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Report

TSI CCS (EU) 2023/1695 Article 12, ERTMS compatibility and future revision

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Contents

Table 1: List of abbreviations and acronyms

Abbreviations	*Definition*
AsBo	Assessment Body
CCS	Control, Command and Signalling
CR	Change Request
DeBo	Designated Body
EC	European Commission
ERA	European Agency for Railways (also called 'the Agency' in this document)
ERTMS	European Railway Traffic Management System
ESC	ETCS System Compatibility (ESC is also used in the document as an abbreviation of "ESC checks")
ETCS	European Train Control System
ERJU	Europe's Rail Joint Undertaking
EVC	European Vital Computer
GSM-R	GSM for Railway
IC	Interoperability Constituent
IM	Infrastructure Manager
L2	Level 2 (ETCS level)
LX	Level Crossing
MS	Member State
NNTR	Notified National Technical Rule

Table 1: List of abbreviations and acronyms

Abbreviations	*Definition*
NoBo	Notified Body
NSA	National Safety Authority
NTC	National Train Control
OS	On-Sight (ETCS mode)
RBC	Radio Block Centre
RCC	Route Compatibility Check
RINF	Register of infrastructure
RSC	Radio System Compatibility
RU	Railway Undertaking
SP OD	System Pillar Operational Design
STM	Specific Transmission Module
T&V	Test & Validation
TSI	Technical Specification for Interoperability
TTD	Train Track Detection
VA	Vehicle Authorisation

1. Executive summary

This report is the deliverable to fulfil the Agency obligation from the Control, Command and Signalling Technical Specification for Interoperability (CCS TSI) 2023/1695 Article 12, which is:
"By 1 June 2024, the Agency shall provide the Commission with its analysis on how to phase out the checks to prove the technical compatibility of on-board units with different ERTMS trackside implementations and to achieve harmonisation of engineering and operational rules for the Single European Rail Area."

This report presents the analysis performed by the Agency to phase out the ETCS System Compatibility (ESC) checks and Radio System Compatibility (RSC) checks and proposes recommendations and actions to reach this objective.

The ESC/RSC concept was introduced in the amendment 2019/776 of the CCS TSI Commission Regulation (EU) 2016/919 as a transitional measure aimed at instilling confidence in the compatibility between CCS on-board and trackside implementations deployed at that time or in the near future. However, in some respects, the significant number of ESC/RSC types and the multitude of checks required within these types have led to the establishment of additional processes, sometimes even conflicting with the EC verification process as described in CCS TSI. Also, based on feedbacks received from the sector, it is recognised that the ESC checks lead to additional costs and longer project duration, and to a fragmentation of the ERTMS landscape.

The methodology applied by the Agency to draft this report can be summarised as follow:

- Collect feedbacks on ESC/RSC checks (Agency experience, ESC survey to the railway sector, workshops)
- Analyse and structure the collected information
- Propose a list of recommendations indicating the timeframe and contributors

The ESC survey aimed to collect inputs regarding:

- The current technical compatibility issues observed and how they have been solved
- The trends related to the need of ESC
- The key enablers to phase out the ESC checks

During the ERTMS 2024 Conference three workshops dedicated to "ETCS and Radio System Compatibility checks: on the way to a phase out" were organised. This was an excellent opportunity to collect direct feedback from participants.

In Chapter 2 the working methodology, scope and references of the Agency are presented.

Chapter 3 presents the **ESC survey and ERTMS 2024 conference workshop results analysis**. From the ESC types that have been tested, it appears that only a few of them (less than 10 %) have been reported with train-track incompatibilities. When an issue is detected, most of the time this issue comes from product non-conformities to the specifications, misinterpretation of applicable requirements or incompatibilities between trackside and on-board design choices. To correct the issue, the update of the on-board configuration is the most common solution. Alternatively, in some cases the trackside engineering implementation is modified when the on-board update process is too long. The survey and the workshop highlighted the following rationales for the need of ESC:

- Ambiguity in technical requirements
- Partial fulfilments
- Need to check critical/safety functions
- Need to check specific trackside implementations
- Checks coming from lessons learned with other vehicles

The results also show that **the sector generally agrees** that:

- ESC should be phased out
- ETCS products are not yet mature enough for a complete ESC removal
- ESC remains a good instrument to evaluate the technical compatibility
- The number of ESC checks should be limited

The **recommendations of the Agency** are listed under Chapter 4. They span two main areas, namely recommendations that are a continuation of already existing measures or processes contributing to the technical compatibility (and by consequence lowering the need of ESC) and recommendations consisting of new measures/actions.

The **first category of recommendations** gathers several existing measures/processes.

- The error correction process introduced in CCS TSI (EU) 2023/1695 §7.2.10 that aims to upgrade on timely basis trackside and on-board products/implementations correcting the errors that could prevent a normal service
- The removal of the partial fulfilment clause for ETCS on-board that should lead to fully compliant Interoperability Constituents (implementing all functions)
- The clean-up of the CCS national rules that should contribute to the reduction of the ESC checks when these checks have precisely been put in place to demonstrate the respect with the national rules

In conclusion, the strong appliance of the existing processes should already have a positive impact on the ESC checks reduction.

The **second category of recommendations** gives new proposals of actions or processes to phase out the ESC.

- One of the main recommendations is to define criteria for the types of verifications that could be/could not be part of the ESC. It is indeed important to avoid checks that have to be proven on Interoperability Constituents level or demonstrating basic ETCS functions
- A guideline should be drafted to help Infrastructure Managers (IM) establishing the ESC checks respecting the defined criteria
- The removal of ESC tests relating to ETCS on-board functions should be accompanied by a review of the completeness of SUBSET-076
- The CCS TSI conformity assessment requirements for the on-board and trackside subsystems should better describe what are the types of tests or evidence expected to demonstrate the technical compatibility in the context of the conformity assessment
- The development of harmonized engineering rules should bring a very positive contribution to the ESC reduction. Indeed, the variety of ETCS trackside implementations has an important impact on the amount of ESC checks
- Finally, the Agency proposes to set up a Working Group aiming to follow up, coordinate and facilitate the implementation of the actions from the report between the different stakeholders

As a **conclusion**, it seems that a reduction of the number and scope of ESC is beneficial and desirable for all actors, but this has to be organised step by step, applying the proposed recommendations. This reduction has to be built by the strict application of existing and new processes/actions. It is currently not possible to guarantee a complete removal in the short or medium term; this complete removal being not considered possible by the Railway sector due to several factors such as the current product maturity, the non-harmonised trackside engineering or the ambiguity/misinterpretation of requirements.

It is possible to accelerate the process of implementing the recommendations and reducing/consolidating the ESC checks, by dedicating additional resources from the Agency to this activity and to support the process at IM and MS level.

In addition, the TEN-T Regulation mandating radio-based ETCS could help reducing future ESC needs by removing opportunities for non-harmonised engineering solutions on the trackside.

Annexes 1 to 6 contain the list of ESC survey questions, the sector view on compatibility checks per profile, the overview of the ESC and RSC types per country, some considerations regarding RSC and finally the mapping between the IM motivations for ESC and the recommendations. It is noted that the Annexes are included as support to this report.

The Agency would like to thank all contributors to the ESC survey and the workshops. Their valuable inputs allowed the Agency to collect the information in the limited timeframe.

2. Introduction

2.1. Context

ETCS System Compatibility Checks (ESC) and Radio System Compatibility Checks (RSC) have been introduced in the amendment (EU) 2019/776 of CCS TSI Commission Regulation (EU) 2016/919.

These checks have been defined as:

"4.2.17.1. ETCS System Compatibility

ETCS System Compatibility (ESC) shall be the recording of technical compatibility between ETCS on-board and the trackside parts ETCS of the CCS subsystems within an area of use.

4.2.17.2. Radio System Compatibility

Radio System Compatibility (RSC) shall be the recording of technical compatibility between voice or data radio on-board and the trackside parts of GSM-R of the CCS subsystem."

The main reasons for these checks have been justified by:

"4.2.17. ETCS and Radio System Compatibility

Due to the different possible implementations and the status of the migration to fully compliant CCS Subsystems, checks shall be performed in order to demonstrate the technical compatibility between the on-board and trackside CCS Subsystems. The necessity of these checks shall be considered as a measure to increase the confidence on the technical compatibility between the CCS subsystems. It is expected that these checks will be reduced until the principle stated in 6.1.2.1 is achieved.

6.1.2.1. Principle

The principle is that a Control-Command and Signalling On-board Subsystem covered by an 'EC' declaration of verification is able to run on every Control-Command and Signalling Trackside Subsystem covered by an 'EC' Declaration of verification, under the conditions specified in this TSI, with no additional verifications.

Achievement of this principle is facilitated by:

(1) rules for the design and installation of the Control-Command and Signalling On-board and the Trackside subsystems;
(2) test specifications to prove that the Control-Command and Signalling On-board and Trackside Subsystems comply with the requirements of this TSI and are mutually compatible."

Although the concept of ESC/RSC has been introduced in the CCS TSI, the idea of a catalogue of tests to prove the technical compatibility of an existing ETCS/GSM-R infrastructure with ERTMS equipped vehicles was not new. In some Member States, this was achieved by means of national rules and/or was made of scenarios originated from incompatibilities detected during first integrations of on-board and trackside. Nevertheless, access to and description of the verifications requested could be difficult for some applicants, so one of the aims of introducing these verifications in the CCS TSI was to ensure access to the information in a transparent manner.

Amendment (EU) 2019/776 also defined responsibilities for Infrastructure Managers, in a view to indicate a deadline for the submission of the checks:

"Infrastructure Managers, with the support of the ETCS suppliers for their network, shall submit to the Agency the definition of the necessary checks (as defined in 4.2.17) on their network by 16 January 2020 at the latest."

The Agency sent a first report on the implementation of ETCS System Compatibility (ESC) and Radio System Compatibility (RSC)[1] to the Commission in June 2020. The 2020 report highlighted some actions that were discussed within the Test and Validation Subgroup of the ERTMS Stakeholder Platform[2] until March 2021 when the activities of the group were handed over to CCS TSI WP in the context of CCS TSI 2023 recommendation.

Some of the actions were implemented through an update of the CCS TSI (2016) Application Guide or through a change introduced in the CCS TSI 2023. The other actions were considered for the medium/long term when sufficient return of experience on ESC/RSC is available.

Until the principle expressed in CCS TSI §6.1.2.1 is achieved, return of experience showed that due to the different possible trackside and on-board implementations and the status of the migration to full compliant CCS subsystems, additional checks have to be performed in order to demonstrate the technical compatibility between the on-board and the trackside subsystems.

It is assumed that these checks may be reduced as the confidence on the technical compatibility increases.

2.2. Current situation and problem description

The Annexes 3 and 4 respectively give the overview of the ESC types and RSC types per country. Focusing on the ESC, it shows that the number of types per country can be high. For example, vehicles applying for an authorisation to operate in Italy, France, Netherlands and Spain are facing up to a total of 105 ESC-types. It is not only the number of applicable types that is impacting the vehicle authorisation process, but also the amount and complexity of the checks included in those types. There could also be areas of use where only one type is applicable but the complexity to demonstrate it is high.

This brings the sector to a situation where the ESC demonstration is becoming more or more demanding in terms of preparation, effort, time and cost. Indeed, not only the time/cost of the effective execution of the ESC have to be taken into account, but also the time/cost involved in the preparation process (getting price offers, obtaining time slots to execute the checks, preparation of the laboratory/on-site environment, involvement of all the stakeholders, …) and in the results analysis (post-processing of the logs, drafting reports, consultation of the sector, discussion of issues, …).

The **CCS TSI 2023/1695 Article 12** expresses the intention to reduce the ESC/RSC by the following Agency action:

"By 1 June 2024, the Agency shall provide the Commission with its analysis on how to phase out the checks to prove the technical compatibility of on-board units with different ERTMS trackside implementations and to achieve harmonisation of engineering and operational rules for the Single European Rail Area."

2.3. Scope

This report is aiming to answer the CCS TSI 2023/1695 Article 12 obligation by proposing recommendations/actions to phase out the ETCS System Compatibility checks.

Even though the CCS TSI 2023/1695 Article 12 considers the technical compatibility of on-board units with different ERTMS trackside implementations, the core of this report is focussed on the ETCS part only (ESC). However, general considerations related to the radio part (RSC) are mentioned in the Annex 5 (see §5.5).

For what concerns the harmonisation of the engineering and operational rules, the Agency is preparing the detailed actions related to the EC request for recommendations to the Commission pursuant to Article 5

[1] ESCRSC Art11a V 1.1 - Report on the implementation of ETCS system compatibility (ESC) and radio system compatibility (RSC).pdf (europa.eu)

[2] Group initially composed of members of EC, UNIFE/UNISIG, CER, EIM, EUG, Agency and joined later by members of UNITEL, UIC and EAL

paragraph 2 of the Interoperability Directive (EU) 2016/797 - Multi-annual TSI revision framework. For the EC-requests CS-03, CS-11, CS-12, all three being related to harmonised engineering rules, the Agency is currently participating to several meetings with the stakeholders (ERJU SP OD, ERTMS manufacturers, ERTMS User Group) to coordinate the activities.

The Agency is categorising the engineering guidelines in two categories:

- Category 1 – Guidelines not directly related to the target system (ETCS L2 without line side signalling/without overlay Class B): this category gathers, among others, guidelines such as transition to NTC, Baseline 2, pure packet/messages rules, …
- Category 2 – Guidelines related to the target system: this category gathers, among others, guidelines such as LX handling, Start of Mission, ATAF, management of SH, …

The importance of harmonised trackside engineering rules will be further developed within the report, as it is a key enabler for the ESC/RSC reduction.

2.4. Methodology

In order to produce recommendations/actions on how to phase out the ETCS System Compatibility checks, the Agency has based its analysis on 3 major sources:

1. Agency's experience since the introduction of ESC
2. Results of the Agency’s ESC survey addressed to the railway sector
3. Outputs from the ESC dedicated workshops held during the ERTMS 2024 Conference

2.4.1. The Agency's experience since the introduction of ESC

After the introduction of ESC in amendment (EU) 2019/776 to the CCS TSI, various issues arose, some of them were highlighted in the first report on the implementation of ETCS System Compatibility (ESC) and Radio System Compatibility (RSC):

- Delays or non-notification of ESC by some IMs, after the date defined in the CCS TSI. This led to the possibility of still using a "national procedure" as a transitional measure
- Use of ESC not in line with their original purpose (for example, to verify the implementation of national rules or request additional activities not foreseen in the CCS TSI)
- Use of ESC by vehicle authorization applicants as an acceptable means of compliance with the CCS TSI, instead of complying with the requirements defined in the SUBSETs, to justify partial implementation or product non-conformities
- Difficulty or significant delays in accessing the laboratory and/or track for conducting ESC reported by stakeholders

2.4.2. ESC survey

The Agency has launched end of 2023 an ESC survey to the main participants from the complete railway sector, i.e. Infrastructure Managers, ERTMS Interoperable Constituent manufacturers, Vehicle manufacturers, Railway Undertakings and National Safety Authorities.

The purpose of this survey was to collect information about the current usage of ESC. Participants have been specifically selected (or designated through their management or through the representative organisation) because their feedback was considered as valuable.

