
Software Product Quality Assurance

A b s t r a c t

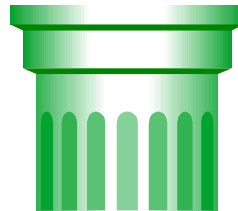
Software Product Quality Assurance aims at ensuring the quality of the final SW products, mainly through:

- identification of product quality requirements in quantitative and unambiguous terms;*
- identification of a set of metrics to verify that these requirements have been met.*

This module introduces the participant to the content and rationale of the relevant requirements contained in section 7 of the ECSS-Q-80B Standard.

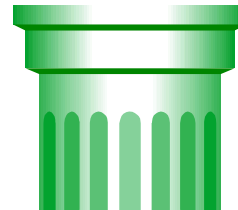
Software product quality assurance

Software product assurance programme implementation



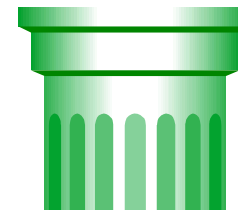
Focus on issues in setting up and running an SPA programme

Software process assurance



Focus on adequate definition and execution of software engineering processes and activities

Software product quality assurance



Focus on software product quality requirement definitions and achievements

Requirements on products

Product Quality Objectives and Metrication

Product Quality Objectives and Metrication

7.1 Product quality objectives and metrication

7.1.1 Assurance activities for product quality requirements

7.1.2 Deriving of requirements

7.1.3 Quality models

7.1.4 Product metrics

7.1.5 Measurement

7.1.6 Measurement results

7.1.7 Basic metrics

7.1.8 Metrication process

7.1.9 Metrics analysis

7.1.10 Numerical accuracy

7.1.11 Analysis of software behaviour

7.1.12 Metrics trend

7.1.13 Improvement actions

Software product quality assurance

7.1 Product quality objectives and metrication

7.2 Product quality requirements

7.3 Supporting documentation

7.4 Standard hardware for operational system

7.5 Firmware



Assurance Activities for Product Quality Requirements

- The **supplier** must define assurance activities to ensure that the product meets the quality requirements as specified in the technical specification
- These assurance activities must be described in the **S/W product assurance plan**



