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TABLE OF CONTENTS

GLOSSARY

Questionnaire	document with structured list of question
Questionee	Person, who are asked by questionnaire
Majority	means a vote bigger than 85 percent
Emphasis	means a vote between 55 and 85 percent
Minority	means a vote lower than 45 percent
Intelligent Interface	Data electronically transmitted on base of a protocol
Non Intelligent Interface	Data transmitted in parallel (typically relay or opto coupled)

List of abbreviations

DOORS	Dynamic Object Oriented Requirements System
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
DoW	Document of Work
INESS	Integrated European Signaling System
UIC	Union of Railways
UML	Unified Modeling Language
UNIFE	Union of European Railway Industry
WP	Work Package
WS	Work Stream
RBC	Radio Block Center

Section 1 – Executive Summary

1 Section 1 – Executive Summary

1.1 Content

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 3 – MAIN PART shows the considerations, making of and distribution of the questionnaire, completed by description of collecting data and first findings. Data is analysed. Similarities and differences are shown graphically. Conclusions are derived from the evaluation of questionnaire data.

Section 2 – INTRODUCTION

2 Section 2 – INTRODUCTION

2.1 Task Description

The task leading to this document is defined within WS E of the INESS project. WS E deals with functional architecture and interfaces of interlocking systems in Europe. Currently no harmonized functional architecture exists for either complete signalling systems or even the integral parts of interlockings. WS E is responsible for defining a European harmonized functional architecture of interlocking systems. The WS E task is divided into four WPs. Within this, the first WP, the existing state of the art is examined. This is to define a base for defining a future harmonized architecture, looking for similarities and differences. It also attempts to obtain data for a common strategy to migrate the installed interlocking base over time to the new European harmonized functional interlocking architecture.

WP 1 therefore is entitled “collect information from relevant state of the art projects”. Objectives are

- To define projects to be assessed and questioned
- Collection of information from various railways and/or suppliers
- It should be evaluated as to whether the situation of having differing system architectures is in fact disadvantageous for the railways
- Comparison of interface definitions and functional structures of the various state of the art projects
- Collect information about current differing migration and fall back methods happening today

To perform this it is requested to set up a questionnaire for partners to fill in. From information received, it shall be possible to answer the following high level questions:

- How are functional interfaces made today?
- How is the apportionment of function and safety made today?
- How much of the system is “standard”, supplier specific and railway specific?
- Are fallback system used and if so why?
- How is the migration of trackside equipment made?

The questionnaire shall be created by members of WP E1, agreed on and distributed to supplier and railways participating in INESS. After that the feed back has to be analyzed and documented in three defined deliverables (D.E.1.1 – D.E.1..3).

The document you are reading is report two (D.E.1.2) entitled “Report on the information collected from various railways and/or suppliers **about** the ETCS”.

This title was discussed intensively in the WP team. Members agreed that the title could be misleading and would put more focus on the ETCS system than on the intended interlocking system. As a solution, the title was interpreted as "“Report on the information collected from various railways and/or suppliers **including** the ETCS”. This interpretation was reported by WS leader to the steering board and agreed on (see [1]).

Section 3 – Main Part

3 Section 3 – Main Part

3.1 Description of the Questionnaire

3.1.1 Creation of the Questionnaire

Creation of the Questionnaire was the topic of the first two WP meetings. WP members agreed on a creation process and content, shown in detail in the following paragraphs.

3.1.2 Questionnaire Requirements

In order to have a feasible high quality feed back of the questionnaire, requirements were defined as follows:

- Questions shall focus on interfaces of a given structure
- Questions shall be defined in a systematic manner in order to assure comparability and minimize effort in analysis phase
- Answering shall be done with minimal effort in order to motivate questionees for participating. Effort shall be focused on the answers not on understanding the questionnaire
- Questions shall be created on base of a common and known European understanding, to avoid misunderstandings respectively call backs
- Questions shall be helpful for task of WS E and not go unnecessarily deeply in technical details

- Scope of questions shall be precise and clear. Possible mismatch of answers complicating analysis because of unclear scope has to be avoided.

3.1.3 Structure

To make an easy to answer questionnaire it was decided to use excel as tool. This provides the questionees maximum support.

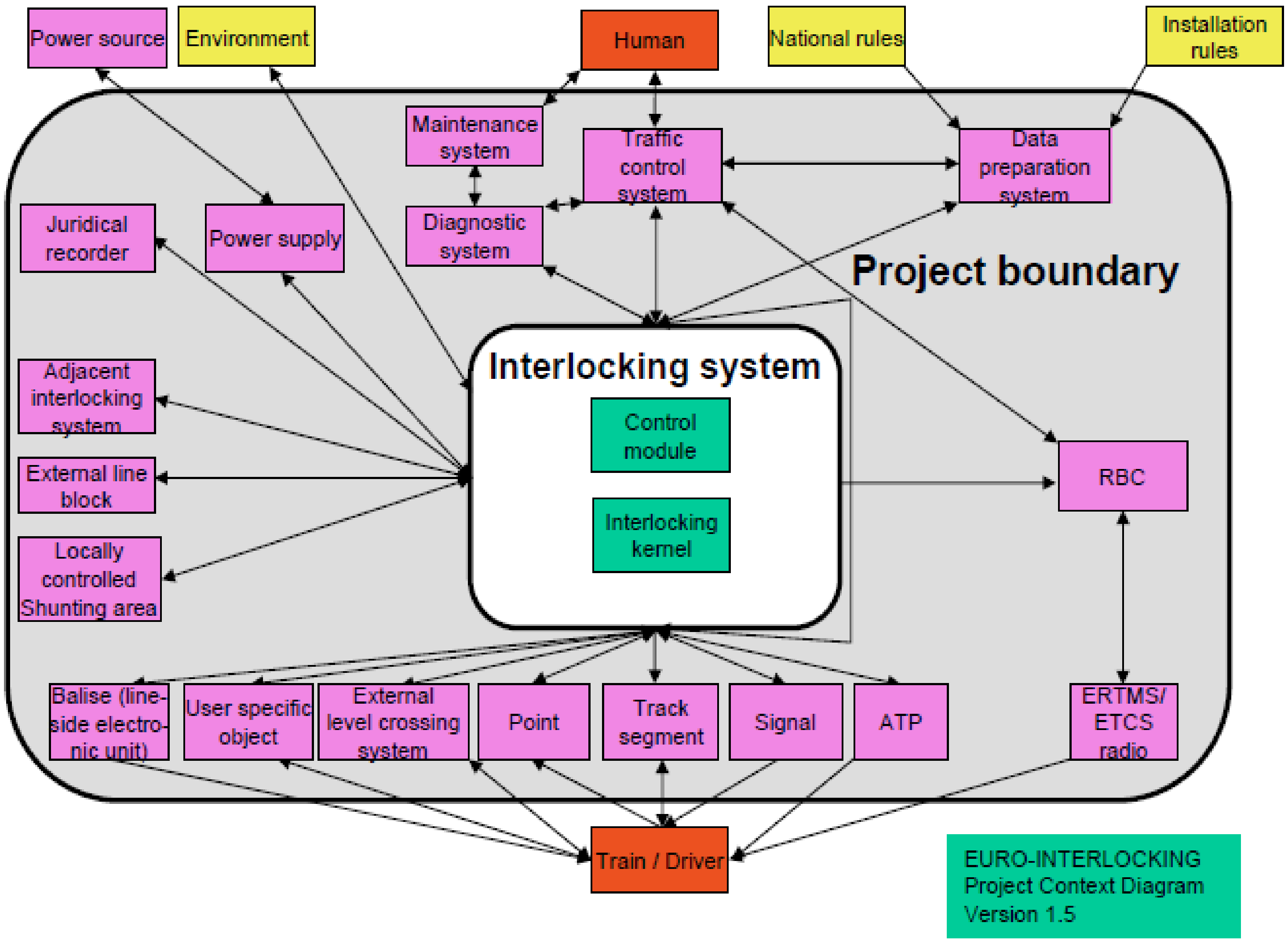
The questionnaire was built on base of macros, which hide unnecessary sub questions in case of non applicability. Checkboxes are used where ever possible. In some cases textual information was asked to get an idea of underlying system (e.g. fall back information).

3.1.3.1 Architectural Base

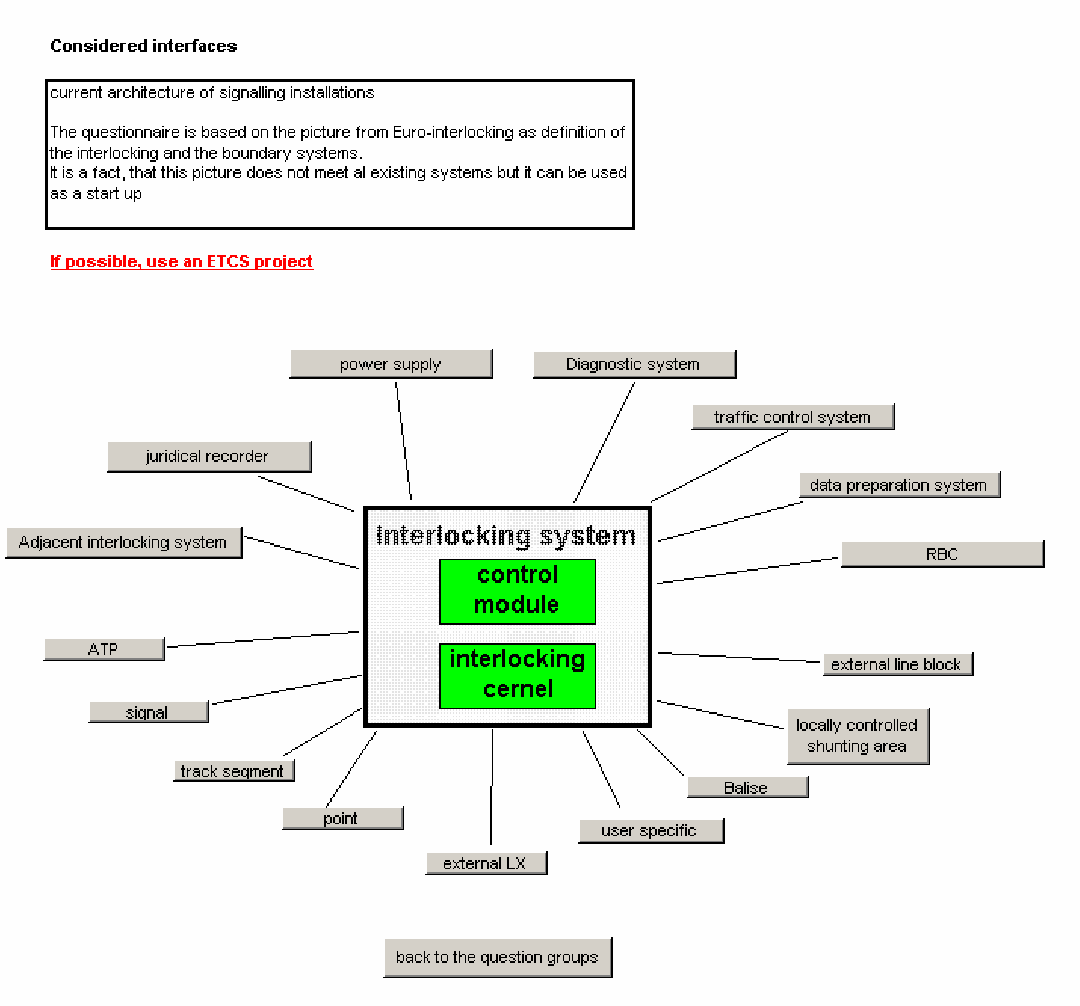
To have a common understanding of interfaces (which build the main part of the questionnaire) it was agreed to use the architecture defined in European research project Eurointerlocking release 8.0. These interfaces are linked to the interlocking system consisting of interlocking kernel and control module.

Interfaces are defined as

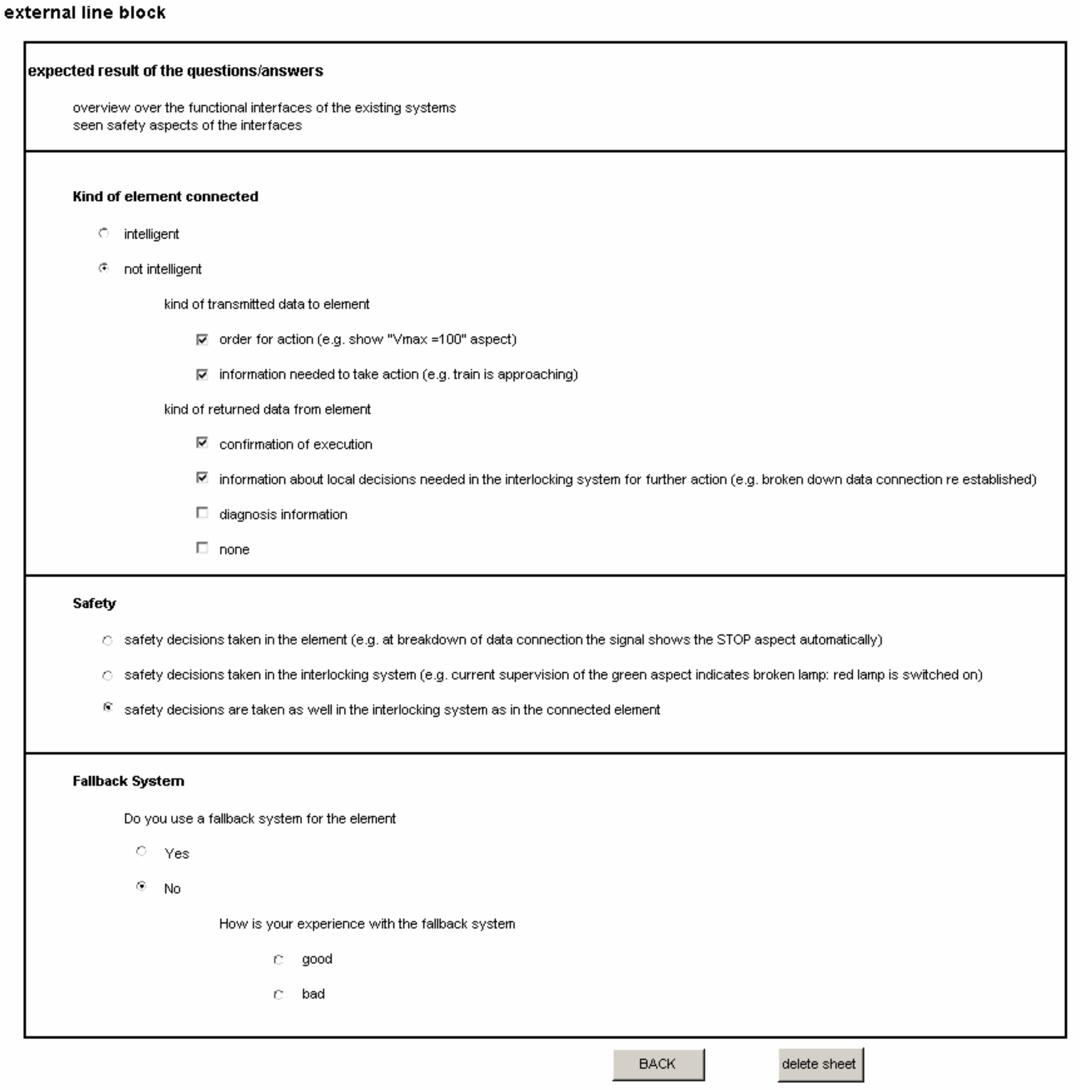
- Power supply
- Diagnostic system
- Traffic control System
- Data preparation system
- RBC
- ATP
- Signal
- Track segment
- Point
- External level crossing
- User specific object
- Balise
- Locally controlled shunting area
- External line block
- Adjacent interlocking
- Juridical recorder



Picture 1 Euro Interlocking Release 8.0 Architecture



Picture 2 Example of Considered Interfaces


external line block

expected result of the questions/answers

overview over the functional interfaces of the existing systems
seen safety aspects of the interfaces

Kind of element connected

- intelligent
- not intelligent

kind of transmitted data to element

- order for action (e.g. show "Vmax =100" aspect)
- information needed to take action (e.g. train is approaching)

kind of returned data from element

- confirmation of execution
- information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)
- diagnosis information
- none

Safety

- safety decisions taken in the element (e.g. at breakdown of data connection the signal shows the STOP aspect automatically)
- safety decisions taken in the interlocking system (e.g. current supervision of the green aspect indicates broken lamp: red lamp is switched on)
- safety decisions are taken as well in the interlocking system as in the connected element

Fallback System

Do you use a fallback system for the element

- Yes
- No

How is your experience with the fallback system

- good
- bad

BACK delete sheet

Picture 3 Example of Structured Questionnaire

3.1.3.2 Question Groups

The agreed Euro Interlocking structure was assigned to question groups. These groups were completed by questions to meet the given goal of WS E.

The resulting structure is as follows. Each chapter is represented by an excel page.

- General information about participant/s of the questionnaire
- Document information
- Objective / Introduction
- General questions about interlockings
- Trackside elements (clockwise from ATP to external line block)

- Other interfaces (clockwise from adjacent interlocking system to RBC)
- Fall back levels
- Migration strategy
- Project information

3.1.4 Considerations

3.1.4.1 Precise and Non Generic Questions

In order to get clear and precise information, the WP team decided not to ask for signalling technology in general. This is to avoid broad and wide ranging answers with unclear preconditions. To have a technology scope it was advised to use electronic interlocking technology as the base of questionnaire.

3.1.4.2 Answer on base of Real Life Systems

In order to get comprehensive information the WP team decided to ask for a dedicated project in operation or, if not possible, in installation. This is to support the involved organizations to address a clear contact person as questionee. Otherwise it would be difficult for an organization (supplier as well as railway) to find a person able to answer the questionnaire.

3.1.4.3 Guideline for Project Selection

In order to get information meeting the questionnaire requirements, the WP team decided to ask for projects with an interlocking – RBC interface. This is to get information about realized or to be realized interfaces concerning interlocking and ETCS that WP E1 needs.

3.1.5 Creation and Release

With the input given by chapter 3.1.2 to 3.1.4 two members of the WP team generated a draft of the excel file. Thanks to Leo Gossen (LG / Scheidt und Bachmann) and Michiel Lim (LM / ProRail).

This draft was distributed, discussed and completed by WP Members during WP Meeting 2 on June 25th 2009. Due to a lack of time, the part of the questionnaire dealing with fallback and migration, author Martin Woiton (MW / TUBS), was not discussed in detail.

The following action plan was agreed:

The group sends its comments to the part of the questionnaire dealing with fallback and migration to MW before the 30/6. MW sends an updated version of this part of the questionnaire (fallback and migration) to LG/LM for integration on the main questionnaire documents.

LG/ML sent a new version of the questionnaire before the end of 3/7 for a final review by WP.E1 members (3 days had to be given for the final comments).

After rework and release, the questionnaire was ready for distribution on July 20th 2009. Reference is [3].

To avoid probable Excel problems (mismatch Excel versions, languages and macros) the questionnaire was published and distributed in parallel as an adobe acrobat reader pdf file.

3.1.6 Extent of Questionnaire

The questionnaire consists of about twenty excel pages with about 8 Questions per page together with roughly three possible answers per question. There are about 160 questions and 500 possible answers, taking approximately 1,5 hours to be completed.

3.2 List of Questionnaires

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

3.2.1 Distribution

3.2.1.1 Distribution Organization

Questionnaire distribution for WP members was planned to be done by and fulfilled by questionnaire author Leo Gossen July 20th 2009 via mail.

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

3.2.1.2 Dead Line for Questionnaire

Feed back of the filled questionnaire was requested to be sent to WP E1 members Leo Gossen and Michiel Lim before end of September 2009.

3.2.1.3 Participants

Distribution was planned mandatory for INESS Members, because there exists a commitment from member organizations to participate in elaborating existing data.

The questionnaire was sent to the following **WP E1 Members** (supplier and railways):

- ADIF (Supplier)
- ANSALDO (Supplier)
- AZD (Supplier)
- Bombardier (Supplier)
- Banverket (Railway)
- DB AG (Railway)
- Invensys (Supplier)
- Mermec (Supplier)
- Network Rail (Railway)
- ProRail (Railway)
- RFI (Railway)
- Scheidt und Bachmann (Supplier)
- TIFSA (Consultancy and Engineering Company)
- TUBS (Institute)
- UIC (Institute)

Furthermore, it was planned to involve additional **INESS**-, **UIC-members** and the **Umbrella Railways**.

3.2.1.4 Document Organization

Both questionnaire and filled questionnaire are stored in the INESS project documentation system Myndsphere. Results can be accessed under the following link:

Questionnaire: [3]

Filled Questionnaire: [4]

Documentation accompanying the questionnaire is stored in appropriate subfolders.

3.2.2 Feed Back

Participant organizations gave feed back by returning the filled questionnaire. Without exception this was done by using the Excel file.

3.2.2.1 Questionees

In total, the questioners received twelve answers. The following organizations where gave feed back (in alphabetical order):

• ADIF	Railway	Spain
• Ansaldo STS	Supplier	Italy
• AZD	Supplier	Czech
• Banverket	Railway	Sweden
• Balfour Beatty Rail	Supplier	UK
• Bombardier	Supplier	Germany
• DB AG	Railway	Germany
• MerMec	Supplier	Italy
• Network Rail	Railway	United Kingdom
• Nucleo	Supplier	Spain
• ProRail	Railway	Netherland
• RFI	Railway	Italy
• Scheidt und Bachmann	Supplier	Germany
• Thales	Supplier	Germany

3.2.2.2 Anonymisation

In order to keep an open atmosphere, WP members agreed to de-personalise specific user data. Therefore, names and organizations are covered in analysis. Nevertheless, classifications, like supplier and railway are acceptable.

3.2.2.3 Related Projects

Questionees were asked to answer in relation, if possible, to an existing electronic interlocking in operation, using an RBC interface. Description of chosen installations, geographical distribution and assignments of system interfaces to Euro Interlocking structure is shown in [2].

3.2.2.4 Experiences

A first look at the returned questionnaires showed problems with the excel macros. In some questionnaires the sub question part was not opened automatically by the macro. Consequentially, answers were missing. One problem was the page protection in combination with macro and older excel version. This problem was solved by distributing the unprotect password and repeating the questionnaire.

3.2.2.5 Interpretation

Another experience was loss of information from normalisation of specific information in check boxes offering a simple yes or no. This approach made compiling a master table [2] easier, but gave no room for additional information. In analysis, this loss of information must be considered in order to not misinterpret questionnaire information.

One supplier and railway chose the same project to answer the questionnaire by accident. The information should have been consistent, but it was found not to match. After discussing this topic the two affected participants harmonized their interpretation and obtained a more coherent result. Lessons learnt out of this, was that even with a clear structure of questionnaire (mostly multiple choice), a well defined architecture and a dedicated installed project room, for interpretation is still considerable. Extracting information out of the questionnaire and deriving common answers for European Interlocking must be done very carefully.

Even with the given European interlocking structure misinterpretation of interface location was possible. E.g. it was not clear how to apportion the radio infill balise in the Euro Interlocking context.

3.2.3 Evolution of Questionnaire

To maximise the quality of the questionnaire data, the WP team decided to have some clarification and start a second round of questions. This also enabled the possibility to obtain further information.

The additional round of questions was done by email with the idea of updating the existing filled questionnaire.

3.2.3.1 Aspects to be clarified

Following aspects were clarified by email:

- Information about interface to Euroloop can be put into the ATP sheet.
- Information about interface to Radio Infill Units can be put into the user specific objects sheet.

3.2.3.2 Additional Questions

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

- About intelligent interfaces:
  - Which information is exchanged in the intelligent interfaces?
    1) Are there any special timing requirements for this interface?
    2) If yes, what are the requirements?

