OCORA

Open CCS On-board Reference Architecture

RAMS – Discussion on Optimized Approval Process

Document ID: OCORA-TWS07-040

Version: 1.10

Date: 10.06.2022

Management Summary

The overall purpose of this document is to present a discussion and an analysis of the current approval process, which is defined in EU Directive 2018/545, and to make a first step towards a new one; tailored from the current process to optimize it thanks to the new OCORA modular architecture.

Starting from the current approval process, this document proposes to define a tailored and optimized approval process adapted to a modular safety approach which remains compatible with the requirements of EU Directive 2018/545. Therefore, several ideas, pain points and benefits were collected in a workshop to this topic in Berlin in October 2021 with representatives from DB, NS, SBB and SNCF. Moreover, there is an explaining example with the overall new Functional Vehicle Adapter (FVA) given.

Revision history

Version	Change Description	Initial	Date of change
0.01	Gamma Release as a starting point	JB	31.03.2022
1.01	First draft for R2 release	JB	12.05.2022
1.10	First review for R2 release	LS	10.06.2022

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References

Reader's note: please be aware that the numbers in square brackets, e.g. [1], as per the list of referenced documents below, is 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.

[1] OCORA-BWS01-010 – Release Notes

[2] OCORA-BWS01-020 – Glossary

[3] OCORA-BWS01-030 – Question and Answers

[4] OCORA-BWS01-040 – Feedback Form

[5] OCORA-BWS02-010 – Executive Summary Slide Deck

[6] OCORA-BWS02-030 – Technical Slide Deck

[7] OCORA-BWS03-010 – Introduction to OCORA

[8] OCORA-BWS04-010 – Problem Statements

[9] OCORA-TWS07-010 – RAMS – Modular Safety Strategy

[10] OCORA-TWS09-110 – Train Adapter Block Integration Plan

[11] OCORA-TWS10-100 – CENELEC Phase 1 – Concept

[12] OCORA-TWS07-020 – RAMS Evolution management

[13] EN 50126-1:2017-10 – Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process

[14] EN 50126-2:2017-10 – Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Systems Approach to Safety

[15] EN 50128:2011-06 – Railway Applications – Communication, signalling and processing systems - Software for railway control and protection systems

[16] EN 50129:2018-11 – Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling

[17] EN 50506-1: 2007: Railway applications — Communication, signalling and processing systems — Application Guide for EN 50129 — Part 1: Cross-acceptance

[18] TSI CCS: 02016R0919 - EN - 16.06.2019 - 001.001 - 1: COMMISSION REGULATION (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union, amended by Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 L 139I#

[19] Directive 2018/545 - COMMISSION IMPLEMENTING REGULATION (EU) 2018/545 of 4 April 2018 establishing practical arrangements for the railway vehicle authorisation and railway vehicle type authorisation process pursuant to Directive (EU) 2016/797 of the European Parliament and of the Council

[20] *Final Report Summary - MODURBAN (Modular urban guided rail systems)*. Cordis EU Research Results. (2011, April 14). Retrieved June 2, 2022, from https://cordis.europa.eu/project/id/516380/reporting

[21] Regulation (EU) No 402/2013 – COMMISSION IMPLEMENTING REGULATION (EU) No 402/2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009

[22] OCORA-BWS09 – Acceptance of Global Standards

1 Introduction

1.1 Purpose of the document

The purpose of this document is to present an analysis of the current approval process defined in Directive 2018/545 [19] and to discuss the possibility and the need to develop a new one, tailored from the current one to optimize it considering the new modular architecture introduced by OCORA. Starting from the current approval process, a future intention would be to propose an optimized approval process adapted to OCORA modular safety approach.

Today, feedback of many RU's shows that the approval process for railway vehicles takes too long and is too costly, especially for train types or fleet that are usually managed as independent projects. Therefore, in this paper the pain points of the current approval process were identified. Also, the current approval process introduced by the 4th Railway Package is considered too costly (in terms of labor and time).

One great advantage of the modular architecture introduced by OCORA is that it allows to widely use the concept of a "reference system" as defined in the CSM-RA [21] to avoid "one-off" project certifications and accelerate the overall approval process. Furthermore, modular architecture is supposed to provide various advantages for both new and retrofit projects.

This process as shown in Figure 1 shall allow the use of standardized parts (as defined by OCORA) which could be used to build a 'reference system' as defined in CSM-RA [21] from risk assessment to the certification (i.e. the whole safety lifecycle). Cross-acceptance (as defined in EN 50506-1) up to the highest GASC has to be optimized at maximum to ensure that all generic parts are only certified once and then cross-accepted on different parallel projects (i.e., installed on different RST).

