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BSI Standards Publication

Space engineering — Software engineering handbook

National foreword

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Ingénierie spatiale - Guide d'ingénierie logiciel

Raumfahrttechnik - Handbuch zur
Softwareentwicklung

This Technical Report was approved by CEN on 20 April 2022. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

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European Foreword

This document (CEN/TR 17603-40:2022) has been prepared by Technical Committee CEN/CLC/JTC 5 “Space”, the secretariat of which is held by DIN.

It is highlighted that this technical report does not contain any requirement but only collection of data or descriptions and guidelines about how to organize and perform the work in support of EN 16603-40.

This Technical report (CEN/TR 17603-40:2022) originates from ECSS-E-HB-40A.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any TR covering the same scope but with a wider domain of applicability (e.g.: aerospace).

Introduction

The ECSS-E-ST-40C Standard defines the principles and requirements applicable to space software engineering. This ECSS-E-HB-40A handbook provides guidance on the use of the ECSS-E-ST-40C.

History of the ECSS-E-40

At the beginning was ESA PSS-05. It was a prescriptive list of requirements ordered all along a waterfall lifecycle. It was necessary to improve it because it was too prescriptive and not flexible enough to apply new technologies such as UML.

ECSS was created in the 90's, and ECSS-E-40A was published in 1999. It was derived from ISO 12207, which is a process model. A process model proposes a set of abstract processes, and the software developer defines its own lifecycle that enters and leaves and re-enters the various processes. The process model was very abstract, with sort of meta-processes that were "invoking" other sub-processes. The new ECSS-E-40A was not prescriptive and very flexible to any kind of lifecycle.

ECSS-E-40A was improved because it was too abstract and it was not clear what had to be done. ECSS-E-40B was worked out in order to downsize the abstraction. The invocation was simplified, some processes were grouped. ECSS-E-40B was sent for public review.

The public review recommended improving further the pragmatic aspects of the standard. Therefore another ECSS-E-40B version was produced where the process model was streamlined.

At a workshop in 2004 on the use of ECSS-E-40B, it was recognised that some of the requirements left room for interpretation, which in turn lead to many discussions in the project reviews (especially when they were overlooked during the Software Development Plan review). Therefore the version C of ECSS-E-ST-40 was produced to improve the usability of the standard, refining and streamlining the open requirements, and somehow coming closer to the ESA PSS-05 spirit.

1 Scope

This Handbook provides advice, interpretations, elaborations and software engineering best practices for the implementation of the requirements specified in ECSS-E-ST-40C. The handbook is intended to be applicable to both flight and ground. It has been produced to complement the ECSS-E-ST-40C Standard, in the area where space project experience has reported issues related to the applicability, the interpretation or the feasibility of the Standard. It should be read to clarify the spirit of the Standard, the intention of the authors or the industrial best practices when applying the Standard to a space project.

The Handbook is not a software engineering book addressing the technical description and respective merits of software engineering methods and tools.

ECSS-E-HB-40A covers, in particular, the following:

a. In section 4.1, the description of the context in which the software engineering standard operates, together with the explanation of the importance of following standards to get proper engineering.

b. In section 4.2, elaboration on key concepts that are essential to get compliance with the Standard, such as the roles, the software characteristics, the criticality, the tailoring and the contractual aspects.

c. In section 5, following the table of content of the ECSS-E-ST-40C Standard, discussion on the topics addressed in the Standard, with the view of addressing the issues that have been reported in projects about the interpretation, the application or the feasibility of the requirements. This includes in particular:

    1. Requirement engineering and the relationship between system and software

    2. Implementation of the requirements of ECSS-E-ST-40 when different life-cycle paradigms are applied (e.g., waterfall, incremental, evolutionary, agile) and at different levels of the Customer-Supplier Network

    3. Architecture, design and implementation, including real-time aspects

    4. Unit and integration testing considerations, testing coverage

    5. Validation and acceptance, including software validation facility and ISVV implementation

    6. Verification techniques, requirements and plan

    7. Software operation and maintenance considerations.

d. In section 6 and 7, more information about selected topics addressed in section 5 such as (in section 6) use cases, life cycle, model based engineering, testing, automatic code generation, and (in section 7) technical budget and margin, computational model and schedule analysis.

NOTE In order to improve the readability of the Handbook, the following logic has been selected for sections 5, 6, and 7: