

# PV260 COURSE INTRODUCTION

## ROADMAP TO SOFTWARE QUALITY

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Barbora Bůhnová  
buhnova@fi.muni.cz

LAB OF SOFTWARE ARCHITECTURES  
AND INFORMATION SYSTEMS

FACULTY OF INFORMATICS  
MASARYK UNIVERSITY, BRNO



# Outline of the lecture

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- Course introduction
  - Course motivation and goals
  - Course organization
  - Our team
- Roadmap to quality engineering methods
  - Define quality issues
  - Prevent quality issues
  - Detect quality issues
  - Repair quality issues
  - Keep track of quality issues
- Choose well, plan well



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# Course motivation and goals

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“People forget **how fast** you did a job – but they remember **how well** you did it” – Howard Newton

- The **aim of the course** is to help the students to
  - understand activities contributing to building **high-quality software**;
  - develop **critical thinking** and be able to identify **code flaws** related to reliability, performance, scalability, maintainability and testability;
  - be able to **refactor existing code** to improve different quality attributes;
  - have practical experience with software **testing** and related **tools**.

# Outline of lectures

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Lect 1. Course organization. Roadmap to software quality engineering methods.

Lect 2. **Clean Code, Bad Code Smells** and code refactoring.

Lect 3. Software measurement and metrics, and their role in quality improvement.

Lect 4. Automated testing and testability. **Continuous integration/delivery**.

Lect 5. **Basic Principles of Testing**. Requirements and test cases. Test plans and risk analysis.

Lect 6. Focus on **quality attributes and conflicts** between them.

Lect 7. Challenges of quality management in **cloud applications**.

Lect 8. **Performance engineering** and performance testing.

Lect 9. The role of **software architecture** - practitioner view.

Lect 10. The role of **software architecture II** - practitioner view.

Lect 11. **Static code analysis** and code reviews.

Lect 12. Software architecture – **case study**.

Lect 13. Software quality management process.

[All] Colloquium event / Final test

# Course organization

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- Lectures
  - Shared by us and **experts** from companies
  - May **not be recorded**
  - Final **colloquium event** / **written test** after the end of the semester
- Seminars
  - Practical assignments on computers
  - Teamwork, homework, projects
  - **Java** seminar groups – by **NetSuite, Aricoma** experts
  - **Java/multi** seminar group – by **Red Hat** experts
  - **C#** seminar groups – by **Y Soft** experts

# Course organization

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- Evaluation
  - **45** points for seminar **assignments**
    - All the assignments **need to be at least submitted**, otherwise, the student cannot attend the final colloquium event and write the test.
  - **10 seminar activity** points
  - **10 lecture activity** points
  - **35** points for **final colloquium assessment**, consisting of either
    - the interactive **colloquium event**, or
    - the final **written test**
  - Minimum of **70 points** for passing the course
- Colloquium event
  - **Discussion groups** led by industrial experts
  - **Student presentations** of outcomes
  - **Written test**

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# Quality Engineering (QE) methods

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Coding best practices  
Code conventions  
Pair programming