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

- System description
  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
     - a mapping between the questionnaire's generic interlocking (Euro-interlocking) and the interlocking described in the filled questionnaire (project's interlocking)
     - an indication if the subsystems have safety requirements or not and if yes, which SIL level (if applicable).
  3. Provide a picture of the Project layout with the different parts of the interlocking and their geographical distribution (distances between the different elements)

3.2.3.3 Distribution of second Question Lap

The second round of questions was opened immediate after the third WP meeting. Deadline for the second round was 15th of November 2009. Questionees were asked to upload a new release of the completed questionnaire to Mindsphere. This was to ensure enough time for advanced analysis and update the deliverables of work.

3.3 Analysis

Analysis was done based only on questionnaire data. Interpretation must be done exclusively on work described by questionnaires.

3.3.1 Analysis Process

Analysis follows the steps documented in the following chapters.

3.3.1.1 Compiling Master Table

Questionnaire data loaded up in Myndsphere must be prepared in order to be comparable. Therefore, a master table [2] has to be compiled. For each Excel page all participants' data are page wise aligned in columns. In a first step this was done for all interface describing pages. In a second phase, compilation was completed for the entire questionnaire.

3.3.1.2 Two steps of Analysing

Analyse Phase was separated into two steps. Step one uses data from the first round of questions. This to get started and collect first experiences. In a second step (beginning after dead line of question lap 2) the whole data is considered in analysis.

3.3.1.3 Making Anonymous

As already mentioned in chapter 3.2.2.2 analysis results have to be de-personalized after analysis. It has to be ensured that no supplier or railway information can be derived on the basis of analysis documentation.

3.3.1.4 Creation of DoW and Release

After finishing analysis, all results have to be discussed by WP team E1. The derived information has to be checked for correctness, completeness, against the requirements of INESS project, and against the team agreed rules.

The document D.E.1.2 has to be drafted and released by working package team members.

3.4 Creation Process DoW

3.4.1 Leader, Author, Contributor

The organization committed to create this deliverable D.E.1.2 is Thales Rail Signalling Solutions GmbH located in 70435 Stuttgart. Lorenzstraße 10, Germany. Author is mentioned in head of document. Contributors support analysis and reviews. The contributors are RFI and MERMEC.

3.4.2 Creation and Review

This document is created and drafted monthly via myndsphere. Contributors (and WP Team-members) are informed to support creation process via review comments.

3.5 Analysis of Consistencies

This section analyses the requested interfaces for consistency. The explanatory section is followed by a table summarizing the questionnaire results about intelligent / non intelligent interfaces in absolute figures. Within this two alternatives 100% agreement is shown by green flags. If there is only one exception within an agreement this is shown by light brown flag

Some providers / suppliers claimed to have neither or both intelligent and non intelligent interfaces in place. Therefore, analysis is completed by 7 charts giving an overview in relative numbers. The charts are structured in

- Use of the interface in the investigated projects
- When the kind of interface (intelligent / non intelligent) is used
- To graphs separated as intelligent / non intelligent interfaces, each with information about to / from directionality
- One graph about safety issues showing whether safety functions are assigned in the interlocking, in the interfaced element or distributed over the interface
- Two graphs about fall back usage and experiences

All Graphs are taken from [5]

Issues belonging to safety are reported in [6]. Issues belonging to migration and fall back are reported in [7].

Terms **majority**, **emphasis** and **minority** are defined in section glossary. Definition of Intelligent / non intelligent interface see section glossary.

Database of trackside elements (chapter 3.5.1 to 3.5.8) are shown in Section 6 – ANNEXES.

3.5.1 External Line Block

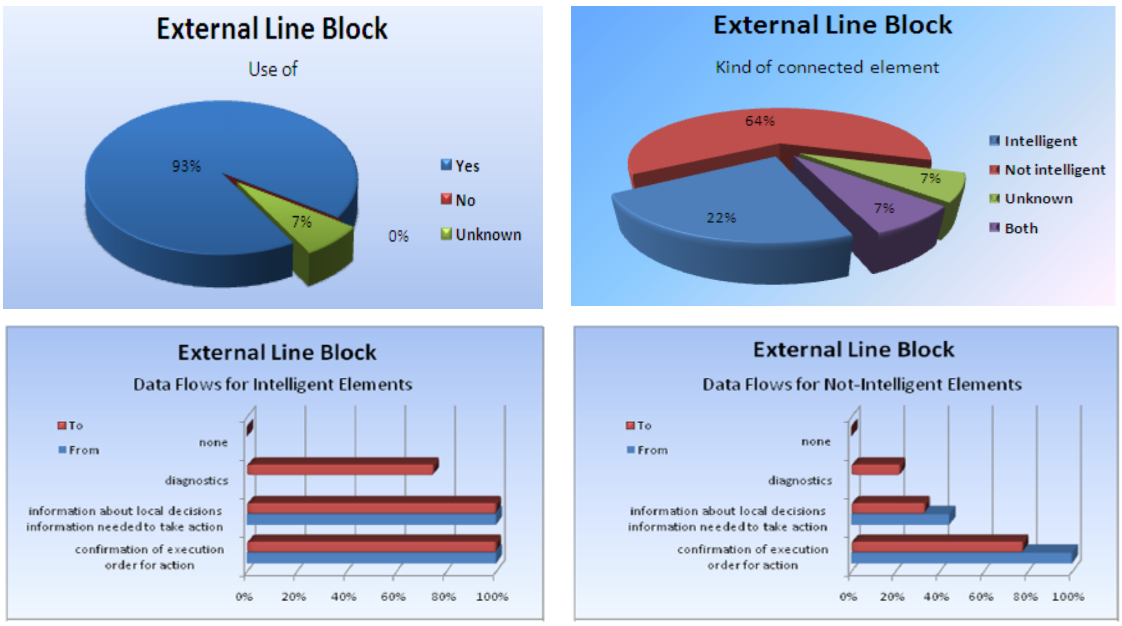
A major vote was having External Line Block as **not intelligent** (Ratio 9:4).

This **majority** agreed (100%) to have Order for Action to the element like activating adjacent block neighbors. They agreed (100%) also to have any kind of returned data from element

The **minority** declared to have an intelligent External Line Block Interface. They agreed (100%) to have transmitted data to element in order for taking action (like activating block neighbors) and (also 100%) to have information needed to take action (like train is approaching). They also agreed (100%) to have the same kind of returned data from element like confirmation of execution and information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established).

			External Line Block			
			Yes		No	
Kind of element connected intelligent			4		9	
			Yes	No	Yes	No
	kind of transmitted data to element					
		order for action (e.g. activate level crossing)	4		9	
		information needed to take action (e.g. train is approaching)	4		4	5
	kind of returned data from element					
		confirmation of execution	4		7	2
		information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	4		3	6
		diagnosis information	3	1	2	7
		none		4		9

Table 1 Consistencies and Deviations Overview External line Block



Picture 4 Graphs with Statistic of External Line Block

3.5.2 Local Shunting Area

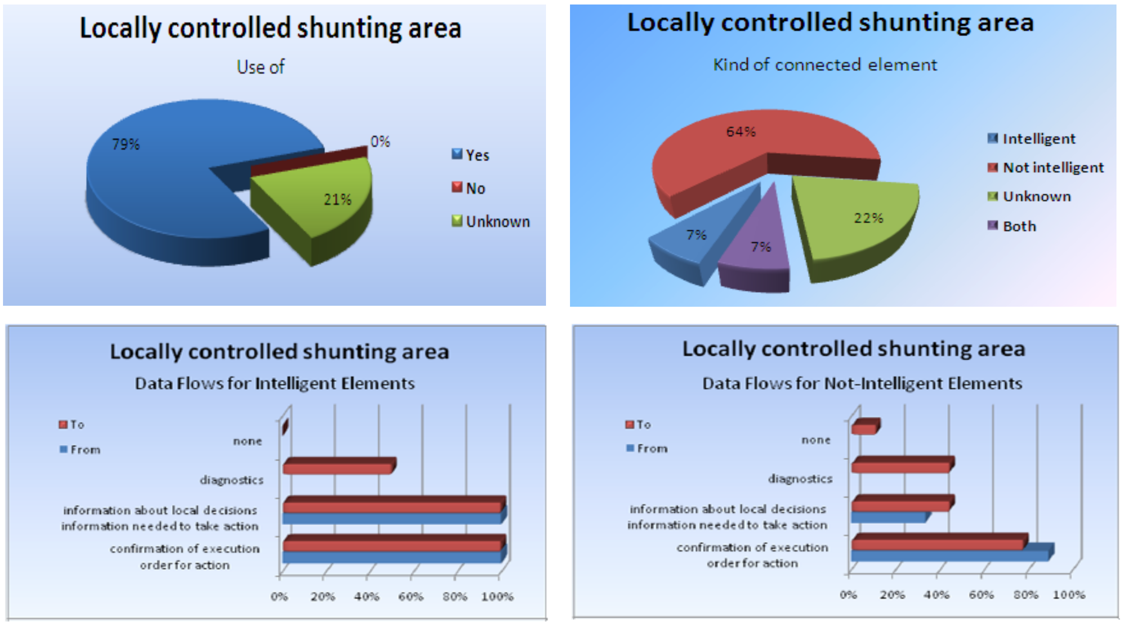
A major vote was having local shunting area as **not intelligent** (Ratio 10:2).

This **majority** agreed mainly to have order for action like activating functions in local shunting area. With only one exception, they all expect return data from local shunting interface.

The **minority** declared to have an intelligent local shunting area interface. They agreed (100%) to have transmitted data to element in order for taking action and (also 100%) to have information needed to take action in an operational sense. They agreed also (100%) to have the same kind of returned data from element like confirmation of execution and information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established).

	LSA			
Kind of element connected intelligent	Yes		No	
	2		10	
	Yes	No	Yes	No
kind of transmitted data to element				
order for action (e.g. activate level crossing)	2		9	
information needed to take action (e.g. train is approaching)	2		3	5
kind of returned data from element				
confirmation of execution	2		8	1
information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	2		4	4
diagnosis information	1	1	5	4
none		2	1	8

Table 2 Consistencies and Deviations Overview Local Shunting Area



Picture 5 Graphs with Statistic of Local Shunting Area

3.5.3 Balise

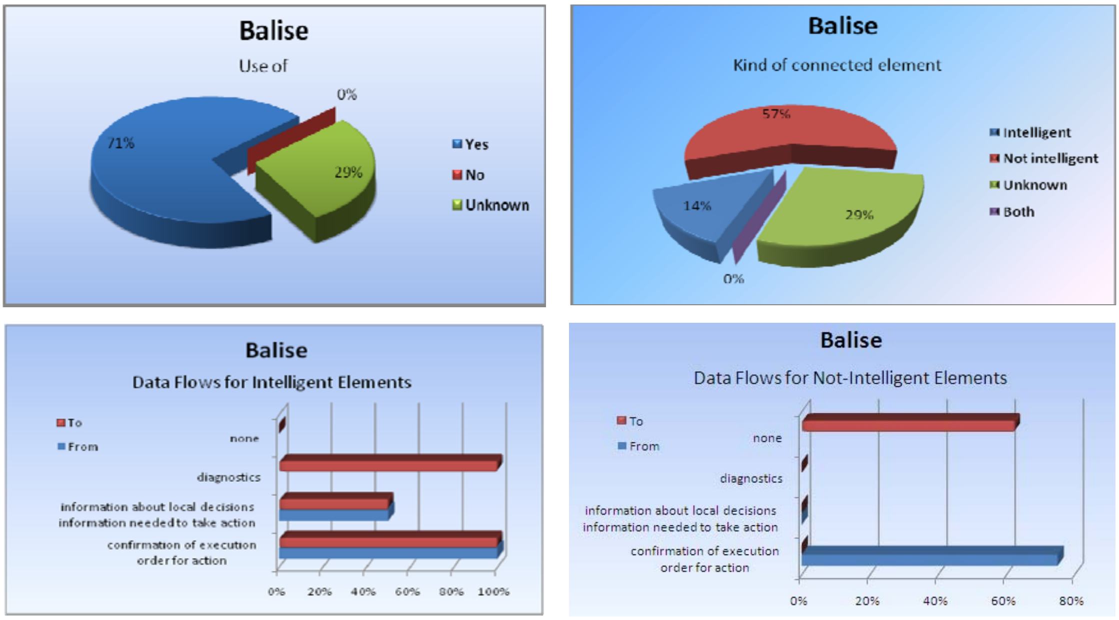
A major vote was, having balise as **not intelligent** (Ratio 8:2).

This **majority** agreed mainly to have order for action like transferring commands to vehicles, but do not expect return data in any way from balise.

The **minority** declared to have an intelligent balise, intelligent in this context seems to get information back from balise (100% agreement). All intelligent balise returns diagnosis.

			Balise			
			Yes		No	
Kind of element connected intelligent			2		8	
			Yes	No	Yes	No
	kind of transmitted data to element					
		order for action (e.g. activate level crossing)	2		6	
		information needed to take action (e.g. train is approaching)	1	1		6
	kind of returned data from element					
		confirmation of execution	2			6
		information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	1	1		6
		diagnosis information	2			6
		none		2	5	1

Table 3 Consistencies and Deviations Overview Balise



Picture 6 Graphs with Statistic of Balise

3.5.4 Level Crossing

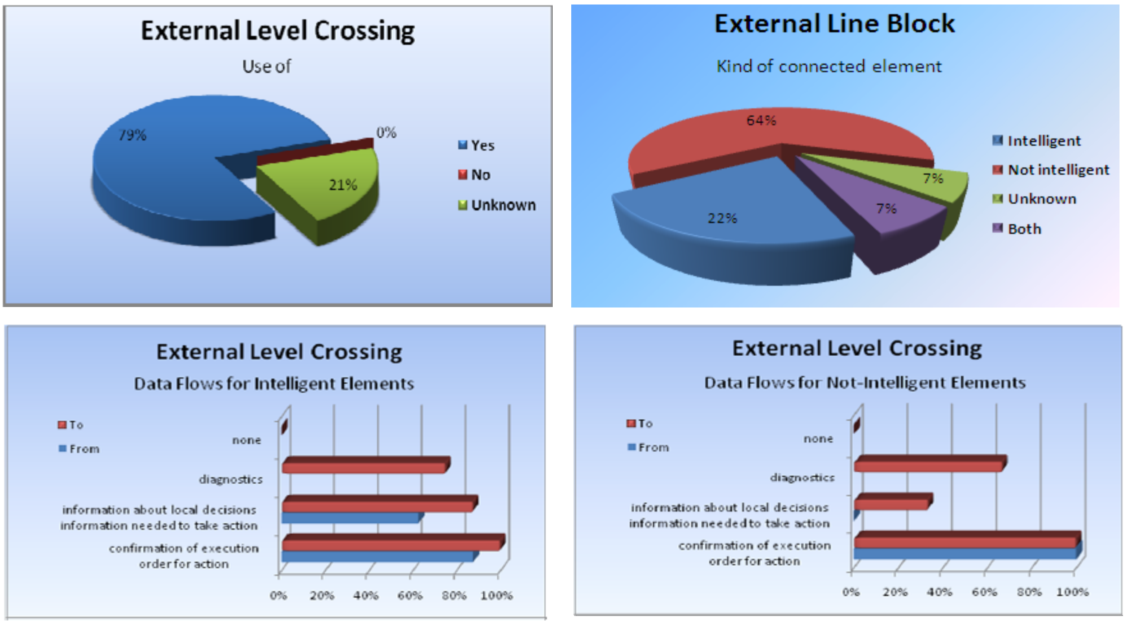
Concerning level crossings with interface to interlocking a major vote was, having level crossings as **intelligent** (Ratio 8:3).

This **majority** agreed mainly (with one exception) to have order for action like activating functions of level crossing. They also agreed (100%) to insist on confirmation of execution. None of the questionee drives level crossings without returned data from element.

The **minority** declared to have non intelligent level crossings. But this level crossings are also driven, like the intelligent ones. The minority agreed (100%) not to transmit information to level crossing in order to pass information needed to take action.

			External LX			
			Yes		No	
Kind of element connected intelligent			8		3	
			Yes	No	Yes	No
	kind of transmitted data to element					
		order for action (e.g. activate level crossing)	7	1	3	
		information needed to take action (e.g. train is approaching)	5	3		3
	kind of returned data from element					
		confirmation of execution	8		3	
		information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	7	1	1	2
		diagnosis information	6	2	2	1
		none		8		3

Table 4 Consistencies and Deviations Overview Level Crossing



Picture 7 Graphs with Statistic of External Level Crossing

3.5.5 Point

A major vote was having Point as **not intelligent** (Ratio 12:3).

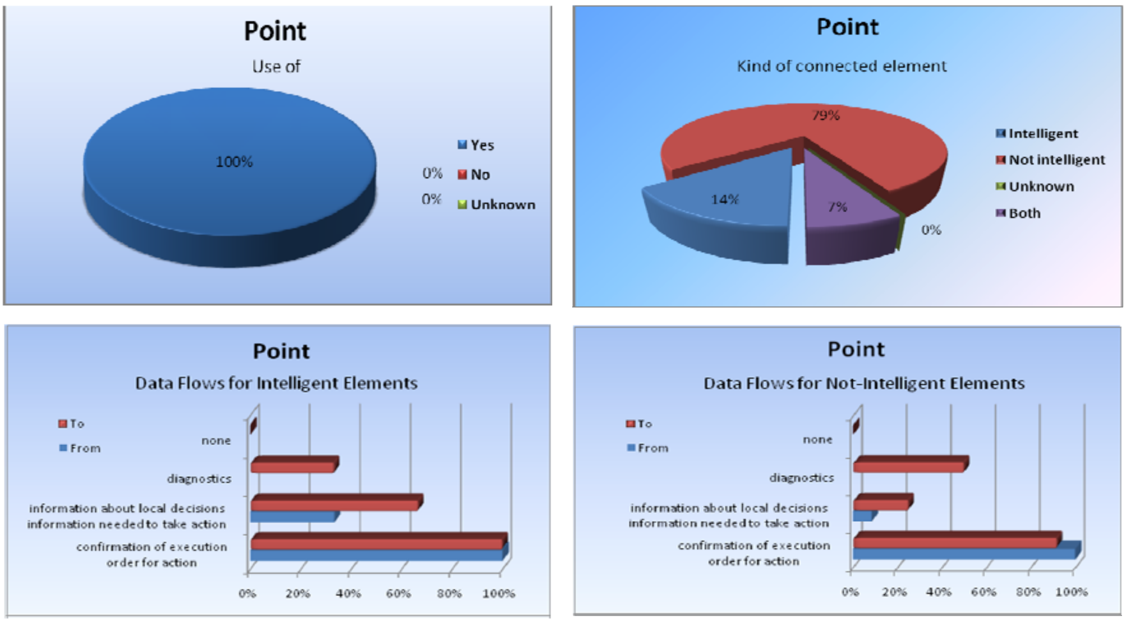
This **majority** agreed (100%) to transmit data to element in order for action (like point movements). Except of one questionee point are agreed to be used to pass information needed to take action.

The **minority** declared to have an intelligent point interface. Like majority (with one exception) point are agreed to be used for passing information needed to take sction.

They agreed (100%) to have confirmation of execution and no one disclaims return data from element.

			Point			
			Yes		No	
Kind of element connected intelligent			3		12	
			Yes	No	Yes	No
	kind of transmitted data to element					
		order for action (e.g. activate level crossing)	3		12	
		information needed to take action (e.g. train is approaching)	1	2	1	11
	kind of returned data from element					
		confirmation of execution	3		11	1
		information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	2	1	3	9
		diagnosis information	1	2	6	6
		none		3		12

Table 5 Consistencies and Deviations Overview Point



Picture 8 Graphs with Statistic of Point

3.5.6 Track Segment

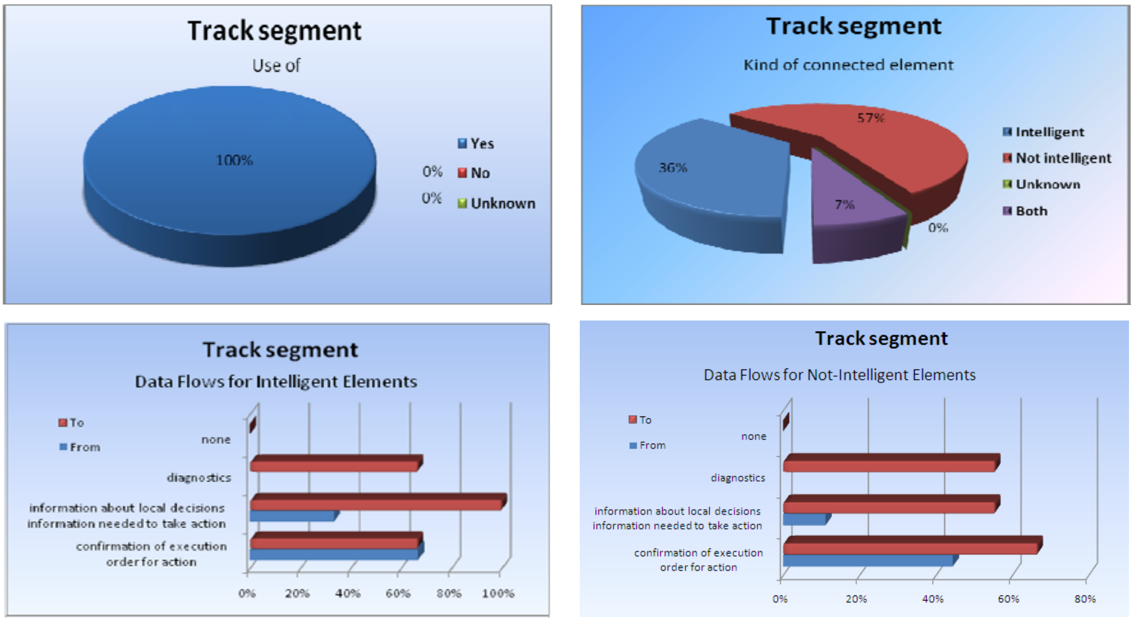
Track Segments are some considered as intelligent and some as not (Ratio 6:9).

The small **majority** agreed to have non intelligent Track Segments. These are (with one exception) not used to pass information needed to take action. Of course the questionees agreed (100%) to expect information from track segment.

The **minority** agreed (100%) to expect information from track segment in order to take further action in interlocking (which is not the case with non intelligent track segments).

	Track Segment			
	Yes		No	
Kind of element connected intelligent	6		9	
	Yes	No	Yes	No
kind of transmitted data to element				
order for action (e.g. activate level crossing)	4	2	4	5
information needed to take action (e.g. train is approaching)	2	4	1	8
kind of returned data from element				
confirmation of execution	4	2	6	3
information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	6		5	4
diagnosis information	4	2	5	4
none		6		9

Table 6 Consistencies and Deviations Overview Track Segment



Picture 9 Graphs with Statistic of Track Segment

3.5.7 Signal

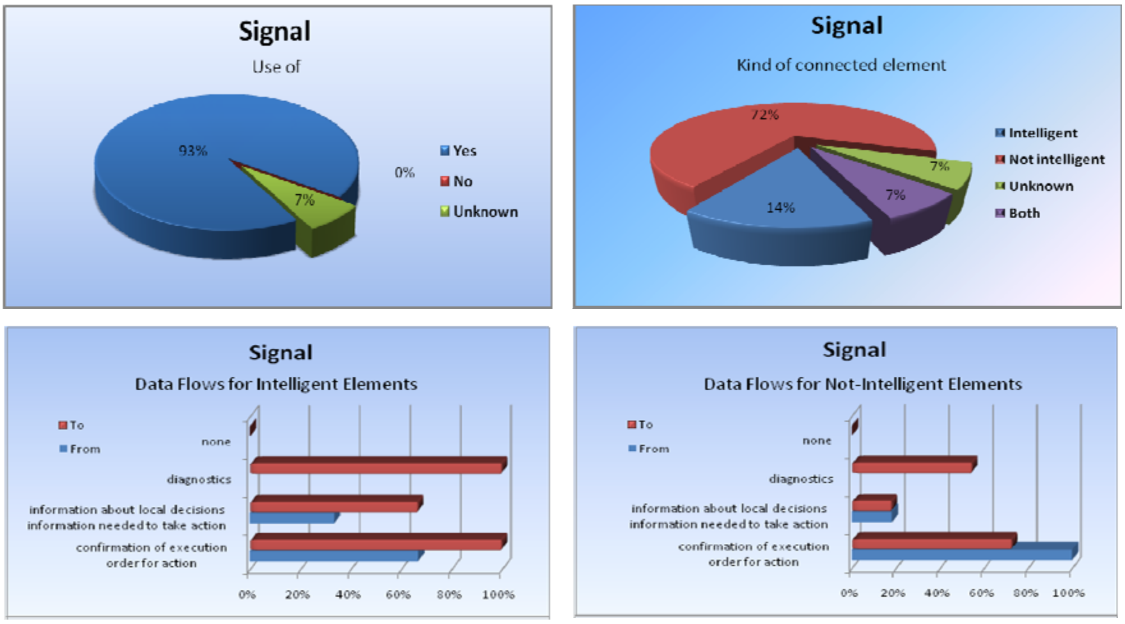
A major vote was having signals as **not intelligent** (Ratio 3:11).

