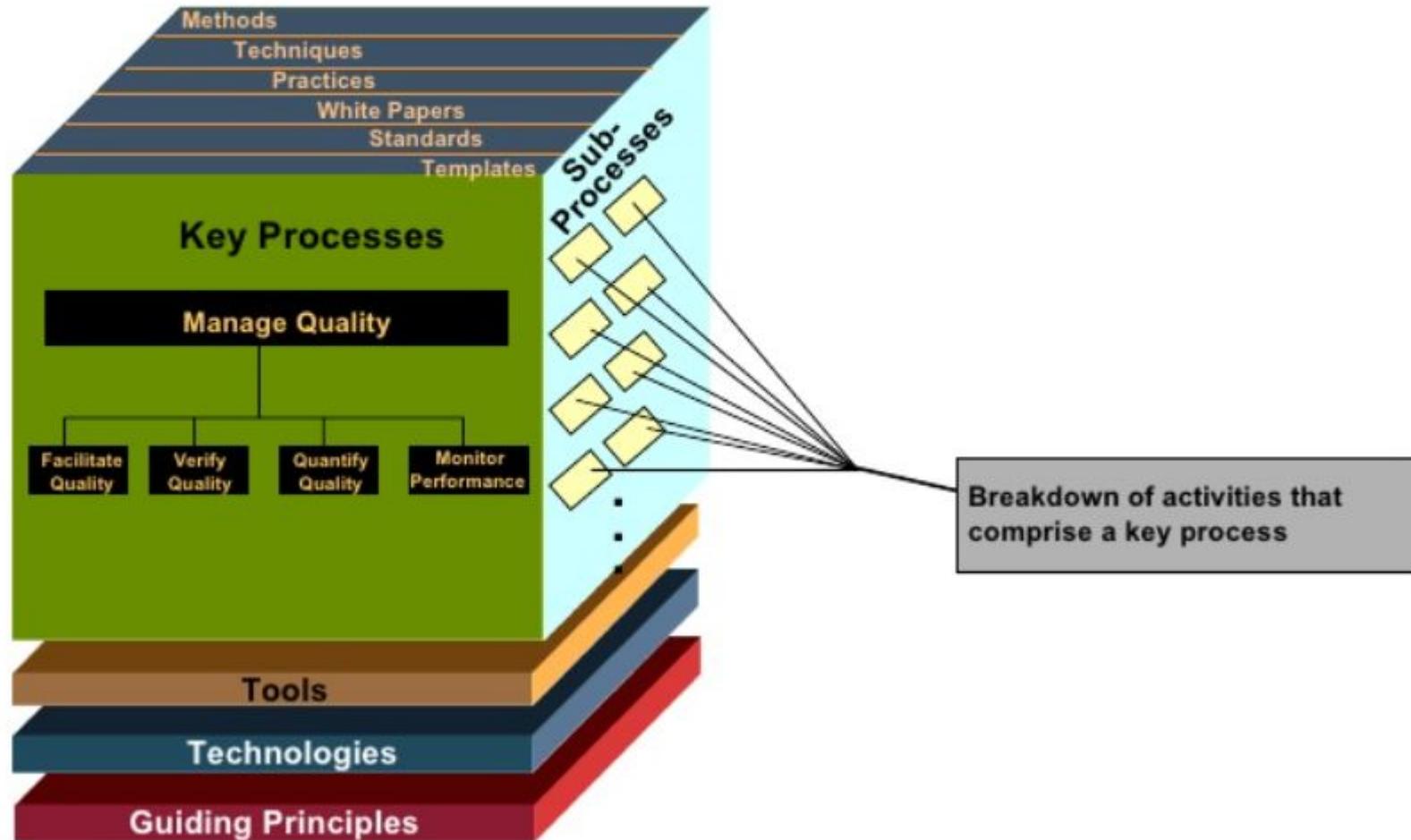


The Framework can accommodate known and projected projects yet remains independent of the technical environments so that the Framework can be enhanced over time.

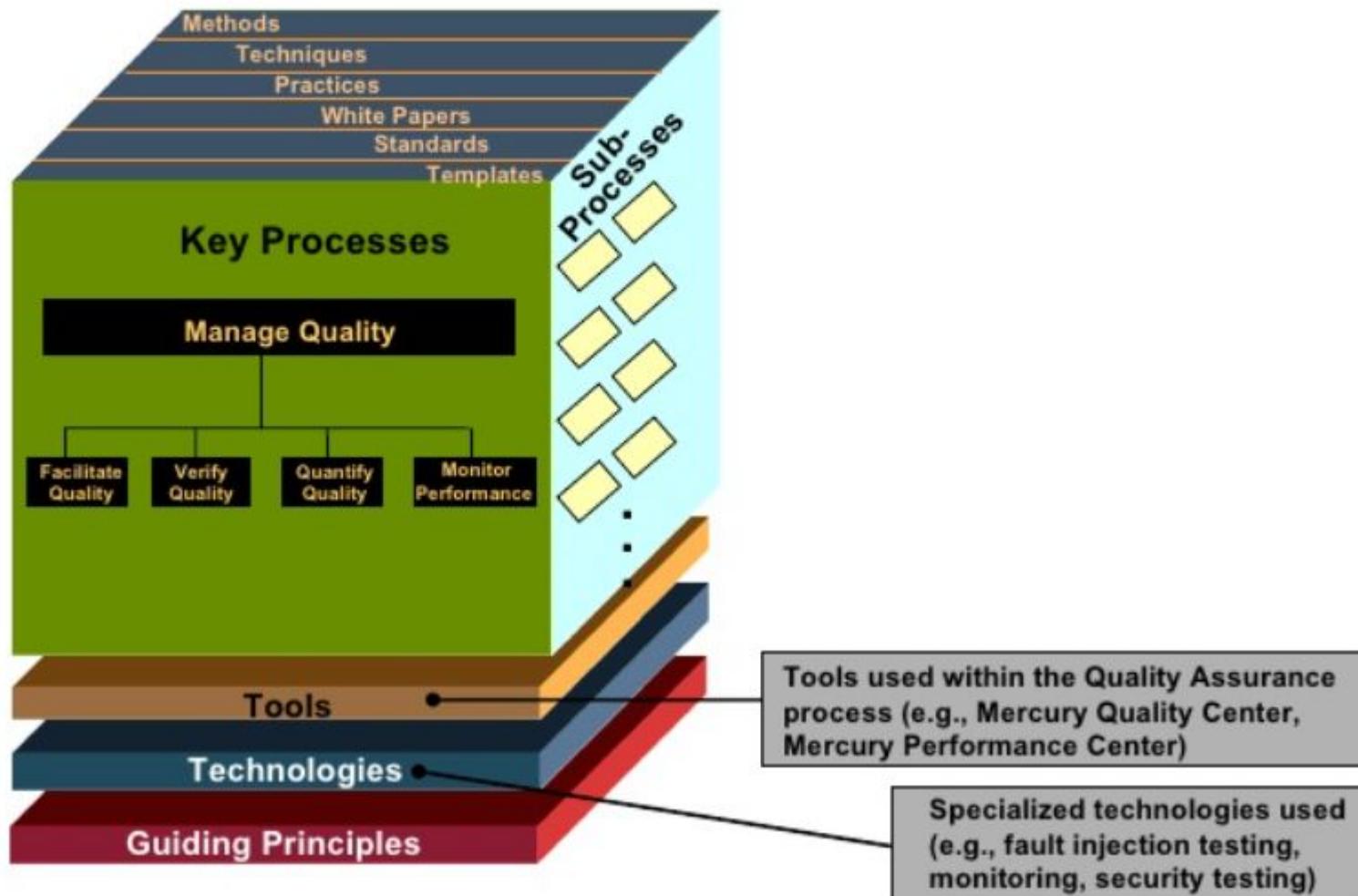
Architecture: Templates -- Software Quality Process Framework



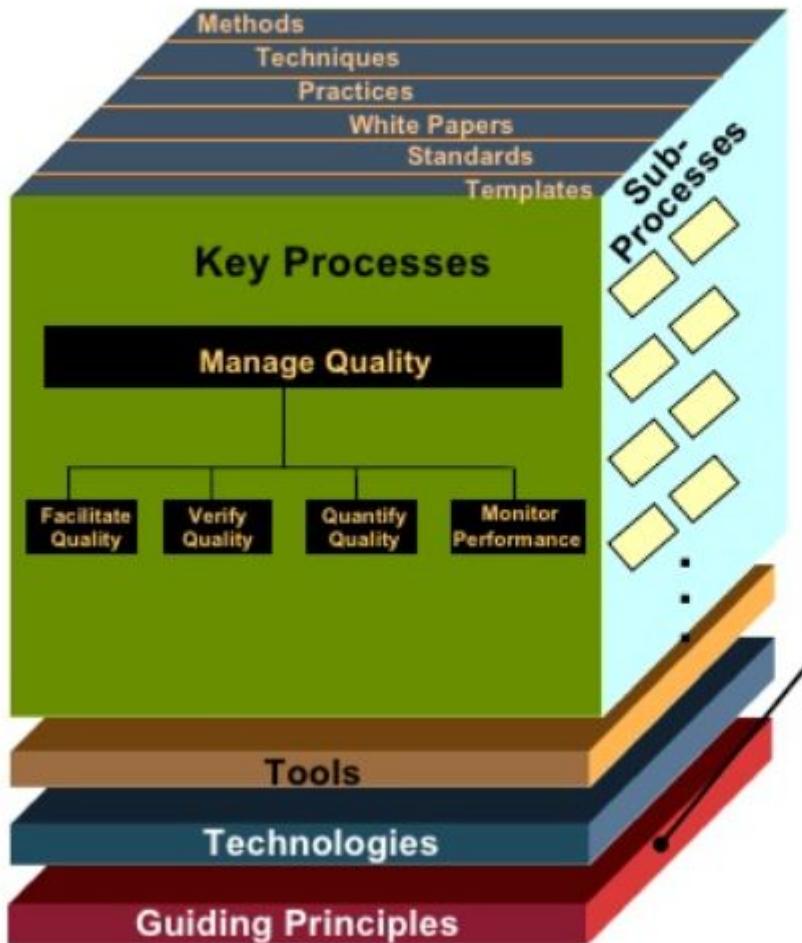
Architecture: Sub-Processes -- Software Quality Process Framework



