FP7 Project 2007- Grant agreement n°: 218575

Project Acronym: **INESS**

Project Title: **INtegrated European Signalling System**

Instrument: Large-scale integrating project
Thematic Priority: Transport

Document Title:

INESS_WS E_Deliverable
D.E.1.1_Safety constraints from interfaces_Report

Due date of deliverable	2010.01.10
Actual submission date	20

Deliverable ID:	**D.E.1.1**
Deliverable Title:	**Safety constraints from interfaces point of view**
WP related:	**E1**
Responsible partner:	MerMec
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Contributors:	Ansaldo, S&B, Siemens, Thales, DB, RFI, UIC

Start date of the project: 01-10-2008 Duration: 36 Months

Project coordinator: Paolo De Cicco
Project coordinator organisation: UIC
Revision:
Dissemination Level[1]: CO

[1] PU: Public, PP: Restricted to other programme participants (including the Commission Services), RE: Restricted to a group specified by the consortium (including the Commission Services), CO: Confidential, only for members of the consortium (including the Commission Services).

Document Information

Document type: Report
Document Name: INESS_[WS E]_Deliverable [D.E.1.1]_[Safety Constraints_from_the_interfaces]_[WS Finalised]_Report_Ver [2010-02-08]
Revision: 1.1
Revision Date: 2010-02-08
Author: Giuseppe Saracino (MerMec)
Dissemination level: **CO**

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Document history

Revision	Date	Modification	Author
1.0	2009/12/10	Deliverable first issue	Giuseppe Saracino
1.1	2010/02/08	Language revision	Andrew Stuart

TABLE OF CONTENTS

Glossary

Term	Description
Questionnaire	Document with structured list of questions
Questionee	Person, who completes the questionnaire

Table 1 – Glossary

List of Abbreviations

Acronym	Description
ATC	**A**utomatic **T**rain **C**ontrol
ATO	**A**utomatic **T**rain **O**peration
ATP	**A**utomatic **T**rain **P**rotection
ATS	**A**utomatic **T**rain **S**upervision
BTM	**B**alise **T**ransmission **M**odule
CER	**C**ommunity **E**uropean **R**ailways
DMI	**D**river **M**achine **I**nterface
DoW	**D**escription **o**f **W**ork
DOORS	**D**ynamic **O**bject **O**riented **R**equirements **S**ystem
ERTMS	**E**uropean **R**ail **T**raffic **M**anagement **S**ystem
ETCS	**E**uropean **T**rain **C**ontrol **S**ystem
FFFIS	**F**orm **F**it **F**unctional **I**nterface **S**pecification
FIS	**F**unctional **I**nterface **S**pecification
FS	**F**ull **S**upervision (ETCS mode)
GSM-R	**GSM R**ailway
INESS	**IN**tegrated **E**uropean **S**ignalling **S**ystem
IUPT	**I**nternational **U**nion of **P**ublic **T**ransport
MA	**M**ovement **A**uthority
MT	**M**obile **T**erminal
OS	**O**n **S**ight (ETCS mode)

RBC	**R**adio **B**lock **C**entre
PHA	**P**reliminary **H**azard **A**nalysis
SB	**S**tand **B**y (ETCS mode)
SH	**SH**unting (ETCS mode)
SR	**S**taff **R**esponsible (ETCS mode)
SOW	**S**tatement **O**f **W**ork
STM	**S**pecific **T**ransmission **M**odule
TBD	**T**o **B**e **D**efined
TSR	**T**emporary **S**peed **R**estriction
UIC	**U**nion **I**nternationale des **C**hemins de Fer (International Union of Railways)
UML	**U**nified **M**odelling **L**anguage
UNIFE	**UN**ion des **I**ndustries **F**erroviaires **E**uropéennes (Union of European Railway Industries)
URL	**U**niform **R**esource **L**ocator

Table 2 – List of Abbreviations

Section 1. Executive Summary

This document describes the way of defining and creating a questionnaire in order to collect information from relevant state of the art architectures in projects or signalling systems involving ETCS.

Section 2 shows the considerations, making of and distribution of the questionnaire, completed by description of collecting data and first findings.

Safety related data is analysed. Similarities and differences are shown graphically. Conclusions are derived from the evaluation of questionnaire data.

Section 2. Introduction

2.1 Task E.1.1 Make Questionnaire

The Workstream-E questionnaire was created, agreed-on and distributed by members of work package E1, to suppliers and railways participating in INESS. After that, returned feedback was collected, analysed and documented in three defined documents of work (D.E.1.1 – D.E.1.3). This deliverable is the first one of those reports (D.E.1.1).

Initial Requirements

In order to maximize the quality of feed back, following requirements were placed on the questionnaire:

- Questions in the questionnaire focus on interfaces compliant with the given question's hierarchical structure;
- Questions have been defined in a systematic manner in order to assure comparability and minimize efforts in the analysis phase;
- Answering is to require minimal effort, in order to motivate questionees to participate, but care must be taken to preserve a certain degree of freedom to avoid the forcing toward "fixed answers";
- Questionnaire simple structure leads the questionee's effort to be focused on the answers and not on interpreting the questionnaire;
- Questions have been created on the basis of a common and established European understanding, to avoid any misunderstandings;
- Questions have been defined to facilitate the forthcoming tasks of work stream E and not go unnecessarily deeply into technical details;
- Questions are precise and clear, to avoid any possible mismatch of answers which would complicate next analysis.

Questionnaire Structure

To build an easy to answer questionnaire it was decided to use excel as tool. This will provide the questionees with maximum support.

The questionnaire was built on a base of macros, that hide unnecessary sub questions where they don't apply. Checkboxes are used where ever possible. In some cases textual information was asked to get an idea of underlying system (e.g. fallback information).

An initial look at questionnaires showed problems with the excel macros. In some questionnaires, a question's sub section was not opened automatically the by macro.

Hence, it was sometime not possible to fill in answers. One cause was the page protection in combination with macros. Another was the use of an older excel version. This problem was solved by distributing the unprotect password and repeating the questionnaire.

To have a common understanding of interfaces (that form the main part of the questionnaire) it was agreed to use the architecture defined in European research project Euro-Interlocking release 8.0. There interfaces are linked to interlocking system specifications in this Project, consisting of the interlocking kernel and control module.

The following figure summarises the assumptions made around the interlocking interfaces and project boundary:

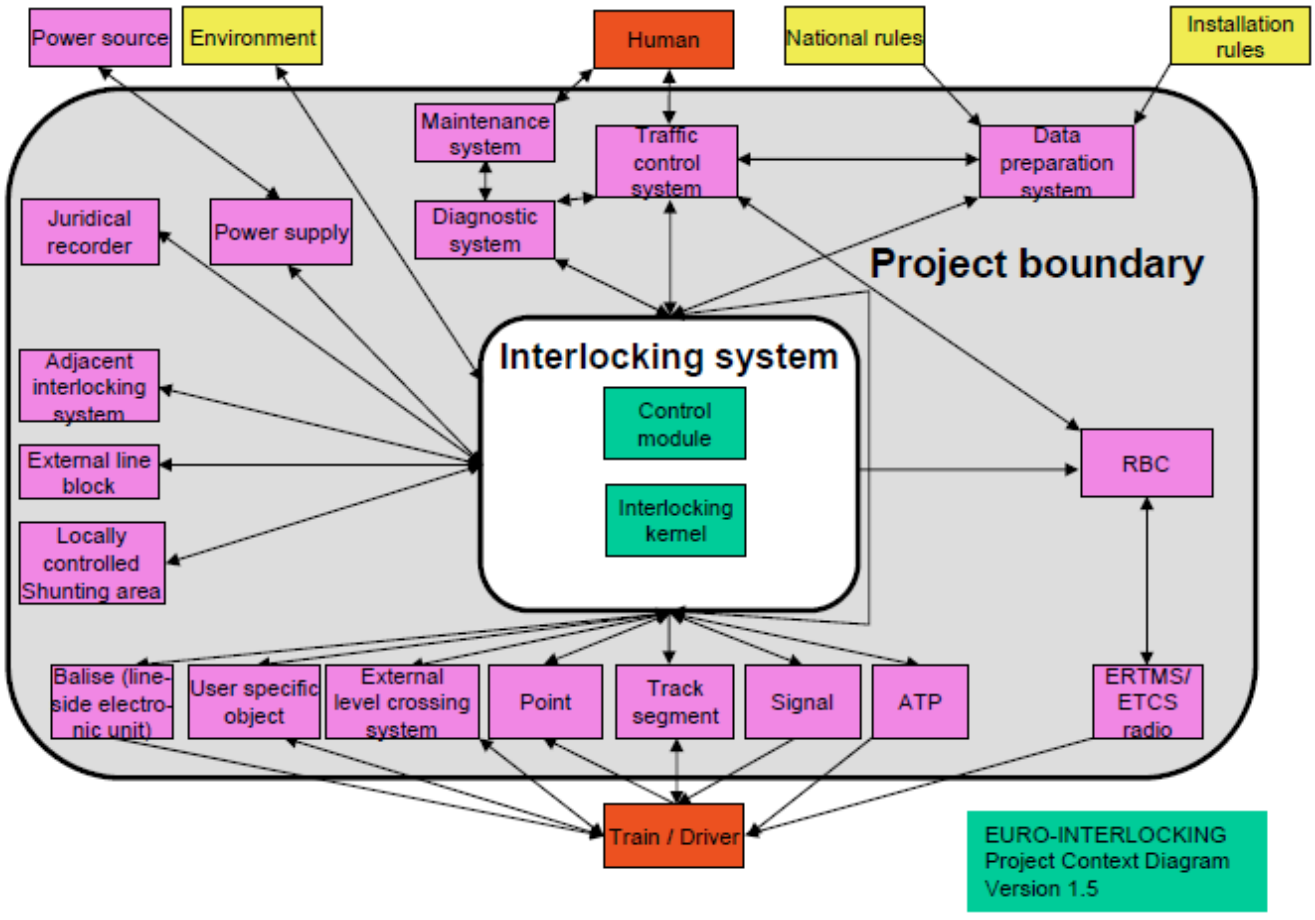


Figure 1 – Euro Interlocking Architecture (8.0)

The agreed Euro Interlocking structure suggested structuring the questionnaire by "*question groups*". These groups were elaborated by additional questions to meet the given goal of Workstream-E.

The WS E- Questionnaire structure is as follows:

A. General questions

B. Trackside Interfaces

1. Locally controlled shunting area
2. Balise (LEU included)
3. User specific object
4. External level crossing
5. Point
6. Track segment
7. Signal
8. ATP

C. Other Interfaces

9. Adjacent interlocking
10. Juridical recorder
11. Power supply
12. Diagnostic system
13. Traffic control System
14. Data preparation system
15. RBC
16. External line block

D. Fallback methods

E. Migration strategy

F. Project information

Considerations

1) *Precise and Non-generic Questions*

   In order to get clear and precise information, the work package team decided not to ask for signalling technology in general. This was to avoid broad and wide ranging answers with unclear preconditions. To scope the technology, questionees were advised to use electronic interlocking technology as the basis of questionnaire.

2) *Answer based on Real Life Systems*

   In order to get credible information, the work package team decided to ask for a dedicated project in operation or, if not possible, in installation. This was to support the involved organizations to address a clear contact person as questionee. Otherwise it would be

difficult for an organization (suppliers and railways alike) to find a person able to answer the questionnaire.

3) *Guideline for Project Selection*

In order to obtain information matching the questionnaire requirements, the work package team decided to ask for projects with an interlocking – RBC interface. This was to elicit information regarding realized or about to be realized interfaces concerning interlocking and ETCS that work package E1 is asking for.

With structured and considerations defined as above, two members of work package team generated a draft of the excel file. Thanks to Leo Gossen (LG / Scheidt & Bachmann) and Michiel Lim (LM / ProRail).

This draft was distributed, discussed and completed by WP Members during WS E Meeting 2 on June 25th 2009. The part of the questionnaire dealing with fallback and migration, authored by Martin Voiton (MW/TUBS), was proposed at that meeting and later commented and agreed by WP members. Finally, MW sent an updated version of the fallback and migration section of the questionnaire to LG/LM for integration with the main questionnaire and final review.

After rework and release, the questionnaire was ready for distribution on July 20th 2009.

Reference URL to final version of Questionnaire on Myndsphere site is:

https://www.myndsphere.com >> Collaboration Group Memory >>Projects >> INESS >> Documents >> WS E >> WP E.1 >> WP E.1 Other technical documents >> questionnaire E1 formula draft 2 xls

The questionnaire consists of about 20 excel sheets, each sheet with about 8 questions and roughly 3 possible answers to each question. The whole questionnaire contains about 160 questions and 500 possible answers taking approximately 1,5 hours required to be completed.

To avoid any Excel problems (e.g. mismatch Excel versions, languages and macros), the questionnaire was published and distributed in parallel as an Adobe Acrobat Reader pdf file.

2.2 Task E.1.2 Collect Information

In order to exploit the summertime for participants to complete the questionnaire, it was released in the very early third quarter of 2009. At this stage it was already clear, that a second phase of questioning might be necessary to clarify potential open issues or late arising questions.

Distribution

Questionnaire distribution for work package members was planned to be done by questionnaire author Leo Gossen by July 20th 2009 via mail and was duly completed.

The UIC, represented by Florian Lesné, distributed the questionnaire to the other INESS-members not forming part of WP.E1 and to the umbrella railways. It was requested that each questionnaire was to be completed and sent to WP.E1 (LG/ML) before the end of September 2009.

Dead line for Questionnaire

Completed-questionnaires were requested to be returned to WP E1 Members Leo Gossen and Michiel Lim before the end of September 2009.

Participants

Distribution was mandatory for INESS Members, because member organizations are committed to participate in elaborating existing data.
The questionnaire was sent to the following WP E1 Members (suppliers and railways). In addition, it was planned to involve additional INESS or UIC members and Umbrella Railways.

These are listed in the table below:

Short name	Name	Type	Short description
ADIF	ADIF	Railway	Spain – Railway Administrator
Ansaldo	Ansaldo STS	IND	Italy – Industry – Supplier
AZD	AZD Praha	IND	Czech – Industry – Supplier
BBR	BBR	SME	Germany – Industry – Medium-sized Supplier
BT	Bombardier	IND	UK – Industry – Supplier
BV	Banverket	Railway	Sweden – Rail Administrator
DB	DB Netz AG	Railway	Germany – Rail Administrator
Mermec	Mermec	SME	Italy - Industry – Medium-sized Supplier

NR	Network Rail	Railway	UK – Railway Administrator
Nucleo	Nucleo de Comunicaciones y Control, S.L.	IND	Spain – Industry – Supplier
ProRail	IND	IND	Netherlands – Rail Administrator
RFI	RFI	Railway	Italy – Rail Administrator
S&B	Scheidt und Bachmann	IND	Germany – Industry – Supplier
Thales	Thales	IND	Germany – Industry – Supplier
TIFSA	TIFSA	Other	Spain – Consultancy and Engineering Company
TUBS	TUBS	University	Germany – Technical University - Braunschweig
UIC	UIC	Other	

Table 3 – E.1 Questionnaire Participants

Feedbacks

Participant organizations returned the completed questionnaire as requeted. This was done, without exception, using the Excel file. In total 14 answers were received. The following organizations returned questionnaires (in alphabetical order):

ADIF	Ansaldo	AZD	BBR
Bombardier	BV	DB	Mermec
NR	Nucleo	ProRail	RFI
S&B	Thales		

All filled questionnaires are stored in INESS project documentation system Myndsphere. Results can be accessed under the following link:

https://www.myndsphere.com » Collaboration Group Memory » Projects » INESS » Documents » WS E » WP E.1 » WP E.1 Other technical documents » Filled Questionnaires

The list of projects covered by the assessment, are as follows:

1. **High Speed Line Madrid - Valencia**
2. **High Speed Line Milano - Bologna**
3. **ETCS Pilot Project Poricany - Kolin**
4. **Answers are based on multiple projects**
5. **Amsterdam-Utrecht**

6. **Haparandabanan**
7. **POS**
8. **High Speed Line: Rome - Naples**
9. **Cambrian Early Deployment Scheme (EDS)**
10. **Monforte-Orense**
11. **Betuwroute**
12. **High Speed Line: Milano - Bologna**
13. **Kurhessenbahn**
14. **Saarbrücken as part of Project "POS Nord" DB AG**

Questionees were asked to answer in relation to an existing electronic interlocking in operation, where an RBC interface is present, where possible. Descriptions of chosen installations, geographical distribution and assignment of system interfaces to the Euro Interlocking structure is shown in next Section 3. Safety Constraints.

