

# Software Testing Methodologies

# Agenda



Software Quality



Software Testing



Testing Phases and Techniques



System Testing Types



Test Automation



Professional Testers – Skills and Attitude



Conclusions

# About Quality

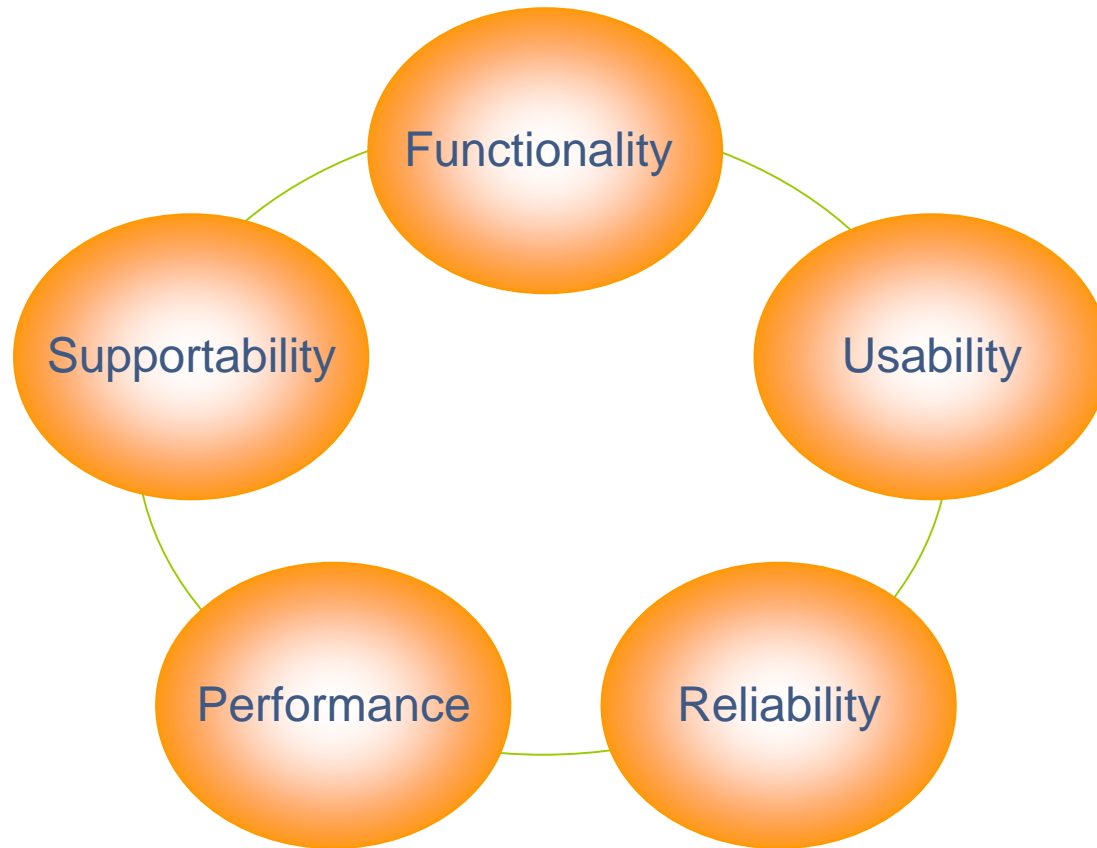
## Quality

- Is a customer determination
- Is not an absolute, but value to some person  
(*who matters*)
- Is based upon the customer's actual experiences with the product or service
- Has to be not only professionally created, but also professionally verified and validated

# Software Quality

- The adjective *quality* may apply
  - to *source code* as seen by software developers, or
  - to *applications software* as seen by the end-users
- *Software Quality* is seen as *Fitness for purpose*
  - The purpose of the software is to be used to deduce the attributes that should be used to measure its quality
- Some attributes to be evaluated
  - Conformance to Requirements
  - Absence of bugs
  - Correctness and Completeness
  - Extensibility and Maintainability
  - Documentation

# Software Quality Perspectives



# Software Quality from Human Perspectives

## Technical Perspective

- meets requirements
- delivered on time and within budget
- reasonably bug-free (according to the set objectives)
- maintainable

## Customer Perspective

- meets expectations
- cost effective
- user-friendly
- bug-free

Focus on the End Customer's Needs !