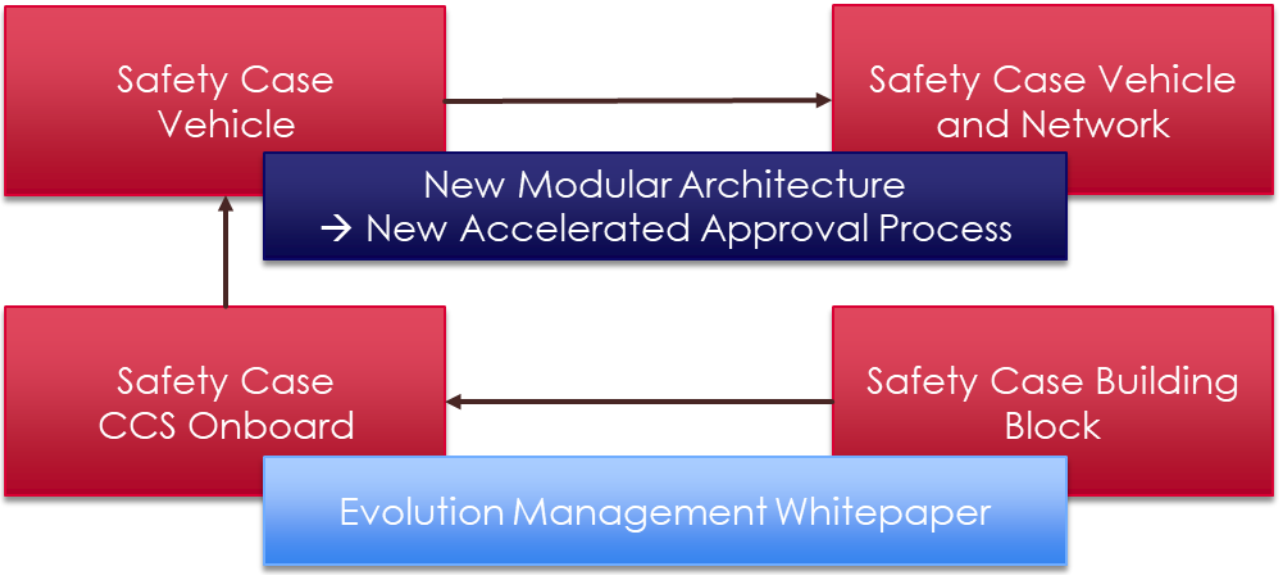

Figure 1: Safety Cases and new approval process

This process shall also consider the results of the AoGS TWS of OCORA to ease the integration of "non-railway" parts into CCS OB construction without complete recertification. The management of the "evolutions" of already certified systems should be dealt with separately and will be described later. [12]

Optimization of the current process involving current EVC as monolithic systems with proprietary interfaces is out of scope.

The document is structured in the following manner:

1. Introduction
2. Analysis of the current approval process

3. Stakeholder Analysis
4. Pain Point Analysis
5. Benefits of OCORA for the approval process

Many new ideas for a new OCORA approval process were collected during a workshop of the OCORA RAMS team, held in Berlin in October 2021. The content of chapter 3, 4 and 5 is based on the results of the workshop. The overall RAMS strategy is shown in Figure 2: OCORA RAMS Strategy and RAMS Documentation

This document shall serve as an input for the definition of a new optimized approval process to be developed at a future stage within OCORA and/or within the EU-Rail-System Pillar.

The 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 [4].

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

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

1.2 Applicability of the document

The document is currently considered informative, but a new approval process may become a standard at a later stage for OCORA compliant on-board CCS solutions. Subsequent releases of this document will be developed based on a modular and iterative approach, evolving within the progress of the OCORA collaboration.

The future process shall be applicable in case of complete retrofit of CCS OB by new OCORA compliant ones. Furthermore, it shall be applicable to new fleets equipped with OCORA compliant CCS OB.

In case of management of evolution in fleets already equipped with OCORA compliant CCS OB (I.e., when new re-certification and new vehicle authorisation becomes mandatory, (EU) 2018/545) [19], this process shall be strongly connected to the “Evolution process management”.

As a clarification, in this document the current approval process is analysed to identify relevant process steps which might benefit from OCORA. A complete new OCORA approval process shall be defined at a later stage.

It is considered that the new approval process should benefit from the concept of RAMS Modular Safety to avoid a complete recertification and focus on changes, whenever it is possible.

1.3 Context of the document

This document, introduced in OCORA Modular Safety Strategy [9], is published as part of an OCORA release, together with the documents listed in the Release Notes [1]. Before reading this document, it is recommended to read the Release Notes [1]. If you are interested in the context and the motivation that drives OCORA it is recommended to read the Introduction to OCORA [7], and the Problem Statements [8]. The reader should also be aware of the Glossary [2] and the Question and Answers [3].

The Whitepaper on Optimized Approval Process is connected to other RAMS deliveries which are also part of the R2 release. The following Figure 2 presents the link between these different deliverables. It must be noticed that the Whitepapers on SRAC/AC Management, on Evolution Management, discussion on Optimized Approval Process and on RAM Strategy are additional documents besides the documents according to the formal CENELEC V cycle Documentation (represented in brown in the figure below) required for the new modular approach.

