Software Quality Assurance

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Software Quality Assurance

- Aim
  - Help an organization develop high **quality** software products in a **repeatable** manner

Repeatable vs. Non-repeatable Software Development

- Repeatable Software Development
  - Person-independent
- Non-Repeatable Software Development
  - Success depends on initiative, effort, brilliance, or enthusiasm of team members
  - Successful development of one product does not imply the successful development of the next product

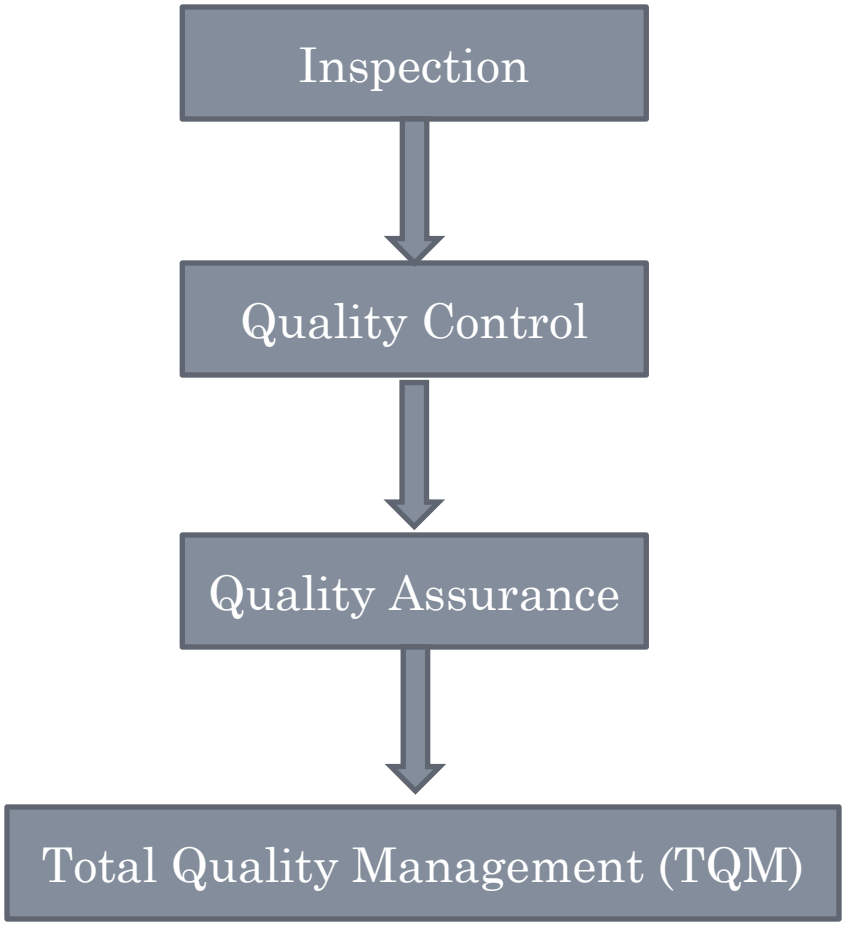
Software Quality

- Quality Factors
  - Portability
    - Product works in different operating system environments
  - Usability
    - Both expert and novice users can invoke product functions
  - Reusability
    - Modules of the product can be reused to make new products
  - Correctness
    - Correct implementation of requirements specified in SRS
  - Maintainability
    - Errors can be easily corrected
    - New functions can be easily added
    - Existing functionalities can be easily modified

Software Quality Management System

- Managerial structure and individual responsibilities
  - Quality system is the responsibility of the whole organization
  - Quality system should have the support of the top management
- Quality system activities
  - Auditing of the projects
  - Review of the quality system
  - Development of standards, procedures, and guidelines
  - Production of reports for the top managements

Evolution of Quality Systems



Evolution of Quality Systems

- Inspection
  - Existed prior to World War II
  - Finished products were inspected and defective products were eliminated
- Quality Control
  - Detects and eliminates defective products
  - Determines cause behind the defects
- Quality Assurance
  - Includes guidelines for recognizing, defining, analyzing, and improving the production process
- Total Quality Management (TQM)
  - Aims at continuous process improvement

ISO 9000

- ISO
  - International Standards Organization
  - Consortium of 63 countries
  - Established to formulate and foster standardization
  - Published its 9000 series of standards in 1987

What is ISO 9000 Certification?

