Tarkvara kvaliteet ja protsessid : põhimõisted
Software quality and processes : basics

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Short intro (no registration needed): https://tepandi.ee/spqs/
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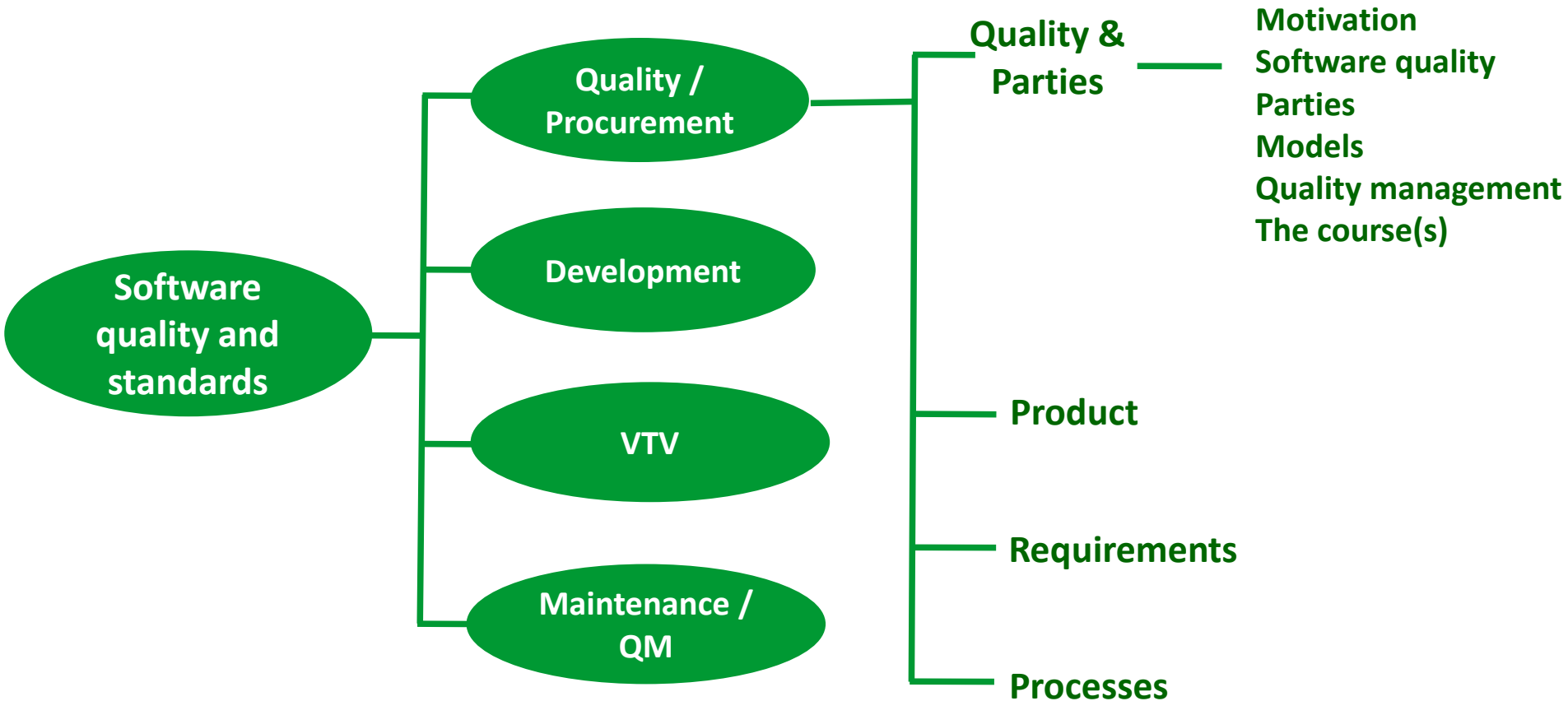
Context and content



Motivation

To whom?

purchasers – to prepare the call for proposals, to formulate requirements, to choose the product, to cooperate in development and to evaluate the outcome

system developers and testers – to apply software verification, validation, and quality management methods and tools; to understand program testing principles, select and apply testing methods, and evaluate system quality

maintainers – maintenance processes and activities

users – to know what to request and expect from the software product

leaders – to know what to expect from and how to manage the parties

society – assurance against software related problems

Sorry, your luggage didn't arrive. There was a software problem....

...what does this mean?

The National Audit Office: why the state's software development projects fail

Four of nine analysed software development projects failed

Goals are set and worded incorrectly or inadequately

The developers don't know what exactly they're supposed to do

The people involved don't know how to accurately describe the requirements

Incorrect estimation of the scale and time of the development

Technological risks, e.g. the selected software platform proves to be unsustainable, a closed source code is used or there are legal restrictions, the implementation process is complicated, errors have not been identified or are hidden

Risks related to testing and receipt, poor version management, problems related to uploading the development outcomes

(11.09.2019)

https://commons.wikimedia.org/wiki/File:Iceberg_Ilulissat.jpg

Software quality and economy

Example: Knight Capital Group: lost $440 million in 45 minutes

Example: The National Audit Office analysis: Four of nine analysed software development projects failed

Example: Everyday experience

Example: State Economy

- In 2020: The total Cost of Poor Software Quality (CPSQ) in the US is $2.08 trillion (T). We also note that the 2020 US figure for the software technical debt residing in severe defects that need to be corrected would be $1.31 T (minus interest) but did not include technical debt in the total CPSQ since it represents a future cost which is increasing (14% rise since 2018). Source: The Consortium for Information & Software Quality™ (co-founded by OMG and the Software Engineering Institute at Carnegie Mellon University)
- About 10% of US gross domestic product (GDP, 20.94 trillion USD in 2020) ... Estonian GDP 31.03 billion USD (2020) => 3 billion USD?
- In 2002: According to a federal study, buggy software costs the US economy nearly $60 billion a year … 0.6% of US gross domestic product (GDP, 2002) ... Estonian GDP: about 30 BEUR => about 180 MEUR for software bugs?