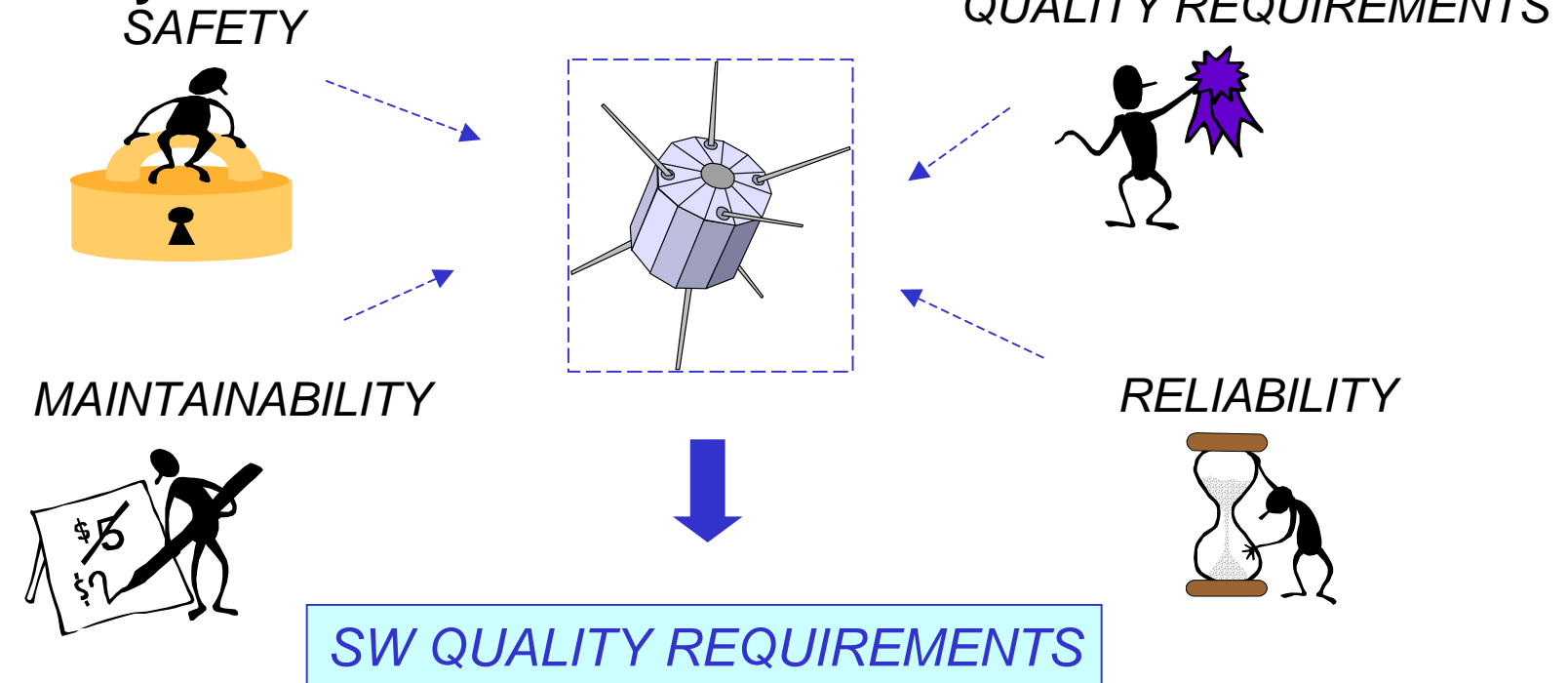
Assurance Activities



Supplier

Deriving Requirements

The SW quality requirements must be **derived** from the reliability, safety, maintainability and quality requirements of the system.

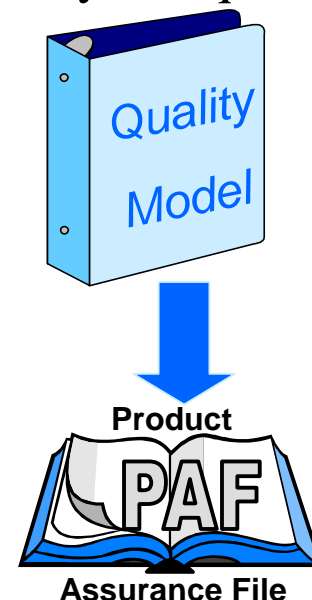


Quality Models

- **Quality models** must be used to specify the quality requirements
- **Quality requirements** must be expressed in quantitative terms or constraints
- The following **characteristics** must be used to specify the quality model:

- functionality
- reliability
- maintainability
- reusability
- operability
- documentation quality
- suitability for safety
- security