# The High “Quality” Software

- Number of functional defects in software
  - During development: it could reach peaks of 50 bugs per kLOC (thousand lines of code)
  - Delivered software: typically varies from 10 down to 1 defects per kLOC
- Very high quality software sample

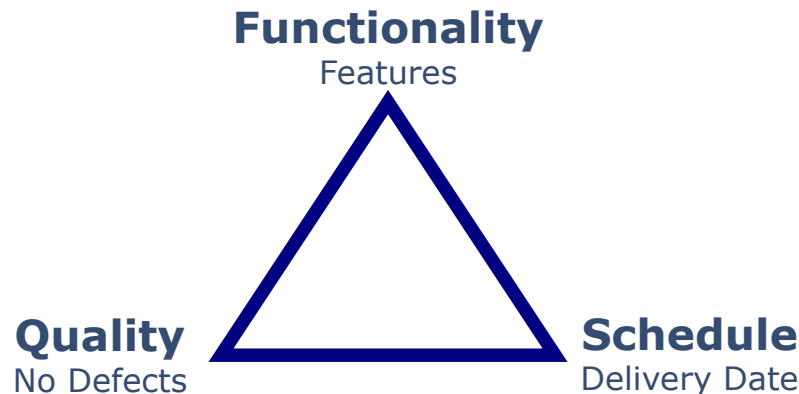
*NASA space shuttle on-board flight software*

  - ~ 3 million lines of code
  - < 1 error per 10 kLOC after release (!)
  - Final cost: the order of \$1000 / LOC (!!!)

The very high quality software is not a dream,  
but it asks for its price

# The “*Good Enough*” Software

- A product is good enough when *all* of these conditions apply
  - It has sufficient benefits
  - It has no critical problems
  - The benefits sufficiently outweigh the problems
  - In the present situation, and all things considered, further improvement would be more harmful than helpful
- Conformance to *all* requirements





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# Software Testing – Meaning

- The process used to identify the *correctness, completeness, quality, and security* of developed computer software
- Is a process of technical investigation, intended to reveal quality-related information about the product
- This includes, but is not limited to, the process of executing a program or application with the intent of :
  - finding errors, and
  - comparing the behaviour against requirements
- *A Good Test*
  - sometimes described as one which reveals an error
  - the recent thinking: ...the one which reveals information of interest to someone who matters

# Software Testing – Why is necessary?

*Motto:*

*One test is worth  
a thousand expert opinions*

- Analysts and Developers are human, hence not perfect
- The number of defects in the new soft remains high
- There is no perfect prevention – yet
- One can't ship successfully software that doesn't work
- An objective, external, valuable opinion is a necessity

The testing activity plays a key role in  
facilitating, checking and certifying the quality

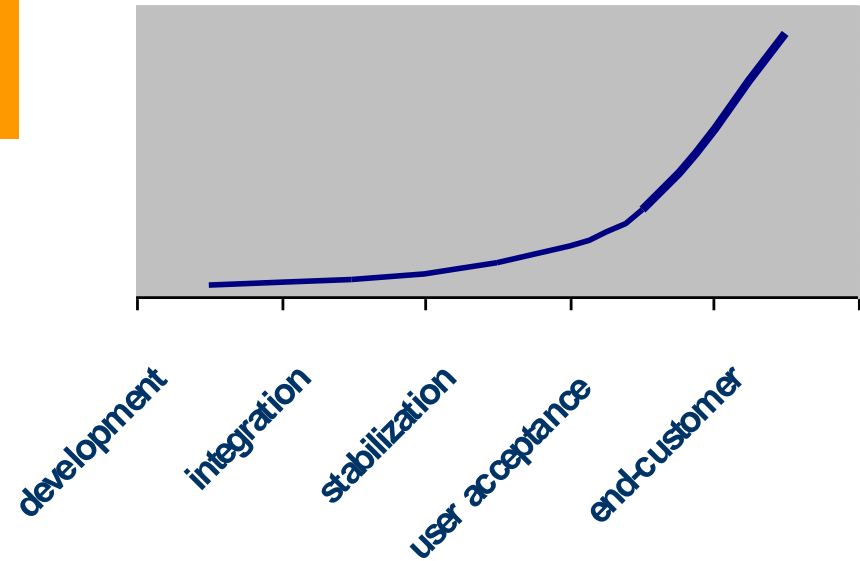
# Software Testing – When to test?