Architecture: Technologies -- Software Quality Process Framework



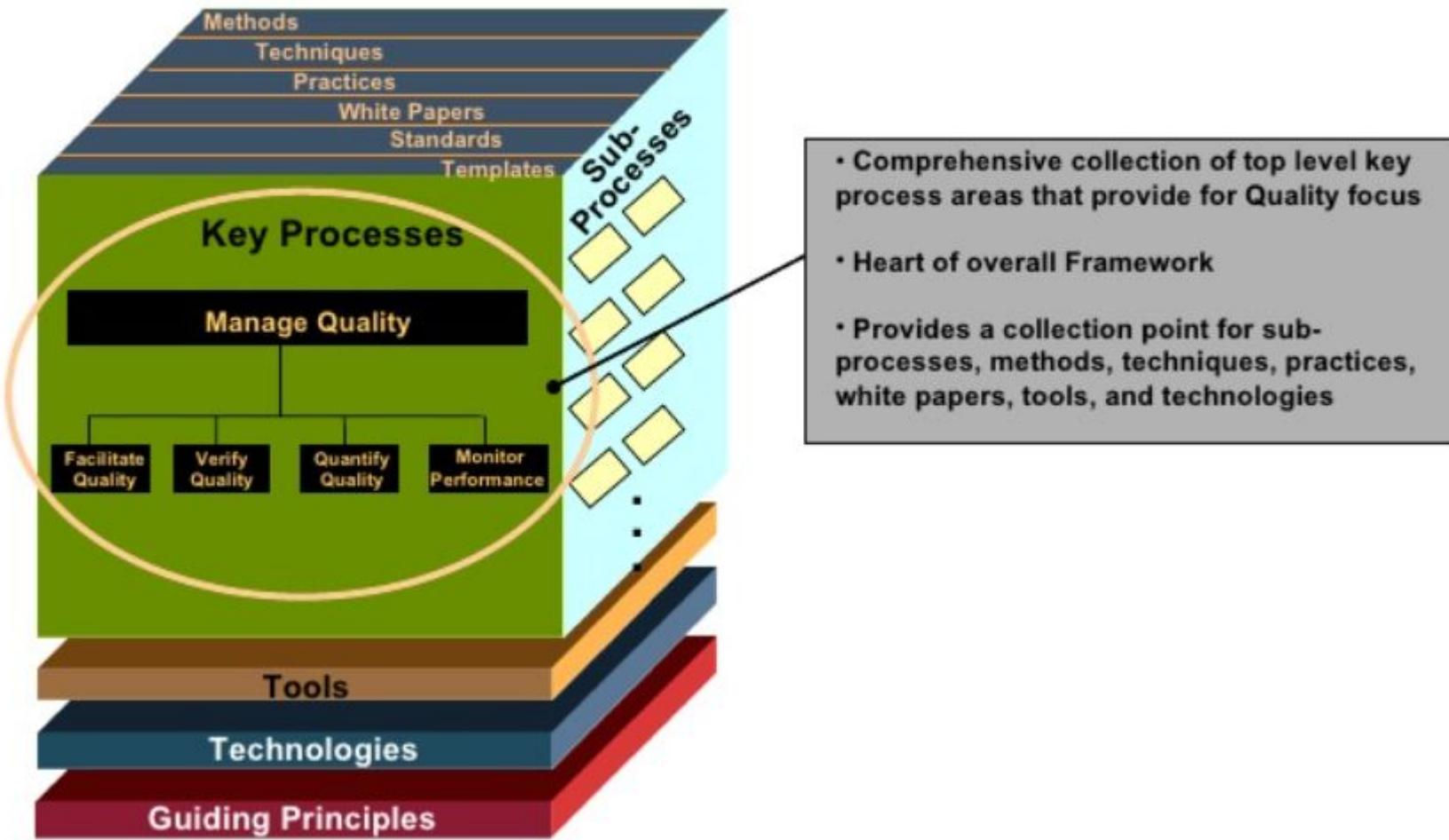
Architecture: Guiding Principles -- Software Quality Process Framework



Guiding Principles -- Examples

- Theme 1: The Quality Assurance function will be involved in every identified software development life cycle (SDLC) phase to provide appropriate consulting, advise, support, and quality oversight
- Theme 2: Requirements-based Quality Assurance testing activities are based on accurate, correct, and testable requirements
- Theme 3: Continuous process improvement will provide renewed and constant value to the company
- Theme 4: Automated testing with a high ROI will be exploited
- Theme 5: Software quality will be gauged by facts and data (metrics and measurements) rather than perception
- Theme 6: The long term goal is to move from defect detection to defect prevention

Architecture: Key Processes -- Software Quality Process Framework



=> Framework => Foundation

=> Activities

↳ Actions

↳ task's

=> Umbrella Activities:

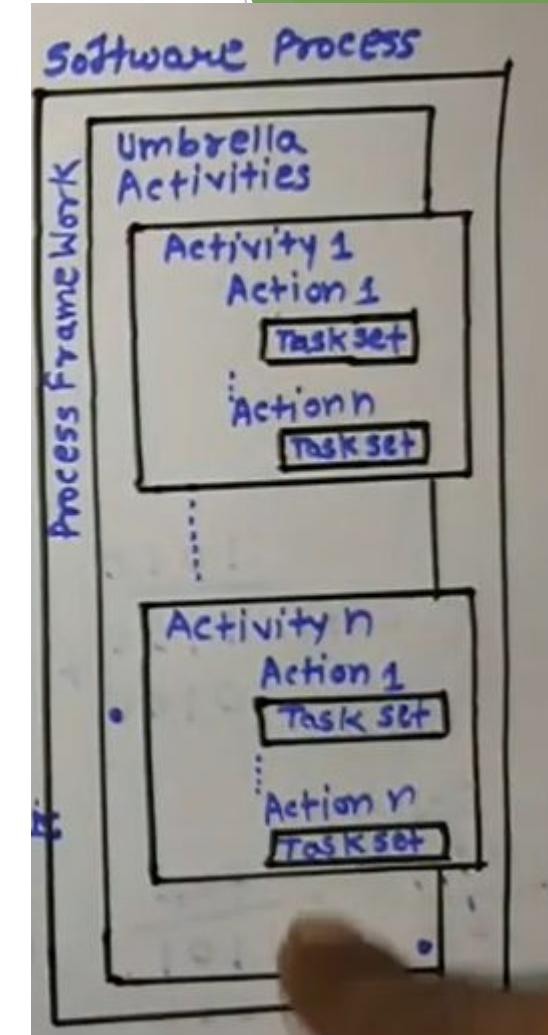
Generic framework Activities:

- ① communication: customer.
- ② Planning: risk information, work product.
- ③ Modeling: creation of diff. model. / design
- ④ Implementation: actual coding & testing
- ⑤ Deployment: work product. feedback.

* Umbrella activities:

- ① software project tracking and control
- ② risk management
- ③ quality assurance
- ④ reusability management
- ⑤ work product preparation

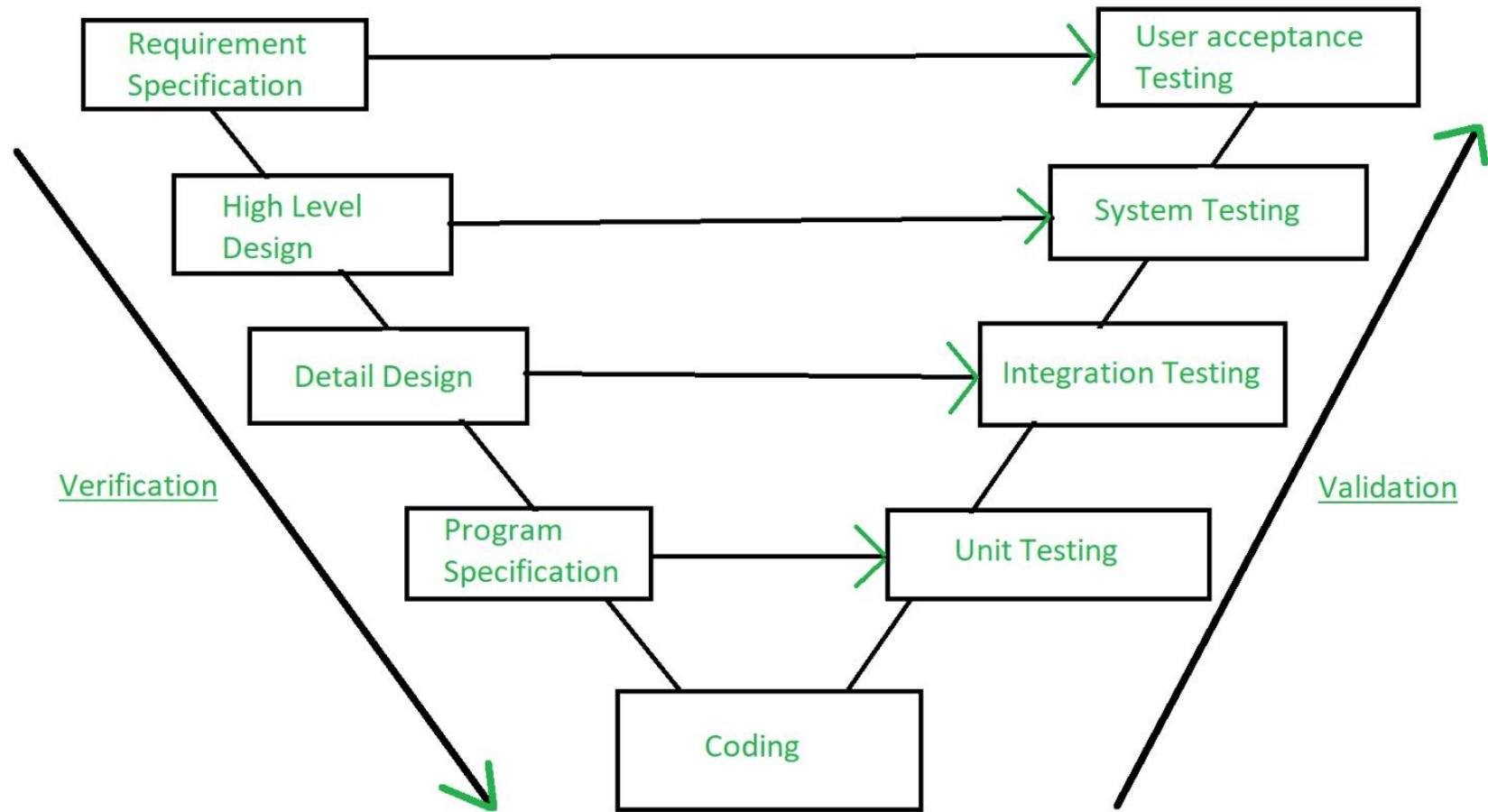
20-02-2025



49

Verification and Validation

- **Verification** checks whether the software confirms a specification whereas **Validation** checks whether the software meets the requirements and expectations.



