

esa



# Restructuring of E-40B

# Module Abstract

*This module contains a description of the modifications to the major draft of E40B of May 2002 resulting in the final, approved Standard. This information is useful for those familiar with the earlier draft to understand the differences in the current version of the Standard.*

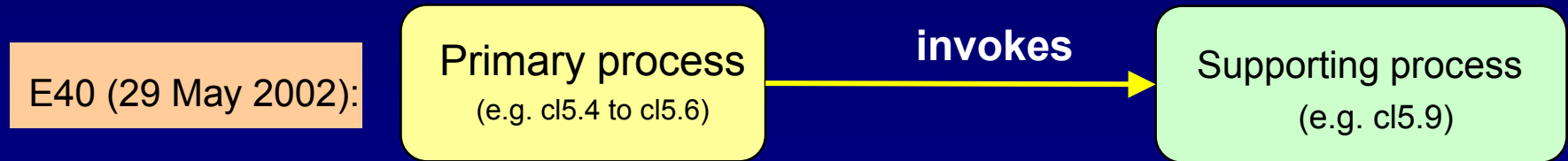
## History in Brief

- ❑ ECSS-E40B went in public review from 29 May 2002 to 16 August 2002, together with ECSS-Q80B
- ❑ There were 226 DRRs for ECSS-E-40B
- ❑ The DRR were dispositioned together with the ECSS-Q80 working group through meetings and teleconferences
- ❑ ECSS-E40 and ECSS-Q80 have been consistently modified according to the dispositions
- ❑ In addition, the DRDs for ECSS-E40 and ECSS-Q80 have been updated and are now consistent with the last versions of the standards. DRD's are now under the Public Review process.
- ❑ The result has been a restructuring of E-40B

## Main Changes in E-40 Part1B

- ❑ Internal invocation mechanisms have been removed ( former section 5.9 and its invocation in section 5.5, 5.6, 5.7) and therefore :
  - ✧ Split of the former software verification and validation (supporting) process into two separate ones: the software verification process and the software validation process
  - ✧ The former software validation and acceptance process has been reshaped.
- This leads to the restructuring of the standard.
- ❑ Merging of the former clause 6: “Special Requirements” into the appropriate software processes of clause 5
- ❑ Improvement of the naming and renumbering of most of the software processes (software requirements and architecture, software design and implementation, software delivery and acceptance, software validation, software verification)
- ❑ Link with ECSS-E-10 has been re-enforced (in clause 4)

# Removal of Invocation Mechanisms (1)



Mostly the case for all the software development processes invoking the software verification and validation process subclauses

E40 (19 June 2003):

The invocation links have been removed, calls to the Verification and Validation subclauses are no longer done. The notion of supporting process has disappeared ( the software verification process and the software validation process have their own life in parallel with the other development processes, the verification and validation activities to be performed are not “repeated” in every development process.

*This implies a structural re-organization and a better process identification by removing the “invoking” V&V activities*

# Removing of Invocation Mechanisms (2)

## Example 1

5.4 /Software requirements and architecture process activities:

### **E40 (29 May 2002 ):**

5.4.2- software requirements analysis

5.4.2.4 - Evaluation of software requirements ( invoking 5.9.4.1)

5.4.3 - software architectural design

5.4.3.7 – Evaluation of the software architecture ... (invoking 5.9.4.2)

5.4.4- software verification and validation (invoking the 5.9 SVVP sub clauses 5.9.2 and 5.9.3 for the implementation of this V & V process for PDR )