Lessons learned

Some critical points were discovered and resolved during the feedback phase are listed below :

- In some cases, the normalization of specific information by check boxes forces a simple yes or no choice, with the consequence of losing information. This approach make the master table compilation simpler, but gives no room for specific and detailed information. In the analysis phase, this loss of information has been considered in order not to misinterpret questionnaire information.
- Some suppliers and railway have chose, coincidentally, to answer the questionnaire regarding the same project. Moreover, this information should match, but did not correlate well. After discussing this with the two affected participants, their interpretations were harmonised to a more consistent result. The lesson learnt from this was, that even with a clear questionnaire structure (mostly multiple choice), a well defined architecture and a dedicated installed project, there is still considerable room for interpretation.
- Extracting information from the questionnaire and deriving common answers for European Interlocking, must be done very carefully.
- Even with the given European interlocking structure, ambiguity surrounding some interfaces was still possible: e.g. it was not clear how to apportion the radio infill balise given in the Euro Interlocking context.

Refinements on Questionnaire

To maximise the quality of questionnaire data, the WP team decided to request some additional clarifications and to start a second round of questions. This decision also gave the WP team the opportunity to get some further information from additional questions. A new round of questionnaires was done via email, with the intention of updating the existing filled questionnaire.

The following aspects were clarified:

- Information about the interface to Euroloop was put in ATP sheet;
- Information about the interface to Radio Infill Units was put in the user specific objects sheet.

The following questions were added, in order to obtain further information:

A. About intelligent Interfaces

1. Which information is exchanged via intelligent interfaces?
2. Are there any special timing requirements for these interfaces?
3. If yes, what are their performance requirements?

To have a better idea of system apportionment (centralization and decentralization), geographical distribution and its effect on interfaces, safety and migration, some special information for system descriptions was requested:

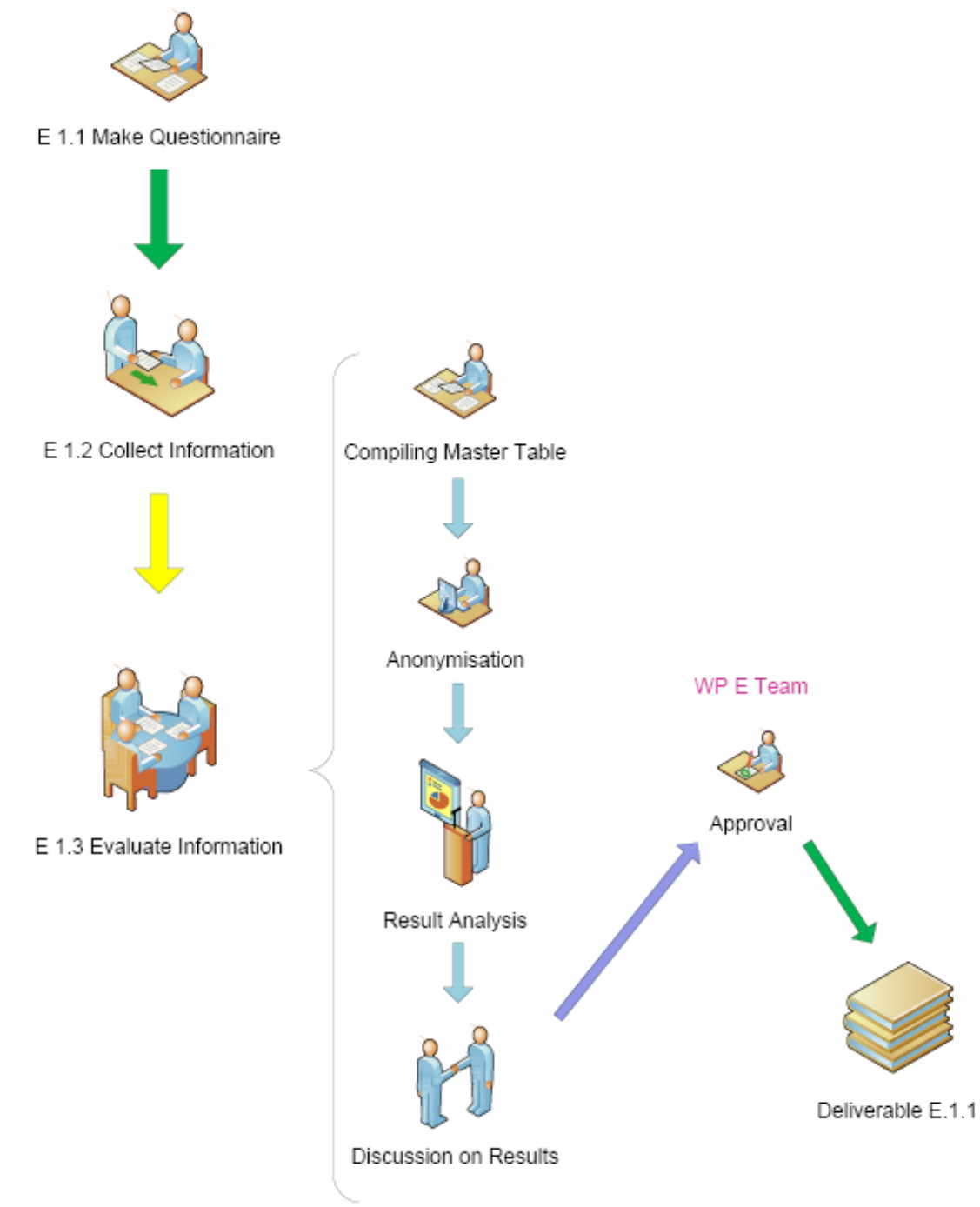
B. System description enhancements

1. Provide a picture of the System architecture, with the different sub-systems that are part of the interlocking described in the questionnaire
2. Add a brief description of each sub-system
3. Add a mapping between the questionnaire's generic interlocking (Euro-interlocking) and the interlocking described in the filled questionnaire (project's interlocking)
4. Add an indication if the subsystems have safety requirements or not and if applicable which SIL level
5. Provide a picture of the Project layout with the different parts of the interlocking and their geographical distribution (distances between the different elements)

The second round of questions was opened immediately after the third WP meeting. To ensure enough time was available for advanced analysis and updating of all the deliverables of work, a deadline for the second round was fixed at 15th of November 2009. Questionees were asked to upload a new release of filled questionnaires to Myndsphere by substituting the older version.

2.3 Task E.1.3 Evaluate Information

Analysis of collected information is only based on questionnaire data, so evaluation of information has been done exclusively on the Project's Work described by filled questionnaires. The E 1.3 analysis process follows steps shown in the next figure:



Details about each step are reported in the following chapters/paragraphs:

Compiling Master Table

During the first phase of the data evaluation task, data coming from all questionnaires uploaded in Myndsphere needs to be prepared for easier comparison and management, so a master table was compiled.

For each Excel sheet in the Questionnaire, all questionee's data was page-wise aligned in columns. In the first step, this task was done for all trackside interfaces (B.) and all other interfaces (C.) and all description pages. Later, MT compilation was completed for the entire questionnaire's structure, covering general question class (A.), fallback methods (D.), migration strategy (E.) and project information (F.).

The final version of WP E.1 Master Table has been stored in the INESS project's documentation repository system: Myndsphere. It can be accessed under the following link:

https://www.myndsphere.com » Collaboration Group Memory » Projects » INESS » Documents » WS E » WP E.1 » WP E.1 Other technical documents » Filled Questionnaires » Mastertable_01P01_GS_091202.xls

Anonymisation

In order to maintain an open atmosphere, work package members agreed to depersonalise any specific user collected data. Therefore, results have been depersonalized before analysis, i.e. names and organizations have been hidden. Hence, grand-totals or semi-totals are calculated to permit later elaboration phase. Hence, it has been guaranteed that no supplier or railway information can be derived on basis of the analysis documentation.