Design patterns

SOLID principles  
Clean Code

Fault tolerance mechanisms  
Performance tuning

Measurement and metrics  
CMMI, ITIL

Test driven development

QA processes  
Standards

Requirements engineering  
Quality attributes

V-model of testing

Security tactics

Functional testing  
Performance testing

Usability testing  
Security testing

Design inspections  
Code reviews

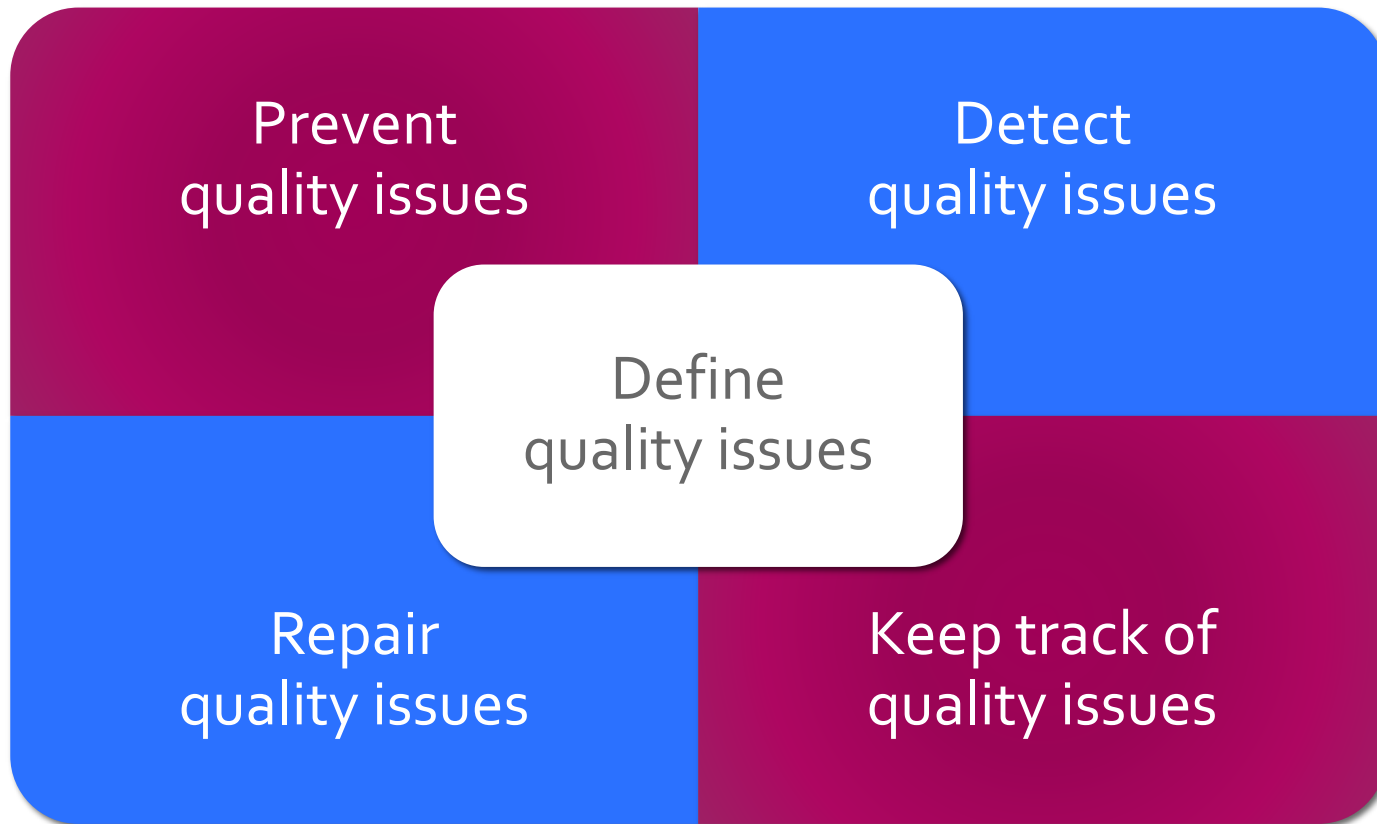
Static code analysis

Issue tracking  
Configuration management

Technical debt management

# Roadmap to QE methods

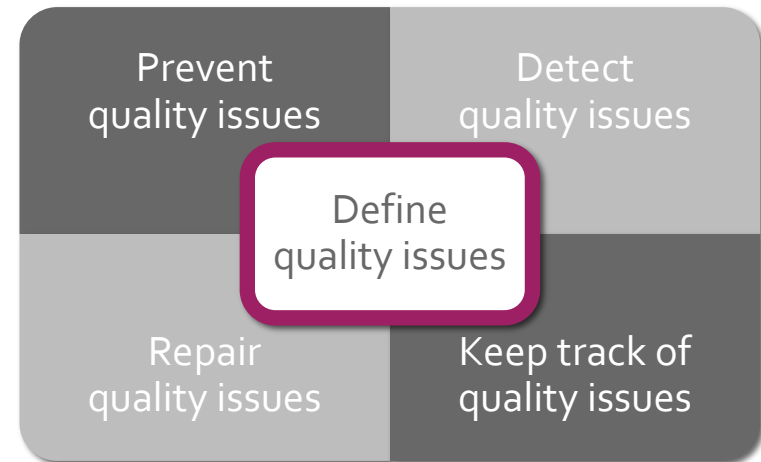
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# Define quality issues

