OCORA

Open CCS On-board Reference Architecture

High Level Methodology
Beta Release

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Revision history

Version	Change Description	Name (Initials)	Date of change
0.01	Draft for Scope and Structure Discussion	RM	2019-12-12
0.02	Input for further Discussion	BJ	2019-12-17
0.03	Draft for first Review	RM	2019-12-20
1.00	1st version incl. review comments	RM	2020-01-24
1.01	Document adapted to the OCORA Beta Release template	RM	2020-04-17
2.00	Final Version, ready for OCORA Beta Release	RM	2020-04-29
2.01	Proposal for OSI Layer and CENELEC process proposed to be done by OCORA	BJ	2020-06-11
2.10	Final Version incl. OSI & CENELEC, ready for OCORA Beta Release	RM	2020-06-17
2.11	Final Version for Beta Review	RM	2020-06-26
2.12	Final Version for Beta Release, incl. new figure 4	RM	2020-06-29

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References

The following references are used in this document:

[1] OCORA-10-001-Beta – Release Notes

[2] OCORA-90-002-Beta – Glossary

[3] OCORA Memorandum of Understanding, dated March 25th, 2019

[4] OCORA Code of Conduct, dated October 20th, 2019

[5] IEC 61375-3-4:2014 - Electronic railway equipment – Train communication network (TCN) – Part 3-4: Ethernet Consist Network (ECN)

1 Introduction

1.1 Document context and purpose

This document is published as part of the OCORA Beta release, together with the documents listed in the release notes [1].

The purpose of this document is to provide the OCORA participants with an overview of the used methodology. It is and will remain a high level document with the aim to ensure common approach and basis and also give the freedom of choice in all not defined areas to the workstream leaders to define appropriate processes, methodology and tools if required for the specific type of work foreseen.

The basis of this document is the OCORA contractual framework including the MoU [3] and the CoC [4].

2 Best Practice

In the various workstreams, documents are created and compiled by geographically distributed teams. Each member of these teams has a different background and specific ideas and goals.

When developing a documentation in a workstream, the reviewing process must take place in parallel by the members of the workstream. This is to ensure that the document is developed in alignment with the ideas and goals of each team member.

While the workstream leader has the responsibility to compile the document (unless defined differently), the other workstream members provide input and constantly ensure that their respective organisation is in line with the major decisions taken by the team. This is to avoid major surprises during the final review process.

Documents that are submitted for final review shall be made available to the review team at least 2 weeks before the final review TELCO. The review comments are due at least 1 week prior to the final review TELCO. This allows enough time for the author to incorporate all review comments, using the change tracking mode and to forward a revised version to the review team. Review team members need to be in the possession of the revised document not later than 2 days prior to the final review TELCO.

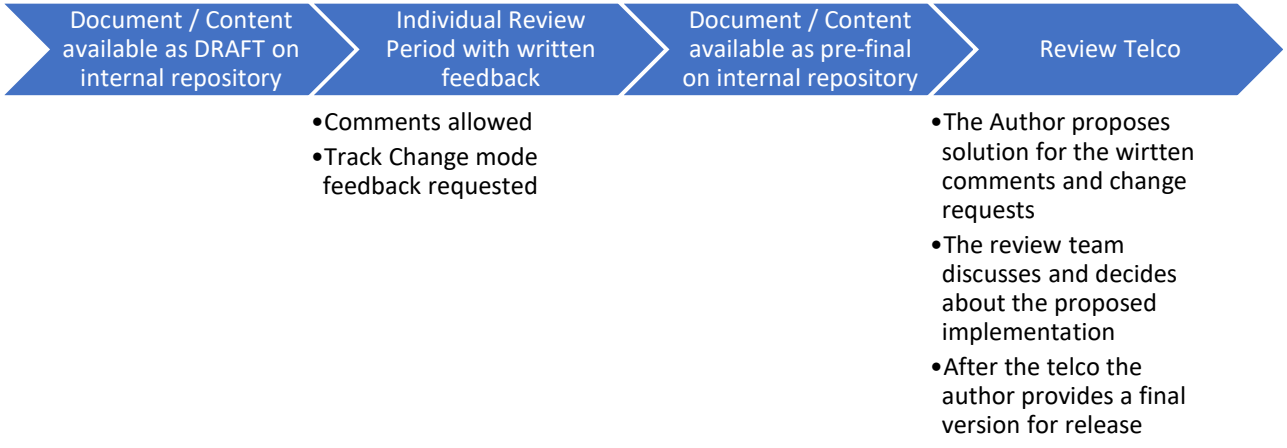

Figure 1 - Best Practice Document Review

A final review cycle is very costly, especially in respect to the time needed. A minimum of 2 weeks is needed. Therefore, the workstream leader has to make sure that documentation submitted for final review is in a perfect condition and workstream members have to ensure that their organisation's thinking is in line with the submitted documentation.