Note: nevertheless classifications, like supplier and railway are still acceptable and might be still used in the analysis phase.

From this "anonymisation task", for each original sheet in the Master Table, an additional sheet has been created, usually named "<original_sheet_label>.1", which is linked with the original one and containing non-anonymous data.

For example, the "1.LSA" sheet in trackside interfaces class is now followed by an additional sheet named "1.LSA.1" containing anonymous data about "Locally controlled Shunting Area", arranged in a suitable manner to be used in next analysis step.

Results Analysis

After the 'anonymisation' phase, in each 'additional' sheet, a set of analysis results have been obtained using the available data.

Resulting from this "result analysis", for each original sheet ■ in the Master Table, an additional sheet has been created, usually named "<original_sheet_label>.2" ■, which is linked with both the original

sheet and the relevant sheet named "<original_sheet_label>.1" ■ containing anonymised data. This new sheet groups all graphics obtained from the two previous sheets during this analysis phase.
For example, the "1.LSA" sheet (in light-blue) in trackside interfaces class is followed by a sheet named "1.LSA.1" (in yellow) containing anonymous data and by another sheet named "1.LSA.2" (in red colour) with all results analysis' graphics about "Locally controlled Shunting Area".

The final version of this WP E.1 "Enhanced" Master Table has been stored in the INESS project's documentation repository system: Myndsphere. It can be accessed here:

https://www.myndsphere.com » Collaboration Group Memory » Projects » INESS » Documents » WS E » WP E.1 »WP E.1 » WP E.1 Drafts of deliverables & milestones

The analysis phase of results described below, with the results being shown in the next Section 3 where the Safety Constraints are presented using both textual and graphical representations.

A. General questions

The "General Questions to IXL" sheet in the Questionnaire and Master Table worksheet file refers not to single projects (one of those interviewed), but instead to each Country or Railway Administration. It covers 3 main arguments: 1) the use of different IXL system architectures, with details about the number of architectures and the reasons cited for this, 2) safety related performance requirements in Interlocking Interfaces and 3) the use of standard safe protocols for IXL external interfaces. Questionnaire was structured to obtain information so that the data can be grouped and published as follows:

a. Use of different IXL architectures

To report about the use of different IXL system architectures in each 'interviewed' Country.

b. How many different IXL Architectures ?

To report the number of various IXL architectures (old and new) that are actually used and in operation.

c. Reasons for Heterogeneity

There may be a lot of different reasons leading to a new system IXL architecture: it may be due to different IXL System suppliers, and/or because of new requirements and/or due to of different line categories (main rail line or regional lines) to be applied.

d. Advantages of IXL Architectures Heterogeneity

Here all **advantages** (if any) emanating from IXL Architecture Heterogeneity are listed: if heterogeneity saves money, or makes IXL solution prices more competitive/comparable, if it permits (new) requirements to be fulfilled, or if it is more suitable for a specific application/line.

e. **Disadvantages of IXL Architectures Heterogeneity**

Here all **disadvantages** (if any) emanating from IXL Architecture Heterogeneity are listed: if heterogeneity costs money, or makes IXL solution prices less competitive/comparable, or if it makes IXL systems cross-incompatible.

f. **Safety Performance Requirements (max time to rise)**

Regarding the accepted **IXL time of reaction** (to IXL Operator), 3 quality levels have been identified: “less or equal to 1 second”, “less or equal to 2 seconds” or “more than 2 seconds”.

g. **Which IXL Data Communication Safe Protocols ?**

To know about the use of **Proprietary** or **Standard** IXL Data Communication Protocols in each ‘interviewed’ Country.

h. **What about the use of Open Network Safe Protocols (EN 50159-2 compliant)?**

More specifically, to know about the use of **Proprietary** and/or **Standard** Open Network Safe Communication Protocols in each ‘interviewed’ Country. Note: IXL Open Network Safe protocol means that the protocol stack is complaint with CENELEC 50159-2 norm.

B. Trackside Interfaces

For each trackside element interfaced to by IXL Systems (i.e. locally controlled shunting area, balise, user specified objects, external level crossing, point, track segment, signal, ATP and external line block) following information was analysed and published:

a. **Use of**

To report about the effective use of this class of trackside elements in all evaluated projects.

b. **Intelligent/Not Intelligent**

Examples were used to help avoid misunderstanding between “term used to identify” and “effective functionalities of”.

c. **Exchanged Data (from and to IXL)**

To identify what data is usually exchanged between the class of trackside element and the IXL System and differentiated by the flow direction (input/output).

Data exchanges have also been differentiated, depending of the kind of trackside element (Intelligent/Not Intelligent).

d. **Safety Apportionment**

To report on safety apportionments in IXL System and to identify where safe functions for each class of trackside elements are executed.

C. Other Interfaces

For each element classified as “other interfaces” to IXL Systems (i.e. adjacent interlocking, juridical recorder, power supply, diagnostic system, traffic control system, data preparation system, and RBC) a number of questions were requested of IXL Suppliers and Rail Managers. They are listed below:

a. Adjacent Interlocking system

Adjacent Interlocking system interfaces

To report about the current interfaces used with adjacent interlocking systems: if only **relay interfaces** or only **data communication channels** or both.

Types of adjacent Interlocking systems

To report about the current types of adjacent interlocking systems used: if line block systems, or electronic IXL from same supplier or other types of systems.

Same interface of line block systems ?

To query whether the interface which is similar to that used in line block systems.

Exchanged information

To report what kind of information is usually exchanged with adjacent interlocking systems.

Do IXL borders fit with operational borders ?

To understand any correspondence between interlocking borders and operational ones.

b. Juridical Recorder

Use of

To report about the effective use of juridical recorders in all interviewed projects.

What data needs to be recorded ?

To report what data is required to be recorded by juridical recorders in all evaluated projects.

Do you have time synchronization on data recording ?

To query whether there is time synchronization between the juridical recorders and other systems for all interviewed projects.

Which data gathering channels are used?

To report which channels are used to collect data by juridical recorders in all interviewed projects.

JRU Remote Access support

To report about the use of (or requirement for) remote access functionality in juridical recorders used in all interviewed projects.

What are JRU available channels for Remote Accessing ?

For each IXL project where remote access functionality is provided, to understand the nature of all the available channel(s) to access juridical recorder data.

Who is the JRU supplier ?

To report who is the supplier of juridical recorder unit.

Who is able to analyze data from JRU ?

To identify who is able or who has the responsibility of the JRU data analysis activity when IXL System is in normal operation (i.e. except in case of accidents): whether it is the supplier of IXL system, or only railway infrastructure manager, or both or a third party.

Who is authorized to analyze JRU data in case of accident ?

To identify who is authorized to analyse JRU data following an accident: the same responses as the previous question were offered plus an ISA Assessor and/or an Rail Regulation Office member.

Is failure of JRU reported ?

To know what happens in case of a failure of juridical recorder itself: is the failure reported or not and by which alarm data communication channel; if via a diagnostic channel, or via IXL itself, or otherwise.

c. Power Supply

Traction Power Supply

To query the use and characteristics of traction power supply in each interviewed project and to identify differences between various countries and/or railway infrastructures.

External Sources Power Supply

To report the characteristics of external power sources available in each interviewed project and/or railway infrastructure to supply power to IXL systems and signalling.

Has your IXL Project Redundancy on Power Sources?

To know whether redundant external sources are available in each interviewed project and/or railway infrastructure to supply power to IXL systems and signalling.

Is there any restriction on running on the fallback power supply ?

To report any restrictions (if any) when the system falls back to the redundant power supply system.

Is Energy Saving possible ?

To query on energy saving options available in “interviewed” IXL projects.

Who is the supplier of the external power supply ?

To report about the supplier of external energy: if it is an external energy company, the infrastructure provider, and/or a mixed configuration of power supply coming from both.

Trackside Elements Power Supply

To report the use of different power supply types (voltage, frequency, …) for each trackside element interfaced to IXL Systems, i.e. Signals, Train Detection (Track Circuits or Axle Counters), Switch and Point Heating, etc.

Who is the Supplier of the Power Supply (for IXL/Trackside Elements)

To report who provides the power supplies to IXL Systems and trackside elements used by it: the supplier of IXL system, or the infrastructure provider, or third party.