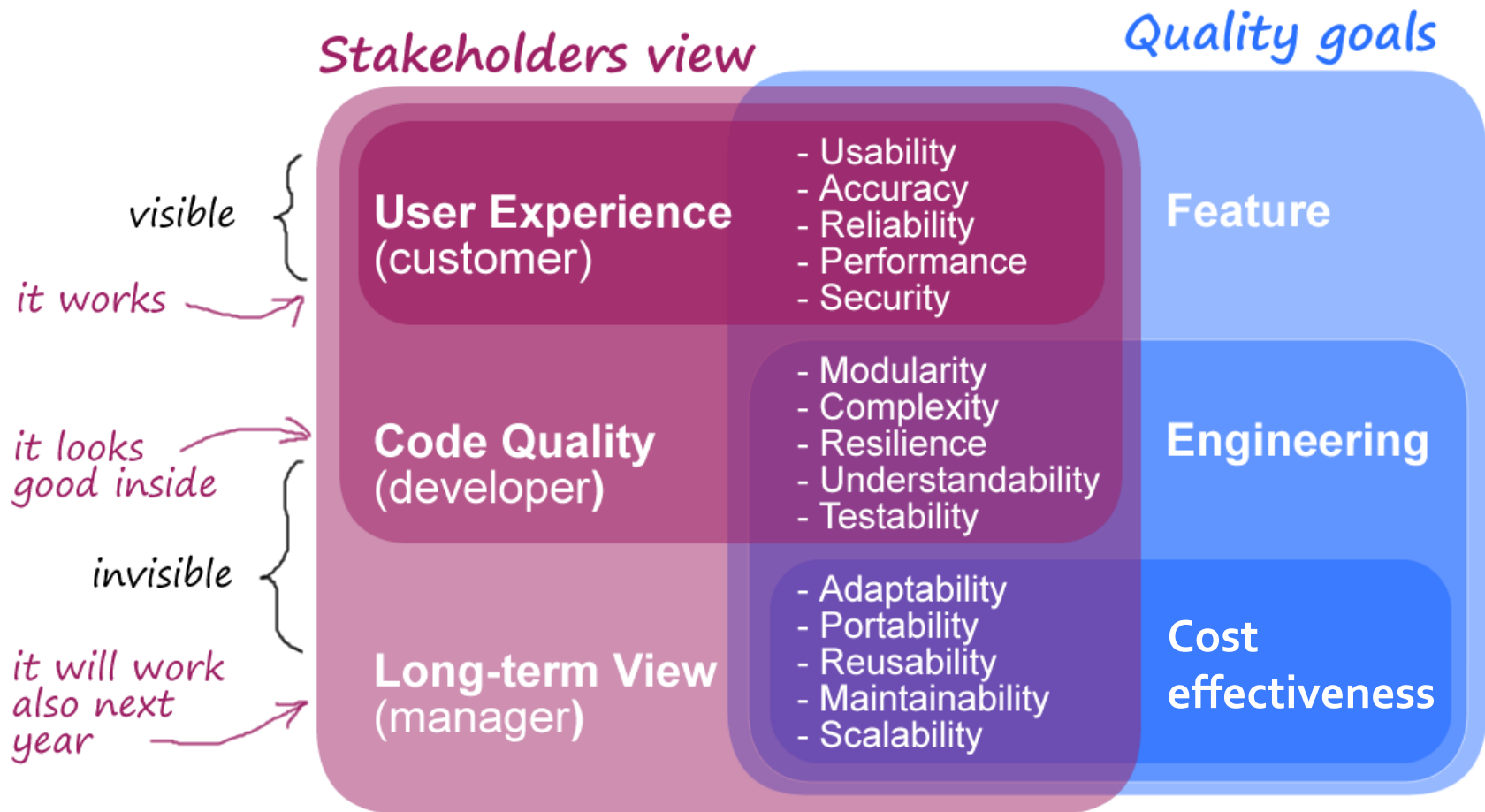
- Software quality is commonly defined as the **capability of a software product to conform to requirements** [ISO/IEC 9001].