3 OSI Model

OCORA decided to follow the OSI Layer protocol specification according the international standard ISO/IEC 7498-1:1994 and used within S2R X2R1 for Subset 143.

This protocol specification is divided into separate layers. **Error! Reference source not found.** shows the representation of the different layers according to the Open Systems Interconnection (OSI) model.

All OOCORA developments shall be compliant to the End Device Interface characteristics as specified in [5]. This affects Layer 1 – Layer 7.

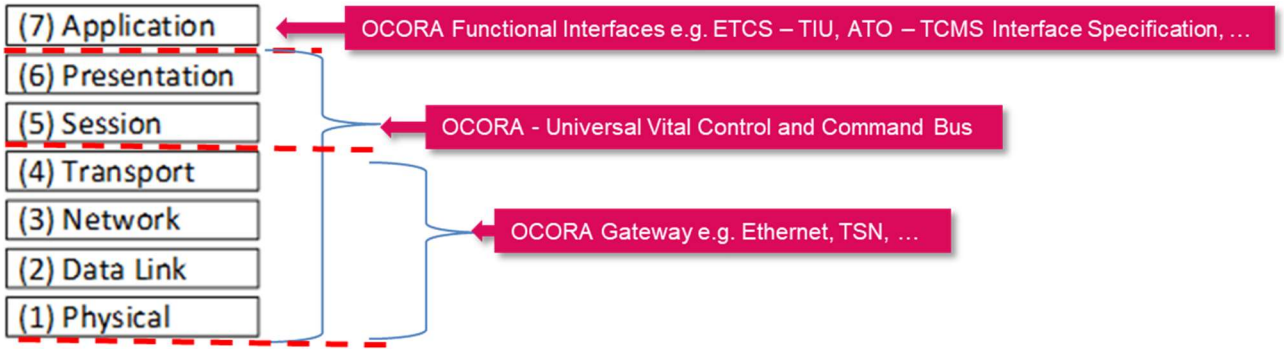

Figure 2 - OSI Layer

4 OCORA Quality Gates / Review Process

The following process shows the two quality gates applied on OCORA content. It is applied if content is been shared with other OCORA workstreams or external stakeholders e.g. Shift2Rail.

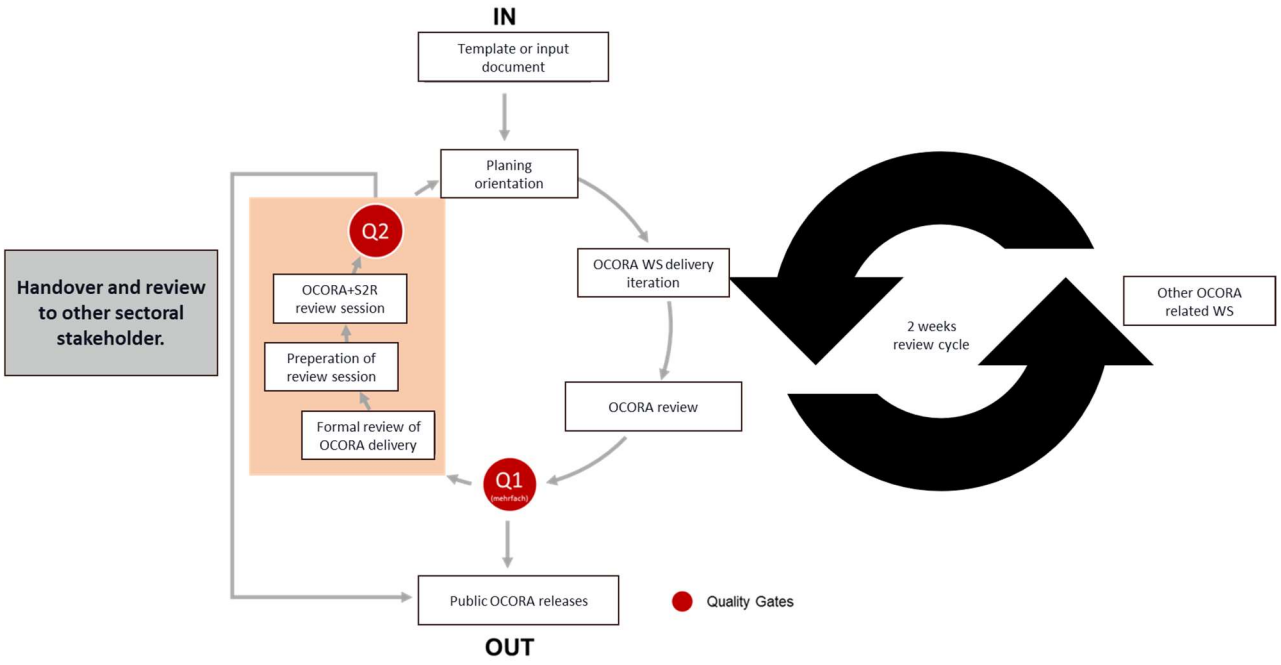

Figure 3 - OCORA review and collaboration process

5 Model Based System Engineering

5.1 EULYNX MBSE Specification Framework

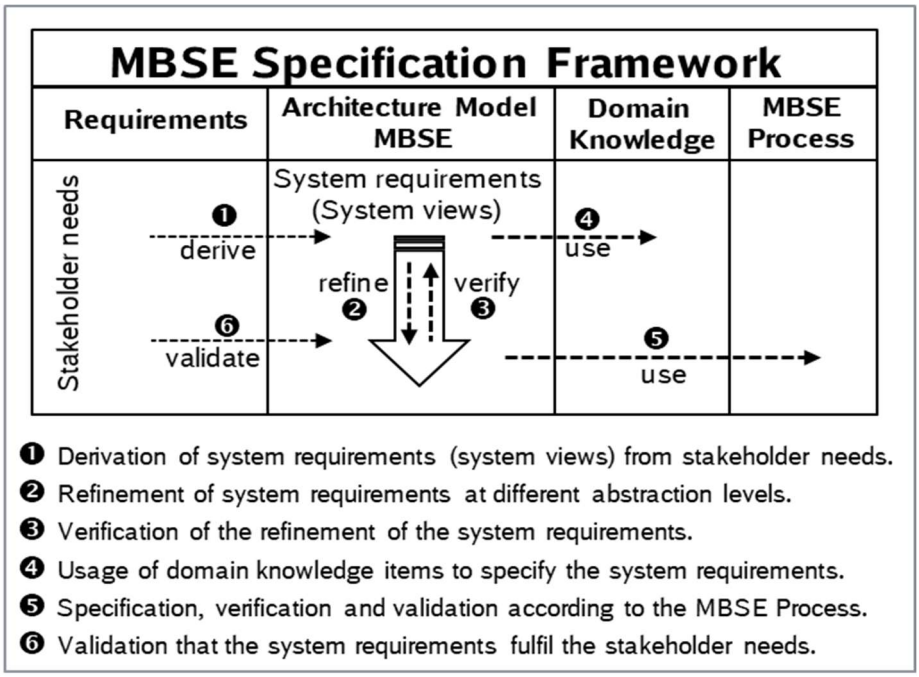

Figure 4 - EULYNX MBSE Specification Framework

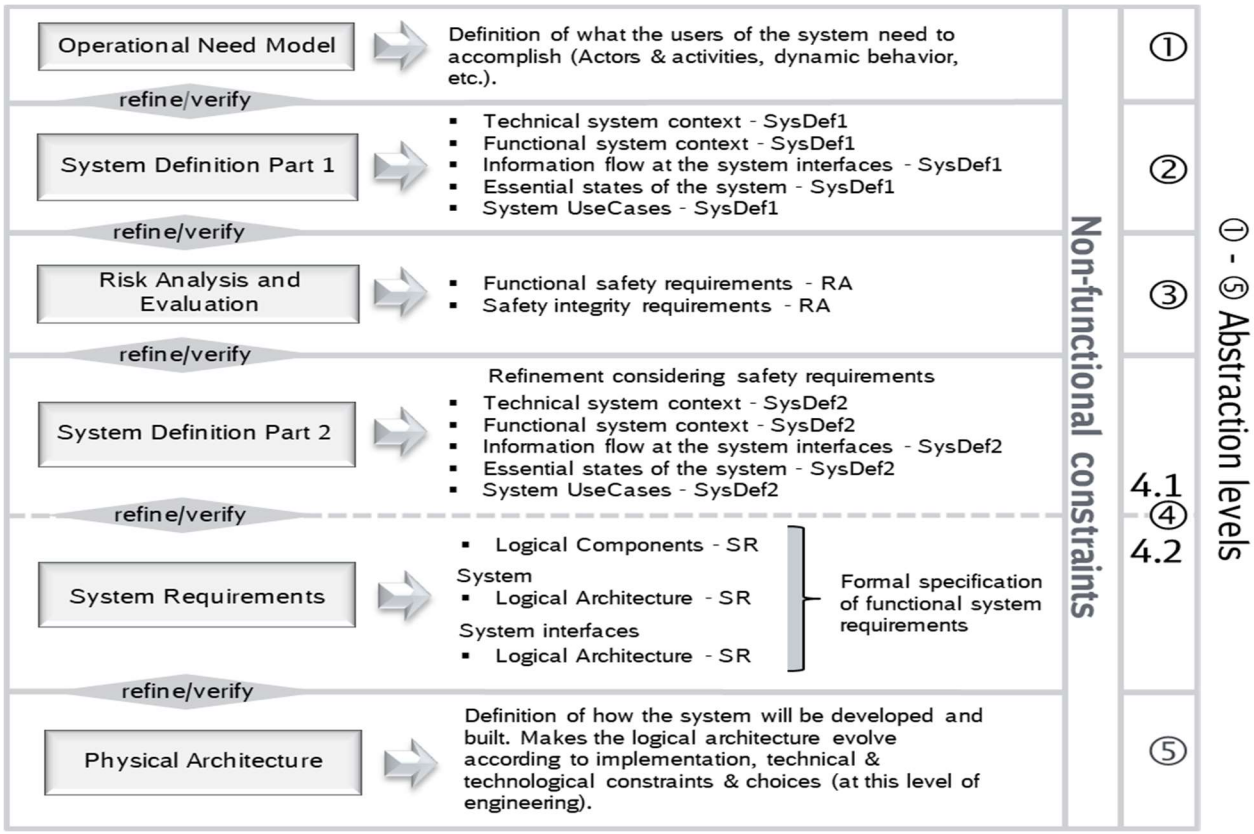

Figure 5 - EULYNX full development process

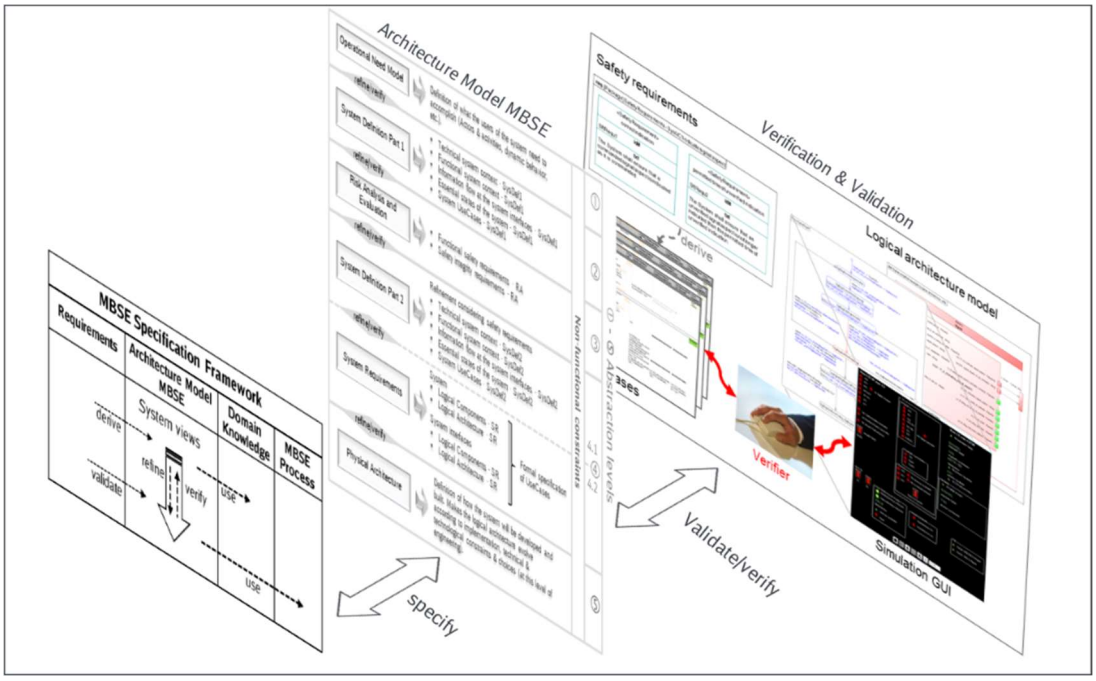

Figure 6 - EULYNX CENELEC V-Model

5.2 Model-based Systems Engineering: Arcadia

For the development of the detailed system level specification, MBSE is used. For the following reasons, OCORA has decided to use the Arcadia method for MBSE:

- Arcadia is a system engineering method developed for safety critical subjects and therefore relevant in the context of OCORA
- The method is supported by a dedicated, powerful tool (Capella)
- Most founding members of OCORA are using the Arcadia method in their CCS projects already

It is yet to be decided to what extent and in what phases of the product definition/development cycle the Arcadia method will be used.

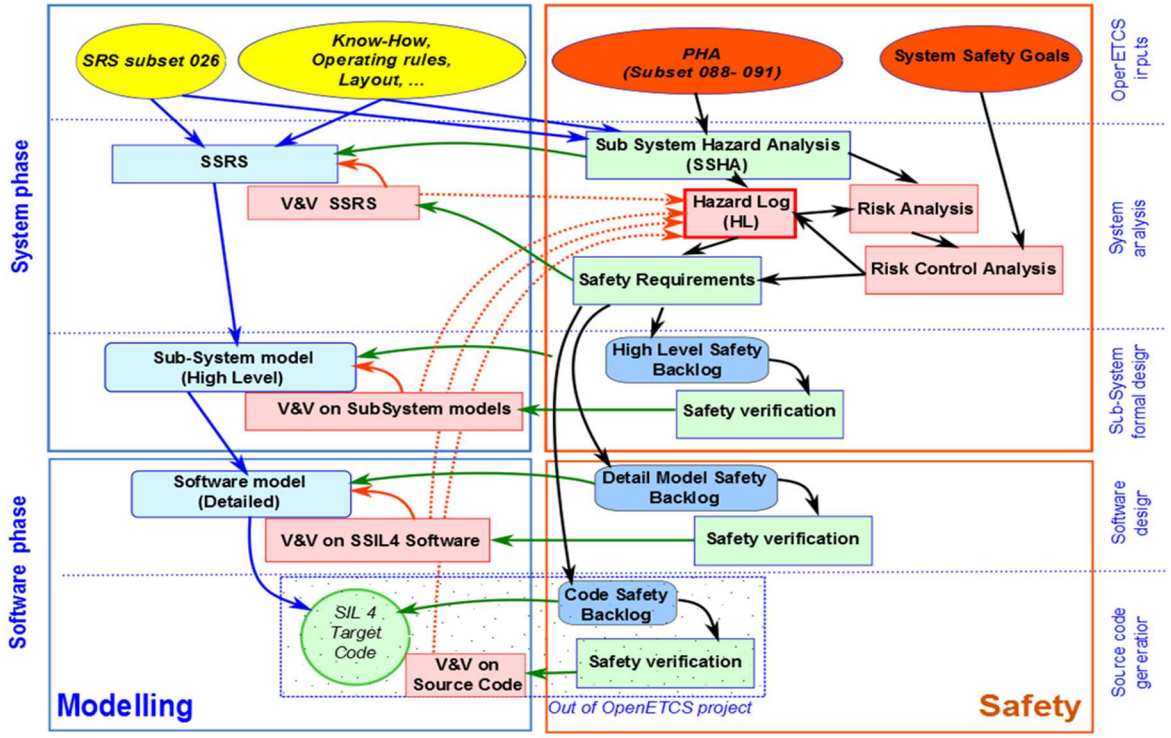

Figure 7 - MBSE Process applied at OpenETCS –correct Modelling and Safety

6 OCORA deliverables in compliance with the CENLEC phases

OCORA will be fully compliant and follow the CENELEC process as defined within the international standard and the application within the S2R IP 2 GoA 3/4 activities to use for Model Based System Engineering as described in chapter 5.