Does the Power Supply contain a battery or UPS ?

To query whether battery or UPS is available in Power Supply systems for all “interviewed” IXL projects.

What is the expected backup time the Power Supply contain a battery or UPS ?

In the cases where a battery and/or UPS is available, what is the expected backup time (Max, Min and Average values).

d. Diagnostic System

Does the IXL have a Diagnostic System ?

To report about the use of diagnostic systems in all evaluated IXL projects.

Is the Diagnostic System the same for all subsystems (IXL, TBC, TCS, …) ?

To know if the diagnostic system used is applied to all subsystems (IXL, RBC, TCS, …) or not.

What Data is recorded (required to be managed) by Diagnostic System ?

To report what data is required to be managed by diagnostic system in all evaluated projects.

Does the Diagnostic System support Remote Access ?

To know about the use of (or requirement for) remote access functionality in Diagnostic Systems used in all interviewed projects.

What are Diagnostics available channels for Remote Accessing ?

For each IXL project in which remote access functionality has been provided, what are the channel(s) available to access diagnostic data.

Is the Diagnostic System connected to a Maintenance System ?

To report on the integration between Diagnostic systems and Maintenance system (if any) used by Infrastructure Managers.

What are the channels available for Diagnostic/Maintenance Link ?

For each IXL project in which integration between Diagnostic and Maintenance systems has been provided, to report all the channel(s) available to interface between those Systems.

Who operates the Maintenance System ?

To understand who is the user of the Maintenance System: if it is the supplier of IXL, the railway Infrastructure provider or a third party.

Is failure of the Diagnostic System reported ?

To know what happen in case of a failure of the Diagnostic System itself: if failure is reported or not.

By which channel(s) Diagnostic system's failures reporting is done ?

To know which alarm data communication channel is used in case of a failure of the Diagnostic System itself: if failure is reported via TCS, via Maintenance System, via SMS and/or e-mail or simply via the IXL itself.

Is Diagnostic System compliant with EuroInterlocking 8.0?

To query about the compliance of the Diagnostic System to EuroInterlocking 8.0 specifications.

e. Traffic Control System (TCS)

How is the IXL operated ?

To know how the IXL operator can issue commands to the IXL system: if through a separate TCS, or using a dedicated Man Machine Interface.

What type of information is exchanged (TCS -> IXL) ?

What kind of information is usually exchanged between the Traffic Control System and Interlocking in the direction TCS to IXL: so we are considering various types of commands to Trackside elements and block systems, and also commands to internal IXL routes.

What type of information is exchanged (IXL -> TCS) ?

What kind of information is usually exchanged between Traffic Control System and Interlocking in the direction IXL to TCS: so we are considering various types of controls status from Trackside elements, trains and block systems, and also controls from internal IXL logical elements or routes or even power supply and diagnostics.

Is the train dispatcher allowed to issue safety critical commands ?

To query whether the train dispatcher can issue safety critical commands in “interviewed” IXL projects.

By which system all safety critical commands are issued ?

To know from where safety critical commands to IXL System could be issued in each “interviewed” projects: via a separate TCS or a dedicated MMI.

Where is the TCS located with respect to the IXL system?

To locate the TCS (if any) with respect to the IXL System: at the same station/location or at a centralized position.

Where is located each MMI of IXL system?

To locate all Man Machine Interface(s) (if any) with respect to the correspondent IXL System: at the same station/location or at a centralized position.

f. Data Preparation System

Is Data Preparation results exchange performed by means of transfer of file(s)?

To query what transfer medium is used to exchange data preparation information.

Who takes care of Data-Prep consistency ?

To who is responsible for the consistency of data preparation information: the supplier of the IXL system, or infrastructure provider, or a third party.

Who prepare the Data?

To obtain information about who actually prepares the system data: the supplier of the IXL system, or infrastructure provider, or a third party.

Who checks Data-Prep ?

To obtain information about who checks the data preparation results: the supplier of the IXL system, or infrastructure provider, a third party or an independent safety assessor (ISA).

g. Radio Block Centre (RBC)

How many IXLs for each RBC?

To report the typical number of IXLs covered by a single RBC: if there is a 1:1 correspondence between IXL and RBC, or if 2 IXLs control the coverage area of 1 RBC, or if usually there are 3 IXLs for each RBC, or if there are 4 or more IXLs for each RBC in each ERTMS application which has been interviewed by INESS WP E Questionnaire.

Where is located the RBC system?

To locate the RBC (if any) with respect to the IXL System: at the same building as the IXL, or if at a distance less or equal to 10 Km, or at a distance of between 10 and 20 Km, or at a distance of between 20 and 50 Km, or at location more than 50 Km.

What type of information is exchanged (RBC -> IXL) ?

To report the kind of information that is exchanged between Radio Block Centre and Interlocking in the direction RBC to IXL: so we are considering various types of information about trains and issued MA.

What type of information is exchanged (IXL -> RBC) ?

To report the kind of information that is exchanged between Radio Block Centre and interlocking in the direction IXL to RBC: so we are considering various types of controls status from Trackside elements, and also controls from internal IXL logical elements or routes or temporary speed restrictions.

What route-related functions are supported by RBC System ?

To query the availability in the RBC system of route-related functions for each “interviewed” IXL project, such as: Route setting or Cancelling or other route-related functions.

What “special” functions are supported by RBC System ?

To query the availability in the RBC system of “special” functions for each “interviewed” IXL project, such as: Temporary Speed Restrictions, Cooperative MA revocations, Conditional Emergency Stops, RBC-RBC handover or other special functions.

D. Fallback methods

For each trackside element interfaced to IXL Systems (i.e. locally controlled shunting area, balise, user specified objects, external level crossing, point, track segment, signal, ATP and external line block) fallback questions were asked. The result has been analysed and processed thus:

a. **Use of fallback (for each trackside element)**

   To report about the use of a fallback system for each of this class of trackside element in all evaluated projects.

b. **Returned experience about the use of fallback (for each trackside element)**

   Here, the real experience of each user in the use of fallback on each trackside element has been reported.

Furthermore, **for each IXL Project** a specific, separate and detailed sheet of questions about Fallback Methods has been included in the questionnaire and submitted to all questionees. This Fallback sheet includes the following questions:

c. **Are there any technical or operational fallbacks being used?**
d. **Are conventional signalling systems used as a fallback?**
e. **Are there differences between various IXL generations (mechanical, electric-mechanical, relay, electronic IXL)?**
f. **And the differences reasons why.**
g. **Which of these fallback issues will be provided in ERTMS?**
h. **Are there new fallback issues used in ERTMS?**
i. **Which of these new fallback issues are based solely on specific national requirements?**
j. **Mandatory Fallback Issues.**
k. **Optional Fallback Issues.**
l. **Benefits generated by the use of Fallback.**
m. **For non-existing but planned fallback issues: what are the estimated benefits?**
n. **What are non-tangible (i.e. no direct financial return) benefits of fallbacks?**
o. **Any differences in using solely mandatory or mandatory and optional fallback issues?**
p. **Any difference in benefits by using different fallbacks?**

E. Migration strategy

For each IXL Project a specific, separate and detailed sheet of questions about Migration strategy has been included in the questionnaire and submitted to all questionees. This Migration sheet includes the following questions:

a. How many IXL migration strategies are there?
b. What are reasons to establish a migration strategy?
c. How can the overall migration strategy be described?
d. What are reasons for this decision (on overall migration strategy)?
e. Linewise Migration - Is there a migration priority for each line?
f. Linewise Migration - What are reasons for this decision (on migration priority for each line)?
g. Linewise Migration - What is the migration order on existing tracks?
h. Linewise Migration - What are reasons for this decision (on migration order on existing tracks)?
i. Stepwise Migration - Is there a migration priority for each single step?
j. Stepwise Migration - What are reasons for this decision (on migration priority for each single step)?
k. Stepwise Migration - How is the equipment installed on existing lines?
l. Stepwise Migration - What are reasons for this proceeding (for installing equipment on existing lines)?
m. Stepwise Migration - Are there any circumstances which have to be given for a migration, implementation or installation under "Rolling wheels"?
n. Are there special (migration) rules?
o. What is the content of these (migration) rules?
p. What further circumstances might have any impact on the migration strategy?
q. What are the experiences gained in former technique migrations which influence the new strategies?

