

esa



# An Introduction to the ECSS Software Standards

# Abstract

*This introduces the background, context, and rationale for the creation of the ECSS standards system presented in this course. Addresses the concept that the software is just one element in the overall engineering system, the E40-B standard for space software is one standard within the overall engineering branch of standards. This module explains the relationship between E-40 and the E-10 standard for space system engineering.*

## What is ECSS?

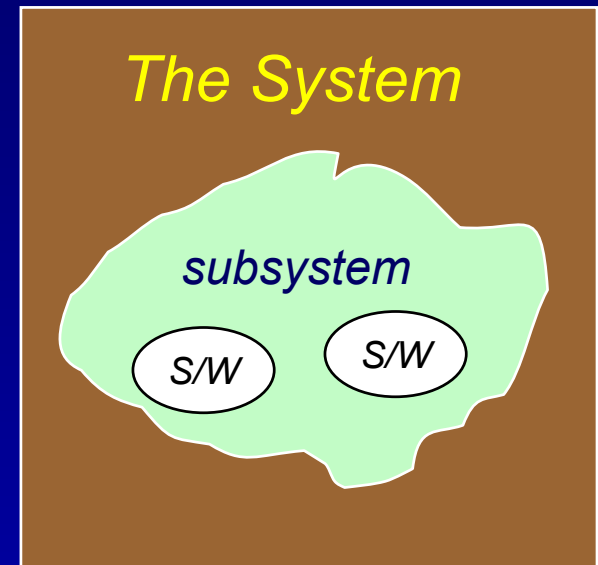
- In June 1994, the ESA Council adopted a resolution to confirm the Agency's commitment to the transfer of the PSS system of ESA space standards to the new set of standards prepared by the European Cooperation for Space Standardisation



**ECSS** = European Cooperation for Space Standardization

# Why ECSS?

- ❑ There were standards before
  - ✦ In particular, the software area had a well-developed set of standards, the **PSS** series
- ❑ But the standards were not coordinated with each other
  - ✦ Different **concepts** and **approaches**
  - ✦ Different **terminology**
- ❑ A standard was needed for the **total system**
  - ✦ software is pervasive in the system, an integral part of the whole
- ❑ Seeking compliance with ISO standards (e.g. ISO/IEC 12207)
- ❑ Pursuing homogeneity across Space Organisations (Agencies, Industry)