This **majority** agreed (100%) to transmit data to element in order for action (like commands). They also agree to expect data back from element. Six out of eleven expects diagnosis information back from signal, although element is not intelligent.

The **minority** declared to have an intelligent signal. They agreed (100%) to have confirmation of execution, as well they agreed (100%) to expect diagnosis information back from signal.

			Signal			
			Yes		No	
Kind of element connected intelligent			3		11	
			Yes	No	Yes	No
	kind of transmitted data to element					
		order for action (e.g. activate level crossing)	2	1	11	
		information needed to take action (e.g. train is approaching)	1	2	2	9
	kind of returned data from element					
		confirmation of execution	3		8	3
		information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)	2	1	2	9
		diagnosis information	3		6	5
		none		3		11

Table 7 Consistencies and Deviations Overview Signal



Picture 10 Graphs with Statistic of Signal

3.5.8 ATP

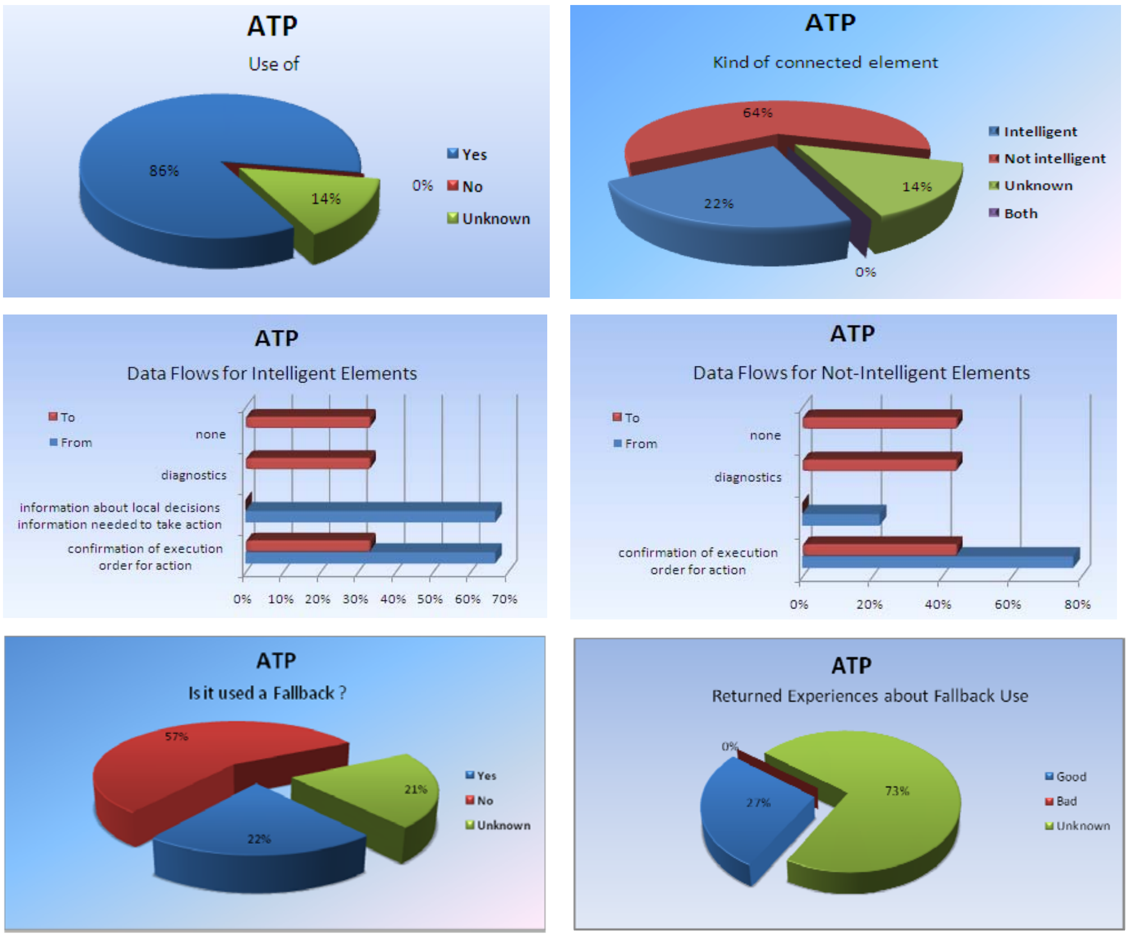
A major vote was having ATP as **not intelligent** (Ratio 9:2).

This **majority** agreed (100%) not to have information back about local decisions needed in the interlocking system for further action.

The **minority** declared to have an intelligent ATP. They agreed (100%) to have transmitted data to element in order for taking action and (also 100%) to have information needed to take action in an operational sense. They agreed also (100%) to have the same kind of returned data from element like majority have information back about local decisions needed in the interlocking system for further action.

	ATP			
	Yes		No	
Kind of element connected intelligent	2		9	
	Yes	No	Yes	No
kind of transmitted data to element				
order for action (e.g. activate level crossing)	2		7	2
information needed to take action (e.g. train is approaching)	2		2	7
kind of returned data from element				
confirmation of execution	1	1	4	5
information about local decisions needed in the interlocking system for further action (e.g. broken down data connection re established)		2		9
diagnosis information	1	1	4	5
none	1	1	4	5

Table 8 Consistencies and Deviations Overview ATP

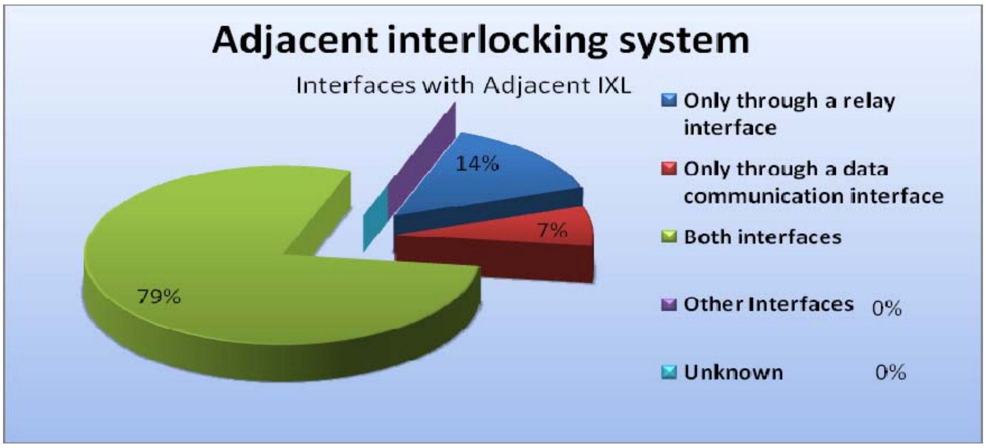


Picture 11 Graphs with Statistic of ATP

3.5.9 Adjacent Interlocking system

3.5.9.1 Adjacent Interlocking system interfaces

The **majority** (79%) of provider / supplier claimed to have both relay and electronic interface in place. The installed base of these is at fifty / fifty. The **minority** has only one technology in place.



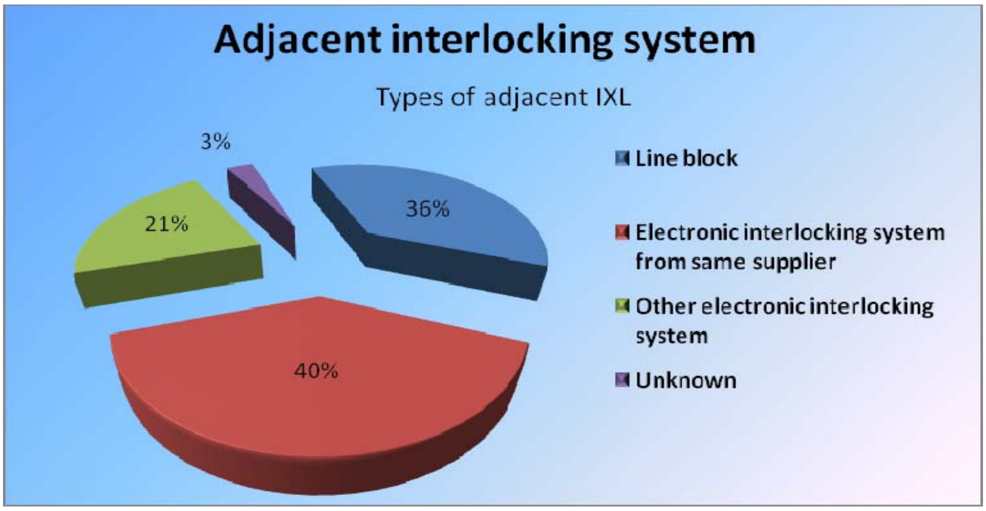
Picture 12 – Interfaces with Adjacent IXL systems

Answer	Quantity
I use **only relay interfaces** with adjacent IXL systems	2 (14%)
I use **only data communication interfaces** with adjacent IXL systems	1 (7%)
I use **both** relay interfaces and data communication interfaces with adjacent IXL systems	11 (79%)
No, I use other kind of interfaces	0 (0%)
I don't know	0 (0%)

Table 1 – Interfaces with Adjacent IXL systems

3.5.9.2 Types of adjacent Interlocking systems

Most provider / supplier claims to have an adjacent electronic interface to the same supplier or to Line block. Anyhow a up to quarter of questionees do have an electronic interface to another supplier.



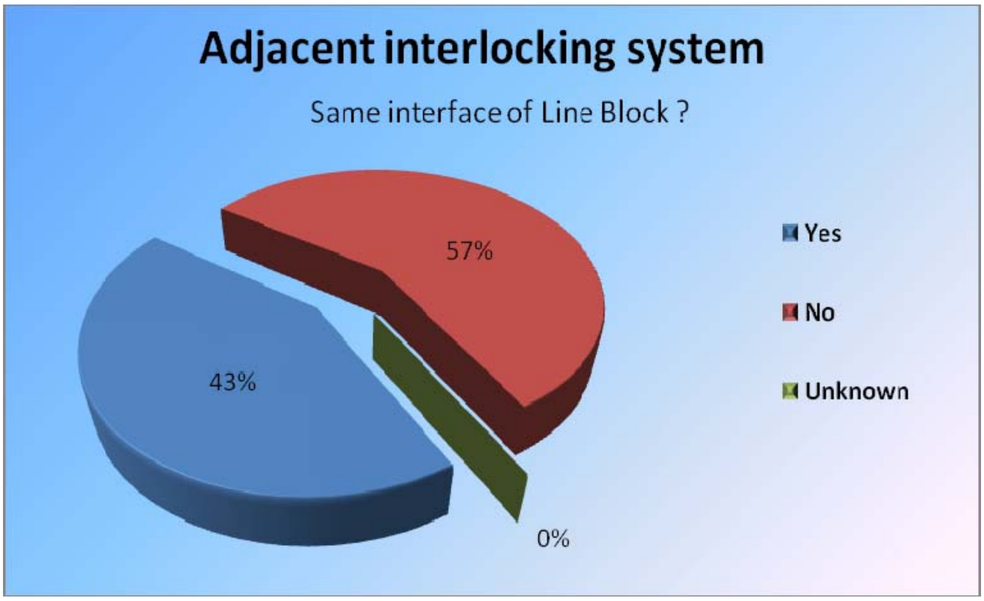
Picture 13 –Types of adjacent Interlocking systems

Answer	Quantity
Adjacent IXL systems are usually **line block** systems	12 (36%)
Adjacent IXL systems are usually **electronic interlocking systems from same supplier**	13 (40%)
Other kind of electronic interlocking systems	7 (21%)
I don't know	1 (3%)

Table 2 – Types of Adjacent IXL systems

3.5.9.3 Same interface of line block systems ?

At about half of the questionees have the same interface to adjacent IXL than to Line Block. This may be a hint, that it is usual to locate adjacent IXL interfaces on block boarders.



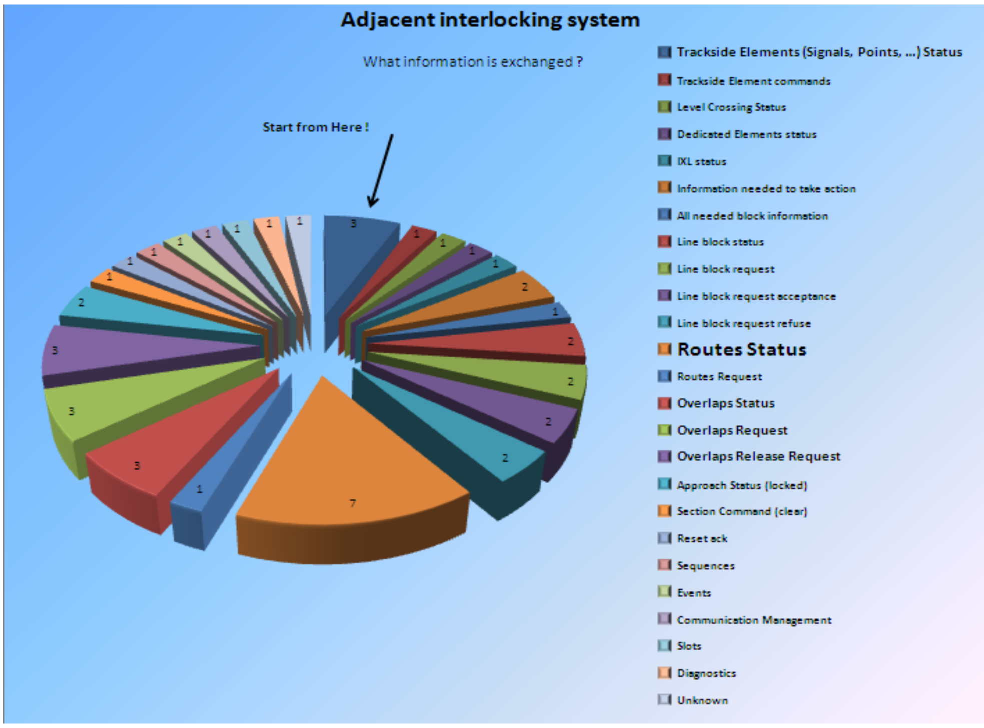
Picture 14 - Same interface of line block systems

Answer	Quantity
Yes, adjacent IXL interfaces are usually similar to interfaces used for line block systems	6 (43%)
No, adjacent IXL interfaces are different from line block system interfaces	8 (57%)
I don't know	0 (0%)

Table 3 – Adjacent IXL vs Line Block systems interfaces

3.5.9.4 Exchanged Information

Information transmitted over the adjacent IXL Interface is very heterogenic. It is not possible to define a common subset of information. On the other hand it seems, providing all information on the interfaces covers most operational scenarios customer / supplier independent.



Picture 15 - Exchanged Information

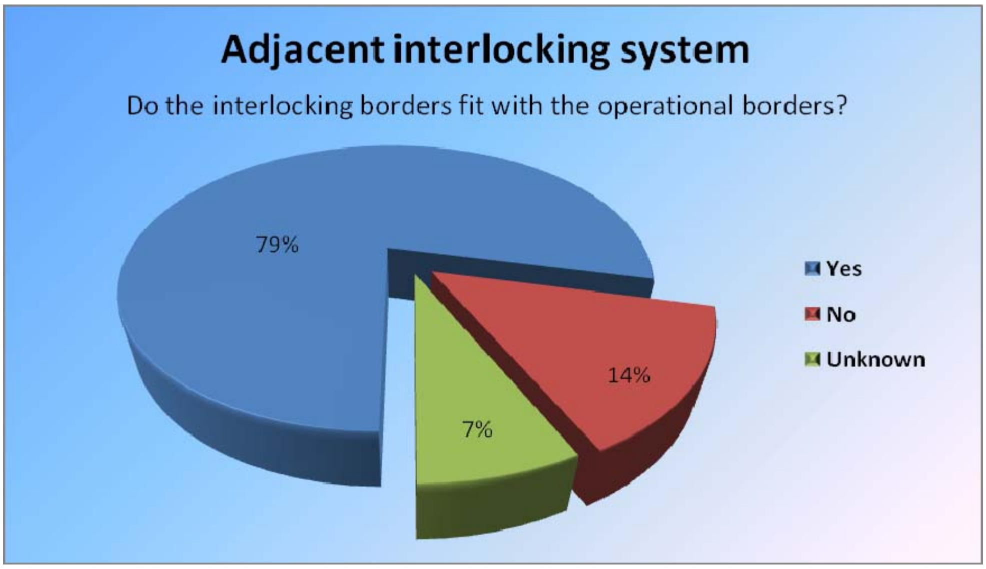
Answer	Quantity
Trackside Elements (Signals, Points, …) Status	3 (7%)
Trackside Element commands	1 (2%)
Level Crossing Status	1 (2%)
Dedicated Elements status	1 (2%)
IXL status	1 (2%)
Information needed to take action	2 (4%)
All needed block information	1 (2%)
Line block status	2 (4%)
Line block request	2 (4%)
Line block request acceptance	2 (4%)
Line block request refuse	2 (4%)
Routes Status	7 (16%)
Routes Request	1 (2%)

Overlaps Status	3 (7%)
Overlaps Request	3 (7%)
Overlaps Release Request	3 (7%)
Approach Status (locked)	2 (4%)
Section Command (clear)	1 (2%)
Reset ack	1 (2%)
Sequences	1 (2%)
Events	1 (2%)
Communication Management	1 (2%)
Slots	1 (2%)
Diagnostics	1 (2%)
Trackside Elements Status	1 (2%)
I don't know	1 (2%)

Table 4 – Exchanged Information with adjacent interlocking

3.5.9.5 Do interlocking borders fit with operational borders ?

The **Majority** of supplier / provider claims to have IXL boarders fitting with operational boarders.



Picture 16 – Fit between interlocking and operational borders

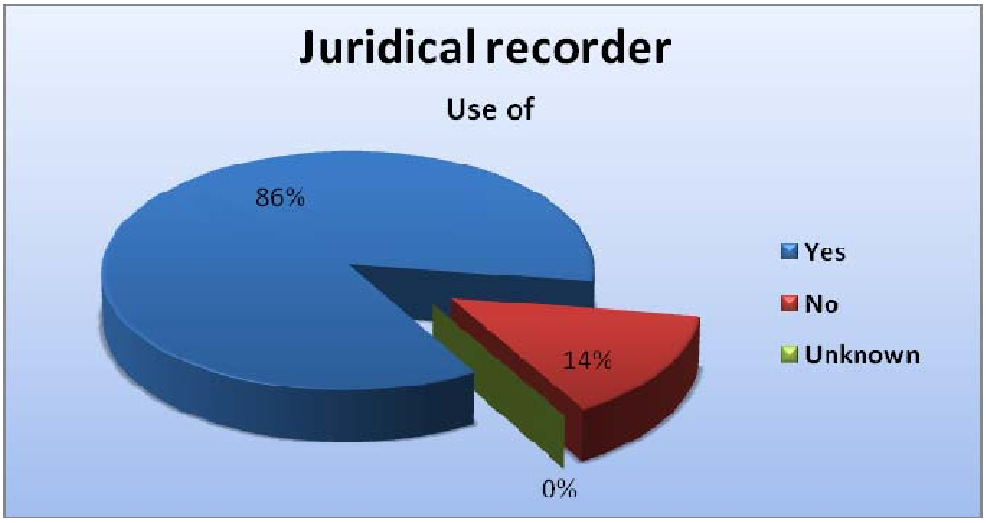
Answer	Quantity
Yes, interlocking borders and operational borders are the same	11 (79%)
No, interlocking borders and operational borders are different	2 (14%)
I don't know	1 (7%)

Table 5 – Fit between interlocking and operational borders

3.5.10 Juridical Recorder

3.5.10.1 Use of

The **Majority** of supplier / provider is using a juridical recorder.



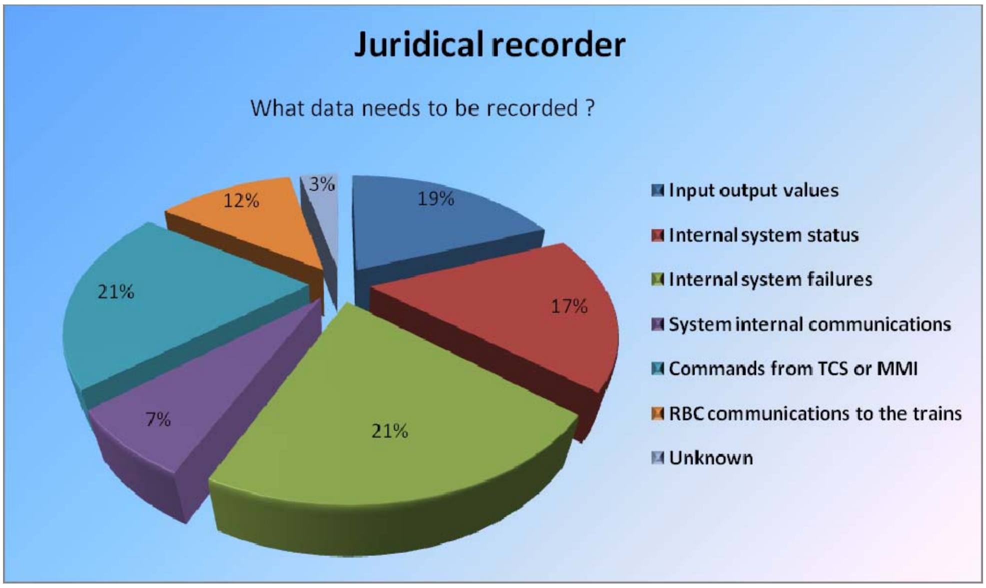
Picture 17 – Use of Juridical Recorder systems

Answer	Quantity
Yes, Juridical Recorders are used	12 (86%)
No, they are not used	2 (14%)
I don't know	0 (0%)

Table 6 – Use of Juridical Recorder systems

3.5.10.2 What data needs to be recorded ?

Kind of data recorded on juridical recorder is very heterogenic. It is not possible to define a common subset of information. On the other hand it seems, providing all information for the juridical recorder covers most supplier needs.