F. Project information

a. **Does the project cross a National Border?**

To know if the IXL project line crosses borders between two or more Countries, so involving more railway infrastructures.

b. **How many kilometres of tracks are involved by the Project?**

To consider the typical length of railway lines covered by IXL Projects. The following values were requested: average, min and max lengths of project's line.

c. **Max Speed Allowed**

To query the maximum speeds allowed on the project. The following values were requested: average, min and max of allowed max speeds on project's line.

d. How many Junction Points are on the Project line?

The number of Junction Points which might be foreseen in an IXL Project between the ERTMS high speed line and traditional railway infrastructure influence the complexity in new system IXL design. So, the average, max and minimum number of junction points were requested.

e. Who is the supplier of IXL?

This question (and the next one) investigate the heterogeneity of supplying for IXL systems: the main supplier company was requested.

f. Who is the supplier of RBC (if applicable) ?

The same scope of previous question, but investigating RBC sourcing instead.

g. What Level Transitions are implemented ?

By considering of the ETCS level transitions foreseen in each Project, the reports which requirements are usually issued on new IXL Projects and how infrastructure managers drive their railways with ERTMS compliant systems.

h. What is the Project status ?

To query the IXL Project status: if it is in operation without restrictions, or in restricted service until a certain year (which is requested to be specified) or if implementation is not yet finished.

i. What is the expected time between Contract Sign and Full Service of the line ?

Here, the average, max and minimum expected time between the moment of Contract Sign and the time of full service commissioning were requested.

Discussion on Results

After finishing the analysis, all results were discussed by WP E members. The obtained information was checked in detail for correctness, and completeness, against the requirements of INESS project, and against the team rules agreed.

At the end of this activity, this document D.E.1.1 was issued and released by the work package Team E.

Section 3. Safety Constraints

3.1 Standard Safety System Architecture

The scope of this section is to group safety constraints on current IXL system architectures firstly to identify a common core of functionality, "use of" and architectural solutions for European Interlocking, and then to underline the key differences between European interlocking applications.

General Questions

a) Use of **different IXL architectures**

(See Deliverable D.E.1.2)

b) **How many different IXL architectures ?**

(See Deliverable D.E.1.2)

c) **Reasons for Heterogeneity**

(See Deliverable D.E.1.2)

d) **Advantages of IXL Architectures Heterogeneity**

(See Deliverable D.E.1.2)

e) **Disadvantages of IXL Architectures Heterogeneity**

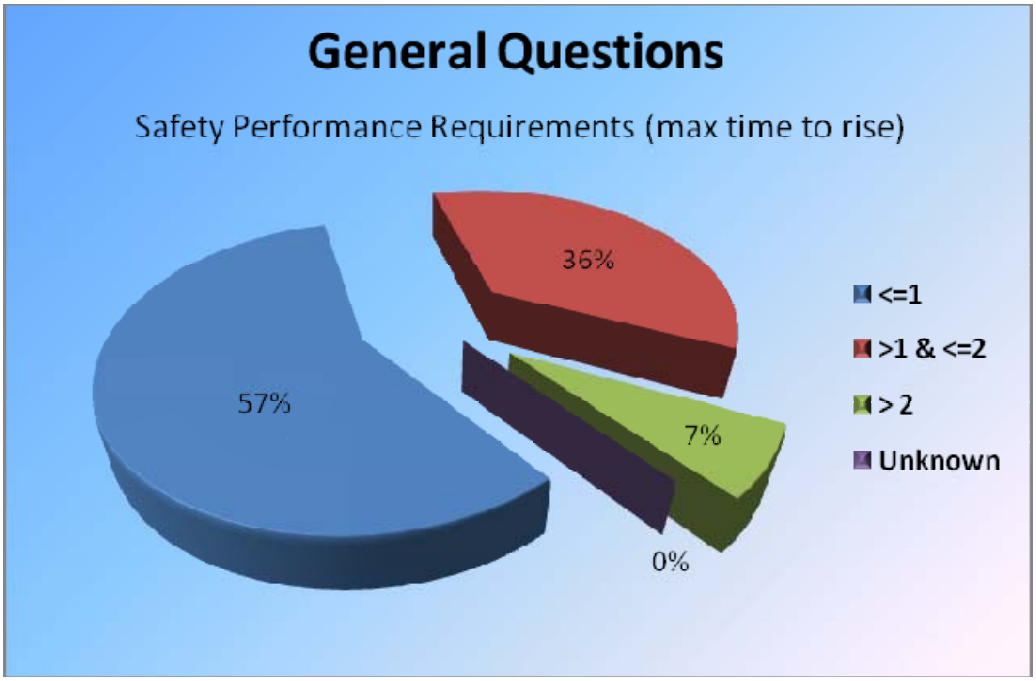
(See Deliverable D.E.1.2)

f) **Safety Performance Requirements (max time to rise)**

Answer	Quantity
IXL max time to rise is requested to be **<= 1 sec**	8 (57%)
IXL max time to rise is requested to be **<= 2 secs**	5 (36%)
IXL max time to rise is accepted to be **> 2 secs**	1 (7%)
I don't know	0 (0%)

Table 4 – Safety Performance Requirements (max time to rise)

Graphics is:

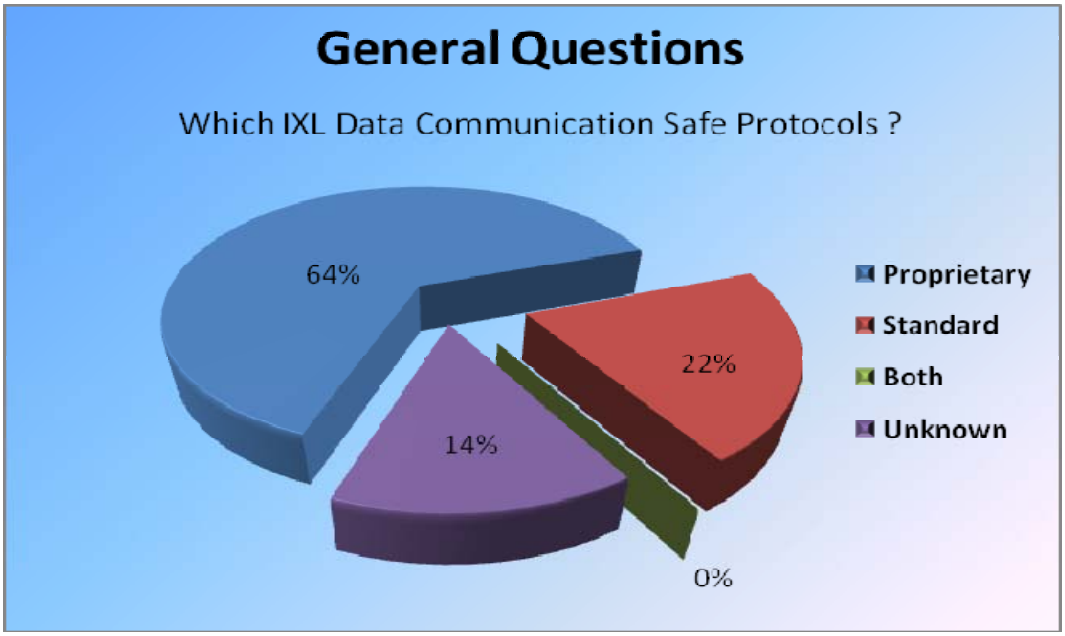


g) Which IXL Data Communication Safe Protocols ?

