



Introduction to the Q-80B Standard

Space System Software Product Assurance

(excerpt version for sample purposes)





(excerpt version for sample purposes)


Abstract

ECSS-Q-80B is the standard for space software product assurance. This module introduces the participant to the standard: its structure; its role in the overall context of space project engineering; the requirements for the implementation of a space software product assurance programme; the quality assurance requirements for both process and product; the organisation of software documentation and the concept of tailoring as applied to the standard.

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Status and Origins of the Q-80B Standard

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ECSS-Q-80 Status

ECSS-Q-80A April 1996
Currently approved issue

ECSS-Q-80B Draft May 2002
Former version, completed by the end of August 2002

ECSS Q-80B 10 October 2003
Current baseline. It is the reference for this course.

Online at www.ecss.nl


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Q-80B alignment with ISO/IEC 12207

- ❑ The structure and approach of the Q-80B standard is aligned with the ISO/IEC standard 12207 (last version of 2002)
 - ✦ Title: **Information Technology – Software Life Cycle Processes**
- ❑ The ISO standard has a clear set of goals:
 - ✦ “This International Standard establishes a **common framework for software life cycle processes**, with **well-defined terminology**, that can be referenced by the software industry.”
 - ✦ “It contains **processes, activities**, and **tasks** that are to be applied during the acquisition of a system that contains software, a stand-alone software product, and software service and during the supply, development, operation, and maintenance of software products.”
 - ✦ “This International Standard also provides a process that can be employed for **defining, controlling**, and **improving** software life cycle processes.”

An internationally recognized common framework for terminology and software life cycle description

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ECSS Covers the ISO/IEC 12207 Standard

Other ECSS ■

E-40B ■

Q-80B ■

Details for SPA and/or SWE

Primary Life Cycle Processes

Acquisition

Supply

Development

Operation

Maintenance

Supporting Life Cycle Processes

Documentation

Configuration Management

Quality Assurance

Verification

Validation

Joint Review

Audit

Problem Resolution


Organisational Life Cycle Processes



Management

Infrastructure

Improvement


Training



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The Context and Objectives of Software Product Assurance

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4.4

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Definition of Software Product Assurance

A **Software Product** is a set of computer programs, procedures, documentation and their associated data

Software Product Assurance (SPA) is the totality of activities, standards, controls and procedures in the lifetime of a software product which establishes confidence that the delivered software product, or software affecting the quality of the delivered product, conforms to customer requirements

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3.1.21-22


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The Objectives of Software Product Assurance

- The objectives of software product assurance are to provide adequate confidence to the **customer** and to the **suppliers** that developed or reused software satisfies the requirements throughout the system lifetime
 - ◇ In particular the software is developed to perform **properly** and **safely** in the operational environment, while meeting the quality objectives agreed for the project
- SPA consists of both:
 - ◇ The assurance of the **process** (software process assurance)
 - ◇ The assurance of the quality of the **product** (software product quality assurance)


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4.1-2

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The Context of Software Product Assurance

- The context of space software product assurance is the overall space system product assurance process and the space software engineering process
- ECSS-Q-80B covers all aspects of space software product assurance including the implementation aspects of the software product assurance process and both software process and product related assurance activities
- ECSS-Q-80B defines the scope of the SPA process and its interfaces with management, engineering, and other system level PA activities, explaining how they apply to the software PA process




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Principles of the Q-80B Standard

- ❑ ECSS-Q-80B defines the detailed SPA requirements
- ❑ It is implemented by a program through which:
 - ❖ All software requirements are adequately specified
 - ❖ All software applications are categorized according to criticality
 - ❖ Appropriate design and development methods and standards are established and applied in accordance with software categories
 - ❖ Development and maintenance processes are continually monitored
 - ❖ Software problems are found and corrected with sufficient timeliness to minimize their impact
 - ❖ Performance requirements are demonstrated through customer agreed qualification and acceptance tests
 - ❖ Verification and validation are properly achieved
 - ❖ Design, implementation and inspection allow a real capability to maintain and/or to reuse software

