
MCI
MANAGEMENT CENTER
INNSBRUCK
SYSTEMS PLANNING
Software Quality Management
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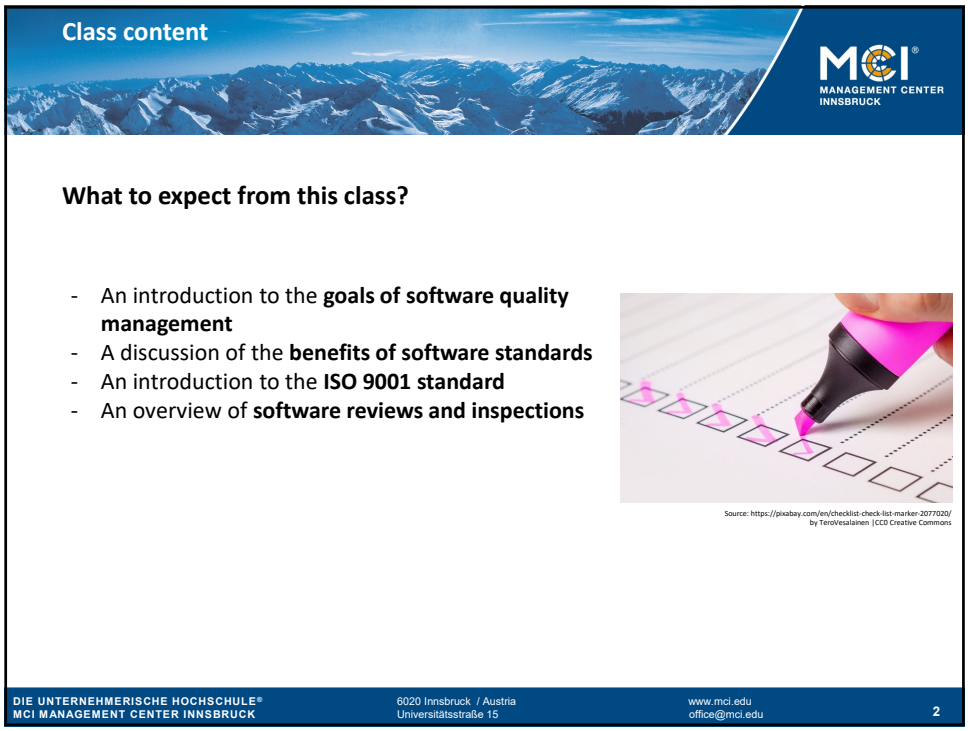
Class content
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What to expect from this class?
- An introduction to the goals of software quality management
- A discussion of the benefits of software standards
- An introduction to the ISO 9001 standard
- An overview of software reviews and inspections
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Class learning goals

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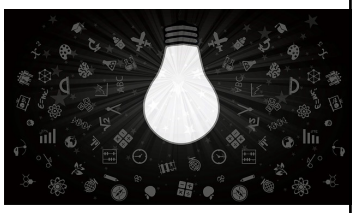
What should be your learning outcome?

- Understand the **goal of software quality management**
- Know the **benefits of standards**
- Be familiar with the **principles of the ISO 9001 standard**
- Know **the goal of software reviews and inspections**



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Software Quality Management

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Software Quality

- Problems with software quality were **initially discovered in the 1960s**
- Software was **slow, unreliable, difficult to maintain, and hard to reuse**
- **New techniques** and **better software** testing led to improvements

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Quality management for software systems

Software quality management **has 3 concerns**:

- **Processes at the organizational level**
  Processes and standards that will lead to high quality software (documentation, design, and code)
- **Processes at the project level**
  Check that organizational processes have been followed
- **Quality management at the project level**
  Establish **a quality plan** for the project which sets out the **quality goals** for the project and defines what **processes and standards** are to be used

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Quality assurance, quality control, quality management

Quality assurance
- Definition of processes and standards that should lead to high quality products
- Introduction of quality processes into the manufacturing process

Quality control
- Seek out products that do not meet the required quality level
- Not really used in software engineering

Quality management
- Check whether procedures, processes and standards are met
- Usually taken on by a **separate QM team** which is different from the development team

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Quality management process

Source: Sommerville, I. (2011). Software Engineering, 9th Ed. Boston, MA, USA: Pearson Education Inc.

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Quality management team

- Optimally quality management is not associated with any particular group **(i.e. QM team),** but rather **has organization-wide responsibility**
- If **QM lies with the project management** there may arise the temptation to sacrifice quality to meet goals
- However, in **small organizations** it is often impossible to have an explicit QM team

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Quality planning

- Developing a **quality plan for a project**
- Describe the **desired software qualities and how they are to be assessed**
- Without definition, there may be **conflicting assumptions** about the desired quality
- **Agile methods** use a **less formal approach** to quality management i.e. the customer usually evaluates the quality through testing

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Quality culture

- Standards and processes are important but quality managers should also aim to develop **a 'quality culture'**
- **Everyone** responsible for software development should be **committed to produce high quality software**
- They should **themselves develop new approaches for quality improvement**
- There are also **intangible qualities** that cannot be measured by standards (e.g. readability of code, elegance, etc.)

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Software Quality

- Fundamentals of quality management were established by **manufacturing**
- The idea was that **products could be completely specified** (Crosby, 1979)
- Consequently one can **check a product against its specification**
- A small **tolerance was allowed** ('almost right')
- This notion of quality **cannot be applied to digital systems!**

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Software Quality

The idea of tolerance **is not applicable** to software/digital systems because:

- It is **difficult to write complete and unambiguous specifications**
- Specifications usually **integrate requirements from several classes of stakeholders** and hence are full of compromise
- It is **impossible to measure certain quality characteristics** (e.g. maintainability)

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Software Quality

The QM team has to use their judgment to decide if an acceptable level of quality has been achieved. Some questions asked may include:

- Have **programming and documentation standards** been followed in the development process?
- Has the software been properly **tested**?
- Is the software sufficiently **dependable** to be put into use?
- Is the **performance** of the software **acceptable** for normal use?
- Is the software **usable**?
- Is the software **well-structured and understandable**?

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Note: you may have a separate testing group for checking software against its requirements!

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Software Quality

- **Subjective quality** of software systems is **largely based on non-functional characteristics**
- If the **functionality is not exactly** what the user expects, **he/she will find a way around this**
- Yet, if the software is **unreliable or too slow**, then it is practically **impossible to achieve any goals** with it
- Boehm et al. (1978) suggest **15 important software quality attributes**

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Software Quality Attributes (Boehm et al., 1978)

Safety	Understandability	Portability
Security	Testability	Usability
Reliability	Adaptability	Reusability
Resilience	Modularity	Efficiency
Robustness	Complexity	Learnability

Source: Sommerville, I. (2011). Software Engineering, 9th Ed. Boston, MA, USA: Pearson Education Inc.

Note: you cannot optimize for all of these attributes e.g. **improving robustness may lead to loss of performance.** The **quality plan** needs to **define** which **attributes** are important.

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Manufacturing vs. Software Engineering

- In **manufacturing** there is a **clear link between process and product quality**
- Once the **process is well defined** it will consistently **output high-quality products**
- **However, software is not manufactured but rather designed!**
- There is a **high influence** of individual **skills** and **creativity**
- Still, **best practices encapsulated in standardized processes** can help produce high quality software

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Software Standards

- An important part of quality assurance is the **definition** or **selection** of standards
- Once standards have been selected, project-specific processes have to be defined to **monitor** the use of these standards

2 types of software engineering standards
- **Product standards**
  Applies to the software product being developed i.e. documentation standards, coding standards, etc.
- **Process standards**
  Define the processes to be followed during development e.g. definition of specification, design and validation processes, etc.