Verification and Validation in Software Testing

- ▶ **Verification in Software Testing** is a process of checking documents, design, code, and program in order to check if the software has been built according to the requirements or not. The main goal of verification process is to ensure quality of software application, design, architecture etc. The verification process involves activities like reviews, walk-throughs and inspection.
- ▶ **Validation in Software Testing** is a dynamic mechanism of testing and validating if the software product actually meets the exact needs of the customer or not. The process helps to ensure that the software fulfills the desired use in an appropriate environment. The validation process involves activities like unit testing, integration testing, system testing and user acceptance testing.

Verification and Validation

specification

	<u>Verification</u>	v/s	<u>Validation</u>
<u>Objective</u>	→ Ensures that product is being built according to the requirements and design specifications	→ Ensures that the product actually meets the user's needs	
<u>Process</u>	→ Describes whether the outputs are according to inputs or not	→ Describes whether the software is accepted by the user or not	
<u>Question</u>	→ Are we building the product right?	→ Are we building the right product?	
<u>Target Items</u>	→ Plans, Requirement Specs, Design Specs, Code, Test Cases	→ Actual product/software	
<u>Testing Type</u>	→ Static testing	→ Dynamic testing	

Verification

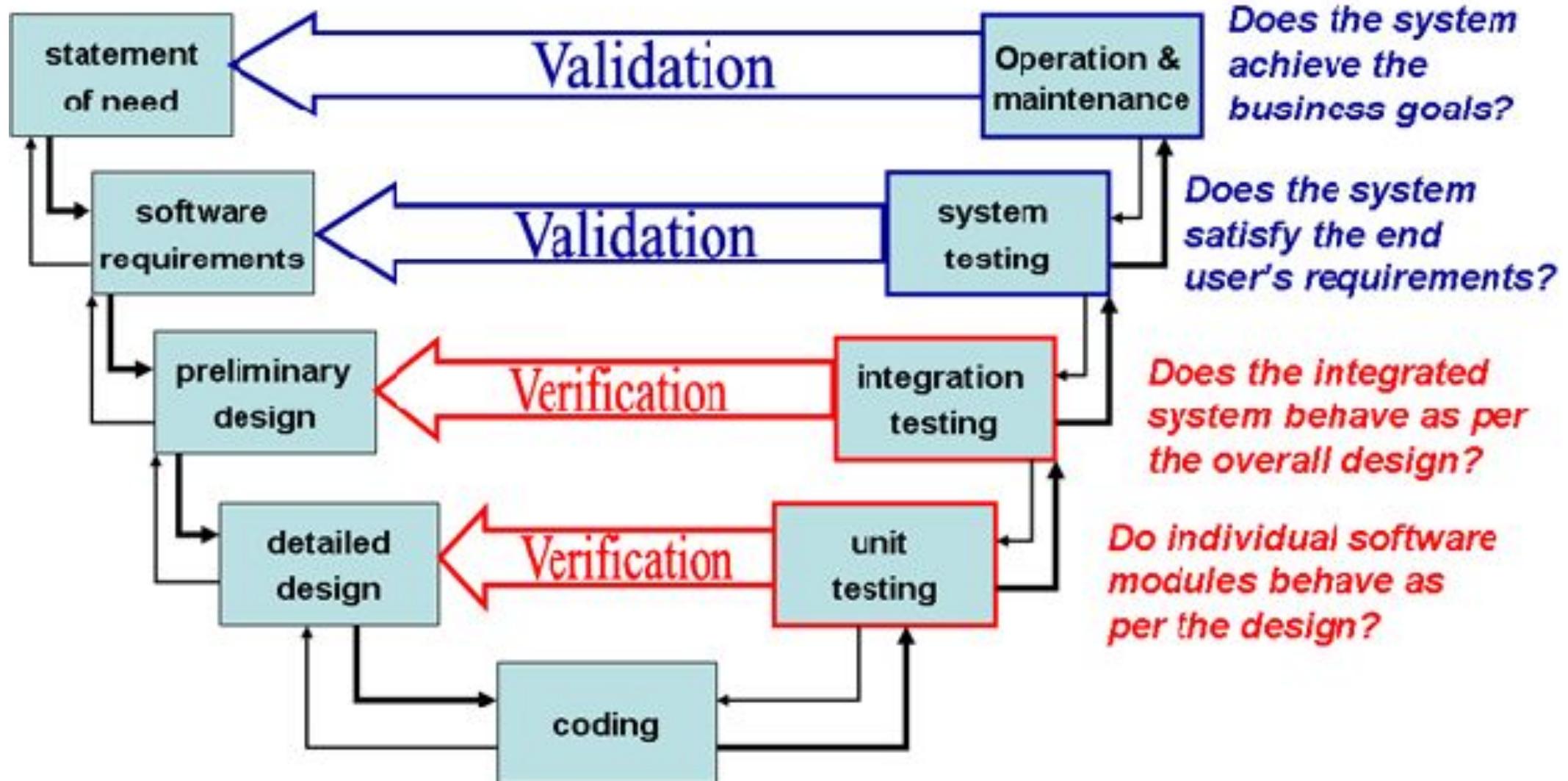
- The verifying process includes checking documents, design, code, and program
- It does ***not*** involve executing the code
- Verification uses methods like reviews, walkthroughs, inspections, and desk-checking etc.
- Whether the software conforms to specification is checked

Validation

- It is a dynamic mechanism of testing and validating the actual product
- It always involves executing the code
- It uses methods like Black Box Testing, **White Box Testing**, and non-functional testing
- It checks whether the software meets the requirements and expectations of a customer

- It finds bugs early in the development cycle
- Target is application and software architecture, specification, complete design, high level, and database design etc.
- QA team does verification and make sure that the software is as per the requirement in the SRS document.
- It comes before validation
- It can find bugs that the verification process can not catch
- Target is an actual product
- With the involvement of testing team validation is executed on software code.
- It comes after verification

Dynamic Testing



Verification

Validation

style
checkers

static analysis

proofs of
correctness

consistency
checking

unit test
integration
test
automated
testing

robustness
analysis

testing

regression
test

system test

beta test

code
inspection

customer
acceptance
test

usability
test

model
checking

model/specification
inspection

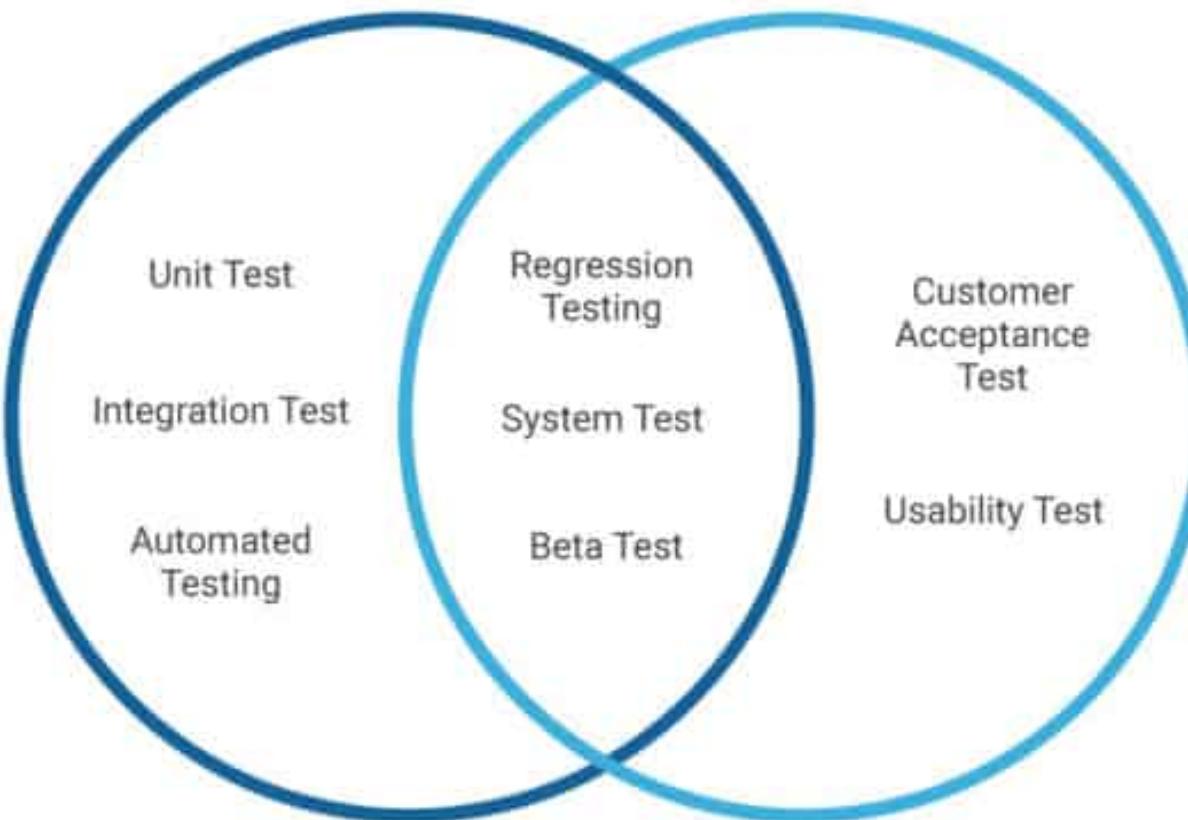
prototyping

modeling
e.g. UML,
formal methods

goal analysis

VERIFICATION

Am I building
the product right?



VALIDATION

Am I building the
right product?

SEI CMM

20-02-2025

59

Software Engineering Institute Capability Maturity Model (SEICMM)

- ▶ The Capability Maturity Model (CMM) is a procedure used to develop and refine an organization's software development process.
- ▶ The model defines a five-level evolutionary stage of increasingly organized and consistently more mature processes.
- ▶ CMM was developed and is promoted by the Software Engineering Institute (SEI), a research and development center promote by the U.S. Department of Defense (DOD)

SEI CMM model

- ▶ What is CMM ?
 - ▶ essential **practices and processes from various bodies of knowledge.**
 - ▶ Describes **common sense, efficient, proven ways of doing business**
 - ▶ CMM **measures the maturity of the software development process on a scale of 1 to 5.**

SEI CMM model

- CMM was **originally developed for Software Development and Maintenance** but later it was developed for :
 - ▶ Systems Engineering
 - ▶ Supplier Sourcing
 - ▶ Integrated Product and Process Development
 - ▶ People CMM
 - ▶ Software Acquisition
 - ▶ Others...

What is Maturity ?

- ▶ Well defined
- ▶ Repeatable
- ▶ Measured
- ▶ Analyzed
- ▶ Improved
- ▶ And most importantly ... Effective

Poor but mature processes are just as bad as no maturity at all!