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Key Concepts in the Q-80B Standard

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The Key issues of the ECSS-Q-80B Standard

- The relation to the ECSS M-series, E-series and Q-series standards
- The recursive customer-supplier relationship
- Requirements and expected output
- Expected output and files
- Files and reviews
- The concept and considerations for tailoring

SW Product Q-80B Assurance ↔ E-40B Software

Supplier ↔ Customer

Requirement

Expected Output

XYZ PDR

S/W Product Q-80B Assurance Q-80B 4.1-4.5

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The Relationship of Q-80B to the M- Series

- The M-series standards define requirements applicable to management of all space projects
- Some of the M-standards are particularly relevant to PA of software projects
 - ✦ M-00 defines the terms “customer” and “supplier”
 - ✦ M-30 defines the phasing and planning with a system view of the entire project
 - ✦ M-40 defines CM requirements, whereas Q-80B defines specific SPA activities for software CM
 - ✦ M-50 defines requirements to ensure coherence and accessibility of information to all parties of the project; Q-80B defines SPA requirements for information/documentation management of the software

Policy & Principles M-00

Project Phasing And Planning M-30

Configuration Management M-40

Info / Doc Management M-50

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The Relationship of Q-80B to the E- Series

- ❑ Q-80B specifies SPA requirements on software engineering processes and product-related assurance over all the activities specified in E-40B
- ❑ E-40B covers all aspects of space software engineering from requirements definition to retirement
- ❑ Each of these two standards interfaces the other to its respective branch
 - ✦ The interface of Q-80B to the ECSS-E branch is via E-40B
 - ✦ Equally, the interface of E-40B to the ECSS-Q branch is via Q-80B
- ❑ Together the two standards either specify or refer to definition of all software relevant process for space projects

S/W Product
Q-80B
Assurance



E-40B
Software

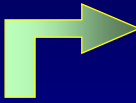
Q-80B
4.4.2

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The Relationship of Q-80B to the Q- Series


The top-level standard Q-00 defines product assurance policy, objectives, principles and rules for the establishment and implementation of product assurance programmes to be applied to all aspects of a space project, including software.



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graph TD
    ECSS[ECSS system] --- ECSS_Q00[ECSS-Q-00 SPACE PRODUCT ASSURANCE]
    ECSS_Q00 --- ECSS_Q20[ECSS-Q-20 Quality Assurance]
    ECSS_Q00 --- ECSS_Q30[ECSS-Q-30 Dependability]
    ECSS_Q00 --- ECSS_Q40[ECSS-Q-40 Safety]
    ECSS_Q00 --- ECSS_Q60[ECSS-Q-60 EEE Components Control]
    ECSS_Q00 --- ECSS_Q70[ECSS-Q-70 Material, Mech. Parts & Processes]
    ECSS_Q00 --- ECSS_Q80[ECSS-Q-80 Software Product Assurance]
    ECSS_Q80 --- Q80B[Q-80B 4.4.3]
            
```

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The Key Level-2 Standards

Quality
Q-20B 8 March 2002
Assurance

Q-30B 8 March 2002
Dependability

Q-40B 17 May 2002
Safety


Three Level-2 standards in the Q-Series are particularly relevant to the Q-80B standard. Their presence in Q-80B is pervasive.


ECSS system

ECSS-Q-00
SPACE PRODUCT ASSURANCE

- ECSS-Q-20
Quality Assurance
- ECSS-Q-30
Dependability
- ECSS-Q-40
Safety
- ECSS-Q-60
EEE Components Control
- ECSS-Q-70
Material, Mech. Parts & Processes
- ECSS-Q-80
Software Product Assurance

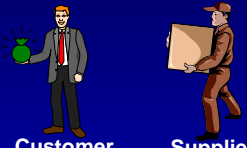
Q-80B
4.4.3.3-5

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The Customer-Supplier Relationship


- ❑ The fundamental principle in the Q-80B Standard is the **customer-supplier relationship**
 - ✦ it is assumed for the entire software lifetime
 - ✦ the organisational aspects are defined in M-20
- ❑ The customer is usually the procurer of the software and/or hardware




Customer **Supplier**

organisational aspects Project **M-20**
Organisation


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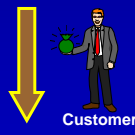
The Recursive Customer-Supplier Relationship

- The concept of the customer-supplier relationship is applied **recursively**
 - ◇ that is, the customer is often also a supplier (to a higher-level customer)
- The software customer therefore has **two important interfaces**
 - ◇ The customer has an interface to his **suppliers**
 - ◇ The customer has an interface to his own **customers**
- The customer ensures that his SPA requirements are expressed completely and unambiguously
- The supplier demonstrates compliance with the SPA requirements and provides the specified evidence of compliance




Supplier

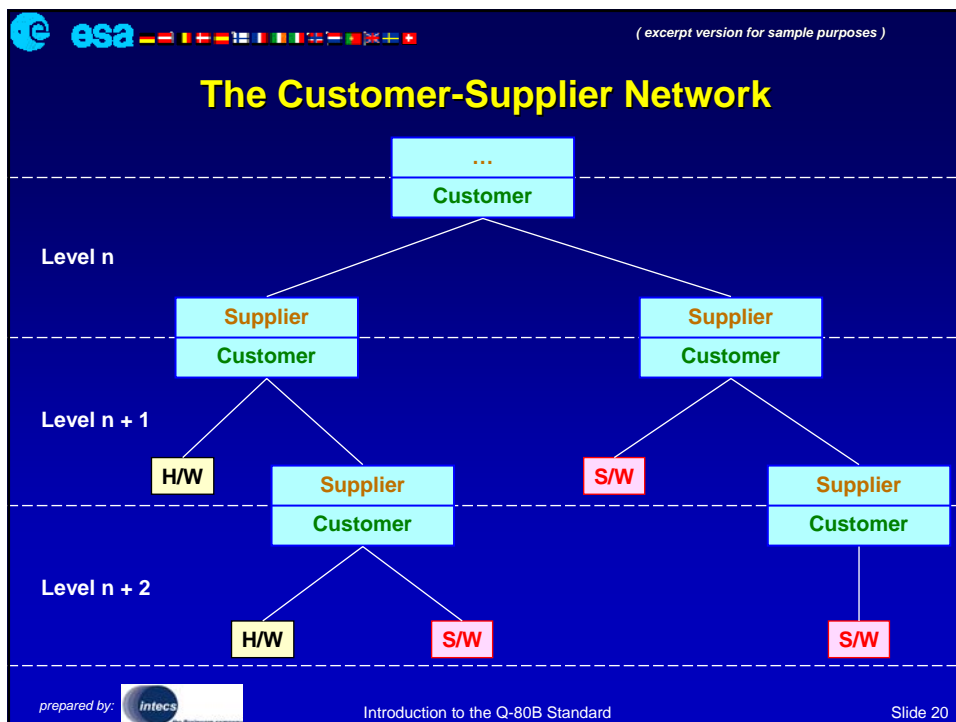
Two roles




Customer

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4.1

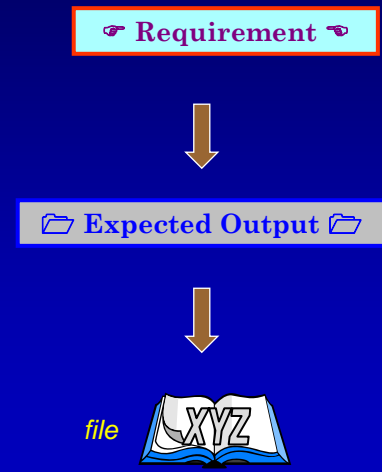
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Requirements and Expected Outputs

- ❑ The Q-80B requirements cause **information** to be collected into **files**
- ❑ This information may be, depending on the requirements:
 - ✦ A document (e.g. a plan)
 - ✦ A form (e.g. a nonconformance)
 - ✦ A report
 - ✦ An approval
 - ✦ A set of requirements
 - ✦ etc.