Software quality

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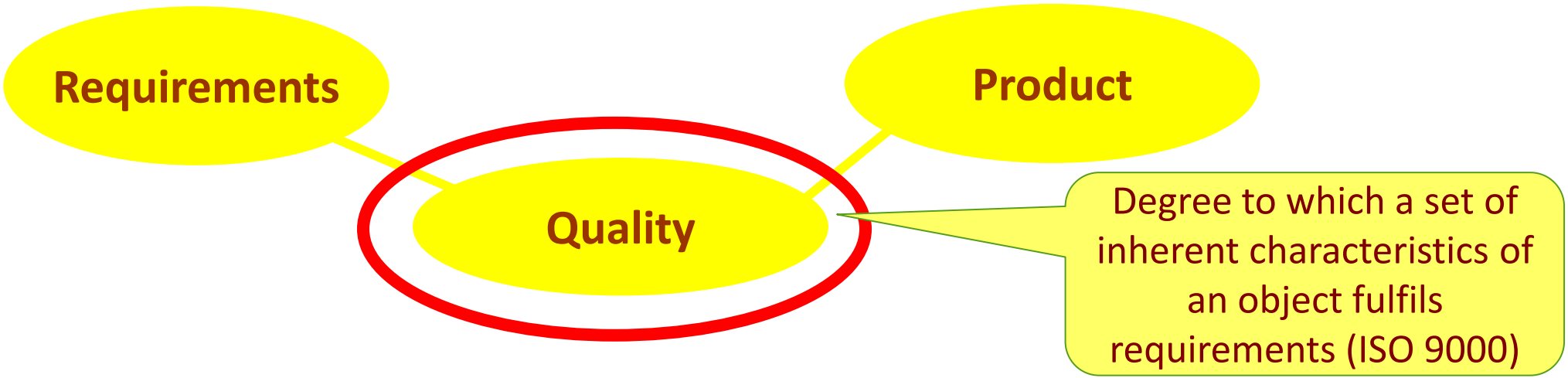
Quality: conformance to requirements



Quality challenges for software systems

„Quality = a product should meet its specification” is problematical for software systems:

- There may be different quality requirements from different parties, e.g., customer (efficiency, reliability, etc.) and developer (maintainability, reusability, etc.)
- Some quality requirements are difficult to specify in an unambiguous way
- Some quality requirements are difficult to verify and/or expensive
- Software specifications are usually incomplete and often inconsistent

Process and product quality

- The quality of a developed product is influenced by the quality of the production process.
- This is important in software development as some product quality attributes are hard to assess.
- However, there is a very complex and poorly understood relationship between software processes and product quality.

  The application of individual skills and experience is particularly important in software development;

  External factors such as the novelty of an application or the need for an accelerated development schedule may impair product quality.

Ian Sommerville. Software Engineering. Ninth Edition. Addison-Wesley

Quality: product – requirements - process - people - ...

„We want to_do that“

Quality concepts

From a forum discussion - “There is no software quality because of hurrying and overload of programmers”

- Quality as an ideal
- Quality as a relationship
- Quality as a measure

Which quality concept is applied? When is it possible to have no quality?

When quality is a trade-off?

Interested parties / Life cycle stakeholders

Views on software quality

Customer
Acquirer
Owner...

User
Power user
...

Developer
Project manager
Architect...

Software

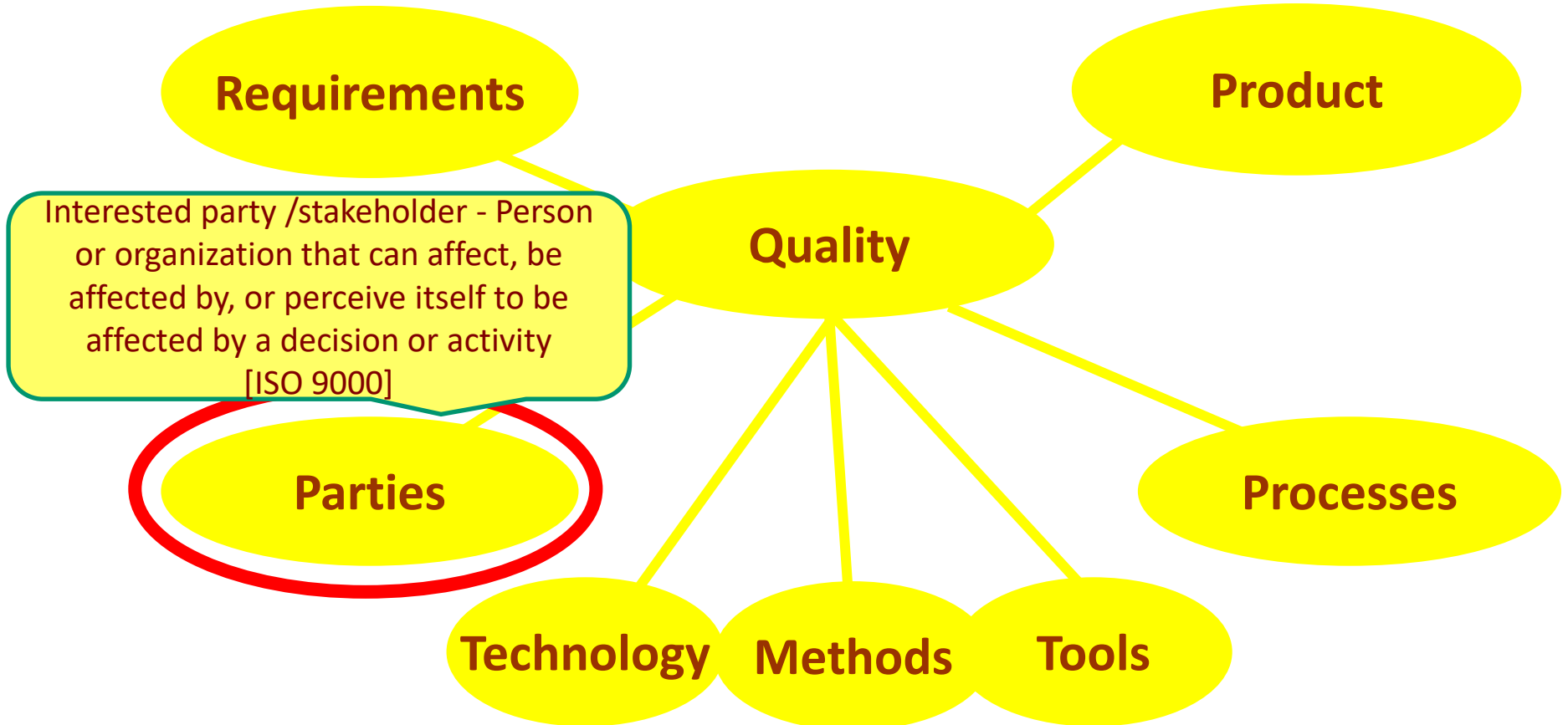
Maintainer
Administrator
...