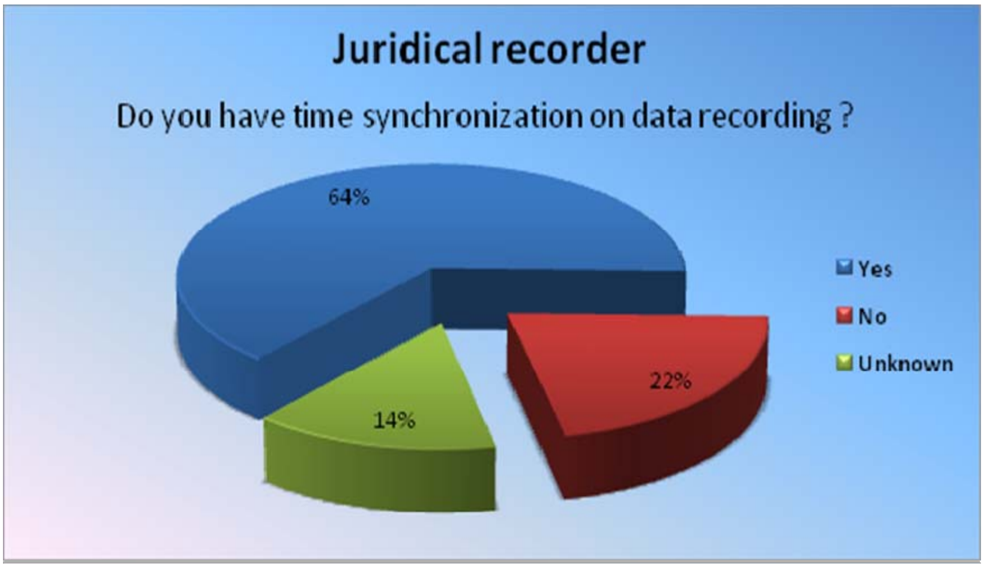
Picture 18 - Data recorded by Juridical Recorder systems

Answer	Quantity
I/O values	11 (19%)
Internal system status	10 (17%)
Internal system failures	12 (21%)
System internal communications	4 (7%)
Commands from TCS or MMI	12 (21%)
RBC communications to the trains	7 (12%)
Unknown	2 (3%)

Table 7 – Data recorded by Juridical Recorder systems

3.5.10.3 Do you have time synchronization on data recording ?

Most supplier / provider do time synchronizing of subsystems they collect data from. A minority covers time and events without synchronizing clocks in subsystems.



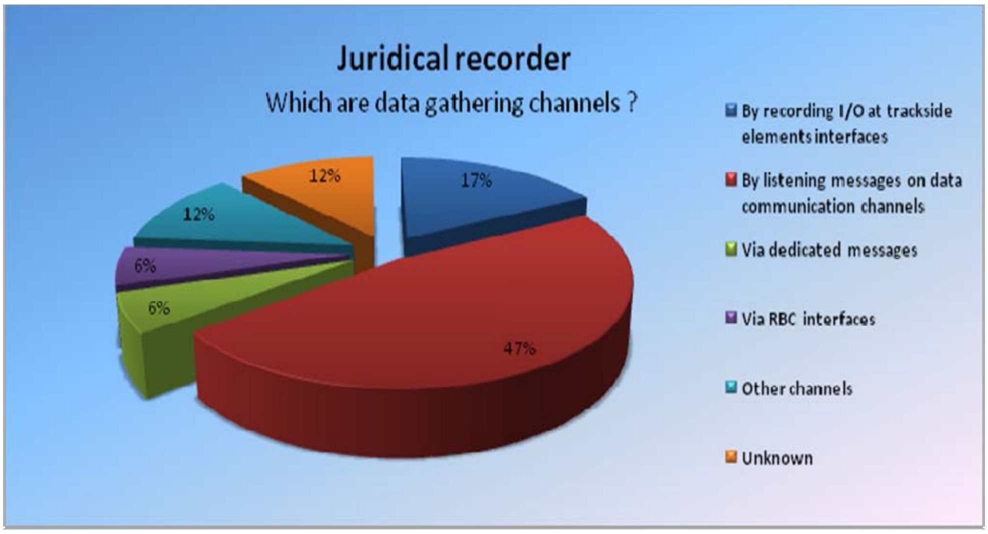
Picture 19 – Data Synchronization in Juridical Recorder systems

Answer	Quantity
Yes, recorded data in the project has synchronized time stamps	9 (64%)
No, data time stamps are not synchronized	3 (22%)
Unknown	2 (14%)

Table 8 – Data Synchronization in Juridical Recorder systems

3.5.10.4 Which are data gathering channels ?

At about half of supplier / provider collects data by listening messages on data communication channels. The other half shows a heterogenic approach of techniques and kind of data collected.



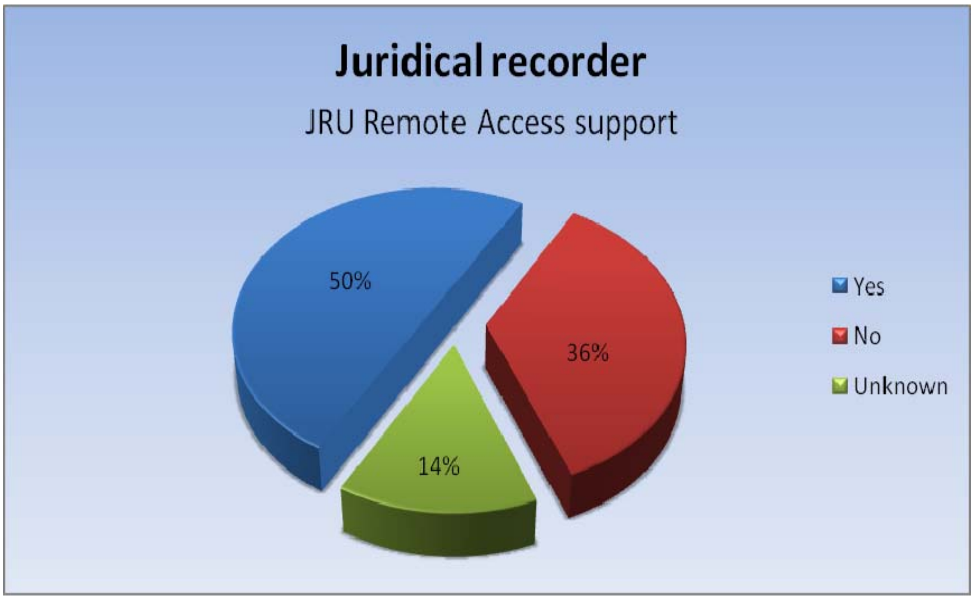
Picture 20 – Data Gathering Channels used by Juridical Recorder systems

Answer	Quantity
By recording I/O **at trackside elements interfaces**	3 (17%)
By listening messages **on data communication channels**	8 (47%)
Via **dedicated messages**	1 (6%)
By **RBC interfaces**	1 (6%)
Other channels	2 (12%)
Unknown	2 (12%)

Table 9 – Data Gathering Channels used by Juridical Recorder systems

3.5.10.5 JRU Remote Access support

Half of provider / supplier have remote access to their juridical recorders. One third collects data offline e. g. in case of accident.



Picture 21 – JRU Remote Access support

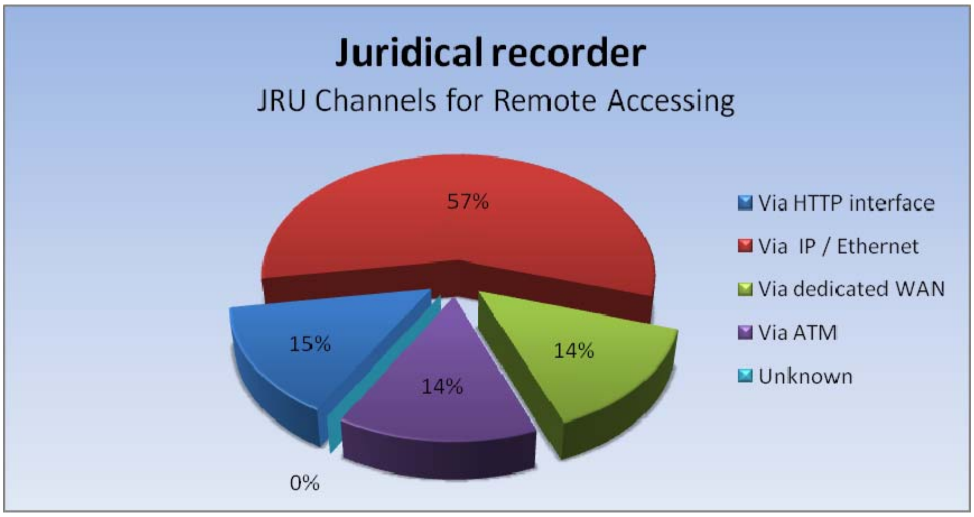
Answer	Quantity
Yes, remote access is supported	7 (50%)
No, remote access is not supported	5 (36%)
Unknown	2 (14%)

Table 10 – JRU Remote Access support

3.5.10.6 JRU Channels for Remote Accessing

If remote access exists over one half of provider / supplier do access via a WEB interface (HTTP) (this is a quarter in total of all supplier / provider). The other half is uniformly distributed on IP/Ethernet, dedicated WAN and ATM.

The problem with this chart is the unclear separation of terms in context of OSI layers. So information may overlap e.g. HTTP is communicated over IP / Ethernet and that may be a dedicated WAN connection.



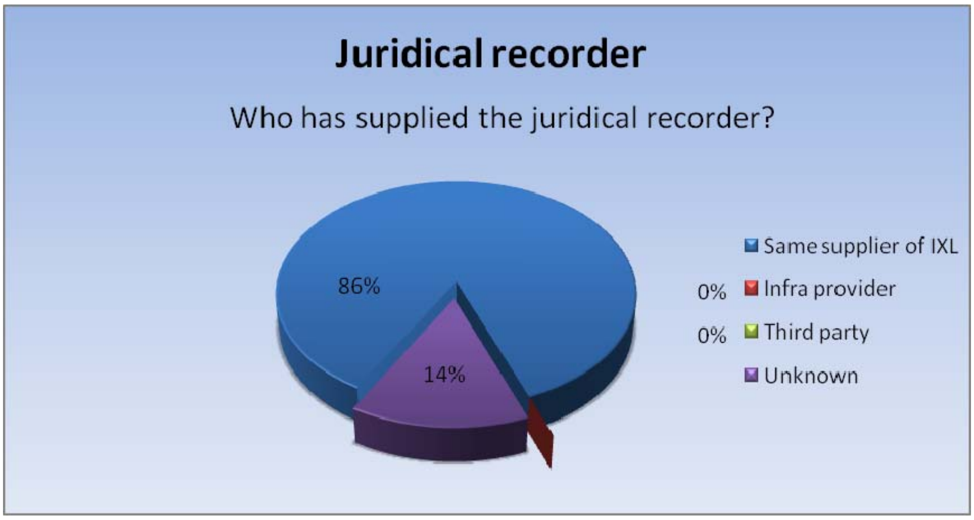
Picture 22 – JRU Remote Access Channels

Answer	Quantity
Via HTTP interface	1 (15%)
Via IP / Ethernet	4 (57%)
Via dedicated WAN	1 (14%)
Via ATM	1 (14%)
Unknown	0 (0%)

Table 11 – JRU Remote Access Channels

3.5.10.7 JRU Suppliers

Juridical recorders seems generally supplied by IXL provider.



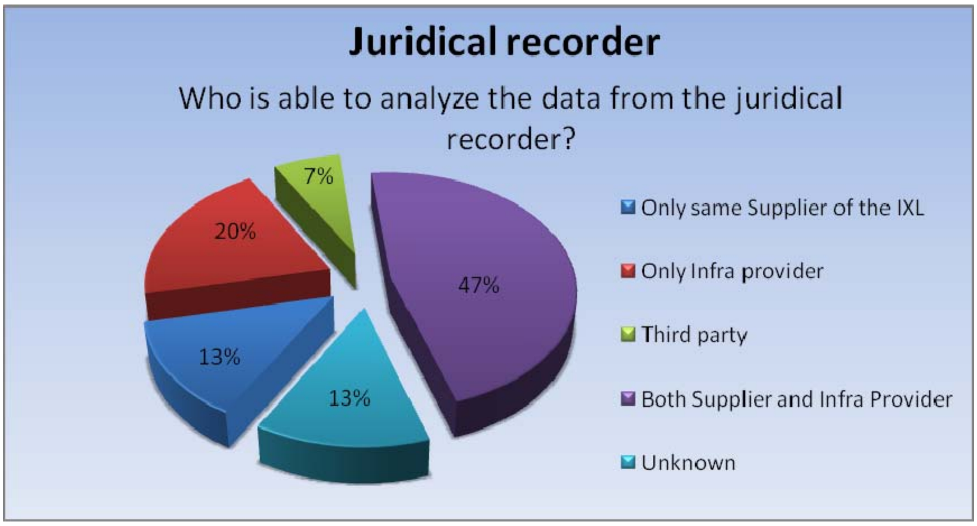
Picture 23 – JRU Suppliers

Answer	Quantity
Same supplier of IXL system	12 (86%)
Infra provider	0 (0%)
Third part	0 (0%)
Unknown	2 (14%)

Table 12 – JRU Suppliers

3.5.10.8 Who is able to analyze data from JRU ?

Typical supplier and provider do analyze data of juridical recorder (one half). A clear **minority** uses a third party to analyze juridical data



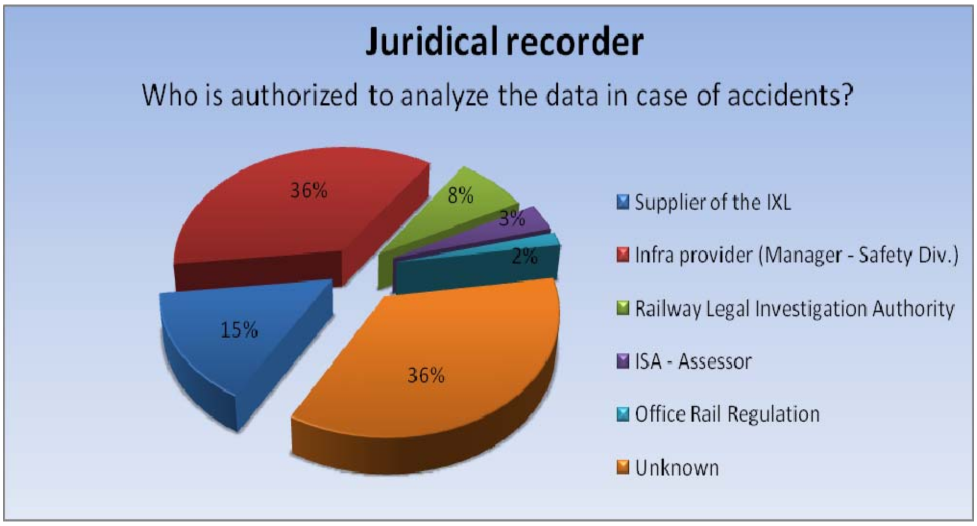
Picture 24 – Who is able to analyze data from JRU ?

Answer	Quantity
Only **same supplier of IXL system**	2 (13%)
Only **Infra provider**	3 (20%)
Both supplier of IXL and Infra provider	7 (47%)
Third part	1 (7%)
Unknown	2 (13%)

Table 13 – Who is able to analyze data from JRU ?

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

This question shows an unbalanced picture, which seems to be driven by national law.



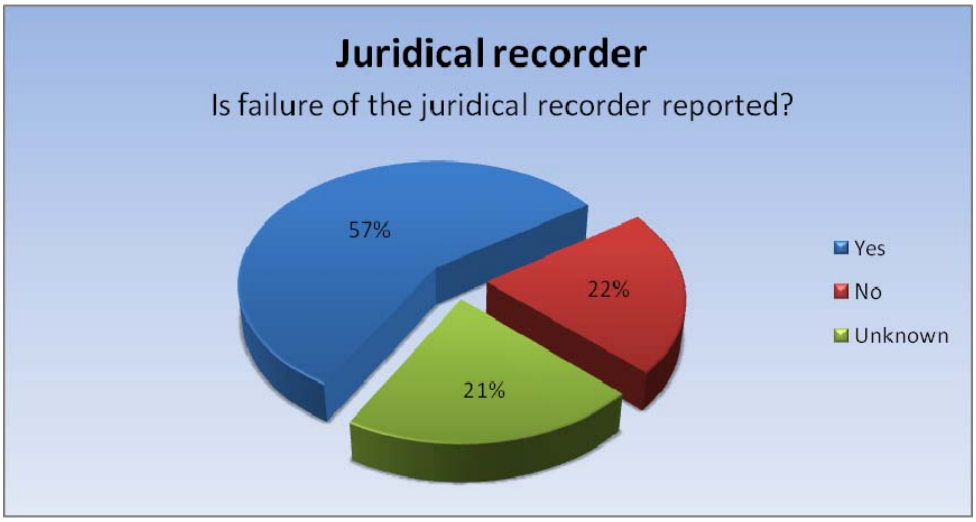
Picture 25 – Who is authorized to analyze data in case of accident ?

Answer	Quantity
Same supplier of IXL system	2,08 (15%)
Infra provider (Manager – Safety Div.)	5,08 (36%)
Railway Legal Investigation Authority	1,08 (8%)
ISA Assessor	0,50 (3%)
Office Rail Regulation	0,25 (2%)
Unknown	5 (36%)

Table 14 – Who is authorized to analyze data in case of accident ?

3.5.10.10 Is failure of juridical recorder reported ?

Typical juridical recorder is under supervision of IXL (over one half). The **minority** does not have supervision (a quarter). Any JRU failure is reported mainly (80%) via diagnostic system, or (20%) via an alarm in IXL equipment itself.



Picture 26 – Is failure of juridical recorder reported ?

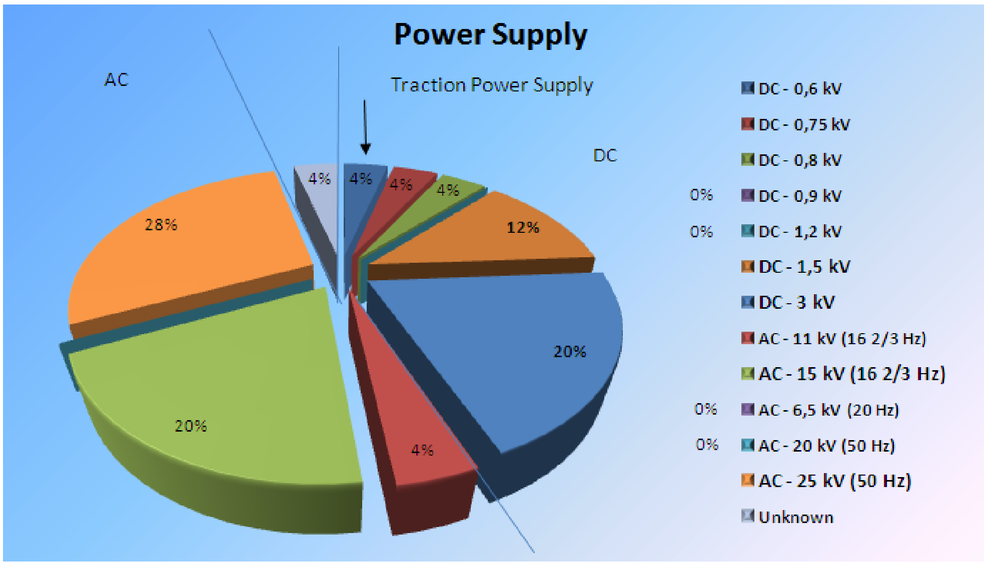
Answer	Quantity
Yes	8 (57%)
No	3 (22%)
Unknown	3 (21%)

Table 15 – Is failure of juridical recorder reported ?

3.5.11 Power Supply

3.5.11.1 Traction Sources Power Supply

Traction Sources diagram shows a versatile image with some clusters. No trend and no majorities are visible.



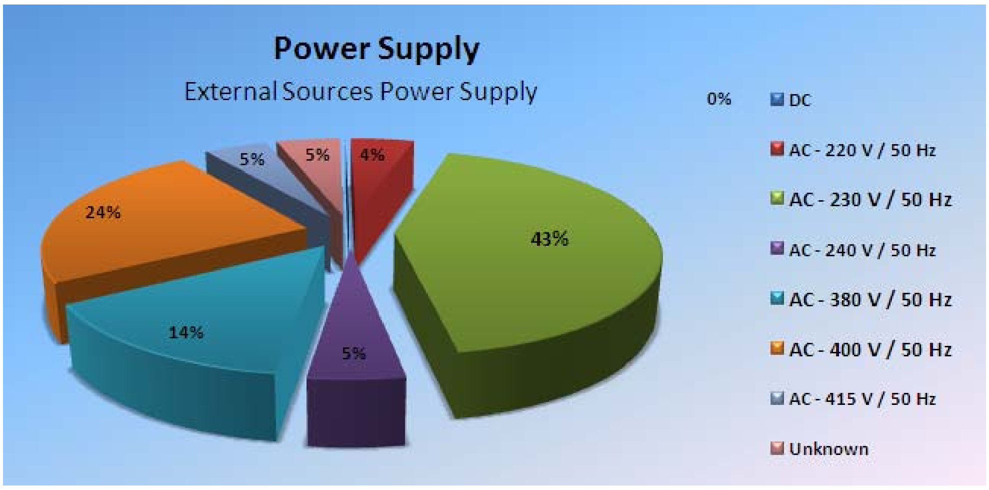
Picture 27 – Traction Power Supplies

Answer		**Quantity**
DC	0,6 kV	1 (4%)
	0,75 kV	1 (4%)
	0,8 kV	1 (4%)
	0,9 kV	0 (0%)
	1,2 kV	0 (0%)
	1,5 kV	3 (12%)
	3 kV	5 (20%)
AC	11 kV (16 2/3 Hz)	1 (4%)
	15 kV (16 2/3 Hz)	5 (20%)
	6,5 kV (20 Hz)	0 (0%)
	20 kV (50 Hz)	0 (0%)
	25 kV (50 Hz)	7 (28%)
Unknown		1 (4%)

Table 16 – Traction Power Supplies

3.5.11.2 External Sources Power Supply

External sources power supply shows a versatile image partly with a clusters at AC 230V / 50 Hz. No trend and no majorities are visible.



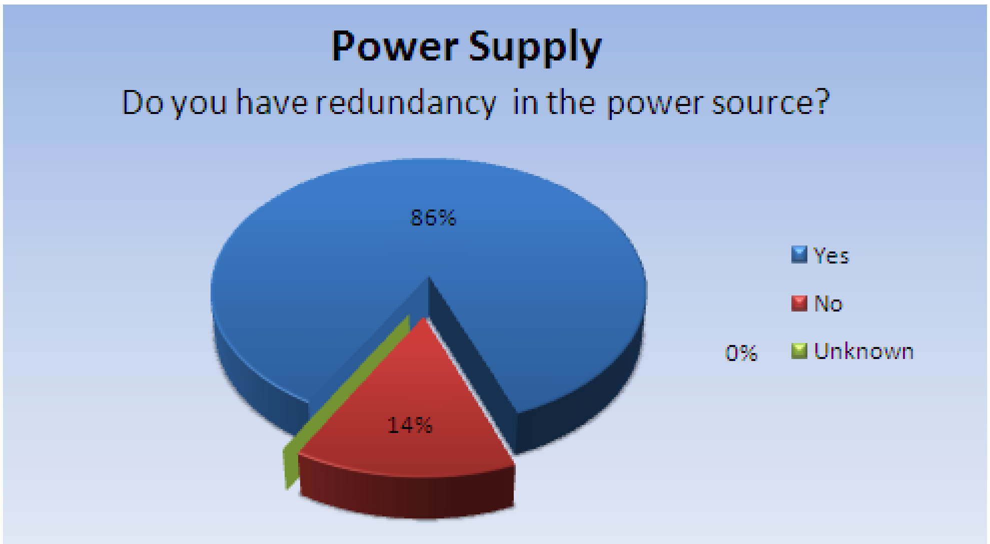
Picture 28 – External Sources Power Supplies

Answer		Quantity
DC	All	0 (0%)
AC	220 V / 50 Hz	1 (4%)
	230 V / 50 Hz	9 (43%)
	240 V / 50 Hz	1 (5%)
	380 V / 50 Hz	3 (14%)
	400 V / 50 Hz	5 (24%)
	415 V / 50 Hz	1 (5%)
Unknown		1 (5%)

Table 17 – External Sources Power Supplies

3.5.11.3 Power Source Redundancy ?

Majority of supplier / provider claims to have a redundant power source.



