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I2M Consolidated Functional and Non-functional requirements

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Executive Summary

The overall aim of the In2Rail project is to set the foundation for a resilient, cost-efficient, high capacity and digitalised European rail network.

There are three In2Rail Work Packages relating to Intelligent Mobility Management (I2M), one of which is WP7. This WP deals with the definition of the functional specification of future TMS/dispatching systems.

This document is the second deliverable in WP7 and completes the initial analysis of the work done in WP7.1, to consolidate the functional and non-functional requirements of TMS /dispatching systems.

The identification and definition of Use Cases has been carried out to specify processes that must be supported by a future Traffic Management System (TMS). We assume, that the principals introduced in the 1990s by the European regulations, separating the Infrastructure Manager (IM) and the Railway Undertakings (RUs), will be still valid in the context of 20 to 25 years planning horizon. The Use Cases have been defined in several steps and include: processes, operational entities and user's needs to be satisfied.

This report also provides requirements resulting from client expectations, which were identified as a result of three approaches: a rail-end client survey, the analysis of certain European Law and Regulations *(regulation law 2007/1371/EC of 23 October 2007 concerning the passengers' rights and obligation and the Technical Specifications for Interoperability for Persons with Reduced Mobility)* and the analysis of the EU funded project ModAir under Grant Agreement n°314348. The survey was defined by a group of WP7.1 partners and details many aspects of the rail system, including both the actual current system and prospects in evolution. The results do not intended to be exhaustive, however they do reflect the client expectations of major customer associations in France, Italy and Spain.

The relevant inputs for the requirements consolidation were recent tenders of Infrastructure Managers (Network Rail, Trafikverket) for Traffic Management Systems in operation in the next five years. These documents provide the basis for WP8 (Intelligent Mobility Management (I^2M) - Integration Layer) to specify the architecture and interfaces of the Integration Layer and the Generic Framework for Applications.

The requirements matrix, generated with deliverable [In2Rail D7.1], has been gathered from all these results. The complete set of requirements for the future Traffic Management System/ dispatching system are described by the present document and the associated attachment (In2Rail reference document INR-WP07-T-SYS-001-02).

DRAFT – AWAITING EC APPROVAL

TABLE OF CONTENTS

DRAFT – AWAITING EC APPROVAL

Glossary, Abbreviations and Acronyms

** Definition extract from §Common Glossary of the* [In2Rail D7.1] *deliverable of In2Rail.*

Abbreviation / Acronyms	Description
Capacity restrictions, tunnel restrictions, bridge restrictions *	(Reduced) availability of infrastructure imposed by the Infrastructure Manager due to its own needs for managing the infrastructure. This can include restrictions on route opening hours and on times of possessions for maintenance, renewal and enhancement works. This also includes speed, length and weight restrictions or other influences on rolling stock (e.g. diesel only)
Contingency plan *	Plan to be drawn up by the IM, listing the various bodies to be informed in the event of serious incidents or serious disturbance to train movements.
DAS *	**D**rivers **A**dvisory **S**ystem: the on-board system that allows reception of information sent from the Traffic Management System to the trains. It allows indication to the driver of modifications to be made to the train departure in order to fulfil the Real Time Traffic Plan.
DTT	**D**aily **T**ime**T**able: an extract of the long term plan for each day, including any specific modifications approved for a particular day.
DOMP	**D**ay of **O**peration **M**aintenance **P**lan: an extract from the medium-long term maintenance plan generated daily.
EU *	**E**uropean **U**nion
IM *	**I**nfrastructure **M**anager: any body or undertaking that is responsible for establishing and maintaining railway infrastructure. This may also include the management of infrastructure control and safety systems. The functions of the infrastructure manager on a corridor or part of a corridor may be allocated to different bodies or undertakings.
I²M *	**I**ntelligent **M**obility **M**anagement: information developed as a strategically critical asset: • A standardised approach to information management and dispatching systems enabling an integrated Traffic Management System (TMS). • An Information and Communication Technology (ICT) environment supporting all transport operational systems with standardised interfaces and with a plug and play framework for TMS applications. • An advanced asset information system with the ability to 'nowcast' and forecast network asset statuses with the associated uncertainties from heterogeneous data sources.
KPI	**K**ey **P**erformance **I**ndicators
Perturbation (Minor) *	A minor perturbation is an unplanned perturbation that can be resolved through correction by an ICT system with no human intervention. IM/RU communication will be between systems.
Perturbation	A major perturbation is an unplanned perturbation that can only be

DRAFT – AWAITING APPROVAL

Abbreviation / Acronyms	Description
(Major) *	resolved with human intervention to make decisions about the reallocation of resources (paths, crew, and rolling stock). These decisions will need RU/IM communication between both human and ICT systems.
PRM	**P**erson with **R**educed **M**obility: all people who have difficulty when using trains or the associated infrastructure.
RTTP	**R**eal **T**ime **T**raffic **P**lan: the timeframe of the Daily Timetable transferred from the IM planning department to the Traffic Management Department.
RU *	**R**ailway **U**ndertaking: bodies such as train operating companies and freight operating companies, which are responsible for the operation of passenger and freight trains.
TAF & TAP TSI	**T**elematic **A**pplications for **F**reight **&** **T**elematic **A**pplication for **P**assengers **T**echnical **S**pecification for **I**nteroperability
TOC *	**T**rain **O**perating **C**ompany: a company with access rights to operate passenger trains on the railway network.
TMS *	**T**raffic **M**anagement **S**ystem: a traffic control-command and supervision/management system, such as ERTMS in the railway sector.
TSR	**T**emporary **S**peed **R**estriction: this restriction is a type of temporary traffic restriction.
TTR	**T**emporary **T**raffic **R**estriction is considered to be a capacity restriction (see above definition).
UC	**U**se **C**ase
VSTR	**V**ery **S**hort **T**ime **R**equest: the individual request for a path according to Article 23 of Directive 2001/14/EC due to additional transport demands or operational needs.
WP7	**W**ork **P**ackage **7**: System Engineering of Intelligent Mobility Management (I^2M) of In2Rail.
WP8	**W**ork **P**ackage **8**: Integration Layer of Intelligent Mobility Management (I^2M) of In2Rail.

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1. Background

This document constitutes the first issue of Deliverable D7.2 "Consolidated functional and non-functional requirements" in the framework of the project entitled "Innovative Intelligent Rail" (Project Acronym: In2Rail; Grant Agreement No 635900).

The overall objective of Work Package 7 – WP7 – is to provide the specification to validate the Intelligent Mobility Management (I²M) open integrated platform for Traffic Management Systems (TMS) and dispatching systems of the future. WP7 is strongly coupled with two other work packages, 8 and 9. It covers three topics, which come at different development stages of the future Traffic Management System:

- *WP7.1*: to carry out the requirement analysis;
- *WP7.2*: to specify a Standard Operators' Workstation allowing the display and control of all services and functions applied in an integrated traffic control centre;
- *WP7.3*: to validate an integrated I²M TRL3 proof-of-concept built around the Integration and Application Layer, the Demand Management functionalities and the 'nowcasting' and forecasting of the network assets status.

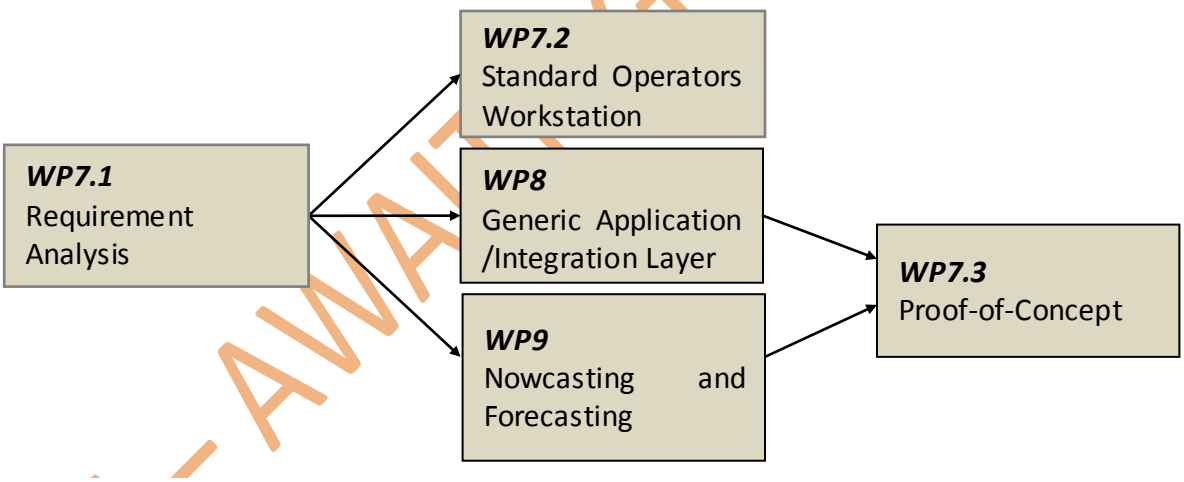

Figure 1.1 - Simplified view on integration of WP7 with WP8 and WP9

The aim of WP7.1 is to define the functional and specific non-functional requirements (e.g. performance, security, safety, etc.), that must be fulfilled by TMS/dispatching systems.

Deliverable D7.2 is the result of the second step of WP7.1, the consolidation of the high level requirements from those first gathered results presented in Deliverable [In2Rail D7.1].

This document has been prepared in three main iterations between a single participant, and reviews by WP7 contributors who are Infrastructure Managers. The work was carried out between October 2015 and February 2016, followed by a final review during a workshop in March 2016.

DRAFT - AWAITING EC APPROVAL

This document provides specific and detailed requirements for work packages 7.2, 9 and more especially for 8.1, 8.2:

- *WP8.1* "Integration Layer" provides a framework for cooperative work with the Traffic Management System (TMS), Crew management, Fleet Management, Maintenance Management, Automatic Train Operation, Asset Management, etc.
- *WP8.2* "Application Framework" provides a framework to integrate the specific functionality of the TMS in a plug-and-play way.

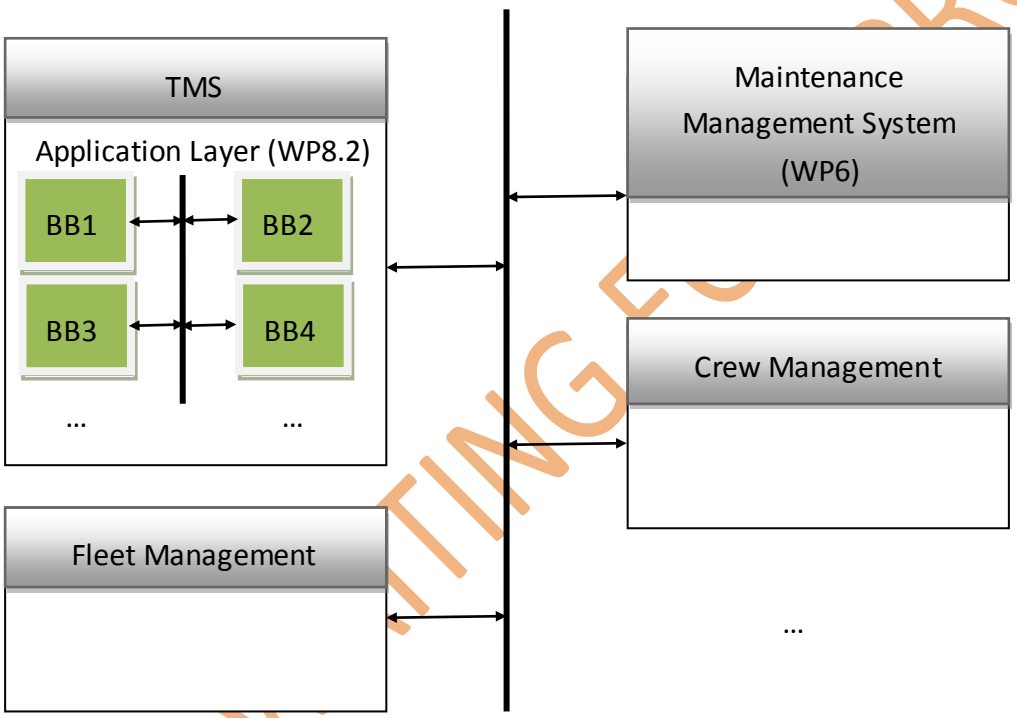

Figure 1.2 – Integration Layer (WP8.1) and Application Layer (WP8.2)

DRAFT AWAITING EC APPROVAL

2. Objective / Aim

This document was created to consolidate the previous D7.1 deliverable [In2Rail D7.1] reports which draw up a list of the high-level requirements which must be fulfilled by a future Traffic Management System / dispatching system. The result of the consolidation has consisted in inserting some specific requirements, describing others with more precision or making deletions.

The defined aim is to specify the requirements of a Traffic Management System to be used in 20 to 25 years' time, without changing the principals introduced in the 1990s by the European regulations separating the Infrastructure Manager (IM) and the Railway Undertakings (RUs).

The main consequences that are sought by the adoption of this TMS of the future are:

- Maximise the satisfaction of travellers, and the utility for public society, through minimizing the travel time, optimizing connections and improving punctuality;
- Maximise the satisfaction of the infrastructure managers through maximising the use of the rail infrastructure, with particular regard to congested areas and bottlenecks;
- Maximise the satisfaction of the railways undertakings through maximising the use of rolling stock materials and crew;
- Maximise the flexibility of the commercial offer by inserting freight train paths in congested routes at an operational level;
- Minimise penalties/fines by the railway undertakings, optimizing the contract management.

The description of the TMS of the future given in this document is developed from analysis, identification and description of the use cases. The main objective of these actions is to identify and describe the processes that must support a traffic management system to ensure that the needs of a future train control centre operation will be met.

The Use Cases comprise a definition of:

- Actors communicating with the TMS;
- Scope of responsibility and functions of the subsystems;
- Input and output relations of every involved subsystem.

The definition of the use cases was done jointly with the Infrastructure Manager partners of the In2Rail project.

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3. Functional and Non-Functional Requirements

During the initial planning the collection of the requirements for a future TMS was divided into two parts:

- Collection of high level requirements (Deliverable [In2Rail D7.1]);
- Consolidation and more detailed description of the requirements (D7.2).

During the first step approximately 900 requirements assigned to 19 topics were collected. More than 70% of the requirements came directly from recent TMS tenders produced by Network Rail (2012), Trafikverket (2013), and documentation by Rail Net Europe. In contrast to the initial planning these requirements provide not only a high level description of the future TMS, but a very detailed specification of the system, up to the list of parameters to exchange between subsystems.

Therefore the objective of this document was not to provide additional requirements, but to define a coherent system description in the form of use cases, where the requirements covering separated areas are shown in an integrated way. To establish the connection between the two information sources (Use Cases and Requirements Matrix) the requirements matrix has been extended with references to the Use Cases. During the definition of the Use Cases any missing requirements were identified and added to the requirements matrix.

The modifications to the requirements matrix are recorded in version 02 of the functional and non-functional requirements matrix (In2Rail reference document INR-WP07-T-SYS-001-02), and the updated version of the matrix is attached to Deliverable [In2Rail D7.1].

The matrix contains 3 sections:

- **Section 01**: this section is the Requirements Matrix for the state-of-the-art. It contains all functional and non-functional requirements collected;
- **Section 02**: this section provides a complete list of documents used to collect the High Level Functional Requirements during the state-of-the-art activity;
- **Section 03**: this section describes the different lists used in the generation of the matrix requirements.