IT Manager
Technical Release Manager
...

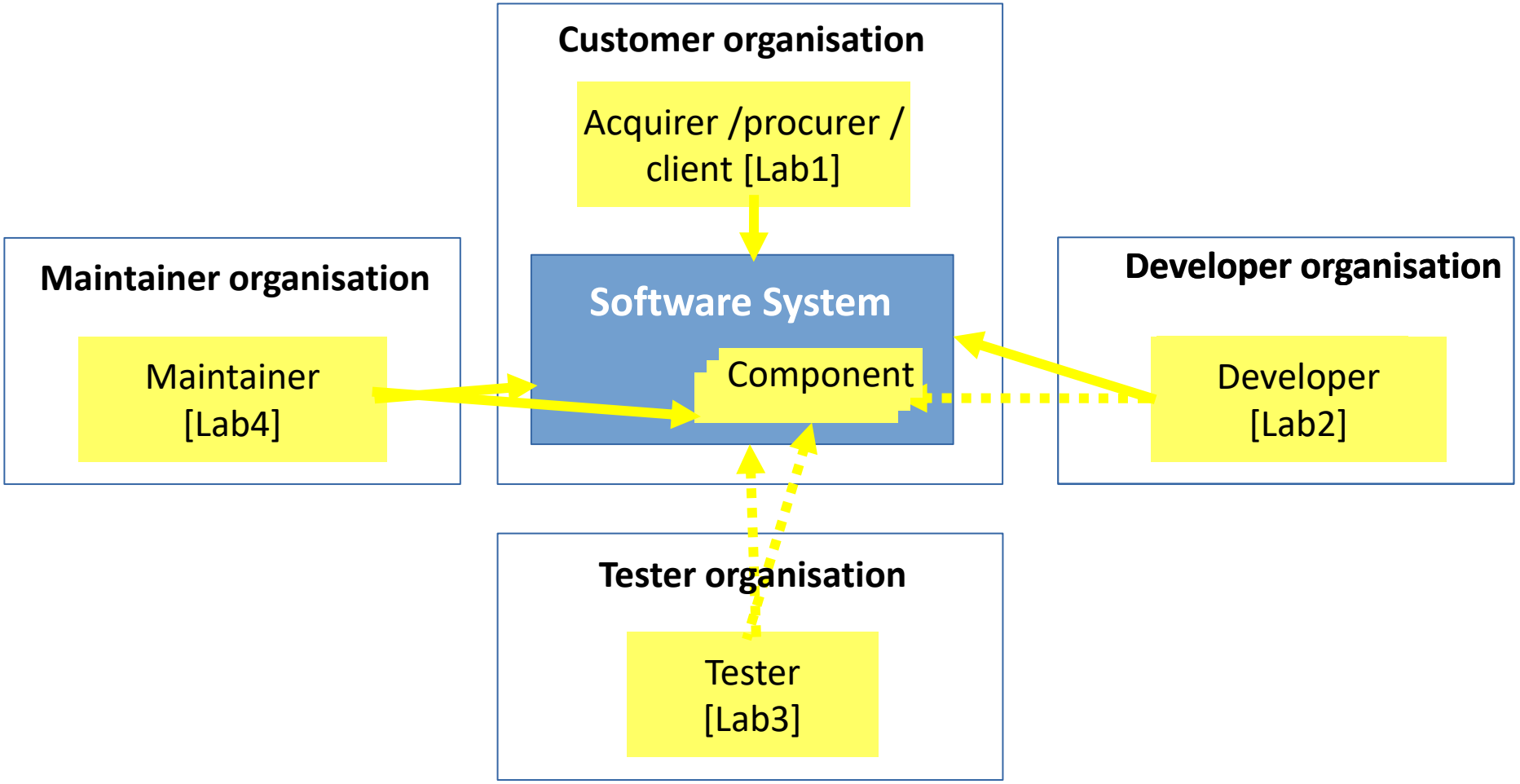
Tester
Quality Engineer
Automation Software Test Engineer
...

Quality: product – requirements - process - people - ...