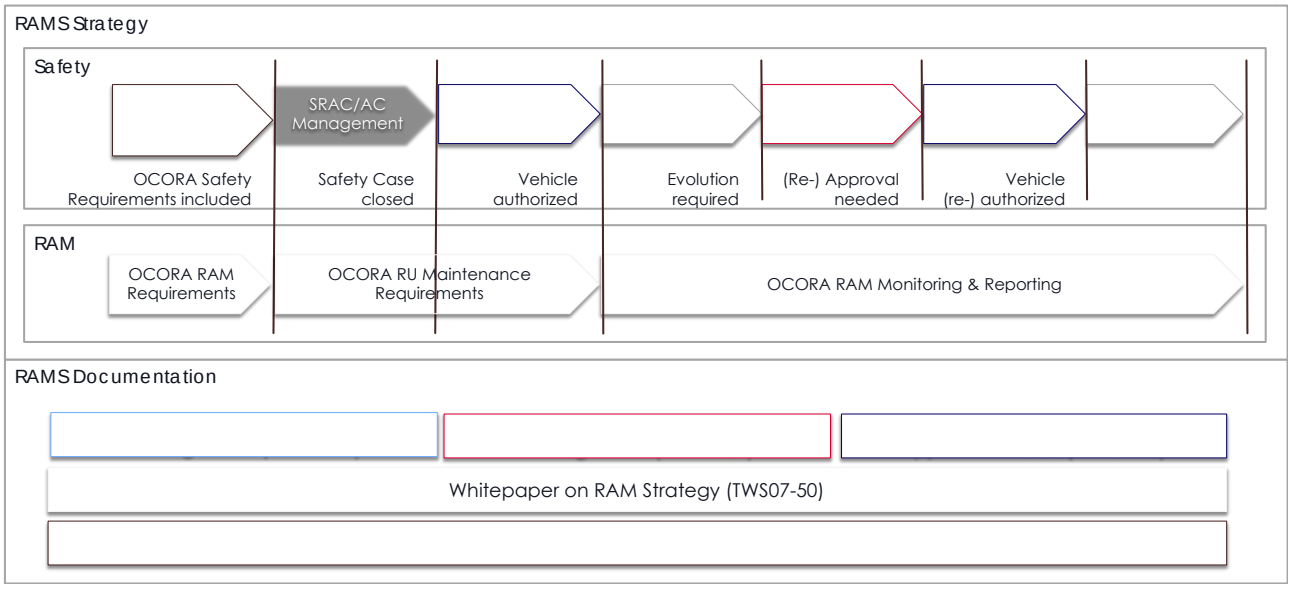

Figure 2: OCORA RAMS Strategy and RAMS Documentation

Currently, RUs are not satisfied with current approval process for the following reasons:

- Approval takes too much time (feedback from the market, NSA needs up to 5 months)
- Approval process is not flexible
- Processes are too complex and thus too costly (see Table 2: Pain points brainstorming)
- Not focusing on the modifications (i.e., sometimes an update of an approval process means complete recertification)

This is partly due to the monolithic approach of the current CCS-OB (e.g.: EVC). Today, each CCS-OB needs project specific customisation (to a degree) and cannot be 1:1 reused on other fleets. Furthermore, due to other issues (e.g. poor management, time/cost assessment) some projects are managed as a “one-off” project and scarcely benefit from previous certifications of other fleets.

The new modularity coming with OCORA (e.g., independent building blocks) is an opportunity to make evolution on the current approval process. This should ease the use of generic cross-accepted elements (BB or complete CCS OB). This should aim at making the approval process more efficient (faster deployment) and better understandable. As a result, more frequent evolutions in CCS-OB systems may be possible.

2 Analysis of current approval process

In the following, this chapter deals with describing the current workflow for the approval process from the CCS-OB up to the final APOM (Authorization for Placing on the Market). This first approach is done for the scenario of a complete retrofit, meaning the integration of a new CCS-OB (made according to current monolithic approach) into an existing vehicle. Additional scenarios will be provided in a second step into the optimized approval process.

The goal of this activity is to see from today's situation where are the pain points related to the current approval process and where the modularity concept of OCORA can help at improving it without degrading the overall RAMS level. To give an example, the release of a new ETCS Baseline (set of specifications) often results in changes to many ETCS components (e.g., peripheral equipment), which lead to a disproportionately long approval process (including safety case). Therefore, the goal is to release a new/modified OCORA approval process, based on modularity.

Starting point for this approach is the first activity performed during the workshop in Berlin on 26.10.2021, which corresponding result is presented in Figure 3. The picture also presents a time aspect where the gates dates do not correspond to realistic cases. Realistic dates shall be provided in a future release of the document. This timeline presents the amount of work to be performed in a sequential mode from the new CCS-OB to the new APOM.

The context taken is an update of the monolithic CCS-OB system to fulfill TSI CCS 2022 (no reference is available yet). As this new release of the TSI CCS will not lead to a revolution of the current CCS-OB systems, it can be concluded likely, that the current CCS-OB systems will be widely reused by the manufacturers to propose the future ones compatible with the new TSI CCS 2022. It must be noticed that OCORA will not be part or mentioned by TSI CCS 2022.

