

# Systems Engineering

## Lecture 5

### Introduction to Software Quality Management

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## Learning outcomes

After attending this lecture you should be able to:

- Discuss the issue of Software Quality and the activities present in a typical Quality Management process.
- Discuss the advantages and difficulties presented by the use of Quality standards in Software Engineering
- Explain the origins and rationale behind the ISO 9000 standards.
- Describe two complementary approaches to Quality Control.
- Define the term “Software Metric” and what is meant by an internal and external quality attribute.

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## Software Quality Management

### What is Quality?

- A product should meet its specification [Crosby, '79]

### What is Software Quality?

- Difficult to define when specification does not necessarily = customer expectation.
  - Requirements often incomplete and/or inconsistent
  - Conflicts between customer and developer quality requirements
  - Ambiguity

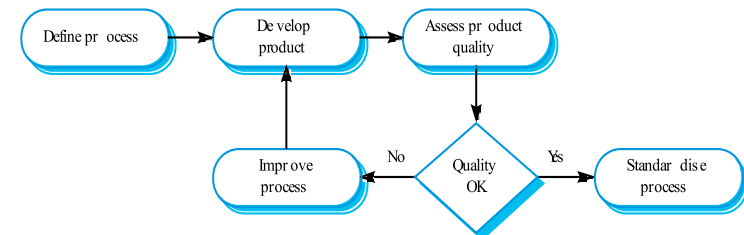
### The Quality Compromise



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## Product reflects Process

### Strong link in manufacturing:



### More complex link in Software Engineering:

- Individual skills and experience can have a large impact on quality.
- External factors e.g. compressed development schedule or application novelty can impact quality.

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# Quality Management Activities

- [ Quality Assurance
  - Establish organisational procedures and standards for quality.
- [ Quality Planning
  - Select procedures and standards for a particular project.
- [ Quality Control
  - Ensure quality procedures and standards are followed by the software development team.
- [ Quality Management should be independent from project management.



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# Quality Assurance (QA)

- [ QA procedures define how...
  - We can achieve high quality.
  - We can identify whether we have achieved this.
- [ Product Standards
  - Documentation standards.
  - Coding standards.
  - Presentation standards / product & document structure.
- [ Process standards
  - Define processes to be followed during software development.
  - Use to ensure delivery of product standards.

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# Quality Assurance (QA)

- [ Examples of each:

## Product Standards

Design review form  
Requirements document structure  
Method header format  
Java programming style  
Project plan format  
Change request form

## Process standards

Design review conduct  
Submission of documents  
Version release process  
Project plan approval process  
Change control process  
Test recording process

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# Using Software Standards

- [ Advantages
- [ Disadvantages

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# Using Software Standards

## Advantages

- Encode best practice / organisational knowledge.
- Adherence to a formal standard forces adherence to this best practice.
- Continuity between developers.

## Disadvantages

- Can be overly bureaucratic (overhead).
- Perceived as tedious, pedantic.
- May not reflect recent innovations in best practice.

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# Avoiding the problems

- Involve practitioners in standards development.

- Engineers should understand the rationale underlying a standard.

- Review standards and their usage regularly.

- Standards should have associated tool support.

- Excessive clerical work is the most significant complaint against standards.

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# ISO 9000 Standards

- Developed out of independent need for quality certification (from BS 5750)

- Some customers demand quality certification

- An international set of standards for quality management

- ISO 9001:2000 is a generic model of the quality process; ISO 9001:2008 clarifies ISO 9001:2000

- ISO 9001:2008 applicable to any organisation that designs, develops and maintains products (or services)

- ISO 9000-3 interprets 9001 for software dev.



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# Features of ISO 9001:2008

- Organisational Quality Manual

- Say what you do. Do what you say
- Write it down.

- Companies select appropriate clauses from the ISO 9001:2008 spec.

- Some are mandatory

- Compliance Auditing

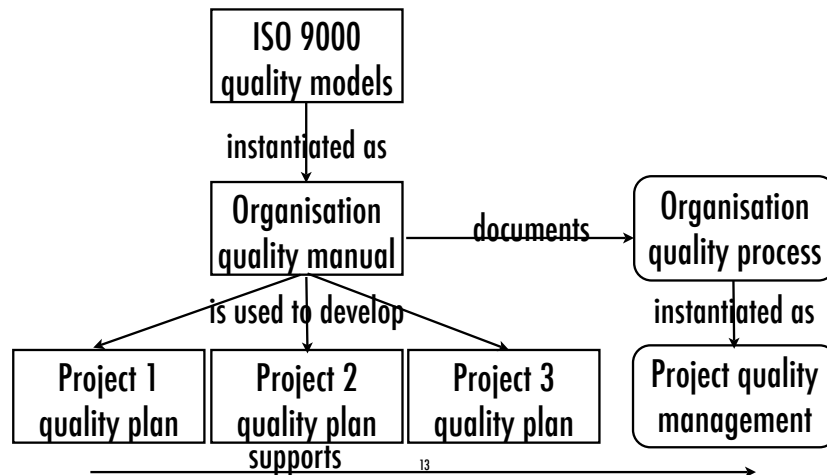
- External bodies (certification); Trained internal staff