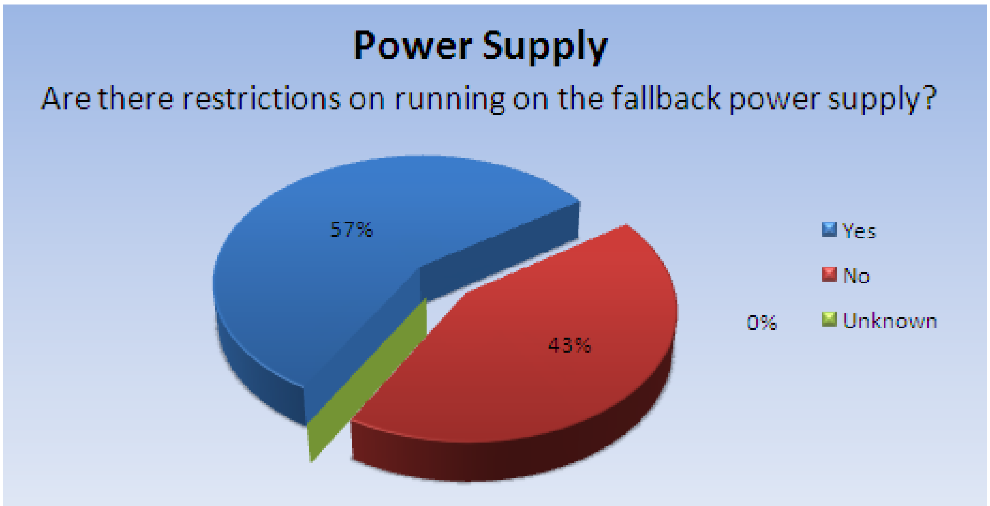
Picture 29 – Power Source Redundancy

Answer	Quantity
Yes	12 (86%)
No	2 (14%)
Unknown	0 (0%)

Table 18 – Power Source Redundancy

3.5.11.4 Restriction on running fall back

A strong half of supplier / provider does have restriction in case of power supply fall back.



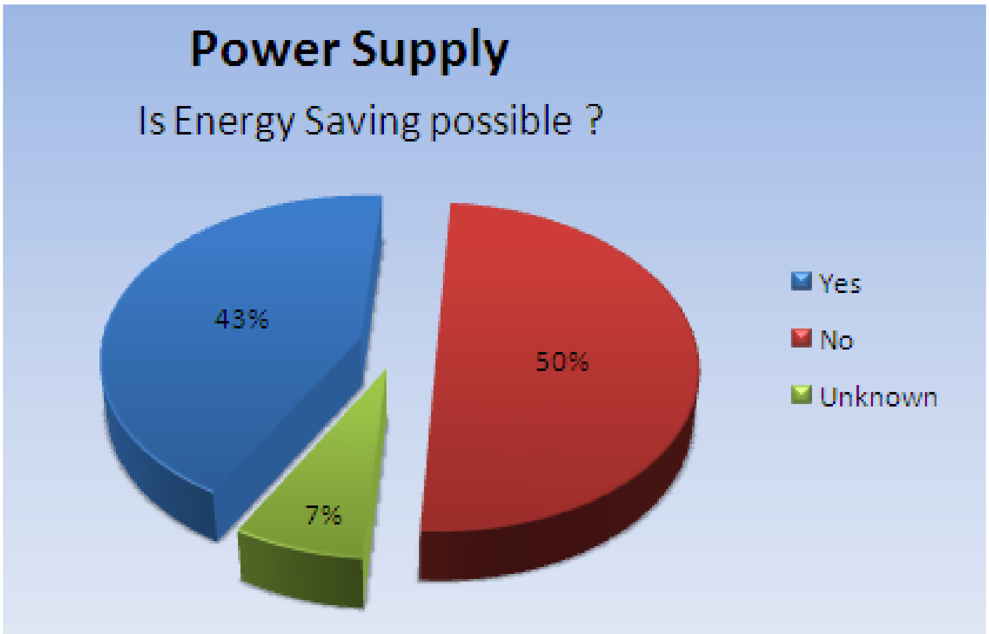
Picture 30 – Power Source Redundancy

Answer	Quantity
Yes	8 (57%)
No	6 (43%)
Unknown	0 (0%)

Table 19 – Is there any restriction on running on the fallback power supply ?

3.5.11.5 Is Energy Saving possible ?

A weak half of supplier / provider have power supply feature implemented in order to save energy.



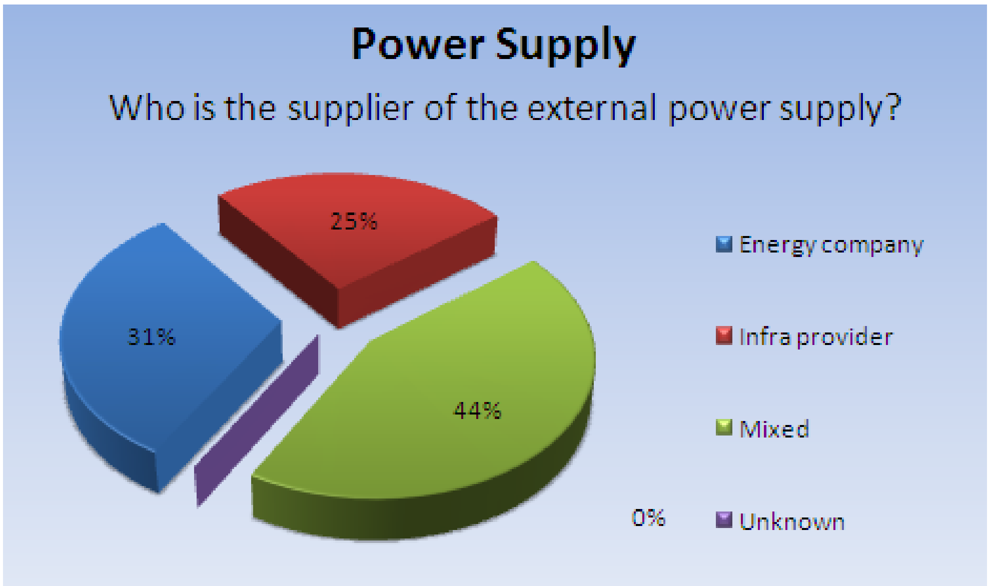
Picture 31 – Is Energy Saving possible

Answer	Quantity
Yes, it is possible	6 (43%)
No, it isn't	7 (50%)
Unknown	1 (7%)

Table 20 – Energy Savings

3.5.11.6 Who is the supplier of the external Power Supply ?

The information about “who is supplier of external power supply” seems to have an emphasis at provider mixed between on Energy resp. Infra provider.



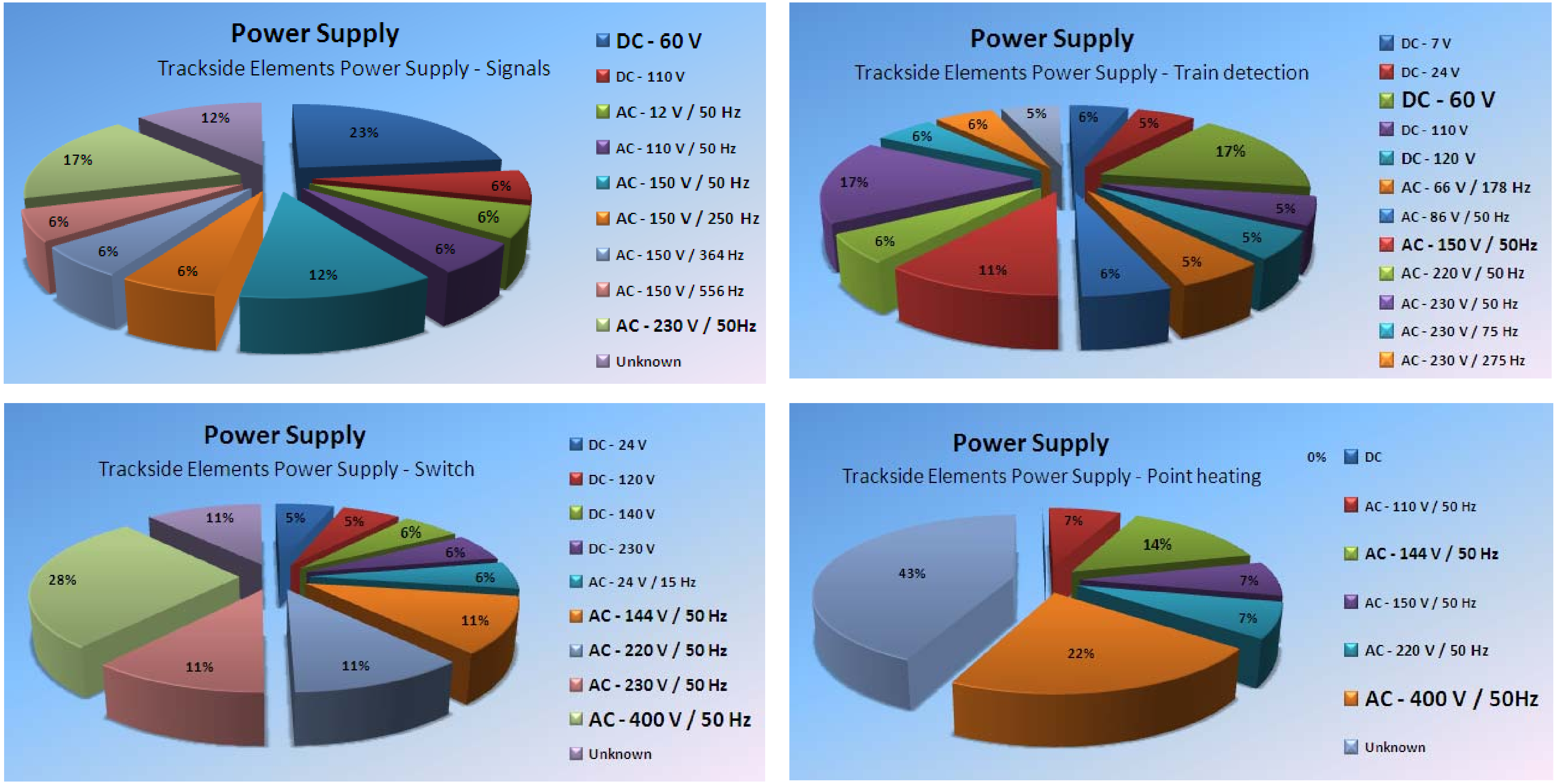
Picture 32 – Who is the supplier of the external Power Supply?

Answer	Quantity
Energy Company	5 (31%)
Infra provider	4 (25%)
Mixed	7 (44%)
Unknown	0 (0%)

Table 21 – External Power Suppliers

3.5.11.7 Trackside Elements Power Supply

Traction Sources diagram shows a versatile image partly with some clusters. No trend and no majorities are visible.



Picture 33 – Trackside Elements Power Supply

SIGNALS Answer	Quantity
DC - 60 V	4 (23%)
DC - 110 V	1 (6%)
AC - 12 V / 50 Hz	1 (6%)
AC - 110 V / 50 Hz	1 (6%)
AC - 150 V / 50 Hz	2 (12%)
AC - 150 V / 250 Hz	1 (6%)
AC - 150 V / 364 Hz	1 (6%)
AC - 150 V / 556 Hz	1 (6%)
AC - 230 V / 50Hz	3 (17%)
Unknown	2 (12%)

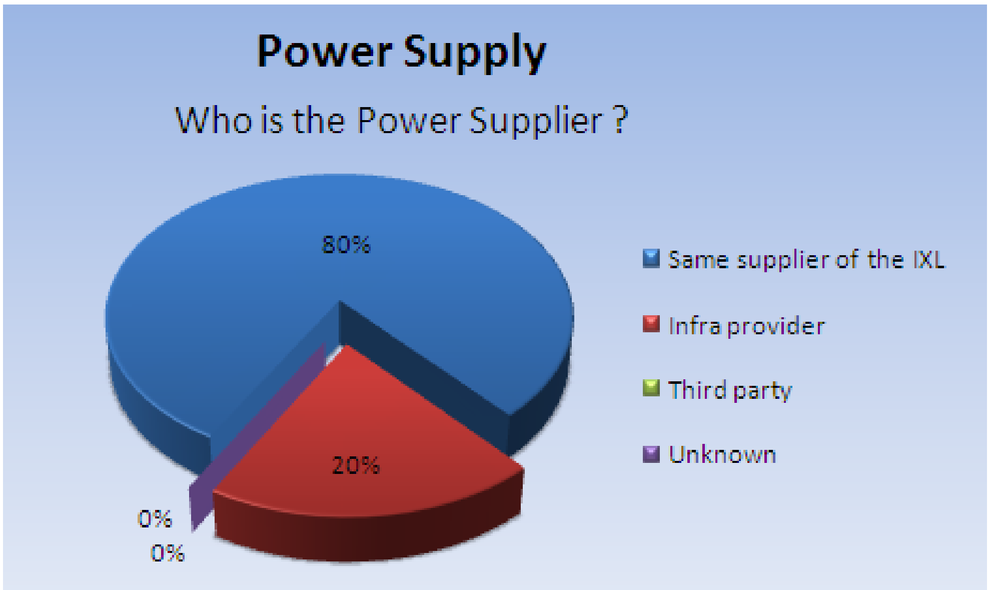
TRAIN DETECTION Answer	Quantity
DC - 7 V	1 (6%)
DC - 24 V	1 (6%)
DC - 60 V	3 (17%)
DC - 110 V	1 (5%)
DC - 120 V	1 (5%)
AC - 66 V / 178 Hz	1 (5%)
AC - 86 V / 50 Hz	1 (6%)
AC - 150 V / 50Hz	2 (11%)
AC - 220 V / 50 Hz	1 (6%)
AC - 230 V / 50 Hz	3 (17%)
AC - 230 V / 75 Hz	1 (6%)
AC - 230 V / 275 Hz	1 (6%)
Unknown	1 (5%)

SWITCH Answer	Quantity
DC - 24 V	1 (5%)
DC - 120 V	1 (5%)
DC - 140 V	1 (6%)
DC - 230 V	1 (6%)
AC - 24 V / 15 Hz	1 (6%)
AC - 144 V / 50 Hz	2 (11%)
AC - 220 V / 50 Hz	2 (11%)
AC - 230 V / 50 Hz	2 (11%)
AC - 400 V / 50 Hz	5 (28%)
Unknown	2 (11%)

Table 22 – Trackside Elements Power Supply

3.5.11.8 Who is the Power Supplier ?

Majority votes for having same supplier of power supply and IXL.



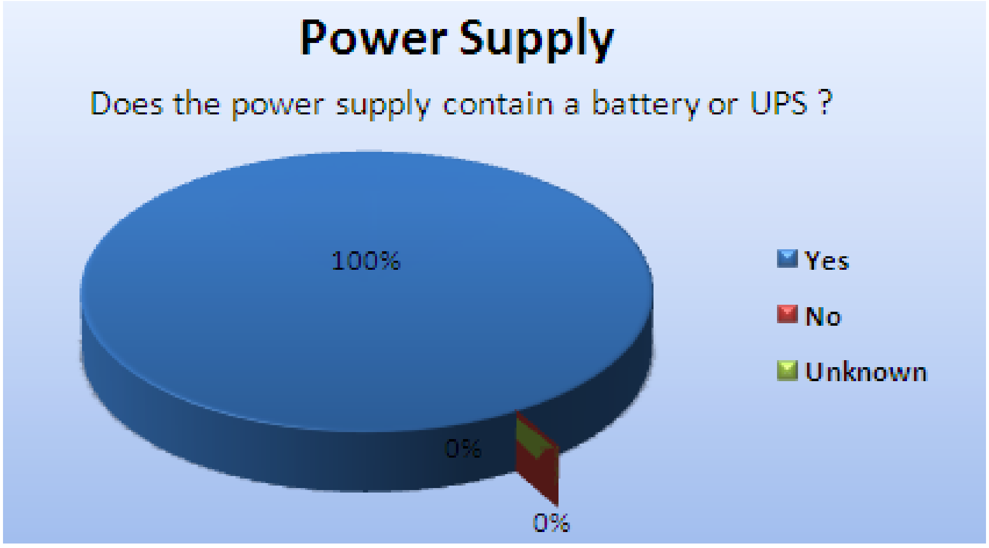
Picture 34 – Power Suppliers

Answer	Quantity
Same supplier of the IXL	12 (80%)
Infra provider	3 (20%)
Third Part	0 (0%)
Unknown	0 (0%)

Table 23 – Power Suppliers

3.5.11.9 Does the Power Supply contain a battery or UPS ?

All supplier / provider agrees to use batteries in power supply.



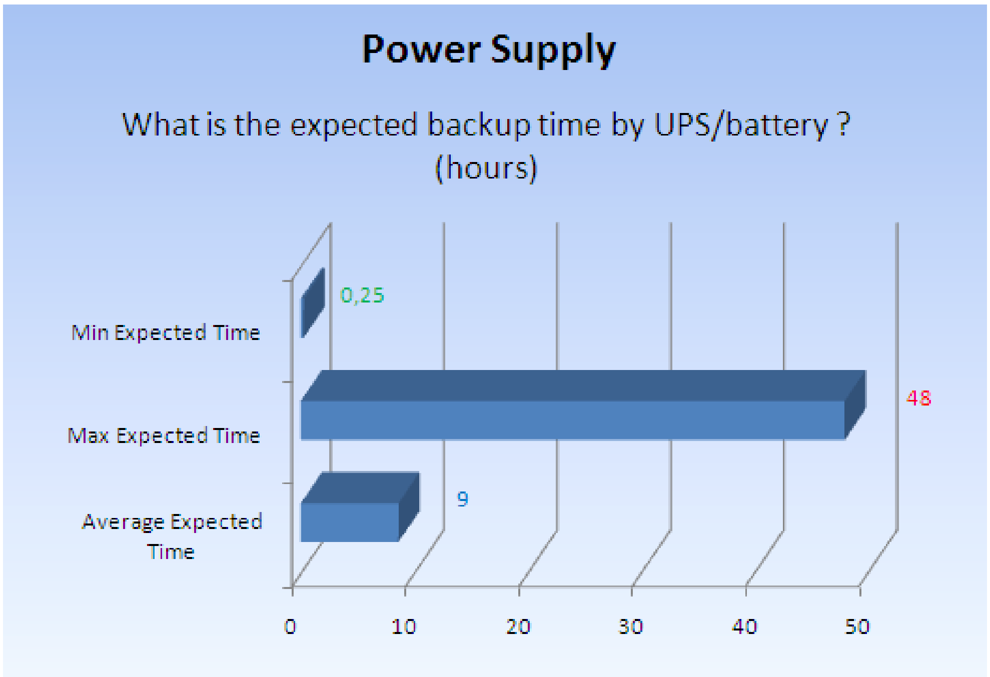
Picture 35 – Use of UPS

Answer	Quantity
Yes, it includes UPS	14 (100%)
No, it doesn't include	0 (0%)
I don't know	0 (0%)

Table 24 – Use of UPS

3.5.11.10 What is the expected backup time by UPS/battery ?

Battery usage in UPS seems to be common sense is used for spanning the gap while switching to redundant power supply in case of power supply break down.



Picture 36 – Expected backup time by UPS/battery

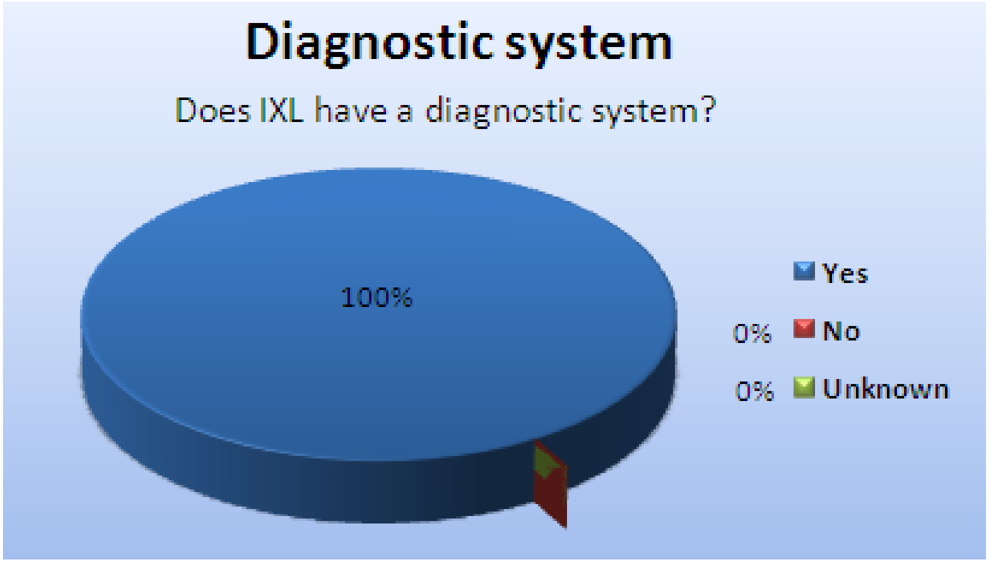
Answer	Quantity
Average expected UPS backup time	9 hours
Max expected UPS backup time	48 hours
Min expected UPS backup time	0,25 hours

Table 25 – Expected backup time by UPS/battery

3.5.12 Diagnostic System

3.5.12.1 Does IXL have a diagnostic system?

All IXL do have Diagnostic systems



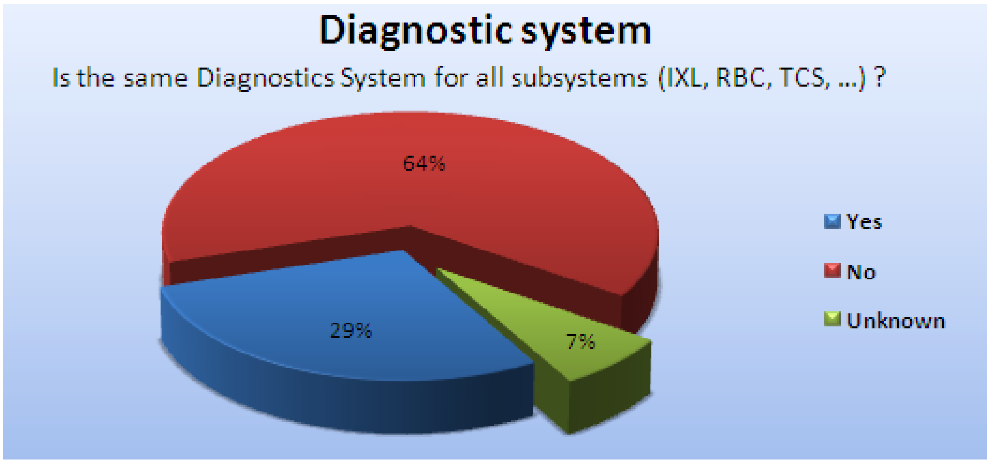
Picture 37 – Diagnostic System use

Answer	Quantity
Yes	14 (100%)
No	0 (0%)
Unknown	0 (0%)

Table 26 – Diagnostic System use

3.5.12.2 Is the same Diagnostics System for all subsystems (IXL, RBC, TCS, …) ?

The **majority** agrees to have separate diagnostic systems for IXL, RBC and TXL.



