OCORA

Open CCS On-board Reference Architecture

Program Requirements

Document ID: OCORA-TWS05-021

Version: 2.21

Date: 31.01.2025

Management Summary

OCORA requirements are engineered in a top-down manner. The following levels are defined:

- **"Stakeholder Requirements" (A-Level requirements)**
- **"Program- & Design Requirements" (B-Level requirements)**
- **"System Requirements" (C-Level requirements)**
- **"Building Block Requirements" (D-Level requirements)**

This document intend to hold all **"Program Requirements" (B-Level requirements).** It will be updated and enriched with return on experience.

OCORA requirements are engineered in Polarion with full traceability.

Revision History

Version	Change Description	Initials	Date of change
1.01	Official version for OCORA Delta Release	RM/TM	30.06.2021
2.0	Official version for OCORA Release R1	RM/TM	26.11.2021
2.1	All requirements updated to follow the Eurospec syntax	TM	01.06.2022
2.2	Updated certain requirement categories	TM/FK	31.05.2023
2.21	Editorial updates in the introduction chapter	TM	31.01.2025

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References

Reader's note: please be aware that the document ids in square brackets, e.g. [OCORA-BWS01-010], as per the list of referenced documents below, are used throughout this document to indicate the references to external documents. Wherever a reference to a TSI-CCS SUBSET is used, the SUBSET is referenced directly (e.g. SUBSET-026). OCORA always reference to the latest available official version of the SUBSET, unless indicated differently.

[OCORA-BWS01-010] – Release Notes
[OCORA-BWS01-020] – Glossary
[OCORA-BWS01-030] – Question and Answers
[OCORA-BWS01-040] – Feedback Form
[OCORA-BWS03-010] - Introduction to OCORA
[OCORA-BWS03-020] - Guiding Principles
[OCORA-BWS04-010] - Problem Statements
[OCORA-BWS08-010] - Methodology
[OCORA-BWS08-020] - Tooling
[OCORA-TWS05-010] – Requirements – Management Guideline
[OCORA-TWS05-020] – Stakeholder Requirements
[OCORA-TWS05-022] – Design Requirements
[OCORA-TWS09-010] - Testing - Strategy

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide a collection of all Program Requirements (B-Level requirements) in a structured manner. Please be aware of the Stakeholder Requirements (A-Level requirements) provided in [OCORA-TWS05-020]. Also note that Design Requirements are not covered in this document as they are covered in a [OCORA-TWS05-022].

This document is addressed to experts in the CCS domain and to any other person, interested in the OCORA concepts for on-board CCS. The reader is invited to provide feedback to the OCORA collaboration and can, therefore, engage in shaping OCORA. Feedback to this document and to any other OCORA documentation can be given by using the feedback form [OCORA-BWS01-040] .

If you are a railway undertaking, you may find useful information to compile tenders for OCORA-inspired CCS building blocks, for tendering complete on-board CCS systems, or for on-board CCS replacements for functional upgrades or life-cycle considerations.

If you are an organization interested in developing CCS on-board building blocks according to the OCORA design principles, the information provided in this document can be used as input for your development.

1.2 Applicability of the document

The document is informative. Subsequent releases of this document will be developed based on a modular and iterative approach, evolving within the progress of the OCORA collaboration.

1.3 Context of the document

This document is published as part of an OCORA Release, together with the documents listed in the release notes [OCORA-BWS01-010] . Before reading this document, it is recommended to read the Release Notes [OCORA-BWS01-010]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [OCORA-BWS03-010], and the Problem Statements [OCORA-BWS04-010]. The reader should also be aware of the Glossary [OCORA-BWS01-020] and the Question and Answers [OCORA-BWS01-030].

1.4 Requirements Engineering Process

This OCORA requirement document is developed, using the Requirements Management Guideline [OCORA-TWS05-010]. The requirements are engineered in a top-down manner:

- As a starting point all **"Stakeholder Requirements"** towards the OCORA initiative **(A-Level requirements)** are captured and formalised.

- In a second step, the **"Program- and Design Requirements" (B-Level requirements)** are developed. These requirements define tools, processes, methodologies and design rules to be used within the program and to be considered during the system analysis and the system design/architecture work.

- As a next step, the A- and B-Level requirements are further developed in the MBSE analysis to become **"System Requirements" (C-Level requirements).**

- As part of the MBSE architecture work, building blocks are identified taking into account the MBSE analysis (C-Level requirements). All applicable requirements (A-Level, B-Level, and C-Level) are apportioned to the identified building blocks, resulting in **"Building Block Requirements" (D-Level requirements)**, forming the OCORA tender templates, together with the applicable program & design requirements.

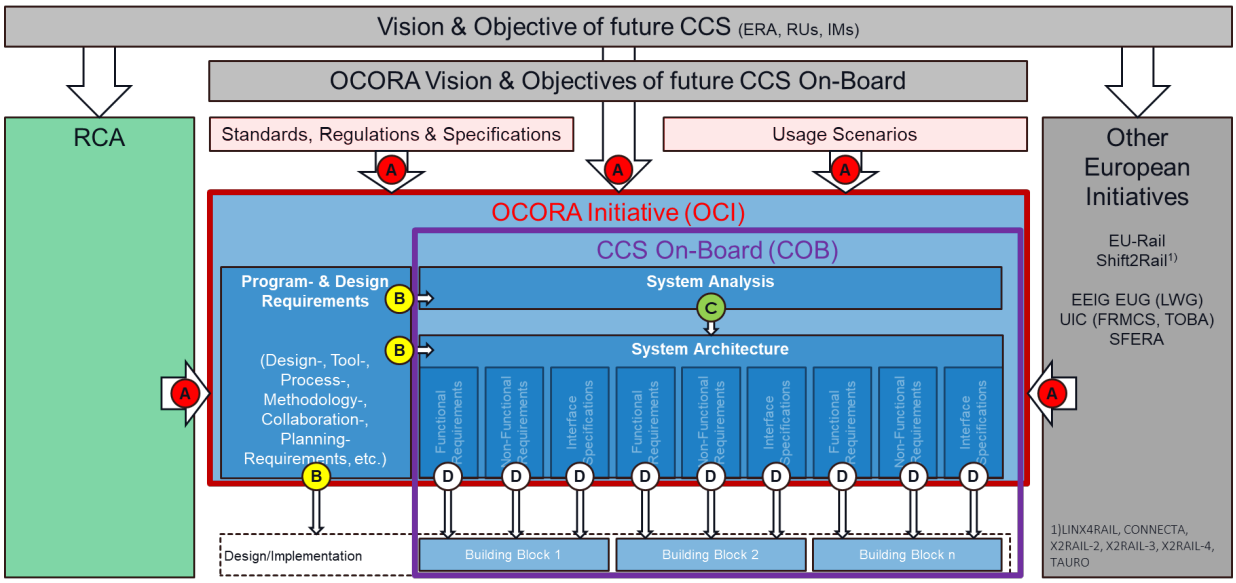

Figure 1 OCORA Requirements Engineering Process

Please note, that the A-Level requirements are applicable to the OCORA Initiative (OCI) while the B- and C-Level requirements are targeted towards the CCS On-Board System (COB) and its architecture. D-Level requirements are applicable to the respective building blocks.

2 Requirements

2.1 Collaboration

OCORA-473, B-Level - Organise collaboration among defined bodies

The OCORA initiative shall be organised as follows:

- The Steering Committee is defining the OCORA strategy and allocates funding.
- The Core Team is in charge of the operational management.
- The Workstream Teams are in charge of the development of topic specific content

Status	✔ Approved
Classification	Requirement
Rationale	• To organise the OCORA collaboration
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-470, B-Level - Split the activities in topic specific workstreams

The OCORA initiative shall split its activities into topic specific workstreams.