*customer needs*

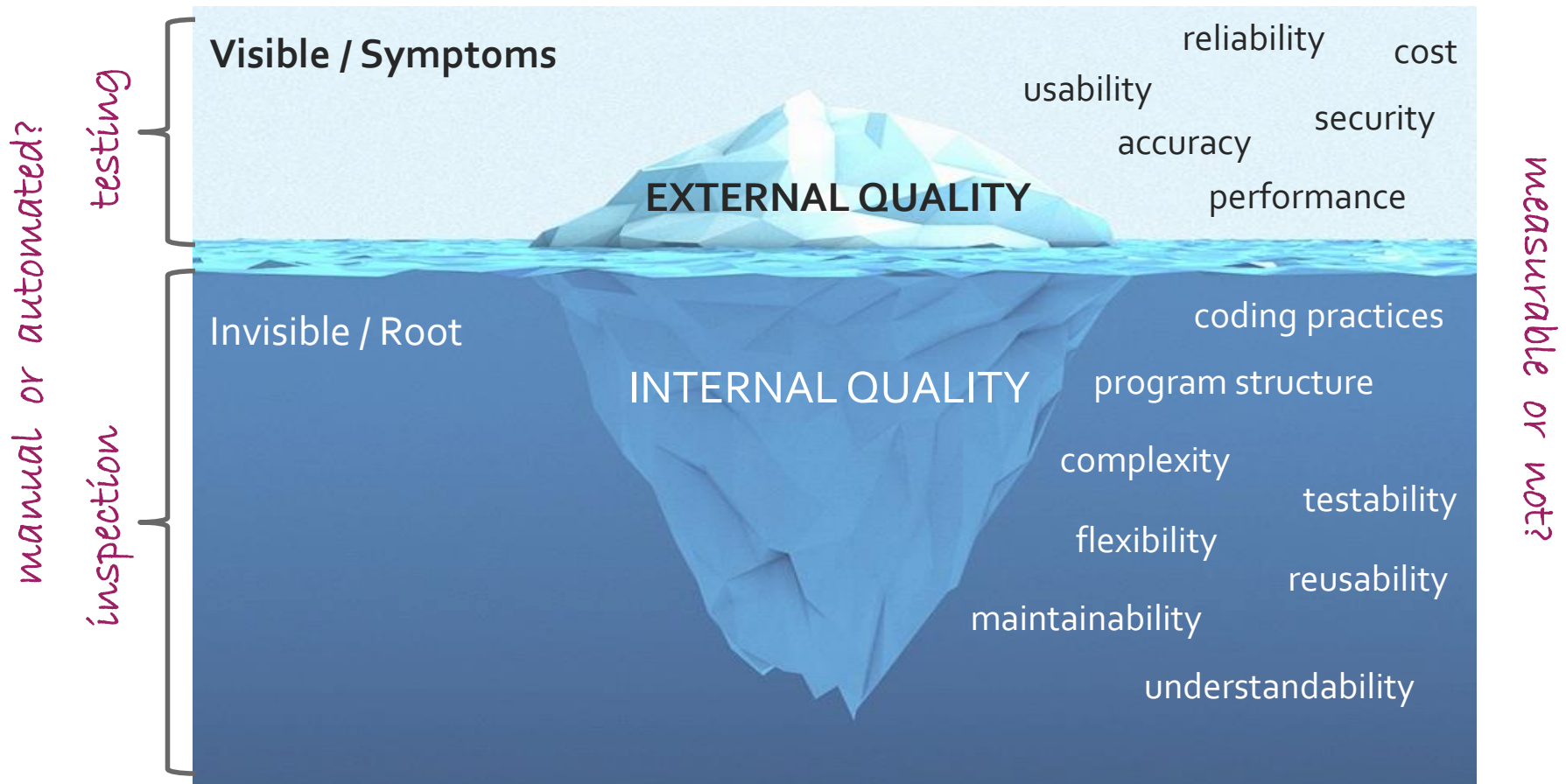


- Requirements engineering
- Software metrics
  - 'You cannot manage what you cannot measure'
- Quality attributes
  - Of a **product**, process and resources

# ... and your customer? What "quality" means to you? ... and your manager?



# The Software Quality Iceberg



Inspiration from [5]

# The big five

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- Along the course we will focus on:
  - **Maintainability** – **ease of change** (without increased technical debt)
  - **Performance** – **response time** and efficiency in resource utilization
  - **Reliability** – probability of **failure-free operation** over a period of time
  - **Testability** – degree to which the system **facilitates testing**
  - **Scalability** – system's ability to handle **growing work load**
- Quality attributes studied in related courses:
  - **Security** – system's ability to **protect itself** from attacks
  - **Usability** – ease of system **use and learnability**