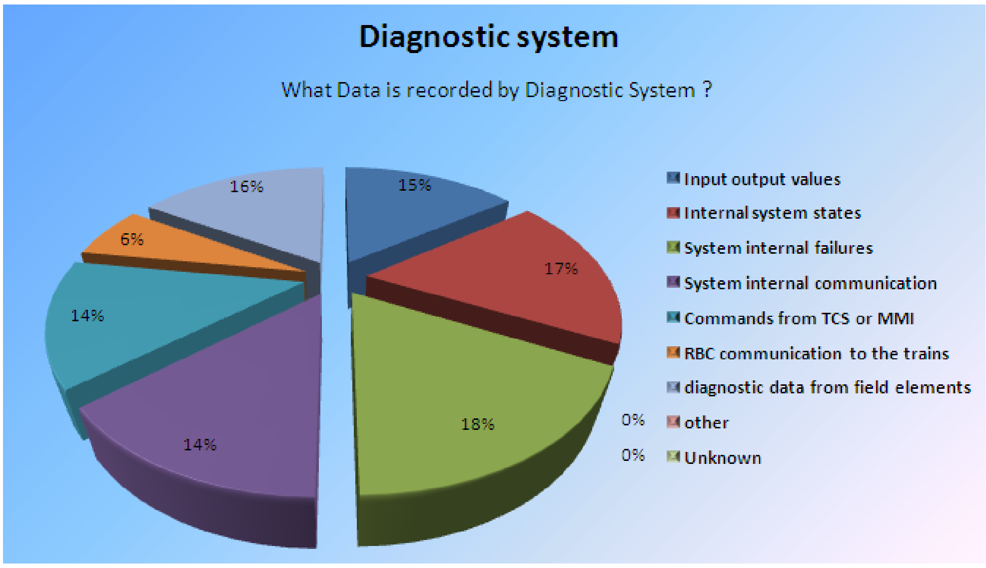
Picture 38 – Is the same Diagnostics System for all subsystems (IXL, RBC, TCS, …) ?

Answer	Quantity
Yes, it is.	4 (29%)
No	9 (64%)
Unknown	1 (7%)

Table 27 – Is the same Diagnostics System for all subsystems (IXL, RBC, TCS, …) ?

3.5.12.3 What Data is recorded by Diagnostic System ?

Type of data collected of diagnosis systems seem to be equal distributed without any emphasised types of data.



Picture 39 – Recorded Data by Diagnostic System

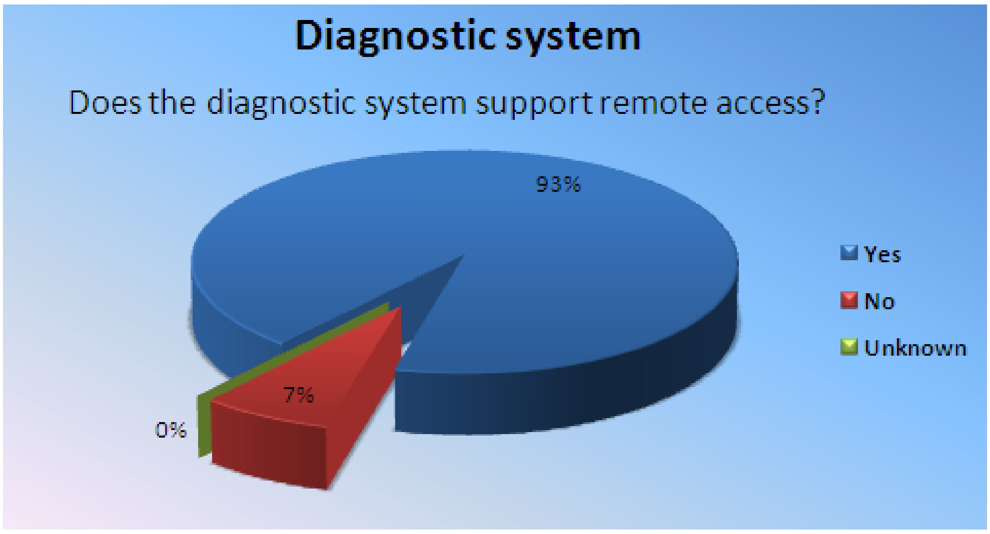
Answer	Quantity
Input output values	12 (15%)
Internal system states	14 (17%)
System internal failures	14 (18%)
System internal communication	11 (14%)
Commands from TCS or MMI	11 (14%)
RBC communication to the trains	5 (6%)

diagnostic data from field elements	13 (16%)
other	0 (0%)
Unknown	0 (0%)

Table 28 – Recorded Data by Diagnostic System

3.5.12.4 Does the diagnostic system support remote access?

The predominant majority of supplier / provider do have remote access to their diagnostic system(s).



Picture 40 – Does the diagnostic system support remote access?

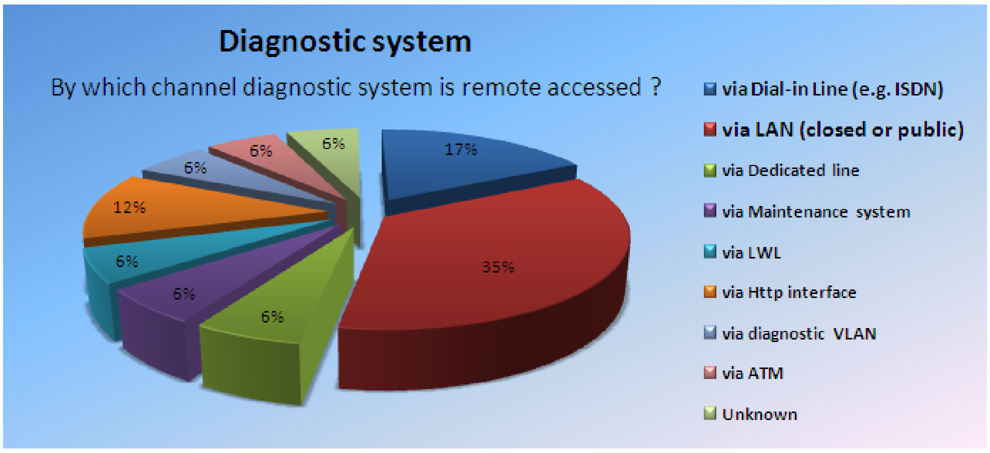
Answer	Quantity
Yes, it does.	13 (93%)
No	1 (7%)
Unknown	0 (0%)

Table 29 – Does the diagnostic system support remote access?

3.5.12.5 By which channel diagnostic system is remote accessed ?

How diagnostic system is accessed is heterogenic witch an emphasis of LAN (closed or public) access.

The problem with this chart is the unclear separation of terms in context of OSI layers. So information may overlap e.g. HTTP is communicated over IP / Ethernet and that may be a dedicated WAN connection.



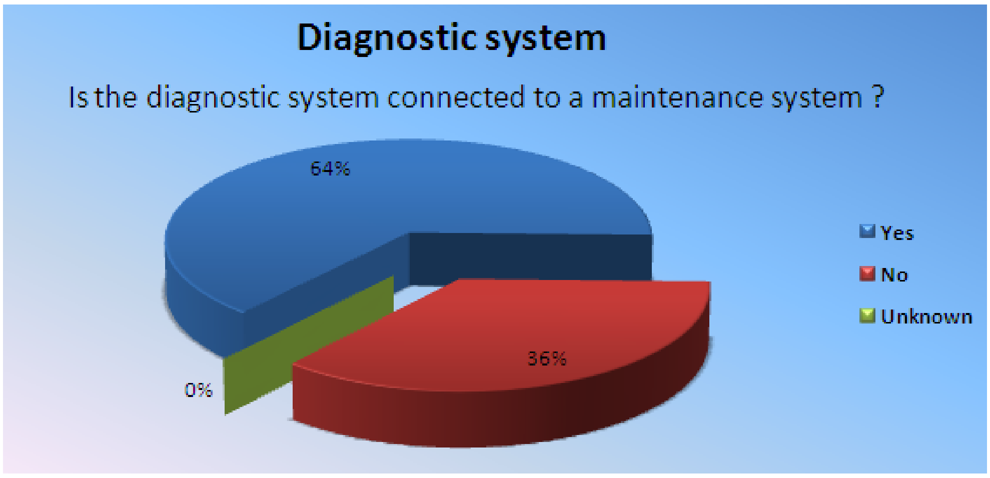
Picture 41 – By which channel diagnostic system is remote accessed ?

Answer	Quantity
via Dial-in Line (e.g. ISDN)	3 (17%)
via LAN (closed or public)	6 (35%)
via Dedicated line	1 (6%)
via Maintenance system	1 (6%)
via LWL	1 (6%)
via Http interface	2 (12%)
via diagnostic VLAN	1 (6%)
via ATM	1 (6%)
Unknown	1 (6%)

Table 30 – Diagnostic system remote access available channels

3.5.12.6 Is the diagnostic system connected to a maintenance system ?

The majority of supplier / provider reports to have connected the diagnostic to a maintenance system.



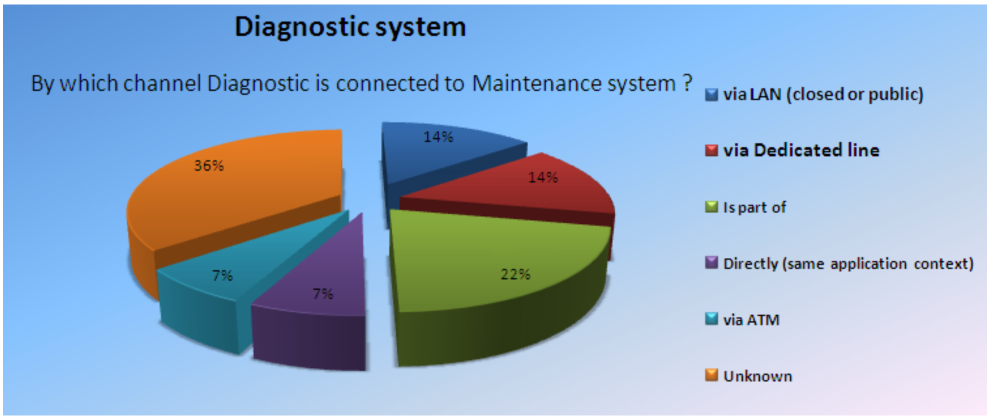
Picture 42 – Is the diagnostic system connected to a maintenance system ?

Answer	Quantity
Yes, it is.	9 (64%)
No	5 (36%)
Unknown	0 (0%)

Table 31 – Is the diagnostic system connected to a maintenance system ?

3.5.12.7 By which channel Diagnostic is connected to Maintenance system ?

By which channel diagnosis system is remote accessed shows a heterogenic picture with an emphasized area: “channel as part of diagnostic system”.



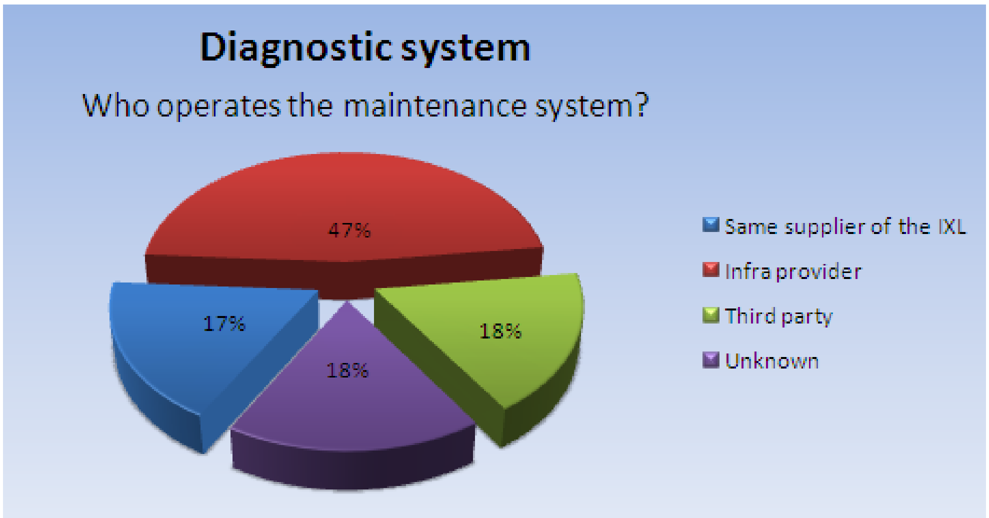
Picture 43 – By which channel diagnostic system is remote accessed ?

Answer	Quantity
via LAN (closed or public)	2 (14%)
via Dedicated line	2 (14%)
Is part of	3 (22%)
Directly (same application context)	1 (7%)
via ATM	1 (7%)
Unknown	5 (36%)

Table 32 – By which channel(s) Diagnostic system is connected to Maintenance ?

3.5.12.8 Who operates the maintenance system?

Nearly half of supplier / provider states the infra provider operates the maintenance system. The **minority** is parted in two equivalent blocks "third party" resp. "IXL supplier" is running the maintenance system.



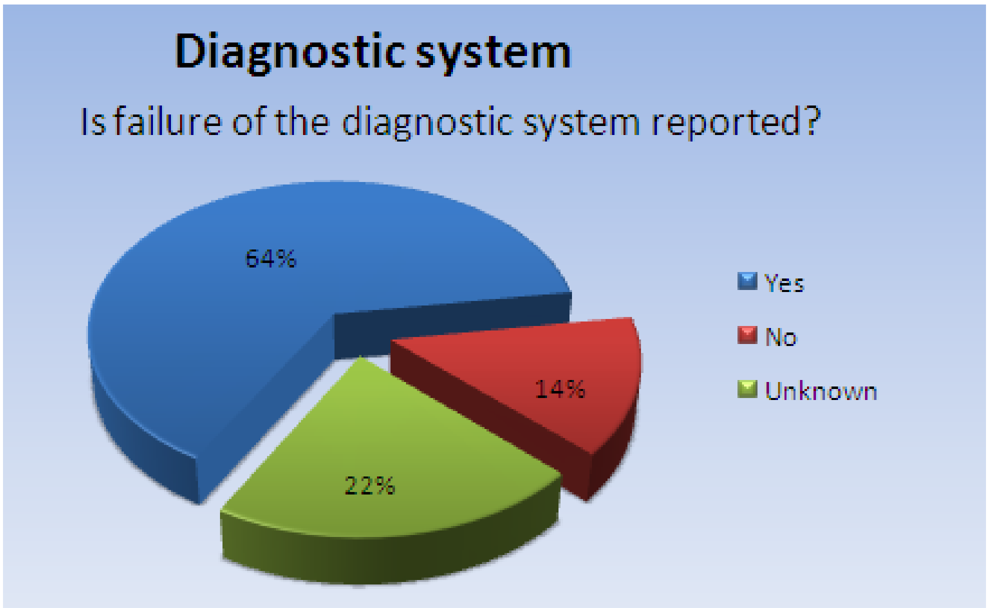
Picture 44 – Maintenance System Operator

Answer	Quantity
Same supplier of the IXL	3 (17%)
Infra provider	8 (47%)
Third part	3 (18%)
Unknown	3 (18%)

Table 33 – Maintenance System Operator

3.5.12.9 Is failure of the diagnostic system reported?

A majority (more than a strong half) states to have a supervised diagnostic system.



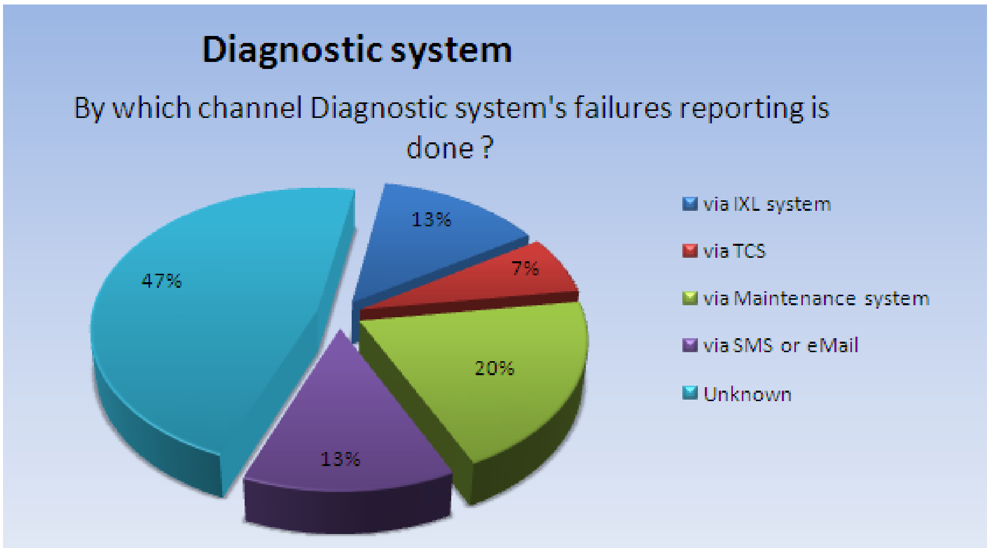
Picture 45 – Diagnostic System failure reporting

Answer	Quantity
Yes, it is reported	9 (64%)
No	2 (14%)
Unknown	3 (22%)

Table 34 – Diagnostic System failure reporting

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

Various possibility are shown with more or less equivalent apportionment.



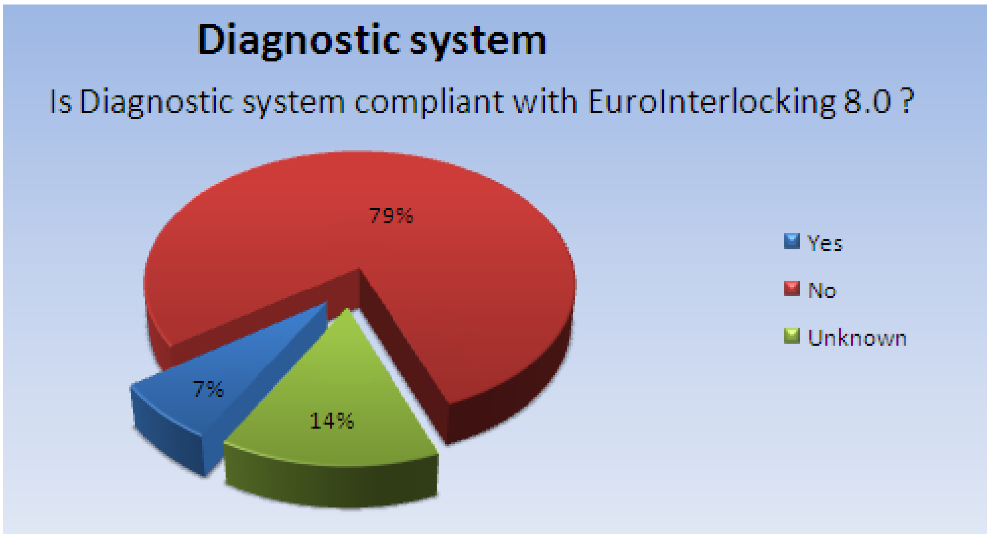
Picture 46 – By which channel Diagnostic system's failures reporting is done ?

Answer	Quantity
via IXL system	2 (13%)
via TCS	1 (7%)
via Maintenance system	3 (20%)
via SMS or eMail	2 (13%)
Unknown	7 (47%)

Table 35 – By which channel Diagnostic system's failures reporting is done ?

3.5.12.11 Is Diagnostic system compliant with EuroInterlocking 8.0 ?

Early 80% of supplier / provider states, that diagnostic system does not match with latest Eurointerlocking 8.0 architecture



Picture 47 – Is Diagnostic system compliant with EuroInterlocking 8.0 ?

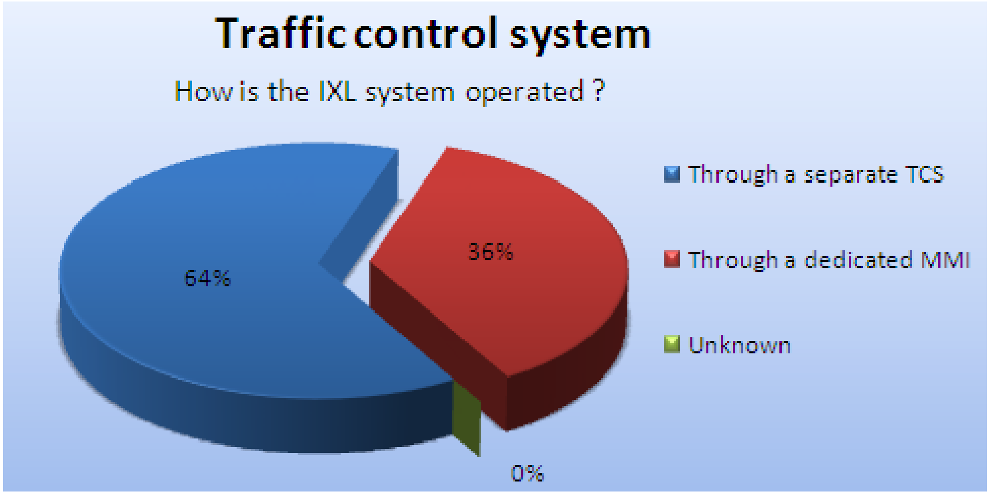
Answer	Quantity
Yes, it is.	1 (7%)
No	11 (79%)
Unknown	2 (14%)

Table 36 – Is Diagnostic system compliant with EuroInterlocking 8.0 ?

3.5.13 Traffic Control System (TCS)

3.5.13.1 How is the IXL operated?

More than half of supplier / provider runs a from IXL separated traffic control system.



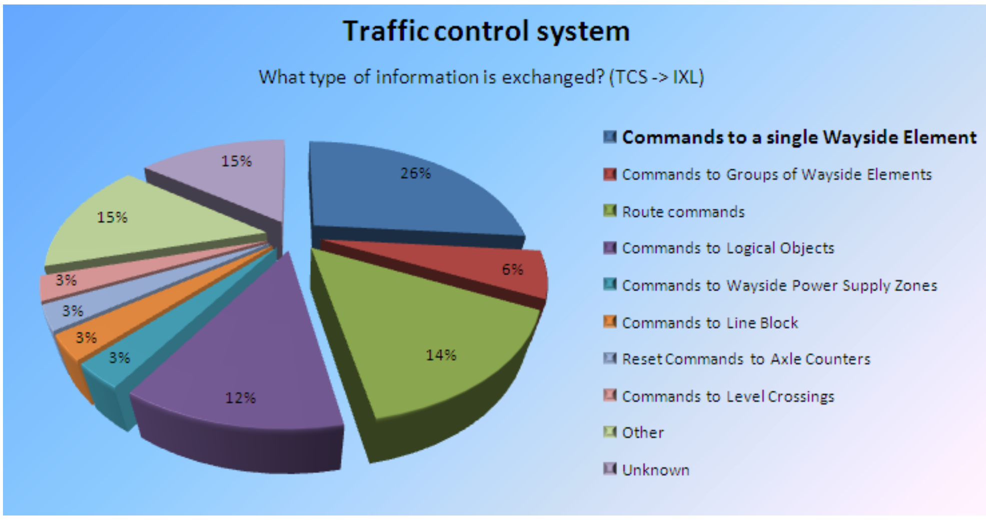
Picture 48 – How is the IXL operated?

Answer	**Quantity**
Through a separate TCS	14 (64%)
Through a dedicated MMI	8 (36%)
Unknown	0 (0%)

Table 37 – How is the IXL operated?

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

Various type of information is exchanged between TCS -> IXL. A strong emphasis lays on the type “commands to single wayside elements”.



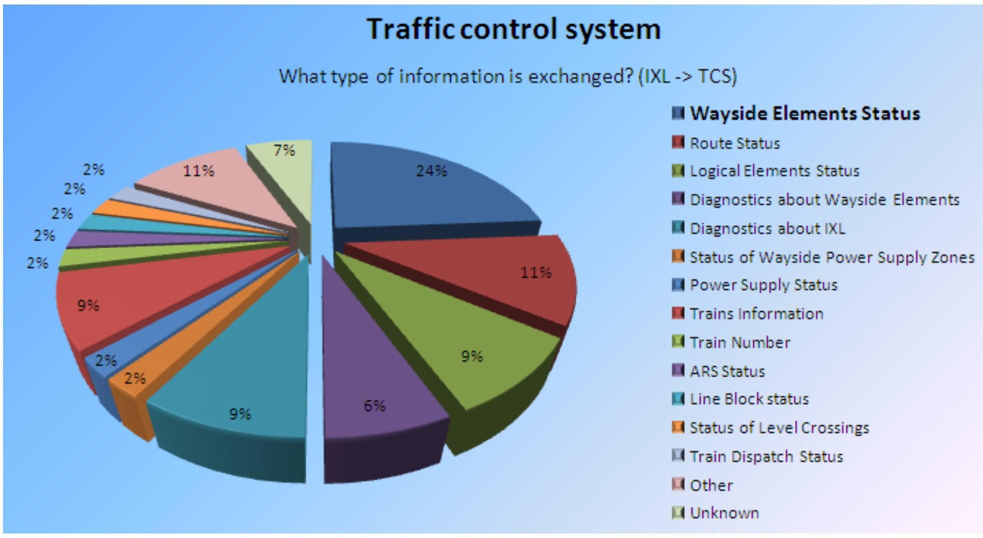
Picture 49 – Information exchanged (TCS -> IXL)

Answer	Quantity
Commands to a single Wayside Element	9 (26%)
Commands to Groups of Wayside Elements	2 (6%)
Route Commands	5 (14%)
Commands to Logical Objects	4 (12%)
Commands to Wayside Power Supply Zones	1 (3%)
Commands to Line Block	1 (3%)
Reset Commands to Axle Counters	1 (3%)
Commands to Level Crossings	1 (3%)
Other	5 (15%)
Unknown	5 (15%)

Table 38 – Information exchanged (TCS -> IXL)

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

Various type of information is exchanged between IXL -> TCS. A strong emphasis lays on the type "wayside elements status".