The survey content intended to address multiple aspects of the ESC:

- Identification of ESC types already tested and the potential technical compatibility issues related to them
- The way technical compatibilities, if met, have been solved
- The reason why ESC is considered as necessary or not

- The main trends from the sector regarding the ESC
- The key enablers for the ESC phase out
- The cost and duration of ESC

The full list of ESC survey questions is documented in annex §5.1. The analysis of the replies received to the ESC survey can be found in §3.1.

2.4.3. Workshop ERTMS 2024 Conference

During the first day (23rd of April) of the ERTMS 2024 Conference, 3 workshops have been organised to exchange and acquire knowledges for particular fields. The workshop n°6 was dedicated to "**ETCS and Radio System compatibility checks: on the way to a phase out?**" and had as description:

"The CCS TSI 2023/1695 gives the Infrastructure Managers (IMs) the possibility to publish a catalogue of ETCS/Radio System Compatibility Checks (ESC/RSC) for their network. Applicants for vehicle authorisation have to demonstrate compatibility to the IMs' ETCS network by executing successfully the ESC (and/or RSC). Agency launched a questionnaire to capture feedback on ESC from the sector. In preparation to the substantiated report, Agency wants to further collect input from the sector. This workshop will be used as a sharing experience platform where Infrastructure Managers, Railway Undertakings, Manufacturers, Notification Bodies, National Safety Authorities and Laboratories can exchange experiences and make proposals aiming at reducing or even removing these checks."

In total, this workshop has taken place 3 times with approximatively between 20 to 30 participants per session.

First, the participants were asked to indicate their level of understanding of the ESC process, which is summarized in the Figure 1:

Figure 1

Subsequently, participants, organized into small groups, were invited to express themselves and present their views on the following issues:

Question 1:

What are the reasons why the following principle from the CCS TSI is not yet achieved or cannot be achieved?

CCS TSI §6.1.2.1: 'The principle is that a Control-Command and Signalling On-board Subsystem covered by an 'EC' declaration of verification is able to run on every Control-Command and Signalling Trackside Subsystem covered by an 'EC' Declaration of verification, under the conditions specified in this TSI, with no additional verifications.'

In other terms: why is the EC verification procedure of subsystem today not sufficient to demonstrate technical compatibility between ETCS on-board and ETCS trackside?

Question 2:

Interoperability Directive requires Vehicle Authorisation (VA) applicants to demonstrate technical compatibility between vehicle and infrastructure (cf. in articles 21.2 &21.3d).

a) *Which improvements should be brought to current ESC?*
b) *In your view what kind of checks/tests should be part of ESC? What kind of checks/tests should not be part of ESC?*

Question 3:

a) *What would be the pre-conditions to consider that ESC is no longer required to prove the technical compatibility of on-board units with different ERTMS trackside implementations?*
b) *If ESC is no longer required, which risks do you see and what would be the alternative(s) to demonstrate the ETCS technical compatibility?*

The result of the ERTMS conference workshops can be found in §3.2.

2.5. European Union legislations relevant for this Report

- Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union
- 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
- Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 amending Commission Regulations (EU) No 321/2013, (EU) No 1299/2014, (EU) No 1301/2014, (EU) No 1302/2014, (EU) No 1303/2014 and (EU) 2016/919 and Commission Implementing Decision 2011/665/EU as regards the alignment with Directive (EU) 2016/797 of the European Parliament and of the Council and the implementation of specific objectives set out in Commission Delegated Decision (EU) 2017/1474
- COMMISSION IMPLEMENTING REGULATION (EU) 2023/1695 of 10 August 2023 on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union and repealing Regulation (EU) 2016/919

2.6. Other informative documents

- Guide for the application of the CCS TSI in accordance with Article 19(3) of Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016[3]

[3] Guide for the application of the CCS TSI_2016

3. Analysis

3.1. ESC Survey results

3.1.1. Statistics and facts

The ESC survey has been sent to 130 participants from the complete railway sector, i.e. Infrastructure Managers, ERTMS Interoperable Constituent manufacturers, Vehicle manufacturers, Railway Undertakings, National Safety Authorities.

Among these 130 participants, 48 contributions have been received, which correspond to a participation rate of 37 %.

The Figure 2 gives the distribution of contributions according to the participant's profile.

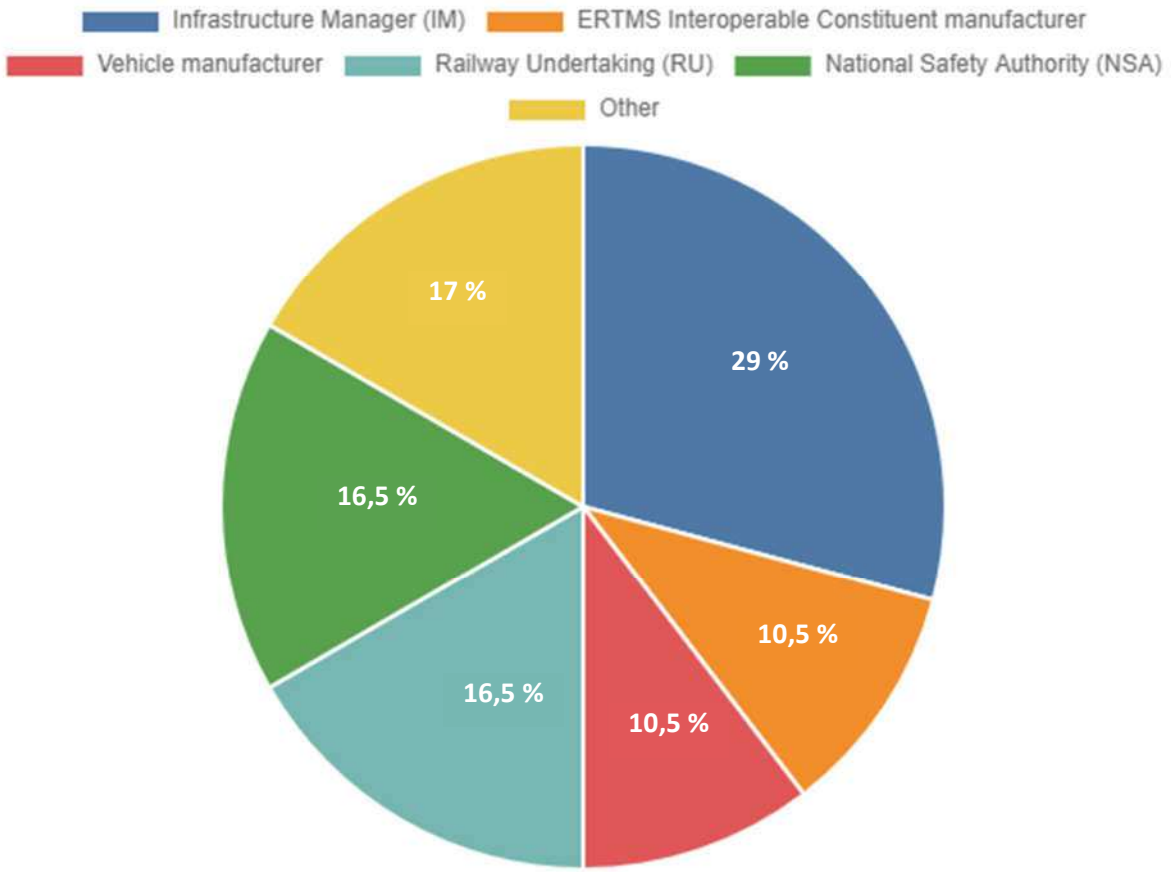

Figure 2

In terms of country representation, nearly all countries that have valid ESC types have contributed to the survey. The Agency considers that the survey is representative and covers all the ESC active countries.

Other facts (based on TD/011REC1028 v27.0):

- 135 ESC types published and valid for 16 countries (14 countries do not have ESC types defined yet)
- 8 ESC types were reported as never been tested (6 %)
- To get an overview, only ESC types having received at least 4 contributions have been considered. It concerns 93 ESC types. On these 93:
    - 49 ESC types have been always reported with success or minor shortcomings (52,5 %)

- 36 ESC types have been reported at least once with product non-conformities (39 %), mainly in the Netherlands (23 ESC types) and in France (6 ESC types)
- 8 ESC types have been reported at least once with train-track incompatibilities (8,5 %), in Italy, Switzerland, Sweden and Czech Republic

3.1.2. Overview of the issues detected during ESC test campaigns (see Annex 1 §5.1 - questions 2.2/2.3)

As a result from the survey depicted in the previous section, more than 50 % of the 93 ESC types considered to get an overview have been passed without any products non-conformities and technical compatibility issues discovered.

When asking the contributors to describe what issues have been detected, it comes out that most of the times it concerns product non-conformities to the specifications. Also, these products non-conformities were sometimes known in advance of the ESC test campaigns, from previous test campaigns. However, performing ESC checks on the real on-site installations and with degraded conditions allows to discover new issues not detected in earlier laboratory test activities.

Moreover, even with well-defined ESC checks describing in detail the expected results, the issues (non-conformities or technical compatibility issues) are often discovered by chance during the scenario execution, without any link with the real purpose of the ESC check itself.

We also observe a trend that usually most of the products non-conformities detected are found on the brand-new on-board units, compared to the ones that have been put on the market for a long time and that have been subject to continuous upgrades.

Several root-cause analysis show that the issues mainly come from:

- Products non-conformities to the specifications
- Misinterpretation of the applicable requirements
- Incompatibility between ETCS on-board and trackside system versions or design choices

Below some examples of products non-conformities or technical compatibility issues reported by the survey contributors:

- Excessive confidence intervals
- ETCS on-board not respecting the T_NVCONTACT timer
- Unexpected entry in System Failure mode, hardware failures or STM failures
- System Failure with balise antenna over a balise
- Wrong train position (confidence interval) when changing cab or closing/opening cab (issues reported several times)
- No balise error message is sent to the RBC when travelling in OS mode
- Consecutive OS Mode profiles not handled correctly (issues reported several times)
- Missing position report due deletion position report parameters when leaving Level 2 area
- Relocation without linking information (related to CR782/CR1370, issues reported several times)
- OS-mode acknowledgement required by ETCS on-board even though the ETCS on-board is already running in OS
- LX unprotected icon not correctly displayed
- Low adhesion symbol is shown outside the low adhesion area
- Situations leading to disconnections between trackside and on-board subsystems
- Managing the “P88 – Level Crossing Information” after passing the unprotected LX

3.1.3. Solutions brought to the detected issues (see Annex 1 §5.1 - question 2.4)

From previous section, one problematic point is the fact that when an issue/error/non-conformity has been detected, most of the time it concerns significant topics that cannot be corrected easily or with minor upgrades.

Most of the time, the issues are on-board related and there is a need to update the on-board configuration, i.e. implementation of corrections, odometry improvement, update of the on-board versions, … Because of the long duration of the on-board correction process, vehicles could be prohibited to operate on the concerned lines. In this case, it has been reported several times that the trackside engineering implementation has been modified, on a voluntary basis, to mitigate the on-board deficiencies and to allow the vehicles to operate.

In less critical situations, the following actions have been considered as workaround:

- Description of the 'wrong' on-board behaviour in the driver's manual/documentation
- Definition of specific operational procedures to mitigate the issue
- Definition of restrictions or conditions/limitations of use in the EC Declaration of Verification of the CCS On-board subsystem
- Acceptance of the non-conformity or incompatibility based on an analysis of the residual risk (safety and operation related analysis) together with an action plan defining the timeframe to correct the issue in a next on-board (software) update

In some other limited reported cases, the issues reveal not proper/not correct trackside implementations that require adaptations by the IM.

3.1.4. Rationales from the Infrastructure Manager survey regarding the need of ESC (see Annex 1 §5.1 - questions 2.6/2.7)

Before planning to phase out/remove the ESC checks, it is important to understand why IMs consider them as necessary to demonstrate technical compatibility between on-board and trackside on top of the trackside and on-board EC declaration of verification.

To this purpose, the following questions have been asked to the IM:

- In case you have ESC types, why do you consider them as necessary? (See Annex 1 §5.1 - Question 2.6)
- In case you don't have ESC types, why do you consider them as not necessary? (See Annex 1 §5.1 - Question 2.7)

From the ones having ESC types defined, the main reasons expressed are the followings:

- There is no evidence that on-board suppliers have used the ESC checks as an input for their test cases
- The CCS TSI technical requirements are ambiguous and lead to different possible interpretations
- To verify that requirements are correctly implemented on-board
- Specific safety features that are used in the ETCS installation are verified
- The tests performed during on-board/trackside products or subsystems development may not cover all the possible implementations of ETCS
- Because of on-board certified with partial fulfilment of requirements or with deviations
- ETCS on-board without error corrections
- The ESC checks are derived from "lessons learned" with other previous vehicles
- To test that the on-board behaviour to the specific trackside implementations or to critical functions (like level transitions) is the one expected
- To cover previous existing train-track integration tests
- To check the on-board behaviour related to specific ETCS CR that have impact on the considered trackside

- To verify the on-board reaction in specific configurations manipulating the processing times of several subsystems (RBC, interlocking, TTD) and radio transmission and to check if it is compatible with the overall system performance

There was no rationale provided to the question addressed to the IM without ESC types defined.

3.1.5. General trends from the sector regarding the ESC (see Annex 1 §5.1 - Questions 2.8/2.9)

The Figure 3 gives an overview of the agreement level of the sector to statements related to the ESC checks. The following trends can be observed:

- ESC are revealing technical compatibility issues and they are a good instrument to prove compatibility
- ESC should be phased out
- ESC should not be demonstrated on-site only
- The maturity and stability of the ETCS products are not high enough to remove the ESC
- Issues discovered during ESC should have been detected during previous steps of the project development cycle
- The subsystem certificates are not enough to demonstrate technical compatibilities and therefore not enough to get rid of ESC
- The ESC types should be defined per ETCS system version
- The number of ESC types per MS should be limited to one if possible
- It should be avoided to have ESC type from different MS checking the same on-board behaviours
- Limitations and restrictions from the ESC checks are clearly reflected in the reports
- The test environment architecture for ESC checks should be better harmonised

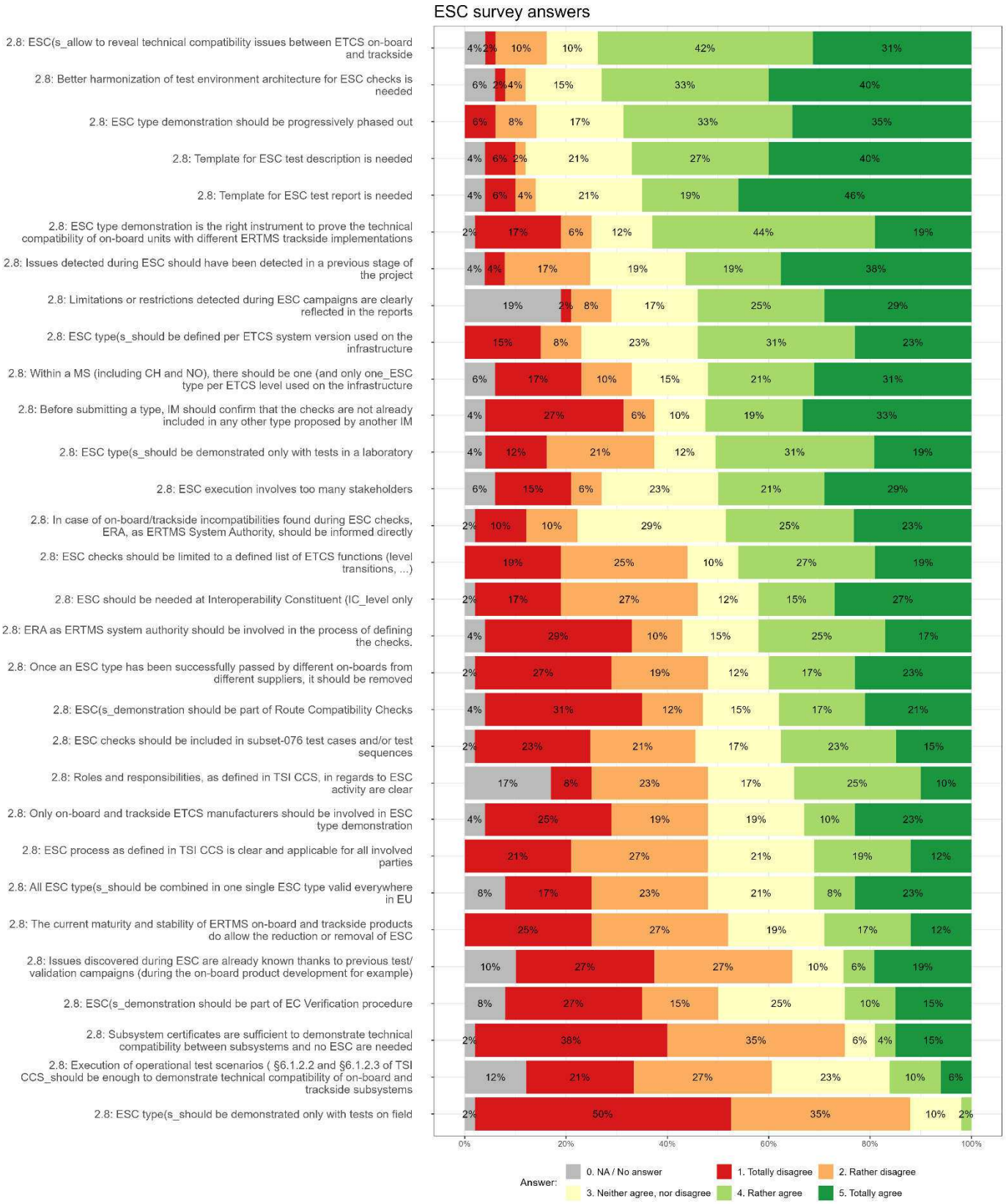
ESC survey answers
2.8: ESC(s_allow to reveal technical compatibility issues between ETCS on-board and trackside
2.8: Better harmonization of test environment architecture for ESC checks is needed
2.8: ESC type demonstration should be progressively phased out
2.8: Template for ESC test description is needed
2.8: Template for ESC test report is needed
2.8: ESC type demonstration is the right instrument to prove the technical compatibility of on-board units with different ERTMS trackside implementations
2.8: Issues detected during ESC should have been detected in a previous stage of the project
2.8: Limitations or restrictions detected during ESC campaigns are clearly reflected in the reports
2.8: ESC type(s_should be defined per ETCS system version used on the infrastructure
2.8: Within a MS (including CH and NO), there should be one (and only one_ESC type per ETCS level used on the infrastructure
2.8: Before submitting a type, IM should confirm that the checks are not already included in any other type proposed by another IM
2.8: ESC type(s_should be demonstrated only with tests in a laboratory
2.8: ESC execution involves too many stakeholders
2.8: In case of on-board/trackside incompatibilities found during ESC checks, ERA, as ERTMS System Authority, should be informed directly
2.8: ESC checks should be limited to a defined list of ETCS functions (level transitions, ...)
2.8: ESC should be needed at Interoperability Constituent (IC_level only
2.8: ERA as ERTMS system authority should be involved in the process of defining the checks.
2.8: Once an ESC type has been successfully passed by different on-boards from different suppliers, it should be removed
2.8: ESC(s_demonstration should be part of Route Compatibility Checks
2.8: ESC checks should be included in subset-076 test cases and/or test sequences
2.8: Roles and responsibilities, as defined in TSI CCS, in regards to ESC activity are clear
2.8: Only on-board and trackside ETCS manufacturers should be involved in ESC type demonstration
2.8: ESC process as defined in TSI CCS is clear and applicable for all involved parties
2.8: All ESC type(s_should be combined in one single ESC type valid everywhere in EU
2.8: The current maturity and stability of ERTMS on-board and trackside products do allow the reduction or removal of ESC
2.8: Issues discovered during ESC are already known thanks to previous test/ validation campaigns (during the on-board product development for example)
2.8: ESC(s_demonstration should be part of EC Verification procedure
2.8: Subsystem certificates are sufficient to demonstrate technical compatibility between subsystems and no ESC are needed
2.8: Execution of operational test scenarios (§6.1.2.2 and §6.1.2.3 of TSI CCS_should be enough to demonstrate technical compatibility of on-board and trackside subsystems
2.8: ESC type(s_should be demonstrated only with tests on field
0%
20%
40%
60%
80%
100%
Answer:
0. NA / No answer
1. Totally disagree
2. Rather disagree
3. Neither agree, nor disagree
4. Rather agree
5. Totally agree

Figure 3

The additional remarks/observations given by the survey contributors to the statements of Figure 3 are listed and commented in Table 2.

This table is composed of:

- Column 1 – 'Statement'
- Column 2 – 'General trends': the average agreement level of the sector to the statement. The following categories are defined:
  - **Agree**: If more than 50% of the contributions indicated 'rather agree' or 'totally agree'
  - **Disagree**: If more than 50% of the contributions indicated 'rather disagree' or 'totally disagree'
  - **Neutral**: if "neither agree, nor disagree" was indicated. When 'Neutral' is indicated as general trends, it is also described if the statement received a significant number of diverging opinions (in other words, when lots of participants 'totally disagree' and others 'totally agree')
- Column 3 – 'Survey participants remarks and/or opinions': the additional inputs from the survey contributors related to this statement. The inputs are also sorted in 3 categories:
  - **Agree**: when the input tends to agree with the statement
  - **Disagree**: when the input tends to disagree with the statement
  - **Neutral**: when the input does not present strong position but is discussing the statement or when the input does not directly answer the statement
- Column 4: Agency's remarks and opinion

Note: the average agreement level can be the opposite of the additional comments provided by the survey contributors (example: average agreement level to 'agree' (column 2) while only comments (column 3) tending to 'disagree' are provided). This is because the provision additional comments were not mandatory in the survey.

Table 2

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
1) All ESC type(s) should be combined in one single ESC type valid everywhere in EU	Neutral but lots of diverging opinions	<u>Agree</u> • We totally agree. To clarify this, the objective of a single ESC with a single version of ETCS throughout Europe is the constraint that we would like to see implemented in Europe. This ESC should also contain transitions to and from Class B equipment. <u>Disagree</u> • Unnecessary checks depending on the area of use should be avoided • As long as an IM involves different trackside suppliers, only one ESC type is difficult to set in place. • Complexity could unnecessarily increase (no need to test scenario not part of the area of use or interest of a specific manufacturer) • A single ESC type valid everywhere in Europe would not be an improvement if it concatenates as many test cases as when spread over the existing national ESC types, if it imposes to perform useless, costly and time-consuming test cases regarding the planned area of use. • ESC types are physically linked to the trackside subsystem, its functionality as defined by the hardware, software and configuration. Test cases can	Contributions are torn between agreement and disagreement to this statement. The repartition of the answer shows that inside a MS, the number of types depends on the number of trackside engineering set of rules, which depends on the type of national ERTMS implementation plan (being national wise or by isolated lines) Agency is therefore of the opinion that it is not the number of types which is relevant but the number of checks. Focus should be put on the quality, the necessity and the relevance of the ESC checks. If a single ESC valid everywhere in EU would have to be proposed, this presupposes the harmonisation of the ETCS operational and engineering rules in order to limit the influence of hardware, software and specific implementations and also the possibility to select only the ETCS functions to be checked depending on the area of use. As an intermediate step, the CCS TSI proposed that ESC type can be common to

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		be reused across different ESC types, but this does not mean that the ESC types are the same (unless the trackside subsystem has exactly the same hardware, software and configuration) • Today the variability of the ESC types, especially the infrastructure functions used and the implemented RBC-releases are too different to combine all different countries ESC, nevertheless a huge simplification of the tests shall be done - this is time and money consuming. <u>Neutral</u> • It would first require harmonised operational rules to define a single ESC type (taking into account level transition) and more standardised products • We believe that it is possible to write such a single document in order to achieve uniformity across all regions and to run a train from Country A to Country B, however drafting such a document would not be the easiest task and would only be possible if suppliers follow a standard product architecture.	several IM "*4.2.17.1 It is possible to use the same ESC type for cross border infrastructure and for different national infrastructure*". Currently at cross border level, there is no real application of that principle. This could be probably because corridors are composed by a concatenation of routes among several IMs, but the ETCS implementation is not designed with common engineering rules among the IMs. On the national approach, in Member States with several IMs, there are examples of reusing ESC when the same engineering rules are used on the different networks, as in France or Italy.
2) Before submitting a type, IM should confirm that the checks are not already included in any other type proposed by another IM	Agree	<u>Agree</u> - <u>Disagree</u> • It would be very complex for an IM to perform this check from the existing ESC checks • We believe that verifying each ESC check against another ESC type is a lot of work and would not be a feasible solution in the long run	Agency supports the concept that the repetition of identical checks should be avoided to the greatest extent possible. Nevertheless, acknowledging potential variations in trackside implementations among different IMs, it is recognised that such confirmation by the IMs may not always be achievable. Agency would recommend focussing instead on the quality, the necessity and the relevance of the ESC proposed by an IM.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Neutral • ESC tests can be defined by more IMs in parallel but then the manufacturer could avoid executing them if already performed in another ESC • It should be avoided that one and the same test case has to be tested several times in different countries of the area of use. If one and the same ESC test case occurs several times in different ESC types of the area of use, it should be possible to carry out this test on only one of the affected routes and transfer the result to the other affected routes • A regular check of test cases by IM should be done in order to clean-up tests without added value (or possibly redundant as border transition tests) • Identical ESC tests between different infrastructures should be merged under Agency's control (not the role of each IM to check if similar ESC types exist somewhere in Europe) • Harmonization of ESC tests should be ensured by the Agency and not the IMs	
3) Better harmonization of test environment architecture for ESC checks is needed	Agree	Agree - Disagree - Neutral • To make use of SUBSET-110 and SUBSET-111 • The IM seems to have different levels of involvement in ESC depending on the testing facility (lab or on-site) and who owns or controls it. It would be difficult to	Agency supports the proposal of introducing SUBSET-110 (UNISIG Interoperability Test – Guidelines) and SUBSET-111 (Interoperability Test Environment Definition) in the CCS TSI, under the condition that the requirements defined in those SUBSETS are merged with requirements defined in SUBSET-094 (Functional requirements for an on-board reference test facility)

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		require harmonisation of the trackside test environment	
4) Agency as ERTMS system authority should be involved in the process of defining the checks.	Neutral but lots of diverging opinions	<u>Agree</u> • Agency as ERTMS system authority could be involved to avoid MS to require irrelevant ESC and manage equivalence between tests / systems when possible • The ESC must be a document produced by the Agency (neutral EU entity), and both IM's and suppliers must validate their equipment against this European ESC <u>Disagree</u> • The role of the Agency is more at the level of the referee. The content of the tests is derived from the trackside implementations • Agency is not active in infrastructure authorisation • Agency could give more "guidelines". However, since it's the responsibility of the IM to define the checks, Agency should not be involved in that process <u>Neutral</u> • Agency should validate that the content of the ESC is in line with NNTR • Agency shall validate that the required tests are not already covered by the specifications • Agency should be involved when there is a disagreement between the IM and the ETCS on-board supplier especially when different interpretations of the subsets is involved or the error is clearly on trackside, but a correction of trackside is "not possible" (as per "your OBU have to pass the ESC as defined,	Contributions show divergences in the sector opinion. Based on the multiple approach taken by the IM to define the ESC types, Agency is of the opinion that the scope of ESC should be better clarified. Also, Agency considers that it is up to the IM to justify why ESC checks are defined for on-boards compliant to the specifications (i.e. having successfully passed the SUBSET-076 test cases).

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		even when it tests a conformity with a wrong trackside implementation")	
5) ESC checks should be included in SUBSET-076 test cases and/or test sequences	Neutral but lots of diverging opinions	<u>Agree</u> • The test frequently used or too generic could be added in SUBSET-076 and not executed in the ESC campaign • ESC tests should not be necessary, it should be part of SUBSET-076 tests and the on-boards should be fully compliant to the CCS TSI and the SUBSETs. Unfortunately, this is not yet the case • Agency should also validate that ESC tests are not already covered by specifications and SUBSET-076 tests • Yes, for the ETCS tests and to avoid testing non mandatory CR (under Agency control) • ETCS Baseline 3 is on a good way for being stable. All issues should be solved in SUBSET-076, so there is no more specific testing needed <u>Disagree</u> • Experience shows that SUBSET-076 is not enough. A barrier is that the checks are done in different test environments that are difficult to reproduce exactly • Transitions with national system should not be part of SUBSET-076 • The integration of ESC into SUBST-076 is not a good solution. With each new ESC test defined in a member state, the SUBSET would evolve. And how would the link with the RINF be made? SUBST-076 concerns the authorization of on-board equipment EVC while the ESC tests concern compatibility	Agency agrees with the feedbacks asking that SUBSET-076 should be improved as much as possible, including some of the relevant scenarios defined in ESC, in particular for those ESC defined to be executed in a laboratory. It should be clarified what is considered as not enough in SUBSET-076. However, it is recognized that there is no equivalent to SUBSET-076 for trackside constituents and the associated trackside engineering rules. Agency considers that it is up to the IM to justify why ESC checks are needed.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Neutral • Only if possible since ESC was defined as checks between specific on-board product and specific trackside product	
6) ESC checks should be limited to a defined list of ETCS functions (level transitions, ...)	Neutral but lots of diverging opinions	Agree - Disagree • Special (exotic) engineering should be tested regardless of the function even if some functions look more critical than others (e.g. Level Transition) Neutral • This list should be clarified	There are only a few contributions to this statement. Based on the multiple approach taken by the IM to define the ESC types, Agency is of the opinion that the scope of ESC should be better clarified. Agency recognizes that the trackside engineering rules are not harmonised among the IM.
7) ESC execution involves too many stakeholders	Agree	Agree There are clearly too many stakeholders for the ESC tests: Testing body, NSA, DeBo, NoBo, IM... Their roles and the rules for organising the on-site tests are not unified among the Member States. Disagree - Neutral -	There are not enough details in the answers to come with an opinion nevertheless Agency confirms that Debo should not have any role.
8) ESC process as defined in CCS TSI is clear and applicable for all involved parties	Neutral but lots of diverging opinions	Agree • It is clear and somehow applicable, but also due to the different interpretations, extensive and formal	Agency disagrees with the statement that ESC only applies for route compatibility purpose. The execution of the tests, if any, is not a matter of route compatibility, but rather technical compatibility. Moreover,