Quality Model



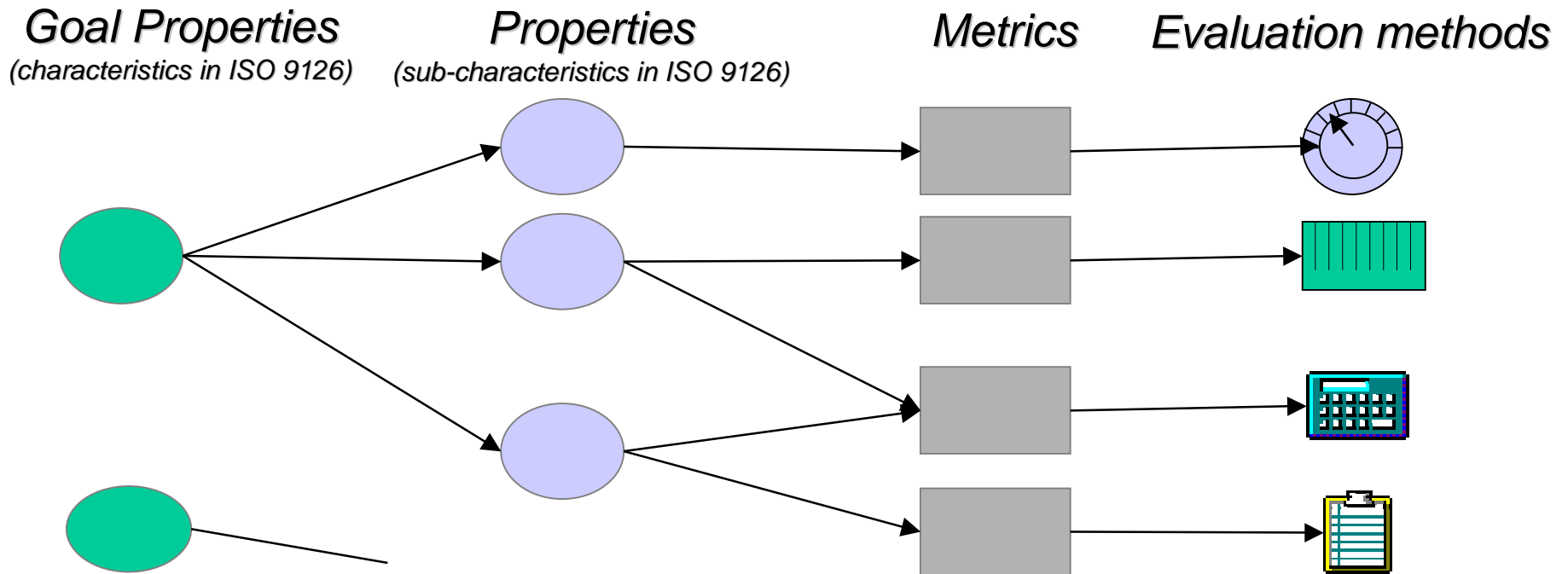
A Quality Model for ESA projects

SPEC is a method to evaluate, and possibly certify, Space Software Product by measuring its quality, based on a tailored quality model.



How to measure quality?

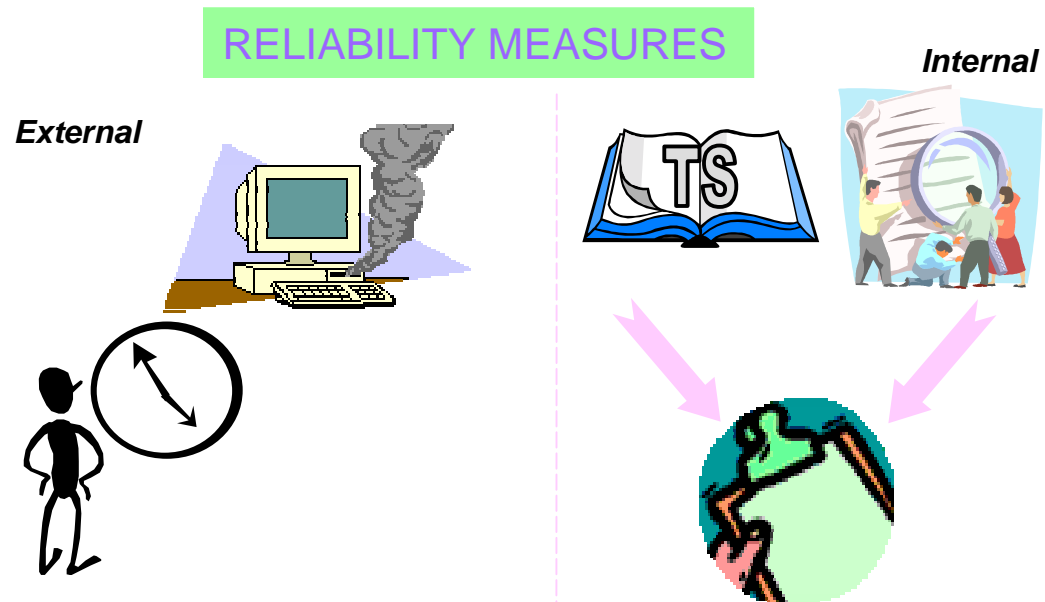
Mc Call was the first proposing to evaluate quality by breaking down properties to form a quality model that can be directly measured and evaluated against reference targets. SPEC further elaborates and defines the model.