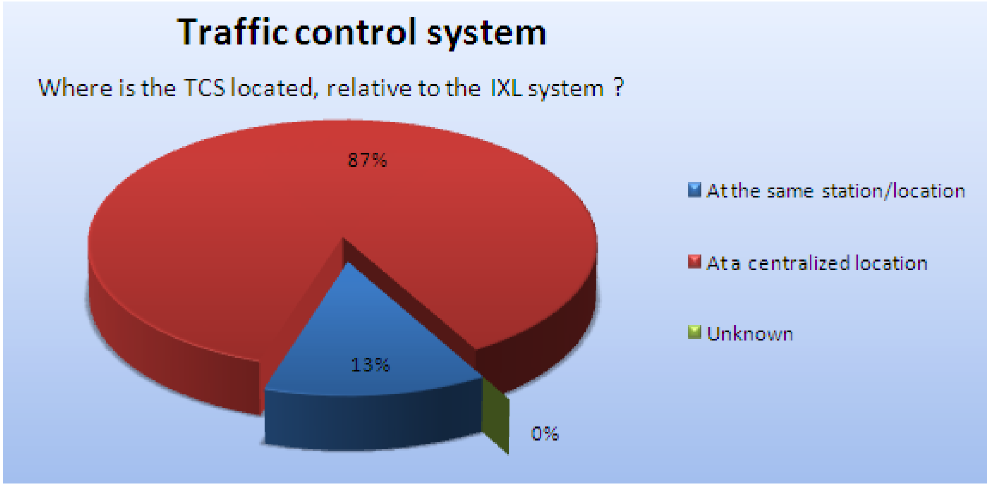
Picture 50 – Information exchanged (IXL -> TCS)

Answer	Quantity
Wayside Element Status	11 (24%)
Route Status	5 (11%)
Logical Elements Status	4 (9%)
Diagnostics about Wayside Elements	3 (6%)
Diagnostics about IXL	4 (9%)
Status of Wayside Power Supply Zones	1 (2%)
Power Supply Status	1 (2%)
Trains Information	4 (9%)
Train Number	1 (2%)
ARS Status	1 (2%)
Line Block Status	1 (2%)
Status of Level Crossings	1 (2%)
Train Dispatch Status	1 (2%)
Other	5 (11%)
Unknown	3 (7%)

Table 39 – Information exchanged (IXL -> TCS)

3.5.13.4 Where is the TCS located, relative to the IXL system ?

In nearly 90% TCS is at a centralized location.



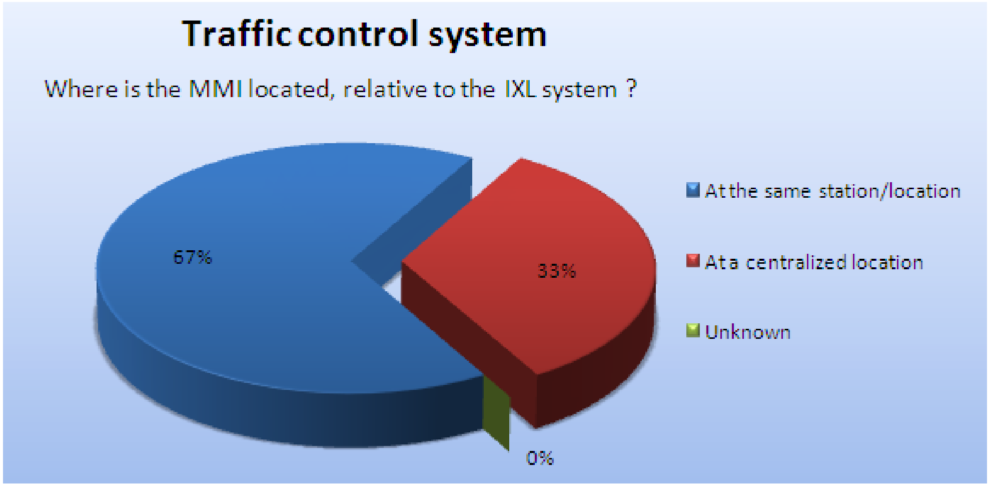
Picture 51 – Where is the TCS located, relative to the IXL system ?

Answer	Quantity
At the same station/location	2 (13%)
At a centralized location	13 (87%)
Unknown	0 (0%)

Table 40 – Where is located TCS respect of IXL system ?

3.5.13.5 Where is the MMI located, relative to the IXL system ?

Other than TCL, MMI is normally located at the same location like IXL.



Picture 52 – Where is the MMI located, relative to the IXL system ?

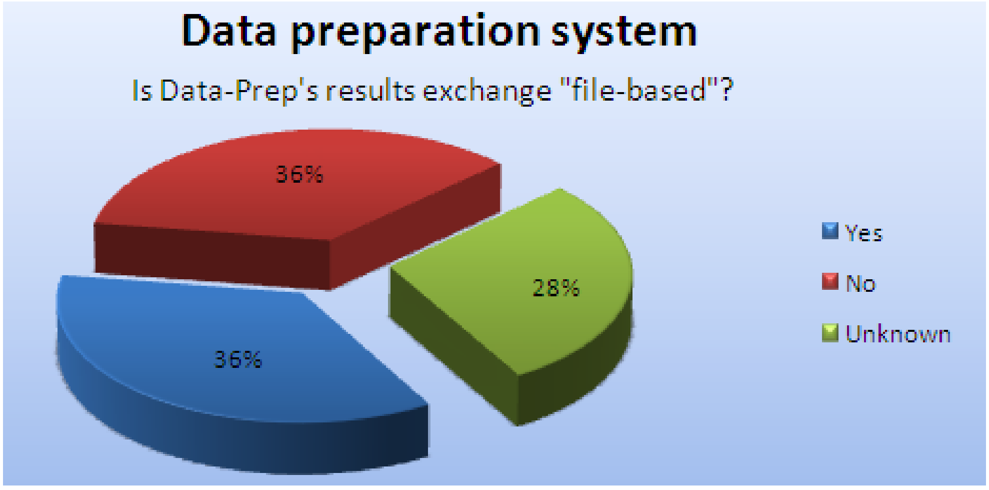
Answer	Quantity
At the same station/location	10 (67%)
At a centralized location	5 (33%)
Unknown	0 (0%)

Table 41 – Where is located each MMI of IXL system ?

3.5.14 Data Preparation System

3.5.14.1 Is Data Preparation results exchange "file-based"?

From known systems data preparation systems are file based driven as well as not file based (fifty / fifty)



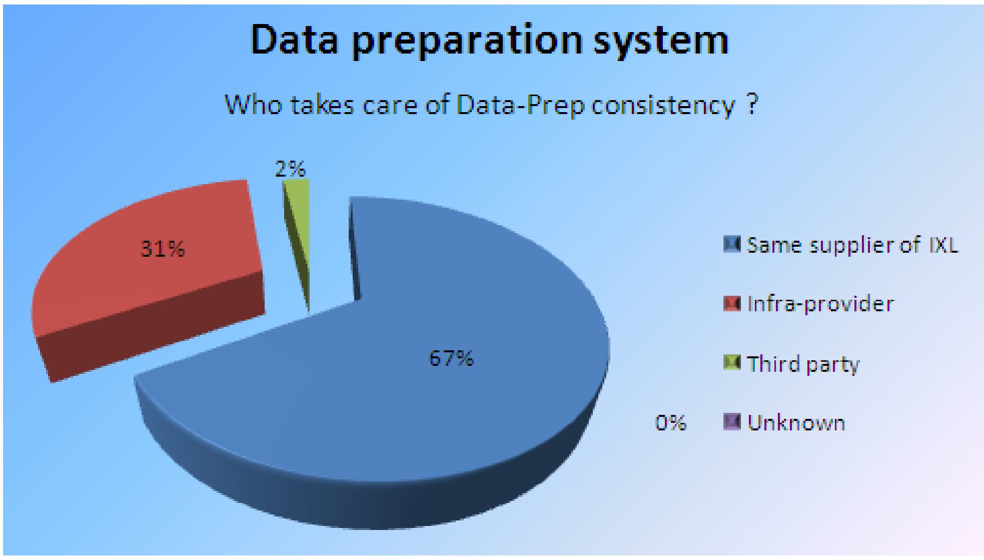
Picture 53 – Is Data Preparation results exchange "file-based"?

Answer	Quantity
Yes	5 (36%)
No	5 (36%)
I don't know	4 (28%)

Table 42 – Is Data Preparation results exchange realized by means of transfer of file(s)?

3.5.14.2 Who takes care of Data-Preparation consistency ?

Two third of supplier / provider claims, that IXL supplier takes care of data preparation consistency.



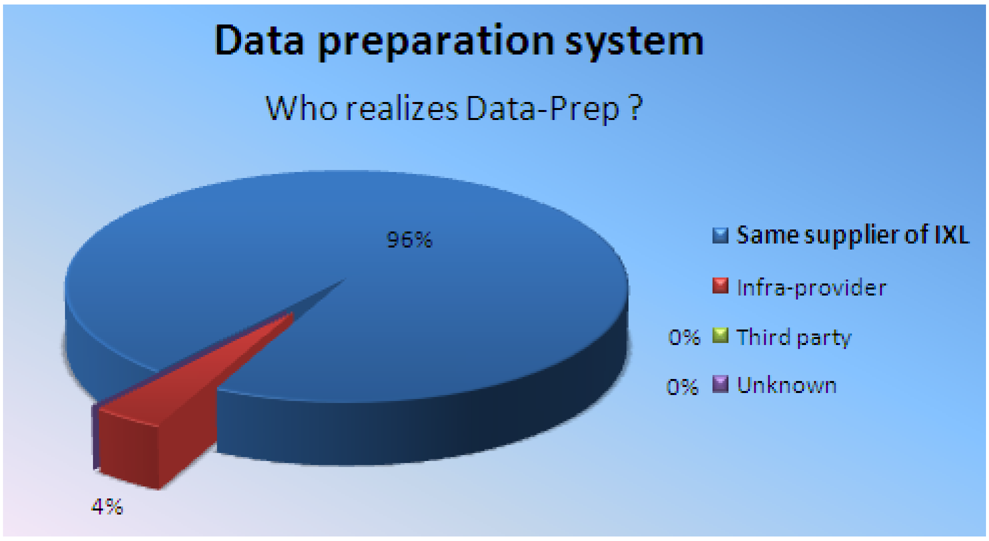
Picture 54 Who takes care of Data-Prep consistency ?

Answer	Quantity
Same supplier of IXL	9,33 (67%)
Infra provider	4,33 (31%)
Third part	0,33 (2%)
I don't know	0 (0%)

Table 43 – Who takes care of Data-Prep consistency ?

3.5.14.3 Who realizes Data-Preparation ?

A significant majority of nearly 100% of supplier / provider states to realize data preparation is done by supplier of IXL.



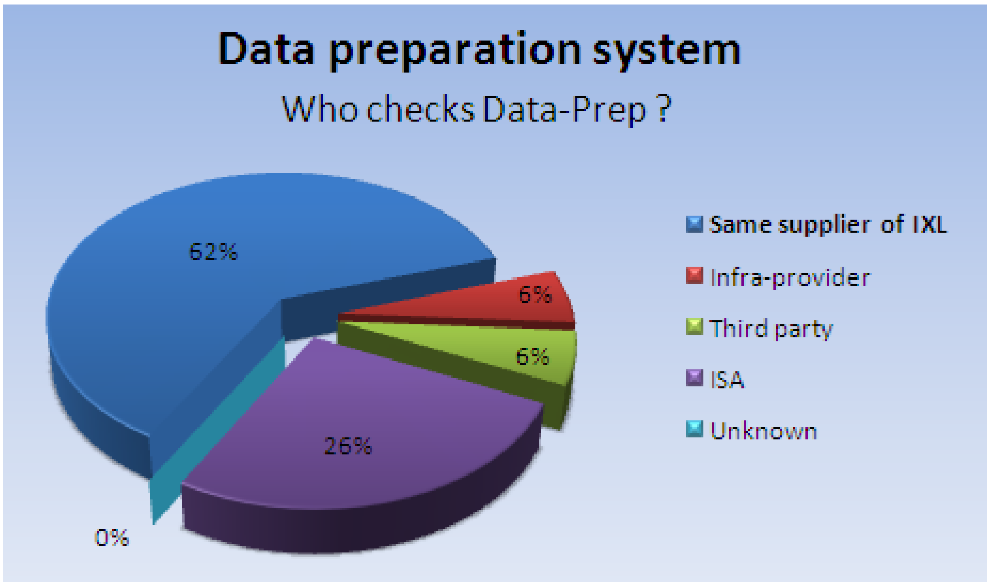
Picture 55 – Who realizes Data-Preparation ?

Answer	Quantity
Same supplier of IXL	12,50 (96%)
Infra provider	0,50 (4%)
Third part	0 (0%)
I don't know	0 (0%)

Table 44 – Who realizes Data-Preparation ?

3.5.14.4 Who checks Data-Preparation ?

Two third of supplier / provider states to do data checking by supplier of IXL. Another significant quarter does this by ISA.



Picture 56 – Who checks Data-Preparation ?

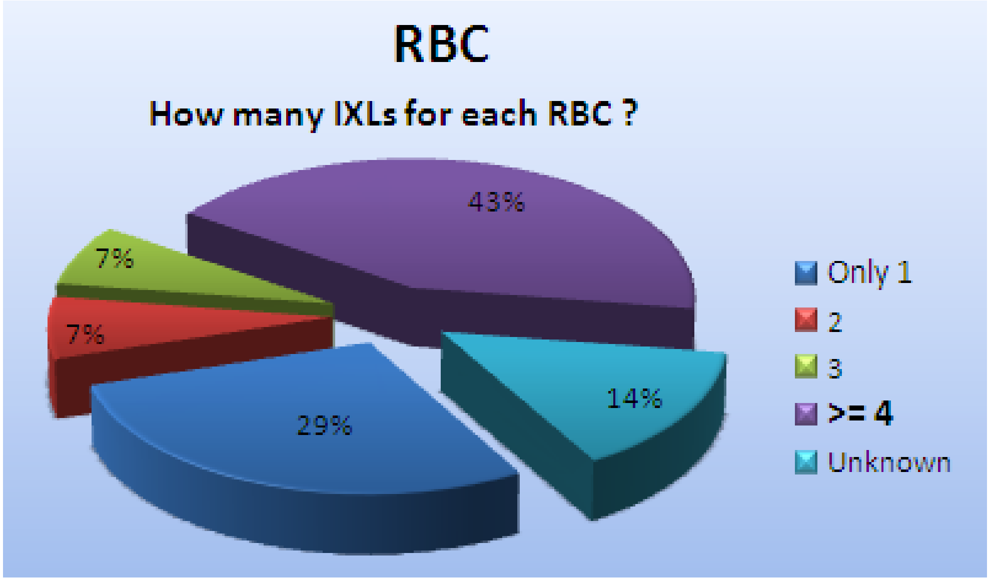
Answer	Quantity
Same supplier of IXL	10,50 (62%)
Infra provider	1 (6%)
Third part	1 (6%)
Independent Safety Assessor (ISA)	4,5 (26%)
I don't know	0 (0%)

Table 45 – Who checks Data-Preparation ?

3.5.15 Radio Block Centre (RBC)

3.5.15.1 How many IXLs for each RBC?

In the range of covering IXL by RBC from 1 to "over three", are two emphasized values: one third of RBCs covers only one IXL. Another strong 40% covers more than three IXL.



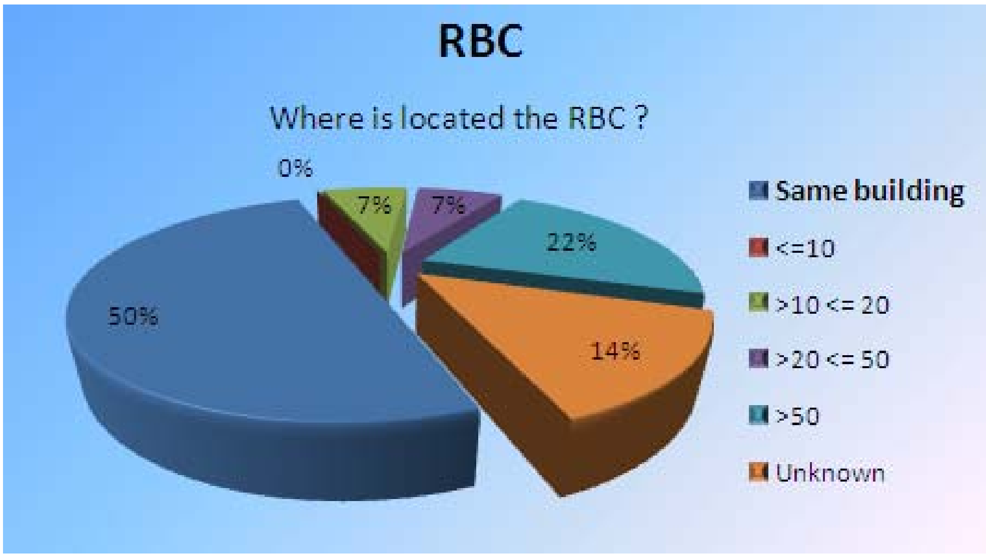
Picture 57 – How many IXLs for each RBC?

Answer	Quantity
Only 1	4 (29%)
2	1 (7%)
3	1 (7%)
>= 4	6 (43%)
I don't know	2 (14%)

Table 46 – How many IXLs for each RBC?

3.5.15.2 Where is located the RBC?

In half of RBC usages RBC is located in the same building than IXL. In one third of RBC usages RBC is distanced from IXL location with up to 100 km.



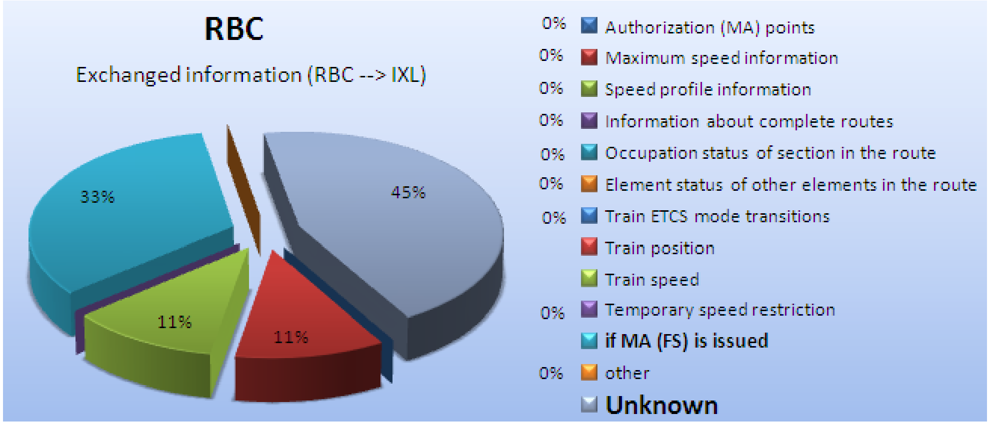
Picture 58 – RBC location

Answer	Quantity
Same building	7 (50%)
At a distance <= 10 Km	0 (0%)
At a distance between 10 and 20 Km	1 (7%)
At a distance between 20 and 50 Km	1 (7%)
At a distance of more than 50 Km	3 (22%)
I don't know	2 (14%)

Table 47 – RBC location

3.5.15.3 Exchanged information (RBC --> IXL)

Within in a wide range of possible exchanged information (RBC->IXL) only train position, train speed an Movement Authority (MA) is transmitted.



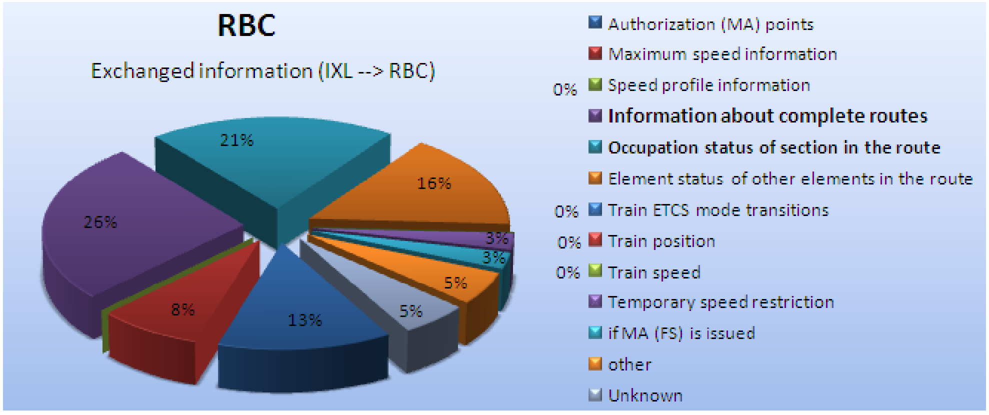
Picture 59 – Exchanged information (RBC –> IXL)

Answer	Quantity
Authorization (MA) points	0 (0%)
Maximum speed information	0 (0%)
Speed profile information	0 (0%)
Information about complete routes	0 (0%)
Occupation status of section in the route	0 (0%)
Element status of other elements in the route	0 (0%)
Train ETCS mode transitions	0 (0%)
Train position	1 (11%)
Train speed	1 (11%)
Temporary speed restriction	0 (0%)
If MA (FS) is issued	3 (33%)
Other	0 (0%)
I don't know	4 (45%)

Table 48 – Exchanged information (RBC –> IXL)

3.5.15.4 Exchanged information (IXL --> RBC)

Within a bunch of information transmitted from IXL to RBC following type information seems to be crucial: Information about complete routes, Occupation of sections in the route, authoration (MA) points, status of rout relevant elements.



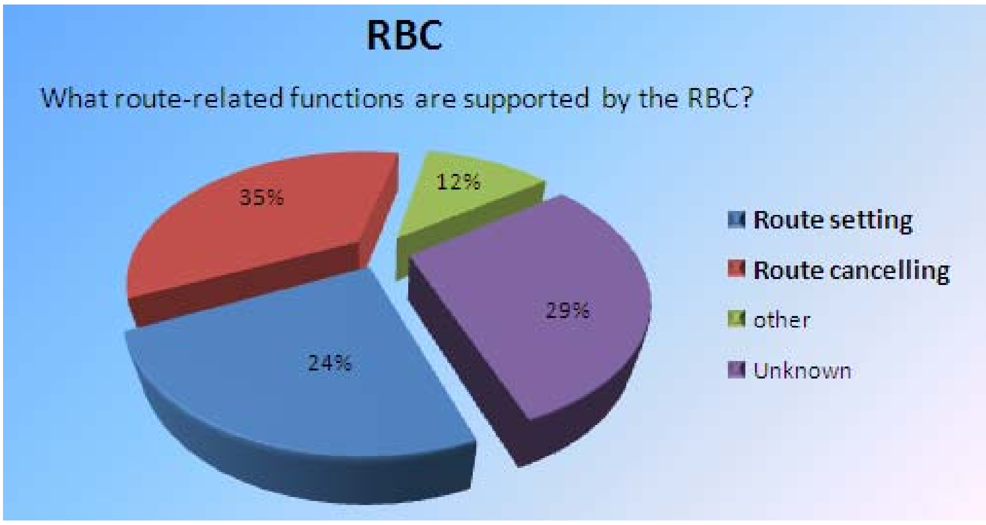
Picture 60 – Exchanged information (RBC –> IXL)

Answer	Quantity
Authorization (MA) points	5 (13%)
Maximum speed information	3 (8%)
Speed profile information	0 (0%)
Information about complete routes	10 (26%)
Occupation status of section in the route	8 (21%)
Element status of other elements in the route	6 (16%)
Train ETCS mode transitions	0 (0%)
Train position	0 (0%)
Train speed	0 (0%)
Temporary speed restriction	1 (3%)
If MA (FS) is issued	1 (3%)
Other	2 (5%)
I don’t know	2 (5%)

Table 49 – Exchanged information (RBC –> IXL)

3.5.15.5 What route-related functions are supported by the RBC?

Route related information (setting / cancelling) are most supported functions by RBC.