Status	✔ Approved
Classification	Requirement
Rationale	• To structure the OCORA collaboration.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-471, B-Level - Publish content in subsequent releases

The OCORA initiative shall publish its work in subsequent releases.

Status	✓ Approved
Classification	Requirement
Rationale	• To provide fast access to OCORA content. • To gain maturity in OCORA content. • To involve the sector early.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-472, B-Level - Follow release process

The OCORA initiative shall adhere to the following release process:
1. The workstream team creates and reviews content, lead by the workstream leader.
2. At the internal release date, the workstream leader hands in the content to the Core Team.
3. The Core Team checks the release consistency among a set of documents and performs a final review on the release.
4. The Steering Committee endorses the release before publication.

Status	✓ Approved
Classification	Requirement
Rationale	• To allocate responsibilty in the release process
Category	Non-functional
Acceptance Method	Process Review
Remark	

2.2 Documentation

OCORA-116, B-Level - English as publication language

All OCORA documentation shall be developed and published in English.

Status	✓ Approved
Classification	Requirement
Rationale	• To allow easy access for all interested parties.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-580, B-Level - Maintain a documentation plan

All published OCORA documentation shall be listed in a documentation plan.

Status	✓ Approved
Classification	Requirement
Rationale	• To allow easy access for all interested parties.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-117, B-Level - Document structure

All OCORA documentation shall follow a standardised structure.

Status	✔ Approved
Classification	Requirement
Rationale	• To facilitate the reading and understanding of the OCORA documentation.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-175, B-Level - Glossary

Terms shall be clearly defined and described, abbreviations explained.

Status	✔ Approved
Classification	Requirement
Rationale	• To facilitate the reading and understanding of the OCORA documentation.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-456, B-Level - Questions and Answers

The OCORA initiative shall maintain and publish a Q&A catalogue including answers to frequently asked questions.

Status	✔ Approved
Classification	Requirement
Rationale	• To facilitate the reading and understanding of the OCORA documentation.
Category	Non-functional
Acceptance Method	Process Review
Remark	

2.3 Planning

OCORA-474, B-Level - Manage topic specific workstreams

The Core Team shall decide on starting and ending of topic specific workstreams.

Status	✓ Approved
Classification	Requirement
Rationale	• To allocate responsibility in the planning process
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-583, B-Level - Create and maintain workstream definitions

The workstream team, lead by the workstream leader, shall propose a workstream definition for each period of active development.

Status	✓ Approved
Classification	Requirement
Rationale	• To clearly define the activities and expected outcome of the next development period.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-582, B-Level - Release workstream definitions

The Core Team shall review and release workstream definitions before the actual development work can start.

Status	✓ Approved
Classification	Requirement
Rationale	• To ensure consistency across different workstreams • To ensure compliance with the overall OCORA program goals
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-482, B-Level - Supervise progress

The Core Team shall supervise the workstream developments by regular progress review meetings where the workstream leaders report current activities, issues and progress based on the workstream definitions.

Status	✓ Approved
Classification	Requirement
Rationale	• To be able to fast react on issues from inside and changes required from outside • To be able to manage and steer, especially overarching topics requiring multiple workstreams
Category	Non-functional
Acceptance Method	Process Review
Remark	• Currently progress reporting is carried out on a bi-weekly basis • Separated among for business- and technical- workstreams

2.4 Methodology

This chapter lists the requirements placed on the OCORA Methodology [OCORA-BWS08-010] .

As a key collaboration principle, OCORA applies Best-Practice enriched with internal (based on knowledge of OCORA members) and external experience.

OCORA-477, B-Level - Apply OSI model for network communication interfaces
The OCORA initiative shall apply the OSI model when specifying standardised network communication interfaces.