Based on that, the assumption is taken that this kind of evolution at vehicle level will fit in the "article 14 (d)" case defined by Directive (EU) 2018/545 [19]:

> *(d) a **change that requires a new authorisation** according to the criteria set out in Article 21(12) of Directive (EU) 2016/797.*
>
> > *Article 21(12) of Directive (EU) 2016/797 - Vehicle authorisation for placing on the market*
> > *12. In the **event of renewal or upgrading of existing vehicles** which already have a vehicle authorisation for placing on the market, **a new vehicle authorisation for placing on the market shall be required if**:*
> > *[…]*
> > *(b) the **overall safety level of the vehicle** concerned **may be adversely affected by the works envisaged**; or […]*

This is because TSI CCS 2022 will require the conformity to the UNISIG SUBSET-119 (e.g., Train Interface) as mandatory. Several critical functions, such as the emergency brakes are covered by this subset.

Once the type of modification is chosen, the RU can create a requirement book for its new vehicle where the request for the CCS-OB supplier to get an update of the system in conformity with TSI CCS 2022 will be mentioned.

Based on that, the CCS-OB supplier can update his current system or propose a new one with, at the end, a successful TSI CCS 2022 assessment (e.g., NoBo and ISA certificated).

From that point, the CCS-OB supplier or the RU can integrate the CCS-OB system into different vehicles. Besides the fact that Subset-119 became mandatory, the latter is unfortunately not sufficient in its current state to ensure a smooth integration with any vehicle type. For that reason, the CCS-OB system must be adapted

to fit the different legacy vehicle types where it must be deployed. This leads to some complications as of today.

Indeed, the non-homogeneity of the CCS-OB system prevents to reuse it directly thanks to the cross-acceptance concept defined in EN 50506-1 [17]. This means that, from this step, parallel projects must be defined (refer to the different fleet lines in the bottom of Figure 3). Based on the unavailability of a generic train adapter between CCS and RST world, the CCS-OB integration cannot be realised as “reference system” as defined by CSM-RA [21]:

> *(20) ‘reference system’ means a system proven in use to have an acceptable safety level and against which the acceptability of the risks from a system under assessment can be evaluated by comparison.*

This means that redundant integration activities inducing high costs will be required to spread the new release of the CCS-OB system in the different vehicle fleets. Furthermore, it could not be directly reused in an additional fleet which is today equipped with another CCS-OB system (i.e., from a different supplier), still because of lack of a common train adapter.

From that point, these parallel project developments, at vehicle level, will unfortunately be spread again in branches with more parallel development when each fleet is integrated in different networks; a SASC is mandatory at this level for each couple vehicle & network to get the final APOM for each fleet on dedicated network.

At the end of the roll-out activities by the RUs, the total cost of the new CCS-OB deployment will likely be astronomic. Therefore, one of the big game changers that must be introduced by OCORA is to define a strategy to develop a ‘reference system’ for each RU at the highest level possible to optimize at maximum the reuse of components and vehicle to limit at the strict minimum the specific application implementation (i.e., when integrating into a network and apply for an APOM). This will be developed in the future release of OCORA.

VTA: Vehicle Type Autorisation (refer to 2018/545 and its Guideline)
APIS: Authorisation for the placing in service of fixed installations (refer to 2018/545)
APOM: Autorisation for Placing on the Market (refer to 2018/545 and its Guideline)
(4) **'network'** means the lines, stations, terminals, and all kinds of fixed equipment needed to ensure safe and continuous operation of the Union rail system;