- ISO 9000 standards specifies the guidelines for maintaining a quality system
- ISO 9000 is a series of three standards
  - ISO 9001
    - Applies to the organizations engaged in design, development, production, and servicing of goods
  - ISO 9002
    - Applies to the organizations which do not design products but are only involved in production
    - Examples: Steel and car manufacturing industries
  - ISO 9003
    - Applies to the organizations involved only in installation and testing of the products

ISO 9000 for Software Industry

- Many clauses in ISO 9000 documents use generic terminologies and it is difficult to interpret them in the context of software industry.
- Two primary reasons
  - Software is intangible and difficult to control. It is difficult to determine how much work has been completed and to estimate how much more time will it take.
  - Only raw material consumed is data. Clauses corresponding to raw material control are irrelevant to software industry.
- In 1991, ISO releases ISO 9000-3 document for software industry.

Why get ISO 9000 Certification?

- Increases confidence of customers
- Well-documented software production process which contributes to repeatable and higher quality of the developed software
- Makes the development process focused, efficient, and cost-effective
- Points out the weak points of an organization and recommends remedial action
- Set the basic framework for the development of an optimal process and TQM

How to Get ISO 9000 Certification?

- Application
  - Organization applies to a registrar for registration.
- Pre-assessment
  - The registrar makes a rough assessment of the organization.
- Document review and adequacy of audit
  - The registrar reviews the submitted documents and suggests improvements.
- Compliance audit
  - The registrar checks whether the suggestions have been complied with by the organization or not.
- Registration
  - The registrar awards the ISO 9000 certificate after successful completion of all previous phases.
- Continued surveillance
  - The registrar continues to monitor the organization, though periodically.

Summary of ISO 9001 Requirements

- Management Responsibility
  - Must have an effective quality policy that is well-documented and reviewed periodically
- Quality System
  - Must be maintained and documented
- Contract Reviews
  - Contract should be reviewed beforehand to ensure understandability and organizational capability
- Design Control
  - Inputs must be verified as adequate and outputs must be of required quality
- Document Control
  - Must have proper procedures for document approval, issue, and removal
- Purchasing
  - Purchased materials must be checked for conforming to requirements

Summary of ISO 9001 Requirements

- Purchaser Supplied Product
  - Must be properly managed and checked
- Product Identification
  - Configuration Management
- Process Control
  - Quality requirements must be identified in a quality plan
- Inspection and Testing
  - Unit testing, integration testing, and system testing
- Inspection, Measuring, and Test Equipment
  - Must be properly maintained and calibrated
- Inspection and Test Status
  - Configuration management and release control

Summary of ISO 9001 Requirements

- Control of Nonconforming Product
  - Isolate untested or faulty software
- Corrective Action
  - Involves correcting errors, investigating the causes of errors and improving the process to prevent errors
- Handling
  - Storage, packing, and delivery of software product
- Quality Records
  - Recording the steps taken for quality control
- Quality Audits
  - Ensures effectiveness of the quality system
- Training
  - Training needs must be identified and met

Salient Features of ISO 9001 Requirements

- Documents should be properly managed, authorized, and controlled.
- Proper plans should be prepared and then progress against these plans should be monitored.
- Important documents should be checked and reviewed for effectiveness and correctness.
- Product should be tested against specification.
- Several organizational aspects should be addressed.
  - Example: Reporting of the quality team to the management

Shortcomings of ISO 9000 Certification

- ISO 9000 requires a software production process to be adhered to but does not guarantee the process to be of high quality.
- ISO certification process is not foolproof and no international accreditation agency exists.
- Organization getting ISO 9000 certifications often tend to downplay domain expertise. However, software development is a creative process and individual skills and experience are important.
- ISO 9000 does not automatically lead to TQM.