# Prevent quality issues

## • Coding best practices

- Clean code, SOLID principles
- Design patterns
- Pair programming

## • Code conventions

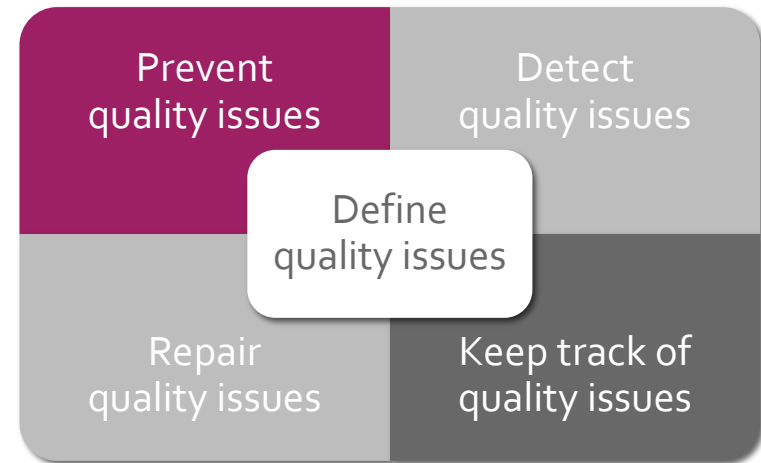
- Language specif. recommendations

## • Quality assurance processes

- V-model of testing, Test Driven Development

## • Standards for development process improvement

- CMMI and ITIL reference models
- ISO 9000, ISO/IEC 25010



code-level

processes

# Detect quality issues

## • Testing functional requirements

- Manual or automated

## • Testing non-functional req.

- Performance, usability, security testing

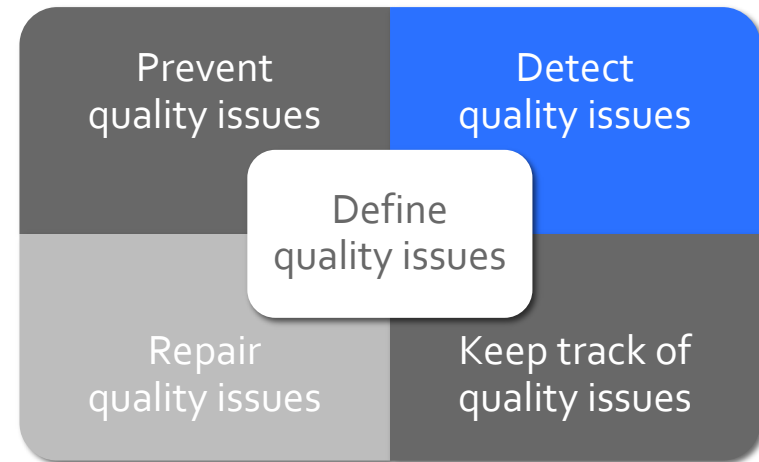
## • Design inspections

- Manual inspections of design artifacts

## • Code reviews

- Manual inspections of code

## • Automated static code analysis

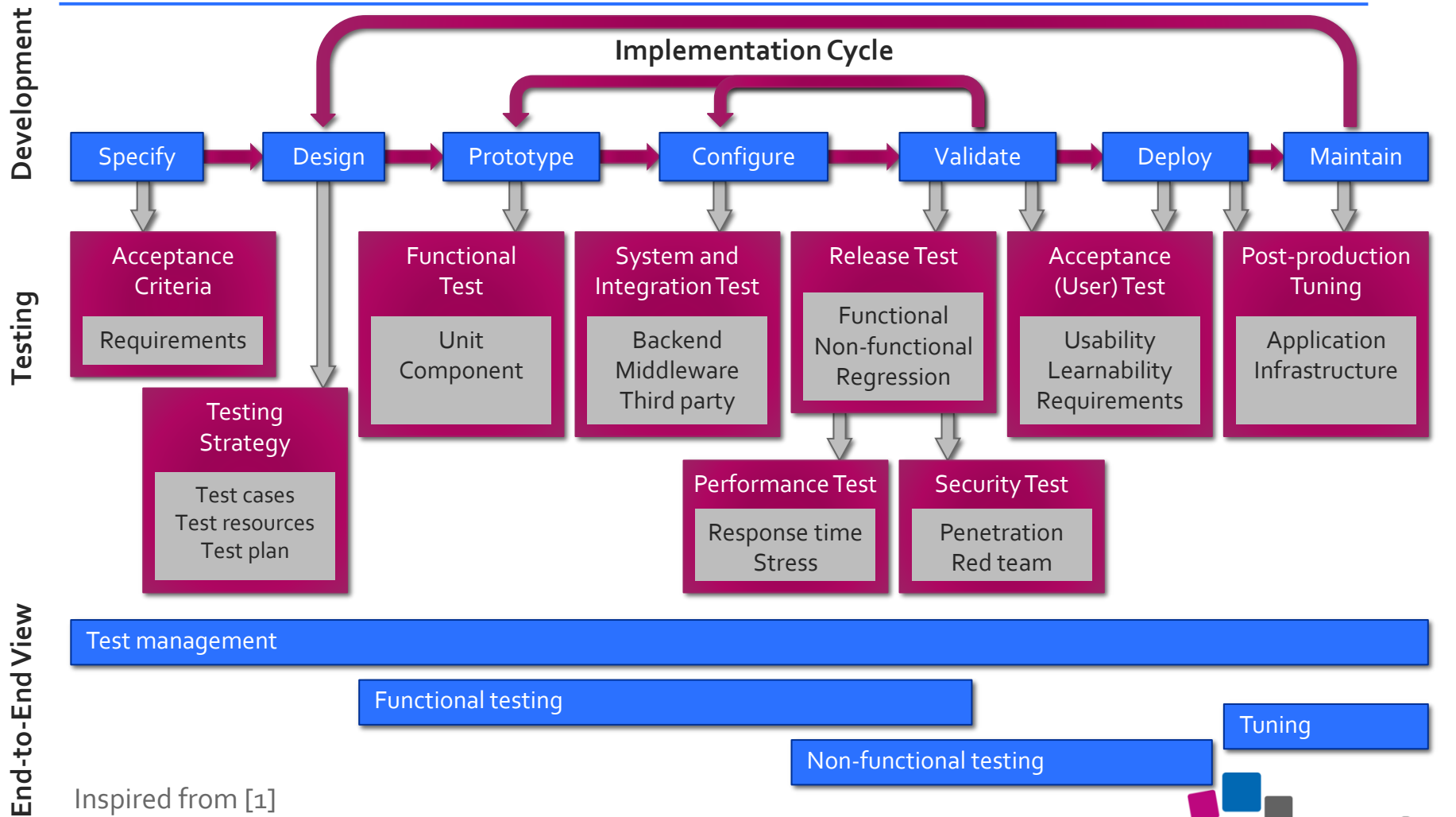


testing

static analysis



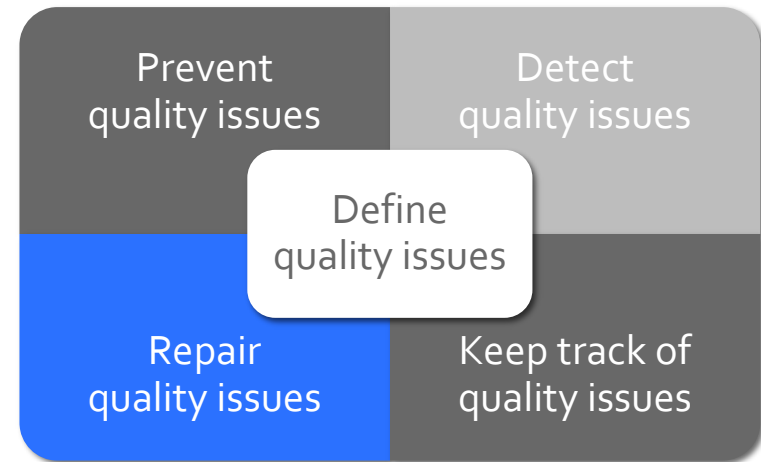
# Roadmap to software testing



Inspired from [1]