```

            graph TD
            Req[Requirement] --> EO[Expected Output]
            EO --> File[file XYZ]
            
```

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Expected Outputs, Specify Files and Reviews



```


            graph TD
            Req[Requirement] --> EO["Expected Output  
\"some information\" [PAF; PDR]"]
            EO --> PAF["Product Assurance File (PAF)"]
            EO --> PDR["Prelim. Design Review (PDR)"]
            
```

The associated file and review(s) are indicated in square brackets. Example:


5.4.1.1 – The supplier shall develop a software product assurance plan in response to the software product assurance requirements.

EXPECTED OUTPUT: *Software product assurance plan [PAF; SRR, PDR]*


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Q-80B Annex A: Software Documentation



Requirements Baseline




Technical Specification




Design Definition File


Design




Justification File



Operational Documentation




Maintenance File




Management File


Product



Assurance File

This annex defines the contents of the documents to be produced

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The Concept of Tailoring

- ❑ The ECSS family of standards is intended to be **tailored** for each individual project
 - ✦ The Q-80B standard is no exception
- ❑ There are several drivers for **tailoring Q-80B**, such as
 - ✦ dependability and safety aspects
 - ✦ software development constraints
 - ✦ product quality objectives and commercial considerations



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Considerations for Tailoring Q-80B

❑ For each type of tailoring, different considerations:

- ✦ **Tailoring for dependability and safety aspects** is based on the selection of requirements which are related to the verification, validation and levels of proofs demanded by the *critical software*.