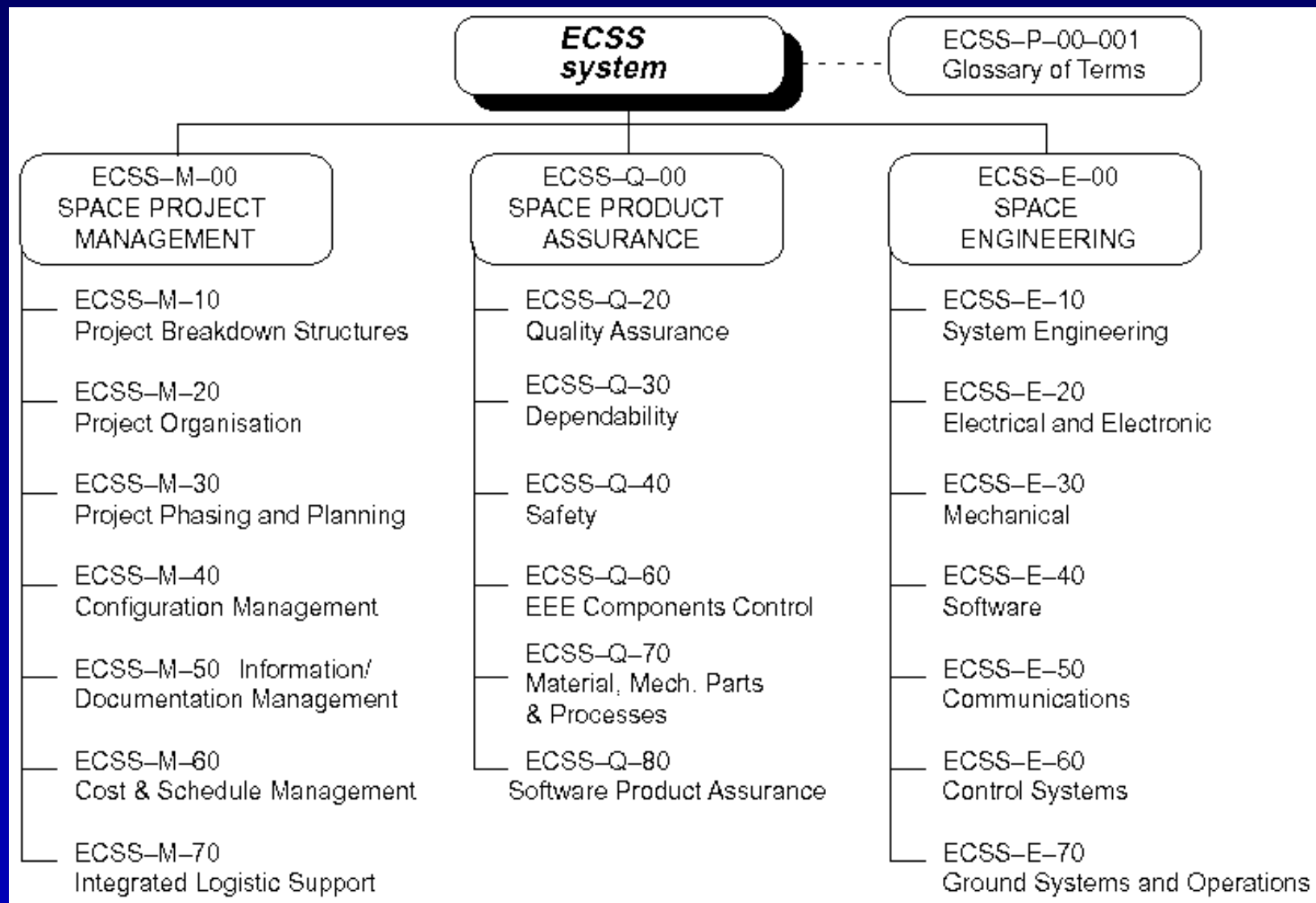
*Software is pervasive!*

# How is the ECSS System Organised?

- ❑ The ECSS system has three major branches:
- ❑ The **management** standards
  - ✧ These provide a uniform approach to a number of common management issues
- ❑ The **engineering** standards
  - ✧ Addressing a broad range of key Space engineering disciplines
- ❑ The **product assurance** standards
  - ✧ Providing both *general* coverage, and *specific* coverage for specific disciplines