- Along
  - or
  - After
- the development process?

Software development stages  
the testing should be started in:

- Analysis and Design ☆☆☆☆
- Implementation ☆☆☆
- Stabilization ☆☆
- User Acceptance ☆

## Cost of fixing a defect



The earlier the testing started, the lower the costs and the bigger the benefits!

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# Testing Techniques

- Aka ...Clear box, ...Glass box or ...Structural Testing
- Uses an internal perspective of the system
- Exercise paths through the code and determines the outputs
- It requires programming skills
- It's performed by developers
- It's typically applied to the units

## White Box Testing

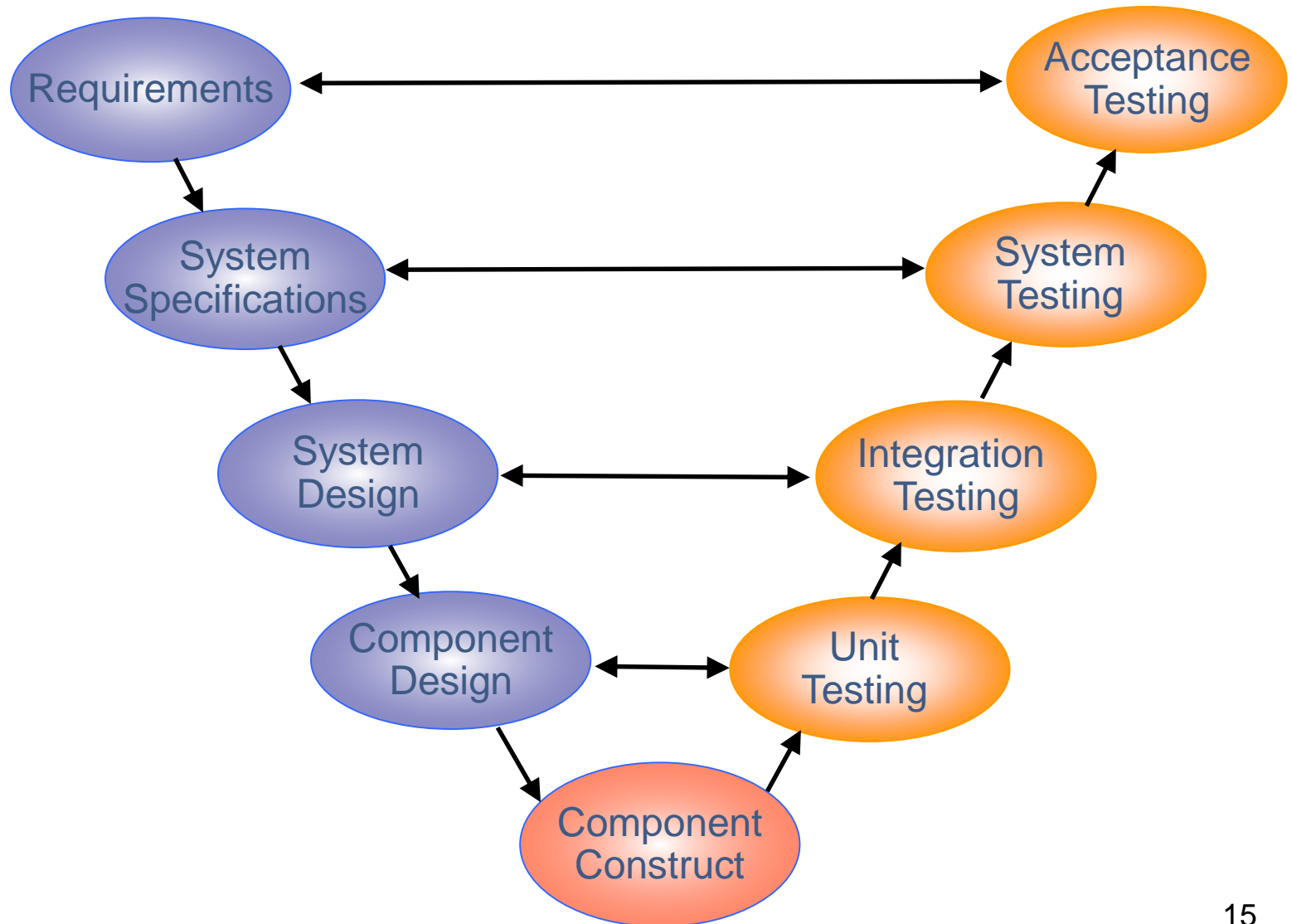
- Takes an external perspective of the test object
- These tests can be either functional or non-functional
- The test designer selects valid and invalid inputs, and determines the correct outputs
- There is no knowledge of the test object's internal structure
- Is applicable to all levels of software testing