Immature vs Mature Organization:

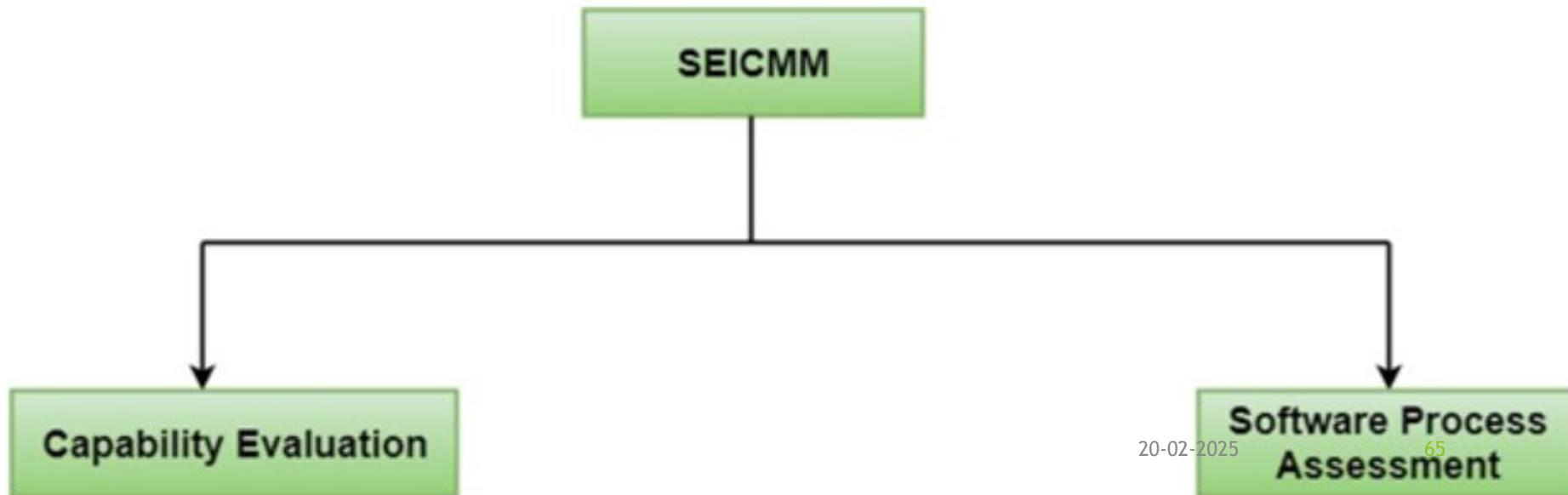
Immature organization:

- ▶ Process improvised during project
- ▶ Approved processes being ignored
- ▶ Reactive, not proactive
- ▶ Unrealistic budget and schedule
- ▶ Quality sacrificed for schedule
- ▶ No objective measure of quality

Mature organization:

- ▶ Inter-group communication and coordination
- ▶ Work accomplished according to plan
- ▶ Practices consistent with processes
- ▶ Processes updated as necessary
- ▶ Well defined roles/responsibilities
- ▶ Management formally commits

- Capability Maturity Model is used as a benchmark to measure the maturity of an organization's software process.
- Methods of SEICMM
- There are two methods of SEICMM:
- **Capability Evaluation:** Capability evaluation provides a way to assess the software process capability of an organization. The results of capability evaluation indicate the likely contractor performance if the contractor is awarded a work. Therefore, the results of the software process capability assessment can be used to select a contractor.
- **Software Process Assessment:** Software process assessment is used by an organization to improve its process capability. Thus, this type of evaluation is for purely internal use.



- SEI CMM categorized software development industries into the following five maturity levels. The various levels of SEI CMM have been designed so that it is easy for an organization to build its quality system starting from scratch slowly.



- ▶ **Level 1: Initial**
- ▶ Ad hoc activities characterize a software development organization at this level. Very few or no processes are described and followed. Since software production processes are not limited, different engineers follow their process and as a result, development efforts become chaotic. Therefore, it is also called a chaotic level.
- ▶ **Level 2: Repeatable**
- ▶ At this level, the fundamental project management practices like tracking cost and schedule are established. Size and cost estimation methods, like function point analysis, COCOMO, etc. are used.
- ▶ **Level 3: Defined**
- ▶ At this level, the methods for both management and development activities are defined and documented. There is a common organization-wide understanding of operations, roles, and responsibilities. The ways through defined, the process and product qualities are not measured. ISO 9000 goals at achieving this level.

- ▶ **Level 4: Managed**
- ▶ At this level, the focus is on software metrics. Two kinds of metrics are composed.
- ▶ **Product metrics** measure the features of the product being developed, such as its size, reliability, time complexity, understandability, etc.
- ▶ **Process metrics** follow the effectiveness of the process being used, such as average defect correction time, productivity, the average number of defects found per hour inspection, the average number of failures detected during testing per LOC, etc. The software process and product quality are measured, and quantitative quality requirements for the product are met. Various tools like Pareto charts, fishbone diagrams, etc. are used to measure the product and process quality. The process metrics are used to analyze if a project performed satisfactorily. Thus, the outcome of process measurements is used to calculate project performance rather than improve the process.
- ▶ **Level 5: Optimizing**
- ▶ At this phase, process and product metrics are collected. Process and product measurement data are evaluated for continuous process improvement.

Key Process Areas (KPA) of a software organization

Except for SEI CMM level 1, each maturity level is featured by several Key Process Areas (KPAs) that contains the areas an organization should focus on improving its software process to the next level. The focus of each level and the corresponding key process areas are shown in the fig.

CMM Level	Focus	Key Process Areas
1. Initial	Competent People	NO KPA'S
2. Repeatable	Project Management	Software Project Planning Software Configuration Management
3. Defined	Definition of Processes	Process definition Training Program Peer reviews
4. Managed	Product and Process quality	Quantitative Process Metrics Software Quality Management
5. Optimizing	Continuous Process improvement	Defect Prevention Process change management Technology change management

- ▶ SEI CMM provides a series of key areas on which to focus to take an organization from one level of maturity to the next. Thus, it provides a method for gradual quality improvement over various stages. Each step has been carefully designed such that one step enhances the capability already built up.

What are the CMM Levels?

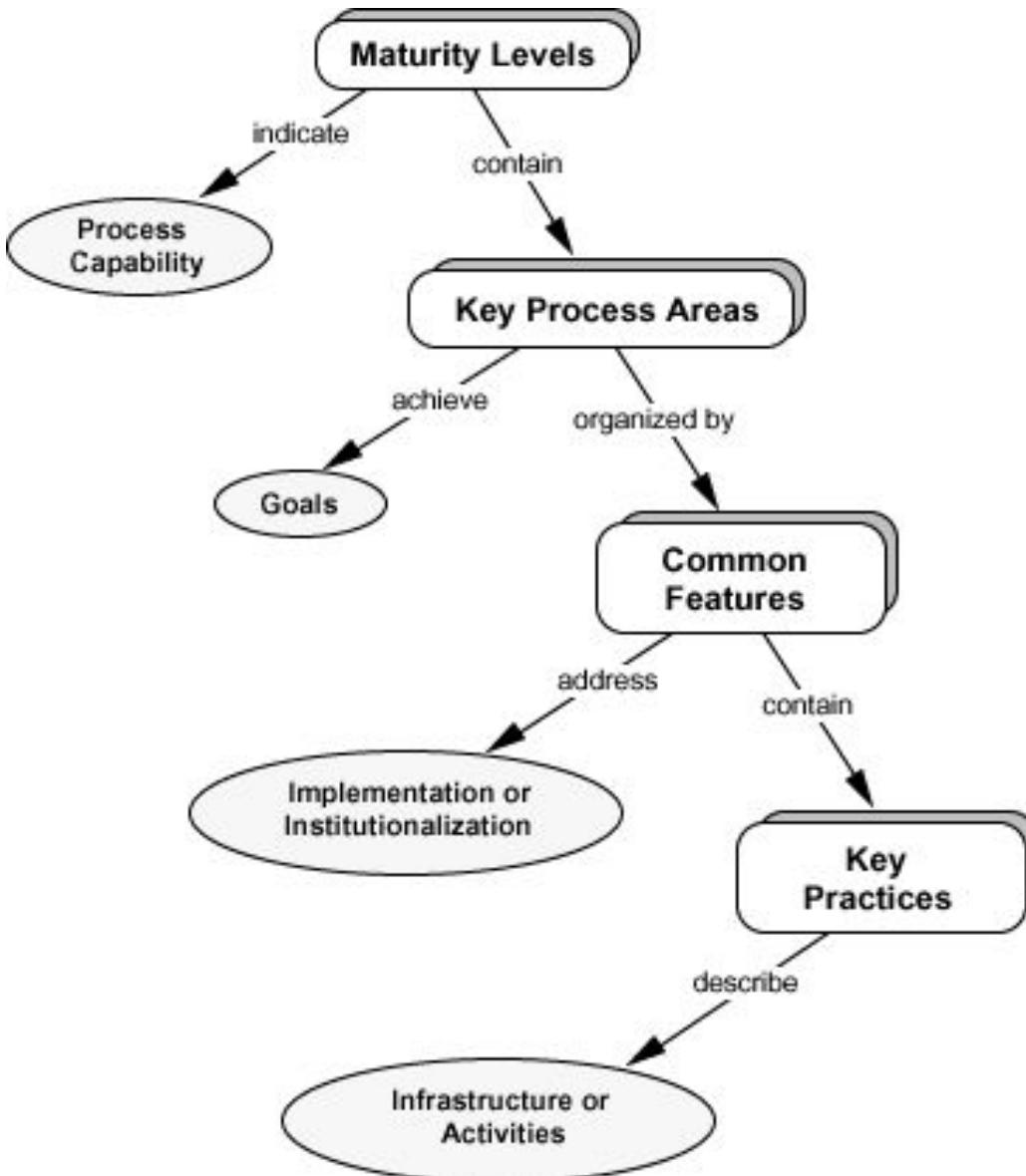
(The five levels of software process maturity)

Maturity level indicates level of process capability:

- Initial
- Repeatable
- Defined
- Managed
- Optimizing

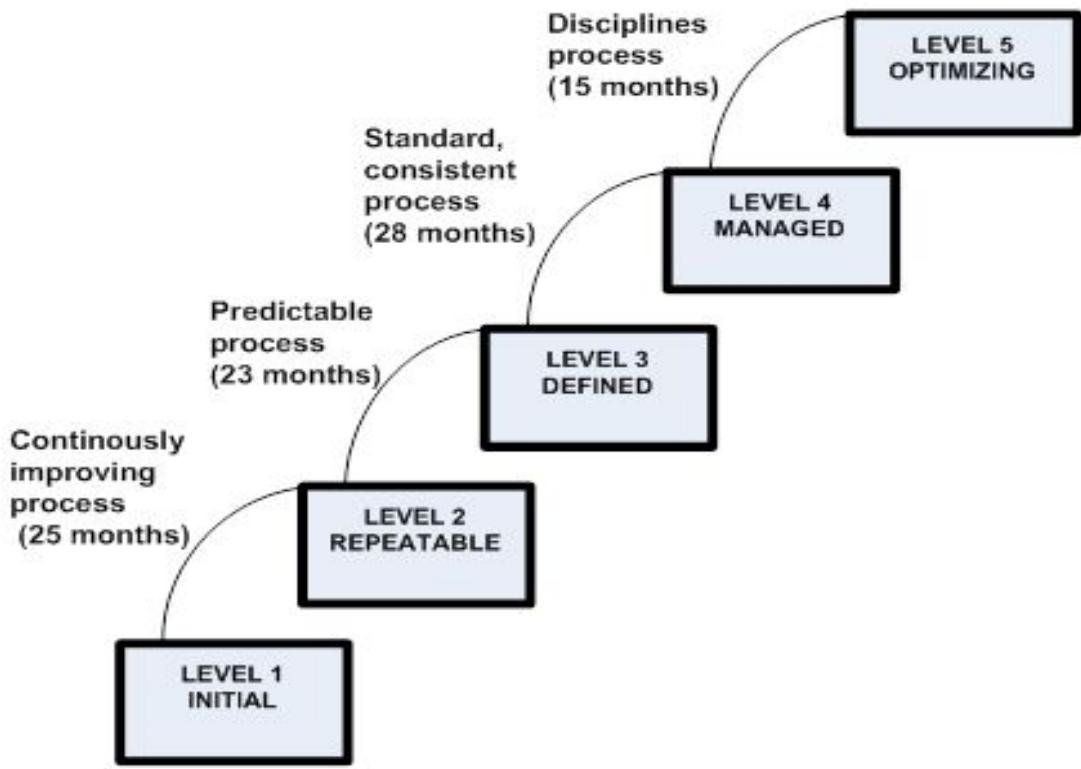
CMMI Model Characteristics

- ▶ Process Categories with **related Process Areas**
- ▶ **Generic Goals (GG)** and generic practices describe the PA's purposes
- ▶ **Specific Goals (SG)** and specific practices to fulfill these GGs
- ▶ Capability and maturity levels associated to generic and specific practices



LEVELS OF CMM

- **Level 1 – Initial**
 - 25 months to get to level 2
- **Level 2 – Repeatable**
 - 23 months to get to level 3
- **Level 3 – Defined**
 - 28 months to get to level 4
- **Level 4 – Managed**
 - 15 months to get to level 5
- **Level 5 - Optimizing**



Key Process Areas of the CMM-SW

Level	Focus	Key Process Area	Result
Level 5 Optimizing	Continuous Improvement	<ul style="list-style-type: none">• Defect Prevention• Process Change Mgmt• Tech Change Mgmt	Productivity & Quality
Level 4 Managed	Product and Process Quality	<ul style="list-style-type: none">• Quantitative Process Mgmt• Software Quality Mgmt	
Level 3 Defined	Organization Wide Engineering Process	<ul style="list-style-type: none">• Org Process Focus• Org Process Definition• Training Program• Integrated Software Mgmt• Software Product Engineering• Inter-group Coordination• Peer Reviews	
Level 2 Repeatable	Basic Project Management	<ul style="list-style-type: none">• Requirements Mgmt• Software Project Planning• Project Tracking & Oversight• Subcontract Mgmt• Software Quality Assurance• Configuration Mgmt	
Level 1 Initial	Heroes	<ul style="list-style-type: none">• None	R I S K

ISO 9001

ISO 9001 : Quality Management System

ISO 9001 is the most established quality framework used worldwide, and sets the standard not only for quality management systems, but management systems in general.

It helps all kinds of organizations to succeed through improved customer satisfaction, staff motivation and continual improvement. ISO 9001 is one of a series of quality management system standards. It can help bring out the best in your organization by enabling you to understand your processes for delivering your products/services to your customers.

- ISO 9001 is based on **eight quality management principles** (all fundamental to good business practice). When fully adopted, these principles can help improve your organizational performance.

Customer focus

Leadership

Involvement of People

Process approach to management

System approach

Continual improvement

Fact based decision-making

Mutually beneficial supplier relationships

Benefits of ISO 9001 Certification Quality Management System :

- Facilitates the organization to become a customer-focused organization.
- Ensures sustained customer satisfaction by producing, delivering services and providing support functions that meet customer's needs and expectations
- Increases the effectiveness and efficiency of the organization through continual improvement in systems and products' / services quality



Overview of ISO 9001

- ▶ ISO standard mainly addresses operational & organizational aspects like responsibilities, reporting etc.
- ▶ It is a set of guidelines for production process & is not directly concerned with the product itself.
- ▶ It says that, **if proper process is followed for production then good quality products are bound to follow automatically.**

ISO 9001

- They are implemented by more than a million organizations in some 175 countries.
- ISO 9001 helps organizations to implement quality management.
- ISO 9001 is for quality management
- ISO 9001 concern the way an organization goes about its work.
- They are process standards.

Insuring Compliance



1. The standard **requires the organization itself to audit its quality system**
2. In addition, the organization **may invite its clients to audit the quality system**
3. Lastly, the organization may engage the services of an **independent quality system certification body to obtain an ISO 9001:2015 Certificate of Conformity.**

- ▶ ISO 9001 are **generic standards**
- Generic means that the same standards can be applied:
 - ▶ **to any organization**, large or small, whatever its product or service
 - ▶ **in any sector of activity**, whether it is a business enterprise, a public administration, or a government department.

9001 Required Documents

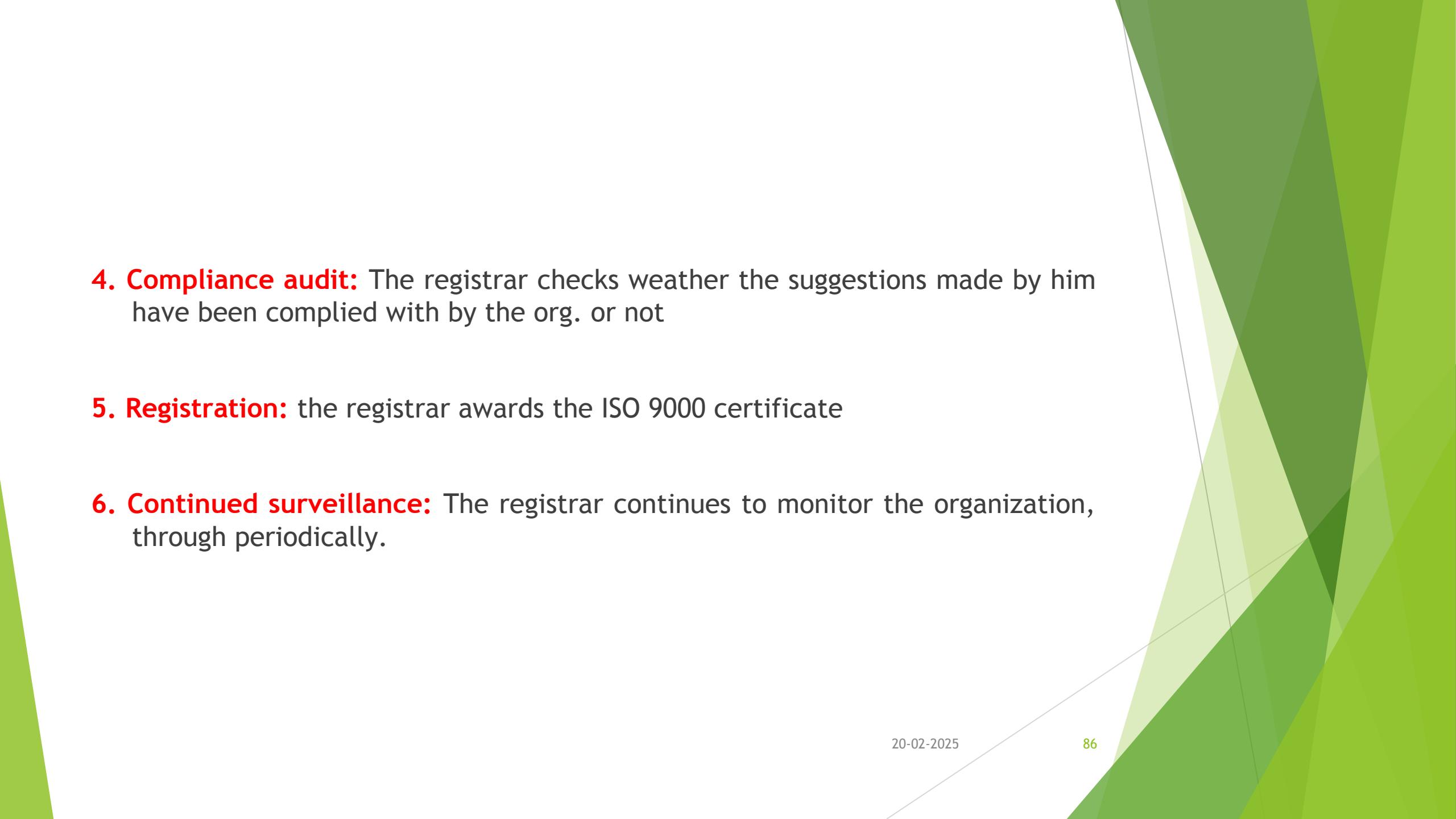
1. Quality Policy
2. Control of Documents
3. Control of Records
4. Internal Audits
5. Control of Nonconforming Product / Service
6. Corrective Action
7. Preventive Action

These may go in a single "Quality Manual".

How to get ISO 9000 Certification?

1. **Application:** application to the registrar
2. **Pre-assessment :** the registrar makes the rough assessment of the organization
3. **Document review and adequacy of audit:**

The registrar reviews the documents submitted and makes suggestion for possible improvement.

- 
- 4. Compliance audit:** The registrar checks whether the suggestions made by him have been complied with by the org. or not
 - 5. Registration:** the registrar awards the ISO 9000 certificate
 - 6. Continued surveillance:** The registrar continues to monitor the organization, through periodically.