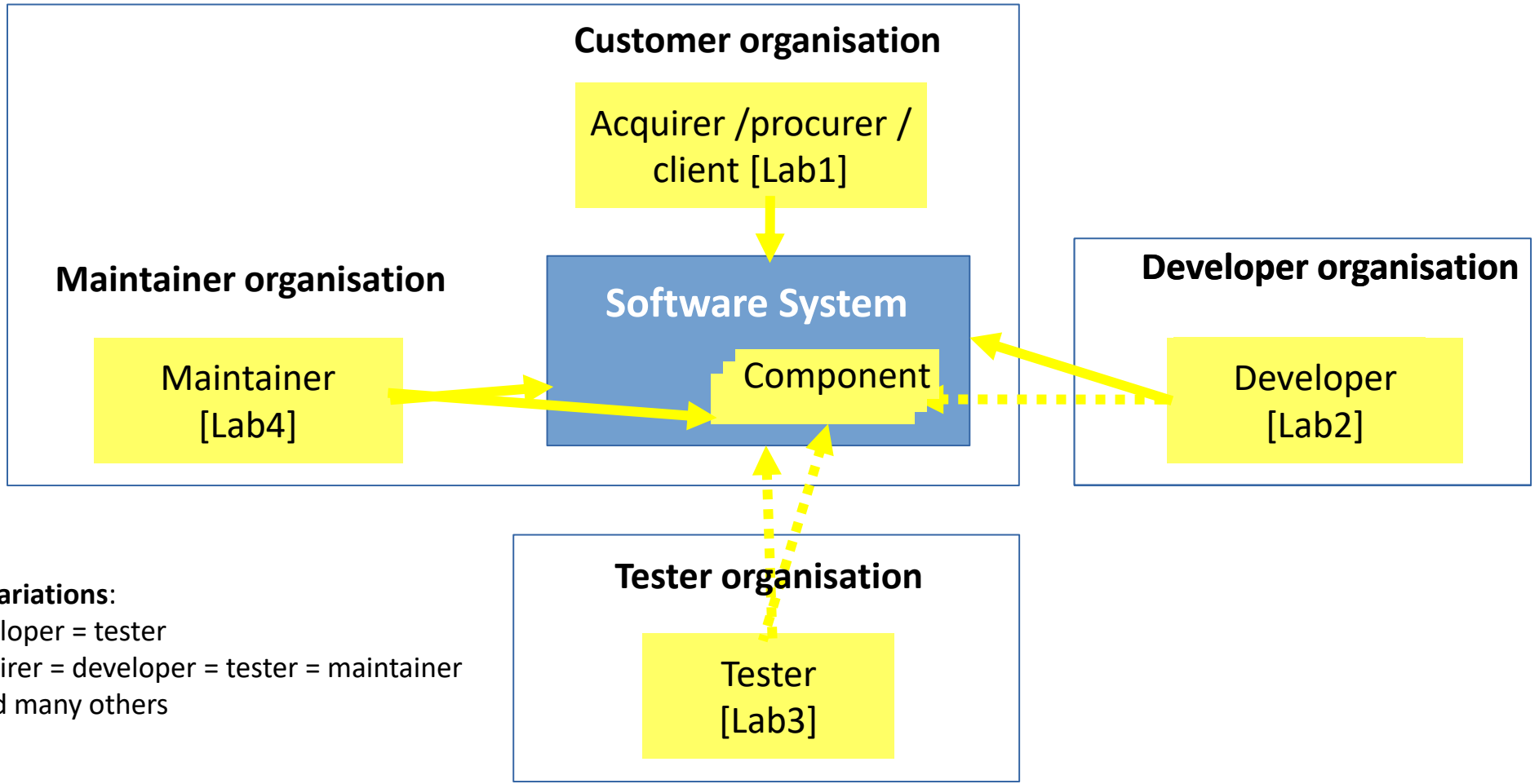
„We want to_do that“



Software life cycle stakeholders [cf Lab 1 ... Lab 4]



Variations: Organisations, processes, systems



More variations:

- Developer = tester
- Acquirer = developer = tester = maintainer
- ...and many others

Quality models

Scope of quality? How to specify?

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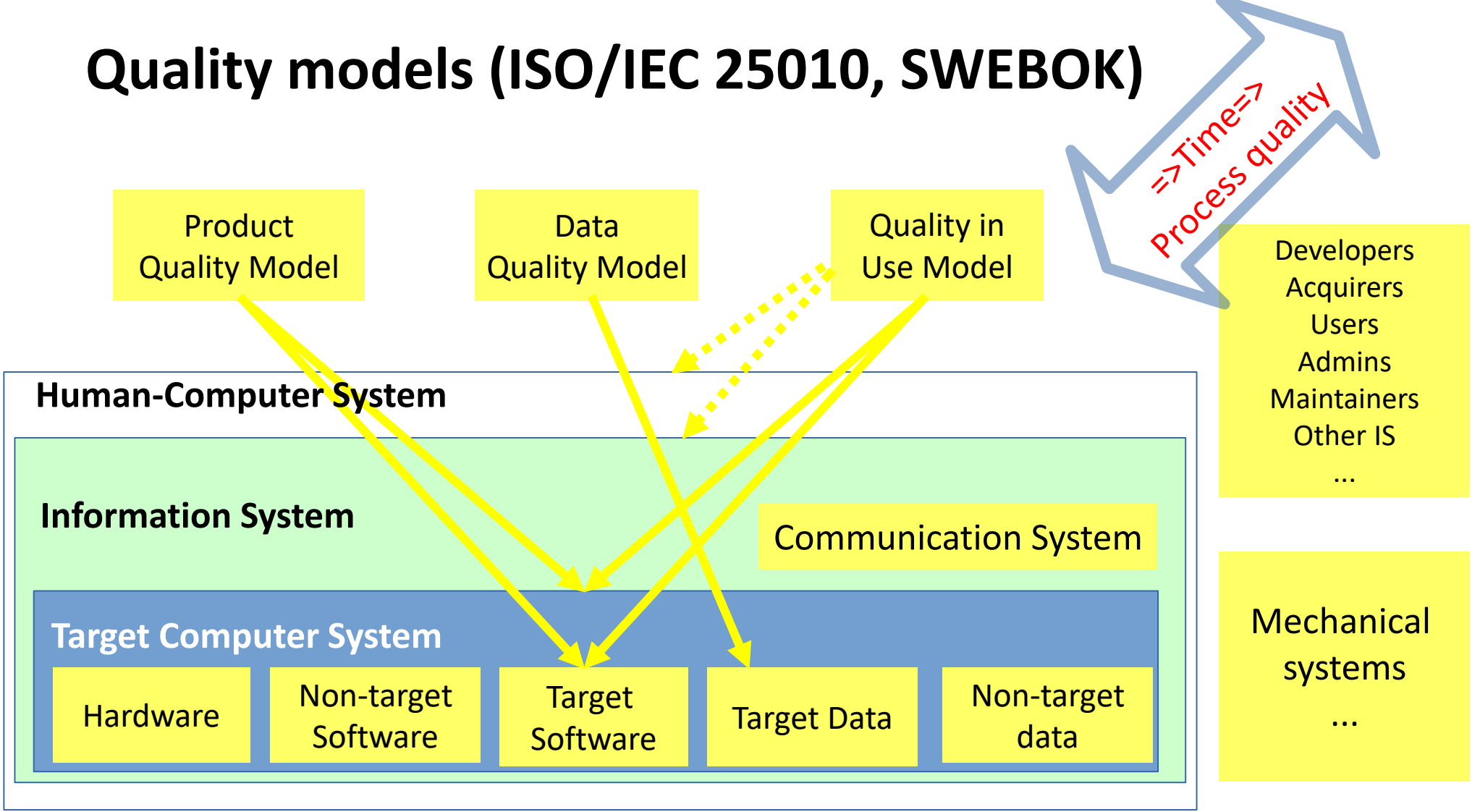
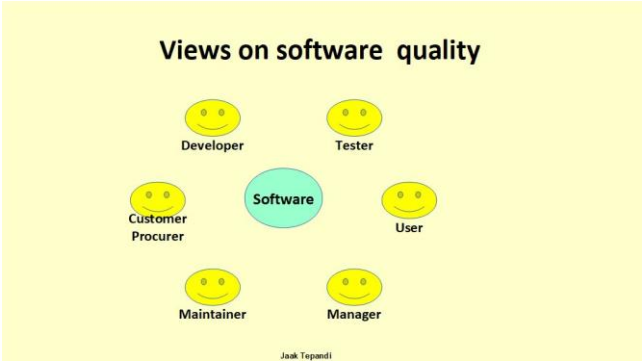
Quality models (ISO/IEC 25010, SWEBOK)



Aspects / models of quality: why needed?