### **E40 part 1B (19 June 2003):**

5.4.2- software requirements analysis

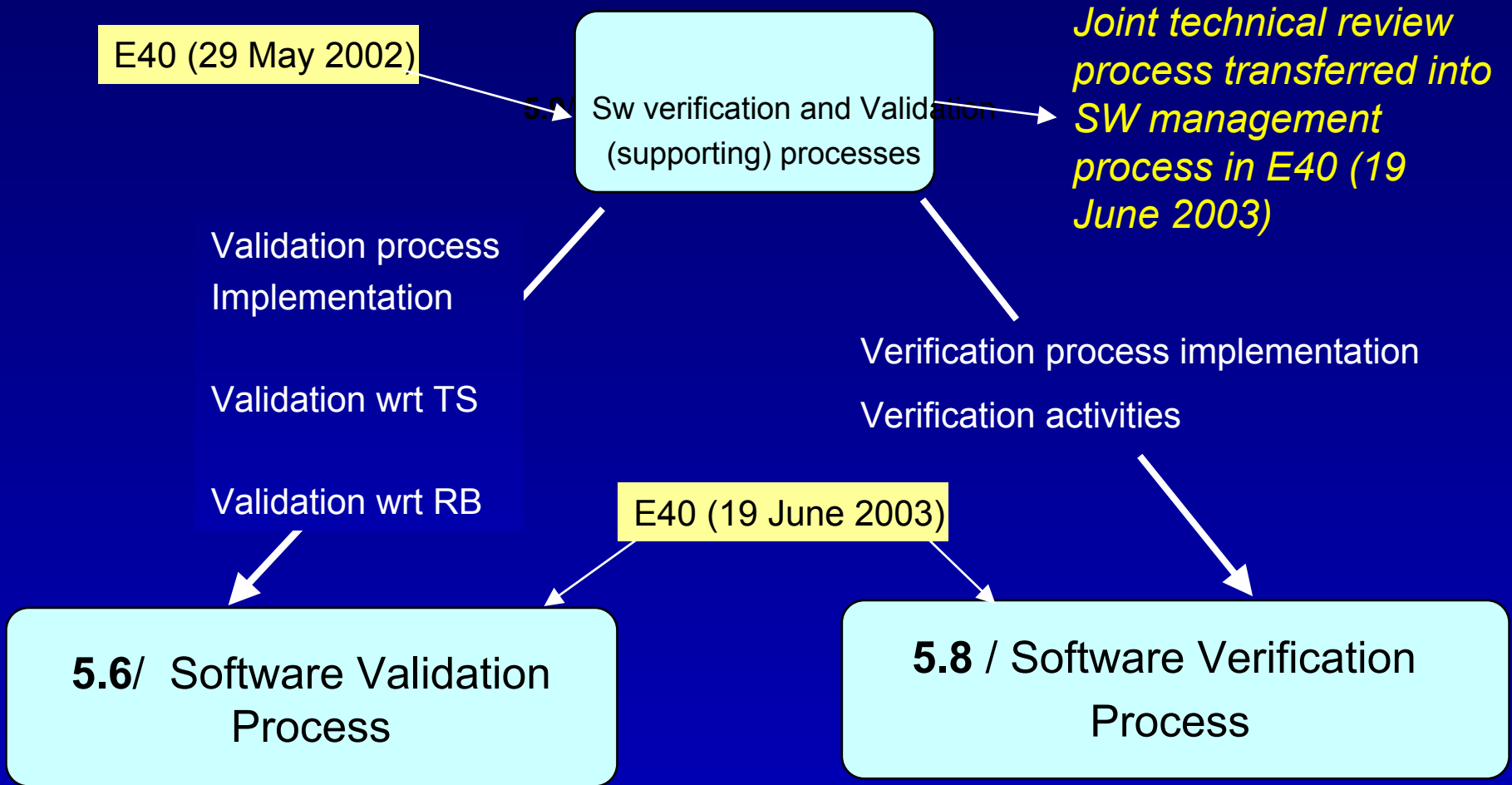
~~5.4.2.4 - Evaluation of software requirements ( invoking 5.9.4.1)~~

5.4.3 -software architectural design

~~5.4.3.7 – Evaluation of the software architecture ... (invoking 5.9.4.2)~~

~~5.4.4 software verification and validation~~

# Splitting the Former Software V&V Process



# Reshaping the Former “5.6 Software Validation and Acceptance”

*By redistribution of activities in other appropriate processes*

5.6 /Software validation and acceptance process activities:

**E40 (29 May 2002):**

5.6.2 - validation wrt RB

5.6.3 - validation and acceptance milestones

5.6.3.1 conducting a qualification Review

5.6.3.2 conducting an acceptance review

5.6.4 - software delivery and installation

5.6.5 - software acceptance

**E40 part 1B (19 June 2003):**

5.7.2 software delivery and installation

5.7.3 - software acceptance

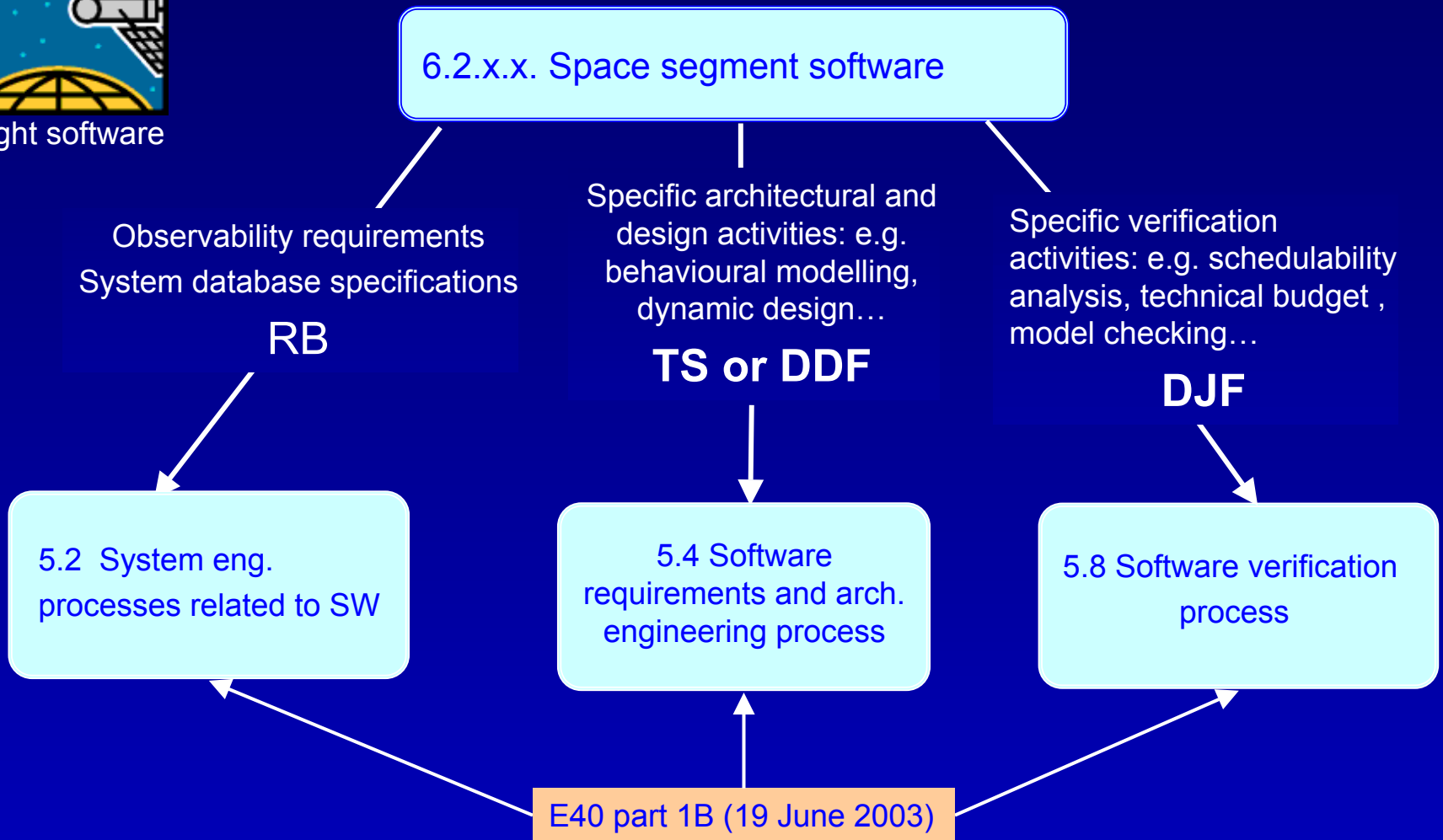
E40 part 1b (19 June 2003)  
5.8 – Software Validation  
Process

**Collateral consequence:** renaming as “ 5.7 /software delivery and acceptance [Note: 5.7 instead of 5.6 because of renumbering ]