Internal and External Attributes

- For each quality characteristic the capability of the software is determined by a set of **internal attributes** which can be measured
- The level of certain **internal attributes** influences the levels of some **external attributes**, so that there is both an external aspect and an internal aspect to most characteristics

reliability may be measured **externally** by observing the number of failures in a given period of software execution time and **internally** by inspecting the detailed specifications and source code to assess the level of fault tolerance



Metrication Programme

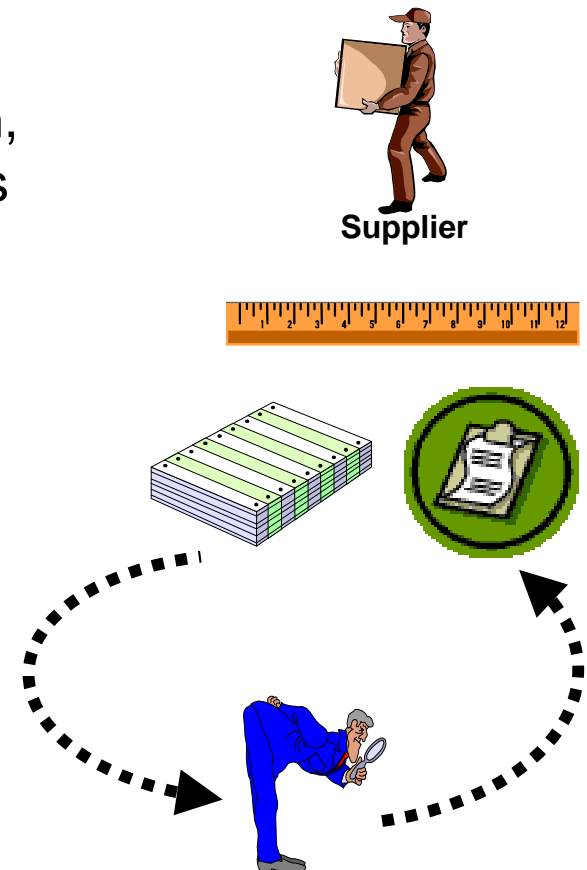
- The supplier must define a **metrication programme**
- The supplier is in charge of defining the relevant metrics, their associated target values and the means to collect or measure them
- The following basic product metrics must be used:
 - size (design and code)
 - complexity (design and code)
 - fault density and failure intensity
 - test coverage
 - number of failures



ECSS-Q-80-04 provides guidelines on **”Software metrication programme definition and implementation”**

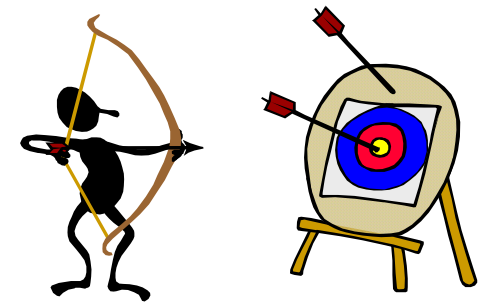
Metrication Process

- A **metrication process** must be defined and followed to assure regular collection, storing, analysis and reporting of metrics
- **Measurements** must be performed throughout the development and the results obtained must be used to define corrective actions
- The results must be provide to the customer with an insight into the level of quality obtained through **software product assurance reports**



Metrics trend and analysis

- Data must be **collected** with respect to predetermined procedures, and processed to derive both descriptive statistics and trend analysis
- The metrics must be **analysed** against target values or quality requirements and remedial actions must be taken to ensure conformance to quality requirements
 - The **supplier** must define the organisation and means implemented to collect and analyse data required for the study of **software behaviour**
- Metrics data must be used to determine further actions to **improve** software