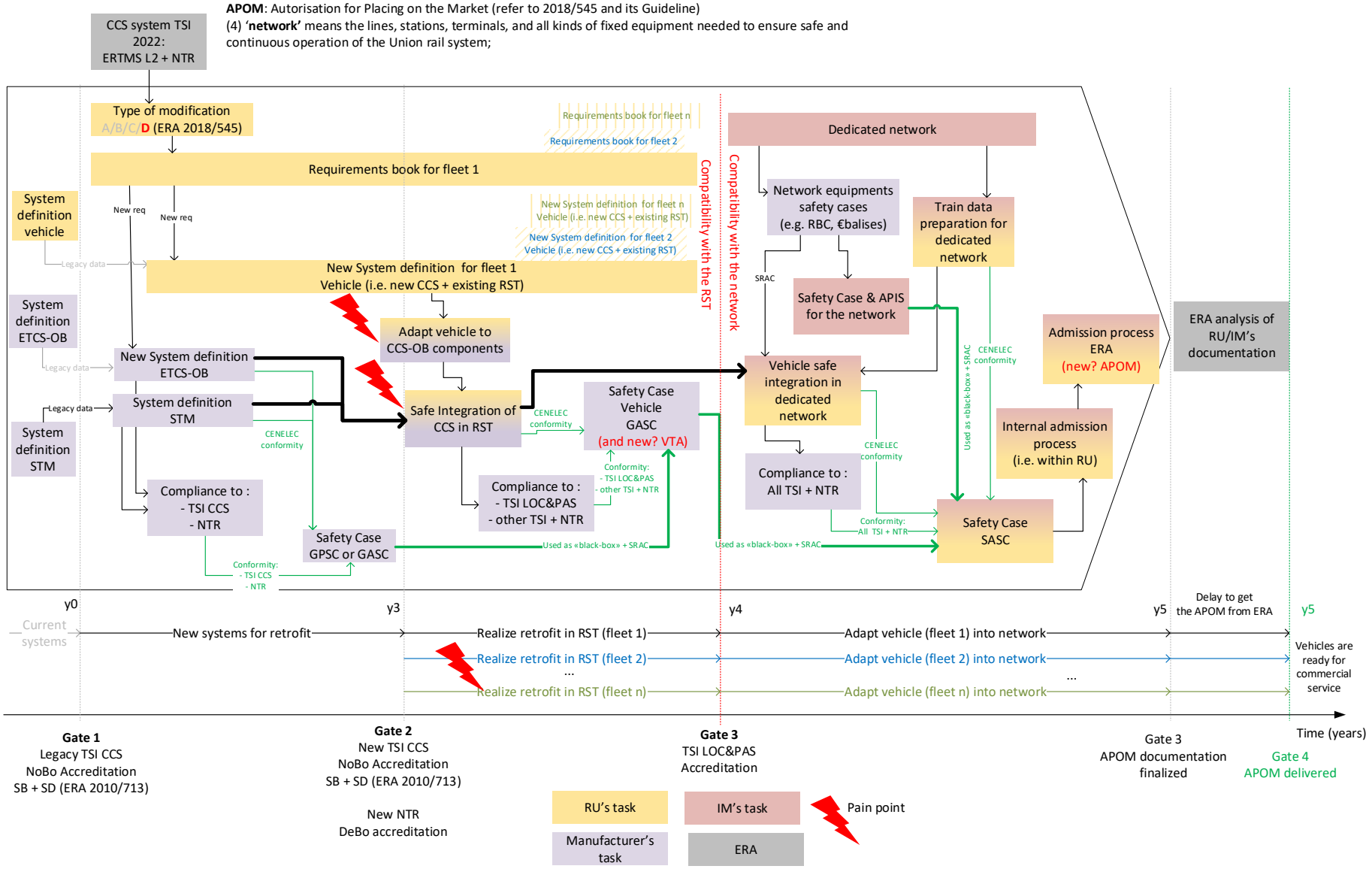

Figure 3: Current approval process in case of CCS-OB retrofit

3 Stakeholders' analysis

Before proposing a new optimized approval process, it is necessary to analyse the involved stakeholders regarding their influence as well as their attitude towards this new process based on the Modular Safety Strategy introduced in [9]. The following Figure 4 presents a coarse overview and classification of the stakeholders of existing approval and approval processes. The stakeholders represented as the integrators, assessors and auditors (brown colour), the suppliers of ETCS components, train manufacturers or Railway Undertakings (RUs, blue colour) as well as the involved organizations as the ERA or Unisig (red colour) are classified according to their influence on the OCORA Modular Safety process design (Strong vs. Weak influence) as well as their attitude towards a Modular Safety approach (Against or for Modular Safety).