The matrix contains different levels for an easy overview, in which the requirements themselves are shown as level 5 and details of the data needed for the requirement are shown as level 6.

- **Levels 1 and 2**: define the capability asked of the system *(light description);*
- **Levels 3 and 4**: define the principal feature of the system *(light description);*
- **Level 5**: is used to describe the high level requirement *(detailed description);*

DRAFT – AWAITING EC APPROVAL

- **Level 6**: is used to define the data needed for the requirement *(detailed description).*

For each requirement collected, the following information has been entered within the respective column:

- **Req. Id**: this is a unique number in the global matrix. This number is specific to the In2Rail project;
- **Level**: the level identified above;
- **Title**: describes the general purpose of the requirement;
- **Description**: gives the description of the requirement for the IN²RAIL project;
- **Collector** and **Date of collection**: IN²RAIL partner who collected the requirement;
- **Source**: identification of the document and section where the requirement was collected. The reference used is described in Section 02;
- **Extract**: this column contains a copy of the original requirement if a rewording has been made. The main purpose is to find any elements of the context that permit a clear understanding of the initial requirement;
- **Type of the requirement**: the complete list of types is defined in Section 3;
- **Requirement link to another(s) one(s)**: given if the requirement is linked to or depends on another requirement;
- **Level of Innovation**: this part has not been filled in during state-of-the-art activity;
- **Data exchange required**: indicates whether the requirement requires data exchange (internal or external exchange). This column has not been filled in during state-of-the-art activity due to a lack of information in the original documents;
- **Comments**: any comments that allow clarification of the requirement or provide traceability of the requirement.

The objective of WP7 is to provide WP8 with a complete list of requirements needed for selection of an appropriate architecture and specification of the interfaces.

WP8 shall specify a common communication and coordination infrastructure for an integrated TMS consisting of functionalities by different suppliers. To select an appropriate solution, WP7 provides specific requirements on:

- Participating subsystems:
  - Which subsystems shall interact with each other;
  - Which communication channels are to be provided?
- Use case specific information flows containing workflows of several subsystems.
- End-customer view to enable evaluation of the improvements at the end of the Shift2Rail development.

DRAFT – AWAITING EC APPROVAL

4. Use Cases for Traffic Management System Operation

This chapter presents the Use Cases which have been defined from the direct experience of WP7.1 Partners and major results from others EU funded project such as ON-TIME and CAP4RAIL, while cohering to EU regulation rules in application.

Two levels of detail have been used to define the processes:

- **Level 1:** Allows a first breakdown of the processes required in a TMS, thereby identifying the first level use cases. The main objective of this level is to determine the different areas in which railway management is divided from the TMS, the actors interacting with each of them and the relationship between different areas detected.
- **Level 2**: For each of the use cases identified at level 1, the high-level operations are identified and described. The main objective of this level is to identify the necessary operations in each area of operation of the TMS. At this level the flow of information, actors and processes involved in each of the operations are detailed and the relationship between each of the operations and the other use cases identified at level 1 is identified.

4.1 TMS operation context

A basic comprehension of the scope of the process (from capacity allocation to traffic management) and responsibility of the actors is required to understand this document.

The following schematic describe the different steps, and timetables used, from planning to the real time environment.

DRAFT – AWAITING EC APPROVAL

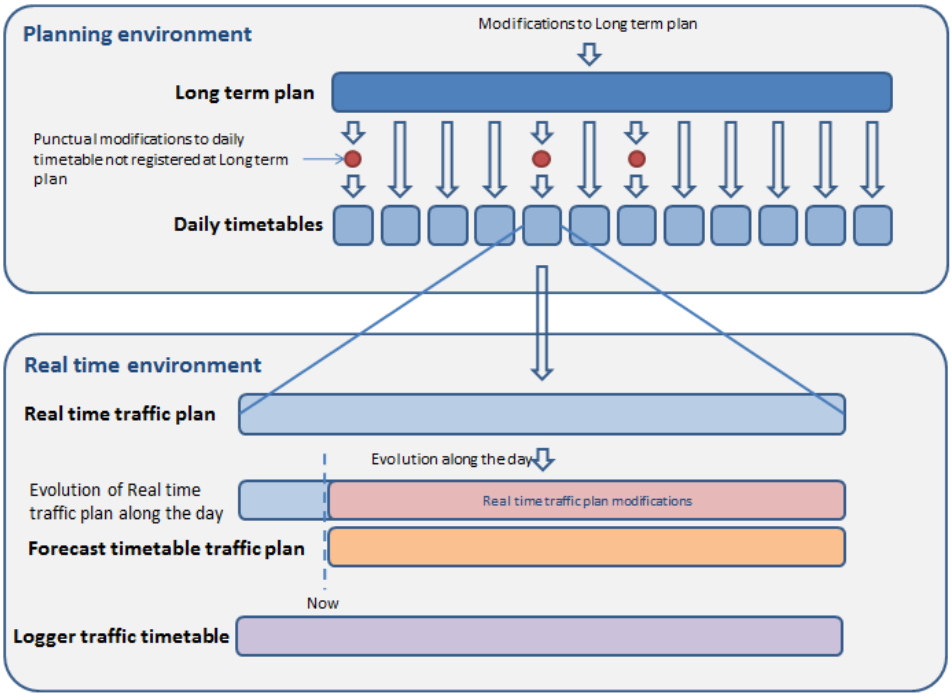

Figure 4.1 – From planning to real time environment schematic

4.1.1 Planning environment

The principles set in Directive 2001/14/EC on the allocation of railway infrastructure capacity remain unchanged. Article 18 and annex III, which dictate the precise long term timetable (indicated as the working timetable in those documents) is established once per calendar year.

The planning environment is under the responsibility of the planning department of the Infrastructure Manager.

4.1.1.1 Long term plan

The following points define the long term plan:

- The Long term plan is the working timetable (ref. to [In2Rail D7.1] glossary) defined for transportation services for a period defined by the Infrastructure Manager;
- The Long term plan is the strategic plan;
- The working timetable includes all trains (commercial and non-commercial) and work possessions information;
- The creation and modification of this plan is the responsibility of the personnel involved in the IM planning department;
- The creation of this plan begins a long time before the entry into force (before the start date of a scheduled train);

DRAFT – AWAITING EC APPROVAL

- It is negotiated between the different RUs and the IM;
- A modification of this long term plan has to be negotiated between the RU and IM and can trigger administrative operations;
- It is possible to negotiate modifications to the long term plan with RUs before its entry into force and once it has entered into force;
- The Long term plan is the strategic plan for the period established by the Infrastructure Manager (usually 1 year before to 24 hours before operations);
- The long term plan is created for the period established by the Infrastructure Manager (usually once a year) and it follows a common European process defined in the Network statement which Rail Net Europe is responsible for harmonizing.

4.1.1.2 Daily timetable

The following points define the daily timetable:

- The daily timetable is an extract of the long term plan for each day and includes any specific modifications approved for a particular day;
- A modification done in the Daily Timetable is not reflected in the Long Term Plan;
- If the Long Term Plan is changed, the Daily Timetable is updated if it is affected by the modification event, if it has already been extracted;
- The Daily Timetable is the planning established for each day;
- A Daily Timetable for day D is extracted from the long term plan for day D and the specific modifications are approved for day D, if they exist;
- If a RU wants to make a change to the planning of a train for a specific day but do not want that this change to be reflected in the transport plan (long term plan), the IM planning department will make a modification of the daily timetable for that particular day.

4.1.2 Real time environment

The real time environment is under the responsibility of the Traffic Management Department of the Infrastructure Manager. The limit between the real time environment and the planning environment must remain adjustable by each Infrastructure Manager and is set according to individual organizations.

Indeed, a train modification which is planned to run in 6 hours, will be considered by Infrastructure Manager A as part of the real time environment, whereas Infrastructure Manager B may consider this to be part of the planning environment.

4.1.2.1 Real time traffic plan

The following points define the real time traffic plan:

DRAFT – AWAITING EC APPROVAL

- The real time traffic plan (RTTP) corresponds to the timeframe of the daily timetable transferred from the IM planning department to the Traffic Management Department;
- The Real Time Traffic Plan includes information about all trains and work possessions;
- The Real Time Traffic Plan includes all information from the Railway Undertaking (which is shared with Infrastructure Managers) which may be impacted by a train delay (rolling stock roster, train crew shifts, maintenance meeting time, etc.);
- The Real Time Traffic Plan represents the ongoing train route and the train route plan according to the daily timetable and includes all operational adaptations (day-to-day incidents, unplanned work, train dispatching decisions, etc.);
- Initially, before the trains begin running, it coincides with the current daily timetable, because the goal of the IM train dispatcher is to make the trains run as defined by the daily timetable. However, day-to-day incidents and unplanned work give rise to the need to adapt the running of trains to try to satisfy the daily timetable;
- Modification of the real time traffic plan is the responsibility of the IM train dispatcher and the IM train dispatcher management board;
- RUs may request changes to trains that are already running (route changes and planned stops, schedule modification, cancellation of a train that is running); these changes are negotiated between the RU and the IM train dispatchers and these modifications are made to the real time traffic plan;
- RUs may request to add or to cancel a service for a train which is not running yet. This request is managed by the IM train dispatcher management board in the real time environment;
- A modification of the real time traffic plan involves the recalculation of the forecast for the trains involved;
- It is the responsibility of the IM Train Dispatcher, supported by the TMS (e.g. by using forecast and simulation functions), to keep the Real Time Traffic Plan updated;
- The Real Time Traffic Plan is shared with all actors involved in the process to ensure that everyone is working with up-to-date information;
- The Real Time Traffic Plan is automatically executed e.g. via automatic route setting.

When is this plan modified?

- Modification is requested by the Infrastructure Manager. This corresponds to any adaptations required to deal with day-to-day incidents. Depending on the impact of the incident, these changes may need to be negotiated between the RU and IM (Traffic Management Department):

DRAFT – AWAITING EC APPROVAL

    - From the Traffic Management Department: alternative route due to capacity restrictions, etc.
    - From the Maintenance Department: unplanned work, temporary speed restriction, gauge restriction, etc.
- Modification is requested by the Railway Undertaking. These changes are negotiated between the RU and IM (Traffic Management Department).
    - Train is already running: any service modifications (e.g. added stops, cancelled stops, end of service, connections and connecting time modifications), any incident that impedes the use of the slot (e.g. rolling stock default).
    - Train will run in the timeframe under the responsibility of the Traffic Management Department: any service modifications, any incident that impedes the use of the slot by the RU (e.g. departure time cannot be respected, slot maximum speed cannot be guaranteed with the rolling stock used, etc.), and any new path request (e.g. new path is requested because of the loss of the original slot, the delay exceeds the limit set by the Infrastructure Manager).
- The IM Train Dispatcher can update this plan at any time, but for operation procedures they will update it when the current and forecast positions of trains deviate to a certain degree from the RTTP.

4.1.2.1.1 Forecast timetable traffic information

This forecast information is part of the information of the Real Time Traffic Plan. The following points define the forecast timetable traffic information:

- The real time environment requires the evaluation of the forecast for the running of the trains for normal operation or disruptive events;
- This forecast is calculated for each train in the Real Time Traffic Plan whenever a new position of the train is known, or a there is a new element of the work possession or every time a feature of the train, that may impact its movement, is changed;
- The forecast is based on:
    - Track infrastructure information;
    - Traffic information;
    - Possession information;
    - Power supply information;
    - Rolling stock physical and mechanical characteristics;
    - The schedule established for the movement of each train (real time traffic plan), e.g. the timetable to comply with and the stops to perform;
    - Traffic restrictions;
    - On-going disruptive events (and related statistical results);

DRAFT – AWAITING EC APPROVAL

    - Infrastructure Manager operational rules agreed for the network, and more specifically priority rules defined between trains, and between trains and works. These rules can be modified by the operator.
- Conflict detection functionality will use the forecast timetable traffic information;
- On request of the operator, the forecast can be replaced by a simulated forecast (see below).

4.1.2.2 Simulated timetable traffic functionality

- The real time environment can simulate a forecast timetable traffic plan on request of the operators of the Traffic Management Department (IM Train Dispatchers and IM train dispatcher management board).
- The purpose of this simulated timetable traffic plan is to evaluate traffic management options before committing to them. The goals are to minimize the overall delay and return as fast and as close as possible to the original timetable (rescheduling definition - extract from the common glossary of [In2Rail D7.1]).
- Before commitment, the simulated timetable can be exchanged with RUs for negotiation.
- The simulator will show different real time traffic plans with different train modifications called simulated timetable traffic plans, but only one of the simulations can be applied.

4.1.2.3 Logger traffic timetable

The following points define the logger traffic timetable:

- This timetable contains all elements that occur on the network concerning trains, works, disruptive event information, traffic conditions, etc.
- This timetable is used in the phase of post analysis.

4.2 Level 1 Use Cases

Use cases identified at this level cover all operations performed during traffic management processes using a TMS. The main processes can be grouped as follows:

- Preparation / adaptation of daily timetable;
- Setting the route of the trains (route and schedule) to meet the established plan;
- Work analysis and study of deviations which occurred during the day.
- The first level breakdown of the Use Cases is as follows:
    - Table 4.1 - Overview of Actors for all Use Cases
    - UC1 – Manage maintenance information,
    - UC2 – Manage very short term request,
    - UC3 – Manage Real time traffic plan,
    - UC4 – Manage & monitor train traffic and infrastructure,

DRAFT – AWAITING EC APPROVAL

- UC5 – Manage train traffic information distribution,
- UC6 – Analysis and tracing of information,
- UC7 – Manage temporary traffic restrictions.

Each of these use cases are involved in one or more processes:

- Preparation / adaptation of daily timetable
  - Table 4.1 - Overview of Actors for all Use Cases
  - UC1 – Manage maintenance information,
  - UC2 – Manage very short term request.
- Setting the running of the trains (route and schedule) to meet the established plan at the real time traffic plan:
  - Table 4.1 - Overview of Actors for all Use Cases
  - UC1 – Manage maintenance information,
  - UC2 – Manage very short term request,
  - UC3 – Manage Real time traffic plan,
  - UC4 – Manage & monitor train traffic and infrastructure,
  - UC5 – Manage train traffic information distribution,
  - UC7 – Manage temporary traffic restrictions.
- Work analysis and study of deviations which occurred during the day:
  - UC5 – Manage train traffic information distribution,
  - UC6 – Analysis and tracing of information.

In the following chapters, each of the use cases is described, indicating the tasks performed by the TMS covering the relationship and exchange of information with other use cases, and the relationship with the actors identified.

DRAFT – AWAITING EC APPROVAL

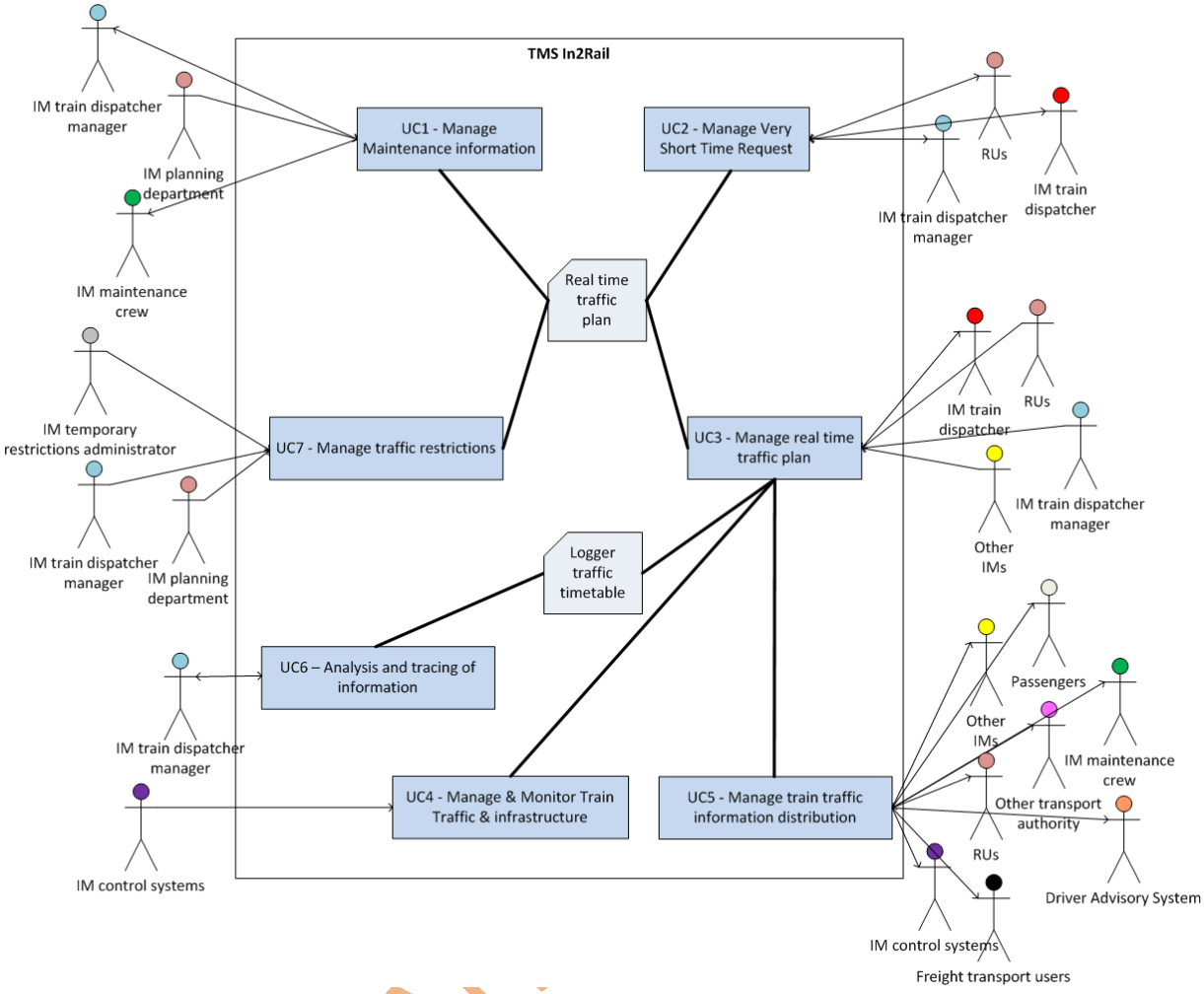

Figure 4.2 – Actors interacting with use cases level 1

4.2.1 Actors

The responsibilities and interactions with the system for each of the actors that have been identified as participants in the processes of traffic management are described below.

4.2.1.1 Actor IM train dispatcher

The "IM train dispatcher" is responsible for the real time traffic regulation within the scope of the TMS. The IM train dispatcher is also responsible for taking any operational decisions to respond to perturbations, minor or major, to meet the daily timetable.

The system must be able to show the operator, in real time, all information managed by the system so that the most appropriate decisions can be made. To do this, the system is able to produce analysis and evaluate the result of possible different decisions to help the operator.

DRAFT – AWAITING APPROVAL

4.2.1.2 Actor IM train dispatcher manager

The “IM train dispatcher manager” is responsible for global traffic management. Their main responsibility is to analyse, prepare and complete the real time traffic plan to address specific unplanned situations and allow train dispatchers to handle them in the most efficient way.

In particular, he is responsible for updating the real time traffic plan to integrate short requests: train paths from RUs or possession from the IM maintenance department. He is also responsible for post-analysis of the objectives, completing any data logged for further analysis.

The main difference between the IM train dispatcher and the IM train dispatcher manager is that the manager has a more tactical and strategic role and is active when handling bigger disturbances in order to communicate with the Railway Undertakings. The IM train dispatcher manager has responsibility for preparing/ modifying/ adapting the train planning for the current day and the IM train dispatcher has responsibility for implementing the actions involved with regard to train movements in order to fulfil the train planning.

4.2.1.3 Actor IM maintenance crew

The IM maintenance crew are responsible for the following activities:

- Import a plan for daily maintenance activities planned on the infrastructure that may affect train paths;
- Adapt the maintenance plan and possessions, according to ongoing events;
- Propose maintenance plans and possessions to recover optimal infrastructure capacity to face operational contingency;
- Update the actual status of works that are being implemented, including forecasted finish times.

IM maintenance crew can work either directly for the Infrastructure Manager or for an undertaking which is accredited by the Infrastructure Manager to perform maintenance activities on the infrastructure of the railway network.

4.2.1.4 Actor IM planning department

This department is responsible for generating and maintaining the long term plan. It is responsible for responding to any requests from RUs to add / modify / remove services and generate the long term plan. The temporal limits of IM planning department interventions are presented in §4.1.2.

DRAFT – AWAITING EC APPROVAL

4.2.1.5 Actor IM temporary restrictions administrator

This actor is responsible for managing and notifying any restrictions (speed, gauge, opening and closing hours of line, stations, yards, etc.) imposed by the IM departments which must be taken into account in the traffic management.

4.2.1.6 Actor IM control systems

The IM control systems include all of the systems that are involved in the control and management of the railway infrastructure. Examples of this type of control system are:

- **Signalling Control System:** This system should be able to invoke operations on the signalling control system in order to modify the field and enable trains to follow the Real Time Traffic Plan defined by the train dispatcher operator and meet their schedule as far as possible. It is also responsible for sending information about the state of the infrastructure and the position of each of the trains to the Traffic Management System.
- **Energy Control System**: Provides information about the power status of the different sections of the catenary to the Traffic Management System in order to determine whether the running of the trains will be affected by a power cut. This information about the state of energy is also used when assigning responsibilities in case of incidents.
- **Infrastructure Detector Control System**: any system providing information about the nowcast and forecast of the state of the infrastructure, including meteorology control systems which measure weather conditions across the railway infrastructure.

4.2.1.7 Actor Other Infrastructure Manager

A body responsible for the development, operation and maintenance of a railway infrastructure (ref. to glossary of [In2Rail D7.1] deliverable) connected to the infrastructure supervised by the IM.

4.2.1.8 Actor Railways Undertaking

Bodies, such as train operating companies and freight operating companies, responsible for the operation of passenger and freight trains (ref. to glossary of [In2Rail D7.1] deliverable). They are in charge of the operation and management of the rolling stock and train crew.

RUs generate path requests during the planning phase to reserve capacity for their services. During operations, RUs may request train path modification.

4.2.1.9 Actor Driver System

The Driver System is the on-board system that allows the exchange of information between individual trains and between the trains and the Traffic Management System. It indicates to

DRAFT – AWAITING EC APPROVAL

the driver any information related to the train's path, such as modifications to be made to the train departure in order to fulfil the Real Time Traffic Plan set by the train dispatcher operator. It also alerts the driver about specific situations which require changes to planning, including maintenance work to tracks, running restrictions, or adverse weather conditions. The Driver System also allows the Driver to easily inform Dispatchers of any situation that may impact the running of the train, such as trespassing by third parties.

On-board systems used for such communication include the Driver Advisory System - DAS, which enables trains to communicate with each other, and Automatic Train Operation - ATO.

It is essential to continuously transfer the Real Time Traffic Plan to the train to ensure that the train/train drivers follow the current schedule and do not act on obsolete planning information.

4.2.1.10 Actor On-board Control System

- **On-board Safety Control System**: ensures safe train movements by monitoring safety relevant conditions (e. g. current speed, state of the next signal) and activation of safety measures if required (e. g. activation of brakes). The system also provides information about the state of the safety of the train such as brakes, axels, wheels, etc.;
- **Driver advisory system**: the system communicates with TMS and provides to the driver an advice for optimal speed and departure times;
- **Security system**: any systems providing information related to the security of the passengers or goods on the train.

4.2.1.11 Actor Passengers

Passengers are the users of the rail transport system. They are informed of the long term plan, the real status of the running trains and the compliance with the planning (delays, disruptions, etc.) through information systems available across different platforms, information at stations, mobile devices and the internet.

4.2.1.12 Actor Freight transport users

These users are the owners of goods transported by different trains. They have to be informed about the current position and the forecast arrival time at the destination of the goods.

4.2.1.13 Actor Other transport authority

A body responsible for the development, operation and maintenance of other transport modes connected to railways at stations. They should bi-directionally exchange information

DRAFT – AWAITING EC APPROVAL

with the IM to facilitate intermodal transport and improve efficiency in order to make the use of different transport modes attractive to users.

4.2.2 Use case definitions

These chapters describe each level 1 use case and their mutual interactions and relationships with the actors. The following table represents the matrix between level 1 use cases and the actors involved in each one.

Actor/Use case	Actors for all Use Cases UC1 – Manage maintenance information	UC2 – Manage very short term request	UC3 – Manage Real time traffic plan	UC4 – Manage & monitor train traffic and infrastructure	UC5 – Manage train traffic information distribution	UC6 – Analysis and tracing of information	UC7 – Manage temporary traffic restrictions
Actor IM train dispatcher			X				X
Actor IM train dispatcher manager	X	X	X			X	X
Actor IM maintenance crew	X				X		
Actor IM planning department	X		X				X
Actor IM temporary restrictions administrator							X
Actor IM control systems				X	X		X
Actor Other Infrastructure Manager			X	X	X		
Actor Railways Undertaking		X	X		X		
Actor Driver System					X		
Actor On-board Control System				X			
Actor Passengers					X		
Actor Freight transport users					X		
Actor Other transport authority			X		X		

Table 4.1 - Overview of Actors for all Use Cases

4.2.2.1 UC1 – Manage maintenance information

In the context of this document we consider only maintenance of the railway infrastructure ignoring maintenance of the rolling stock. Management of the long term maintenance plan is outside the scope of the TMS. This plan must take into account all the activities related to necessary maintenance in order to provide preventive maintenance for the railway infrastructure.

On the other hand, it is very important to know the exact impact of these maintenance activities on running trains along the railway infrastructure. Some types of maintenance activities may impact on the running of trains, since it can be necessary to reduce the speed

DRAFT – AWAITING EC APPROVAL

of the trains or even stop the trains from running in order to carry out maintenance. The location and infrastructure elements involved in each maintenance activity are important, as a maintenance activity at a bottleneck point has a different impact than at a platform of a station with low traffic. Each possession typically containing several maintenance activities takes a different amount of time, which directly impacts the number of trains involved. All of these aspects must be taken into account when building the long term plan for maintenance works.

On each day of operation, it is necessary to take all these aspects of maintenance activities into account, because maintenance activities are necessary to resolve incidents with the infrastructure; the level of the incident must also be taken into account. All tasks related to modifications of the long term plan for maintenance activities are part of this use case. To ensure that this objective is possible, this use case must provide all functionality for:

- Daily maintenance plans, including very short term planning of all maintenance activities;
- Control and monitoring of the evolution of each possession;
- Analyse the impact on the train running of each possession in the real time traffic plan.

In summary, this use case is responsible for the tasks related to the management of the daily maintenance activities and their inclusion in the real time traffic plan. This management includes all changes or modifications of the planned maintenance activities, the real time monitoring of maintenance activities and adjustments to the planned maintenance activities during execution in order to respond to all eventualities on the operation day.

4.2.2.1.1 Use case Actors

The actors involved with this use case are:

- **Actor IM planning** department: Provides the long term maintenance plan to this use case. This actor builds the long term plan to take into account all recurrent maintenance activities necessary to comply with a preventive maintenance plan;
- **Actor IM train dispatcher** manager: He is the responsible of prepare all the aspects of the day of operation plan for the IM train dispatchers. One part of the day of operation plan is the maintenance works, this actor receive the maintenance works desired and provided by other department and their work is talk with the maintenance crew to try to execute the maintenance work at the desired time taking into account the running of the trains and the availability of the maintenance crew;
- **Actor IM maintenance** crew**:** This group is the team responsible for the execution of the works at tracks or at infrastructure installations. They have to provide

DRAFT – AWAITING EC APPROVAL

information about the evolution of each maintenance activity to the TMS and specific information to the IM Train Dispatcher.

4.2.2.1.2 Use cases relationship

This use case is indirectly related to the "UC3 – Manage Real time traffic plan" use case.

All the works included in the daily maintenance plan could have an impact on the train traffic and could affect the main objective of the TMS, which is that the trains should fulfil the established planning. It is necessary that this use case manages all modifications to the real time traffic plan to take into account all the works included in the daily maintenance plan and the use case related to the real time traffic plan management, which has all the actions involved and an analysis of the impact of the maintenance works on the running of trains.

4.2.2.2 UC2 – Manage very short term request

This use case is responsible for managing requests for modification of the "real time traffic plan" made by the different railway undertakings and it also outlines the impact on the real time traffic plan. It is in charge of undertaking all negotiation between the Management Dispatcher of the TMS and the railway undertaking to reach agreement on the modifications to be made to the real time traffic plan (4.1.2.1).

This use case is involved in the requests that are made to adapt the real time traffic plan in the very short term, because changes to the medium-long term plan must be implemented through the IM planning department, which is outside the scope of the TMS.

A very short term request (VSTR) is a modification of a service planned for the current day. There are different types of modifications that can be made to the current real time traffic plan, such as cancellations or modifications of the route or of the schedule or any modification of the characteristics of a planned train. The railway undertaking can need to add new services for the current day; these operations must be included in the real time traffic plan, but the daily timetable and the long term plan will not be synchronised with these modifications.

Operations for the following days will be made through the daily timetable or the long term plan, but these modifications will be analysed by the IM planning department.

The TMS has to provide functionality to allow the modification of the real time traffic plan to adapt the traffic to the needs of the current day. Each Railway Undertaking that has planned trains for the current day is able to adapt the planned schedule for each train. These adaptations need the approval of the Infrastructure Manager, who is responsible for the management of the real time traffic plan (Actor IM train dispatcher manager). The Infrastructure Manager has to take into account the trains of all railway undertakings in real

DRAFT – AWAITING EC APPROVAL

time and has to ensure that the modifications required by a railway undertaking do not affect the other trains. The TMS should support the coordination of requests by other infrastructure managers concerned, by providing approve or reject analyses. If the infrastructure manager is responsible for traffic management across several geographical areas on the network, the TMS should support coordination between those geographical areas.

This use case has to provide a communication channel that allows the interchange of information between railway undertakings and the infrastructure manager, between different infrastructure managers, and between different geographical areas of a same infrastructure manager, in order to coordinate the required modifications to the real time traffic plan.

All these actions need analysis of the impact to the plan before they can be applied. To implement the changes to the plan and to carry out the analysis it is necessary to have all the information required. This use case has to provide the necessary mechanisms to have communication between railway undertakings and infrastructure managers in order to obtain the complete information necessary.

The analysis of the plan modification must take into account the impact of the changes to other trains; if the impact is bigger than the permitted level the infrastructure manager can refuse to make the changes to the plan and can propose different changes that can be established without having a big impact on other trains. This negotiation is part of this use case and it is necessary to register all these communication interchanges.

4.2.2.2.1 Use case Actors

The actors involved with this use case are:

- **Actor IM train dispatcher** manager: Responsible for analysing and making all the modifications to daily timetables and to the real time traffic plan required to take into account all the requests made by railway undertakings;
- **Actor Railways** Undertaking: These actors are the railway operators that manage the rolling stock. They are the owners or managers of the rolling stock and they provide a service to the passengers or to other freight transport users. They need to adapt the daily service to provide a suitable service to passengers and freight transport users, to optimise these services and to respond to the incidents which may occur with the rolling stock.

4.2.2.2.2 Use cases relationship

This use case has an indirect relationship with the use case "UC3 – Manage Real time traffic plan". This relationship is based on the need to analyse the impact of the change to the plan.

DRAFT – AWAITING EC APPROVAL

As part of this use case it is necessary to analyse the impact of the changes in the same manner that the use case "UC3 – Manage Real time traffic plan" does.

When the changes to the plan are accepted by the management dispatcher, it is necessary to implement these changes to the plan, and all of these actions are part of the current use case. All these changes to the plan will be triggers to actions of the use case "UC3 – Manage Real time traffic plan".

4.2.2.3 UC3 – Manage Real time traffic plan

This use case is responsible for:

- The analysis of the current running of trains and differences detected as compared to the established plan;
- Identify the possible actions to adapt the train traffic, in order to maximise the business Key Performance Indicators (KPI) defined by each Infrastructure Manager. A large set of KPIs were presented in §4 of [In2Rail D7.1]. As a reminder, example KPIs include:
  - **Minimising the deviations** versus the daily timetable,
  - **Minimising the peaks** of the delays and the time to restore the schedule,
  - **Minimising a certain measure** of the delays, such as the total lateness.
- Allow to the train dispatcher to adopt the necessary changes to the running of the trains;
- Automatically perform all the necessary actions to allow the running trains to follow the established plan. These actions allow routes to be established so that the trains run on the planned route and schedule. To do this, it is necessary to connect with the centralised traffic control.

There are different aspects that have to be taken into account for this use case related to the trigger for the analysis of the current running of the trains.

- **The modifications to the current plan:** It is possible to make changes to the current plan. When the plan is changed it is necessary to analyse the impact of the change on all of the trains, taking into account the current situation of each train;
- **Modification to the current state of the infrastructure:** The state of the infrastructure can change during the day due to incidents on the infrastructure that can affect current running trains. It is necessary to analyse the impact of these changes to the state of the infrastructure on the running trains;
- **Modifications to the train routes:** The Train Dispatcher can modify the train routes; these changes can be performed to minimize the impact of an incident or the detected delays on other running trains;
- **Current position of the trains:** When the TMS receives a new train position it is necessary to recalculate the possible deviations vs the plan. This action requires an

DRAFT – AWAITING EC APPROVAL

analysis phase to determine if it is necessary to take action to try to minimize this deviation, and, if so, which are the best actions to apply.

The main objective of the TMS is to ensure that the running of trains complies with the established plan. To make this objective possible the TMS must have functionality to analyse all information and show the best alternatives for amending the traffic and make the most appropriate decisions in each case.

The TMS execution philosophy has to follow these points:

- At any traffic situation, the TMS has to be able to monitor the traffic along all the controlled area;
- At any traffic situation, the TMS has to provide all important information about the traffic situation and the system state to the train dispatchers;
- At any traffic situation, the TMS has to unload to the dispatchers any task or information that does not provide any added-value;
- At any traffic situation, the train dispatcher must have the complete control of the system;
- At a normal traffic situation and at a minor traffic disruption the TMS has to be autonomous, providing advanced functionality to be able to fulfil the plan;
- At a high level traffic disruption, the TMS has to attend to the needs of the train dispatchers, providing the best solution in any case, to be able to fulfil the plan to reduce the impact of the disruption;
- All the TMS automatic operations have to try to optimise the traffic according to different KPIs that can be configured.

The TMS can calculate all the different possibilities to adapt the running order of the trains to show the most optimised solution and the train dispatcher can adopt the desired solution. When TMS calculates solutions, it must include all restrictions known when processing the new calculation. Such restrictions can be:

- Permanent or temporary;
- Set for safety or traffic management reasons;
- Applied to all trains, a train pattern, selected trains, or a single train;
- Related to the infrastructure or the train.

Another important aspect of the actions and responsibility of this use case is to ensure that the train dispatcher can make the appropriate changes to the running of the trains. These changes can be performed for several reasons:

- After the analysis of the current situation of the running all current trains: When the system analyses the current situation it could be necessary to modify the route of one or more trains;

DRAFT – AWAITING EC APPROVAL

- To resolve any detected conflicts: The system can detect conflicts between trains or between a train and the infrastructure characteristics. It could be necessary to modify train routes to ensure that the detected conflict disappears;
- To optimise the resources: The train dispatcher can make a change to the running of the trains to optimise the use of the infrastructure resources without detecting any conflicts or deviations of the trains which are running;
- To prioritise the traffic: The train dispatcher can modify the running of the trains to prioritise the traffic of a train or a type of train.

All the changes performed to the running of the trains have to be executed. This task is the responsibility of the actions of this use case. The TMS has to provide functionality that automatically makes all the necessary actions to ensure that the trains fulfil the train running parameters established by the train dispatcher. These actions are based on establishing the appropriate routes at the correct time so that the trains run across the correct route and fulfil the established schedule.

4.2.2.3.1 Use case Actors

The actors involved with this use case are:

- **Actor IM planning** department**:** This actor provides the long term plan. One operation of this use case is to generate the real time traffic plan taking into account the long term plan and the exceptions for the current day described in the daily timetable.
- **Actor Railways** Undertaking: The railway operator companies are involved in this use case because they are the entities that can provide information about the real rolling stock that are used by each planned service. This information is used to validate that the current rolling stock is appropriate to the planned route, that it fulfils the infrastructure characteristics and allows the planned schedule to be carried out;
- **Actor IM train** dispatcher: This is the main actor involved in this use case. The IM train dispatcher is responsible for making all changes to the trains running to adapt the current running to fulfil the daily timetable;
- **Actor IM train dispatcher** manager**:** this actor is active when handling bigger disturbances in order to communicate with the Railway Undertakings;
- **Actor Other Infrastructure** Manager**:** These systems provide information of the current trains running to the TMS. The Other IM systems must provide forecast information about the trains so that the train delays can be known and the route forecast at the border stations;
- **Actor Other transport** authority**:** This use case has to provide a picture of the current state of the infrastructure and the railway exploitation, but to make this possible an intermodal system for freight and passenger traffic is necessary, such that the TMS

DRAFT – AWAITING EC APPROVAL

has updated information about the current situation of other transport modes. This information could be used to adapt the train traffic to be able to provide an intermodal service taking into account the current state of other transport modes.

4.2.2.3.2 Use cases relationship

Modifications to the plan can be performed for several reasons:

- To meet the demands of railway undertakings, managed by the use case "UC2 – Manage very short term request";
- For the management of maintenance and associated works, collected in the use case "Table 4.1 - Overview of Actors for all Use Cases
- UC1 – Manage maintenance information";
- By inserting movement restrictions as temporary speed restrictions or closures of nodes managed in the case of use "UC7 – Manage temporary traffic restrictions";
- By deviations detected in the movement of trains, using information from the traffic control systems covered in the use case "UC4 – Manage & monitor train traffic and infrastructure".

For this reason this use case is indirectly related with all previous use cases. It is also directly related to another two use cases:

- The measures proposed to adapt the plan will also be based on historical information from similar situations provided by the use case "UC6 – Analysis and tracing of information";
- For the operation of the TMS it is necessary distribute all updated information of the real time traffic plan to all interested actors. To do this it is necessary to use "UC5 – Manage train traffic information distribution".

4.2.2.4 UC4 – Manage & monitor train traffic and infrastructure

This use case covers all operations related to the exchange of information between the traffic management system and traffic and IM control systems such as centralised traffic control, the energy and management control system, centralised detector control, meteorology systems, etc.

It is responsible for obtaining information from external systems like remote control systems, and the distribution of all the recovered information across the TMS for treatment.

It is part of this use case to provide functionality to:

- **Get information from different IM control systems:** It is important to allow information to be obtained from several different types of system;
- **Register the information:** All information received from external systems must be registered so that it can be recovered and analysed at future phases;

DRAFT – AWAITING EC APPROVAL

- **Adaptation of the information:** To allow the analysis of the information it is very important to adapt it for use. All the information received will be used to analyse the current situation of the traffic but each external system can provide the information in a different format; this use case must adapt the information to a neutral format to be able to use it internally for all the systems or modules that are part of the TMS;
- **Update the current traffic situation:** All the information recovered must be treated to provide the current situation of the traffic and the current state of the infrastructure. The external system must provide information about their scope but the TMS must provide a picture of the current situation of all the different aspects of railway exploitation.

Therefore, this use case is responsible for obtaining, registering and updating the current situation of railway exploitation.

4.2.2.4.1 Use case Actors

The actors involved with this use case are:

- **IM control systems:** These systems must provide the state of the controlled elements of the infrastructure and the elements related to the railway exploitation. All this information is sent to the TMS to be analysed and to provide high level functionality to help the train dispatcher to understand the current state and to make the most appropriate decision in each case;
- **Actor Other Infrastructure** Manager**:** other IM provides information at the border concerning trains which are planned to run on the infrastructure but have not yet arrived, in order to take them in account as much as possible in advance.

4.2.2.4.2 Use cases relationship

This use case does not have a direct relation with other use cases. The objective of this use case is to collect all the information provided by external systems and to register and distribute the information internally across the TMS.

On the other hand, all the information distributed by the different actions of this use case across the TMS will be used by other operations of different use cases to make their own functionalities.

4.2.2.5 UC5 – Manage train traffic information distribution

This is the use case in charge of distributing information to all stakeholders. Its main task is to send information to each stakeholder taking into account the type and level of detail required. It is also part of this use case to perform the necessary tasks to adapt the format of the distribution of information to each stakeholder based on European standards *[TAF TSI D2]*.

DRAFT – AWAITING EC APPROVAL

It must be highlighted that the work of distributing information to Other Infrastructure Managers to thereby ensure that they have updated information on the status and forecast of each train that is planned to run across the network of the IM.

With the same premise of allowing compliance with the real time traffic plan, this use case is in charge of sending information to the on-board train system so that the cabin crew may have useful information in real time to achieve the daily timetable and may take into account all changes to the intended movement of each train.

The Actor IM train dispatcher manager should be able to filter the data to be sent to an operator before being broadcasted, in order to maintain control and ensure coherence of the data sent.

4.2.2.5.1 Use case Actors

The actors involved with this use case are:

- **Actor** Passengers**:** The passenger must receive all commercial information related to the running of the trains filtered for their needs. They do not need to know all the details about the current state of the trains, but need to know the updated forecast of the arrivals and departures. The passengers need information about the commercial features of the trains, the schedule and the platforms used:
  - Passengers can need different types of information:
  - All the information about all the trains at a specific station,
  - All the information about a specific train from origin to destination,
  - All the information about a specific train at a specific station.
  - The passengers also need different information, the planned information and the forecast information based on the real state of the train and the infrastructure.
- **Actor Freight transport** users**:** These are the owners of the goods transported by freight trains. They need to know the forecast arrival time at the destination of their goods.
- **Actor Other Infrastructure** Manager**:** The other infrastructure managers need to know the forecast of each train that will run along their railway network at a border station. Additionally they need to know the commercial characteristics of these trains to be able to send this information to their station to make announcements to their passengers, to send information to the freight transport users or to be able to make their own forecast calculations to send to the next infrastructure manager involved in the transport of the trains;
- **Actor IM maintenance** crew**:** The personnel involved in the works need to know the daily maintenance planning and need to know the current situation and forecast of the trains that will run across the affected space of each work;

DRAFT – AWAITING EC APPROVAL

- **Actor Railways** Undertaking**:** They need to know the current position and the forecast for their own trains;
- **Actor Other transport** authority**:** To be able to promote intermodal transport it is necessary to exchange information about the traffic of different transport modes. The TMS must send all the information related to the current situation of the trains and the calculated forecast to each one;
- **Actor Driver** System**:** The TMS must provide to the locomotive personnel all the information related to the route of the train made by the train dispatcher;
- **Actor IM control** systems**:** To be able to carry out their functionalities these systems need to know the current state and position of the trains and the forecast calculated along the route.

All these actors need information about the current position and calculated forecast along their route, but each one needs a different level of information. Some of them need more technical information about the route and others need commercial information. All these necessary actions to provide the appropriate level of information are part of the responsibilities of this use case.

4.2.2.5.2 Use cases relationship

This use case is directly related with the "UC3 – Manage Real time traffic plan" use case. The current use case must distribute the information managed by the use case in charge of the management of the real time traffic plan.

The real time traffic plan must contain all the information necessary to be distributed to all stakeholders, the planned information for the trains, the planned information for the infrastructure restrictions, the planned works, and the current state of each train, maintenance works and any state of the infrastructure that could affect the train running. All this information will be distributed by this use case to the different stakeholders combining, completing and filtering the information.

4.2.2.6 UC6 – Analysis and tracing of information

This use case includes the tasks of collecting data, allocating responsibilities, analysing and publishing all the information recorded by the system, and tasks which supplement information recorded by the system. The analysing functions include a playback function.

With the analysis of the information, the TMS should be able to provide conclusions about what is happening within railway operations, and provide real time and post operational feedback. Real time analysis aims to give information to dispatchers and dispatchers' managers to evaluate their decision. Post operational analysis aims to enable good practice

DRAFT – AWAITING EC APPROVAL

by operators in solving certain situations, and provide feedback to planning departments to inform timetable processes.

This use case must also contain all the tasks related to the management of incidents and / or delays detected. The TMS should be allowed to determine their causes, and allocate responsibility to each of them.

As a result of these tasks this use case also includes the generation of detailed reports that include all the information registered about incidences and the conclusions that have been reached after analysis and completion of the information.

All this analysis of recorded information has four main outputs:

- To allow the generation of reports reflecting the conclusions;
- To gain good practice in addressing incidents, delays or disruptions in the real time traffic plan to use in future similar situations and thus improve the service offered;
- To evaluate chosen key performance indicators by operational operators, Dispatchers, and their management, to appreciate the quality of their decision making;
- To publish all elements required for financial systems to bill the RU and establish relevant penalties.

The good practices obtained by this use case may be used by the conflict resolution algorithm to provide the best option to modify the route of the trains involved.

4.2.2.6.1 Use case Actors

The actors involved with this use case are:

- Actor IM train dispatcher manager: Responsible for analysing what happened in the railway exploitation. This actor requires the TMS provide functionality to be able to determine the state of all the trains and the state of the infrastructure at a past date. This actor is also responsible for completing the registered information to determine the actors involved in an incident or in a determinate situation.