## Black Box Testing

## Gray Box Testing

- Newer approach: a black-box testing with limited knowledge of the internals of the system
- Applicable to various areas, like Web Services and DB testing

# Phases of Testing: the V Model



# Phases of Testing ...

## Unit Testing

- Validate that individual units of source code are working properly
- Isolate each part of the program and show that they are correct
- *Unit* = the smallest testable part of an application
  - in *procedural programming* a unit is an individual *Program, Function, Procedure*
  - in *object-oriented programming*, the smallest unit is a *Class*

## Integration Testing

- Individual software modules are combined and tested as a group
- Takes as its input modules that have been unit tested, groups them in larger aggregates, applies a set of predefined tests
- Delivers as its output the integrated system ready for system testing
- Verify functional, performance and reliability requirements



# Phases of Testing ...

## System Testing

- Conducted on a complete, integrated system
- Evaluate the system's compliance with its specified requirements
- The focus is to have almost a positive “*destructive*” attitude
- Test not only the design, but also the behavior, and even the believed expectations of the customer
- Test up to and beyond the bounds defined in the requirements, and specifications.

## Acceptance Testing

- Performed by the customer on a system prior to the customer accepting delivery
- There is generally no degree of success or failure
- The test environment is designed to be identical, or as close as possible, to the anticipated user's environment

# Agenda



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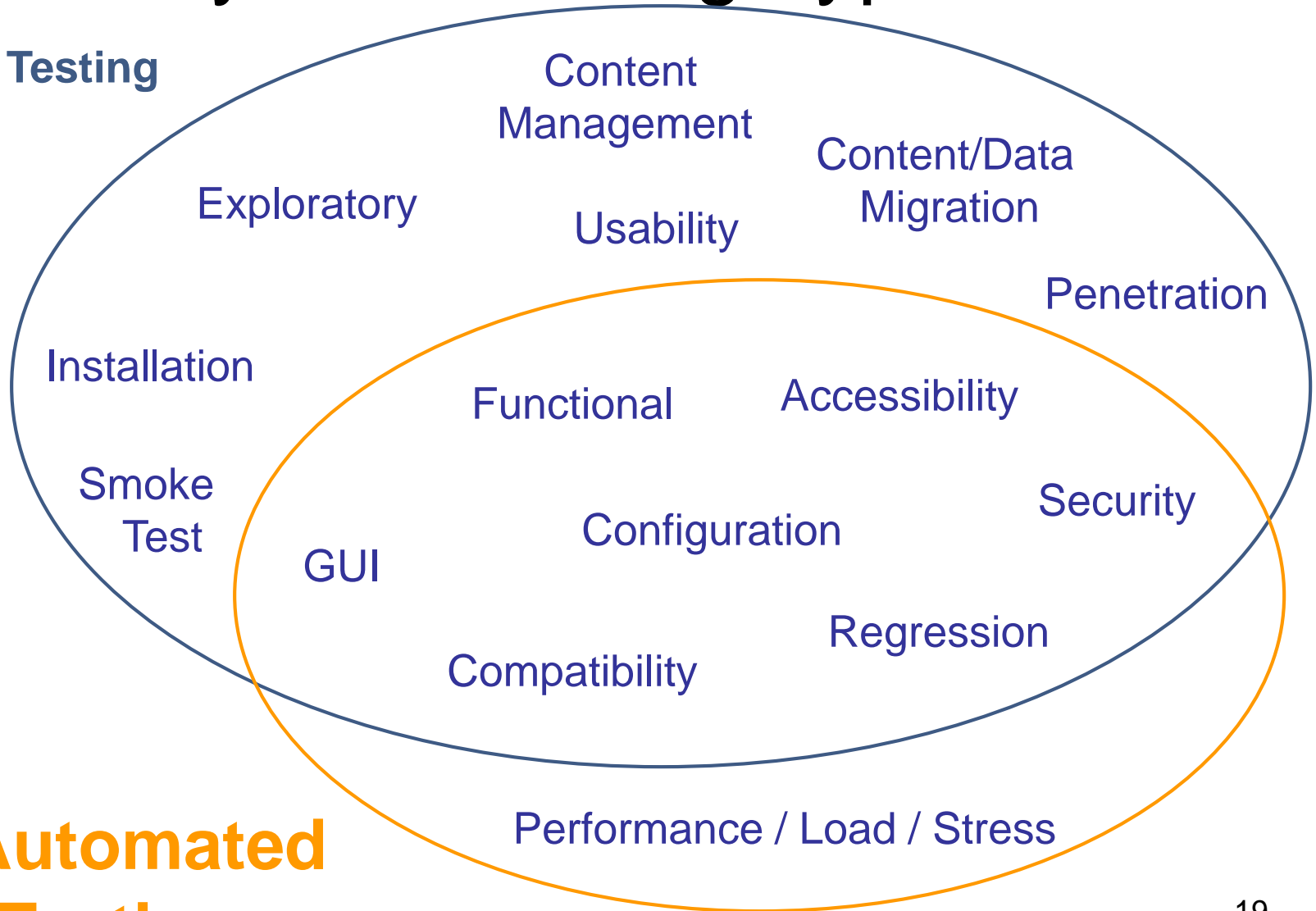
Professional Testers – Skills and Attitude