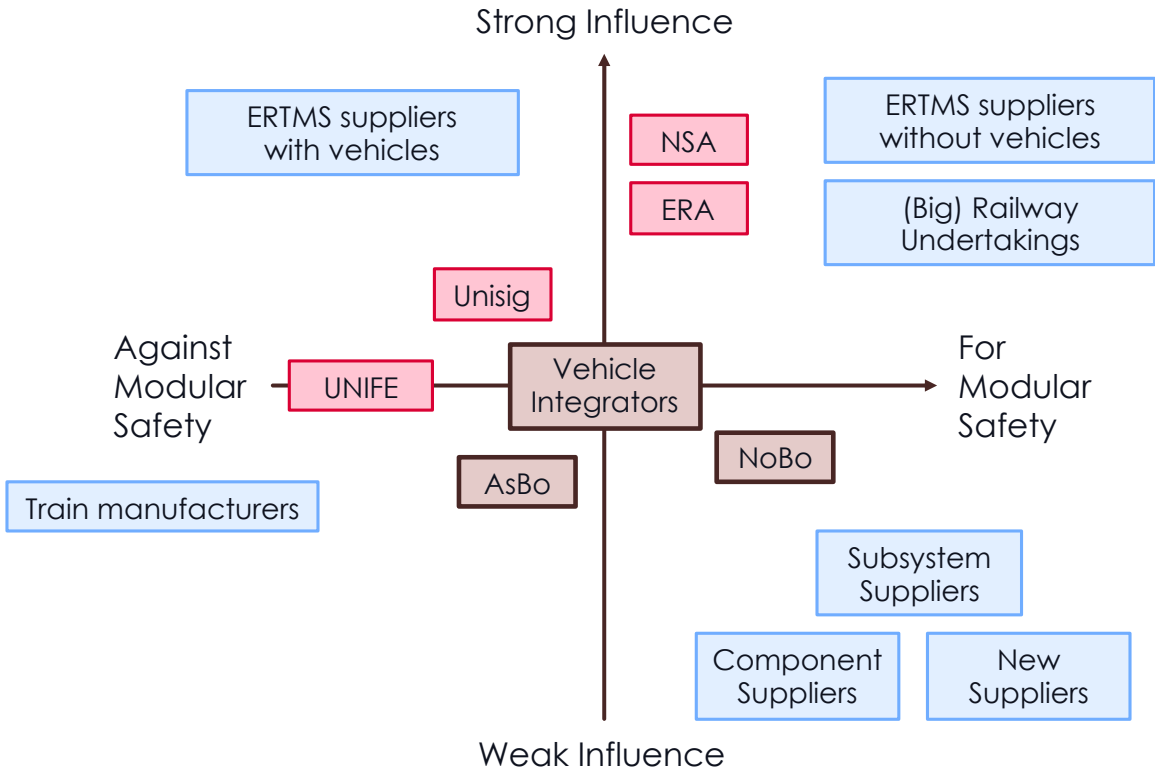

Figure 4: Stakeholders overview

In addition to this coarse overview the stakeholders' perspective has been analysed in detail. The results of the main stakeholders marked in blue colours in Figure 4 are presented. Hereby the stakeholders' attitude as well as their amount of influence on the OCORA program have been concretized and extended with an evaluation of the stakeholders' expectations and challenges regarding the OCORA project, especially the Modular Safety Strategy. A detailed analysis of the relevant organizations and auditors (marked red and brown colours in Figure 4) will be presented within the next release of this whitepaper.

Table 1: Perspective of Stakeholders

Expectations from OCORA?	Challenges regarding OCORA?	Attitude versus OCORA?	Amount of influence on the OCORA program?
European Railway Agency (ERA)			
- Long term vision (remove national rules, new regulations) - Expects a long-term evolution of the CCS OB system - Improve the approval process to extend its use to any RU (i.e., national and international) and decrease costs for approval - Open the market to new players - Increase interoperability and add new functionalities (e.g., FRMCS, ERTMS L3, ATO GoA2 to GoA4)	- Need agreement of all stakeholders (e.g., when deploying a new regulation) - Long taking processes to deploy OCORA stakeholders' requirements and to get new/updated regulations - Compromise may not satisfy everyone	- supports the development of OCORA - No funding at this point, to be checked within the publication of the next release	- HIGH: ERA manages the approval Process of the whole system, defines the new regulations; can decide to refuse/block or integrate the approval of future OCORA compliant systems into the current approval Process
Current suppliers (e.g., ERTMS suppliers **with vehicles** like Alstom, Siemens, Thales, Stadler, Hitachi)			
- Keep status quo regarding the monolithic approach of existing functions defined by TSI CCS - Smaller generic systems decrease the production/ recertification costs, but lots of reorganization may be required inside the company	- Need a lot of investment to create OCORA compliant systems - However, lot of investments done in the past for the current CCS OB systems (e.g., monolithic approach)	- Reservation attitude from now. - They do not want to split the current ETCS OB (based on UNIFE presentation)	- VERY HIGH: If they do not want to follow OCORA, no equipment will be produced
New suppliers (e.g., ERTMS suppliers **without vehicles** like the signaling company, Kontron)			
- Chance to integrate a new important market and not only sell their product to the Current Suppliers but also directly to the RU's - A strong stable architecture design to avoid losts in R&D; similar to the TSI evolutions	- Lack of ETCS/safety experts - Lack of investment capabilities - Lot of R&D investment necessary - Limited testing capacities - Lack of trust from RU's (long time is usually required)	- POSITIVE: OCORA can open new markets for them - OCORA needs to involve them inside the review process after each release	- VERY LOW - Today they are not directly involved into the railway market. In best cases, they are suppliers of the Current Suppliers (e.g., HaslerRail)
Big Railway Undertakings (RUs)			
- Expect at least the same performance/RAM as today (shouldn't be decreased) - Reduced costs for ETCS-OB - Lower delays to get equipped vehicles (retrofit projects) - Lower delays to get evolutions (e.g., new game changers, bug fixing) of the ETCS OB - Lower dependencies between ETCS OB and RS and for the supply of spare parts	- Lack of low level (e.g., LRU) experience on CCS-OB systems - High investments for the OCORA program itself. Can be risky if it takes too long to be finalized or worst cancel - Lots of compromises for the final shape of OCORA call for tenders' requirements - Limiting the overall assessment costs of OCORA compliant system	- Very positive because they are the building members	- Full because they are the OCORA program
Small Railway Undertakings (RUs) or Leasing companies			

Expectations from OCORA?	Challenges regarding OCORA?	Attitude versus OCORA?	Amount of influence on the OCORA program?
- Expect at least the same performance/RAM as today (shouldn't be decreased) - Reduced costs for ETCS-OB - Lower delays to get equipped vehicles (retrofit projects) - Lower delays to get evolutions (e.g., new game changers, bug fixing) of the ETCS OB - Lower dependencies between ETCS OB and RS and for the supply of spare parts - Benefits could help small RUs to avoid bankruptcy and improve their business. Today, the huge costs of maintenance/retrofit activities can be a huge problem.	- Not involved in the OCORA program or even as reviewer. OCORA could miss some interesting hints for the program - Lack of ETCS/safety expert	- Positive because smaller and cheaper systems could help them to stay "alive" in the railway market	- No influence so far because they are not part of OCORA and neither any European organization such as UIC, Shift2Rail