Product Quality Requirements

Topics in Product Quality Requirements

7.2 Product quality requirements

7.2.1 Technical specification

7.2.2 Design and related documentation

7.2.3 Code

7.2.4 Software intended for reuse

6.1 Software development life-cycle

6.2 Requirements applicable to all software engineering processes

6.3 Requirements applicable to individual software engineering process or activities

Documentation

5.5 Supplier selection and control

5.6 Procurement

5.7 Tools and supporting environment

5.8 Assessment and improvement process

Software product quality assurance

7.1 Product quality objectives and metrication

7.2 Product quality requirements

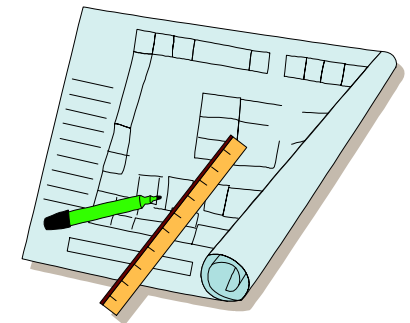
7.3 Supporting documentation

7.4 Standard hardware for operational system

7.5 Firmware

Quality Requirements in TS and Design

- Software quality requirements must be documented in the Technical Specification and must be a complete, unambiguous set of requirements
- Requirements must be stated in terms that allow verification and validation
- For each requirement the method for verification and validation must be specified
- The software design must meet the quality requirements as documented in the technical specification
- The product must be designed to facilitate testing and to meet the non-functional requirements



Supporting Documentation

Topics in Supporting Documentation

Software product assurance process implementation

5.2 Organisation and responsibility	5.6 Supplier selection and control
5.3 Contractual aspects	5.7 Procurement
5.4 SPA programme management	5.8 Tools and supporting environment
5.5 Risk management and critical item control	5.9 Assessment and improvement process

Software process assurance

6.1 Software development life-cycle

7.3 Supporting documentation

7.3.1 Test and validation documentation

7.3.2 Reports and analysis

Software product quality assurance

7.1 Product quality objectives and metrication

7.2 Product quality requirements

7.3 Supporting documentation

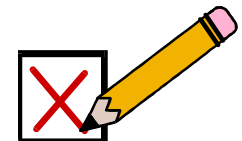
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Test Documentation and Reports

- The test documentation shall cover the planning for required personnel and associated training, tools, test environment and test software
- The completion criteria for each test and any contingency steps shall be specified
- It shall also specify test procedures, data and expected results
- The hardware and software configuration used shall be identified as part of the test documentation
- The execution and results of all assurance, verification and validations activities shall be reported in the software product assurance reports



Standard Hardware for Operational System

Topics in Standard H/W for Operational System

Software product assurance process implementation

5.2 Organisation and responsibility

5.3 Contractual aspects

7.4 Standard hardware for operational system

7.4.1 Procurement

7.4.2 Constraints

7.4.3 Selection

7.4.4 Maintenance

7.4.5 Documentation

5.6 Supplier selection and control

5.7 Procurement

5.8 Tools and supporting environment

5.9 Assessment and improvement process

Software product quality assurance

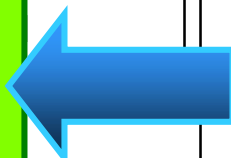
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Firmware

Firmware Topics in ECSS-Q-80B

Software product assurance process implementation

5.2 Organisation and responsibility

5.3 Contractual aspects

5.4 SPA programme management

5.5 Risk management and critical item control

5.6 Supplier selection and control

5.7 Procurement

5.8 Tools and supporting environment

5.9 Assessment and improvement process

Software process assurance

7.5 Firmware

7.5.1 Device programming

7.5.2 Marking

7.5.3 Calibration

Software product quality assurance

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Summary

- Software Product Quality Assurance comprises the measures taken to get a SW product that meets specified quality requirements:
 - ✓ definition of the SW quality requirements, derived from the system dependability and safety requirements, by using a quality model
 - ✓ definition of a metrication programme, including metrics and measurements specification
 - ✓ implementation of a process for metrication and analysis of results
 - ✓ production of detailed documentation for test planning and reporting
 - ✓ careful selection of hardware and handling of firmware