# Repair quality issues

- **Functional issue**
  - Code repair
- **Reliability issue**
  - Fault tolerance mechanisms
- **Performance issue**
  - Concurrency, effective resource utilization, identify and remove system bottlenecks
- **Security issue**
  - Identify and remove system vulnerabilities (single points of failure)
- **Maintainability issue**
  - Refactoring to clean code principles, to design patterns



tactics and patterns

# Keep track of quality issues

- **Issue tracking**

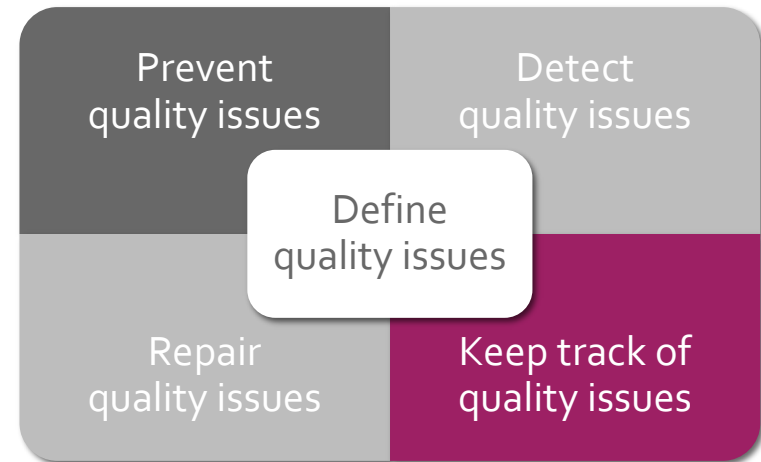
- Supports the management of issues reported by customers

- **Technical debt management**

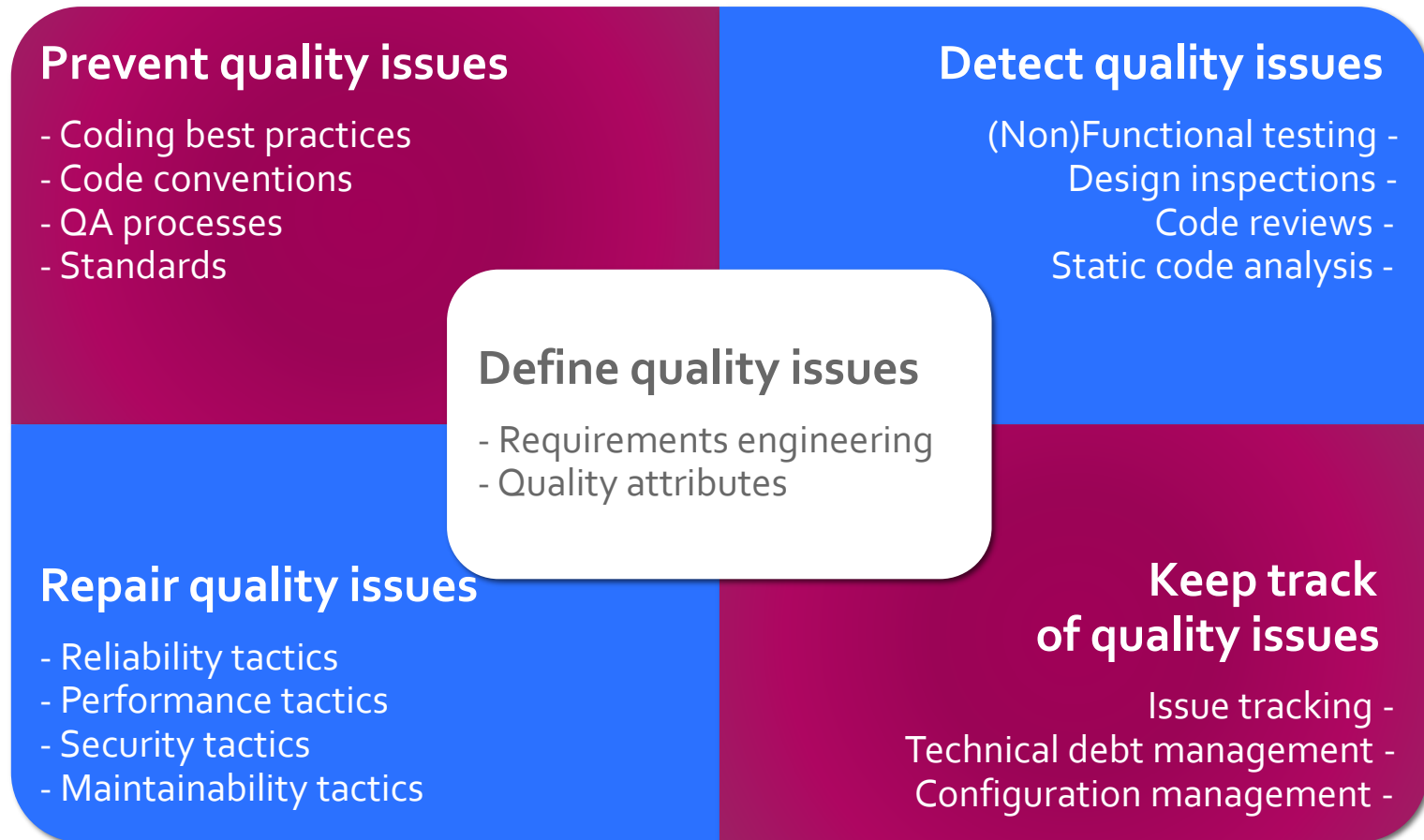
- Level of code quality degradation
- Work that needs to be done before a particular job can be considered complete or proper