Status	✔ Approved
Classification	Requirement
Rationale	• With a modular architecture and required plug and play like exchangeability interface definition becomes a key success factor. • With the introduction of a CCN also the sharing of common layers (e.g. OSI 1. Physical, 2. Data Link, 3. Network, 4. Transport, 5 Session and 6 Presentation) among different subsets are introduces, while the layer 7. Application remines subset specific.
Category	Non-functional
Acceptance Method	Design Review
Remark	

OCORA-478, B-Level - Use model based system engineering MBSE

The OCORA initiative shall perform model based system engineering, MBSE to leverage system complexity in the CCS domain.

Status	✔ Approved
Classification	Requirement
Rationale	• To handle complexity • To enable harmonisation / unification • To ensure consistency • To serve apportionment • To serve with different views, levels and perspectives • To support interactions with other initiatives
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-480, B-Level - Define interlinking between MBSE and CENELEC

The OCORA initiative shall define the interlinking between MBSE and CENELEC

Status	✔ Approved
Classification	Requirement
Rationale	• To define a clear interaction between MBSE and CENELEC • To benefit from MBSE regarding leverage of complexity • To ensure CENELEC required traceability
Category	Non-functional
Acceptance Method	Design Review
Remark	

OCORA-586, B-Level - Iteratively follow the defined interlinking between MBSE and CENELEC

The OCORA initiative shall ensure that the defined interlinking between MBSE and CENELEC is followed in an iterative approach.

Status	✔ Approved
Classification	Requirement
Rationale	• To keep track of the development of the model as it is being made
Category	Non-functional
Acceptance Method	Design Review
Remark	

OCORA-481, B-Level - Use Model Based Software Development (MBSD)

The OCORA initiative shall use model based software development for prototyping and demonstration purposes.

Status	✔ Approved
Classification	Requirement
Rationale	• To develop in a model based approach.
Category	Non-functional
Acceptance Method	Process Review
Remark	

2.5 Tooling

This chapter lists the requirements placed on OCORA Tooling [OCORA-BWS08-020] .

OCORA-464, B-Level - Use Microsoft Office for general purpose

The OCORA initiative shall use Microsoft Word, Excel, PowerPoint and Project for general purpose

Status	✔ Approved
Classification	Requirement
Rationale	• Already existing at the OCORA members • Avoid multiple template management
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-465, B-Level - Use Microsoft Teams for exchange.

The OCORA initiative shall use Microsoft Teams for regular, virtual exchange

Status	✓ Approved
Classification	Requirement
Rationale	• Already existing at the OCORA members
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-466, B-Level - Use GitHub as workspace and internal repository

The OCORA initiative shall use GitHub as project workspace and internal data repository, separated from the external GitHub repository.

Status	✓ Approved
Classification	Requirement
Rationale	• Ensure traceable program management • Ensure traceable document sharing • Ensure traceable prototype development
Category	Non-functional
Acceptance Method	Process Review
Remark	https://github.com/openETCS/OCORA

OCORA-460, B-Level - Use GitHub as external repository

The OCORA initiative shall use GitHub as external data repository, separated from the internal github repository.

Status	✓ Approved
Classification	Requirement
Rationale	• Compliance with EUPL
Category	Non-functional
Acceptance Method	Process Review
Remark	https://github.com/OCORA-Public

OCORA-461, B-Level - Use Polarion for requirements management

The OCORA initiative shall use Polarion for requirement engineering and management

Status	✓ Approved
Classification	Requirement
Rationale	• Usage of best practice tool for CENELEC compliant developments • To ensure traceability in general • To facilitate reviews/publication
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-463, B-Level - Use SCADE for MBSD

The OCORA initiative shall use SCADE for Model-based Software Development

Status	✔ Approved
Classification	Requirement
Rationale	• Usage of best practice tool for safety critical developments
Category	Non-functional
Acceptance Method	Process Review
Remark	Might be applied for OCORA internal prototyping work.