ISO 9001 requirements

- ▶ Management responsibility
- ▶ Quality system
- ▶ Contract reviews
- ▶ Design control
- ▶ Document control
- ▶ Purchasing
- ▶ Purchaser supplied product
- ▶ product identification
- ▶ Process control

- ▶ Inspection and testing
- ▶ Inspection, measuring and test equipment
- ▶ Inspection and test status
- ▶ Control of nonconforming products
- ▶ Corrective action
- ▶ Handling
- ▶ Quality records
- ▶ Quality audits
- ▶ training

Benefits of implementing ISO 9001

- ▶ It will **motivate staff** by defining their key roles and responsibilities
- ▶ **Cost savings** can be made
- ▶ Orders will be met consistently **on time and to correct specification**
- ▶ **Wastage will be less**

SIX SIGMA

20-02-2025

90

- ▶ **Six Sigma** is a method that provides organizations tools to improve the capability of their business processes. This increase in performance and decrease in process variation helps lead to defect reduction and improvement in profits, employee morale, and quality of products or services.
- ▶ <https://www.youtube.com/watch?v=4EDYfSl-fmc>

Course 1

Lean Management

Course 2

Lean Six Sigma Green Belt

Course 3

Minitab®

Course 4

Lean Six Sigma Black Belt



Master's Certificate

*You will get individual certificates for each course.

What is SixSigma?

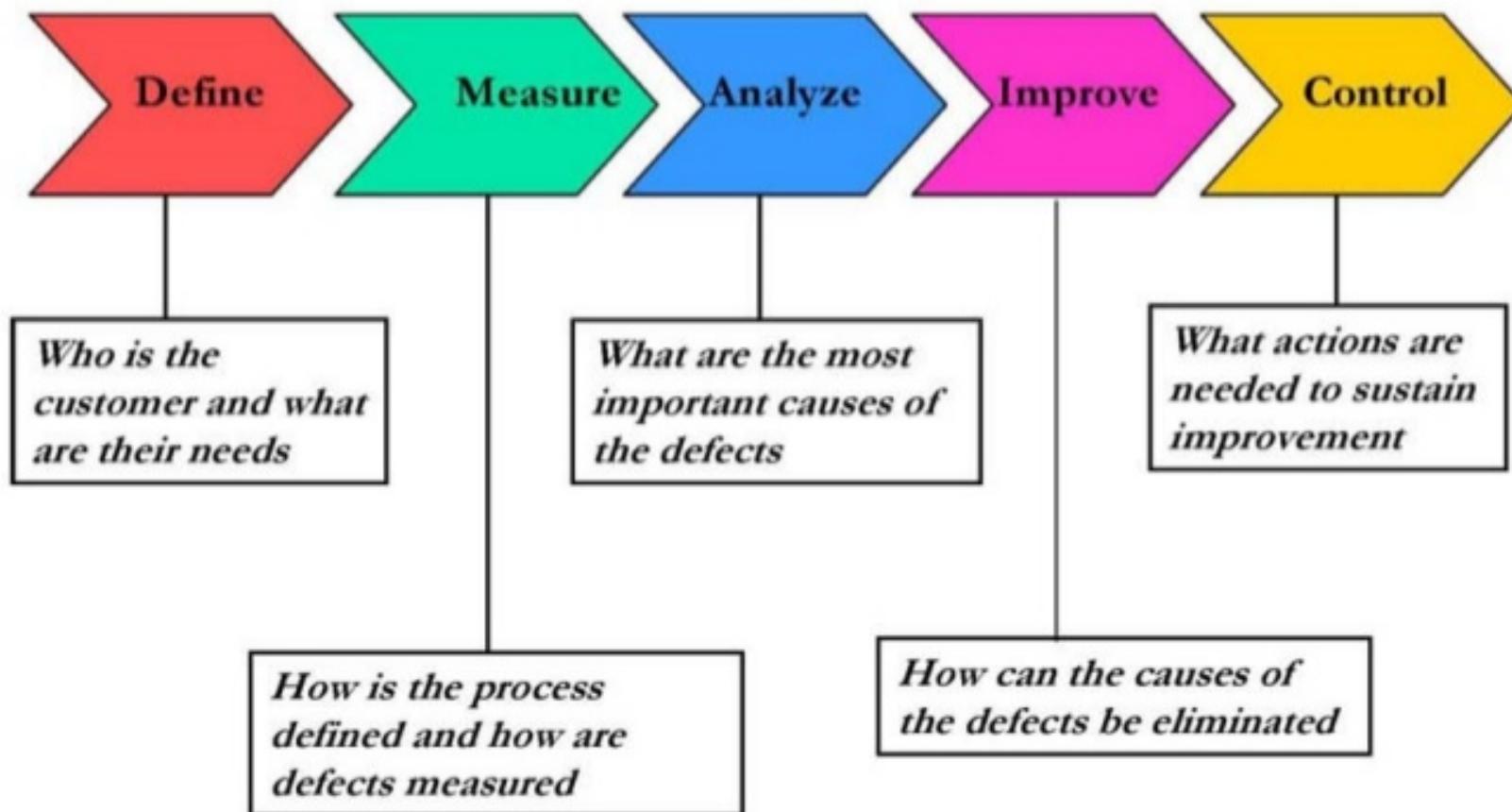
- Six Sigma is a Quality Management System.
- Six Sigma is a set of techniques and tools for process improvement.
- It is a measure of quality that strives for near perfection.
- It is a disciplined, data-driven methodology focused on eliminating defects.
- It was developed by Bill Smith at Motorola in 1986.
- Jack Welch made it central to his business strategy at General Electric in 1995.
- Today, it is used in many industrial sectors for minimizing errors, reduction of costs and increase in profit.

Six Sigma Quality

- Latest popular approach to Quality
- ± 6 standard deviations (6σ) from the process mean = **0.0003% defects**
- Represents a goal
- Certification from ASQ on processes to support Six Sigma
- Many consulting and training firms on how to implement Six Sigma



Phases of Six Sigma



Six Sigma

Statistical Definition

The Statistical Definition of Six Sigma is +/- 6 Standard Deviations of a Normal Distribution. This is equivalent to < 3.4 Defects per Million Opportunities.

Sigma	Defects per Million	Quality Cost % Sales	Benchmark
1	700,000	HIGH	Noncompetitive
2	310,000	15%-25%	Noncompetitive
3	67,000	10%-15%	Noncompetitive
4	6,200	5%-10%	Industry Average
5	230	2%-5%	Best in Class
6	3.4	< 2%	World Class

Six Sigma Methodologies

DMAIC

An improvement system for existing processes falling below specification and looking for incremental improvement

Define
Measure
Analyse
Improve
Control

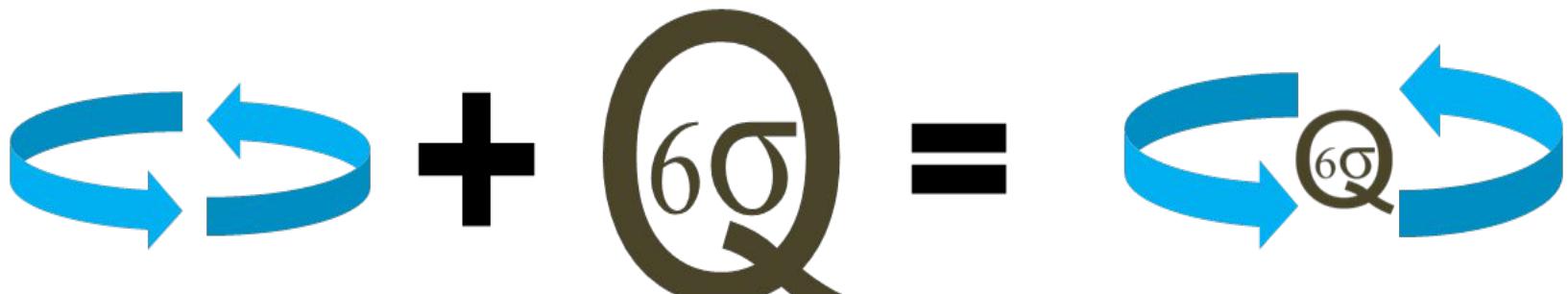
DMADV

An improvement system used to develop new processes or products at Six Sigma quality levels

Define
Measure
Analyse
Design
Verify

Both DMAIC & DMADV are inspired by Deming's Plan-Do-Check-Act Cycle

What is **LEAN SIX SIGMA**?



LEAN
Reduce waste by
reorganizing a process

SIX SIGMA
Reduces defects by
solving problems

LEAN SIX SIGMA
LEAN improves SIX SIGMA:
Reducing waste and solving problems
to be faster and more efficient

Lean Six Sigma: 8 Wastes



Defects

Efforts caused by rework, scrap, and incorrect information.



Overproduction

Production that is more than needed or before it is needed.



Waiting

Wasted time waiting for the next step in a process.



Non-Utilized Talent

Underutilizing people's talents, skills, & knowledge.



Transportation

Unnecessary movements of products & materials.



Inventory

Excess products and materials not being processed.



Motion

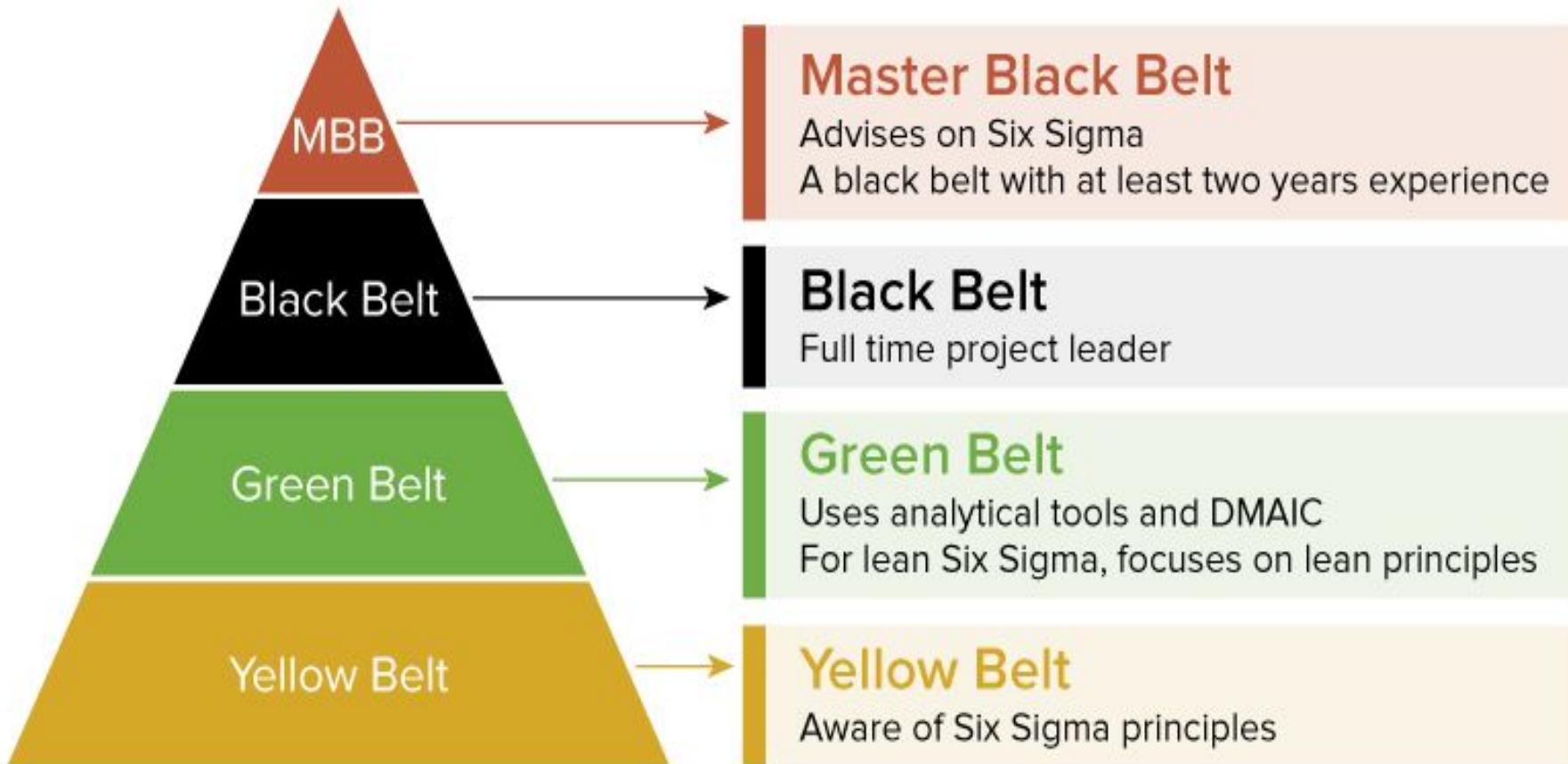
Unnecessary movements by people (e.g., walking).