# Merging Clause 6 into Clause 5 (1)



Flight software



# Merging Clause 6 into Clause 5 (2)



SW reuse

## 6.4.x.x. Software reuse

Requirements for  
"design for reuse"

**RB**

Software acquisition  
process implementation

**MGT**

- 1-Definition of methods & tools for software to be reused
- 2-Evaluation of potential reuse of software
- 3-Analysis of potential reusability

**DJF**

5.2 System eng.  
processes related to  
SW

5.3 Software management  
process

5.4 Software  
requirements and arch.  
process

E40 part 1B (19 June 2003)

# Merging Clause 6 into Clause 5 (3)



MMI software

6.5.x. Man Machine interfaces

- MMI software mock up requirements
- MMI general requirements and guidelines

MMI software development mock up

**TS, DJF**

**RB**

5.2 System eng.  
processes related to SW

5.4 Software  
requirements and arch.  
engineering process

E40 part 1B (19 June 2003)

# Renumbering of the SW Engineering Processes (1)

<b>ECSS-E40B (29 May 2002)</b>	<b>ECSS-E-40 part 1B (15 June 2003)</b>
5.2 System engineering processes related to software	5.2 System engineering processes related to software
5.3 Software management process	5.3 Software management process
5.4 Software requirements engineering process	5.4 Software requirements and architecture engineering process
5.5 Software design engineering process	5.5 Software design and implementation engineering process
5.6 Software validation and acceptance process	5.6 Software validation process

# Renumbering of the SW Engineering Processes (2)

ECSS-E40B (29 May 2002)	ECSS-E-40 part 1B (15 June 2003)
5.7 Software operations engineering process	5.7 Software delivery and acceptance
5.8 Software maintenance	5.8 Software verification process
5.9 Software verification and validation process	5.9 Software operation process
	5.10 Software maintenance process

*Renumbering was driven by the logical order of appearance of software processes during the software life cycle*

# Renaming of the SW Engineering Processes (1)

ECSS-E40B (29 May 2002)	ECSS-E-40 part 1B (15 June 2003)
5.2 System engineering processes related to software	5.2 System engineering processes related to software
5.3 Software management process	5.3 Software management process
5.4 Software requirements engineering process	5.4 Software requirements <b>and architecture</b> engineering process
5.5 Software design engineering process	5.5 Software design <b>and implementation</b> engineering process
5.6 Software validation and acceptance process	<b>5.6 Software validation process</b>