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		• They are clearer when compared to the last CCS TSI, however they need more refinement for clarity <u>Disagree</u> • The ESC process is not clear. ESC should be only a route compatibility issue and not included in vehicle authorization, where the assessment should be limited to SUBSET-076 conformity and CCS subsystem certification • ESC checks as defined in CCS TSI are conducted too late and the current framework is too complex. The process as it is included in CCS TSI should be withdrawn and substituted by a simpler and more efficient process: The ESC checks definition should be used by suppliers at constituent level (early validation phase) in order to anticipate issues detection and eventually solve it at design/production phase. It could be implemented either in new products development or in the relevant functional maintenance updates as defined in CCS TSI. On-Board suppliers (with the necessary support from trackside suppliers) should take the lead and responsibility on this task, in order to better harmonize products development. The role of IM should be limited to (eventually) ESC checks definition and also being informed by the suppliers of the relevant results (also RUs when needed). <u>Neutral</u> • The involvement of a NoBo brings no added value in the process (and additional costs)	ESC may require involvement of ETCS suppliers (on-board and trackside) which is not the case for the route compatibility.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
9) ESC should be needed at Interoperability Constituent (IC) level only	Neutral but lots of diverging opinions	Agree • ESC should be validated on the product level, and not on vehicle level. This would reduce the unnecessary costs and delays • We have supported ESC checks at IC level, but we see that the ETCS on-board supplier has delivered the same ETCS on-board on other train types that do not work as well as the test trains. We have tried to mitigate this by requiring a configuration guideline Disagree • ESC only on IC level is not sufficient. Even if trackside part has been unified across all Europe, testing compatibility of whole vehicle (subsystem or vehicle level) is still needed. Vehicles are constructed differently (e.g. regional trainset x cargo loco) Neutral • They should only be applied on a test bench (maybe a common, pan-European one), thus avoiding any need to on-track tests if the rolling stock configuration is well reproduced on the test bench in terms of interfaces	From Agency's point of view, first, it should be clarified why ESC at IC level only are deemed not sufficient. In addition, external factors (e.g. type of rolling stock parameters, train detection characteristics) influencing the ETCS compatibility should be identified.
10) ESC type demonstration is the right instrument to prove the technical compatibility of on-board units with different ERTMS trackside implementations	Agree	Agree • It is the only instrument to verify the compatibility between on-board subsystem and the specific trackside subsystems Disagree • ESC is not "to prove" but to "gain confidence"	Based on the responses to the ESC survey, it does not appear that the ESC process has identified a significant number of incompatibilities. ESC is most of time successfully passed or revealing product non-conformities that should have been discovered in the product development cycle.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Neutral -	
11) ESC type demonstration should be progressively phased out	Agree	Agree • Related to ESC as it is defined today, moving those tests at subsystem level ("real" scenarios in combination with real components) to the Interoperable constituents, is considered to be useful • This would be the goal, but it would depend on suppliers providing standard products, elimination of errors when specifications are updated, etc. Disagree • The ESC must continue to exist so that when a new supplier wishes to enter the market, the supplier can carry out the necessary validations of the equipment, or when a modification needs to be done on ETCS equipment • ESC check should remain, not to be phased out completely - testing in real environment is still needed Neutral • Only under the condition that the quality of the on-board will sufficiently improve	The sector converges to express that the complete ESC removal is premature in the current situation. Also, the contributors suggest keeping a minimum set of ESC checks for new suppliers or modifications. The Agency is backing the phase out of the ESC with a supporting action plan.
12) ESC type(s) should be defined per ETCS system version used on the infrastructure	Agree	Agree - Disagree -	Agency is of the opinion that it is not the number of ESC types that is relevant, but how the checks are organised within the type. The focus should be on the quality, necessity and relevance of the ESC checks.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Neutral • Since every supplier's product would be slightly different and is applied differently in each project, we believe that there is potential for the idea but we aren't sure if this can be achieved without Suppliers standardisation of products.	
13) ESC type(s) should be demonstrated only with tests in a laboratory	Agree	Agree • Most of the ESC tests should be feasible in laboratory, especially for the "ETCS" tests • ESC tests performed on track should be progressively phase out with the class B system being removed (less transitions to test). However, ESC tests should be kept (in laboratory) for the rest (maybe at Interoperability Constituent level to save time at subsystem level) • All ESC tests should be performed in laboratory. Including Level NTC / Level ETCS transitions. Any accredited laboratory in any member state should have access in a non-discriminatory way to the trackside description of all countries, in order to perform any ESC type of any country Disagree • We believe that having only one option to do demonstration is not the right approach. A blend of options (i.e. lab, trackside and documental analysis) need to be considered to achieve results in the most cost efficient and timely way • The imposition of on-track tests ensures that the complete on-board system reacts well. The	Despite the advantages of carrying out tests in the laboratory, it is necessary to be able to determine and justify the types of tests that cannot be carried out in the laboratory and that must be carried out on-site to demonstrate technical compatibility. Notifying ESC should be accompanied by the provision of a laboratory capable of carrying them out. From the survey participant feedbacks, there is no concrete evidence that laboratory testing is effectively more affordable and faster.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		environment is difficult to configure in the laboratory, particularly in NTC<->ETCS transitions Neutral • Lab advantages: for newcomers, for on-board supplier different from trackside supplier, time for testing, consultation and making corrections, testing complicated scenarios • Lab drawbacks: not possible to check all actual train configuration. i.e. National systems after transition, not always possible to test all the tracksides, trackside changes not always implemented in laboratory • Cost: For the trackside, to implement laboratory testing for all the tracksides and keeping the trackside updated. For the supplier: Logistical transport of the ETCS system. Tests related to ETCS L2 can be done remotely, however, the connection need to be arranged. Cost of using the laboratory and operating support	
14) ESC type(s) should be demonstrated only with tests on field	Disagree	Agree - Disagree • We believe that having only one option to do demonstration is not the right approach. A blend of options (i.e. lab, trackside and documental analysis) need to be considered to achieve results in the most cost efficient and timely way • No: Some tests can be carried out in the laboratory	The contributors express that it is not a good option to only perform ESC checks in the on-site. Agency is sharing this opinion.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Neutral • On-site test advantages: Allows to test real situations with the actual train configuration and multiple actions => Detection of issues not possible in laboratory. Allows to test all existing tracksides, quick to organize in normal operation, does not necessary disturb normal operation if well organized, convenient for short tests • On-site drawbacks: Less room and time for mistakes, operational pressure, require preparation time. Costs: Test authorisation, preparation and execution (locomotive, driver, train path, …)	
15) ESC allow to reveal technical compatibility issues between ETCS on-board and trackside	Agree	See §4.1.2 and §4.1.3 Agree • Today the ESC is still needed to detect compatibility issues not detectable during the subsystem certification • ESC test results have shown the need for ESC tests as there are regularly issues detected Disagree • Globally, few errors are detected from ESC test campaigns compared to the level of effort (time & costs) invested Neutral -	ESC are not designed to detect product non-conformities. Thus, it is essential to identify and rectify the underlying causes of these non-conformities. From the survey results (see section 3.1.1), it seems that ESC are most of time successfully passed or revealing product non-conformities that should have been discovered in the product development cycle. The Agency is not convinced that ESC allows to discover real technical compatibility issues.
16) ESC demonstration should be part of EC Verification procedure	Neutral but lots of diverging opinions	Agree -	Agency believes that there is room for improvement in the content of CCS TSI. This

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		Disagree - Neutral • Some IM consider ESC demonstration as part of EC verification procedure	enhancement is necessary to address technical compatibility more effectively.
17) ESC demonstration should be part of Route Compatibility Checks	Neutral but lots of diverging opinions	Agree • The vehicle authorisation should not require ESC check, only the route compatibility should be necessary. This implies to move the ESC from CCS TSI §4.2.17 to another location, and to modify the Agency 1209-143 clarification note • ESC tests should only be related to route compatibility Disagree • No, this is a duty of railway undertakings after the authorisation process. If done so, there should be an authorisation by line based on the RINF and new authorisation for each modification of the line Neutral -	ESC have been introduced in order to increase confidence on the technical compatibility between CCS subsystems. Of course, the comparison of the values 'ESC type' recorded in the databases RINF/ERATV are relevant for route compatibility check (RCC) but the execution of the ESC checks and demonstration of compatibility shall be done well before the RCC.
18) Execution of operational test scenarios (§6.1.2.2 and §6.1.2.3 of TSI CCS) should be enough to demonstrate technical compatibility of on-board and trackside subsystems	Neutral	Agree - Disagree • No because degraded modes are not sufficiently covered by the operational test scenarios	Agency believes that there is room for improvement in the content of CCS TSI Table 6.2.1, which covers "Conformity assessment requirements for an On-board Subsystem or for groups of Parts", as well as Table 6.3, which addresses "Conformity assessment requirements for a Trackside Subsystem", and section 6.1.2. This enhancement is

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
		• Operational test scenarios (§6.1.2.2 and §6.1.2.3 of TSI CCS) are not specific enough to cover the compatibility field of ESC types Neutral -	necessary to address technical compatibility more effectively.
19) In case of on-board/trackside incompatibilities found during ESC checks, Agency, as ERTMS System Authority, should be informed directly	Neutral	No input from the participants	Agency should be informed in case a real ETCS on-board/trackside compatibility issue is detected (product non-conformities are not concerned), no matter if it comes from ESC checks or via other ways. In this way, Agency can get an overview of the overall technical compatibility (state) and what the real problems are.
20) Issues detected during ESC should have been detected in a previous stage of the project	Agree	Agree • In an ideal world, yes. But which trackside or on-board supplier does really implement a 100% accurate product while the specifications are evolving? • Even if in theory the issues should have been identified during the process, the current not harmonized engineering process makes hard to identify potential issues Disagree - Neutral -	Agency acknowledges and shares the opinion that due to non-harmonized trackside engineering, technical compatibility issues may still be present.
21) Issues discovered during ESC are already known thanks to	Disagree	No clear input from the participants	From Agency's point of view, ESC should not be a tool to discover products non-

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
previous test/validation campaigns (during the on-board product development for example)			conformities (or to debug on-board products).
22) Limitations or restrictions detected during ESC campaigns are clearly reflected in the reports	Agree	Agree - Disagree • Unfortunately, this is not always the case Neutral -	No strong opinion on the Agency side because the only way for the Agency to access the report is through the VA applications. From VA activities in general, the ESC check reports being seen by the Agency are reflecting the limitations and restrictions.
23) Once an ESC type has been successfully passed by different on-boards from different suppliers, it should be removed	Neutral but lots of diverging opinions	Agree - Disagree • How to deal with newly built on-boards? • The ESC must continue to exist so that when a new supplier wishes to enter the market, it can carry out the necessary validations of the equipment, or when a modification needs to be done on ETCS equipment • For newly developed on-board and trackside subsystems, the ESC are more relevant than for existing/updated on-board and trackside subsystems Neutral -	The conditions under which an ESC type can be removed after successfully passing a certain number of ETCS on-boards should be identified and discussed with the sector.
24) Only on-board and trackside ETCS manufacturers should	Neutral but lots of diverging opinions	Agree -	From Agency's point of view, ETCS manufacturers (on-board and trackside) involvement is needed.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
be involved in ESC type demonstration		Disagree • No, there is conflict of interest • Since other stakeholders than manufacturers can perform subsystem integration, ESC type demonstration should not be limited to ETCS manufacturers Neutral -	
25) Roles and responsibilities, as defined in CCS TSI, in regards to ESC activity are clear	Neutral	Agree • Roles are clearly defined, but the process is too exhaustive and formal • Roles and responsibilities, as defined in CCS TSI, in regard to ESC activity are clear, but it's not always exactly applied in all countries Disagree • Roles and responsibilities not well perceived at RU level • There is a need to harmonize (and clarify) the role and responsibility of the NoBo, DeBo or other assessment bodies for ESC tests. As of today, CCS TSI requires a NoBo assessment, and at the same time, the national rules often (but not always) require a DeBo (even perhaps an AsBo). ESC test being only related to route compatibility and specific tests, it would be relevant to only require a DeBo (and not a NoBo anymore). ESC tests are related to infrastructure specificities. A NoBo assessment is relevant for a European assessment Neutral -	From the participant feedbacks, the roles and responsibilities in the ESC process is sometimes well understood and correctly applied, but sometimes not understood and perceived as too exhaustive and formal. From Agency's point of view, CCS TSI section related to the ESC/RSC (see CCS TSI 2023-1695 §4.2.17) has improved the definition of the roles and responsibilities of the different actors. Concerning the relation with national rules, the Agency wants to clarify that it is not the intention to use the ESC checks to verify the correct implementation of the national rules.

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
26) Subsystem certificates are sufficient to demonstrate technical compatibility between subsystems and no ESC are needed	Disagree	Agree - Disagree • Today's situation does not allow to remove ESC tests, but we consider them as useful to move the ESC tests to the generic product. That would also increase the meaningfulness of the certificate Neutral -	This remains the objective to be achieved as defined in the CCS TSI.
27) Template for ESC test description is needed	Agree	No additional input from the participants	Agency supports the statement.
28) Template for ESC test report is needed	Agree	Agree • A template for ESC test report is needed. For example, in the Spanish ESC as the same way that for L1/L2 files, it should include a template to check the CRs (595, 1257, 1288, 1300, 1309, 994, 1120, 1166, 1259, 1264, 1313, 1318, etc.). Currently, for each CRs to check, only it is included a brief description of each one Disagree - Neutral -	Agency does not see a direct benefit (in providing a template for ESC test report) for the ESC reduction/phase out.
29) The current maturity and stability of ERTMS on-board and trackside products do	Disagree	Agree - Disagree	Agency is of the opinion that the maturity and stability of the on-board and trackside products are beneficial to phase out the ESC because these products have been

Statement	General trends	Survey participants remarks and/or opinions	Agency's remarks and/or opinion
allow the reduction or removal of ESC		• For existing/updated on-board and trackside subsystems, ESC tests seem to be less relevant than for newly developed on-board and trackside subsystems Neutral -	debugged thanks to their use in real life and the return of experience. It is true that newly designed products could, even if based on the latest ETCS Baseline, suffer from teething troubles. However, Agency considers that a strict compliance to the technical specifications is extremely important for assuring the technical compatibility.
30) Within a MS (including CH and NO), there should be one (and only one) ESC type per ETCS level used on the infrastructure	Agree	Agree • Even more, there should be one ESC type for the whole territory of member state • The objective of having only one ESC type per network/level/system version is an interesting idea, but in our opinion, it is still very far from the current state of the art. It can only be possible with harmonized on-board and trackside products (not yet there). So again, the focus should be on product design and validation by the relevant supplier Disagree • We prefer to use the M_VERSION differentiation as defined in the SUBSET-026 Neutral -	From the opinions received, some participants are in favour of one ESC type per level or one per system version. Others are promoting to have only one ESC type per MS. From the already published ESC types, Agency notices a large disparity in the way the types are built. For some MS, one type is only containing a few checks while there exist a lot of types. For other MS, there are a few ESC types but these ESC types contain a lot of checks. In some cases, a type is related to a specific location in a track (e.g. transition points between Class B and ETCS). Therefore, the Agency is of the opinion that it is not the number of types that is relevant but rather the number of checks. The focus should be on the quality, necessity and relevance of the ESC checks.

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3.1.6. Key enablers for the ESC phase out (see Annex 1 §5.1 - question 2.10)

The survey contributors were also asked to rank the following proposals of key enablers in order of importance as contributing to the phase out of the ESC:

- Full application of error correction process as introduced in CCS TSI (EU) 2023/1695
- Authorisation process for ERTMS Interoperability Constituents
- Fully CCS TSI compliant ERTMS Interoperability Constituents
- More harmonisation in ERTMS trackside engineering
- Harmonised test specification for ERTMS track - train integration

The score is giving in the Figure 4.

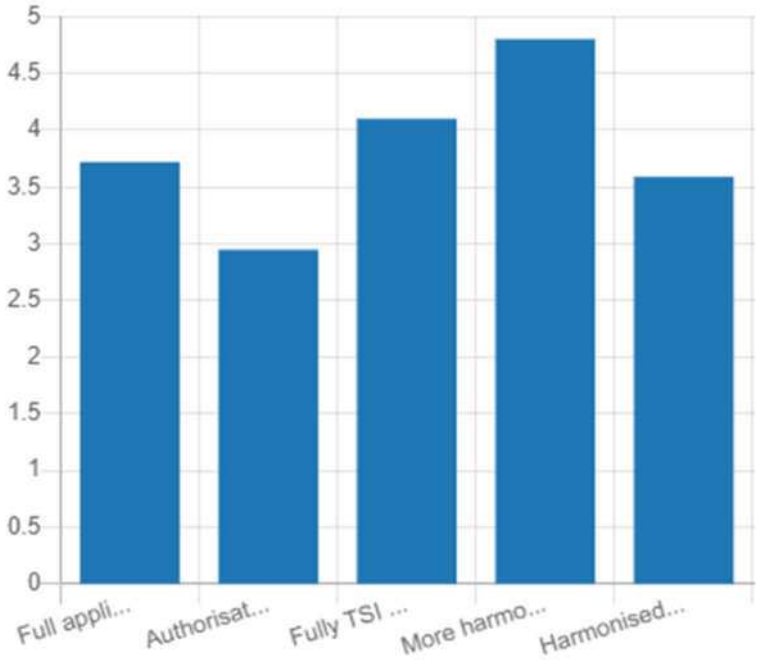


Figure 4

By order of importance, contributing the most to the less on the phasing out of ESC, we have:

1. More harmonisation in ERTMS trackside engineering
2. Fully CCS TSI compliant ERTMS Interoperability Constituents
3. Full application of error correction process as introduced in CCS TSI (EU) 2023/1695
4. Harmonised test specification for ERTMS track - train integration
5. Authorisation process for ERTMS Interoperability Constituents

The Agency agrees with this priority list. Further details and discussions on the proposals are provided in §4.

3.1.7. Ideas for ESC phase out (see Annex 1 §5.1 - question 2.11)

The survey contributors have largely participated to propose ideas/actions to reach a progressive phase out/removal of the ESC checks. The main ones are given below:

- Enhanced SUBSET-076: by integrating as many as ESC checks possible, so that the IC are directly ESC-proven
- Full compliant IC: no derogation nor partial fulfilment accepted
- Quick implementation of error correction process on both trackside and on-board
- ESC simplification: one ESC type per MS per ETCS Level
- Harmonisation of trackside engineering rules (operational and technical rules)
- Stable and unambiguous (error-free) specifications
- Strong ERTMS deployment policy: to avoid unstandardized deployment
- Clean-up of the existing ESC checks: to remove tests with no added value or that have been successfully passed with several on-board suppliers
- Make CCS TSI expectations (tests on operational conditions) more explicit
- Guidelines for defining ESC types/checks
- Set-up a laboratory allowing to perform all the ESC types published

Some of these ideas are rather focused on the reduction of ESC, other ideas are focused on the process and some of the ideas are really meant to get rid of the ESC.

3.1.8. ESC duration and costs

3.1.8.1. Average time to obtain price offers for ESC (see Annex 1 §5.1 - question 3.1)

According to contributors' responses, the duration varies from one week to several months, with an extreme case of two years. Obtaining a quotation takes less time for laboratory tests compared to on-site tests, as on-site tests involve additional actors.

3.1.8.2. Average waiting time for test slots (on-site and/or laboratory) (see Annex 1 §5.1 - question 3.2)

The average duration ranges from 3 to 6 months (with a range from 2 weeks to 3 years), exceeding the timeframe specified in the Interoperability Directive (3 months from the applicant's request). The time to secure a laboratory testing slot is not always shorter and can sometimes be longer than slots for on-site tests. For on-site tests, the duration includes obtaining temporary authorization from the NSA and overall test organization arrangements.

3.1.8.3. Average duration of ESC campaign from slot allocation to issuance of ESC Statements (see Annex 1 §5.1 - question 3.3)

The average duration ranges from a few days to up to 6 months to obtain ESC statements, including checks analysis reports and NoBo assessment. For laboratory tests, integration between ETCS on-board and laboratory facilities may take additional few weeks in addition to this average duration.

3.1.8.4. Average costs and cost breakdown for an ESC campaign (see Annex 1 §5.1 - question 3.4)

The average cost of an ESC test campaign ranges from 10k to 1M€. This cost encompasses all aspects, including path reservation, testing preparation, energy, personnel costs, results analysis, and certification expenses. The cost varies depending on factors such as the distribution between lab and on-site tests, the complexity and number of ESC types/checks, and the need for NoBo/DeBo participation. A laboratory ESC test campaign costs between 70k€ and 500k€, while on-site tests costs around 50k€ per day. The cost for a single ESC type is approximately 120k€, with a range from 10k to 800k€.

3.1.8.5. Conclusion

On costs and duration for the executing ESC, we see a high variety. The long duration and high costs are certainly elements that are put forward by applicants (RU, vehicle keeper, manufacturers) to question the ESC and push for a quick phasing out of ESC.

The high cost of the ESC test campaign was also pointed out in the "ERTMS – Analysis of on-board cost drivers" analysis performed under the EC initiative. This analysis reports the data collection exercise on the costs of on-board ERTMS retrofitting and splits the costs in 3 categories:

- Design: 20-30 % of the total cost
- Deployment: 40-50 % of the total cost
- Validation/authorisation: 20-30 % of the total cost

Although the ESC testing, being part of the "Validation/authorisation" category, has been explicitly mentioned as a cost driver, no specific amount has been provided. Arguments reported are related to the fact that tracks are booked in advance and in case of unforeseen project delays, the ESC can be delayed for a considerable period, leading to higher downtime and consequently higher costs.

3.2. ERTMS conference 2024 workshops results

In workshop #6, held on the 23rd of April 2024, participants suggested the following as potential contributions to reducing ESC:

- Harmonised trackside engineering rules
- Harmonised trackside operational rules
- More tests at IC level – less tests at system level
- Less level transition thanks to Class B decommissioning
- No deviation of CSS trackside and on-board
- Definition of checks reuse criterion
- Continuous error corrections

The suggestions formulated during the workshop are very much in line with the proposals the Agency received via the survey, except for the proposal on Class B decommissioning which is new.

Nevertheless, the workshop was very useful for participants and Agency, to raise awareness and to provide the possibility to exchange about ESC phase out between all different actors from the railways.

In preparation of ERTMS Conference Workshop #6, the same questions have been asked to some Agency internal Project Officers, working in ERTMS Unit and/or Vehicle Authorisations. In addition to the feedback received during the workshop, the proposals are complemented with the following ideas:

- In case a trackside is authorised with deviations, IM must take in charge the compatibility checks
- Regulatory requirements/obligations for IMs how to facilitate the execution of remaining specific ESC tests/specific integration tests
- To test only specificities of the lines (if there are any), not generic ETCS functions
- To include mandatory feedback to the Agency (or some other workgroups) of the results of non-passed checks
- Agreement for common ESC between IMs, at least at network borders

4. Recommendations

To answer to the request as described in Article 12 of CCS TSI "*By 1 June 2024, the Agency shall provide the Commission with its analysis on how to phase out the checks to prove the technical compatibility of on-board units with different ERTMS trackside implementations and to achieve harmonisation of engineering and operational rules for the Single European Rail Area.*", the Agency proposes a list of recommendations that will serve as a starting point for further discussions and actions with the sector.

Based on the information gathered from the survey, the information from the Workshop and the analysis of this information performed in §3, a first conclusion is that in the sector there is no consensus on how and when to phase out ESC because there are different interpretation on the "role and content of ESC".

From the sector contributions to the survey, Agency observed a strong disagreement with the statements:

- Subsystem certificates are sufficient to demonstrate technical compatibility between subsystems and no ESC are needed
- The current maturity and stability of ERTMS on-board and trackside products do allow the reduction or removal of ESC

This means that today the sector does not yet believe that we can "quickly" phase out the ESC as we know them today. The Agency will also need to take this into consideration when drafting the recommendations.

Therefore, the Agency is not able to propose a straightforward plan for the phase out of ESC, it must be tackled in an overall action plan with different steps that can have different timelines.

The Agency has formulated the following recommendations that will contribute stepwise to the phase out of the ETCS System Compatibility checks. For each recommendation, it has been evaluated how far the proposal contributes to ESC reduction and whether the first positive results would be expected on short/medium/long term.

As a definition for short, medium and long term, the Agency proposes:

- Short term = up to 1 year
- Medium term = 1 year to 3 years
- Long term = more than 3 years

4.1. Recommendation 1: Establishment of a dedicated Working Group

This proposal suggests setting up a dedicated Working Group comprising experts from the Agency and Representative Bodies (Railway Undertakings, Infrastructure Managers, manufacturers, laboratories, and NoBo), comparable to the T&V sub-group within the ERTMS Stakeholder Platform. This Working Group would oversee and monitor the various initiatives outlined in this report.

The main objective of this working group would be to develop and facilitate the implementation of an action plan among the stakeholders.

Effective communication among stakeholders is essential for identifying and addressing ESC-related challenges in a timely manner. Therefore, it is recommended to enhance existing communication channels and establish new ones to facilitate the exchange of information, feedback from ESC, and best practices. The working group would be tasked with identifying the principal challenges encountered with current ESC. It

could also revisit proposals from the initial ESC/RSC report[4] that were not executed due to insufficient feedback.

Responses to the ESC survey have shown that most issues encountered during ESC campaigns stem from products non-conformities. For issues related to system-level compatibility, it is important to put in place a communication channel where the sector could introduce them. Afterwards, a detailed root cause analysis must be performed in order to identify what shall be the actions to correct them.

Moreover, the Working Group should work on a realistic planning and ambitious deadline for starting the concrete phasing out of the ESC checks. This would allow to define key steps to reach this objective, e.g. analysis of the ESC redundant/duplicate checks, merging of equivalent types, …

Also, in parallel to who bears the costs of the ESC checks, the Working Group should focus on balancing the burden of proof among the stakeholders, for example, by requiring the Infrastructure Managers to justify their need of ESC types/checks and to share the cost of the ESC campaigns.

This dedicated Working Group could finally present potential changes to the CCS TSI WP in order to enforce and/or incentivise the implementation of recommendations proposed in this report.

This action is envisaged as short term, aiming to establish an efficient collaborative approach with relevant stakeholders, ultimately contributing to the reduction of ESC.

Agency could chair this Working Group under condition that appropriate staffing can be made available.

4.2. Recommendation 2: Harmonized definition of ESC content

The procedure surrounding ESC was introduced in the amendment of the CCS TSI in 2019, notably with a description of the roles of the Agency, Infrastructure Managers, NoBo, and vehicle authorization applicants. However, at that time, it was decided not to detail the content of the ESC, which would have required additional discussions and would have delayed their scheduled implementation for January 16, 2020.

Nevertheless, continuing with the principle that ESC are not meant to replace constituent-level tests, it is important to define the detailed criteria for the types of verifications that could be allowed as ESC; and consequently, to define what falls outside the scope of ESC.

In general, verifications of purely ETCS on-board functions should not be classified as ESC but should be included in product test specifications (such as SUBSET-076). Some infrastructure managers argue, notably, that verification requests related to on-board/trackside ETCS exchanges are classified at the ESC level because they depend on the trackside configuration (e.g. specific RBC application); however, from the Agency's opinion, there is no justified obstacle preventing these exchanges from being deterministically defined to be subsequently deployed in product test specifications (respectively ETCS on-board or RBC) and thus executed in any laboratory.

It could also be considered to harmonize a test catalogue for trackside interoperability constituents.

However, certain types of verification, such as performance verification for point-to-point communications, cannot solely be verified at the product or subsystem level only but require the entire CCS system. In this case, the issue does not lie so much in the content of the tests but rather in balancing the burden of proof among the different subsystems – and actors – if performance requirements, in this example, cannot be allocated to each subsystem individually.

Lastly, transition tests (ETCS <-> ETCS, ETCS <-> NTC, NTC <-> NTC under ETCS supervision) require specific discussions to determine which types of transitions should be part of ESC or not.

[4] ESCRSC Art11a V 1.1 - Report on the implementation of ETCS system compatibility (ESC) and radio system compatibility (RSC).pdf (europa.eu)

To summarize, the action to harmoniously define the content of ESC considering the current experience feedback and the action to integrate verifications from current ESC catalogues into interoperability component test specifications are seen for the medium term.

4.3. Recommendation 3: Guideline for ESC definition

Once the working group has defined what could fall within the scope of ESC, this group can also propose a guideline for Infrastructure Managers (IMs) to update, thus reducing, in most cases, the tests or checks currently required.

This guideline should also define in more details the conditions under which it is possible to reuse evidence obtained from other stages of the product or subsystem development cycle.

This action is considered for the medium term as it requires resources from the Infrastructure Managers to investigate their existing ESC.

4.4. Recommendation 4: Harmonised trackside engineering rules

Because of the freedom of choice offered by the 'ETCS toolbox', the ETCS trackside implementation de facto varies a lot between member states, and even within a same member state it can vary from one line to another line. Although the ERTMS functionalities themselves are harmonised, the different ways of using them leads to a large disparity among implementations.

As already explained in other recommendations and expressed several times by the survey contributors, these disparities contribute to let the IM unconfident of the technical compatibility with the on-board subsystems.

The development of harmonised engineering rules to streamline the way how the ETCS functions are implemented trackside would certainly contribute to a more standardized on-board/trackside ETCS exchange. Therefore, any doubt about possible unexpected on-board behaviours would be removed. Consequently, currently defined ESC aiming to verify the 'member state-way'/'line-way' trackside implementations would become useless and could be removed.

This action is considered for medium term to produce the first harmonised trackside engineering rules and to be continued to long term for further development of new engineering guidelines and their implementation. The System Pillar Operational Design group (SP OD) is currently working on operational harmonisation supported by harmonised trackside engineering.

When available, a strategy should be defined to implement these engineering guidelines in existing and new trackside.

4.5. Recommendation 5: To review conformity assessment requirements in CCS TSI

CCS TSI §6.3 Control Command and Signalling Subsystems describes what the Notified Bodies (NoBo) must verify for the integration of:

- The on-board subsystem with the CCS trackside subsystem and other subsystems: Table 6.2.1
- The trackside subsystem with the CCS on-board subsystem and rolling stock subsystem: Table 6.3

These tables should better clarify the activities to demonstrate and evaluate technical compatibility between CCS on-board and CCS trackside in the context of conformity assessment.

The content of 'What to assess' could benefit from being more detailed, specifying more precisely the evidence or types of tests to be systematically performed and which are applicable to the targeted area of use. Furthermore, for the trackside subsystem, there is already an obligation for the integration with at least two on-board subsystems from different suppliers using operational scenarios. A more detailed description in the CCS TSI Application Guide of the activities defined in these tables, in collaboration with the Notified Bodies association, should contribute to providing arguments in favour of reducing the ESC and could be

carried out in the medium term. If changes or clarifications are needed in the CCS TSI, then this action is seen for the long term.

4.6. Recommendation 6: Better coverage of ESC by SUBSET-076

The ETCS on-board function tests currently found in the ESC test catalogues requested by IMs should be covered in SUBSET-076. Therefore, this recommendation entails asking Infrastructure Managers to review their current ESC, considering the requirements currently tested in SUBSET-076.

If scenarios currently defined in ESC and being executed in laboratory are not part of SUBSET-076, it should be reflected on whether these scenarios should be considered to enrich SUBSET-076.

This action would require the mobilisation of resources from accredited ERTMS laboratories and Infrastructure Managers and is seen as medium to long term.

4.7. Monitoring of modifications introduced in CCS TSI (EU) 2023/1695

CCS TSI (EU) 2023/1695 has introduced several new principles aimed at reducing ESC, although their effects may only become visible in the medium to long term.

4.7.1. Recommendation 7.1: Specification error correction process – Agency questionnaires

One of the justifications for ESC expressed by Infrastructure Managers concerns verifying the potential impact on their network of errors within interoperability specifications that have not been corrected in previous specification versions but are still legally applicable.

The CCS TSI (EU) 2023/1695 has introduced (in section 7.2.10) the obligation for Infrastructure Managers and ETCS on-board manufacturers to describe their products and system implementations with respect to identified situations by answering to Agency questionnaires on specification errors that could prevent normal service.

This mechanism allows Infrastructure Managers to inform, through the RINF[5], of error CRs that may prevent normal service on their network. It is the responsibility of Railway Undertakings - and their ETCS on-board suppliers - to consider this information and implement the necessary modifications to the on-board products. If followed correctly by all stakeholders, this mechanism would make the obligation to conduct ESC less relevant, as compatibility requirements would be directly taken into account - and tested - during the design and certification of interoperability constituents.

The last paragraph of section 7.2.10.3.1 of CCS TSI 2023/1695 states "*The IM shall update -if applicable- the existing ETCS and radio system compatibility checks type (ESC/RSC) (i.e. this shall not lead to the creation of a new ESC/RSC type)*". As the on-board behaviour on identified trackside implementations is known by the IM from the Agency questionnaires, the ESC intended to verify impact of specification errors will not be relevant anymore.

This action is considered for the medium term for the fulfilment of the Agency questionnaires obligation, and for medium to long term for the IM to clean up their ESC based on this.

4.7.2. Recommendation 7.2: Removal of partial fulfilment clause

Another reason for the justification of ESC to date has been a certain lack of confidence in the implementation of all requirements defined in interoperability specifications. Hence, due to uncertainty about what is implemented at the on-board interoperability constituent level, Infrastructure Managers have tended to request tests to verify that the functions implemented in vehicles are those necessary for compatibility with their network. With the removal of the possibility of partial implementation of requirements in CCS TSI (EU) 2023/1695, this type of testing would be less relevant given the obligation to implement all functions at the interoperability constituent level.

[5] Or Network Statement

In providing assurance that products are fully compliant and avoiding opportunities of deviation from specifications, this will help to build greater confidence and consequently to reduce the need for ESC. However, this effect will only truly become visible in the long term since the transition period before the removal of this clause extends until at least 2030 (see CCS TSI (EU) 2023/1695 Appendix B, Table B1.2, line 16).

4.8. Recommendation 8: Strengthen focus on product deviations

With regards to the issues identified during ESC test campaigns (see section 3.1.2), it appears that some manufacturers have conducted ESC test campaigns with a non-compliant CCS subsystem or with deviations to the ETCS system requirement specifications.

These issues should have been detected during the previous laboratory tests (i.e. during the manufacturer's laboratory integration tests).

The ESC tests are not intended to validate compliance with the ETCS system requirement specifications, nor the safe integration of the on-board equipment. This type of issues must be identified during the development phase by applying the CSM regulation and carrying out laboratory tests and must be the subject of an assessment and a safety analysis, positively evaluated by the NoBo and the AsBo of the project.

Safety hazard and product deviations must be identified and corrected before the vehicle is subject to ESC testing.

To prevent these problems from recurring, it is recommended that NoBos and AsBos increase their focus on these kinds of findings when evaluating the on-board subsystem before the vehicle is used to perform tests on tracks. This will have a direct effect on the reduction of ESC tests linked to the verification of such functions.

Another reason cited justifying the ESC concerns the degree of interpretation of ERTMS requirements for both on-board and trackside subsystems. Although this level of interpretation is acknowledged (i.e. managed according to the CCM process), conducting tests so late in the project development cycle – especially when ESC are only verified at the subsystem level with tests on real lines – does not appear to be an optimal measure to dispel doubts about these potential interpretations. Therefore, the purpose of this recommendation is to encourage ETCS on-board suppliers to request Agency advice on discrepancies/deviations or specific design choices related to interpretations on specifications.

Currently, there is a specific framework within which such actions fall – namely the "Chargeable service" – but this framework could be generalized.

This action is considered for medium term to produce a fully compliant interoperability constituents and CCS subsystems, to be applied to the in-progress project and any new projects.

4.9. Recommendation 9: Implementation of continuous training programs

Given the evolving nature of ETCS, it is imperative to ensure that relevant stakeholders are equipped with the latest knowledge and skills. Therefore, the establishment of continuous training programs focusing on interoperability standards (TSI, ESC procedures, …) should be considered. These training programs, which scope could be proposed by Working Group defined in 4.1, would target personnel involved in the design, implementation, and maintenance of ETCS systems, including engineers, technicians, and project managers, with the aim of training people who will have an ETCS ‘system’ view, i.e. experts with both ETCS on-board and ETCS trackside knowledge.

The development of the training courses and the related dissemination activities could be jointly discussed and worked out on medium term. By improving the expertise of stakeholders on interoperability specifications and related processes (for example training of IM staff on SUBSET-076), these programs will contribute to the reduction of ESC issues over the long term.

4.10. Recommendation 10: CCS National rules cleaning-up

It appears that, in some member states, ESC have been notified to verify compliance with national rules. On initial analysis, one could argue that ESC are not intended to verify national rules since these fall under a different legal framework and require involvement of other actors such as NSAs and DeBos.

However, it is also important to consider the reasons for the introduction of the verification of these national rules. In some cases, these national rules have been introduced due to non-compliance of CCS subsystems with certain interoperability requirements or due to the introduction of functions improving the system but not yet harmonized. In these cases, the legal framework should reinforce the obligation to comply with interoperability specifications currently in force, thereby reducing national rules and associated ESC.

This action is considered for the medium term.

4.11. Recommendation overview

The Table 3 gives the overview of the recommendations and details:

- The "**timeframe**" indicating whether the first positive results are expected on short/medium/long term (see §4 introduction for the definition of short/medium/long term)
- The "**involved stakeholders**" amongst Agency, Infrastructure Managers (IM), ERTMS laboratories, ERTMS manufacturers, Railway Undertakings, ERJU System Pillar, European Commission, National Safety Authorities, NoBo and AsBo associations)
- The "**type**" indicating whether the proposed recommendation is a continuation or follow-up of existing measures or processes – in the CCS TSI or other mandatory regulatory framework, the correct application of which could contribute to the reduction of ESC, or whether it concerns new measures to be introduced
- The "**link to the key enablers**" for the ESC phase out ordered by importance in §3.1.6 as a result of the survey:
    1. *More harmonisation in ERTMS trackside engineering*
    2. *Fully CCS TSI compliant ERTMS Interoperability Constituents*
    3. *Full application of error correction process as introduced in CCS TSI (EU) 2023/1695*
    4. *Harmonised test specification for ERTMS track - train integration*
    5. *Authorisation process for ERTMS Interoperability Constituents*
- The "**dependencies**" of the recommendation between one another. When a recommendation ID is indicated, it means that the corresponding recommendation is a prerequisite

Table 3

N°	*Title*	*Timeframe*	*Involved stakeholders*	*Type*	*Link to key enablers*	*Dependencies*
1	**Establishment of a dedicated Working Group**	Short term	All	New	-	-
2	**Harmonized definition of ESC content**	Medium term	All	New	4	1
3	**Guideline for ESC definition**	Medium term	IM, Agency	New	4	1
4	**Harmonised trackside engineering rules**	Medium term	ERJU SP OD, Agency	New	1	-
5	**To review conformity assessment requirements in CCS TSI**	Medium term	Agency, NoBo association	New	2, 5	-
6	**Better coverage of ESC by SUBSET-076**	Medium term	ERTMS lab, IM, Agency	New	4	-
7	**7.1 Specification error correction process – Agency questionnaires**	Medium term	IM and ERTMS manufacturers	Continuation	3	-
	7.2 Removal of partial fulfilment clause	Long term	ERTMS manufacturers, RU, IM	Continuation	2	-
8	**Strengthen focus on product deviations**	Medium term	ERTMS manufacturers	New	2	-
9	**Implementation of continuous training programs**	Medium term	All	New	-	1
10	**CCS National rules cleaning-up**	Medium Term	Agency, NSAs, EC	Continuation	-	-

5. Annexes

5.1. Annex 1 – ESC Survey questions

1.1) Please indicate your profile (NSA, IM, RU, ERTMS IC manufacturer, Other)

1.2) Member State / Country

2.1) Your experience with ESC type ESC-MS-xxx

2.2) Describe the technical compatibility issues between subsystems, or product non-conformities, detected during ESC test campaigns

2.3) Please explain whether the technical incompatibilities detected are linked to the "passed/failed" criteria defined in the check or are linked to other criteria

2.4) Please describe how the technical compatibility issues described above have been solved

2.5) How the detected compatibility issues have been managed in the frame of conformity assessment?

2.6) As Infrastructure Manager, in case you have ESC types, could you explain why you considered that your types are needed to demonstrate technical compatibility of on-board and trackside subsystems in addition to those checks included in on-board and trackside subsystems certificates?

2.7) As Infrastructure Manager, in case you have no ESC type, could you confirm that you consider that no checks are needed in addition to those checks included in on-board and trackside subsystems certificates?

2.8) Your view on ETCS System Compatibility Checks: ESC allow to reveal technical compatibility issues between ETCS on-board and trackside: Item XX

2.9) Please justify or complement your answers from above questions

2.10) Please classify these proposals as key enabler for ESC phase out

2.11) Please detail your ideas on how ESC should be progressively phased-out and/or removed

3.1) On average, what is the duration to obtain a price offer to carry out the ESC?

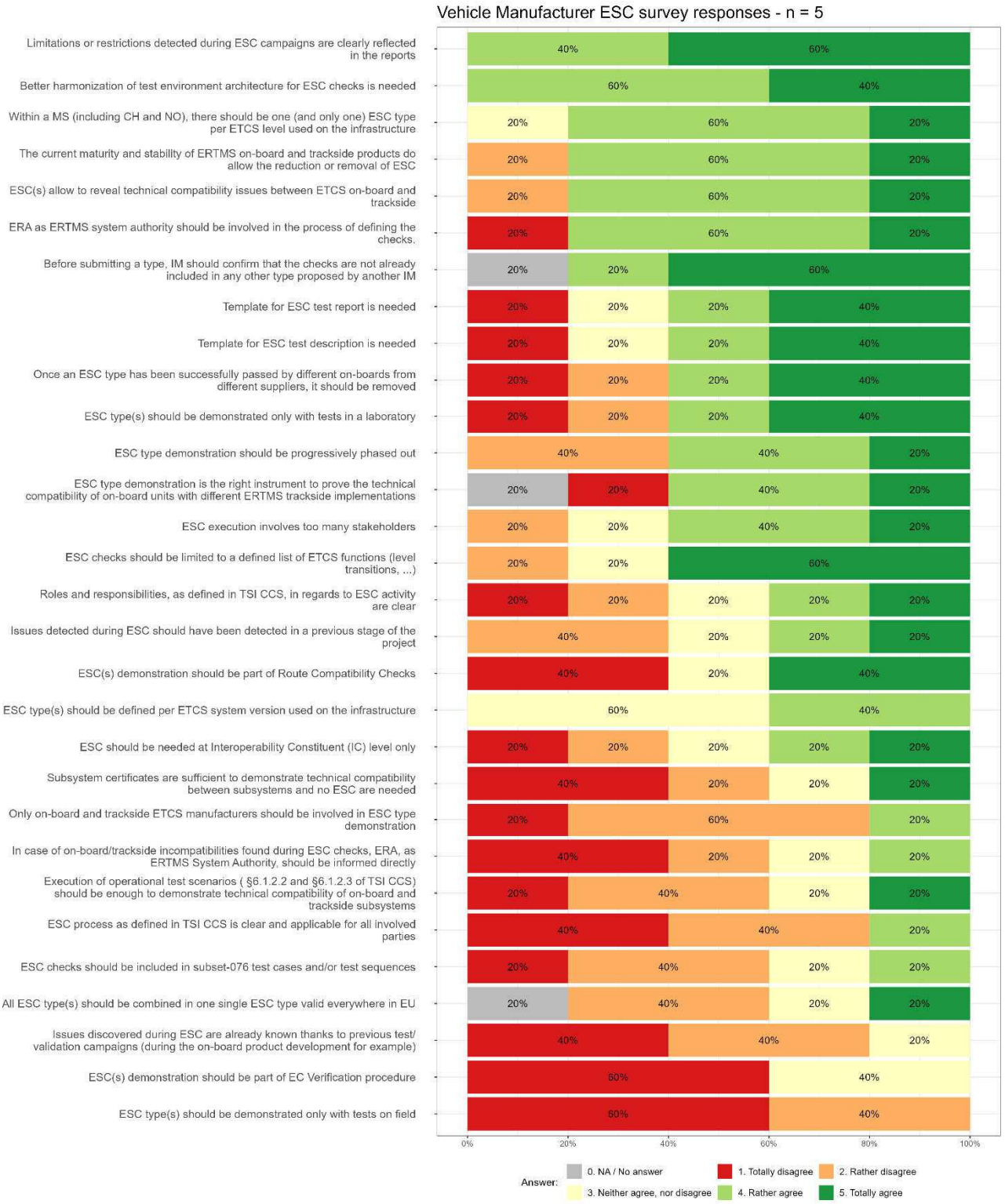
3.2) On average, what is the waiting time to obtain a test slot (field and/or laboratory)?