Extra-Processing

More work or higher quality than is required by the customer.

Six Sigma Certification Structure



The following companies claim to have successfully implemented Six Sigma in some form or another:

- [Amazon.com](#)^[2]
- [Atos](#)^[3]
- [Autoliv](#)^[4]
- [BAE Systems](#)^[5]
- [Bank of America](#)^{[6][7]}
- [BD Medical](#)^[8]
- [Bechtel Corporation](#)^[9]
- [Boeing](#)^[10]
- [Caterpillar Inc.](#)^[11]
- [Computer Sciences Corporation](#)^[12]
- [Convergys](#)^[13]
- [Cooper Tire & Rubber Company](#)^[14]
- [Credit Suisse](#)^[15]
- [Damco](#)^[16]
- [Deere & Company](#)^[17]
- [Dell](#)^[18]
- [Denso](#)^[19]
- [Eastman Kodak Company](#)^[20]
- [Evonik Industries](#)^[21]
- [Ford Motor Company](#)^[22]
- [General Electric](#)^[18]
- [Inventec](#)^[19]
- [Maersk](#)
- [McKesson Corporation](#)^[23]
- [Motorola](#)^[18]
- [Mumbai's dabbawalas](#)^[24]
- [Northrop Grumman](#)^[18]
- [PolyOne Corporation](#)^[25]
- [Raytheon](#)^{[18][26]}
- [Sears](#)^[27]
- [Shop Direct Group](#)^[28]
- [Starwood Hotels & Resorts Worldwide](#)^[29]
- [Unipart](#)^[30]
- [United States Army](#)^[31]
- [United States Marine Corps](#)^[32]
- [The Vanguard Group](#)^[33]
- [Wipro](#)^[34]

Who is Using Lean Six Sigma?

Manufacturing:



Financial Services:



Services:



Companies across
all regions and
industries



MUMBAI DABBAWALAS REDEFINE SIX SIGMA THEORY



- ▶ <https://www.youtube.com/watch?v=N25inoCea24>

20-02-2025

104



The Wonder of Mumbai Dabbawallas Inspiration of Management

20-02-2025

105

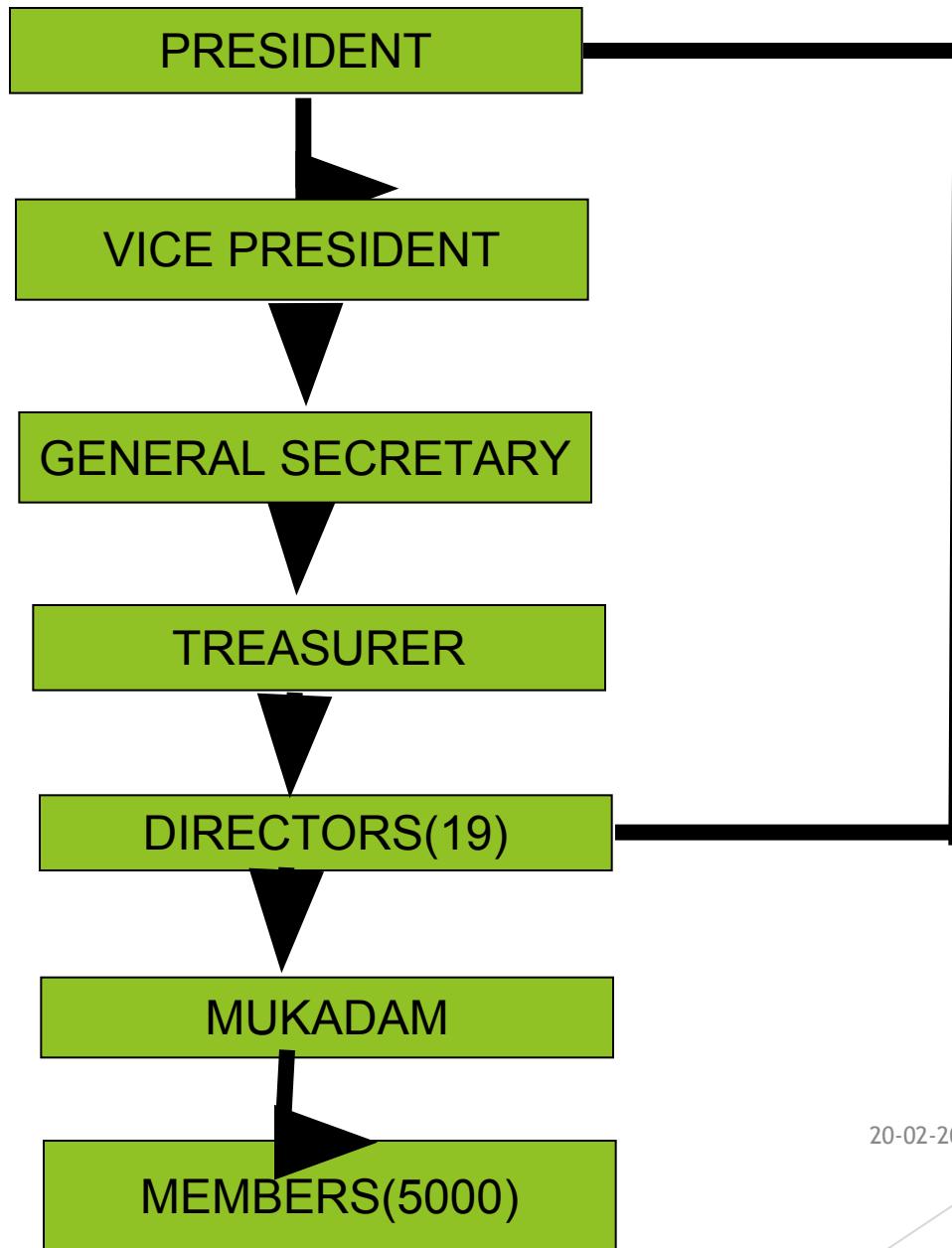


What is NMTBSA?

(Nutan Mumbai Tiffin Box Suppliers Association)

- History : Started in 1880
- Charitable trust : Registered in 1956
- Avg. Literacy Rate : 8th Grade Schooling
- Total area coverage : 60 Kms
- Employee Strength : 5000
- Number of Tiffin's : 2,00,000 Tiffin Boxes
i.e. 4,00,000 transactions
every day.
- Time taken : 3 hrs

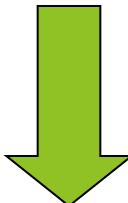
ORGANISATIONAL STRUCTURE



Executive Committee
(5 members)



Teams of 20-25 headed by
a group leader



Individual Dabbawalla
workload = 30 tiffins

WORKING OF NMTBSA

Error Rate : 1 in 16 million transactions

- Six Sigma performance (99.99999)
- Technological Backup : Nil.
- Cost of service -Rs. 300/month (\$ 6.00/month)
- Standard price for all (Weight, Distance, Space)
- Rs. 36 Cr. Turnover approx.
[$6000*12*5000=360000000$ i.e Rs. 36 crore p.a.]
- “No strike” record as each one a share holder
- Earnings -5000 to 6000 p.m.
- Diwali bonus: one month’s from customers.





- Zero % fuel Zero % investment
- Zero % modern technology Zero % Disputes
- 99.9999% performance 100 % Customer Satisfaction