OCORA-467, B-Level - Use Capella plug-in to export modelling artefacts

The OCORA initiative shall use a dedicated Capella plug-in to export modelling artefacts from Capella to Polarion

Status	✔ Approved
Classification	Requirement
Rationale	• Complexity can best be handled in a visual modelling tool, while requirements management (incl. traceability), requirement reviewing and clause-by-clause tendering is best practice in a requirements management tool To minimise effort and avoid double work, modelling artefacts can be exported into requirements tool.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-462, B-Level - Use Capella for MBSE

The OCORA initiative shall use Capella for Model-based Systems Engineering

Status	✓ Approved
Classification	Requirement
Rationale	• To unify modelling approach. • To allow end-to-end modelling with RCA • To allow end-to-end modelling with LynX4rail
Category	Non-functional
Acceptance Method	Process Review
Remark	

RCA and OCORA are both developing their reference architectures based on the Arcadia methodology and are both using the Capella tool for modelling.

OCORA-522, B-Level - One Common Capella Model

The RCA and OCORA Capella models shall be part of the same overall CCS Capella model.

Status	✓ Approved
Classification	Optional Requirement
Rationale	• Eliminate efforts for integrating the RCA and OCORA Capella models. • Guarantee consistency between the RCA and OCORA Capella models at all times.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-584, B-Level - The OCORA Capella model represents CCS on-board only

The OCORA Capella model shall describe the on-board part of the overall CCS system.

Status	✔ Approved
Classification	Requirement
Rationale	• To have a clear separation con concerns between RCA and OCORA
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-585, B-Level - Maintain interface compatibility between OCORA and RCA Capella models

All interfaces between OCORA and RCA shall have a one-to-one correspondence.

Status	✔ Approved
Classification	Requirement
Rationale	• To guarantee compatibility
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-523, B-Level - Capella Model consistency

The OCORA and RCA Capella models shall remain mutually consistent (e.g. as a library) throughout development.

Status	✓ Approved
Classification	Requirement
Rationale	• Guarantee consistency between the RCA and OCORA Capella models in periodic Intervalls.
Category	Non-functional
Acceptance Method	Process Review
Remark	

2.6 RAMS

This chapter lists the requirements issued from the OCORA Safety Strategy

OCORA-1198, B-Level - Define an OCORA Evolutions management process

The RAMS workstream shall define a standardized process for evolution management (including certification aspects) which covers:

- Evolution of the Building Blocks as defined by OCORA Architecture (e.g. new functionalities, defect or enhancement change requests implementation),
- Evolution of the integrated CCS on-board system (e.g. integration of evolved Building Blocks, adding new ones),
- Evolution of the integrated vehicle (e.g. integration of evolved CCS on-board system into rolling stock through the Train Adapter)
- Evolution of the complete system (i.e. evolved vehicle with its dedicated network)

Status	✔ Approved
Classification	
Rationale	This process aims at rationalizing the cost and efforts for the future evolutions of the CCS on-board system through its lifetime. This process will be usable for: - Manufacturers, - Integrators (i.e. at CCS on-board and vehicle levels), - Railway Undertakings In case of first homologation of a CCS on-board system (e.g. vehicle retrofit), the “Optimized Approval process” is applied first to get a “Vehicle Authorization” according to Directive 2018/545.
Category	
Acceptance Method	Process Review
Remark	

OCORA-1199, B-Level - Input standards for Evolution management

The Evolution Management process shall consider as minimum input the following standards.

- Directive 2018/545 - *vehicle authorisation and railway vehicle type authorisation process pursuant*
- CSM-RA - No 402/2013
- EN 50129
- EN 61508-7

No contradiction with above standards shall be allowed.
Additional standards shall be considered for specified items such as:

- EN 13306
- EN 17020
- EN 17023

Status	✓ Approved
Classification	Requirement
Rationale	Additional standards may be judged as relevant during the process realization
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-1200, B-Level - Consider other sectors experience on evolution management

The Evolution Management process shall consider as input the current methodologies deployed by other sectors that are already using modular architectures such as:

- Industry
- Avionics (e.g. AHP methodology)
- Automotive

Status	✓ Approved
Classification	Requirement
Rationale	Reuse as much as possible already well deployed and efficient existing processes
Category	Non-functional

Acceptance Method	Process Review
Remark	

OCORA-1194, B-Level - Define an OCORA SRAC management process

The RAMS workstream shall define a standardized process for SRAC management.