- **Configuration management**

- Version management and release management
- System integration



# Roadmap to QE methods – the Big Picture



# Outline of the lecture

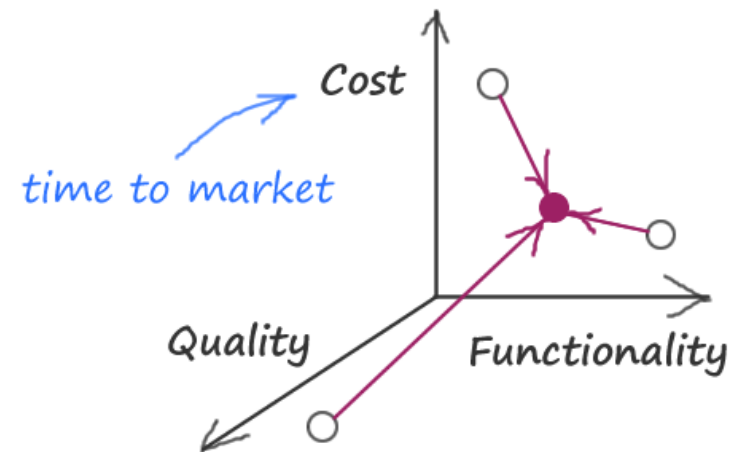
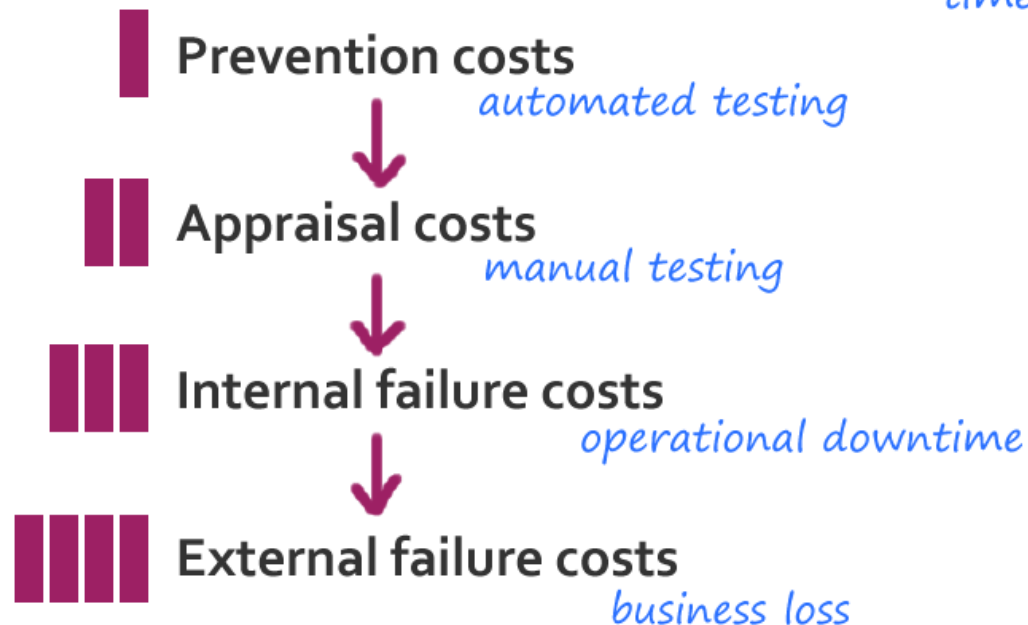
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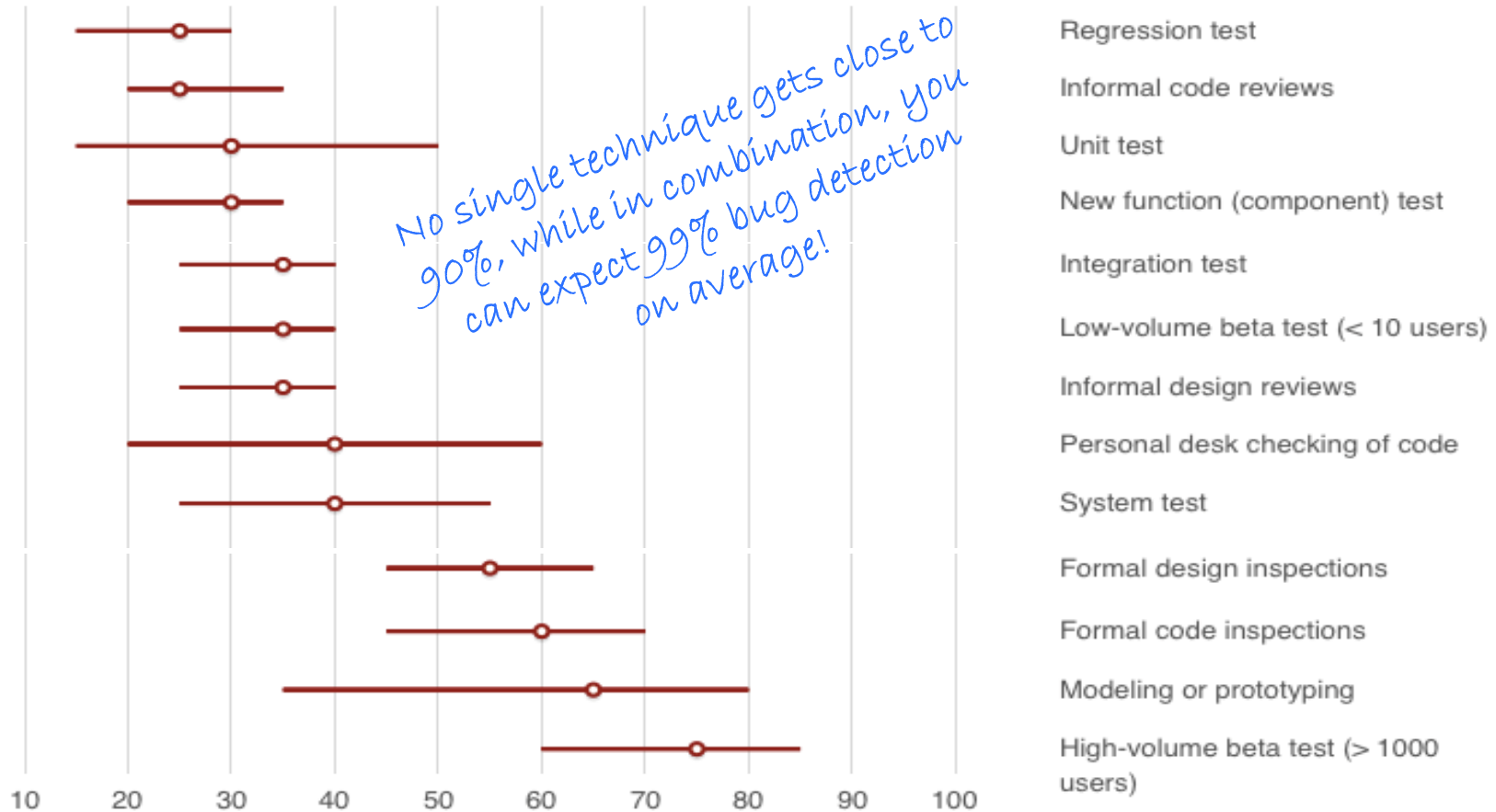