SEI Capability Maturity Model (SEI CMM)

- Proposed by Software Engineering Institute of the Carnegie Mellon University, USA.
- CMM is a reference model for inducting the software process maturity into different levels.
- CMM can be used to predict the most likely outcome to be expected from the next project that the organization undertakes.
- SEI CMM classifies software development industries into five maturity level.

SEI Capability Maturity Model

CMM Level	Focus	Key Process Areas
1. Initial	Competent people	–
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

Comparison Between ISO 9000 Certification and SEI/CMM

- ISO 9000 is awarded by an international standards body. Therefore, ISO 9000 certification can be quoted by an organization in official documents, communication with external parties, and the tender quotations. However, SEI CMM assessment is purely for internal use.
- SEI CMM was developed specifically for software industry and therefore addresses many issues which are specific to software industry alone.
- SEI CMM goes beyond quality assurance and prepares an organization to ultimately achieve TQM. In fact, ISO 9001 aims at level 3 of SEI CMM model.
- SEI CMM model provides a list of key process areas (KPAs) on which an organization at any maturity level needs to concentrate to take it from one maturity level to the next. Thus, it provides a way for achieving gradual quality improvement.

Is SEI CMM Applicable to Small Organizations?

- Small organizations typically handle applications such as Internet, e-commerce, and are without an established product range, revenue base, and experience on past projects .
- For such organizations, a CMM-based appraisal is probably excessive.
- These organizations need to operate more efficiently at the lower levels of maturity. For example, they need to practice effective project management, review, and configuration management.

Personal Software Process (PSP)

- Scaled down version of the industrial software process
- SEI CMM does not tell software developers how to analyze, design, code, test, or document software products, but assumes that engineers use effective personal practices
- PSP recognizes that the process for individual use is different from that necessary for a team
- The quality and productivity of an engineer is to a great extent dependent on his process
- PSP is a framework that helps engineers to measure and improve the way they work
- It helps in developing personal skills and methods by estimating and planning, by showing how to track performance against plans, and provides a defined process which can be tuned by individuals