# The ECSS System



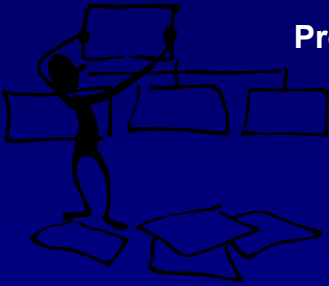
# The M-Series

*A uniform set of standards for general Space project management*

Project Breakdown

**M-10**

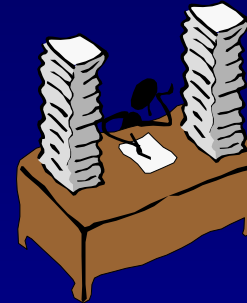
Structures



Info / Doc

**M-50**

Management



Project Phasing

**M-30**

And Planning



Configuration

**M-40**

Management



Project

**M-20**

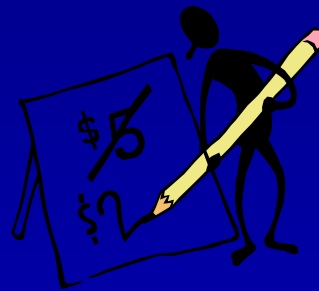
Organisation



Cost & Schedule

**M-60**

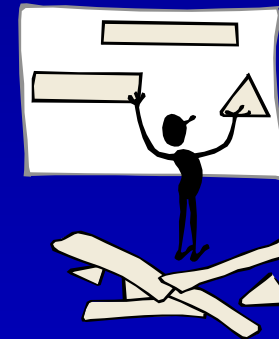
Management



Integrated

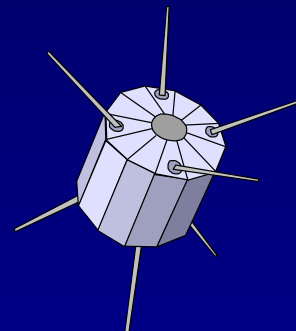
**M-70**

Logistic Support



# The E-Series

- ❑ A series of standards covering all of the essential areas of engineering within Space projects
- ❑ The **Systems Engineering standard** covers the *total* system engineering process
- ❑ Specialised standards for engineering disciplines
  - ✧ **Software**
  - ✧ Electric and electronic
  - ✧ Mechanical
  - ✧ **Ground segment E70**



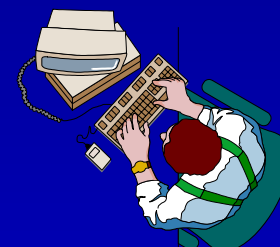
System  
**E-10**  
Engineering

*Systems engineering for the overall system*



*more specialised standards*

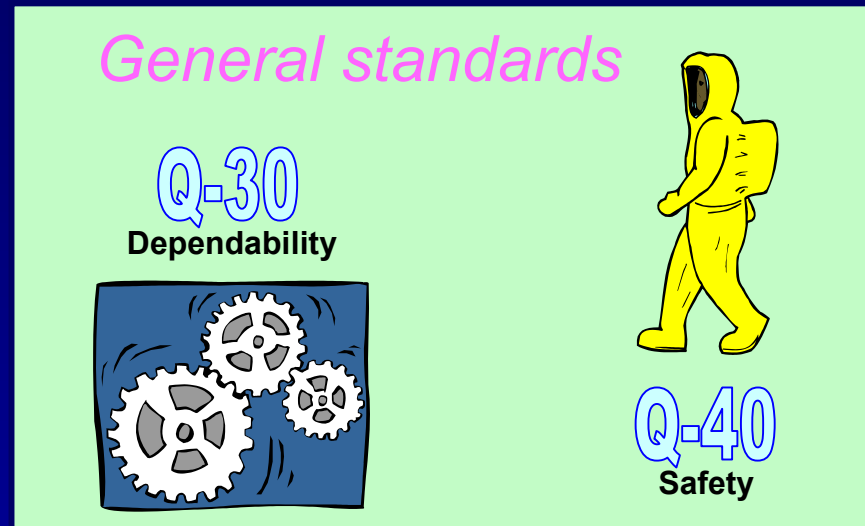
**E-40B**  
Software



*software*

# The Q-Series

- General standards covering key topics critical to all Space projects
  - ✦ Quality assurance in general
  - ✦ Safety
  - ✦ Dependability (RAM)
- Plus standards for specialised parts of the system
  - ✦ Software
  - ✦ Materials
  - ✦ ...