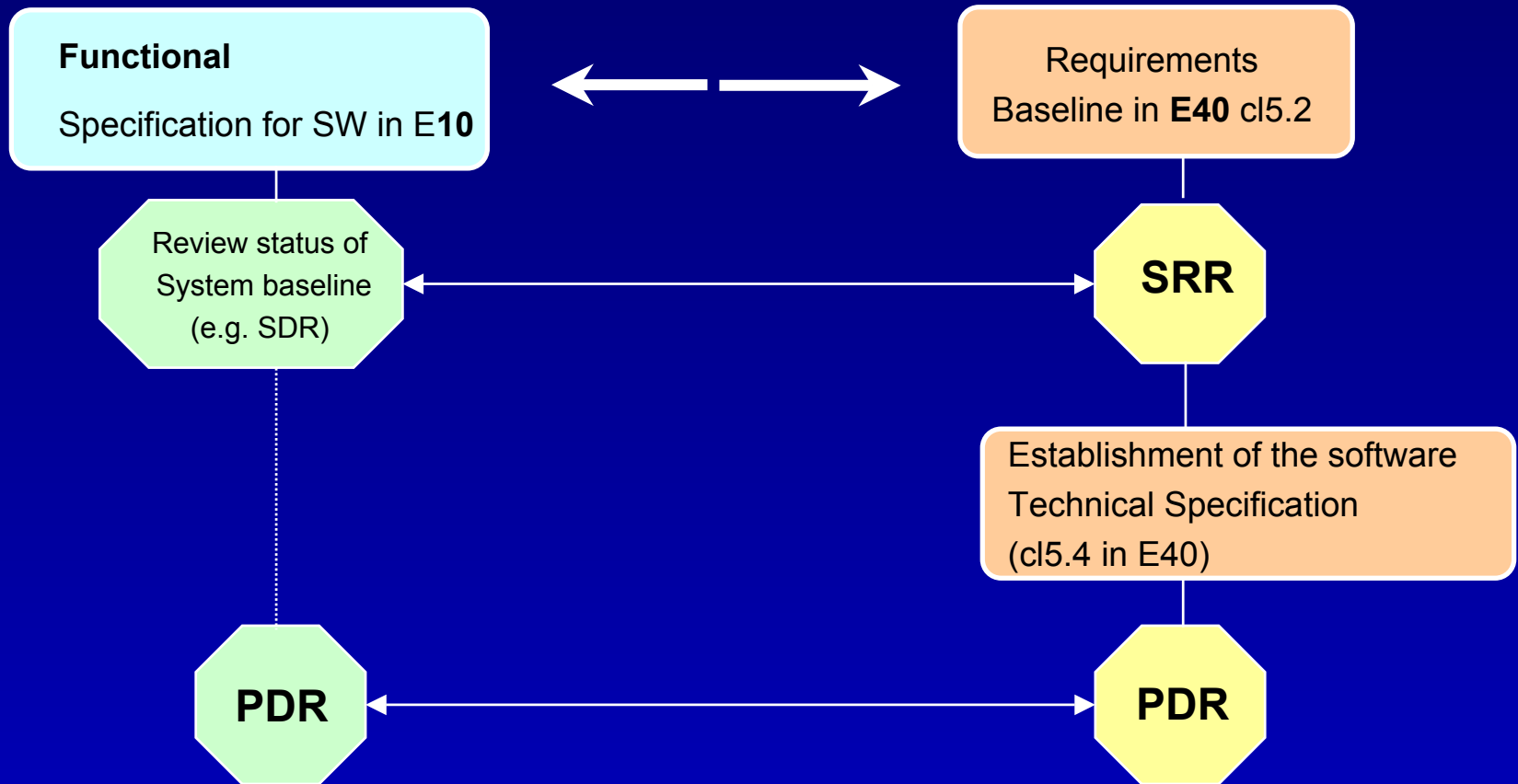
*Renaming was driven by the new scope of the software processes*

# Renaming of the SW Engineering Processes (2)

ECSS-E40B (29 May 2002)	ECSS-E-40 part 1B (15 June 2003)
5.7 Software operations engineering process	<b>5.7 Software delivery and acceptance</b>
5.8 Software maintenance	<b>5.8 Software verification process</b>
5.9 Software verification and validation process	5.9 Software operation process
	5.10 Software maintenance process

# Reinforcing the Link to E-10

*Re-enforcing, in clause 4, the link between the system engineering Standard (ECSS-E-10) and the software engineering Standard (ECSS-E-40)*





**SYSTEM ENGINEERING PROCESSES**  
 System Requirement Analysis  
 System Partitioning  
 System Level Requirements for Software Verification and Validation, System Level Integration of Software, Operations, Maintenance

**SRR**  
 Requirement Baseline  
 Interface Requirement Document

**SOFTWARE OPERATION ENGINEERING PROCESS**  
 Process Implementation  
 Operational Testing  
 System Operation  
 User Support

**ORR**  
 Operational Plan

**SOFTWARE REQUIREMENT ENGINEERING PROCESS**  
 Software Requirement Analysis  
 Software Architectural Design  
 Software Verification and Validation (plans)

**PDR**  
 Technical Specification  
 Interface Control Document  
 Design Justification File  
 Design Definition File

**29 May 2002**

**SOFTWARE MAINTENANCE PROCESS**  
 Process Implementation  
 Problem and Modification Analysis  
 Modification Implementation  
 In flight Modification  
 Maintenance Review/Acceptance  
 Software Migration  
 Software Retirement

**SOFTWARE DESIGN ENGINEERING PROCESS**  
 Design Of Software Item  
 Coding and Testing  
 Integration  
 Validation with respect to the Technical Specification

**CDR**  
 Design Definition File  
 Design Justification File  
 Interface Control Document

**SOFTWARE MANAGEMENT PROCESS**  
 Software Life Cycle  
 Interface Management  
 Technical Budget & Margin

**SOFTWARE VALIDATION AND ACCEPTANCE PROCESS**  
 Validation with respect to the Requirements Baseline  
 Software Delivery and Installation  
 Software Acceptance

**QR**  
 Design Justification File

**AR**  
 Design Justification File

Customer  
 Supplier  
 Operator  
 Maintainer

**ECSS-E40B**  
Software

<p><b>SOFTWARE VERIFICATION AND VALIDATION (Supporting) PROCESS</b>          Verification process implementation          Validation process implementation</p>	<p style="text-align: center;"><b>VALIDATION Activity</b></p> <p style="text-align: center;">Development and Documentation of A Software Validation Testing Specification          Conducting the Validation Tests          Updating the Operations Manual          Evaluation of the Design, Code, Tests, Test Results, Operation Manual          Problem and Non Conformance Handling</p> <p style="text-align: center; border: 1px solid red; display: inline-block;">Test Readiness Review</p>
<p>Verification of Requirements          Verification of Arch. Design          Verification of Detailed Design</p>	<p style="text-align: center;"><b>VERIFICATION Activity</b></p> <p style="text-align: center;">Verification of Code          Verification of Integration          Verification of Documentation</p> <p style="text-align: right;">Evaluation of Test Specification          Verification of Validations (TS, BS)          Problem and Non Conformance Handling</p>



**SYSTEM ENGINEERING PROCESSES (E10)**  
 System Requirement Analysis  
 System Partitioning  
 System Level Requirements for Software Verification and Validation,  
 System Level Integration of Software, Operations, Maintenance

**SRR**  
 Requirement Baseline  
 Interface Requirement Document

**SOFTWARE OPERATION ENGINEERING PROCESS**  
 Process Implementation  
 Operational Testing  
 Software Operation  
 User Support

**ORR**  
 Operational Plan

**SOFTWARE REQUIREMENT & ARCHITECTURE ENGINEERING PROCESS**  
 Software Requirement Analysis  
 Software Architectural Design

**PDR**  
 Technical Specification  
 Interface Control Document  
 Design Justification File  
 Design Definition File

**19 June 2003**

**SOFTWARE MAINTENANCE PROCESS**  
 Process Implementation  
 Problem and Modification Analysis  
 Modification Implementation  
 Maintenance Review  
 Software Migration  
 Software Retirement

**SOFTWARE MANAGEMENT PROCESS**  
 Software Life Cycle  
 Interface Management  
 Technical Budget & Margin  
 Joint Technical Reviews

**SOFTWARE DESIGN & IMPLEMENTATION ENGINEERING PROCESS**  
 Design Of Software Item  
 Coding and Testing  
 Integration

**DDR**  
**CDR**  
 Design Definition File  
 Design Justification File  
 Interface Control Document

**QR**  
 Design Definition File

**SOFTWARE DELIVERY AND ACCEPTANCE PROCESS**  
 Software Delivery and Installation  
 Software Acceptance

**AR**  
 Design Definition File  
 Design Justification File

**Development Plan**

**SOFTWARE VALIDATION PROCESS**

Validation process implementation → **PDR** Validation Plan

Validation with respect to the Technical Specification → **CDR** Design Definition File, Design Justification File  
Test Readiness Review

Validation with respect to the Requirements Baseline → **QR** Design Definition File, Design Justification File  
Test Readiness Review

**SOFTWARE VERIFICATION PROCESS**

Verification process implementation → **PDR** Verification Plan

Complement of validation Problem & Non Conf. Handling

Verification of Requirements, Verification of Arch. Design, Verification of Detailed Design, Verification of Code, Verification of Integration, Verification of Documentation, Evaluation of Test Specification, Verification of Validations (TS, BS), Schedulability Analysis, Technical budgets, Behaviour verification, Feasibility of testing

**PDR, DDR, CDR, QR, AR**  
 Design Justification File

- Customer
- Supplier
- Operator
- Maintainer

**ECSS-E40B**  
**Software**

# Conclusions

- ❑ No **fundamental changes** in the contents of ECSS-E-40 part1B (19 June 2003)
- ❑ Only **structural changes** consisting in a re-organization, re-allocation, re-distribution of the existing sub clauses in the appropriate software engineering processes with some coherence alignment
- ❑ Global improvement of the Standard's readability, clarity and understandability