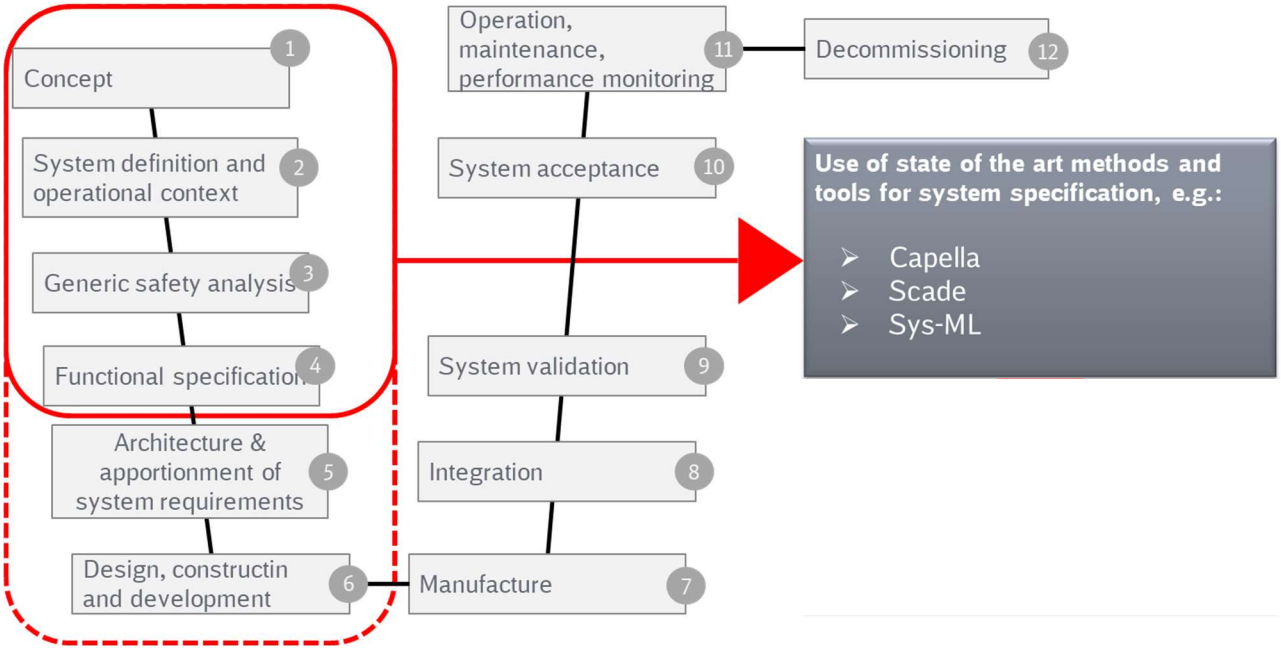

Figure 8 - CENELEC Phases 1 – 12

CENELEC Phase 1	**Concept**
1.1 Operational Needs and Mission	- Textual description of operation needs and Related milestones.
1.2 Roles and Responsibilities (Actors)	- System context diagram (operation point of view) -> Internal Block Diagram - Definition of the Actors external to the system - Textual description of roles and responsibilities of the Actors
1.3 System Input/Outputs (interface with the actors)	- Description of the Interfaces with the Actors
1.4 Operational Environment (Ops environment and contexts)	- Identification of the different Operational Context with the associated Context Diagram Internal Block Diagram - Description of the Operational Context - Specification for the transitions between the different Operational Contexts
1.5 Non-functional specification	- Assumptions - Environment conditions - Reliability, Availability and Maintainability - Safety - Portability - Performance - Interoperability - Interchangeability

CENELEC Phase 2	System definition part 1 and operational context
2.1 Functional Entities (Use Cases)	- Identification and description of the Use Cases associated to the different Operational Contexts (Use Case diagrams)
2.2 Operational Scenarios (Sequence diagrams)	- Specification of nominal and degraded operational scenarios - Based on Sequence Diagrams - Stimulus-Response Specification
2.3 User Interface Principles	- Definition of the MMI principles - Specification of the required devices (push buttons, levers, touch screen, etc...)
2.4 Logical Architecture (high level functional architecture)	- Description of the Logical Architecture
2.5 Interfaces definition (high level with the expected level requirements FIS or FFFIS)	- Definition of the interfaces (internal to the system) with the required standardisation level (FIS Or FFFIS)
CENELEC Phase 3	**Generic Safety Analysis**
3.1 Functional safety requirements	- PHA - SyHA - Hazard Log
3.2 Safety integrity requirements	- Safety assessment
CENELEC Phase 4	**Functional Specification**
4.1 Functional requirement	- Functional breakdown Structure: - System functional breakdown structure - Functional dependencies - Functional data - Detailed description of functions which are part of the FBS - Detailed Functional breakdown if needed - Internal functions interactions - Inputs: detailed formal description of Inputs - Detailed description - Associated requirements - Processing - Textual description - Activity diagrams - State machines - Outputs: detailed formal description of inputs