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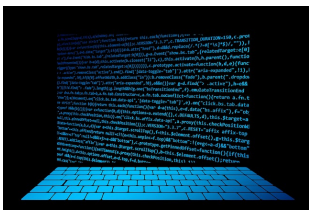
Software Standards and Engineers

Although engineers usually agree about the general need for standards, **they often find reasons** why a certain standard is not necessary

QM should therefore take the **following steps**:
- **Involve software engineers** in the selection of product standards
- **Review and modify** standards regularly to reflect changing technologies
- **Provide software tools** to support standards



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Software Standards and Engineers

Different types of software need different standards. **QM and PM** need to **decide** early in the project which standards

- To **use without change**
- To **modify**
- To **ignore**

Also, **new standards** may have to be created in response to customer or project requirements

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The ISO 9001 Standard Framework

- The ISO 9000 standards are an i**nternational set of standards** that can be used in the development of all quality management systems in all industries
- **ISO 9001** is the **most general** of these standards
- It was originally **developed in 1987** with its most recent **revision in Sept. 2015**
- It **sets out general principles**, **describes quality processes and lays out organizational standards and procedures** that should be defined
- All these should be documented in the **organizational quality manual**

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The ISO 9001 Standard Framework

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The ISO 9001 Standard Framework

- Some software customers demand their **supplier should be ISO 9001 certified** as this **gives them confidence** that the company has an approved quality management system in place
- Yet, this **does not mean that ISO 9001 certified companies develop better** software than those without this certification
- **Agile methods** usually avoid endless documentation and rather focus on the code being developed. Also, these **companies feel opposed** to what they see as bureaucratic **overhead of standards**

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Reviews and inspections

- QA activities that **check the quality of project deliverables**
- Usually involves a **group of people who examines** the software
- It is based on the **documents that have been produced** during the development process
- It is checked for **consistency** and **completeness**
- It is also used to help **discover problems and omissions**
- The conclusion of the reviewing process should be **formally recorded** as part of the QM process

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Reviews and inspections

- The purpose of reviews is to **improve software** quality, **not to assess performance** of people
- It is inevitable that **mistakes made by individuals** will be **revealed to the whole team**
- Project managers therefore, need to be **sensitive**
- They should have developed a working culture that provides **support without blame**

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The review process

The review process is normally structured into **three phases**:

- **Pre-review activities**
  Planning and review preparation; team; time and place; documents; etc.
- **The review meeting**
  'walk through' the document with the reviewing team; should be short i.e. approx. 2 hours
- **Post-review activities**
  Issues and problems raised during the review should be addressed; bug-fixing, refactoring, etc.

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Review

Review team
The review team usually consists **of three to four people** with at least **one senior** who will take the responsibility for **making significant technical decisions**

Agile methods
- In agile the review process is usually **informal**
- **Scrum** uses a **review** meeting after each iteration
- **XP** uses **pair programming** for continuous reviewing

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Program inspections

- 'peer reviews' where **team members collaborate** to find bugs
- Usually **line-by-line code review**
- Aims at identifying **logical errors**, **anomalies** in the code that might indicate an erroneous condition, or **features** that have been **omitted**
- Looks at both **program code** and **design models**
- During inspection checklists **taken from books** or **from knowledge** of common defects may be used

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Software Measurement Metrics

- Tries to **derive a numeric value or profile** for an attribute of a software component
- May be used to **draw conclusions about the quality of software or assess the effectiveness of software processes, tools and methods**
- **Long-term** goal is to **use measurement in place of reviews**
- Numbers could **highlight areas of the software** that could be improved
- However, there is still quite **a long way to go for this ideal solution**

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What you should have taken away from this class:

- **Software quality management** is **concerned** with ensuring that **software has a low number of defects** and that it reaches the required standards of maintainability, reliability, portability, and so on. It includes **defining standards** for processes and products and **establishing processes** to check that these standards have been followed.
- Software standards are important for **quality assurance** as they represent an identification of **'best practice'**. When developing software, standards provide a solid foundation for building good quality software.
- You should document a **set of quality assurance procedures** in an **organizational quality manual**. This may be based on the generic model for a quality manual suggested in **the ISO 9001 standard.**
- **Reviews** of the software process deliverables **involve a team of people** who check that quality standards are being followed. Reviews are the most widely used technique for assessing quality.
- In a **program inspection** or **peer review**, a small team systematically checks the code. They read the code in detail and look for possible errors and omissions. The problems detected are then discussed at a **code review meeting**.
- **Software measurement** can be used to **gather quantitative data** about software and the software process. You may be able to use the values of the **software metrics** that are collected to make inferences about product and process quality.

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Thank you for your attention!

mentoring the motivated.