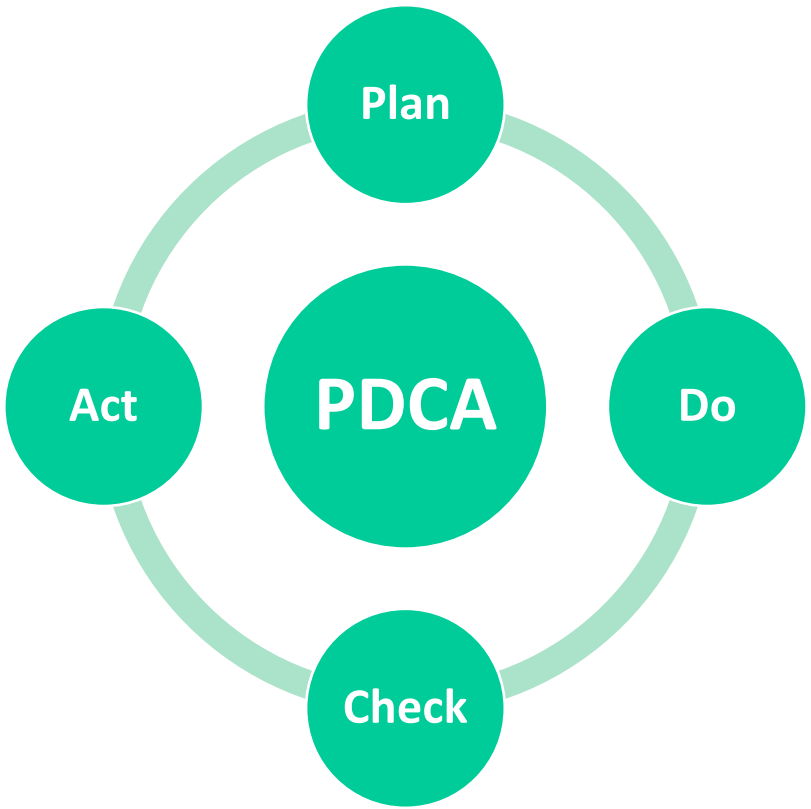


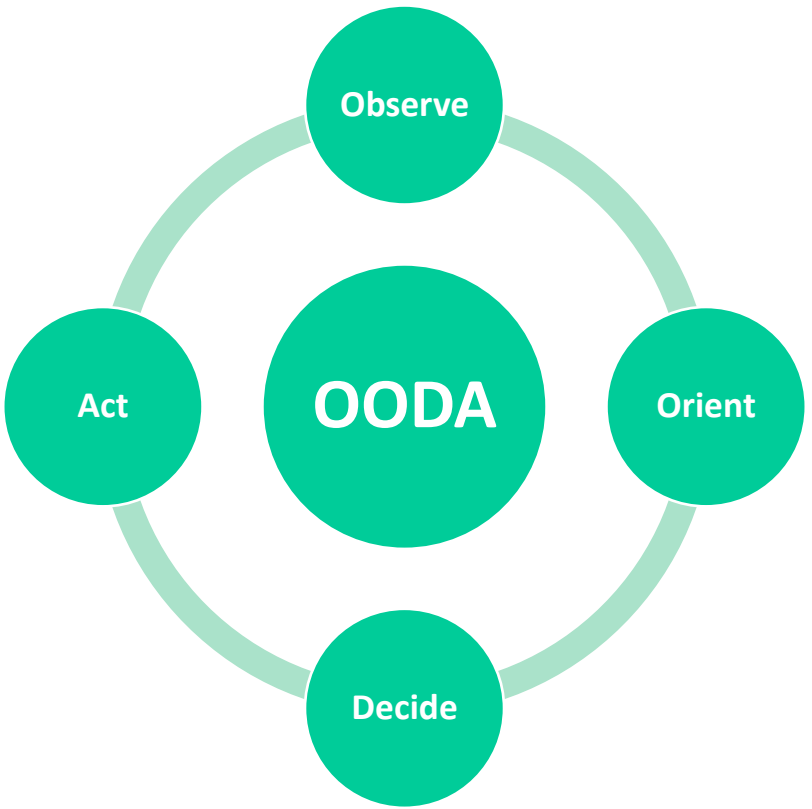
- Product quality
- Data quality
- Quality in use
- Process quality

Guide to the Software Engineering Body of Knowledge, SWEBOK, http://www.computer.org/portal/web/swebok/v3guide

ISO/IEC 25010 Software engineering: Software product Quality Requirements and Evaluation (SQuaRE) — Quality model

Useful process models





Quality management (a lot about parties)

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Quality management etc [...and minimum level]

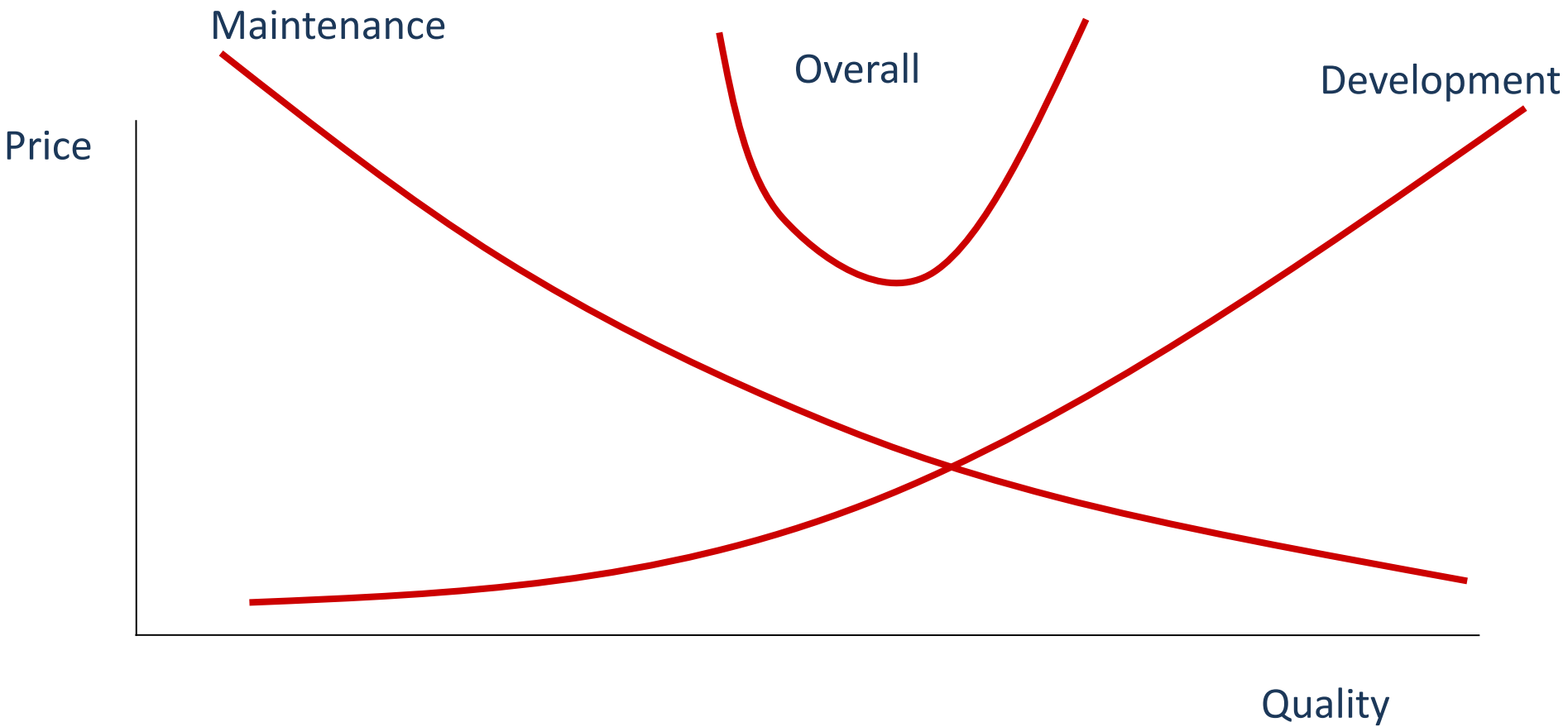
- Quality management (QM) - management with regard to quality, can include establishing quality policies and quality objectives, as well as processes to achieve these quality objectives [... at least, management has a position on quality]