4 Pain points analysis

4.1 Pain points brainstorming

As mentioned above, in a workshop held in Berlin in October 2021, pain points were identified that could jeopardize the success of applying a modular safety approach for on-board CCS. These pain points were clustered and are summarized in the table below, indicating the relevance of these pain points with respect to the optimized approval process aimed for by OCORA:

Table 2: Pain points brainstorming

Subject	Pain Points/Pitfalls	Relevance to Optimized Approval Process

Complex Integration of onboard CCS modules	• Unclear interface definitions:
	  ○ Too generic/abstract
	  ○ Too complex
	  ○ Spongy interfaces
	  ○ Errors in definitions
	• Too many and ambiguous SRACS
		YES
		(partial → assure coherence of modular evidence / approval steps)

Weak stakeholder management	• Weak marketing (including communication) with RU's (e.g., lack of Business Cases, unrealistic Business Cases) • Exclusivity contracts between RU's and ETCS system suppliers • Exclude or not involve important stakeholders (e.g., RU, manufacturers) • No commitment or blocking OCORA from manufacturers • OCORA doesn't consider change requests from external stakeholders • Unclear allocation of roles/tasks/responsibilities for the stakeholders involved in OCORA compliant systems, no allocation of responsibility on a system level • Define responsibilities not regarding contractual relations	NO
Non synchronization of OCORA with its environment	• OCORA is not aligned with latest technologies (e.g., ATO, FRMCS) • OCORA is not in line with railway regulations (TSI, CSM) / standards (CENELEC) • Regulations/standards evolves faster than OCORA • OCORA leads to increase the number of national rules • OCORA is not involved inside TSI/CENECLEC new versions	YES (partial → handle contradiction and inconsistence in requirements)
Weak OCORA program management	• No or reduced funding (e.g., less skilled people) • OCORA requirements are not called as mandatory by any official standard/directive/regulation • RU's invest money in proprietary solutions (e.g., tools, equipment) • Decision power is no more balanced between OCORA and UNIFE within ERJU • OCORA initiative blocked by ERA • First "OCORA approved train" has a catastrophic accident	NO
Wrong architecture design	• OCORA focuses on SW architecture without considering HW: This leads to unrealistic requirements for the HW • Create a "revolution" (e.g., totally new design) in the CCS-OB instead of an "evolution" as mentioned by UNIFE → This prevents the re-use of existing components from the industry	YES (partial → convey knowledge about the new architecture to approval entities)
Prototype	• No prototype / 'proof of concept' is realized • Prototype not in line with full OCORA requirements	NO
Complex Risk Assessment/Safety Assessment/ Approval	• More complexity (because of the integration steps) in the approval process (first and further assessments) • Higher effort for the whole safety activity (more documentation at each step)	YES

4.2 Pain points regarding modularity levels

During the workshop, pain points were identified and analysed with respect to the current situation, meaning without modular safety and with respect to the expected situation when a modular safety approach for on-board CCS (CCS-OB) would be used. The results of this analysis are presented in the table below. The second column indicates whether the pain point applies currently, and the third column indicates reasons if and why such pain points could still exist despite or due to the Modular Safety Approach and what should be done to address these pain points. Finally in the last column is indicated whether the pain point could be addressed or mitigated through the optimized approval process.

Table 3: Identified pain points regarding modularity levels

Pain point	No modular safety	With modular safety (last step of OCORA development)	Relevance to optimized approval process
Interfaces when integrating systems to build a fully equipped train	Pain point currently exists: - time to market very long - high cost because of the monolithic approach (partially, in case of integration with new suppliers)	Pain point could still exist, because: - more complexity because of lot of suppliers to handle - more responsibility for the RU (responsible for the overall synchronization) - more skills required from RU to handle that (in case this task is not subcontracted) - Some RUs could have an advantage when developing a modular structure	YES (partial → clearer definition of responsibilities regarding the approval process, deadline dependencies, faster and easier approval, but pain point is rather a technical issue that goes beyond the approval process only)
RST suppliers specify the "non interoperable" interfaces of today before TSI	Different proprietary solutions live jointly and lead the supplier to create branches of their products to fit each train type	Not applicable All OCORA requirements for call for tenders will be available and connected to the TSI	NO
Management of NTR	Pain point currently exists:	Would still exist Out of "Modular safety" scope	NO
Cross-acceptance between ISA involved in the whole "approval process"	Pain point currently exists	Paint point could still exist Mitigation: OCORA should provide standardized template for OCORA (and ISA) reports to avoid "grey areas"	YES
Long Vehicle approval process	Pain point currently exists (partially)	Paint point could still exist Mitigation: Deployment of: - Evolution Management process - Optimized Approval Process	YES