4.2.2.6.2 Use cases relationship

The operations involved in this use case are indirectly related to the operations of the “UC3 – Manage Real time traffic plan” use case. Part of the operations of the management of the real time traffic plan is the registration of all the managed information at the logger traffic timetable. This use case uses this registered information and processes it, analyses it and generates conclusions.

DRAFT – AWAITING EC APPROVAL

The TMS must register all the information managed by the system independently of the source of the information. This use case must use all this registered information to be able to provide analysis and generate conclusions.

4.2.2.7 UC7 – Manage temporary traffic restrictions

This use case is responsible for managing the impact on the trains of all the temporary infrastructure restrictions imposed on the movement of trains. In particular it must manage different types of restrictions, such as:

- Speed restrictions;
- Gauge restrictions;
- Line, node, yard closures;
- Non stopping areas; etc.

TMS should take into account any temporary traffic restrictions defined in the planning environment and in the Real Time environment. Restrictions from the planning environment are indicated by the IM planning department. In operation, restrictions may come from either the "IM temporary restrictions administrator" or "IM control systems" if the restriction is automated (e.g. speed of wind on certain sections of line). If restrictions are linked to traffic management (e.g. weather conditions such as snow on high speed lines, or rail adhesion issues), the restriction comes directly from the Dispatcher. If the restriction is managed by Dispatchers or their manager, TMS should offer all possibilities to add, cancel or modify unplanned temporary restrictions.

These restrictions have a direct effect on the movement of trains and therefore will have to be taken into account when the train dispatcher takes decisions to make modifications to the real time traffic plan.

The responsibility for the management of all infrastructure restrictions is outside the scope of this use case. This use case contains all the operations to include these restrictions to the TMS and specifically the real time traffic plan, such that the TMS can manage the impact of these restrictions on the trains.

It is important to note that restrictions defined in the TMS are not used to fill in the Infrastructure Restriction Notice Data (see *[TAF TIS D2]*), but each IM is responsible for sending the suitability of a path to each RU on its infrastructure. This point is out of scope of the TMS.

4.2.2.7.1 Use case Actors

The actors involved with this use case are:

DRAFT – AWAITING EC APPROVAL

- **Actor IM temporary restrictions** administrator**:** Responsible for managing and maintaining all the infrastructure restrictions that have a safety component. This actor must notify the modification of each restriction to the TMS to be able to keep the restrictions updated in the real time traffic plan and to be able to take into account the restrictions when analysing the impact on the trains running;
- **Actor IM planning** department**:** Responsible for managing and maintaining the infrastructure restrictions that do not have an associated safety level. This actor must provide the restrictions to the TMS to be used as part of the real time traffic plan;
- **Actor IM train** dispatcher**:** this actor is in contact with all operators involved in train running. The IM train dispatcher is responsible for registering any restrictions appearing during operation that s/he is informed of. This actor is also responsible for managing restrictions in the TMS. It is one of the actors which makes modifications to restrictions managed by the TMS. This actor will use the restrictions information that is registered;
- **Actor IM train dispatcher** manager**:** when the Actor IM train dispatcher is not available, or if a restriction covers a wider area than that under responsibility of a single Actor IM train dispatcher, this actor is responsible for managing the restrictions into the TMS. This is one of the actors which makes modifications to restrictions managed by the TMS. This actor will use the restrictions information that has been registered;
- **Actor IM control** systems**:** is responsible for transmitting any restrictions coming from the infrastructure manager system.

4.2.2.7.2 Use cases relationship

The operations involved in this use case are indirectly related to the "UC3 – Manage Real time traffic plan" use case.

This use case is responsible for maintaining updated information about the infrastructure restrictions in the real time traffic plan, These restrictions will impact on the route of the trains and the modifications required to minimize this impact are the responsibility of the operations involved in the "UC3 – Manage Real time traffic plan" use case.

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4.3 Level 2 Use Cases

In the following chapters we provide a breakdown for each of the use cases that are defined in level 1. This produces a second level of use cases that allow a deepening of the tasks that are the responsibility of each one.

The aim of this level 2 is to identify the different operations that are involved in each use case at level 1 to achieve the objective of each one.

Each operation identified as part of the use case of level 2 could be disaggregated on another level 3, however, the objective of this document is to identify high level operations that must be taken into account. A deep analysis of each single low level operation is not required, which is the reason why we assume that a breakdown of two levels is sufficient.

4.3.1 UC1 – Manage maintenance information

The operations to be taken into account within this use case are all related to the management of maintenance work in the real time traffic plan.

The maintenance management system is responsible for planning and managing maintenance works like inspect insulation joint xyz. It is outside of the TMS scope and "interacts" with the TMS using possessions.

Possession in this context means

- Taking the responsibility for some area of the infrastructure by a PICOP (person in charge of possession). Means, that a normal train operation in this area is not possible;
- Planned of start time and end time;
- Definition of safety conditions required for the maintenance works associated with the possession, like speed restrictions on neighbour tracks, specific switch positions, required catenaries shut offs etc.

The following breakdown covers all the tasks that have to be taken into account at a TMS related to the management of the works and the operations that allow all maintenance works to be updated in the real time traffic plan.

There are four operations that are actually involved in the current operations of a train control centre. Given the impact of these operations, it is important that their management and control is part of the activities of the TMS.

- Table 4.2 - Actors for Use-cases UC1
- UC1.1 - Generate day of operation maintenance plan;
- UC1.2 – Request to modify the day of Operation Maintenance Plan;
- UC1.3 - Monitor and tracking maintenance work;

DRAFT – AWAITING EC APPROVAL

- UC1.4 - Request for extension of time window for a work.

The following operations are the future lines of action of the TMS:

- UC1.5 - Propose optimal working window for a maintenance work.

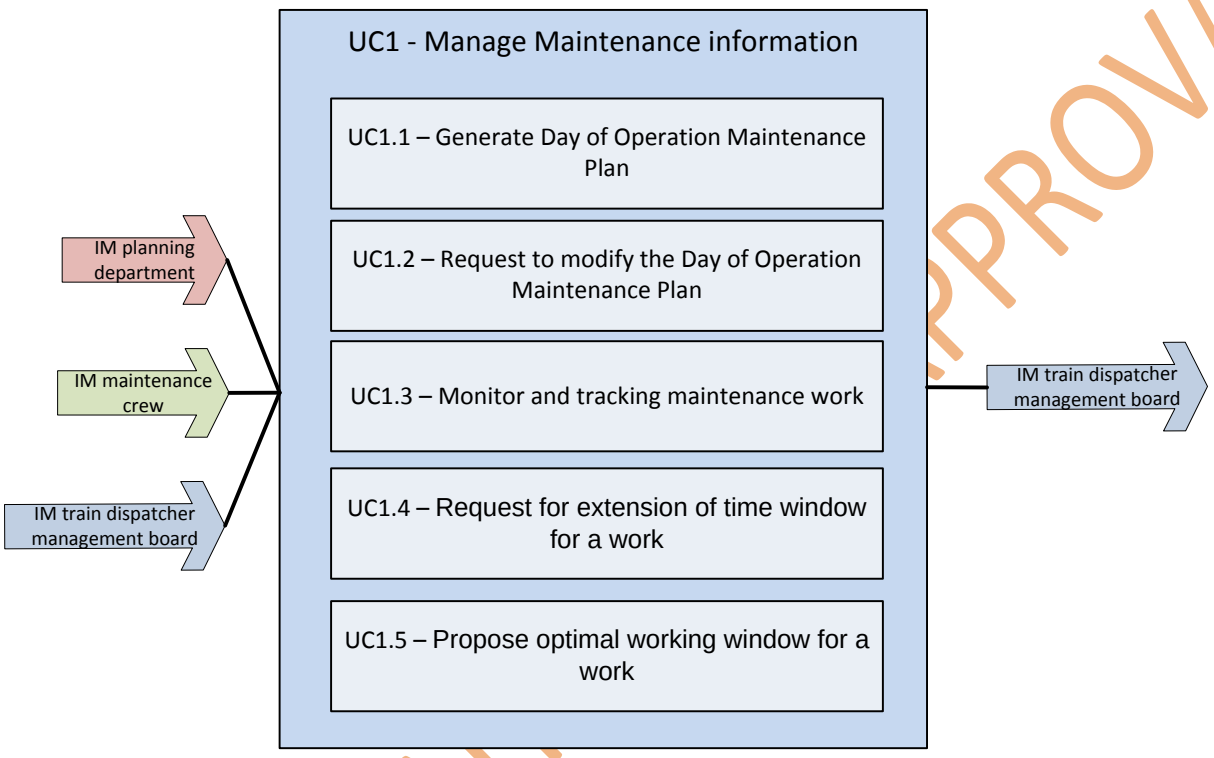

Figure 4.3 – Breakdown of the use case 1

The next table represents the matrix between the level 2 use cases for UC1 - Manage maintenance information and the actors involved in each one.

DRAFT – AWAITING APPROVAL

Actor/Use case	cases UC1 UC1.1 - Generate day of operation maintenance	UC1.2 – Request to modify the day of Operation Maintenance Plan	UC1.3 - Monitor and tracking maintenance work	UC1.4 - Request for extension of time window for a work	UC1.5 - Propose optimal working window for a maintenance work
Actor IM train dispatcher					
Actor IM train dispatcher manager		X		X	X
Actor IM maintenance crew		X	X	X	
Actor IM planning department	X				
Actor IM temporary restrictions administrator					
Actor IM control systems					
Actor Other Infrastructure Manager					
Actor Railways Undertaking					
Actor Driver System					
Actor On-board Control System					
Actor Passengers					
Actor Freight transport users					
Actor Other transport authority					

Table 4.2 - Actors for Use-cases UC1

4.3.1.1 UC1.1 - Generate day of operation maintenance plan

The maintenance department is responsible for planning the medium-long term maintenance plan. This maintenance plan has all the periodical works needed to maintain the infrastructure in good condition; therefore these works are not related to any incidents that occur in the management of the railway network.

The Traffic Management System (TMS) has to receive the medium-long term maintenance plan from the maintenance department and must generate the daily maintenance plan called the Day of Operation Maintenance Plan (DOMP) to determine the specific works to be performed on each day. The planned works for each day are incorporated into the real time traffic plan to be able to analyse the impact on trains each day.

This use case must carry out the following high level operations:

- Get/obtain the long term maintenance plan from the IM planning department;
- Generate the different day of operation maintenance plans;
- Include all works for the current day from the operation maintenance plan in the real time traffic plan.

DRAFT – AWAITING EC APPROVAL

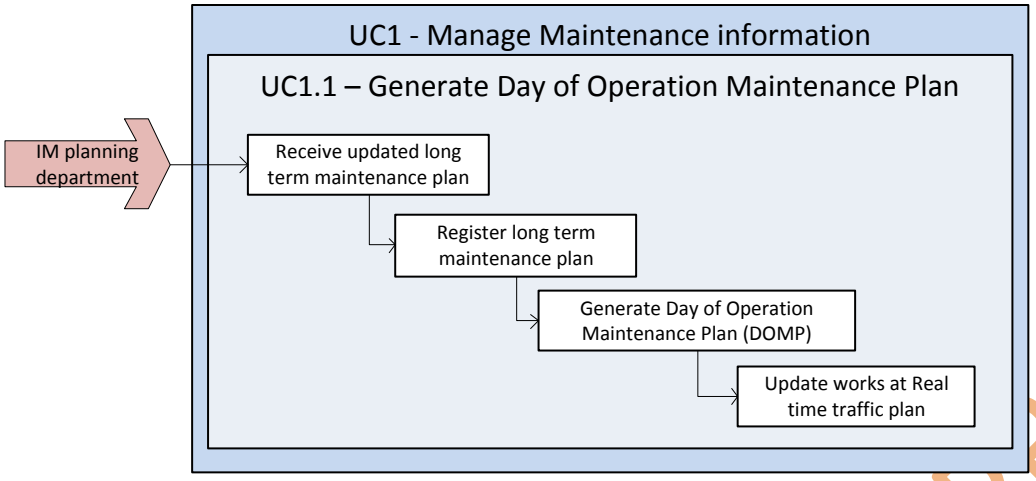

Figure 4.4 – Breakdown of the use case 1.1

4.3.1.1.1 Actors

The actors involved in this use case are:

- **Actor IM planning** department**:** Responsible for creating, managing and updating the medium-long term maintenance plan. This actor must be able to send this maintenance plan to all other stakeholders of the railway exploitation. This department must provide the updated information for this plan to all other stakeholders involved. One of the interested actors is the Traffic Management System.

4.3.1.1.2 Processes

The processes involved in this use case are:

- **Receive updated long term maintenance plan:** This process must provide all recovery policies to ensure that the long term plan information is updated at the TMS. This process must take into account different mechanisms to get the updated maintenance plan. The TMS could be responsible for getting the long term plan or the planning systems could be responsible for sending the long term plan to all stakeholders. In either form, this process uses different policies on the time and periodicity to obtain the maintenance plan:
  - Periodically or at defined hours: The execution of this process has the problem that the changes to the long term plan are not updated immediately into the TMS. In this scenario the TMS can be the starter of the operation because it will be the system that makes the petition to the IM planning department system.
  - Punctual: When the IM planning department make any change to the long term plan, this starts the process of sending the maintenance plan information. With this policy the IM planning department system is the trigger and is responsible

DRAFT – AWAITING EC APPROVAL

for distributing the maintenance plan. The TMS will only be a consumer of the maintenance plan information.

Another aspect of this exchange of information is the amount of information that it is necessary to exchange. The amount of information is independent of the last two policies to start the exchange of information:

- Complete: At each exchange of information the IM planning department and the TMS exchange the complete maintenance plan. This policy is not optimal because a large amount of information exchange will be redundant, but it is not necessary to know which information is updated or not at each system involved in the exchange,
- Only changes: At each exchange of information only the updated information in the long term plan is provided to the TMS.

This process performs all the necessary tasks to ensure that the TMS has the updated information relating to the long term maintenance plan. To do this, the following processes will be executed one after another each time the long term maintenance plan information is received into the TMS.

- **Register long term maintenance plan:** This process is responsible for storing the long term maintenance plan in the TMS. This storage is necessary because the TMS must have the planning of the maintenance works in advance. Another reason for this storage is to be prepared for a possible disconnection with the IM planning department. If this situation occurs the TMS can use the stored information and if necessary it can update this information manually to take into account punctual changes to the long term maintenance plan;
- **Generate Day of Operation Maintenance Plan (DOMP):** This process is responsible for generating the different Day of Operation Maintenance Plans from the long term maintenance plan stored in the TMS. It is important because the TMS must know all the details of each work, the planned information made by the IM planning department, punctual changes to the works made at the TMS and the real time information managed at the TMS for each maintenance work. As part of the operations involved at the TMS it is important that the modification or the adaptation of the planning works can be performed in the long term plan if the change affects works for a long time, or directly at the TMS to modify works planned in the near future. All changes for the near future must be performed to the day of operation maintenance plans.
- **Update works in the Real time traffic plan:** This process is responsible for updating the real time traffic plan with the updated works in the day of operation maintenance plan. The real time traffic plan must contain all the planned works for the current day. It is important to have this information updated because the train

DRAFT – AWAITING EC APPROVAL

dispatcher will use this information to be able to manage the trains in order to adapt the traffic such that the plan can be fulfilled.