Status	✓ Approved
Classification	Requirement
Rationale	• To define an efficient dialogue and exchanges between SRAC emitter(s) up to final SRAC implementer(s) • This process comes from a return of experience of the RU (i.e. OCORA members) to improve the SRAC management from today's situation. • This process aims at limiting the misunderstandings when covering SRAC that can drive to critical safety failure by reinforcing the communication throughout the SRAC lifecycle.
Category	Non-functional
Acceptance Method	Process Review
Remark	Note: This overall process is tagged "nice to have" because depending of the maturity of RU's/Manufacturers' SRAC process already in place, it may not be relevant to be deployed.

OCORA-1195, B-Level - Define OCORA SRAC template

The RAMS workstream shall define a standardized SRAC template for all SRACs emitted in OCORA compliant projects.

Status	✓ Approved
Classification	Requirement
Rationale	This need of template comes from a return of experience of the OCORA members to improve the SRAC management from today's situation. The actual SRACs are not supporting a modular reuse- the improvements shall support the modularity as defined in OCORA. The OCORA set of SRAC including their conformity to a defined template (defined by the OCORA SRAC process) will be tagged as "must have" in refined requirements
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-1196, B-Level - Input standards for SRAC management

The SRAC Management process shall consider as minimum input the following standards:

- EN 50129 (focus on *5.3.13 Management of Safety-Related Application Conditions*)
- EN 61508-7 (focus on *E.26 Check of vendor requirements and constraints* and *E.27 Documentation of synthesis constraint, results and tools*)

No contradiction with existing mandatory measure shall be allowed.

Status	✔ Approved
Classification	Requirement
Rationale	Additional standards may be judged as relevant during the process realization
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-1197, B-Level - Consider RU's experience on SRAC management

The SRAC Management process shall consider as input the current methodologies deployed by the OCORA members.

Status	✔ Approved
Classification	Requirement
Rationale	Reuse as much as possible already well deployed and efficient existing processes dealing with SRAC.
Category	Non-functional
Acceptance Method	Process Review
Remark	

OCORA-1201, B-Level - Define an OCORA approval process

The RAMS workstream shall define a standardized process for the homologation of equipment dealing with OCORA requirements with respect to TSI/CCS and compliant with Directive 2018/545.

Status	✔ Approved
Classification	Requirement
Rationale	This process aims at rationalizing the costs and efforts and increasing the deployment speed from the future first homologation of OCORA compliant systems through its lifetime (e.g. vehicle retrofit to integrate a new “OCORA” compliant CCS on-board system). This process will be usable for: • Manufacturers, • Integrators (i.e. at CCS on-board and vehicle levels), • Railway Undertakings Once a new Vehicle Authorization (i.e. Directive 2018/545) has been provided, future evolutions are handled through the “Evolution management process”
Category	Non-functional
Acceptance Method	Process Review
Remark	The following elements are addressed (not exhaustive): • Respect the current NoBo/DeBo/AsBo activities, • Reassign the roles, tasks and responsibilities of the new “integrators”, • Define assessment bodies’ activities related to the compliance to OCORA specifications, • Reinforced the cross-acceptance criteria to ease the reuse of building blocks in several integrated CCS on-board systems (i.e. based on EN 50506), • Presents the additional costs and savings related to this new process deployment.

OCORA-479, B-Level - Create deliverables compliant with CENELEC

The OCORA initiative shall create deliverables compliant with CENELEC EN50126. In focus are the CENELEC Phases 1-5.

1. Concept
2. System Definition
3. Risk Analysis
4. System Requirements
5. Architecture & Apportionment

Status	✔ Approved
Classification	Requirement
Rationale	• In order to reduce general effort repeatedly spent in specific projects
Category	Non-functional
Acceptance Method	Certification
Remark	