- Coding

**VLP : Vile Parle
(Suburb in Mumbai)**

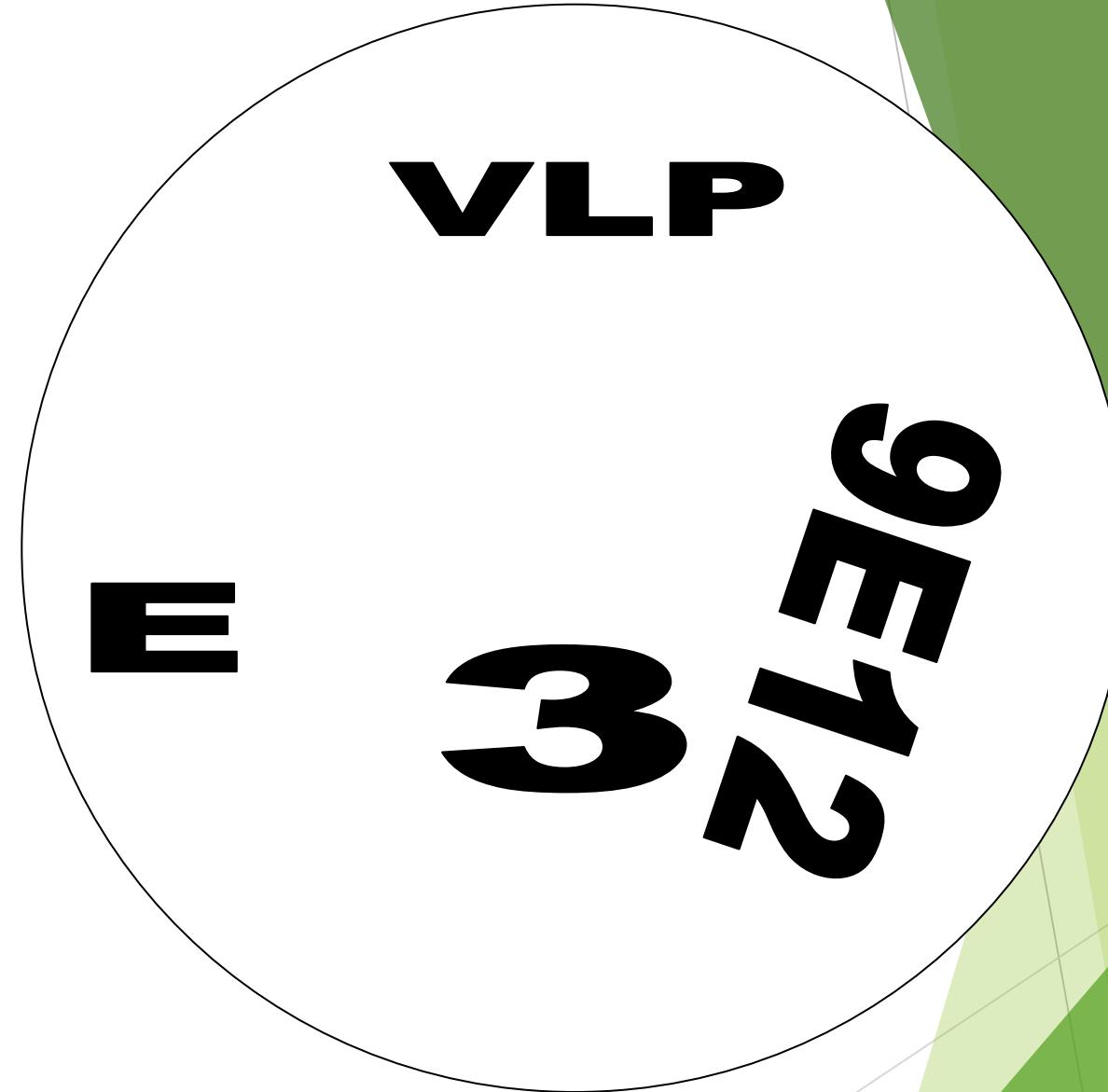
**9E12 : Code
for Dabbawallas at
Destination**

**E : Express Towers
(Bldg. Name)**

12 : Floor No.

**E : Code for
Dabbawallas at
Residential station.**

**3 : Code for Destination station
(E.g.. Nariman Point)**



JOURNEY OF DABBAWALA

9:30 A.M- 10:30 A.M 10:34- 11:20 A.M 11:20- 12:30 P:M

Pick up Dabba from Residence/Caterer and bring it to Andheri Station.

Journey in Local Train

Unloading and Sorting at Destination Station.

2:48- 3:30P:M

1:15- 2:30 P.M

12:30 - 1:00 P.M

Sorting at Destinations station.

Collection of Empty Dabba.

Delivery to respective customers.

Returning Dabba to Residence/Caterer.

3:30- 4:40 P.M

20-02-2025



SIX SIGMA CERTIFICATION

- In 1998, Forbes Global magazine conducted a quality assurance study on the Dabbawalas' operations
- Gave Rating of 99.99999
- Dabbawalas made one error in six million transactions.
- Stood High along with MNC's like Motorola, GE etc...
- Dabbawalas got ISO 9001- 2000 for Excellence in service

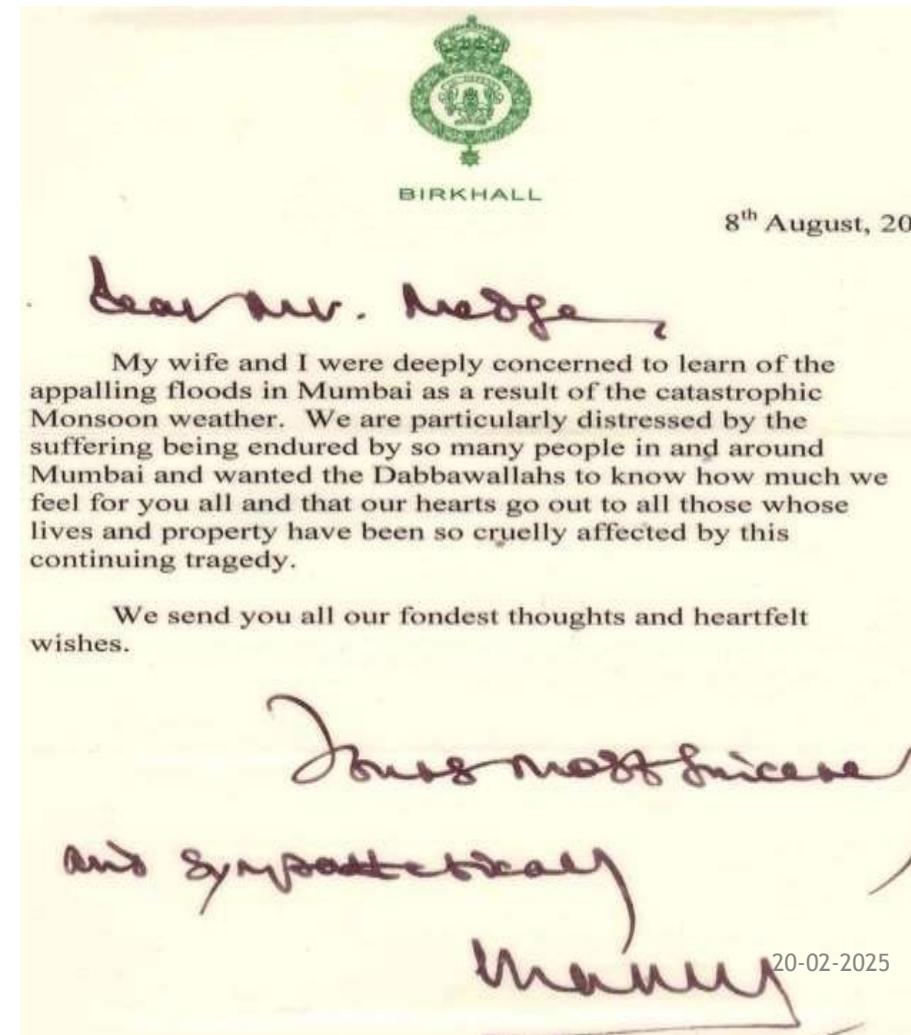


ACHIEVEMENTS

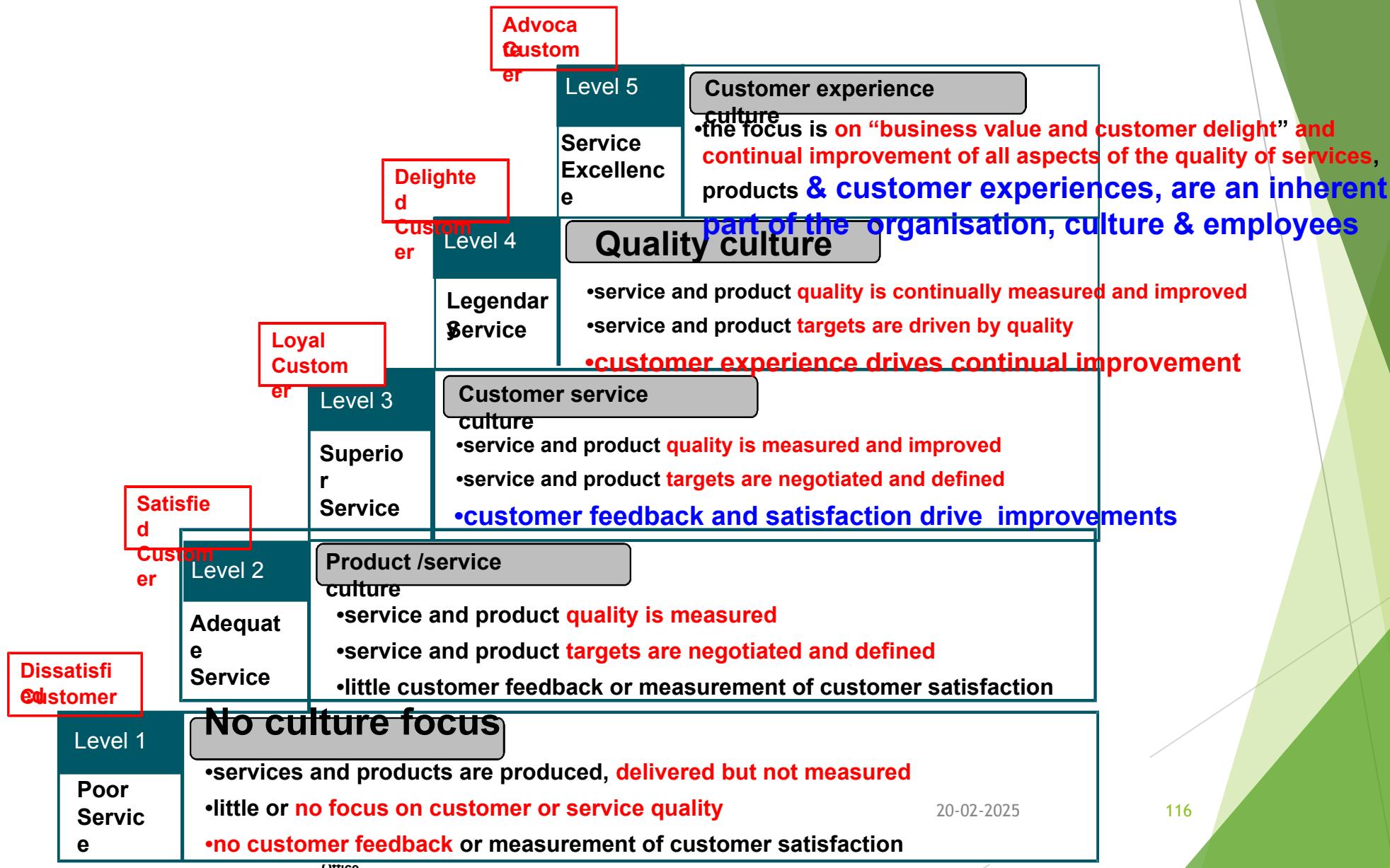
- World record in Best Time management.
- Name in “GUINNESS BOOK of World Records”.
- Registered with *Ripley's “believe it or not”*.
- Invited for marriage of Hon. Prince Charles of England on 9th April, 2005
- Documentary called “Dabbawalas, Mumbai's unique lunch service”
- by two Dutch filmmakers in 1998.



LETTER FROM PRINCE CHARLES



Customer service





thank you!