- Quality control - part of quality management focused on fulfilling quality requirements [... at least, some static analysis and testing is performed] ... related to product

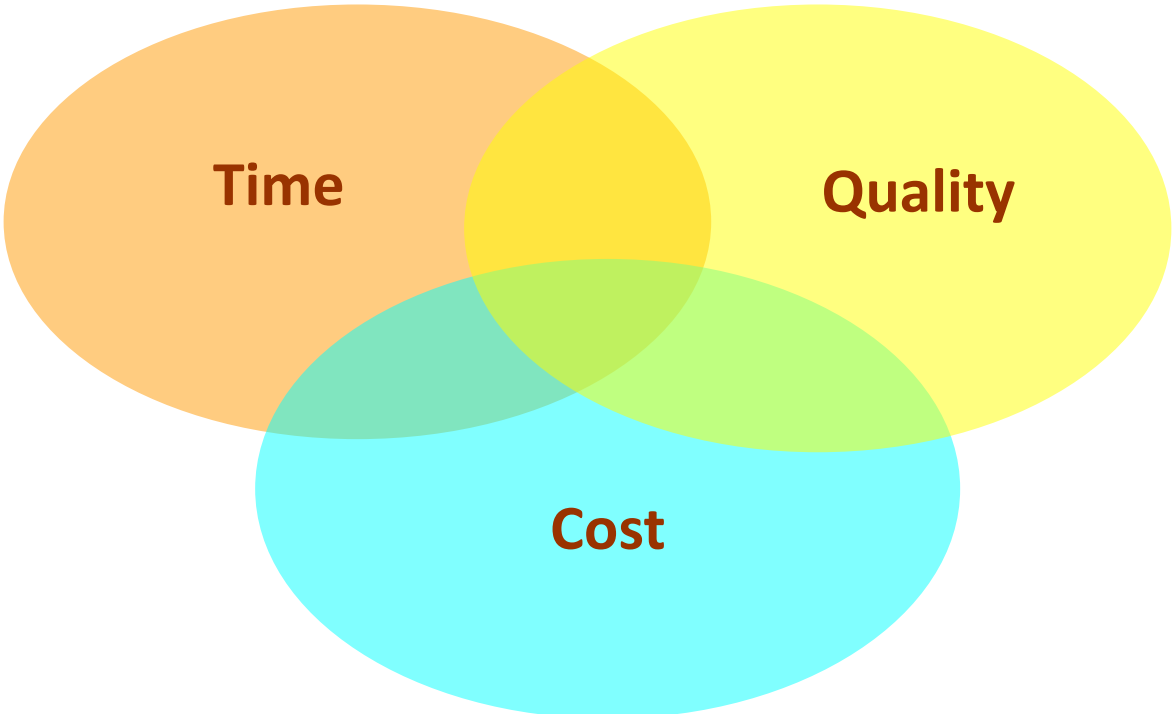
- Quality assurance - part of quality management focused on providing confidence that quality requirements will be fulfilled [...at least, there is feedback on how the policies are implemented] ... related to process

(Based on ISO 9000:2015)