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# System Testing Types

**Manual Testing**



**Automated  
Testing**

# Types of Testing ...

- Functional

Covers how well the system executes the functions it is supposed to execute — including user commands, data manipulation, searches and business processes, etc, AND ...it doesn't do what it's not supposed to do (difficult to prove)

- Graphical User Interface

Focused on GUI objects (design and basic functionality); usually performed as part of the Functional testing

- Exploratory

Systematic informal software test that is based on Tester's knowledge and experience, and not on formal test plans/cases

*Note: discovers approx. half of the defects*

# Types of Testing ...

- Installation

Full, partial and upgrade installs / uninstalls on different hardware and/or software configurations

- Configuration

System testing of different variations of an application against its configurability requirements (functional variants, internationalisation, personalisation, hardware variants)

- Compatibility

System testing on a wide variety of platforms, databases, servers, clients, and browsers

# Types of Testing ...

- Performance/Load/Stress

**Performance testing** – checks the actual performance level related to the one specified in requirements

**Load testing** – checks the behaviour of an application under heavy loads

**Stress testing** – system testing under unusually heavy loads, heavy repetition of certain actions or inputs

- Content Management

Focused on the proper entering, editing, distribution, searching for, and displaying of the information handled by the Content Manager

- Content / Data Migration

Focused on checking the correctness and completeness of the migration process, in terms of content or data

# Types of Testing

- Usability

Establishes the ease of use and effectiveness of a product using specific usability test practices

- Accessibility

Check the product compliance with WCA Guidelines, in order to ensure proper accessing of its features by people having disabilities or facing issues limiting their sessions

- Security

Identifies security flaws in the systems, focusing on user and session management, authentication and authorization, data protection and validation

- Penetration

Identify the system's weaknesses and vulnerabilities, avoiding later damages in case a malicious attacker tries to violate it

# Main Testing Artifacts

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## Input Artifacts

- vision
- requirements specifications
- supplementary specifications
- analysis documents
- use cases

An oval with an orange border and a grey drop shadow, containing the text "Output Artifacts".