- Revisions in 2000 from 1994 version

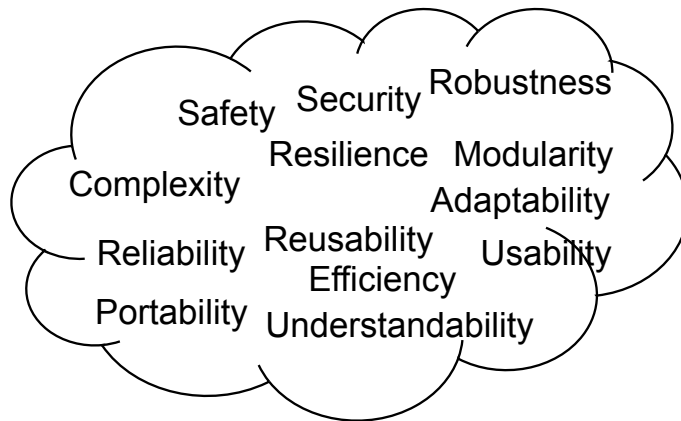
- Process improvement. Examines risk.

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# Applying ISO 9000



# Desired Product Qualities?



# Quality Planning

- [ Writing a quality plan:
  - Identify which organisational standards apply.
  - Determine any new standards to be used.
- [ A quality plan should:
  - describes the desired product qualities,
  - document their relative importance, and
  - specify the processes by which these are assessed.

# Quality Planning

- [ Quality plan structure:
  - Product introduction
  - Product plans
  - Process descriptions
  - Quality goals
  - Risks and risk management
- [ Quality plans should be short, clear documents.
  - If they are too long, no-one will read them.

# Quality Control

- [ Quality control
  - checking the software development process to ensure that procedures and standards are being followed.
- [ There are two approaches to quality control:
  - Quality reviews, and
  - Automated software assessment and software measurement.

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# Quality Reviews

- [ Objective is the discovery of system defects and inconsistencies.
  - Documentation driven.
  - Mismatches between product components and documentation.
  - Deviation from quality standards.
- [ Review teams should be relatively small and reviews should be fairly short.

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# Automated Measurement

- [ Software measurement
  - deriving a numeric value (software metric) for an attribute of a software product or process.
- [ This is intended to allow for objective comparisons.
- [ May be used to predict product attributes or to control the software process.
- [ Most organisations still don't make systematic use of software measurement.
  - There are few established standards in this area.

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# Picking a good metric

- [ Most often we want to measure external quality attributes
  - e.g. maintainability, reliability.
- [ We are usually only able to measure internal attributes (metrics)
  - Static: Size of code, cyclomatic complexity.
  - Dynamic: Average load.
- [ We must ensure metrics...
  - Can be accurately measured.
  - Have well defined mapping to external attributes of interest.

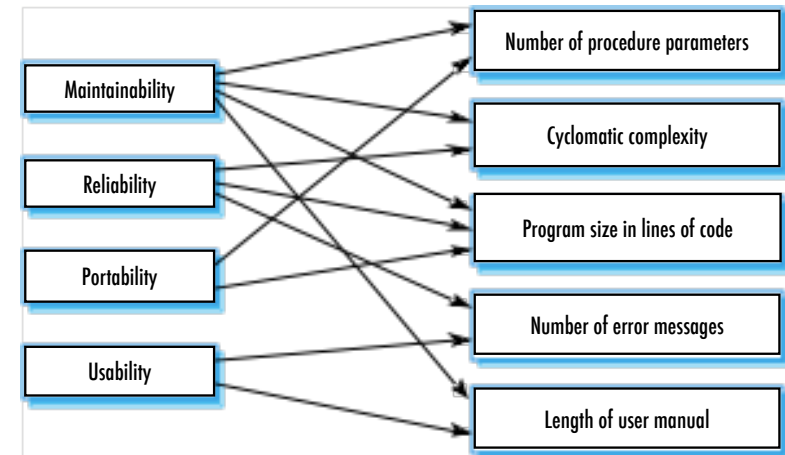
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## Over to you...

- [ Can you think of any internal metrics that would be a useful measure of external quality attributes

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## Internal metrics that usefully measure external quality attributes



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## Summary – you should now be able to...

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