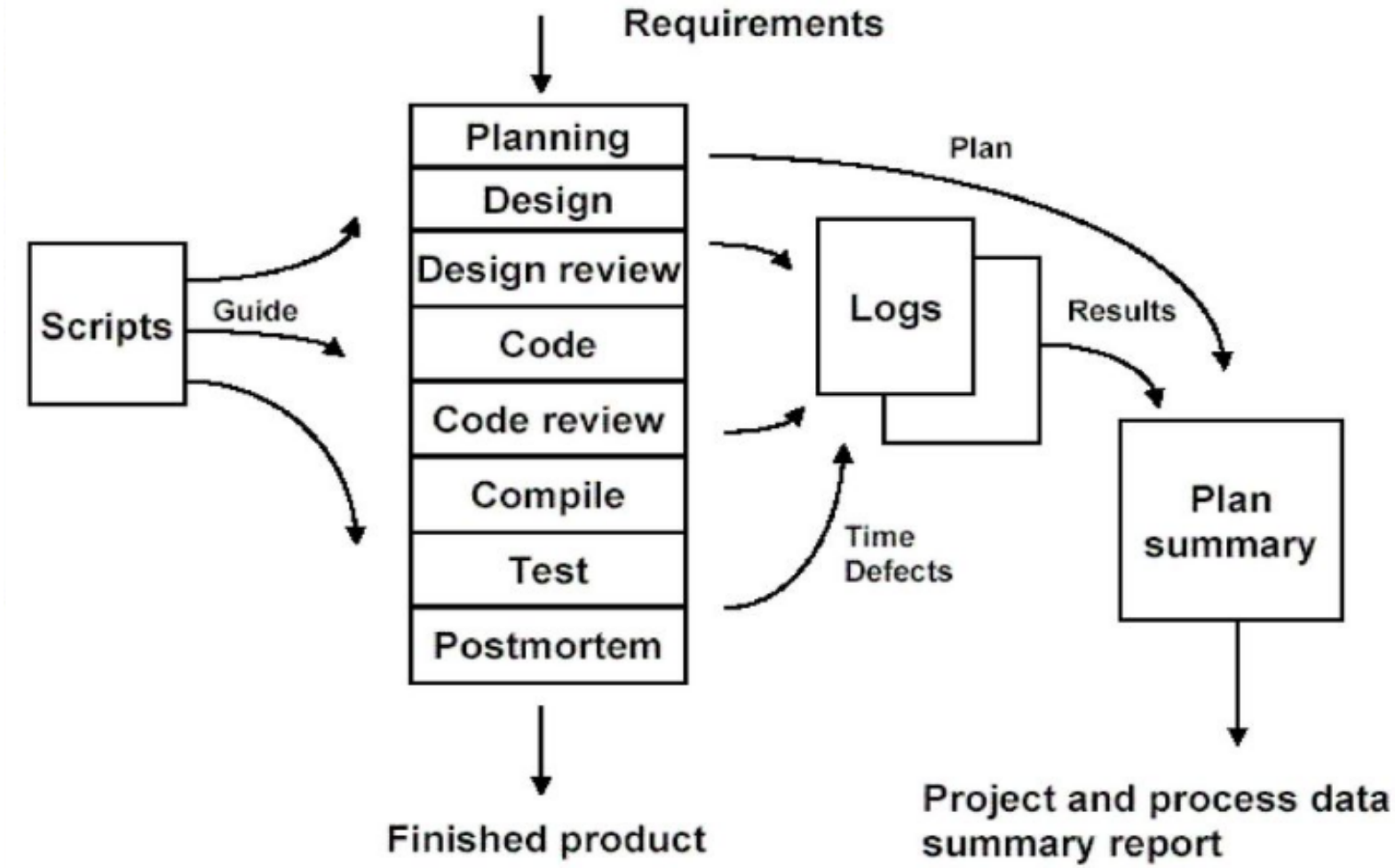
PSP: Time Measurement

- PSP advocates that engineers should rack the way they spend time.
- Because, boring activities seem longer than actual and interesting activities seem short.
- Therefore, the actual time spent on a task should be measured with the help of a stop-clock to get an objective picture of the time spent.
- For example, he may stop the clock when attending a telephone call, taking a coffee break etc.
- An engineer should measure the time he spends for designing, writing code, testing, etc.