*standards in specific areas*

*Both the general and specific standards are applicable to projects*

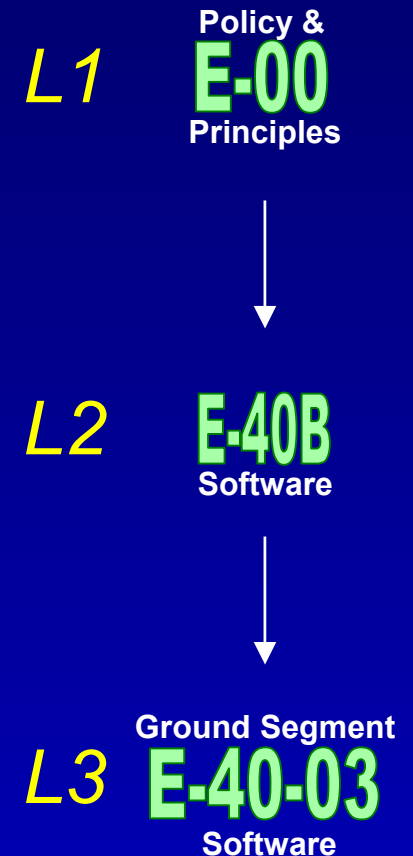


S/W Product  
**Q-80**  
Assurance

# Three Levels

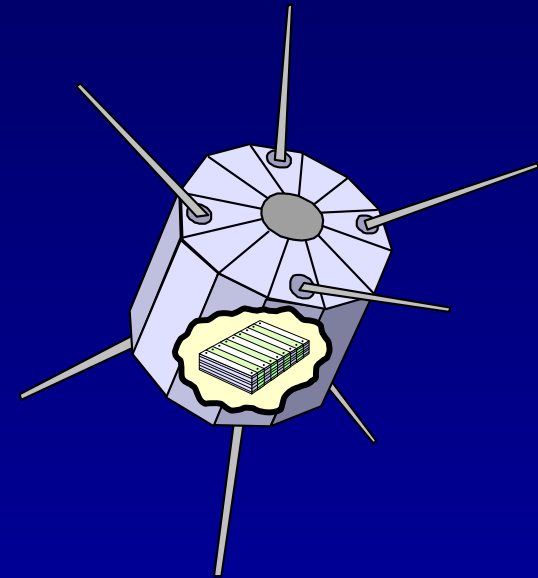
- ❑ The ECSS system is organised into three **levels**
- ❑ **Level 1 – Policy and Principles**
  - ✧ General statements of policy and principles for standardisation in that domain
  - ✧ Example: E-00 for the engineering domain
- ❑ **Level 2 – Requirements**
  - ✧ Requirements for the specific disciplines in that domain
  - ✧ Example: E-40B for software
- ❑ **Level 3 – Normative documents and handbooks**
  - ✧ Guidelines to interpreting the requirements for specific applications
  - ✧ Example: E-40-03 for ground segment software

*Example:*



# Software and Space System Engineering

- ❑ The software components of a space system play a role alongside the other engineering components such as mechanical and electrical
- ❑ All of these various engineering components (including software) are governed by the overall discipline known as **space system engineering**