Cost of quality: cf Total Cost of Ownership



Is quality always a tradeoff?
Project management triangle

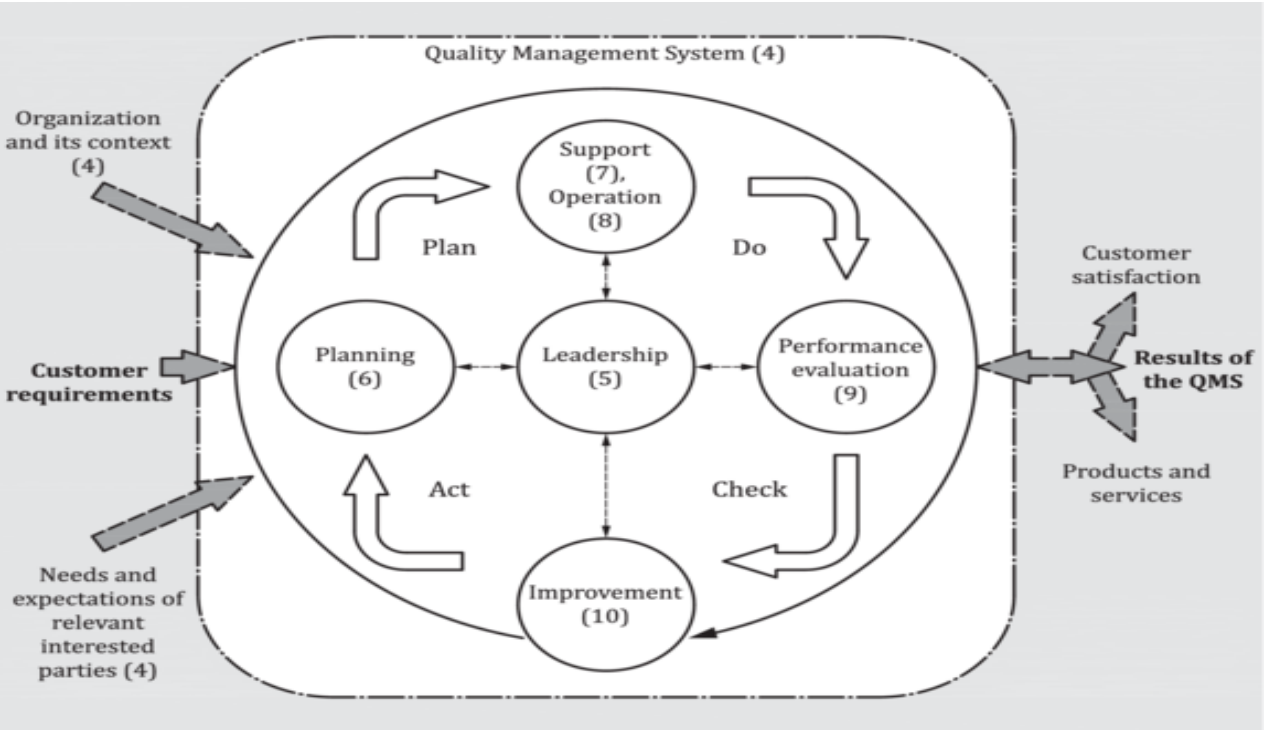


ISO 9000 family of standards: history and present situation

First version 1987 => renewed 1994 (~ 20 standards) => renewed several times => current:

- ISO 9000:2015, Quality management systems. Fundamentals and Vocabulary
- ISO 9001: 2015, Quality management systems. Requirements
- ISO 9004:2018, Quality management. Quality of an organization. Guidance to achieve sustained success
- + more, e.g. ISO/IEC 90003:2018, Software engineering — Guidelines for the application of ISO 9001:2008 to computer software

ISO 9001:2015 and the PDCA cycle



NOTE Numbers in brackets refer to the clauses in ISO 9001:2015

Source: https://www.iso.org/obp/ui/#iso:std:iso:9001:ed-5:v1:en

agilemanifesto.org and quality components

... we have come to value:

Individuals and interactions over processes and tools [people]

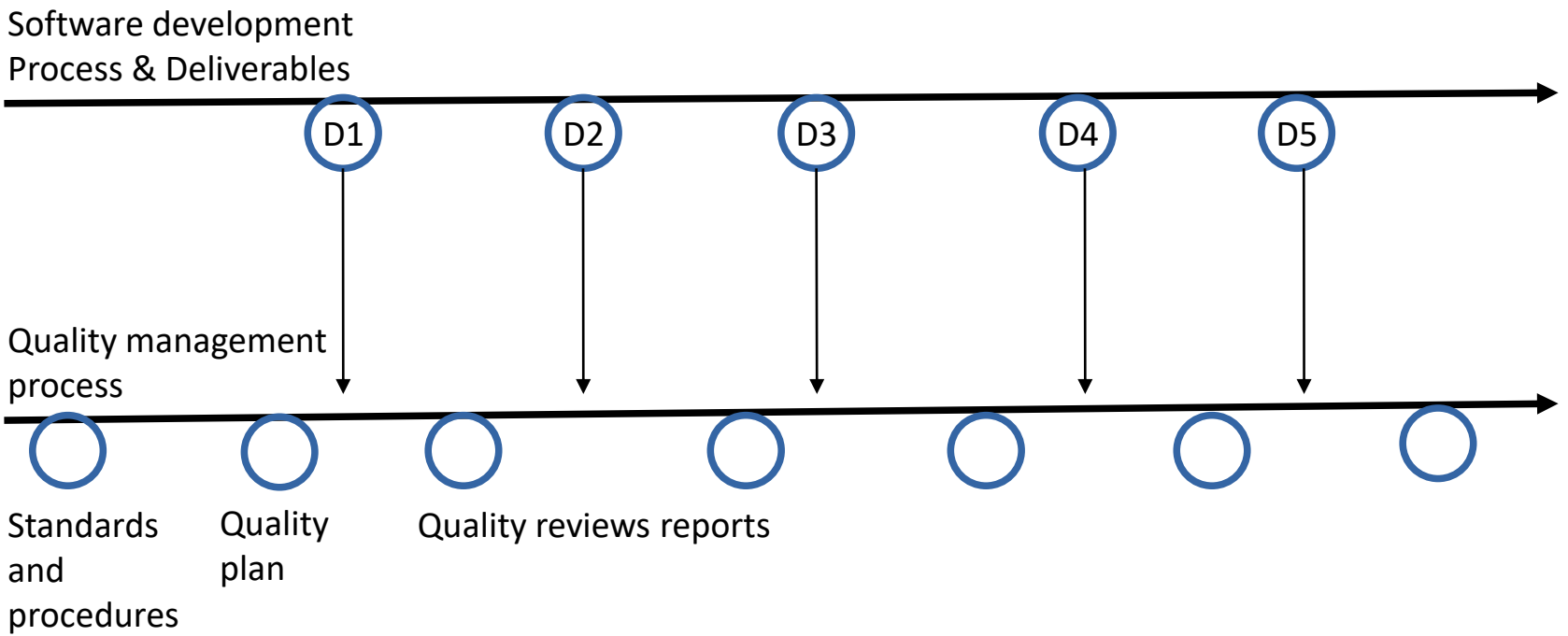
Working software over comprehensive documentation [product]

Customer collaboration over contract negotiation [requirements]

Responding to change over following a plan [processes]

… That is, while there is value in the items on the right, we value the items on the left more.

Quality management and software development



Ian Sommerville. Software Engineering. Ninth Edition. Addison-Wesley

(More) software quality challenges

Software complexity

Unclear / not understood requirements

Unrealistic deadlines

Insufficient resources

Lack of personnel

Software is part of organisation, and organisations are difficult to change

Software quality is not considered from beginning to end

Complex standards

Inadequate processes, methods, tools

Overcoming QM for the sake of QM (or certification, fashion, etc)

Quality: value and smells

QM needed:

- Understanding organisation goals
- Identifying and strengthen critical success factors
- Support reaching the goals in deadline and budget
- Example: Ensuring that critical errors are removed before the software is deployed to millions of customers

QM not needed (“smells”):

- Bureaucracy
- Unnecessary rules
- Inflexible processes
- Example: products and documentation not needed in the short or long run

The course(s)

The course

Software quality related methods and techniques

Independent of concrete programming languages, tools, environments...

