M.Sc. in Computer Science
Department of Computer Science
Faculty of Applied Sciences
University of Sri Jayewardenepura

CSC 540 2.0   Software Engineering

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Software Quality Assurance (SQA)

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Objectives

You will:

- be introduced to the quality management process and know why quality planning is important;

- be aware of the importance of standards in the quality management process and know how standards are used in quality assurance;

Topic Covered

- Quality attributes.

- Introduction to quality assurance.

- Principles of software quality assurance.

- How to implement software quality assurance?

- Different software quality assurance methods.

- Difference between quality assurance and quality control.

What is the Quality Attribute of a software?

1. Functionality

2. Reliability

3. Usability

4. Efficiency

5. Maintainability

6. Portability

What is software quality assurance?

Software quality assurance (SQA) is a methodology to ensure that the quality of the software product complies with a predetermined set of standards.

What is the purpose of software quality assurance?

- SQA is not just a step in the development process; it functions in parallel with the software development life cycle.

- Businesses must ascertain that every part of the software, internal and external, is up to the predefined standard.

- SQA tests every block of this process individually to identify issues before they become major problems.

Principles of software quality assurance

Defect prevention	**Continuous improvement**	**Stakeholder involvement**	**Risk-based approach**

Defect prevention

- Preventing defects is more effective than fixing them later.
- Emphasizes identifying and addressing issues early in the development lifecycle.
- Unlike quality control, SQA aims to fix the root causes of defects, not just the symptoms.

Continuous improvement

- QA is not a one-time activity but an integrated part of the development lifecycle.
- Consistently monitor and enhance software quality throughout its lifecycle.
- Ensure the software meets evolving standards and user expectations.

Stakeholder involvement

- Customers, developers, testers, QA team leads, and project managers must actively participate in SQA.
- Promotes effective communication between all parties.
- Ensures alignment of goals and smooth development processes.
- Objective:
    - Deliver a high-quality software product that meets user needs and business objectives

Risk Based approach

- Identify and address the most critical risks in the software product.
- Assess risks based on their potential impact on software quality and functionality.
- Objective is to minimize the likelihood of high-impact defects or failures.

How to implement software quality assurance?

1. **Define quality standards**

2. **Plan SQA activities**

3. **Conduct reviews**

4. **Perform testing**

5. **Monitor and measure**

6. **Improve continuously**

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Define quality standards

- Clearly define the quality standards that your software product must meet
- This includes:
  - Requirements: Specify what the software should do.
  - Acceptance Criteria: Define conditions for approval.
  - Performance Metrics: Set measurable goals for functionality, reliability, and efficiency.
- Standards must be agreed upon by:
  - Development team
  - Management
  - Customers

Plan SQA activities

- Outline SQA activities across the software development lifecycle.
- Key Activities to Include
    - Reviews: Code reviews, design reviews, and requirement reviews.
    - Testing: Unit testing, integration testing, and system testing.
    - Documentation: Maintain records of standards, test cases, and results.
- Clearly define:
    - Who: Assign roles for each activity (e.g., QA leads, developers, testers).
    - When: Specify timelines and milestones for each SQA activity.

Conduct reviews

Artifacts to Review:
- Requirements
- Design documents
- Code

Review Team
- Conducted by experts not directly involved in the development process.

Benefits of Reviews
- Early Defect Detection: Identify issues early to reduce the cost of fixing them later.
- Improved Quality: Ensure adherence to quality standards and ~~sp~~ecifications.

Perform testing

- Perform different types of testing such as unit testing, integration testing, system testing, and acceptance testing.
- Use automated testing tools to increase efficiency and reduce the risk of human error.

Monitor and measure

- Monitor and measure the quality of the software product throughout the development process.
- This includes tracking defects, analyzing metrics such as code coverage and defect density, and conducting root cause analysis.

Improve continuously

- Continuously improve the SQA process by analyzing the results of the monitoring and measuring activities.
- Use this data to identify areas for improvement and implement changes to the SQA process.

What is the importance of software quality assurance?

- Ensures a high-quality software product
- Ensures a stable and competitive software product
- Saves time and money
- Protects your company's reputation
- Ensures security and compliance
- Ensures customer satisfaction

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Common QA Methods: Manual Testing

- Manual testing is a fundamental aspect of any QA process.
- It involves human testers executing test cases and scripts manually. No automated testing tool is used to identify defects or bugs in the software product.
- The test results also reveal the weak points within the development process itself.
- Manual testing is particularly useful for small projects with limited resources or those with new functionalities that continuously evolve or cannot be automated.

Manual testing techniques

Exploratory Testing
Experiment with different scenarios and inputs to identify defects through creative thinking.

Ad-Hoc Testing
Informal, unstructured testing based on the tester's intuition and experience.

Regression Testing
Ensure software behavior remains correct after modifications, such as bug fixes or enhancements.

User Acceptance Testing (UAT)
Validate that the software meets functional requirements from the end-user's perspective.

Smoke Testing
Preliminary checks to verify basic functionality before more detailed testing begins.

Common QA Methods: Automated Testing

- Automated tests are conducted with the use of specialized automation tools and frameworks.

- It is a fast and cost-effective method of detecting bugs and errors in developed software.

- It speed up the process and save time as well as effort.

- Automated testing enables to prioritize more complex tasks that require human intelligence.

Automated testing techniques

Unit Testing
   Verify individual components work as expected, often automated with frameworks like JUnit or NUnit.

Integration Testing
   Evaluate how different modules interact, using tools like Selenium or Protractor.

Security Testing
   Ensure software remains secure by testing for vulnerabilities:
      Penetration Testing: Identify exploitable vulnerabilities.
      Secure Coding: Ensure encryption and proper handling of sensitive data.

Functional Testing
   Ensure each function operates according to requirements, often automated using Selenium or Cucumber.

Automated testing techniques

Performance Testing

Assess system performance under specific conditions:

Stress Testing: Test extreme workloads.

Load Testing: Test system performance under normal and peak conditions.

Endurance Testing: Evaluate long-term usage.

Spike Testing: Test performance with sudden workload increases.

What is the difference between quality assurance and quality control?

Quality assurance	Quality control
The primary objective of QA is to ensure that the software product meets the needs and expectations of the customers.	The primary objective of QC is to ensure that the software product meets the quality standards and specifications that have been established for it.
QA is a proactive and preventive approach that focuses on preventing defects and errors before they occur.	QC is a reactive and corrective approach that detects and corrects defects after they have occurred.
QA is a process-focused approach that involves various process-improvement activities to ensure that the development process is carried out efficiently and effectively.	QC is a testing-focused approach that involves various testing activities, such as unit testing, integration testing, system testing, and acceptance testing, to identify defects and errors.

QA	QC
QA is a validation-oriented approach that focuses on validating whether the development process is carried out as per the established standards and procedures.	QC is a verification-oriented approach that focuses on verifying whether the product meets the established quality standards and specifications.
QA is a technique to manage quality	QC is a technique to verify quality
QA is carried out by project managers, developers, testers, and other stakeholders involved in the process	QC is carried out by testers, developers, or external reviewers, depending on the stage of the software development lifecycle
QA is carried out throughout the software development lifecycle.	QC is carried out after the software product has been developed.

Quations

1. What is software quality?

2. What are the three definitions of software quality?

3. What are the main software quality characteristics?

Q & A

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