4.3.1.2 UC1.2 – Request to modify the day of Operation Maintenance Plan

When the daily timetable is inserted by the TMS into the real time traffic plan that it has to manage, the IM maintenance crew can make a request to modify/adapt the planning of the maintenance works in the short term. All these changes are made directly with the TMS without the intervention of the IM planning department; that is the reason why the long term maintenance plan does not have these changes.

These requests must be analysed by the Actor IM train dispatcher manager so that he can accept or reject the changes. IM maintenance crew specifies if the maintenance work is mandatory due to safety restrictions. If this is not the case, the management dispatcher is able to negotiate time interval for the maintenance work to minimize the impact on the trains.

This use case must be the same for different actions that make changes to the daily operation maintenance plan. It is possible to:

- Add new works for a day;
- Remove works for a day;
- Modify a planned work for a day.

The analysis phase of this use case must take into account that if the change is requested for a maintenance operation for the current day, it is necessary to know the real state of each train to be able to assess the impact on the current running trains. If the changes are for works that are planned for future days, it is necessary to know only the planned trains for these days.

DRAFT – AWAITING EC APPROVAL

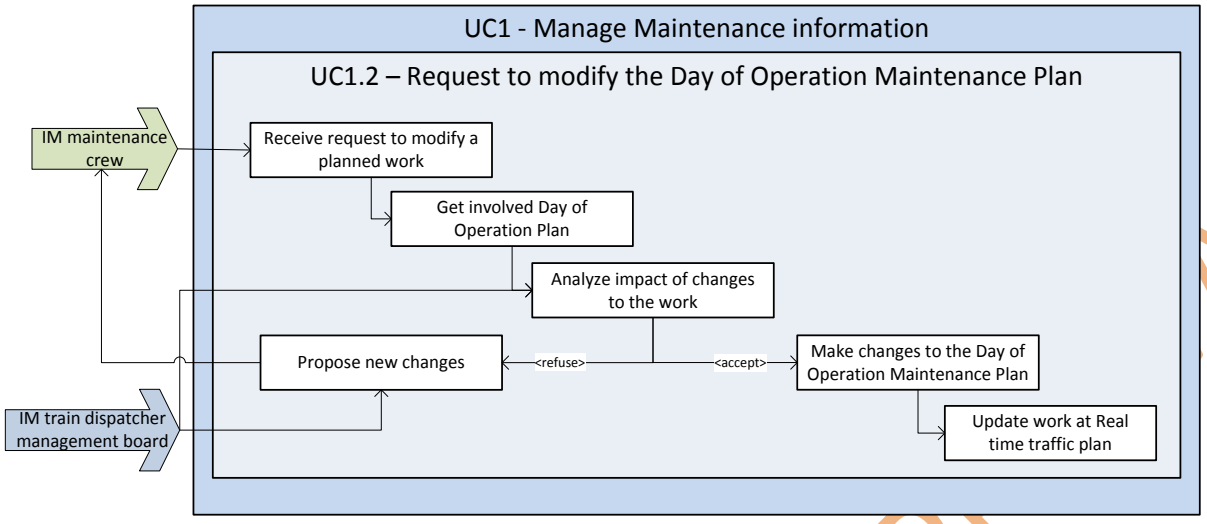

Figure 4.5 – Breakdown of the use case 1.2

4.3.1.2.1 Actors

The actors involved in this use case are:

- **Actor IM maintenance** crew**:** This is the actor that generates requests to modify the daily operational maintenance plan;
- **Actor IM train dispatcher** manager**:** Responsible for analysing the impact of the changes made to the planning maintenance activities.

4.3.1.2.2 Processes

The processes involved in this use case are:

- **Receive request to modify a planned work:** This process is responsible for providing a mechanism to accept a request to modify the maintenance plan for an event in the near future. This process must provide an interface across the IM maintenance crew so that they can make these requests. This process may accept a request to:
  - Add new works to the plan: It must be possible to add new works to the maintenance plan. To do this it is necessary to provide all associated information, the time range, space at the railway network affected and the reason that justifies the work,
  - Remove works from the plan: This operation allows a work to be removed that is not actually performed. It is necessary to provide the reason for this modification to the maintenance plan,
  - Modify the planned works: This operation allows the modification of a work that is not actually performed. It allows the time assigned for a work to be modified.

DRAFT – AWAITING EC APPROVAL

- **Get involved Real time traffic plan:** This is the process to get the real time traffic plan that corresponds to the day of the work which is involved in the request;
- **Analyse impact of changes to the work:** This process has to provide the functionality to analyse the impact of the maintenance operation on the requests and running trains. To do so, it is necessary to obtain all trains from the real time traffic plan that are affected by the work. If any train that is running is affected, it is necessary to know the forecast for the running trains across the space affected by the work. If the requested changes are mandatory, the analysis phase may only be used to understand the impact on the trains, but the result must be always "request accepted". On the other hand, if it is possible to adapt the changes to the work involved, the management dispatcher, the actor that analyses the impact, can propose some adaptation to the time range of the work in order to minimize the impact on the train traffic;
- **Propose new changes**: If, after the analysis phase, the management dispatcher refuses the request, this process must provide mechanisms to notify the rejected state of the request to the IM maintenance crew that made it. The refuse notification must contain the reason for the refusal and the necessary information to change the request so that it is accepted. At this point the IM maintenance crew will make the appropriate changes to the request to initiate the request process another time;
- **Make changes to the Day of Operation Maintenance Plan**: If the changes are accepted, this process will update the DOMP to register and store the changes to the work. This process is necessary to store the information for the different phases associated with each work:
  - Planned information that is obtained from the long term plan,
  - Planned information at short notice that is stored in the day of operation maintenance plan,
  - The real information of the work performed that will be stored in the real time traffic plan.
- **Update work in Real time traffic plan:** This process must contain all tasks related to the update of the work in the real time traffic plan. If the involved work is for the following day, this process will not trigger other operations, but if the work affects any train that is now running, this process will trigger operation of the use case "UC3 – Manage real time traffic plan". This is the reason that these use cases are related indirectly.

4.3.1.3 UC1.3 - Monitor and tracking maintenance work

This use case provides the necessary tasks to track the execution of the maintenance works included in the real time traffic plan. This is the use case responsible for storing the

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information of the evolution of each maintenance work, registering the start time and the finish time in the real time traffic plan.

The inclusion of information from the real status of each work in the real time traffic plan allows control over whether the work is being done as planned or whether it is being diverted from the planned temporal window. With this real information of the evolution of the works the "IM Train Dispatcher" will be able to analyse with more precision which trains will be affected by each work and the impact that it will have on them.

The information recorded for each maintenance work should be the start and end of each work and additionally may include the staff involved, indicating for each of them the work that they do.

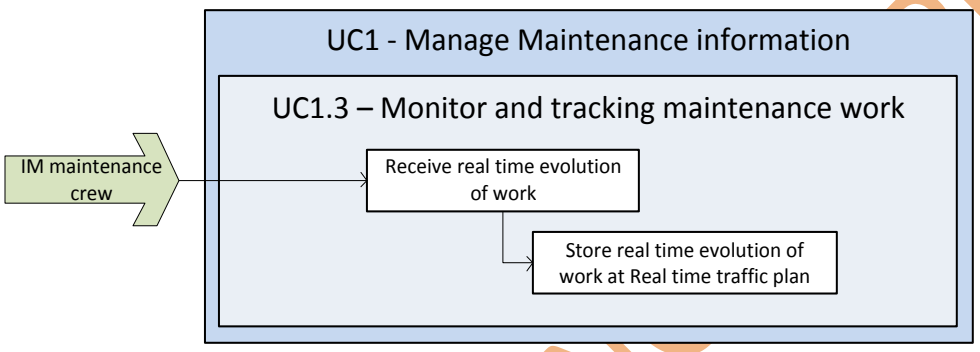

Figure 4.6 – Breakdown of the use case 1.3

4.3.1.3.1 Actors

The actors involved in this use case are:

- **Actor IM maintenance** crew**:** They are the personnel involved in performing the maintenance works, and they are responsible for informing the TMS about the evolution of each work.

4.3.1.3.2 Processes

The processes involved in this use case are:

- **Receive real time evolution of work:** This process must provide an interface to be able to communicate between the IM maintenance crew and the TMS. In an advanced system this communication must be based on mobile devices that allow the IM maintenance crew to inform the TMS of all the details of the evolution of each work. In any case, communication based on voice is mandatory to ensure that the information is updated at the TMS and the train dispatcher working at the control of the zone affected by each work has the latest information about it;

DRAFT – AWAITING APPROVAL

- **Store real time evolution of work in Real time traffic plan:** All information received from the IM maintenance crew must be stored in the real time traffic plan associated with the correct work.
  This information is registered with different objectives:
  - To be able to analyse the impact on the trains of each work,
  - To be able to analyse the impact of a deviation on the planned times for each work,
  - To be able to make an offline study of the evolution of each kind of work and then provide more accurate forecasts about the time needed for each one.

4.3.1.4 UC1.4 - Request for extension of time window for a work

This use case must provide functionality to allow the IM maintenance crew to generate a request to increase the time assigned to a planned work.

It is important that the IM maintenance crew carry out the maintenance operation inside the authorised time. The train dispatcher must take into account the timeframe planned for each operation to make a correct forecast of the actions that he has to make on the train running in order to minimize the impact of the operation.

If more time is necessary to perform a maintenance activity, the IM maintenance crew must initiate the process to obtain an authorization to increase the assigned time. It is important that part of the information for this type of request is the reason for the request and the impact of not obtaining the authorization. With this information, and the time expected to finish the work, the train dispatcher, which is the authority that has the relevant responsibility, can accept or reject the request.

To be able to make a decision, this use case must provide the functionality to analyse the impact of the time increase required for the work.

If the request is rejected, the train dispatcher can also provide an alternative to the original request.

If the request is accepted, the TMS must register the changes to the involved work in the real time traffic plan.

This exchange of information between the IM maintenance crew and the train dispatcher must be stored for further analysis.

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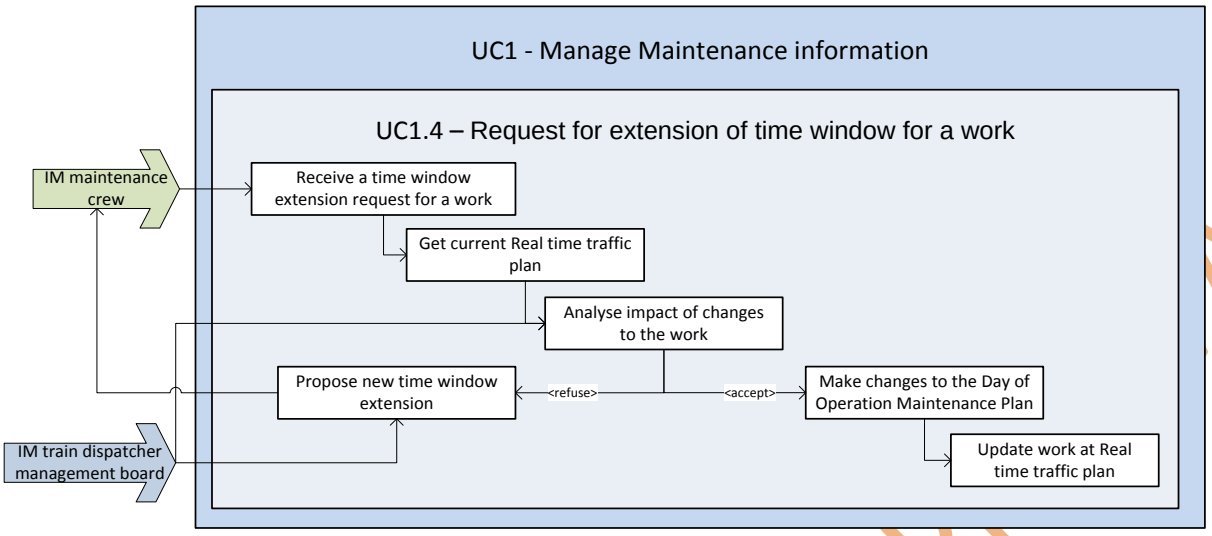

Figure 4.7 – Breakdown of the use case 1.4

4.3.1.4.1 Actors

The actors involved in this use case are:

- **Actor IM maintenance** crew**:** These are the staff who perform the maintenance works and make the request to ask for more time than originally planned to do it;
- **Actor IM train dispatcher** manager**:** Responsible for analysing the impact of the changes made to the planned maintenance activities.

4.3.1.4.2 Processes

The processes involved in this use case are:

- **Receive a time window extension request for a work:** This process must provide an interface between the IM maintenance crew and the train dispatcher staff at the TMS so that they are able to communicate. The interface must take into account the information to be exchanged, enabling the IM maintenance crew to be informed of a new end time for the work and the reasons for the increased time requested;
- **Get current Real time traffic plan:** This process must get the current real time traffic plan to be able to analyse the impact of the changes in the work involved without interfering with the real time traffic plan that is in production;
- **Analyse impact of changes to the work:** This process contains all the necessary functionality to be able to analyse the impact of the work and the changes requested to increase the end time. It is necessary that the functionality provided as part of this process contains the mechanisms to make changes over the works to try to detect the best option to adapt the works and have the minimum impact on the trains.

DRAFT – AWAITING EC APPROVAL

- **Propose new time window extension:** When the request is rejected, this process has the responsibility to inform the IM maintenance crew of the status of the request and propose, if it is possible, a new end time for the work involved;
- **Make changes to the Day of Operation Maintenance Plan:** If the request is accepted this process must modify the work in the day of operation maintenance plan**;**
- **Update work in Real time traffic plan:** If the request is accepted this process must modify the real time traffic plan that is now in execution. From this moment the TMS must use this work as if it was planned with this time window. The TMS must be able to store all these changes in the works for further analysis**.**

4.3.1.5 UC1.5 - Propose optimal working window for a maintenance work

The TMS has a list of types of incidents related to the work associated to fix them with a minimum time of execution. When the TMS receives an incident is when the operations involved in this use case must be taken into account.

This use case must propose the best time to perform the works associated with a type of incident when this kind of incident is detected.

To find the optimal time window to perform the works associated with a detected incident, the TMS must take into account the following points:

- The severity of the incident, and therefore the level of impact on the running trains affected. It is possible that an incident does not affect the compliance of the schedule of the trains. Any kind of impact must be taken into account to evaluate the urgency of the associated maintenance operation;
- The number and type of the running trains affected by the impact of the work, from the moment it is produced until the completion of the work;
- The number and type of running trains that will be affected during the work to be done in the given time window;
- Working hours of maintenance staff.