3.3) On average, what is the duration of ESC campaign from the moment the time slot has been granted and the ESC statement(s) are issued? Please detail.

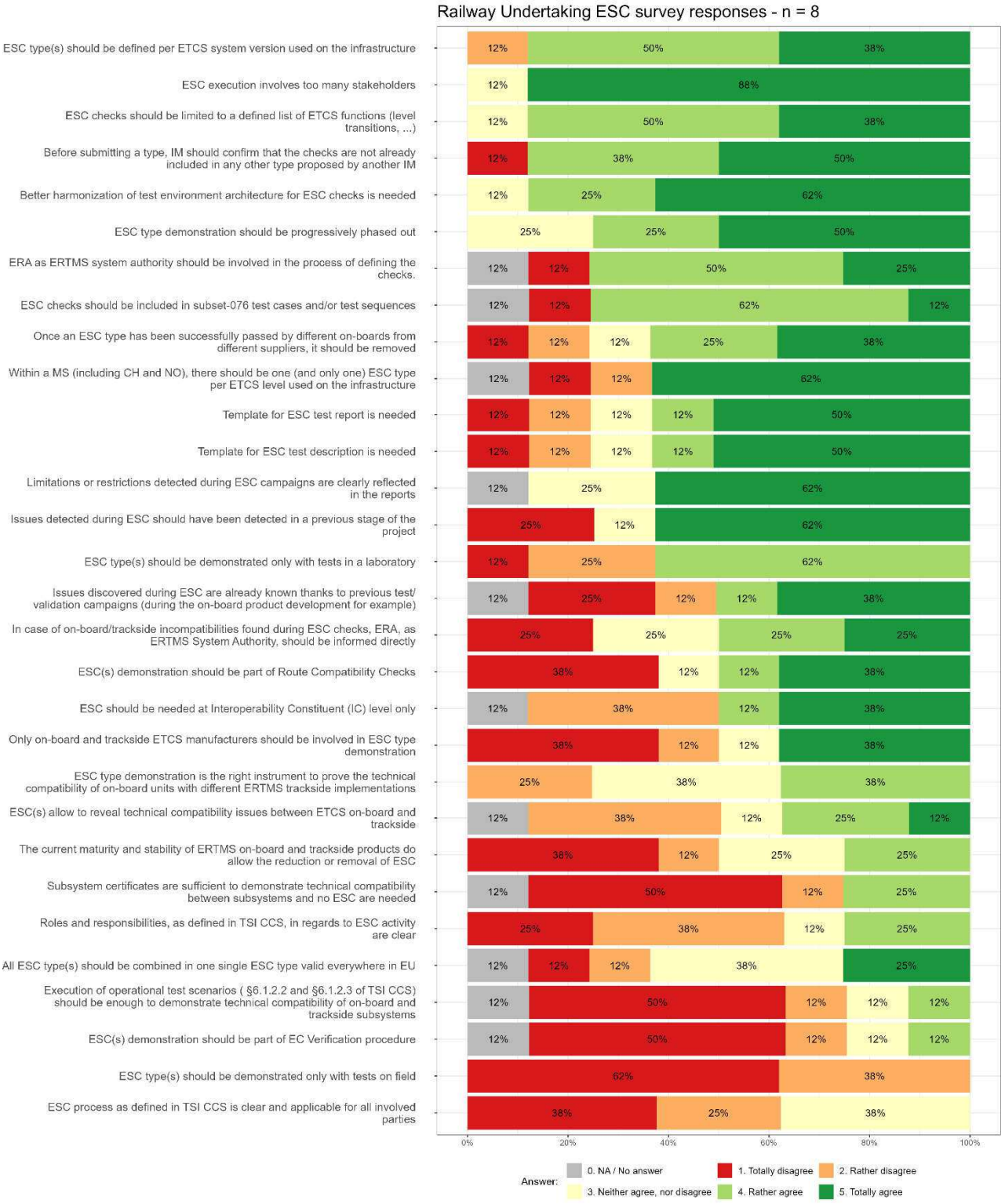
4.1) Could you provide average costs and a costs breakdown for an ESC campaign?