CENELEC Phase 5	Architecture and apportionment of system requirements
5.1 General Architecture Definition (logical and physical)	- Main Design criteria - Textual explanation of design constrains with corresponding rationales - Logical Architecture - Introduction - Logical System Breakdown Structure: Definition of Logical Blocs that will support the functions - System Logical Elements Static Dependencies: External and internal interfaces associated With the Logical Blocs - System Logical Elements Dynamic Dependencies: Stimulus-Response specification of the Dynamic behaviour of the logical blocs - Logical Internal Interfaces: - Role of the Interfaces - Physical level - Protocol level - Application Level - Physical Architecture - Specification of the Physical Component architecture (bdd)
5.2 Interface Specification	- Logical internal interfaces - Role of the Interface - Physical level - Protocol level - Application level
5.3 Physical architecture	- Specification of the Physical Component architecture
5.4 Apportionment	- Functional Distributions - Allocation of the functions to Logical blocs - Logical Architecture Distribution - Allocation of the logical Blocs to Physical Components

Figure 9 - Application CENELEC Norm P1-P5 as applied within S2R IP 2 for ATO GoA 3/4 development

7 OCORA deliverables in the V cycle

The main objectives of OCORA imply creating the preconditions for successful future product development – firmly based in prevailing EU regulations and notably the Technical Specifications for Interoperability or TSI's – that answer the needs and requirements of both the RU's and the supply industry. In the relation to the supply industry, OCORA formulates the requirement specification that products and services on offer have to comply with. Requirements originate from:

- Prevailing Europe and national law and regulations, the development of which OCORA (notably the upcoming 2022 TSI CCS revision) intends to influence using the appropriate channels like ERA. These cover a wide array of functional and technical requirements:
- Business objectives of individual OCORA Members, translated into (mostly non-functional) harmonised requirements for procurement purposes.

With reference to standard systems engineering process modelling, the domain of **OCORA would extend from the specification of customer requirements down to system design** and the role of the **supply industry would be to start product development** based on this input as illustrated below.

Unless otherwise decided (ex. joint development for demonstrators or reference systems) it is assumed, that each party inside OCORA but also outside of OCORA, will apply OCORA specifications themselves to perform validation, testing, operation and maintenance individually.