- … but using and teaching these in order to present course content

Changing, developing, responding to needs

Using large collections of requirements (standards etc)

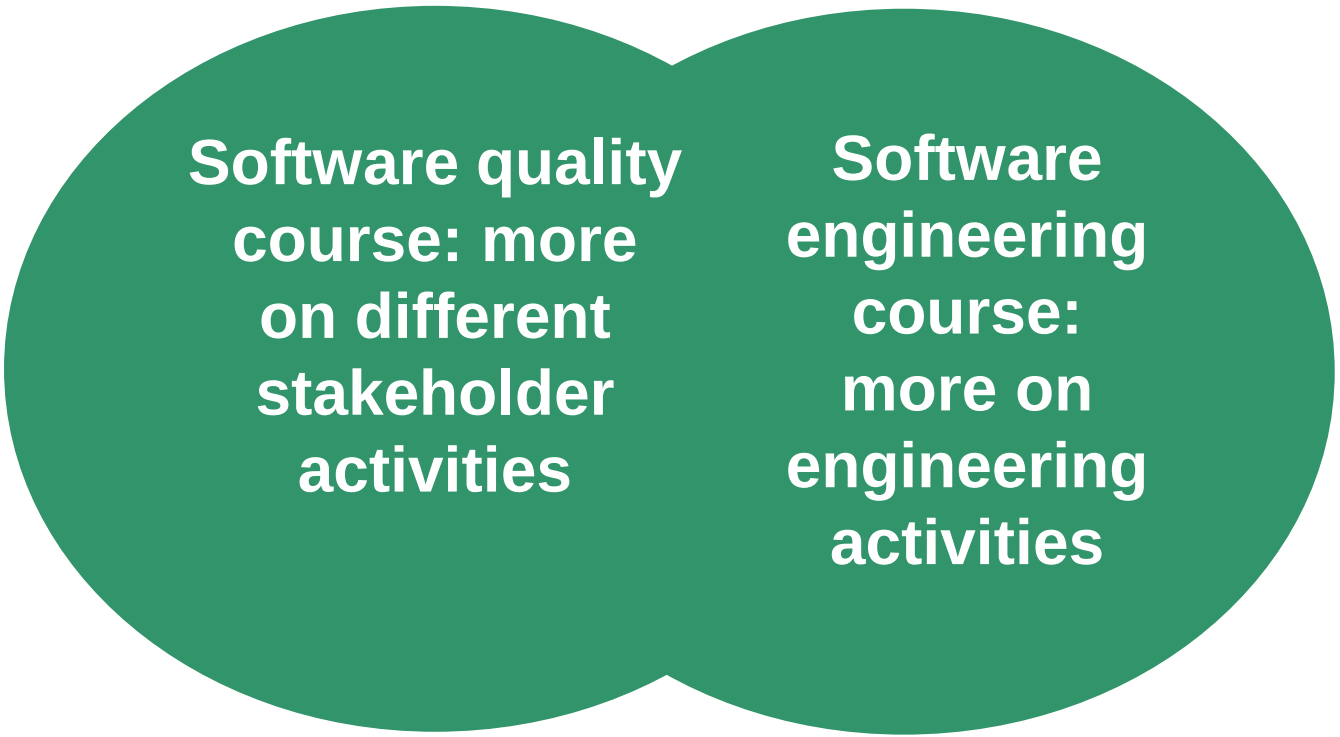
Presenting several roles besides developer + related processes

Not a VTV course (but VTV is a component)

Knowledge: SW QM (requirements / product / testing / maintenance)

Skills and practical experiences: requirements specification, code quality, tests and tools, static methods, processes etc

Courses: quality management and software engineering



The course and ACM/IEEE Computing Curricula

- ACM/IEEE Computing Curricula, Software Engineering Volume, http://www.acm.org/education/curricula-recommendations
- The current course integrates basic concepts of "Software Quality“, "Software Verification and Validation", "Software testing", and (to less extent) ″Software Engineering Process″

+ Guide to the Software Engineering Body of Knowledge, SWEBOK Ch 4 (Software testing), Ch 10 (Software quality),...,

Lectures vs slides&conspectus: Not one-to-one related

Lectures

- present ideas
- are interactive
- refer to and explain slides & conspectus
- do not always fully cover slides & conspectus

Slides (English) & conspectus (Estonian)

- give detailed content
- give references

Lectures, practices, and COVID-19

Lectures, practices, and labs are synchronised

COVID: let us keep distance and follow the University COVID instructions

If you are ill, please stay at home, even if the symptoms are rather mild

Lecture participation vs recordings

Impact of lecture capture availability on student attainment – summary:

- Lecture capture viewing shows no significant relationship with attainment
- Capture viewing also fails to compensate for the impact that low attendance has on attainment
- Thus, the net effect of lecture capture introduction ... is generally negative
- The study serves as a useful example (that can be communicated students) of the pitfalls of an over-reliance on lecture capture as a replacement for lecture attendance

https://link.springer.com/article/10.1007/s10734-018-0275-9

Make it as simple as possible, but no simpler

- Quality – degree of fulfilment of requirements
- Management – creating processes, directing, controlling
- Quality management - management with regard to quality
- Quality control – are quality requirements fulfilled?
- Quality assurance – will quality requirements be fulfilled?
- Components of quality - parties, product, requirements, processes,...
- Procurer, acquirer, customer – receives the value from the product
- User – uses the product
- PDCA – Plan Do Check Act
- „Quality is free“

Quality: people - requirements – product - process

Learning outcomes

- Give examples of the need for software quality
- Analyse different concepts and components of quality
- Explain how quality is context specific
- Characterise stakeholders related to quality
- Explain main quality models
- Explain quality management and challenges, the cost of quality, quality related components in software technologies
- Outline the ISO 9000 standards series, PDCA, OODA

Additional reading (examples)

Ian Sommerville. Software Engineering. Ninth Edition (or later). Addison-Wesley, Ch 1,24.

Daniel Galin, Software Quality assurance from theory to implementation, Pearson - Addison-Wesley. Chapter 2.

Guide to the Software Engineering Body of Knowledge (SWEBOK), IEEE. Chapter 13, Section 8.

Certified Tester Foundation Level Syllabus, ISTQB. Chapter 1.1.

moodle.taltech.ee - slides, arrangement, references, labs etc (short summary: tepandi.ee)