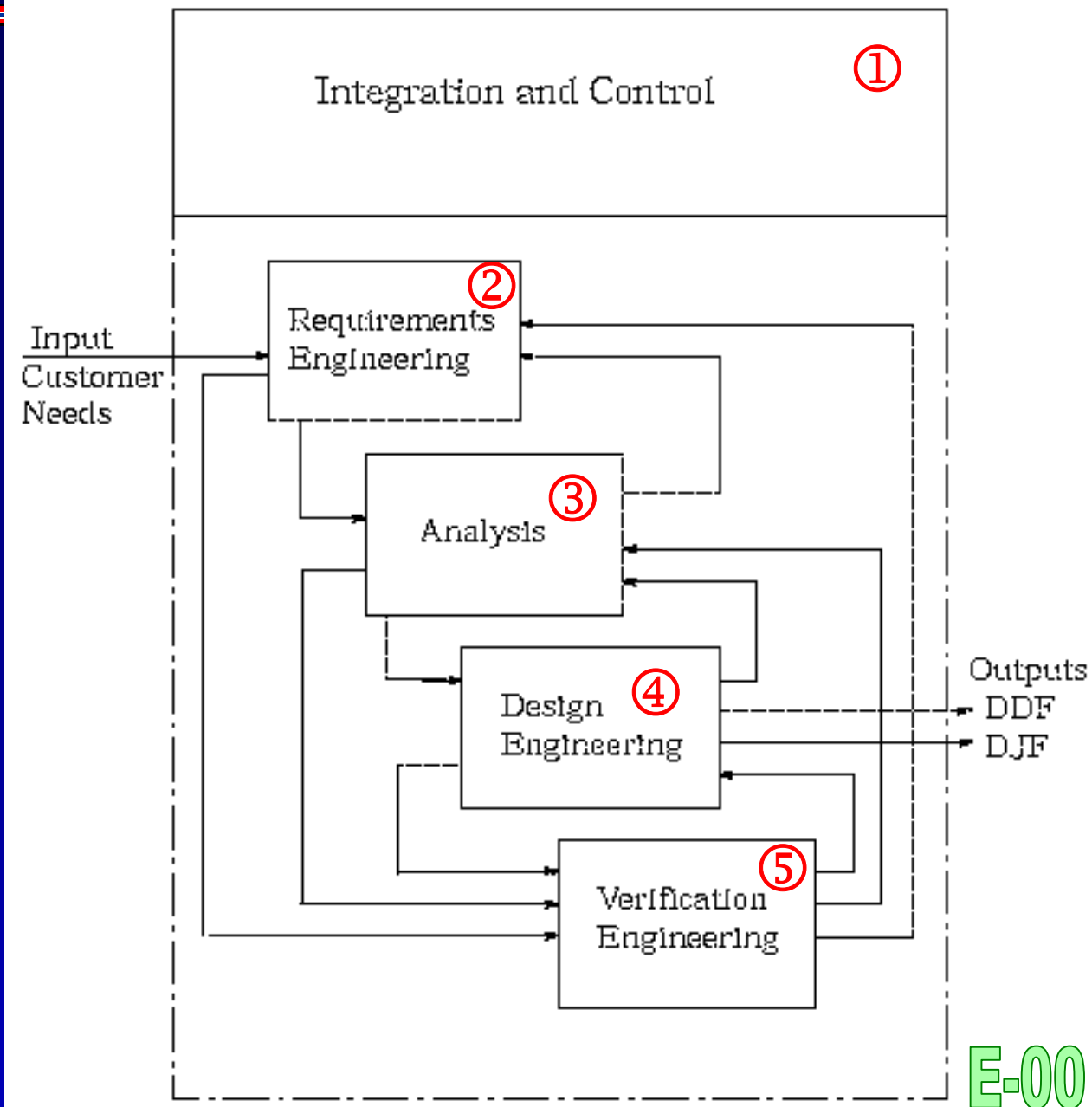


*Software components are part of the overall mission system, together with other engineering components*



# Overview of the System Engineering Process

*A simplified view in which the five main system engineering functions are identified*



E-00

5.2

# The Five System Engineering Functions

1. **Integration and control** - Overall management of the activities
2. **Requirements engineering** - Translates customer needs to input for design
3. **Analysis** - Supports all other activities with various modeling, simulation, test activities
4. **Design and configuration** - creates the physical architecture
5. **Verification** - Checks compliance with requirements

