Software quality
Texts and Readings

- Lecture handouts.
Building quality into software products

Content overview

- Quality defined
- Quality models
- Quality characteristics
- Interrelationships between characteristics
- Measuring quality
- Grouping characteristics
- Prioritising characteristics
Software Quality defined
IEEE std 729-1983

- The totality of **features** and **characteristics** of a software product that bear on its ability to satisfy given needs, for example, conform to specification.
- The **degree** to which software possesses a desired combination of attributes
- The degree to which a customer or user perceives that software meets his or her composite expectations.
- The composite characteristics of software that determine the degree to which the software in use will meet the expectations of the customer.
Software Quality defined

Software quality is the extent to which a set of desirable features (attributes or characteristics) are incorporated into a software product in order to enhance its lifetime performance.
MIS Triad
Brookes et al.

Quality Perspective
- Software product development
- Strategic Considerations
- Software product usage

Brookes, Grouse, Jeffery and Lawrence (1982)
Information system design, Prentice Hall
Software product usage dictates that
- the product possesses a desired combination of quality attributes or characteristics

Software product development dictates that
- quality attributes or characteristics are built into the product during the development life-cycle
- an appropriate model is used for quality assurance during design, development, production, installation and servicing, (i.e. ISO 9001:1994 and IOS/DIS 9000-3 Guidelines)
Models of Quality Attributes

- McCall, Richards and Walters
  - (1976-77)

- Boëhm
  - (1978)

- International Standards
  - ISO, IEEE, DIN, and military standards
Quality Factors
McCall et al.

- Correctness
- Reliability
- Efficiency
- Integrity
- Usability
- Maintainability
- Testability
- Flexibility
- Portability
- Reusability
- Interoperability (Transferability)

Aspects of maintainability
Quality characteristics

Since 1977 three important developments have influenced the set of characteristics.


   - Suitability
   - Ease-of-use
   - Adaptability
2 ISO 9001:1994 *Quality systems - Model for quality assurance in design, development, production, installation and servicing.*

- Installability
- Functionality
- Safety
- Security is the new name for integrity
- Statutory obligations are introduced
Quality characteristics
Extended to comply with European Council directive (1990) relating to display screen equipment and ISO/DIS 9000-3 (1996)

| ✓ Suitability | ✓ Safety |
| ✓ Installability | ✓ Security |
| ✓ Functionality | ✓ Correctness |
| ✓ Adaptability | ✓ Efficiency |
| ✓ Ease-of-use | ✓ Portability |
| ✓ Learnability | ✓ Testability |
| ✓ Interoperability | ✓ Maintainability |
| ✓ Reliability | ✓ Re-usability |
Quality characteristics

- See handout re:
  - The external characteristics of a software product.

- See handout re:
  - The internal quality characteristics of a software product.
Suitability - The extent to which a program complies with the user community ethos, culture and/or mode of use.

Installability - The effort required to install a program and configure it to the user’s requirements.
- **Functionality** - The extent to which the feature set and the capabilities of a program satisfy the user’s requirements.

- **Adaptability** - The effort required to adapt the user interface to suit the user’s preferences and mode of working.
Ease-of-use - The amount of human effort required to operate a program.

Learnability - The ease with which new users can begin effective interaction and achieve maximal performance.
ν **Interoperability** - *The effort required to couple one system with another.*

ν **Reliability** - *The extent to which a program can be expected to perform its intended function with required precision.*
Safety - The extent to which the software’s safety-critical requirements are satisfied.

Security (Integrity) - The extent to which access to software or data by unauthorised persons can be controlled.
Correctness - The extent to which a program satisfies its specifications and fulfils the user’s mission objectives.

Efficiency - The amount of computing resources and code required by a program to perform a function.
Portability - The effort required to transfer a program from one hardware configuration and/or software system environment to another.

Testability - The effort required to test a program to ensure it performs its intended function.
Maintainability - The effort required to locate and fix an error in an operational program. (Adaptive, perfective & corrective)

Re-usability - The extent to which a program can be used in another application - related to the packaging and scope of the applications that programs perform.
Interrelationships between characteristics

Although all software quality characteristics are desirable there can be conflict between some of them. For example,

– Portability conflicts with efficiency.
– Portability and re-usability are concerned with solving problems that might not be directly related to the original requirements.
Interrelationships between quality characteristics - after Perry using McCall

<table>
<thead>
<tr>
<th></th>
<th>Correctness</th>
<th>Reliability</th>
<th>Efficiency</th>
<th>Integrity</th>
<th>Usability</th>
<th>Maintainability</th>
<th>Testability</th>
<th>Flexibility</th>
<th>Portability</th>
<th>Re-usability</th>
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<tr>
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* = Inverse  blank = Neutral  _ = Direct
Examples to approaches to measuring quality.

- Reliability
  - Mean Time Between Failure (MTBF)
  - Mean Time To Recover
  - Mean Time To Rerepair (MTTR)

- Usability
  - Effectiveness, efficiency & satisfaction

- Efficiency
  - Algorithm checking
<table>
<thead>
<tr>
<th>Quality Factor</th>
<th>% Weighting</th>
<th>User/Evaluator's Subjective Rating (e.g. 1-10)</th>
<th>Total</th>
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<tbody>
<tr>
<td>suitability</td>
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<td>installability</td>
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<td>maintainability</td>
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<td>re-usability</td>
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<tr>
<td><strong>Total</strong></td>
<td>100%</td>
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User/evaluator’s subjective rating of each factor can range from 1-10.
Grouping characteristics

- External characteristics
  - H-CI quality which impacts the end user.

- Internal characteristics
  - Technical quality of interest to developers and maintenance staff.
## Grouping characteristics

<table>
<thead>
<tr>
<th>H-CI quality</th>
<th>Technical quality</th>
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</thead>
<tbody>
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<td>✓ Suitability</td>
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MIS Triad

Quality Perspective

BOARD
Strategic Considerations

USER
External quality

IS
Internal quality
Prioritising characteristics

- There is a view that if you cannot install and launch a program then evaluation of all of the other characteristics are irrelevant.

- This gives rise to the concept of a priority scale among quality characteristics.
Conclusion

Building quality into software products

- Definition
- Models
- Characteristics
- Interrelationships
- Measuring
- Grouping
- Prioritising.