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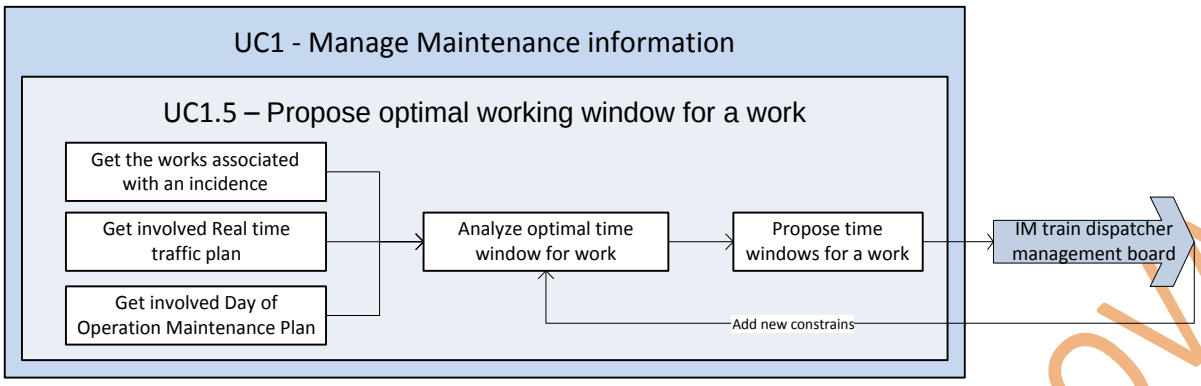

Figure 4.8 – Breakdown of the use case 1.5

4.3.1.5.1 Actors

The actors involved in this use case are:

- **Actor IM train dispatcher** manager**:** Responsible for planning the maintenance works when they have to be executed in the near future. When it is necessary to fix something in the railway infrastructure due to a problem or an incident, this actor must take the optimal decision to plan the necessary works.

4.3.1.5.2 Processes

The processes involved in this use case are:

- **Get the works associated with an incident:** This process must obtain from the TMS database the works associated for a type of incident that is detected along the railway infrastructure. This process must produce the list of works and the duration of each one to be able to fix the current incident;
- **Get involved Real time traffic plan:** This process obtains the real time traffic plan to take it as source of information to be able to analyse the impact of the works on the trains. If an incident is detected, the affected day is the current day; for this reason it is necessary to get the current real time traffic plan to know the planned trains and the evolution of the running of each one taking into account the forecast calculated. From this real time traffic plan, this process also needs to get the real evolution of the works;
- **Get involved Day of Operation Maintenance Plan:** this process gets the maintenance plan to know the information about the planned works. The evolution of the works is part of the information recovered by the previous process, but the maintenance plan is necessary to be able to know about the works that are not included in the real time traffic plan;
- **Analyse optimal time window for work:** This process must contain all the algorithms to detect the best time window to perform the works associated with an incident.

DRAFT – AWAITING EC APPROVAL

This process must be able to take into account several constraints proposed by the management dispatcher;

- **Propose time windows for a work:** This process is responsible for presenting the result of the analysis to the management dispatcher. The result can be formed of several different options; the management dispatcher will decide which one is the most appropriate at each scenario.

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4.3.2 UC2 – Manage very short term request

The operations that must be covered by this use case are related to the management of the requests made by the different railway operators to change the current day plan (real time traffic plan) of the trains to adapt it to the current needs.

There are different types of requests that a railway undertaking can make; each request attends to an aspect of the running of the trains:

- Table 4.3 - Actors in Use-cases 2
- UC2.1 – Manage request to cancel a train path;
- UC2.2 – Manage request to cancel totally or partially a service;
- UC2.3 – Manage request to change the schedule of a train path;
- UC2.4 – Manage request to change a train route;
- UC2.5 – Manage request to change the links between trains;
- UC2.6 – Manage request to create a new train path.

Except for UC2.6, all requests concerning train paths are already allocated by the Infrastructure Manager. For all these kind of requests, it is necessary to carry out an analysis process to be able to decide if the request should be accepted, rejected, or a proposal made by the IM. As a reminder, as mentioned in level 1, the TMS should support any coordination required with others IMs or internally to the IM organisation.

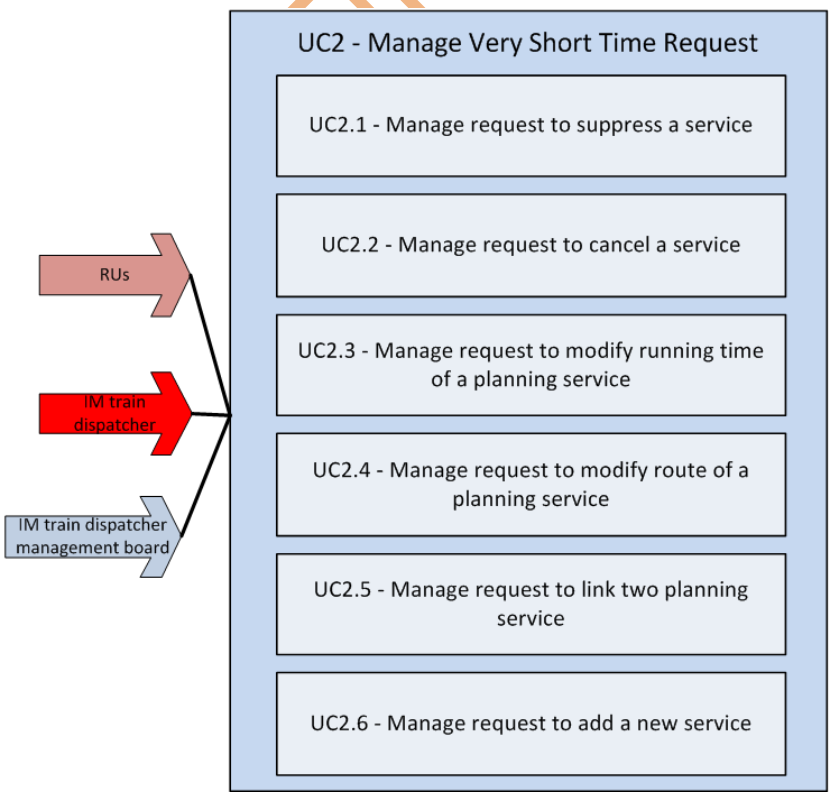

Figure 4.9 – Breakdown of the use case 2

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The next table represents the matrix between the level 2 use cases for UC2 – Manage very short term request and the actors involved in each one.

Actor/Use case	Table 4.3 - Actors in Use-cases 2 UC2.1 – Manage request	UC2.2 – Manage request to cancel totally or partially a service	UC2.3 – Manage request to change the schedule of a train path	UC2.4 – Manage request to change a train route	UC2.5 – Manage request to change the links between trains	UC2.6 – Manage request to create a new train path
Actor IM train dispatcher						
Actor IM train dispatcher manager	X	X	X	X	X	X
Actor IM maintenance crew						
Actor IM planning department						
Actor IM temporary restrictions administrator						
Actor IM control systems						
Actor Other Infrastructure Manager						
Actor Railways Undertaking	X	X	X	X	X	X
Actor Driver System						
Actor On-board Control System						
Actor Passengers						
Actor Freight transport users						
Actor Other transport authority						

Table 4.3 - Actors in Use-cases 2

4.3.2.1 UC2.1 – Manage request to cancel a train path

This request is performed by a railway undertaking when it is necessary to cancel a train path that is not running yet. When a train is cancelled the dispatchers can analyse if it is necessary to modify the planning or route for other trains in order to use the gap left by the cancelled train path on the real time traffic plan.

For example, a freight train is running and a passenger train is planned but not running yet. In this case the passenger train has a higher priority, and the freight train would be delayed in case of conflict. If the passenger train is cancelled the traffic dispatcher could modify the running of the freight train to be able to fulfil the plan.

When a train path is cancelled on request by a RU, it should be possible to cancel this cancellation (reinstate train). In case RU requests to reinstate the previously cancelled train and the IM train dispatcher manager has accepted this request, he has to ensure that:

- The cancelled train is inserted as planned;

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- Path conflicts with neighbouring trains are resolved;
- All planned train connections are inserted as well.

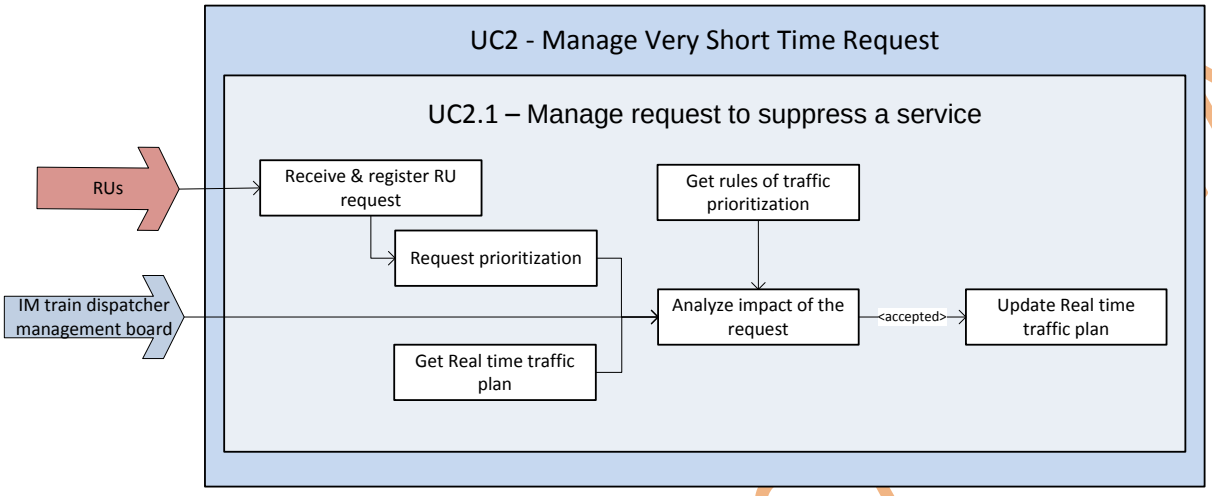

Figure 4.10 – Breakdown of the use case 2.1

4.3.2.1.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that need to cancel a planned service from the real time traffic plan.
- **Actor IM train dispatcher** manager**:** This actor is responsible for managing all modifications to services in connection with cancellation and reinstating of the cancelled service.

4.3.2.1.2 Processes

The processes involved in this use case are:

- **Receive & register RU request:** This process must provide an interface to be able to exchange information between each railway undertaking and the traffic control system. Across this interface each RU can make new requests and this interface must also provide information about the progress status of the request. Each RU must execute a login process to be able to access to the information about each request; this access control is provided by this process. Each RU can only view the state of their requests; this information filter is the responsibility of this process too;
- **Request prioritization:** The management dispatcher must analyse all the requests from the railway undertakings. This task should be prioritised to order the analysis

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work. This process must take into account several parameters to make the prioritization, such as the running day of the involved train, reason for the request, type of train, date of the request and the railway undertaking that made the request;

- **Get Real time traffic plan:** This process is responsible for getting the real time traffic plan so that the latest version of the current plan can be used in the analysis environment. This **proce**ss must provide an updated picture of the complete real time traffic plan for the analysis environment;
- **Get rules of traffic prioritization:** This process is responsible for providing the rules to be taken into account at the analysis phase to be able to decide if the new service can be inserted into the real time traffic plan. These rules should be taken into account to be able to propose changes to the requests so that they can be accepted;
- **Analyse impact of the request:** This process undertakes all the tasks related to the analysis of the impact on the real time traffic plan triggered by the incorporation of the service requested. All these actions must be executed in a controlled environment. All the updated information about the real time traffic plan must be included in order to have the current position of all running trains. The process for the suppress service operation is very simple because it cannot trigger any conflict with other services. This process is necessary to optimise the traffic of other trains. For this reason the result of the analysis for the suppress service request is always request accepted. If the train that is cancelled has a link with other trains along the route, it is necessary that the system removes these links. This operation can trigger other changes in the real time traffic plan. This type of request can be automatically treated by the system without the intervention of any operator;
- **Update Real time traffic plan:** This process is executed when the request is accepted after the analysis phase. This process is responsible for making changes to the real time traffic plan to remove the service suppressed in the request.

4.3.2.2 UC2.2 – Manage request to cancel totally or partially a service

This type of request is performed by a railway undertaking when it is necessary to cancel a train service. This request can be done before or after the departure of the train.

There are many reasons to do it, for example, when there is an incident with the rolling stock assigned to a service that means that this train cannot run along the planned route, or when the RU needs to cancel a train for operational reasons at an intermediate station on the planned route.

This type of request has to inform the train and the station involved and must state the reason for making the cancellation. Note the station has to be one station on the planned route of the train.

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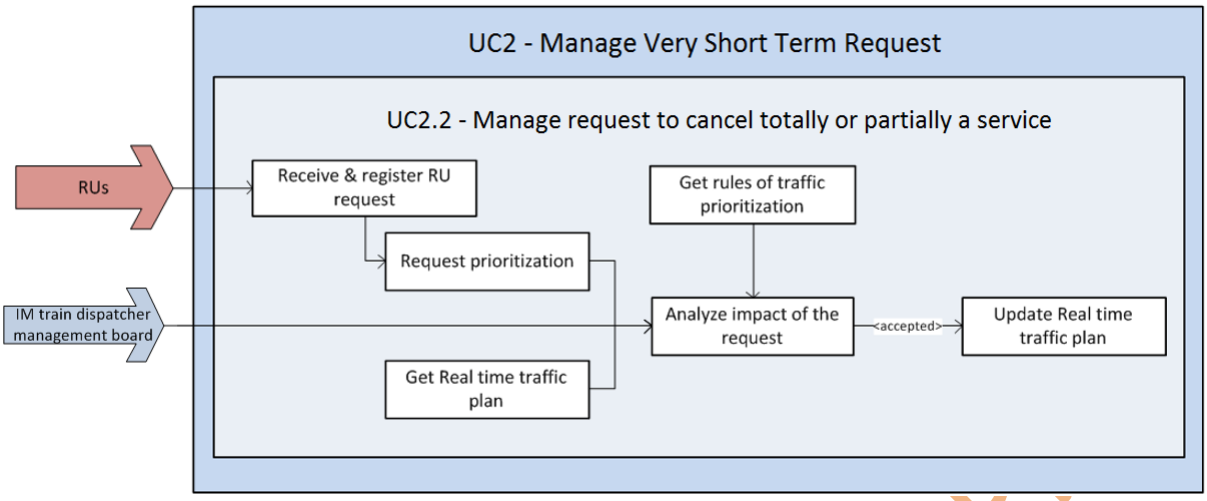

Figure 4.11 – Breakdown of the use case 2.2

4.3.2.2.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** The different railway operator enterprises that need to cancel a running train of a planned service from the real time traffic plan;
- **Actor IM train dispatcher** manager**:** Responsible for the traffic control of all trains that run in an area. This actor analyses and makes all the modifications to the real time traffic plan to take into account all the accepted requests performed by the railway undertaking; in this case a request to cancel a service is the responsibility of this actor because the train is running. That is the difference between this use case and the use case where a train that is not running yet is suppressed**.**

4.3.2.2.2 Processes

The processes involved in this use case are the same as in the previous use case.

For the process "Analyse impact of the request", it is necessary to take into account whether the cancelled train has a link to others trains along the route. If this is the case, it is necessary that the system removes these links, as this operation can trigger other changes in the real time traffic plan.

4.3.2.3 UC2.3 – Manage request to change the schedule of a train path

Based on the train path, a RU intends to change some elements of the train or the timetable that could impact the path details after the path has been booked. Such modifications can be requested for one day, several days or all remaining booked days. For this Use Case, only the D-Days are concerned.

There are different changes that can be requested as part of this type of request:

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- Request to change the departure time at the origin station, shifting it in time forward or backward;
- Request to change the departure time at an intermediate station;
- Request to change the arrival time at an intermediate station;
- Request to change the arrival time at the destination station;
- Modification of train parameters;
- Border/Handover/Interchange times adaptation.

It is possible that in the same request the railway undertaking will try to modify several of these times to be able to adapt the complete schedule of the train along the planned route.