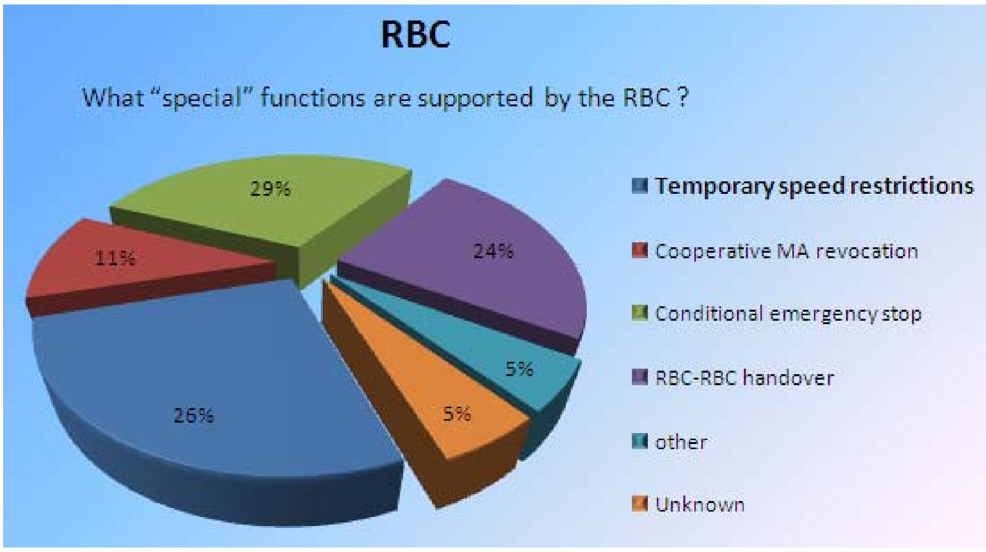
Picture 61 – Route-related functions supported by RBC

Answer	Quantity
Route setting	4 (24%)
Route cancelling	6 (35%)
Other	2 (12%)
I don't know	5 (29%)

Table 50 – Route-related functions supported by RBC

3.5.15.6 What "special" functions are supported by the RBC ?

Most typical special functions supported by RBC are Temporary speed restrictions, conditional emergency stop and RBC-RBC handover functions.



Picture 62 – "Special" functions supported by RBC

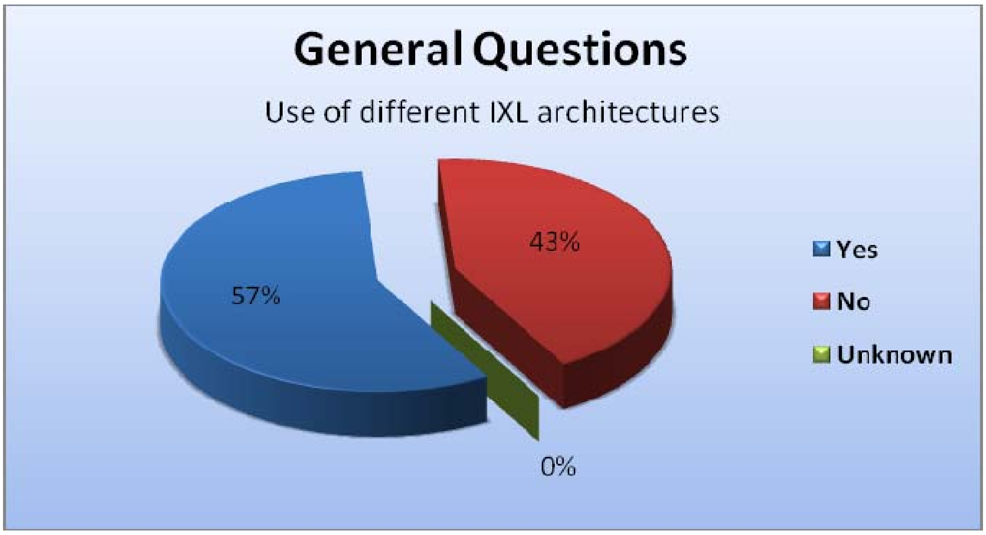
Answer	Quantity
Temporary speed restrictions	10 (26%)
Cooperative MA revocation	4 (11%)
Conditional Emergency stop	11 (29%)
RBC-RBC handover	9 (24%)
Other	2 (5%)
I don't know	2 (5%)

Table 51 – "Special" functions supported by RBC

3.5.16 General Questions

3.5.16.1 Use of different IXL architectures

To report about the use of different IXL system architectures in each 'interviewed' Project/Country:



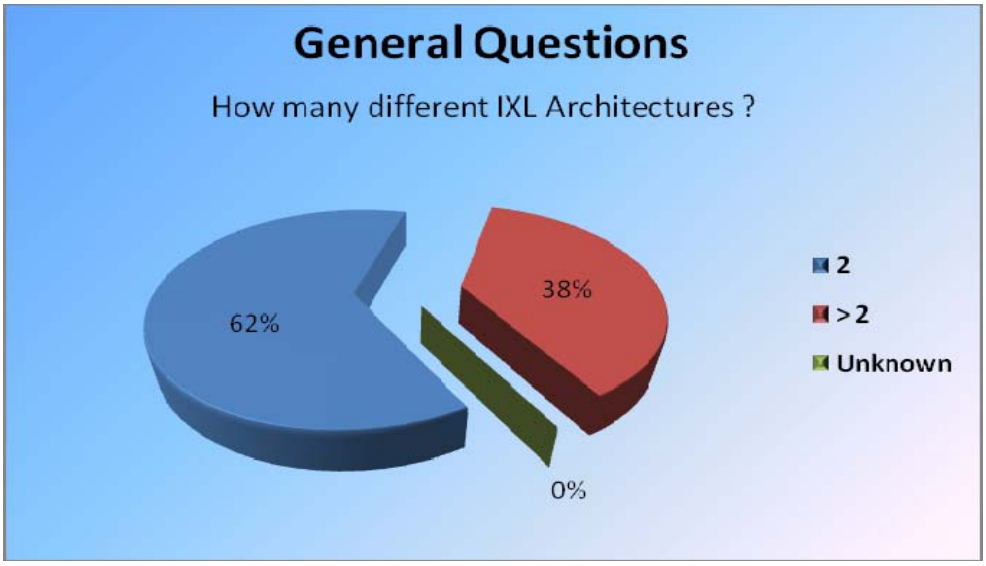
Picture 63 – Use of Different IXL Architectures

Answer	Quantity
Yes, I use different types of system architecture of in operation IXL	8 (57%)
No, I don't use different types of system architecture of in operation IXL	6 (43%)
I don't know	0 (0%)

Table 52 – Use of Different IXL Architectures

3.5.16.2 How many different IXL architectures ?

To report about the quantities of different IXL architectures which are actually in operation in each European country:



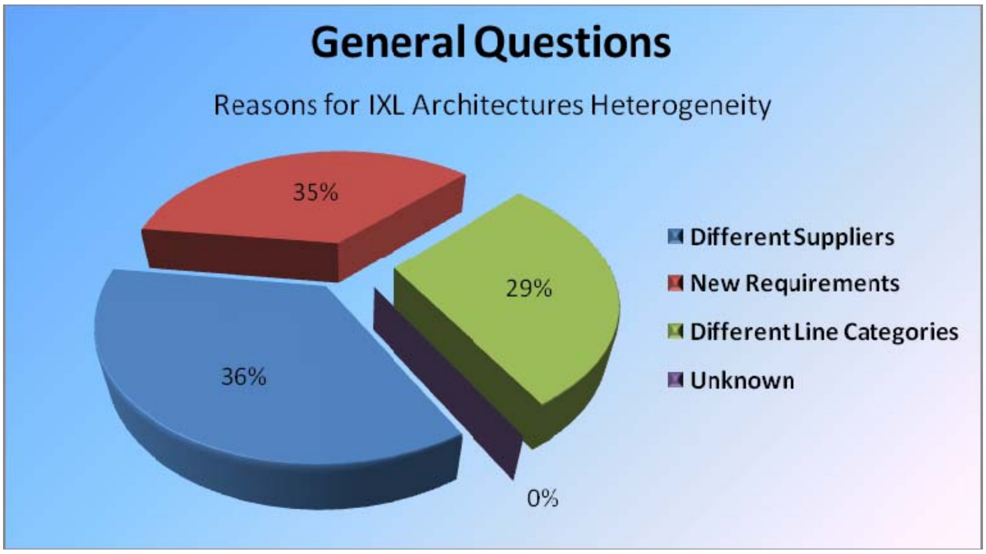
Picture 64 – Number of different IXL Architectures

Answer	Quantity
I have in operation exactly 2 different types of IXL system architectures	5 (62%)
I have in operation more than 2 different types of IXL system architectures	3 (38%)
I don't know	0 (0%)

Table 53 – Number of different IXL Architectures

3.5.16.3 Reasons for Heterogeneity

To make evident all possible reasons which might lead to choose a new system IXL architecture:

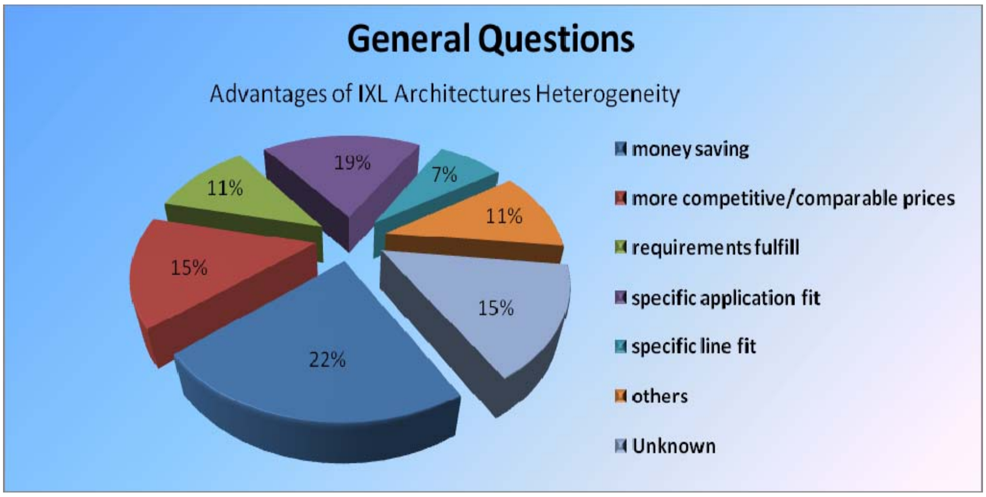


Picture 65 – Reasons for IXL Architectures Heterogeneity

Answer	Quantity
Because of different IXL System **suppliers**	0,36 (36%)
Because of **new requirements**	0,35 (35%)
because of **different line categories**	0,29 (29%)
I don't know	0 (0%)

Table 54 – Reasons for IXL Architectures Heterogeneity

3.5.16.4 Advantages of IXL Architectures Heterogeneity

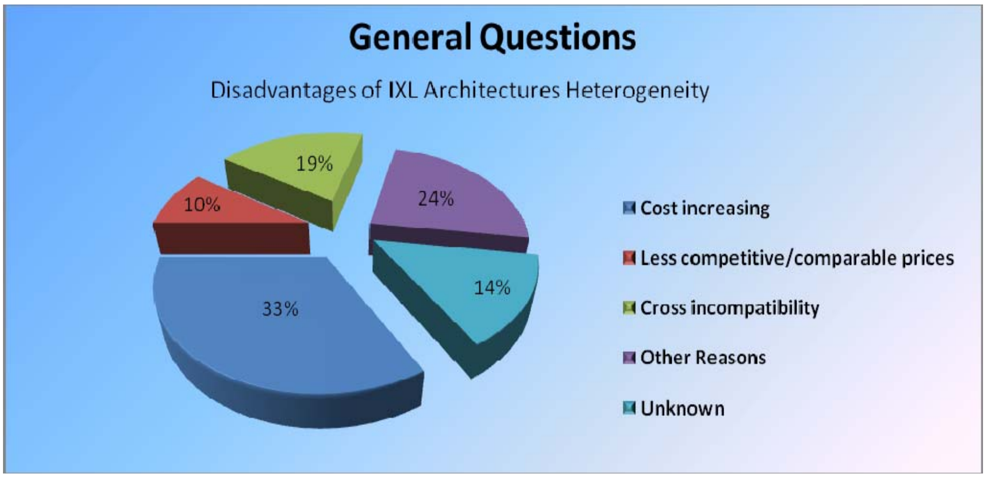


Picture 66 – Advantages of IXL Architectures Heterogeneity

Answer	Quantity
It saves money	6 (22%)
It makes prices more competitive/comparable	4 (15%)
It permits (new) requirements fulfil	3 (11%)
It is more suitable for a specific application	5 (19%)
It is more suitable for a specific line	2 (7%)
Other reasons	3 (11%)
I don't know	4 (15%)

Table 55 – Advantages of IXL Architectures Heterogeneity

3.5.16.5 Disadvantages of IXL Architectures Heterogeneity



Picture 67 – Disadvantages of IXL Architectures Heterogeneity

Answer	Quantity
It costs money	7 (33%)
It makes prices less competitive/comparable	2 (10%)
It makes IXL systems cross-incompatible	4 (19%)
Other Reasons	5 (24%)
I don't know	3 (14%)

Table 56 – Disadvantages of IXL Architectures Heterogeneity

3.6 Appraisal of Results

3.6.1 Functional Apportionment

Functional apportionment is done in a quantitative way. That means for track side Interfaces data is collected in classes FROM or TO element. Results are documented and assessed in chapter 3.5. An qualitative approach of functional apportionment is done for intelligent interfaces Adjacent Interlocking System (see chapter 3.5.9.4), Diagnostic System (see chapter 3.5.12.3), Traffic Control System (see chapter 3.5.13.2 and 3.5.13.3) and ETCS Radio Block Centre (see chapter 3.5.15.3 and 3.5.15.4).

3.6.2 Intelligence Apportionment

In some cases there was confusion about allocating the interface. E. g. for a signal: is the signal driver / supervision part of the signal or part of the interlocking? The same system will have an intelligent interface or not depending on where the driver / supervision part resides. Hence, the information has to be interpreted very carefully.

With the exception of level crossings, the majority of trackside elements are not intelligent.

Half of intelligent elements deliver no diagnosis information.

3.6.3 Interface Definition

In most cases, non intelligent Interfaces are relay based, or electronic opto coupled. These interfaces are not standardized.

Intelligent Interfaces are typically communication based.

Interfaces to adjacent IXLs are half relay based, half intelligent using communication procedures. Some railways claim such interfaces are already standardized (at least with modern interlockings which are ERTMS ready). IXL-Interface content can be read in master table [2] “Adjacent IXL”.

3.6.4 Interface Standards and Railways Compliancy

There is agreement that adjacent subsystems communicating with high data density do so by intelligent interface. This is especially true for theJuridical Recorder, Radio Block Centre and Traffic control system. These are typically Ethernet based.

Field elements typically are accessed with non-intelligent interfaces. The work group assumes that these interfaces are typically relay based. But, a tendency is shown to migrate these to intelligent interfaces. This is especially true for Adjacent Interlocking, External Line Block, External level Crossing and Track Circuit.

The majority of IXL projects use adjacent Interlocking systems from the same supplier or use line block systems.

Diagnosis Systems, Maintenance Centre and in some cases Juridical Recorders are supplied and managed by the supplier. Supplier driven implementation is often provider / railway comprehensive.

3.7 Usability of Questionnaire

It was found that even if in some cases we found 100% agreement, the questionnaire didn't contain questions concerning operational issues. Compliance was only analysed on the basis of technology topics. In other words: even when the questionnaire shows 100% compliance, no interface specification can be derived from this knowledge.

3.8 System Architecture

Due to the fact questionnaire was based on Euro interlocking architecture, it is possible that relevant data may be lost, leading to an overly optimistic conclusion. For example a balise or ATP can be driven by an interlocking interface (EURO Interlocking Architecture) or indirectly when mounted at a signal, deriving information from signal aspect, without any interface to interlocking.

Questionees, were encouraged to answer according to real life system, which preferably realizes an Interlocking - RBC interface. No supplier / railway has till now a significant number of systems operating that match these requirements. Therefore, answers are likely to represent modern, state of the art, but not necessarily typical system architecture.

3.9 Geographical Distribution of Different Parts of Interlocking

One topic is interlocking structure in relation to geographical apportionment. Some systems span wide geographical regions. Remote stations or block sections are part of the interlocking. External line block interfaces exist only at the border to adjacent systems. Other interlockings (usually older ones) distinguish between station and block, but have level crossings integrated into the interlocking: but this does not correspond to any interface in context of Euro Interlocking Architecture.

Another topic is that only 2/3 of infrastructure managers use different interlocking architecture: that is mainly due to different suppliers.

3.10 Is the fact of having differing System Architectures a Disadvantages for Railways ?

The questionnaire shows a wide ranging interlocking environment in Europe. Operational requirements were not focus of questionnaire. However, the operational requirements determine which system architecture is most efficient. For example, typical urban transit has a lower geographical distribution in conjunction with dynamical payload. Conversely, mass transit has a wider geographical distribution with more static behaviour.

The real challenge is to define standardized architectures and interfaces in a manner that decreases costs and compensates disadvantages of harmonizing today's specialized system architectures.

Section 4 – CONCLUSIONS

4 Section 5 – CONCLUSIONS

4.1 Outlook

The WP E.1 questionnaire covers some European suppliers and some European providers. To achieve the FIS and FFFIS interface definition between interlocking and adjacent subsystems as required by DoW D.E.3.2, an enormous effort has to be spent to cover all European suppliers.

More interfaces have to be analysed in much more detail, including operational considerations coming from other WS also. A precise apportionment and allocation of functions (FRS) to system (SRS) has to be done as precondition to breakdown system in subsystems and derive from the system breakdown structure all interface requirements (technical and operational).

To achieve practical results for the INESS idea, even with the given and committed resources, it seems to be necessary to reduce the amount of to be defined interfaces. To preselect the most important interfaces it must be clear what exactly is meant by FIS and FFFIS and what are the most efficient interfaces in a commercial sense of view. This information is necessary from work stream B.

As outlook for WP E.1 it does dot make sense to define further questions to get a deeper understanding of existing European architecture and Interfaces. First and more importantly, the focus for WP E.3 has to be sharpened.

Section 5 – BIBLIOGRAPHY

5 Section 5 – BIBLIOGRAPHY

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[3] Questionnaire: 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

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

[5] Questionees enhanced master table: https://www.myndsphere.com >> Collaboration Group Memory » Projects » INESS » Documents » WS E » WP E.1 » WP E.1 Drafts of deliverables & milestones » D.E.1.1 » D.E.1.1 Enhanced Mastertable_01P01_GS_2010-01-07 Draft.pdf
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Section 6 – ANNEXES

6 Section 6 – ANNEXES

6.1 Additional Information about Trackside Elements

In the subsequent section questionnaire data about trackside elements are shown in absolute and relative numbers.

6.1.1 Use of

Answer	LSA	Balise	User Specific Object	External LX	Point	Track Segment	Signal	ATP	External Line Block
Yes, I use this kind of trackside element	11 (79%)	10 (71%)	6 (43%)	11 (79%)	14 (100%)	14 (100%)	13 (93%)	12 (86%)	13 (93%)
No, I don’t use this kind of trackside element	0 (0%)	0 (0%)	8 (57%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
I don’t know	3 (21%)	4 (29%)	0 (0%)	3 (21%)	0 (0%)	0 (0%)	1 (7%)	2 (14%)	1 (7%)

Table 57 – Use of Trackside Interfaces

6.1.2 Intelligent/Not Intelligent

Answer	LSA	Balise	User Specific Object	External LX	Point	Track Segment	Signal	ATP	External Line Block
I use **Intelligent** trackside elements	1 (7%)	2 (14%)	1 (17%)	8 (57%)	2 (14%)	5 (36%)	2 (14%)	3 (22%)	3 (22%)
I use **Not Intelligent** trackside elements	9 (64%)	8 (57%)	3 (50%)	3 (22%)	11 (79%)	8 (57%)	10 (72%)	9 (64%)	9 (64%)
I use both **Intelligent** and **Not Intelligent** trackside elements	1 (7%)	0 (0%)	2 (33%)	0 (0%)	1 (7%)	1 (7%)	1 (7%)	0 (0%)	1 (7%)
I don’t know	3 (22%)	4 (29%)	0 (0%)	3 (21%)	0 (0%)	0 (0%)	1 (7%)	2 (14%)	1 (7%)

Table 58 – Kind of Trackside Elements

6.1.3 Intelligent Elements

Answer (Intelligent Elements)	LSA	Balise	User Specific Object	External LX	Point	Track Segment	Signal	ATP	External Line Block
From IXL to element									
Order for action	2 (100%)	2 (100%)	2 (67%)	7 (87%)	3 (100%)	4 (67%)	2 (67%)	2 (67%)	4 (100%)
Information needed to take action	2 (100%)	1 (50%)	2 (67%)	5 (63%)	1 (33%)	2 (33%)	1 (33%)	2 (67%)	4 (100%)
From element to IXL									
Confirmation of execution	2 (100%)	2 (100%)	2 (67%)	8 (100%)	3 (100%)	4 (67%)	3 (100%)	1 (33%)	4 (100%)
Information about local decision	2 (100%)	1 (50%)	1 (33%)	7 (87%)	2 (67%)	6 (100%)	2 (67%)	0 (0%)	4 (100%)
Diagnostics	1 (50%)	2 (100%)	1 (33%)	6 (75%)	1 (33%)	4 (67%)	3 (100%)	1 (33%)	3 (75%)
None	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)

Table 59 – Exchange of Data between Intelligent Trackside Elements and IXL

6.1.4 Not Intelligent Elements

Answer (Not Intelligent Elements)	LSA	Balise	User Specific Object	External LX	Point	Track Segment	Signal	ATP	External Line Block
From IXL to element									
Order for action	9 (90%)	6 (75%)	4 (80%)	3 (100%)	12 (100%)	4 (44%)	11 (100%)	7 (77%)	9 (100%)
Information needed to take action	3 (30%)	0 (0%)	1 (20%)	0 (0%)	1 (1%)	1 (11%)	2 (19%)	2 (22%)	4 (44%)
From element to IXL									
Confirmation of execution	8 (80%)	0 (0%)	3 (60%)	3 (100%)	11 (92%)	6 (66%)	8 (73%)	4 (44%)	7 (77%)
Information about local decision	4 (40%)	0 (0%)	3 (60%)	1 (33%)	3 (25%)	5 (55%)	2 (18%)	0 (0%)	3 (33%)
Diagnostics	5 (50%)	0 (0%)	3 (60%)	2 (67%)	6 (50%)	5 (55%)	6 (54%)	4 (44%)	2 (22%)
None	1 (10%)	5 (63%)	1 (20%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (44%)	0 (0%)

Table 60 – Exchange of Data between Not Intelligent Trackside Elements and IXL