## Output Artifacts

- test plan
- test cases
- test input data files
- test scripts  
(manual or automated)
- defects
- test reports



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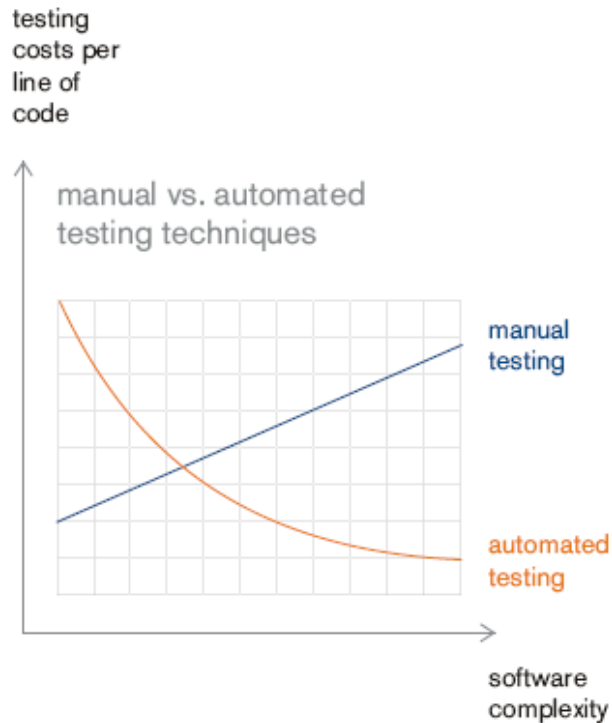


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# Manual vs. Automated Testing



Automated testing is recommended if:

- The project has high-level complexity
- Project exceeds a minimal duration
- The result is a product with several releases
- Software development is continued with maintenance

# Automated Testing – Benefits and Concerns

## Benefits

- Reduces testing duration and costs
- Ensures testing depth and breadth
- Helps analyse problems quickly
- Tests can be run without constant supervision (overnight testing)
- Facilitates regression, configuration and compatibility testing
- Enables performance/load/stress testing
- Allows more Exploratory Testing, increasing the test coverage

## Concerns

- The test code creation requires qualified testers in test automation
- The test code needs constant maintenance
- The test automation initially requires significant time for test code development

Test Automation is not a substitute for manual testing.

It should be used *combined* with manual testing.

# Automated Testing Tools – samples

## Functional Testing Tools

- SilkTest (Borland-Segue)
- Rational Robot (IBM)
- TestComplete (AutomatedQA)
- QuickTestProfessional (Mercury)
- Cypress for Electronic Health Records

## Bug Tracking Tools

- Bugzilla (open-source)
- Rational Clear Quest (IBM)
- JIRA
- Others: AIT, DTS, BTS, ...

## Performance/Stress Testing Tools

- TestComplete (AutomatedQA)
- WebLoad (Radview)
- LoadRunner (Mercury)

## Test Case Management

- Quality Center (Mercury)
- Rational Test Manager (IBM)

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# Professional Testers – The Way They are Thinking

Motto: “Testers light the way”

- Good testers think for themselves, building a *depth and broad understanding* of the tested product
- Testers look at things differently than everyone else, so that they *can find problems no one else will find*
- Testers make *informed* decisions about quality possible, because they think *critically* about software

*Note:* Testers don't get to make *decisions* about quality, but provide qualified *statements* upon it to Managers, who eventually get to make the hard decisions

# Professional Testers – Their Skills

- *Quick Learner*, enjoying performing a variety of different tasks, learning new things, and testing different products
- *Creativity and Adaptability*
  - performing in a variety of different technical environments,
  - using various tools and techniques
- *Detail Oriented*, able to find problems, as well as to see “what's missing”
- Valued *Programming Skills* in at least one technology
- Good system engineering knowledge
- Test-to-break attitude

Effective testing is essentially a process of investigation, not merely a matter of creating and following routine procedure

# Professional Testers – Their Attitude

*Motto:*

“In God we trust,  
the rest we test 😊”

- Sociable and friendly person
- Good communicator, using tact and diplomacy
- Opened to dialogues, but determined in their statements
- Highly committed... and not just involved in
- Reliable and Highly Responsible

There is no QA after QA!



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# Main Software Testing Benefits

- Cost reduction by early defect-discovering
- Improved customer satisfaction, ensuring that the software product works as designed and required
- Time saving by accelerated, efficient software development process
- Improved quality, avoiding side-effect defects
- Avoided, or at least reduced later costs

Today's focus is on Software Testing

➔ A successful career is waiting for you!