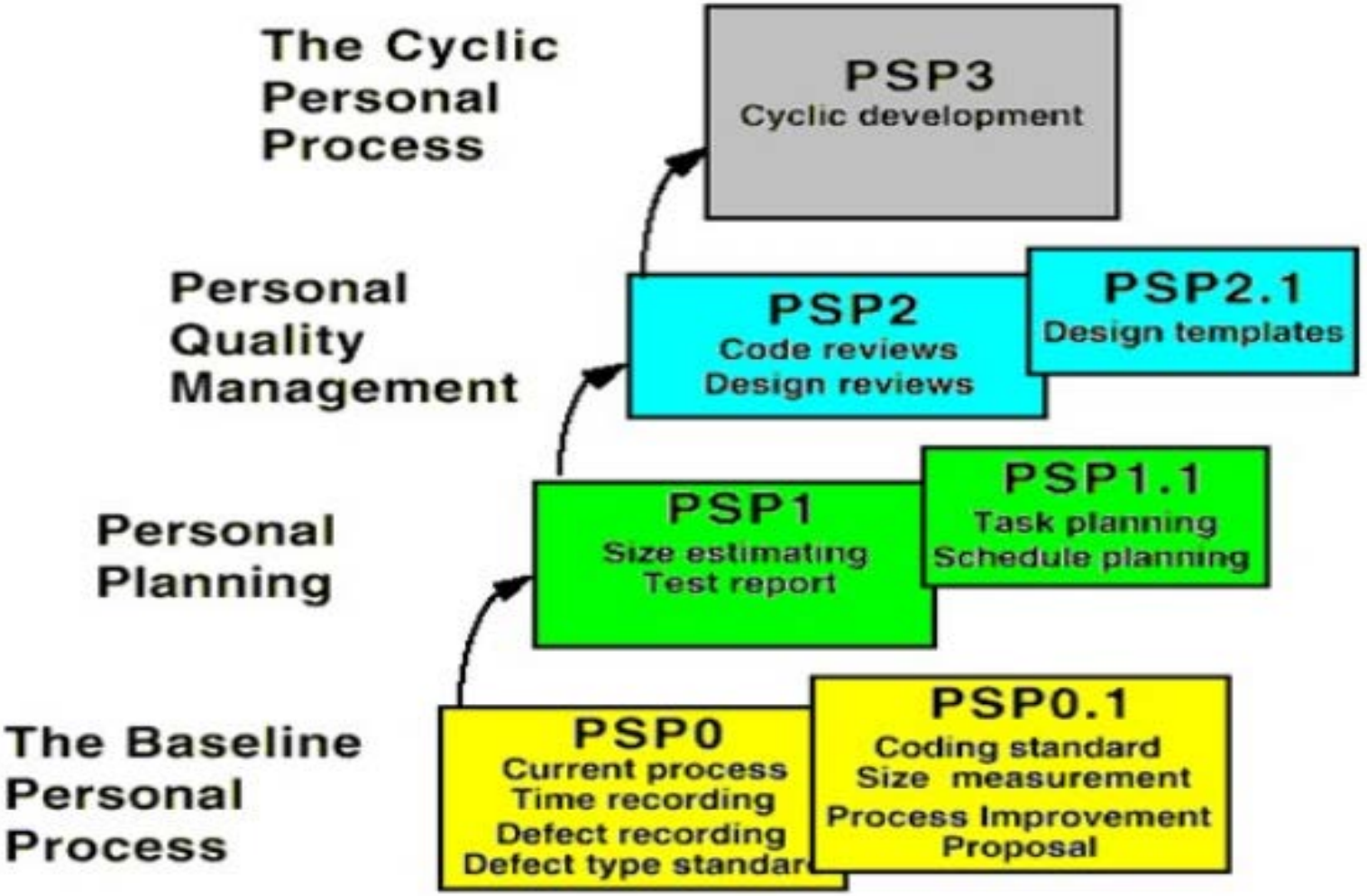
PSP Planning

- Individuals must plan their project.
- They must estimate the maximum, minimum, and the average LOC required for the product.
- They should use their productivity in minutes/LOC to calculate the maximum, minimum, and the average development time.
- They must record the plan data in a project plan summary.

Schematic Representation of PSP



Levels of PSP



Six Sigma

- The purpose of Six Sigma is to improve processes to do things better, faster, and at lower cost.
- Six Sigma is a disciplined, data-driven approach to eliminate defects in any process – from manufacturing to transactional and product to service.
- To achieve Six Sigma, a process must not produce more than 3-4 defects per million opportunities. A Six Sigma defect is defined as any system behavior that is not as per customer specifications.

Six Sigma: The fundamental Objective

Implementation of a **measurement-based strategy** that focuses on **process improvement** and **variation reduction** through the application of Six Sigma improvement projects

Six Sigma Sub-Methodologies

- DMAIC process (define, measure, analyze, improve, control)
  - An improvement system for existing processes failing below specification and looking for incremental improvement
- DMADV process (define, measure, analyze, design, verify)
  - An improvement system used to develop new processes or products at Six Sigma quality levels
  - It can also be employed if a current process requires more than just incremental improvement

THANK YOU