# Choose well, plan well

- Think well about your **requirements** and the **cost of the quality**



# Choose well – Combination is the key



From [2,3], see also [RebelLabs reports](#) [4]

# Plan well – The Power of Analogy

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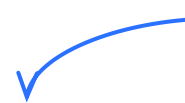
- **Airplane Servicing**

- Requires **regular servicing** e.g. every 100,000 miles.
- Takes place even if everything seems to work all right, because we cannot afford a failure.

- **Technical Debt Management**

- Introduced by Ward Cunningham
- Analogy of **quality degradation with financial debt**  
– if not paid off, interests increase. One can get into trouble.

*Can we quantify it?*



- **Sometimes it is wise to “borrow money”**

- When one expects to **have more money in the future** (start-up company)
- When one needs to **act fast** not to miss a market opportunity
- When one expects **money devaluation** (e.g. developers will become more experienced, it will be easier to understand user needs)





# Takeaways

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- **Quality engineering (QE)** is much more than **testing**, including many different methods to
  - **prevent, detect, repair** and **keep track** of quality issues
- **Combination of the methods is the key** to successful QE
  - But **choose well** and **plan well**, not all methods are best for your project!
- Make sure you understand the **needs of your customer**
  - Balance **both internal and external quality attributes** for both the present and the future

*thanks for listening*

Barbora Bühnová, FI MU Brno

[buhnova@fi.muni.cz](mailto:buhnova@fi.muni.cz)

[www.fi.muni.cz/~buhnova](http://www.fi.muni.cz/~buhnova)

*contact me*

# References

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- [1] Testing You Perform When You Develop a Siebel Application. Available online at [http://docs.oracle.com/cd/E14004\\_01/books/DevDep/Overview5.html](http://docs.oracle.com/cd/E14004_01/books/DevDep/Overview5.html)
- [2] Steve McConnell. Code Complete: A Practical Handbook of Software Construction, Second Edition. Microsoft Press, June 2004.
- [3] Kevin Burke. Why code review beats testing: evidence from decades of programming research. Available online at <https://kev.inburke.com/kevin/the-best-ways-to-find-bugs-in-your-code/>
- [4] RebelLabs. 2013 Developer Productivity Report. Available online at <http://zeroturnaround.com/rebellabs/developer-productivity-report-2013-how-engineering-tools-practices-impact-software-quality-delivery/>
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