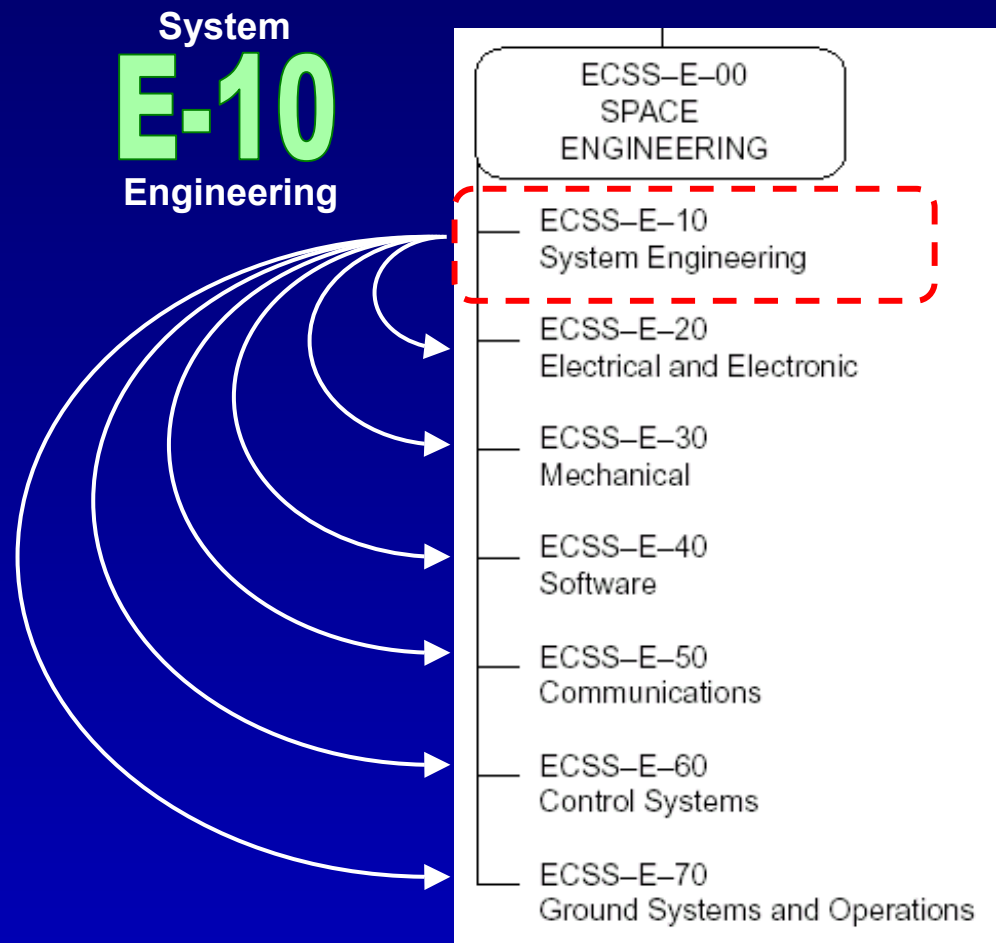
*It is important to be aware how the overall system engineering process is organised*



*Although the E40B standard defines its own processes, they “echo” this overall organisation and terminology*

# The E-10 Standard for System Engineering

- ❑ The **ECSS-E-10** standard is special in that it is relevant to **all** the engineering disciplines, **including software**
  - ✧ It is intended to guide the development of systems including H/W, S/W, man-in-the-loop, facilities & services) for space applications
- ❑ It specifies implementation requirements for the responsible **system engineering organization**