Answer	Quantity
IXL Data Communication Safe Protocols are **Proprietary**	9 (64%)
IXL Data Communication Safe Protocols are **Standard**	3 (22%)
IXL uses both	0 (7%)
I don't know	2 (14%)

Table 5 – IXL Data Communication Safe Protocols

Graphics is:

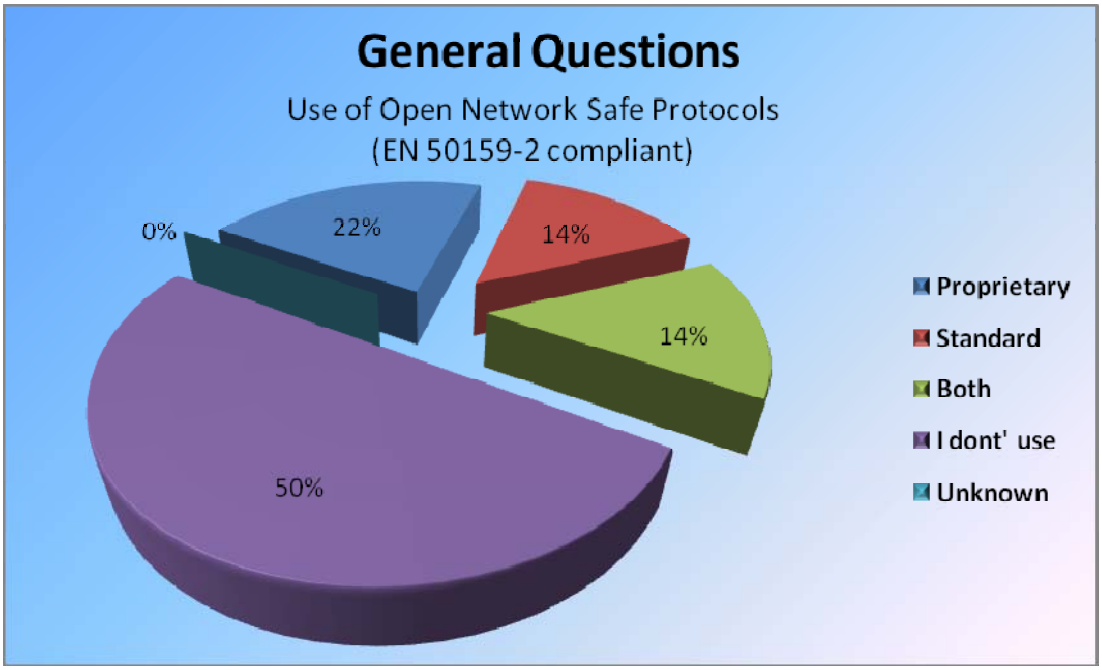


h) What about the use of Open Network Safe Protocols (EN 50159-2 compliant)?

Answer	Quantity
Yes, I use **Proprietary** Open Safe Protocols	3 (22%)
Yes, I use **Standard** Open Safe Protocols	2 (14%)
Yes, I use both **Proprietary & Standard** Open Safe Protocols	2 (14%)
No, I don't use Open Safe Protocols	7 (50%)
I don't know	0 (0%)

Table 6 – Use of Open Network Safe Protocols (EN 50159-2 compliant)

Graphics is:



Trackside Interfaces

For each trackside elements interfaced to IXL System, following results have been obtained from Questionnaire data:

a) Use of

(See Deliverable D.E.1.2)

b) Intelligent/Not Intelligent

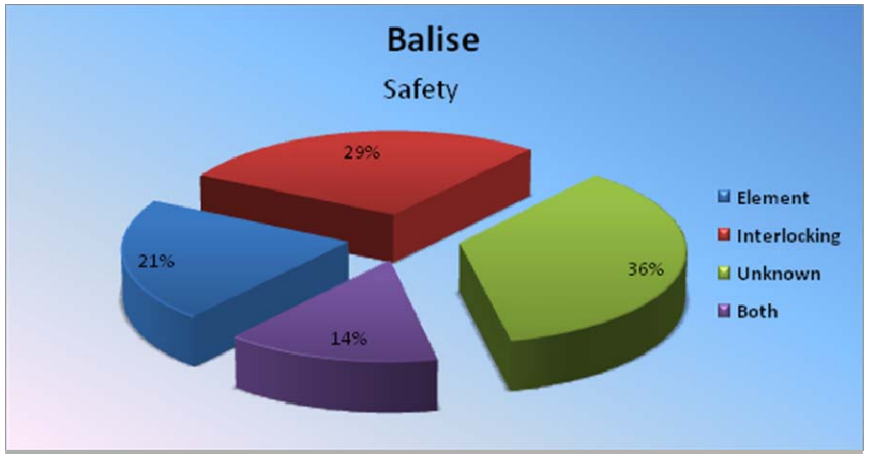
(See Deliverable D.E.1.2)

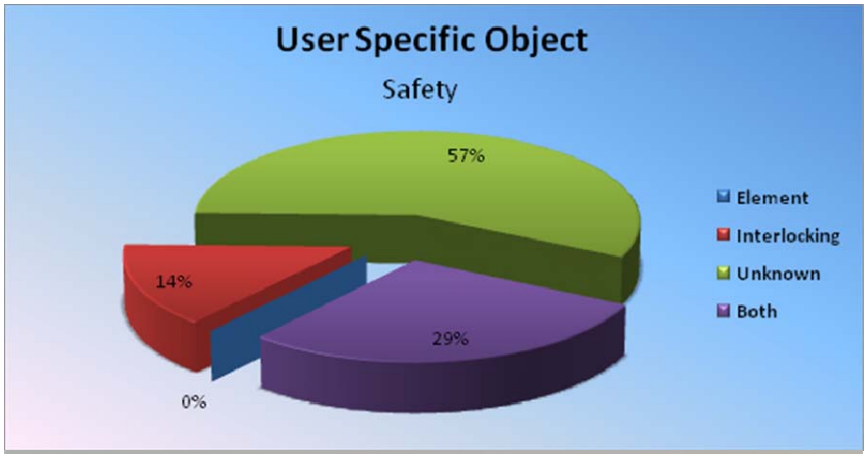
c) Exchanged Data (from and to IXL)

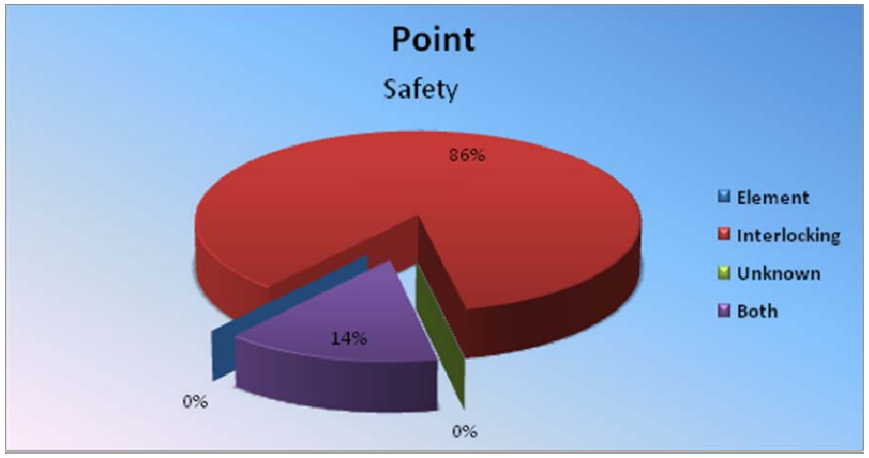
(See Deliverable D.E.1.2)

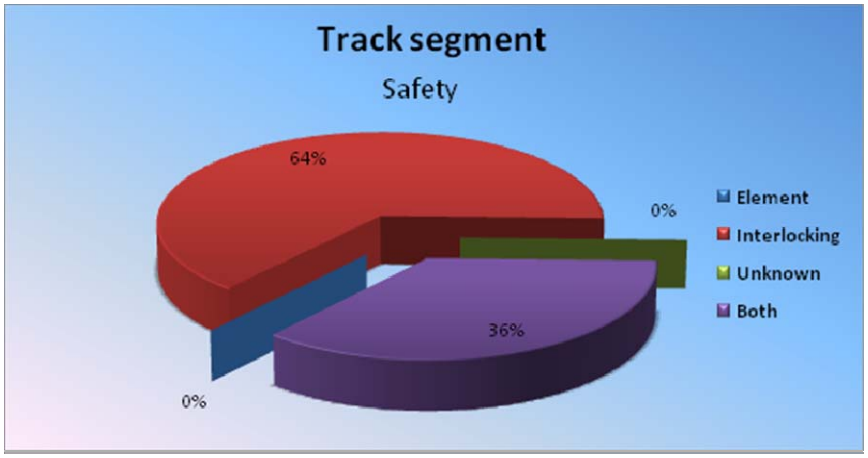
7 0%)	4 (29%)	2 (14%)	4 (29%)	12 (86%)	9 (64%)	8 (57%)	5 (36%)	1 (7%)
3 1%)	2 (14%)	4 (29%)	6 (43%)	2 (14%)	5 (36%)	4 (29%)	4 (29%)	11 (79%)
4 9%)	5 (36%)	8 (57%)	3 (21%)	0 (0%)	0 (0%)	2 (14%)	4 (28%)	2 (14%)