5.2. Annex 2 – Sector view on compatibility checks per profile

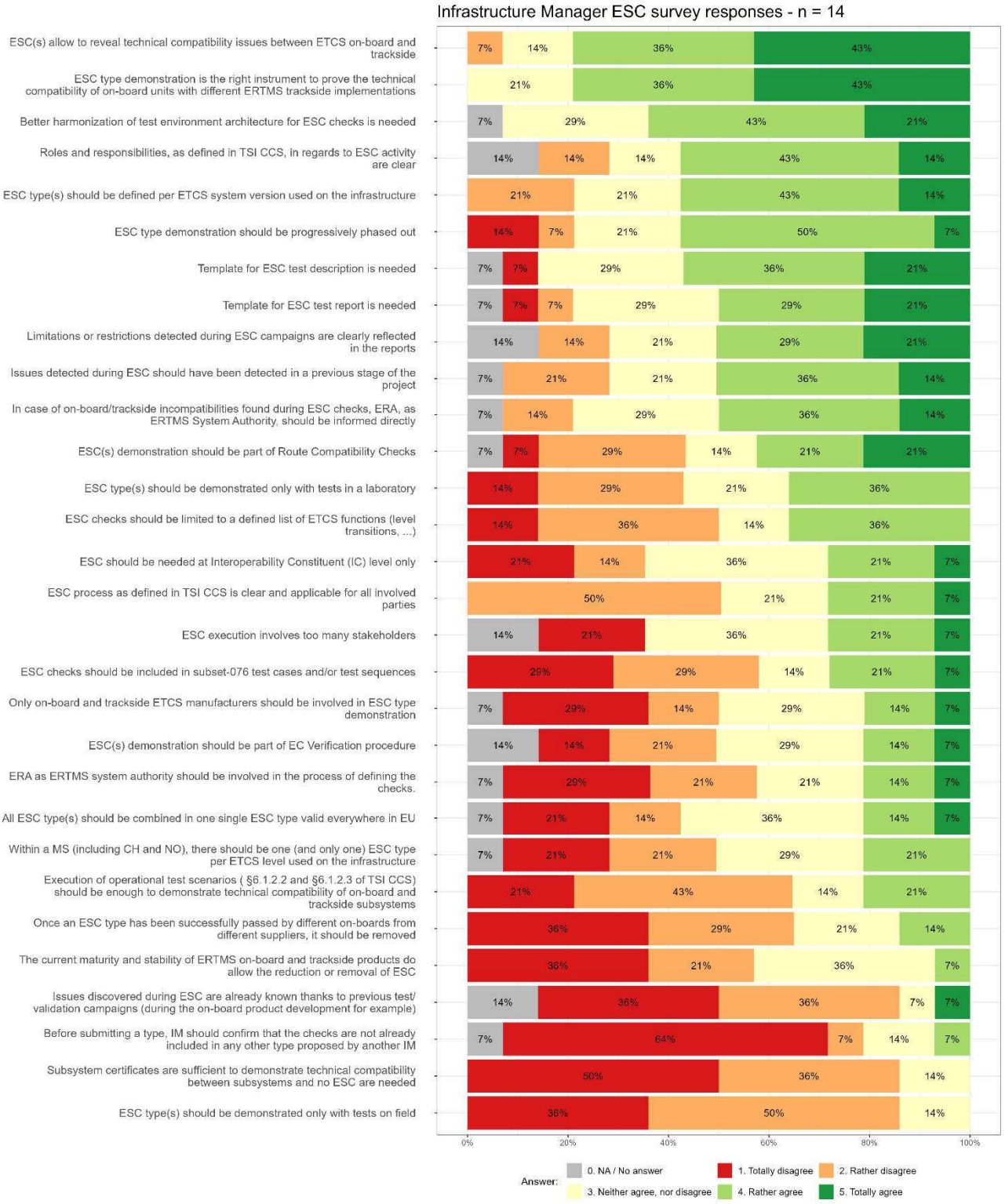
5.2.1. Vehicle Manufacturer



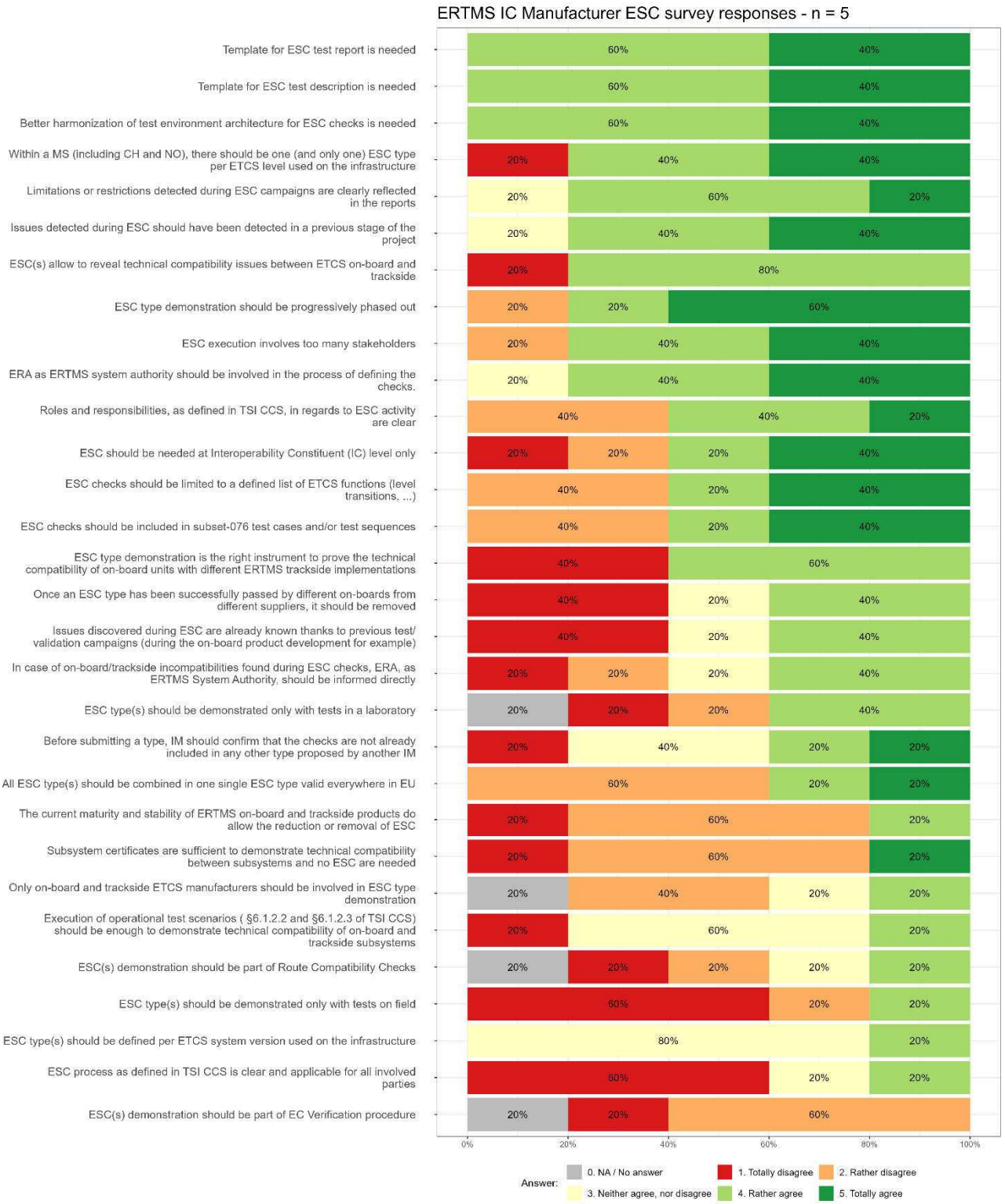
5.2.2. Railway Undertakings



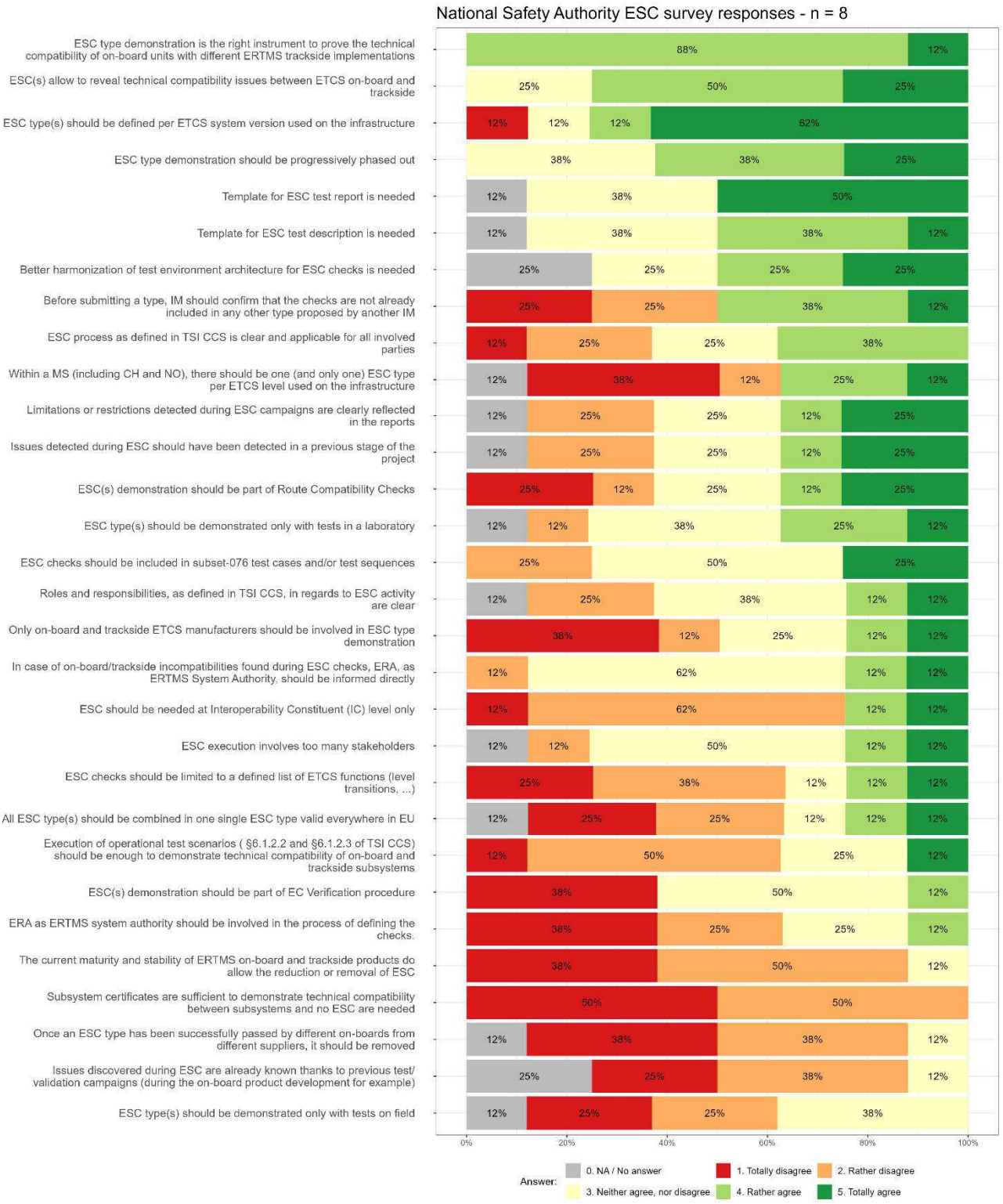
5.2.3. Infrastructure Managers



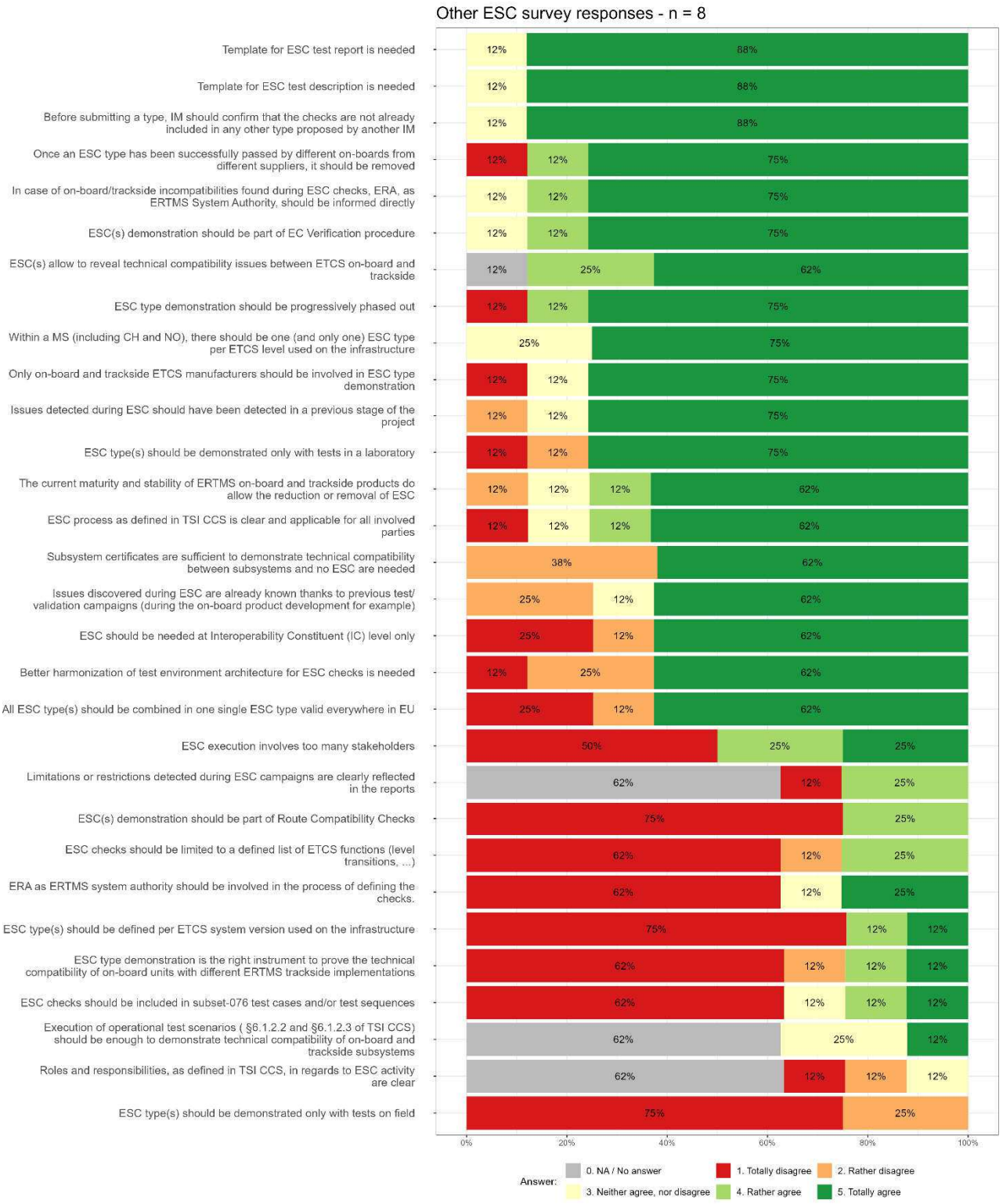
5.2.4. *ERTMS Interoperability Constituent Manufacturers*



5.2.5. *National Safety Authorities*



5.2.6. Others


Other ESC survey responses - n = 8
Template for ESC test report is needed
Template for ESC test description is needed
Before submitting a type, IM should confirm that the checks are not already included in any other type proposed by another IM
Once an ESC type has been successfully passed by different on-boards from different suppliers, it should be removed
In case of on-board/trackside incompatibilities found during ESC checks, ERA, as ERTMS System Authority, should be informed directly
ESC(s) demonstration should be part of EC Verification procedure
ESC(s) allow to reveal technical compatibility issues between ETCS on-board and trackside
ESC type demonstration should be progressively phased out
Within a MS (including CH and NO), there should be one (and only one) ESC type per ETCS level used on the infrastructure
Only on-board and trackside ETCS manufacturers should be involved in ESC type demonstration
Issues detected during ESC should have been detected in a previous stage of the project
ESC type(s) should be demonstrated only with tests in a laboratory
The current maturity and stability of ERTMS on-board and trackside products do allow the reduction or removal of ESC
ESC process as defined in TSI CCS is clear and applicable for all involved parties
Subsystem certificates are sufficient to demonstrate technical compatibility between subsystems and no ESC are needed
Issues discovered during ESC are already known thanks to previous test/ validation campaigns (during the on-board product development for example)
ESC should be needed at Interoperability Constituent (IC) level only
Better harmonization of test environment architecture for ESC checks is needed
All ESC type(s) should be combined in one single ESC type valid everywhere in EU
ESC execution involves too many stakeholders
Limitations or restrictions detected during ESC campaigns are clearly reflected in the reports
ESC(s) demonstration should be part of Route Compatibility Checks
ESC checks should be limited to a defined list of ETCS functions (level transitions, ...)
ERA as ERTMS system authority should be involved in the process of defining the checks.
ESC type(s) should be defined per ETCS system version used on the infrastructure
ESC type demonstration is the right instrument to prove the technical compatibility of on-board units with different ERTMS trackside implementations
ESC checks should be included in subset-076 test cases and/or test sequences
Execution of operational test scenarios (§6.1.2.2 and §6.1.2.3 of TSI CCS) should be enough to demonstrate technical compatibility of on-board and trackside subsystems
Roles and responsibilities, as defined in TSI CCS, in regards to ESC activity are clear
ESC type(s) should be demonstrated only with tests on field
0%
20%
40%
60%
80%
100%
Answer:
0. NA / No answer
1. Totally disagree
2. Rather disagree
3. Neither agree, nor disagree
4. Rather agree
5. Totally agree

5.3. Annex 3 – Overview of the ESC types per country

The Table 4 gives the overview of the number of ESC types per countries (based on TD/011REC1028 v27.0).

Table 4

Country	***Valid ESC***	***Country***	***Valid ESC***
Austria	1	**Latvia**	(no ETCS in service)
Belgium	4	**Lithuania**	(no ETCS in service)
Bulgaria	Not defined	**Luxembourg**	2
Croatia	Not defined	**Malta**	(no railway)
Cyprus	(no railway)	**Netherlands**	23
Czech Republic	2	**Poland**	6
Denmark	2	**Portugal**	(no ETCS in service)
Estonia	(no ETCS in service)	**Romania**	1
Finland	(no ETCS in service)	**Slovakia**	(2 reserved)
France	36	**Slovenia**	Not defined
Germany	2 (1 reserved)	**Spain**	24 (4 reserved)
Greece	No ESC needed	**Sweden**	5 (3 reserved)
Hungary	Not defined	**Norway (non MS)**	2
Ireland	In progress	**Switzerland (non MS)**	3
Italy	22	**United Kingdom (non MS)**	(5 reserved)

Note 1

Regarding Bulgaria, Croatia, Hungary, Slovakia and Slovenia, these countries have lines in operation in ETCS while the ESC has not been notified yet. The Agency has already started consultations with the concerned IM to check whether there is a need for ESC or not.

Note 2

From the number of ESC types, there is a large disparity between countries, e.g. France, Spain, Italy and Netherlands have a large number of types while Germany, Austria, Denmark and Belgium only have a few. As analysed in Table 2, the number of types depends on the national ERTMS implementation plan, either being national wise and therefore with a common set of trackside engineering rules for multiple lines, or being based on isolated lines having different set of trackside engineering rules. Looking at the content of the types, there is also a large disparity concerning to the number and the complexity of the checks included.

Therefore, the overall burden is more linked to the quality, the need and the relevance of the ESC checks, rather than to the numbers of types and/or checks.

5.4. Annex 4 – Overview of the RSC types per country

The Table 5a and Table 5b give the overview of the number of RSC types per countries (based on TD/011REC1028 v27.0).

Table 5a

Country	*Valid RSC voice*	*Country*	*Valid RSC voice*
Austria	1	**Latvia**	Not defined
Belgium	1	**Lithuania**	Not defined
Bulgaria	Not defined	**Luxembourg**	1
Croatia	Not defined	**Malta**	(no railway)
Cyprus	(no railway)	**Netherlands**	No RSC needed.
Czech Republic	(reserved: no RSC needed)	**Poland**	No RSC needed. (NOTE: 1 reserved, to become valid after network migration)
Denmark	No RSC needed.	**Portugal**	2
Estonia	Not defined	**Romania**	1
Finland	(no GSM-R)	**Slovakia**	No RSC needed.
France	1	**Slovenia**	Not defined
Germany	1	**Spain**	3
Greece	No RSC needed.	**Sweden**	1
Hungary	Not defined	**Norway (non MS)**	No RSC needed.
Ireland	Not defined	**Switzerland (non MS)**	1
Italy	No RSC needed.	**United Kingdom (non MS)**	(1 reserved)

Table 5b

Country	*Valid RSC data*	*Country*	*Valid RSC data*
Austria	1	**Latvia**	(no ETCS in service)
Belgium	No RSC needed.	**Lithuania**	(no ETCS in service)
Bulgaria	Not defined	**Luxembourg**	Not defined
Croatia	Not defined	**Malta**	(no railway)
Cyprus	(no railway)	**Netherlands**	No RSC needed.

Country	*Valid RSC data*	*Country*	*Valid RSC data*
Czech Republic	(reserved: no RSC needed)	**Poland**	1
Denmark	No RSC needed.	**Portugal**	2
Estonia	(no ETCS in service)	**Romania**	(reserved: no RSC needed)
Finland	(no ETCS in service)	**Slovakia**	No RSC needed.
France	1	**Slovenia**	Not defined
Germany	No RSC needed.	**Spain**	4
Greece	No RSC needed.	**Sweden**	1
Hungary	Not defined	**Norway (non MS)**	No RSC needed.
Ireland	Not defined	**Switzerland (non MS)**	1
Italy	No RSC needed.	**United Kingdom (non MS)**	(1 reserved)

5.5. Annex 5 – Considerations related to RSC

As shown in the Annex 4, the situation regarding RSC types is quite different from ESC types.

In many cases, no RSC checks are needed, and the Subsystem certificate is sufficient to demonstrate compatibility between the on-board and the trackside.

This is the desired target situation. This can be justified due to the fact that GSM-R is a technology that has been in service since a long time, the products have passed many consecutive design phases which has helped the resolution of the technical issues that appear in the first developments.

For those countries where RSC are needed, there is a reduced number of types: in most cases, there is only 1 type, in other cases a few more (2 to 4 types).

This difference with the number of ESC types is understandable because the GSM-R network is the same for a whole country, and the different types are related to specific network configurations in some lines.

It should be noted that, in some countries which indicate that there are no RSC checks needed for radio data, there are ESC checks for ETCS Level 2 lines that actually include the needed radio checks.

This dependency between ESC checks for ETCS Level 2 lines and RSC-data checks is explicitly indicated in some cases (e.g. in Spain), where the RSC-data checks definition document envisages the possibility of performing the checks together with other tests.

Regarding the types of checks requested:

- In 2 cases, they are limited to documentary checks (no tests requested)
- In 1 case (Romania), there is no GSM-R network in service, but there is an RSC type defined for voice
- In some cases, the efforts for organising the testing requested are very high (e.g. need to mount the cab-radio or EDOR in a test train of a specific IM; need to use specific SIM cards different from those expected to be in the vehicles)
- In other cases, it is mandatory to perform the checks in the track

Several bilateral interviews were done (2 with IM, 2 with RU and 1 with product supplier) with the occasion of the ERTMS Conference 2024 (including the weeks after it) and the following was highlighted:

- There has been only one issue found during the execution of RSC checks, and it was identified as a product issue (which was solved thanks to the testing)
- No additional issues have been found
- The RUs and product suppliers complain about the long time taken by IMs to reply to a request for performing RSC checks, and in some cases, the long delay until the tests can be done (e.g. in one case, over 1 year of delay was reported between the request and the actual date planned for the testing)
- Lab testing is possible only in some cases; but even in those cases, it is sometimes simpler to perform the tests in the track instead of integrating the IC in the laboratory
- For most of the RSC types defined, a subset of the tests defined in the document O-3001-1 is required, but performed with a specific GSM-R network. This means a repetition of the testing is done in different networks, although they may be equivalent.

The main points for improvement noted are:

- The test specifications indicate what to check but not how to check it, therefore, additional documents are needed (either provided by the IM or required to be given by the applicant of the checks)

- The delay for the execution of the tests in lab or in track should be limited to avoid commercial impact to the RUs
- A reduction of tests could be achieved when basing the compatibility check on network configurations (i.e. to consider equivalent types for different countries when they have the same engineering)

5.6. Annex 6 – Mapping table between IM motivations for ESC and the recommendations

The annex aims to establish a mapping table between infrastructure manager motivations of having notified ESC checks (see §3.1.4) and the recommendations to reduce the ESC (see §4).

Table 5

IM motivation from §3.1.4	***Recommendation number from §4.11***
There is no evidence that on-board suppliers have used the ESC checks as an input for their test cases	6 (*)
The CCS TSI technical requirements are ambiguous and lead to different possible interpretations	7.1
To verify that requirements are correctly implemented on-board	5, 6, 7.2
Specific safety features that are used in the ETCS installation are verified	- (**)
The tests performed during on-board/trackside products or subsystems development may not cover all the possible implementations of ETCS	4, 6
Because of on-board certified with partial fulfilment of requirements or with deviations	7.2, 8
ETCS on-board without error corrections	7.1, 7.2, 8
The ESC checks are derived from “lessons learned" with other previous vehicles	8
To test that the on-board behaviour to the specific trackside implementations or to critical functions (like level transitions) is the one expected	4, 5
To cover previous existing train-track integration tests	5, 6
To check the on-board behaviour related to specific ETCS CR that have impact on the considered trackside	4, 6, 7.1
To verify the on-board reaction in specific configurations manipulating the processing times of several subsystems (RBC, interlocking, TTD) and radio transmission and to check if it is compatible with the overall system performance	2, 3, 4

(*) There is no requirement that the on-board test campaign includes the ESC checks as part of the scenarios to be executed.

(**) The safety validation is not the purpose of the ESC checks. No recommendation is therefore linked to this IM motivation.