Pain point	No modular safety	With modular safety (last step of OCORA development)	Relevance to optimized approval process
Changes to existing equipped train difficult because of new/modified external constraints	Pain point currently exists	Pain point could still exist Mitigation: Deployment of the SRAC/AC Mngt - Definition of new standardized interfaces within OCORA - Use of new FVA to fit several train types	NO
Lack of investment capabilities for possible new suppliers	Pain point currently exists (because of the high complexity of the monolithic EVC)	Pain point could still exist Mitigation: - Will ERJU involve new suppliers? (to be confirmed in R3) - OCORA brings a new way to create CCS OB systems - OCORA defines a cross-acceptance process for other sectors (e.g. avionics) [22]	YES (partial → optimized approval process expected to reduce time and cost for approval, but covers only one aspect of this pain point)
Risk of an unsuccessful (e.g., delayed, too costly, not at the good functional level) first OCORA roll-out by an RU	Not applicable	Pain point could exist, because: - not enough support from OCORA (in the documentation) to the RU - roles are not well defined - Approval process is not efficient - bad OCORA requirements (interfaces, testing…) - political issues (= lobbying?)further analysis to be added in OCORA R3	YES (partial → more efficient approval process, only one aspect of this pain point)
OCORA is not yet used into RU's call for tenders	Pain point currently exists	Pain point could still exist, because: - no communication from OCORA to promote our activities - no connection with TSI CCS - OCORA not connected to purchase department - OCORA specifications not (yet) at sufficient degree of maturity	NO
Complexity of the CCS OB	Pain point currently exists	Pain point could still exist. Mitigation: - modular approach will decrease the CCS OB complexity on component level (complexity on system level will remain) - creation of 'proof of concept' or prototype based on COTS aims at showing that OCORA works and has already a concrete realization	YES (partial --> optimized approval process expected to facilitate approval, although it will not reduce the technical complexity of the CCS OB as such)
No mutualization or capitalization of past experience between RU's/Suppliers project (i.e. every time, a new project must almost restart from scratch)	Pain point currently exists (partially)	Pain point could still exist. Mitigation: - The participation of OCORA to the System Pillar (ERJU) with new processes should help (to be confirmed in OCORA R3)	YES

5 Benefits of OCORA for the approval process

In the following Table 4: Benefits of OCORA for the approval process the benefits and ideas of OCORA for the approval process should be shown. Many new ideas for improvement of the approval process were collected in the workshop. These shall be the basis for development and release of a new approval process with the help of OCORA.

Table 4: Benefits of OCORA for the approval process

Benefits of a Modular Safety concept	New ideas for improvement
Systematic approach for safe evolutions	Common European call for tenders; this leads to create interoperable products by the suppliers which could follow the same systematic evolution strategy under definition by OCORA
Easier and faster evolution management	Reference to evolution management (see Figure 2)
No modular safety => No benefit in ERJU	Defining a whole CCS compliant system based on prototypes (within the different OCORA WS) and then deploy our approval process to get the final approval. => this should help to ensure that our strategy is valid (BB definition and approval process) and should give confidence for the RU to follow us.
Cost saving: total cost of ownership lower than now	Benefit from existing modularization => try to get some return of experience of other sectors where module has already been successfully deployed.
Cost efficiency: today the price of a full approval process can be very high	Use the EU "Partnership of innovation" contract
Standardization and reinforcement of the SRAC process between RU's and Manufacturers	We design completely the system as if the current suppliers do not exist Would standardize the Approval Process because also the system is consistent
Safety assessment facilitated (e.g., for defining safety relevance of changes)	Synchronize/harmonize the requirements with "supplier-processes" in order to get faster
Enabling the large ETCS rollout (i.e., the definition of the FVA helps at using the same OCORA compliant on different fleets). This leads to an easier retrofit activities because the same equipments are deployed	New way of working for the whole sector
Win-Win business case with suppliers (e.g., smaller generic LRU are less costly to sustain for the manufacturers)	Get REX from MODSafe and MODUrban projects for modularity used/proposed in urban railway transport.[20] Note: Analysis of results from MODUrban and MODsafe projects show that the modularity proposed in these projects for Urban Railway Transport Control Systems is not very useful for OCORA, since modularity stops at a level equivalent to our OCORA system´s scope (i. e. doesn´t go beyond Carbone Controller, which is the equivalent of our onboard CCS).
Fast integration of new technologies	Cooperate with vehicle suppliers
Enabler for upgradeability	Cross-acceptance between sectors (avionics/car industry)
Longer lifetime of ERTMS systems	Outsourcing possible
More players (more RU's and more suppliers) lead to more competition and more products to be sold (price decreased)	Separate the integration steps to avoid the vendors locks in today systems

Benefits of a Modular Safety concept	New ideas for improvement
Less market-entries barriers	*This idea has to be developed in OCORA Release 3.*
Smaller LRU decrease the complexity of the ETCS on-board system (including safety)	Cooperation with ETCS suppliers
Smaller LRU aims at avoiding "grey areas" related to testing and monitoring	*This idea has to be developed OCORA Release 3.*
A deeper standardization of the interfaces decreases the risks of safety issues at interfaces levels thanks to standardized test scope, monitoring mechanisms...	*This idea has to be developed in OCORA Release 3.*
Smaller systems aim at increasing their test coverage	Time to market will be shorter
Less complex systems will ease their (re)assessments (e.g. ISA, NoBo)	Acceleration of the approval process could be reached
Less complex systems drastically decrease their time to market	*This idea has to be developed in OCORA Release 3.*