Table 7 – Safety Apportionment between Trackside Elements and IXL









Other Interfaces

a) Adjacent Interlocking system

(See Deliverable D.E.1.2)

b) Juridical Recorder

(See Deliverable D.E.1.2)

c) Power Supply

(See Deliverable D.E.1.2)

d) Diagnostic System

(See Deliverable D.E.1.2)

e) Traffic Control System (TCS)

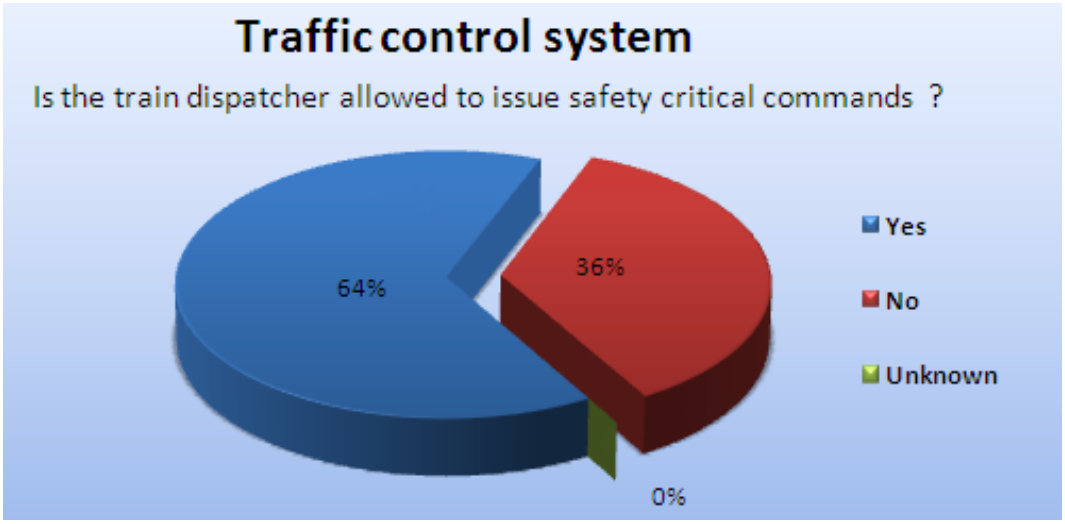
(Other Questions: See Deliverable D.E.1.2)

Is the train dispatcher allowed to issue safety critical commands?

Answer	Quantity
Yes	9 (64%)
No	5 (36%)
Unknown	0 (0%)

Table 8 – Is the train dispatcher allowed to issue safety critical commands?

Graphically:

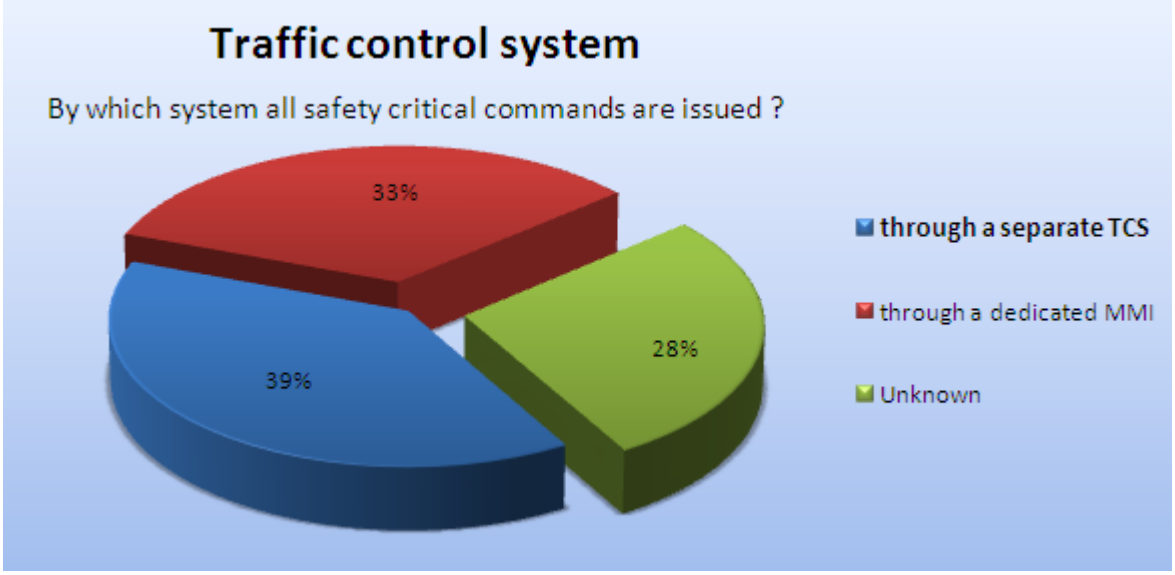


By which system safety critical commands are issued ?

Answer	Quantity
Through a separate TCS	7 (39%)
Through a dedicated MMI	6 (33%)
Unknown	5 (28%)

Table 9 – By which system safety critical commands are issued ?

Graphically:



f) Data Preparation System

(See Deliverable D.E.1.2)

g) Radio Block Centre (RBC)

(See Deliverable D.E.1.2)

Fallback methods

(See Deliverable D.E.1.3)

Migration strategy

(See Deliverable D.E.1.3)

Project Information

(See Deliverable D.E.1.3)

Section 4. Conclusions

It was asked whether safety related decisions are made: in the element, in the interlocking equipment, or in both, as applied to the Euro Interlocking reference architecture.

The conclusive Answers Group gives the following picture:

- **Majority** [2]safety decisions are taken in **interlocking**: point**;**
- **Majority** safety decisions are taken in **both**: External line block;
- **Emphasis** on safety decisions are taken in **interlocking** (i.e. where the data is known in the project). Local shunting area, track segment, signal;
- **Emphasis** on safety decisions are taken in **element**: external level crossing;
- **Emphasis** on issue safety critical commands which are allowed to TCS;
- **Majority** on safety performance requirement for max time to rise are taken in **less than 2 seconds**;
- **Emphasis** on use of **proprietary IXL Data Communication Safe Protocols.**

This shows that safety apportionment is done depending on the type of interfaced element.

[2] **Majority** means more than 80%, **Emphasis** means between 55% 80%;

Section 5. Bibliography

5.1 Reference Documents

[Doc.01] INESS SB - "Minutes of steering board with approval of interpretation", UIC, Paris, France

[Doc.02] Jorge Gamelas - "Minutes of the WP E1 Meeting 1", Draft, 2009-05-26, UIC, Paris, France

[Doc.03] Jorge Gamelas - "Minutes of the WP E1 Meeting 2", Draft, 2009-07-03, S&B, Moenchengladbach, Germany

[Doc.04] Jorge Gamelas - "Minutes of the WP E1 Meeting 3", Draft, 2009-10-26, BV, Stockholm, Sweden

[Doc.05] Jorge Gamelas - "Minutes of the WP E1 Meeting 4", Draft, 2010-01-21, UIC Bruxelles, Belgium

Section 6. Annexes

6.1 Questionnaire

The final version of WP E.1 "Questionnaire" has been stored in the INESS project's documentation repository system Myndsphere. It can be accessed starting at the following directory:

https://www.myndsphere.com >> Collaboration Group Memory >>Projects >> INESS >> Documents >> WS E >> WP E.1 >> WP E.1 Other technical documents

where the original empty Questionnaire file and all completed Questionnaires have also been saved and published.

6.2 Enhanced Master Table

The final version of this WP E.1 "Enhanced" Master Table has been stored in the INESS project's documentation repository system Myndsphere. It can be accessed at the following directory:

https://www.myndsphere.com » Collaboration Group Memory » Projects » INESS » Documents » WS E » WP E.1 »WP E.1 » WP E.1 Drafts of deliverables & milestones