- ✦ **Tailoring for product quality objectives** requires the *customer* to specify the quality objectives for the product

"One size does not fit all"



Tailoring is influenced by many drivers

Q-80B 4.5

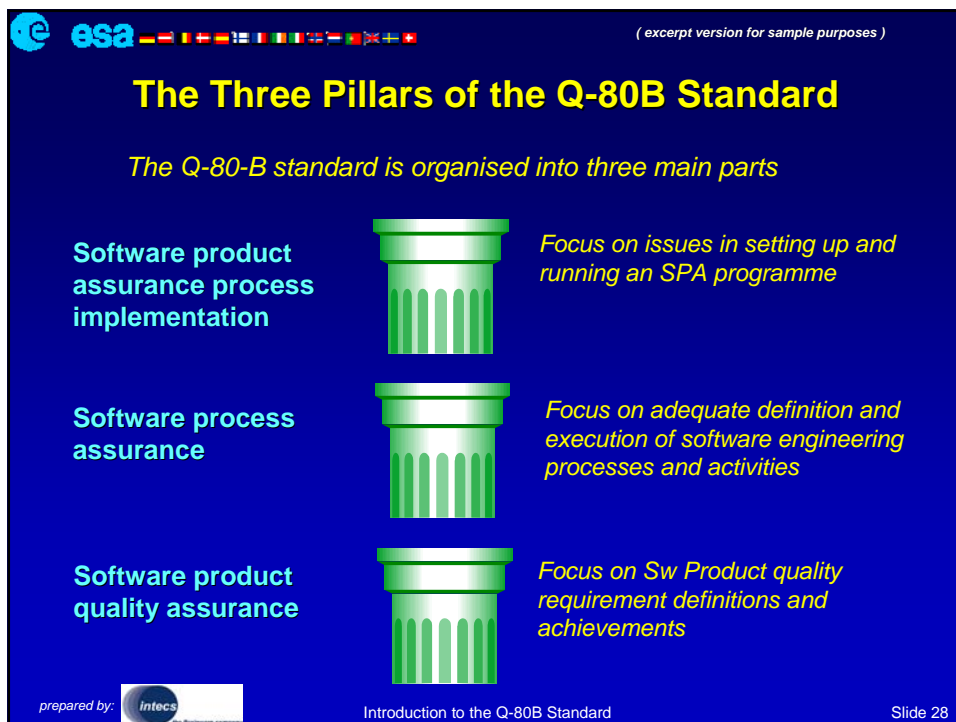
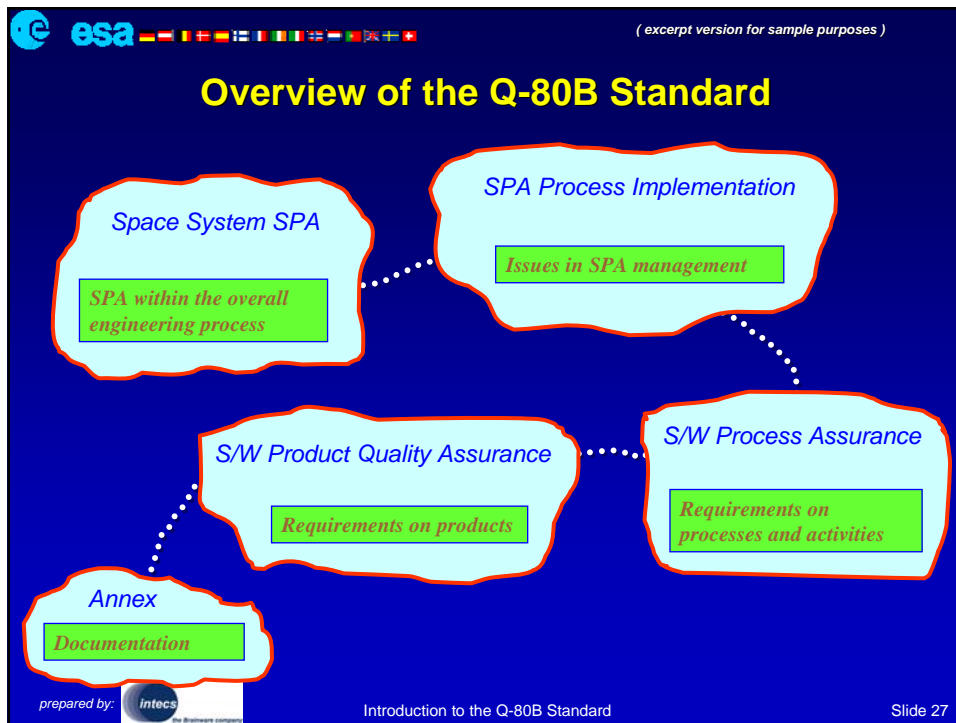
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The Organisation of the Q-80B Standard

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Structure of the Q-80B Standard


Software product assurance process implementation	
5.2 Organisation and responsibility	5.6 Subcontractor selection and control
5.3 Contractual aspects	5.7 Purchasing
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	
6.2 Requirements applicable to all software engineering processes	
6.3 Requirements applicable to individual software engineering activities	
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	

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Summary

- ❑ ECSS-Q-80B is the standard for space software product assurance
 - ✧ It is part of the overall ECSS standardisation effort
 - ✧ It is consistent with the ISO standardisation effort
- ❑ Q-80B is organised into three main parts:
 1. **SPA PROCESS IMPLEMENTATION** – focus on issues in setting up and running an SPA programme
 2. **S/W PROCESS ASSURANCE** – focus on adequate definition and execution of software engineering processes and activities
 3. **S/W PRODUCT ASSURANCE** – focus on Sw Product quality requirement definitions and achievements
- ❑ Requirements generate expected outputs organized into **files**
- ❑ **Reviews** are scheduled at milestones throughout the lifecycle
- ❑ Like all ECSS standards, Q-80B is meant to be **tailored**, giving the customer the freedom to specify his requirements efficiently

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