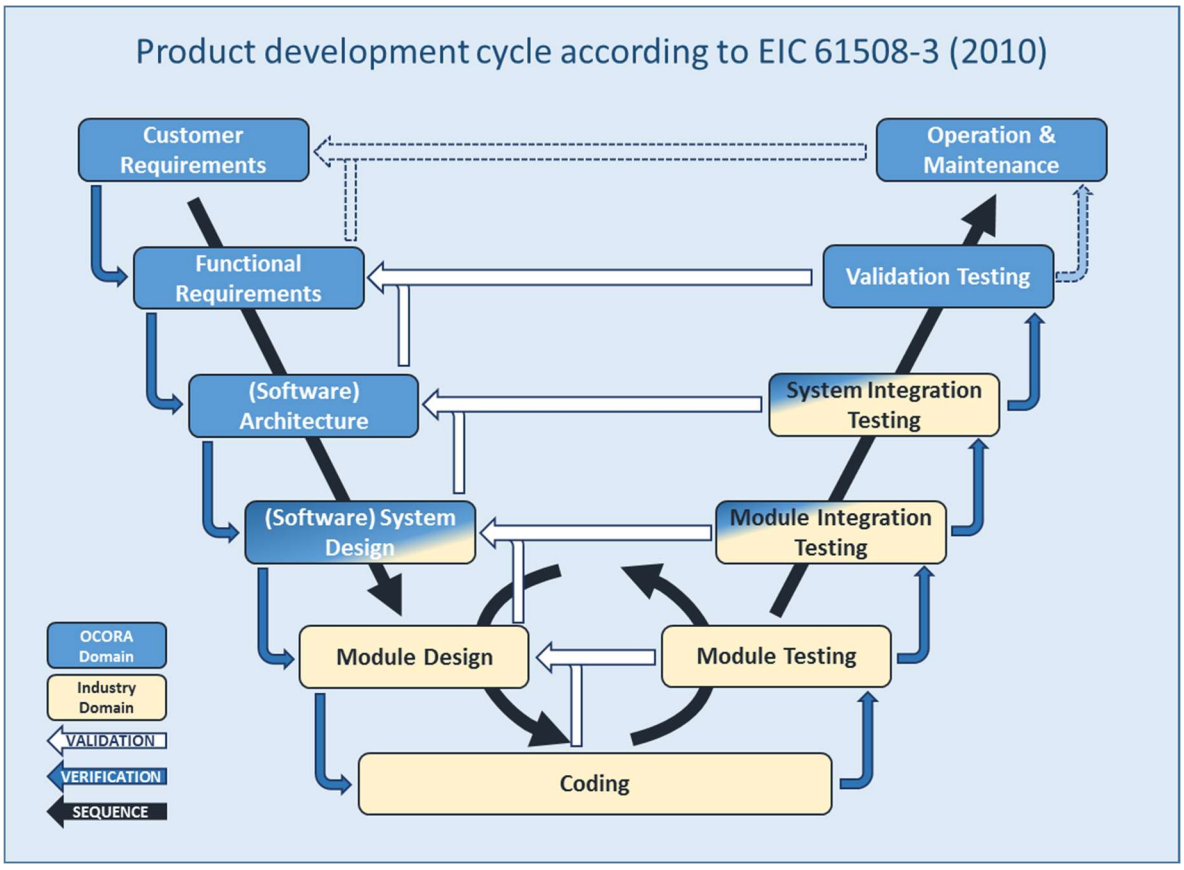

Figure 10 - OCORA preferential distribution of responsibilities in relation to suppliers

7.1 OCORA deliverables in the V-cycle and MBSE process based

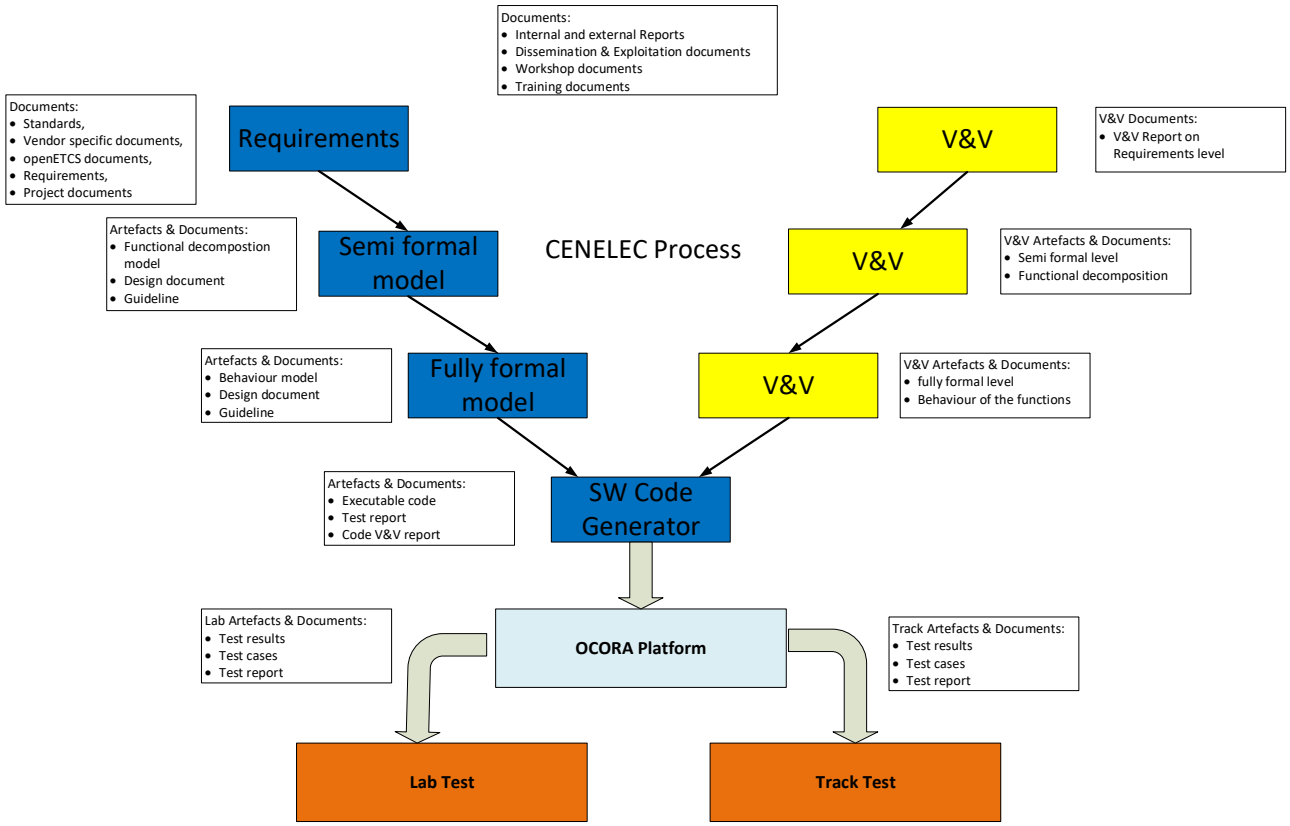

Figure 11 - OCORA V-Model MBSE Process