# The Link Between E-10 and E-40

Space System  
Engineering

System  
**E-10**  
Engineering



**System  
engineering  
processes related  
to software  
(E-40 Section 5.2)**

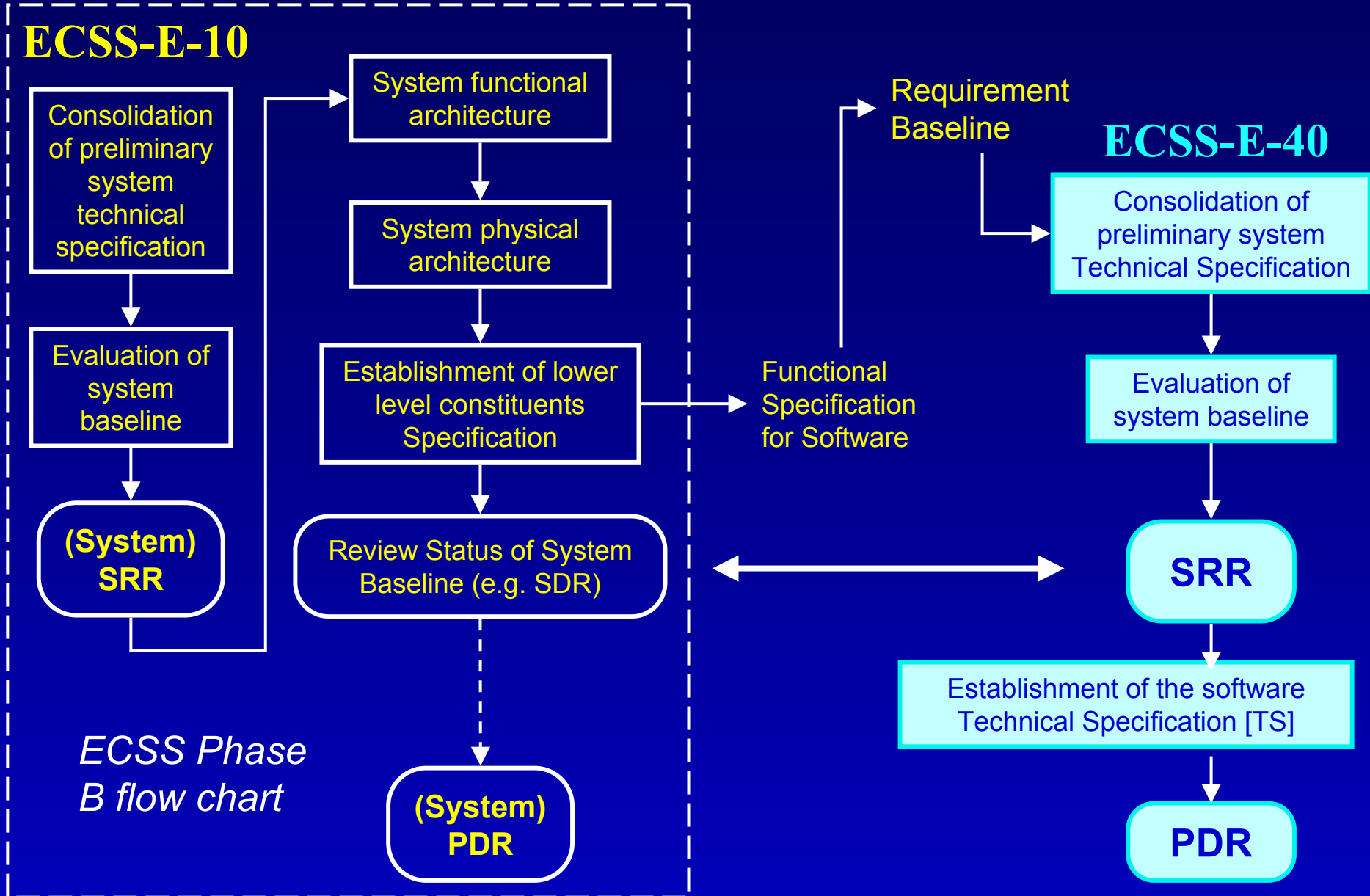


Space Software  
Engineering

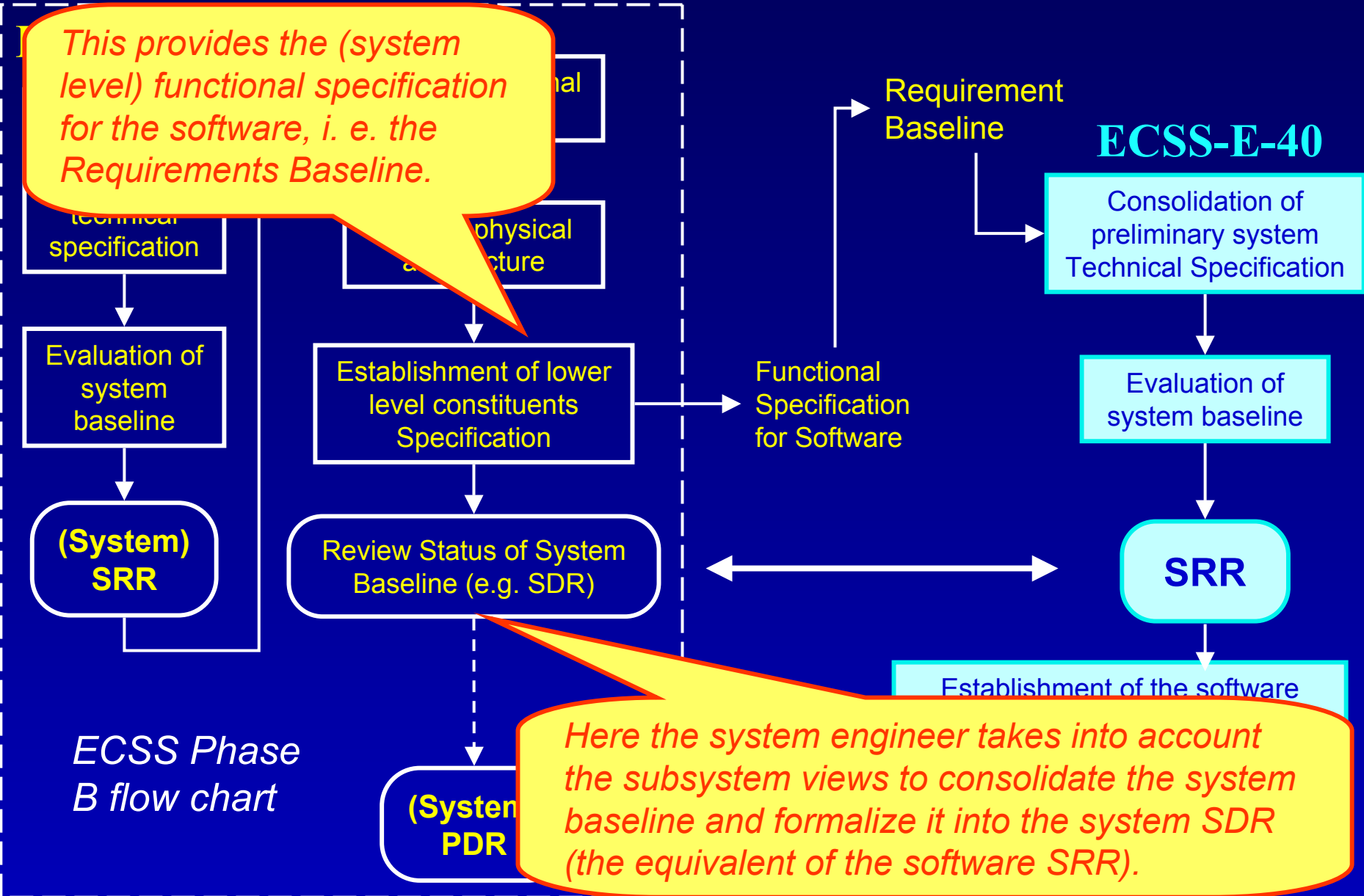
**E-40B**  
Software

*This clause (5.2) of E-40 complements ECSS-E-10 for the specific software activities to be performed at system level by the customer*

# E10 and E40 Relationship



# On the E-10 Side



This provides the (system level) functional specification for the software, i. e. the Requirements Baseline.

Here the system engineer takes into account the subsystem views to consolidate the system baseline and formalize it into the system SDR (the equivalent of the software SRR).

# On the E-40 Side

## ECSS-E-10

Consolidation of preliminary system technical specification

Evaluation of system baseline

**(System) SRR**

*This activity verifies that the specific software activities at system level described in E-40 Clause 5.2 are actually taken into consideration.*

architecture

Establishment of lower level constituents Specification

Review Status of System Baseline (e.g. SDR)

Functional Specification for Software

Requirement  
line

## ECSS-E-40

Consolidation of preliminary system Technical Specification

Evaluation of system baseline

**SRR**

Establishment of the software Technical Specification [TS]

**PDR**

ECSS Phase B flow chart

*This is formalized at the software SRR, and now the software is viewed as a (lower-level) system.*

# Summary

- ❑ Space software engineering is part of the engineering branch of the ECSS standards
- ❑ The **E-10** standard specifies implementation requirements for the responsible system engineering organization
- ❑ E-40 complements E-10 for the specific software activities to be performed at system level
  - ✧ The link is reflected in **E-40 Clause 5.2, System engineering processes related to software**
  - ✧ These specific activities are performed early in the project phases (B or early C/D)
  - ✧ Note that they can be delegated by the customer to the supplier
- ❑ The practical implementation of the scheme is a matter of E-40 **tailoring** (for example, whether to delegate the customer software activities to the supplier)