It is necessary to take into account that the modification of the schedule of a service at a station may lead to the modification of the train schedule at one or more subsequent stations until the destination station.

At this point the system must calculate the margin of trains to be able to know if this margin can absorb the modification of the schedule (if the requested change is to anticipate the planned time) or if it is necessary to change the schedule at the next stations.

This request can be made on running trains or prior to the departure from the origin station.

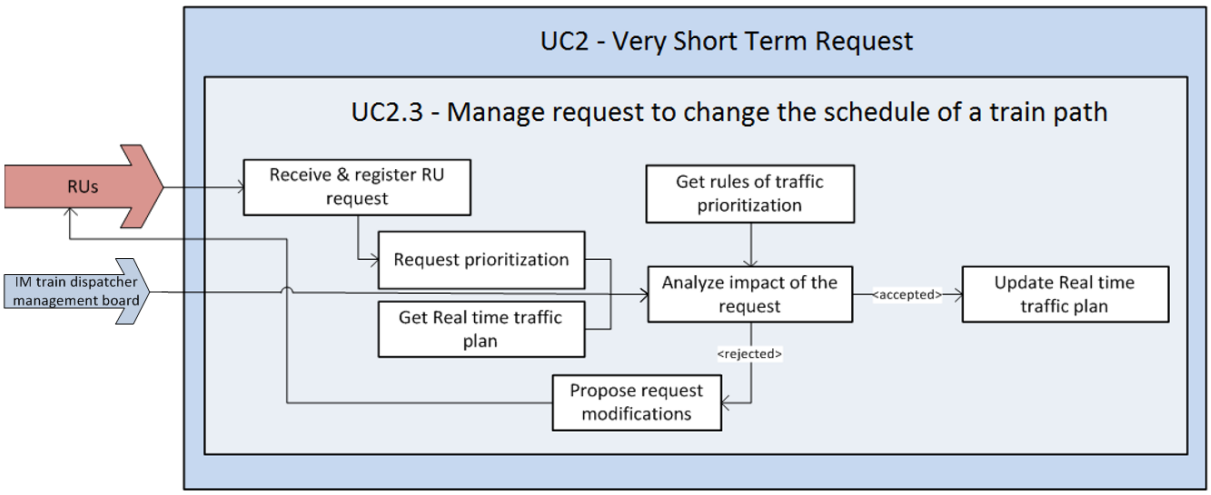

Figure 4.12 – Breakdown of the use case 2.3

4.3.2.3.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that need to make changes to the planned schedule of a service in the real time traffic plan;
- **Actor IM train dispatcher** manager**:** Responsible for the traffic control of all trains that run in an area. This actor analyses and makes all the modifications to the real

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time traffic plan to take into account all the accepted requests performed by the railway undertaking, in this case a request to change the schedule of a service.

4.3.2.3.2 Processes

The processes involved in this use case are the same as in the previous use case but with a new process of informing the RUs that the request is rejected.

- **Propose request modifications:** This process is executed when the request is rejected after the analysis phase. This process must provide the railway undertaking that made the request all the necessary modifications to be able to accept the request.

In the analysis process it is very important to try to detect the impact on the other services because a modification of the departure time at the origin station can trigger a lot of conflicts with many other services.

The system has to be able to make a new forecast on the routes of the involved train because a schedule change is an action of re-planning which is one of the triggers of this forecast calculation.

4.3.2.4 UC2.4 – Manage request to change a train route

This type of request tries to modify the planned route of a service. There are several aspects to these changes:

- Change the origin and the destination stations to be able to enlarge or reduce the planned route;
- Change the intermediate stop stations along the planned route;
- Change the tracks at the stop stations (including the tracks at the origin and destination stations);
- Change the train routes between two consecutive stations.

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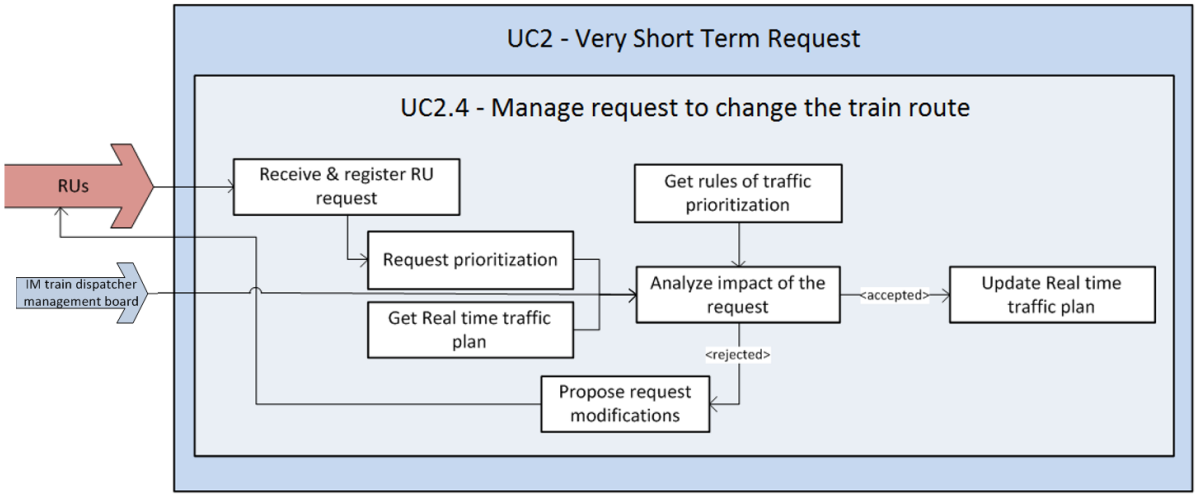

Figure 4.13 – Breakdown of the use case 2.4

4.3.2.4.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that need to make changes to the planned route of a service in the real time traffic plan;
- **Actor IM train dispatcher** manager**:** Responsible for the traffic control of all trains that run in an area. This actor analyses and makes all the modifications to the real time traffic plan to take into account all the accepted requests performed by the railways undertaking, in this case a request to change the route of a service.

4.3.2.4.2 Processes

The processes involved in this use case are the same as in the previous use case.

The changes to the real time traffic plan triggered from a request of this type can provoke conflict with other services or infrastructure conflicts. The system must execute the conflict detection algorithm to try to analyse the impact of the changes requested.

4.3.2.5 UC2.5 – Manage request to change the links between trains

This type of request provides a mechanism to the railway undertaking to be able to add, remove or change the planned links between trains.

The links are the artefacts that are used to make the relationships between two train routes. Each link must have information about the delay time that must be supported, that is to say, when train A is linked with train B, it means that if train B is delayed train A will be delayed

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at the link station; if the delay is bigger than a certain value the system will automatically remove the link.

The train links define the relationship between two trains in a station. The request shall contain all three parameters: linked trains and the station.

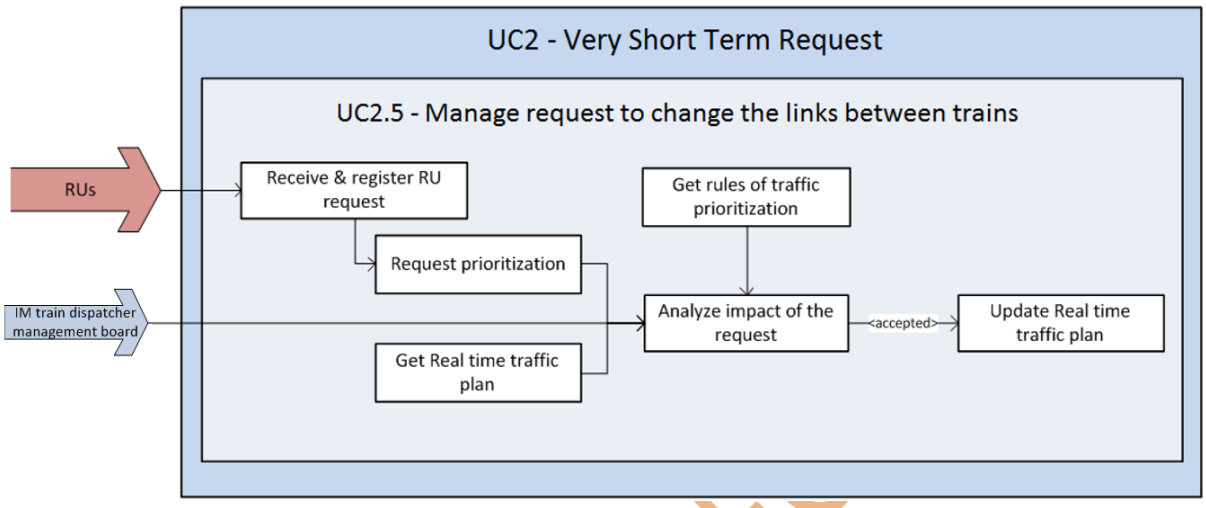

Figure 4.14 – Breakdown of the use case 2.5

4.3.2.5.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that need to make changes to the planned links of a service in the real time traffic plan;
- **Actor IM train dispatcher** manager**:** Responsible for the traffic control of all trains that run in an area. This actor analyses and makes all the modifications to the real time traffic plan to take into account all the accepted requests performed by the railway undertaking, in this case a request to change the link between two services is the responsibility of this actor because links between trains will affect the train traffic.

4.3.2.5.2 Processes

The processes involved in this use case are same as in the previous use case.

A change to the links of a train can trigger changes in the forecast of the trains involved. For this reason the system has to recalculate the forecast of the trains involved. As for the use case "UC3 – Manage real time traffic plan", each re-planning action on the real time traffic plan will be a trigger for the calculation of the forecast. All these actions are made in the "Analyse impact of the request" process.

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4.3.2.6 UC2.6 – Manage request to create a new train path

This type of request tries to add a new train path.

This planning modification is made across the real time environment directly because the request is for a train that runs on the current day. If the train will run on another day, this planning modification will be the responsibility of the planning environment.

The RU must send the request to the real time environment across the Actor IM train dispatcher manager. A new train service request must be done before the train departure.

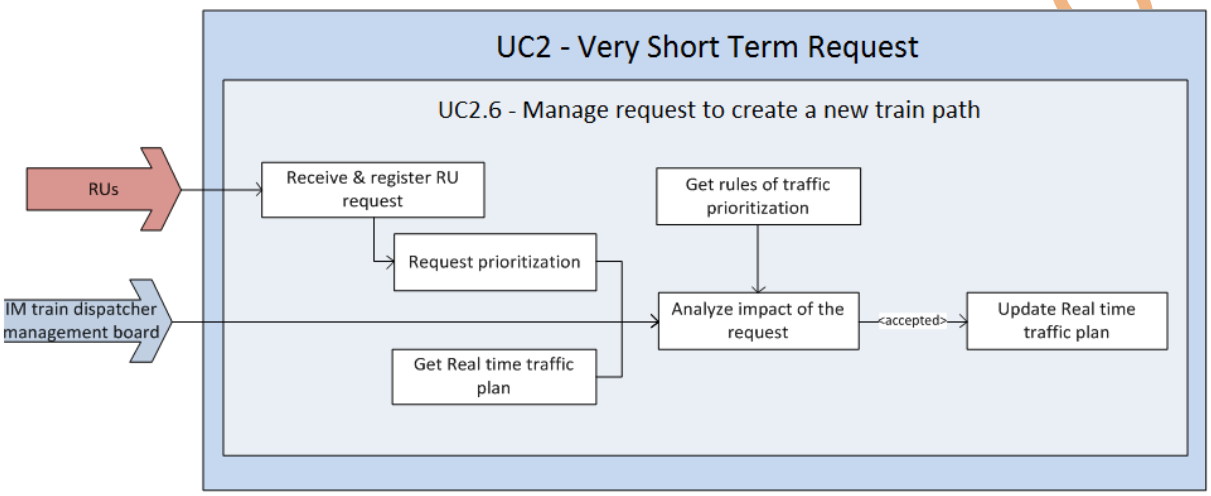

Figure 4.15 – Breakdown of the use case 2.6

4.3.2.6.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that need to add a service to the current day in the real time traffic plan;
- **Actor IM train dispatcher** manager**:** Responsible for the management of the planning for the current day in the real time environment. This actor is the interface with the RUs and has to analyse the requests of all RUs and makes all the modifications to the real time traffic plan to take into account all the accepted requests performed by the railways undertaking, at this case a request to add a service for the current day.

4.3.2.6.2 Processes

The processes involved in this use case are:

- **Receive & register RU request:** This process must provide an interface to be able to exchange information between each railway undertaking and the traffic management system. Across this interface each RU can make new requests and this

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interface must provide information about the progress status of the request too. Each RU must execute a login process to be able to access the information about each request; the access control is provided by this process. Each RU can only view the state of their own requests; this information filter is the responsibility of this process too;

- **Request prioritization:** The Actor IM train dispatcher manager must analyse all the requests from all railway undertakings. This task should be prioritised to order the analysis work. This process must take into account several parameters to make this prioritization, like the date of the running of the involved train, reason for the request, type of train, date of the request and the railway undertaking that made the request;
- **Get Real time traffic plan:** This process is responsible for getting the real time traffic plan to be able to use the latest version of the current plan in the analysis environment. This process must provide an updated picture of the complete real time traffic plan to the analysis environment;
- **Get rules of traffic prioritization:** This process is responsible for providing the rules which should be taken into account in the analysis phase to be able to decide if the new service can be inserted into the real time traffic plan. These rules should be taken into account to be able to propose changes to the requests so that they can be accepted;
- **Analyse impact of the request:** This process is responsible for carrying out all the tasks related to the analysis of the impact on the real time traffic plan triggered by the incorporation of the service requested. All these actions must be executed in a controlled environment, but must take all the updated information from the real time traffic plan into account in order to be able to have the current position of all trains that are running. The changes to the real time traffic plan triggered from a request of this type can provoke conflict with other services or infrastructure conflicts. The system must execute the conflict detection algorithm to try to analyse the impact of the changes requested;
- **Update Real time traffic plan:** This process is executed when the request is accepted after the analysis phase. This process is responsible for making the changes to the real time traffic plan to include the new service with the characteristics informed by the request.

4.3.3 UC3 – Manage real time traffic plan

The operations to be taken into account within this use case are all related to traffic management through the adaptation of the real time traffic plan to ensure that train movements fit with their planned schedule.

The responsibilities of each of those involved in this use case are:

DRAFT – AWAITING EC APPROVAL

- The system must be able to detect, record and process the current and updated situation of the full railway operations;
- The system should provide functionality for analysing the current and future situation of railway operations;
- The IM train dispatcher must analyse the state of the railway operation and must be able to modify the behaviour of the trains to comply, as far as possible, with the plan;
- The system must be able to assist the IM train dispatcher in the decisions amending the trains;
- The system must be able to interact with the available traffic control systems to make the movement of trains comply with the established behaviour in the real time traffic plan.

The cycle of the railway operation must be:

- To know the current status of the entire railway operation (UC3.1, UC3.2);
- Make a forecast about the behaviour of the running trains based on the current state of each train and infrastructure information (UC3.3);
- Identify conflicts between train routes or between the routes of the trains and the characteristics of the infrastructure (UC3.4);
- Provide optimised solutions to resolve the conflicts identified (UC3.5);
- Allow the IM train dispatchers to modify the real time traffic plan (UC3.6 and UC3.7);
- Provide functionality to be able to execute automatic operations with the traffic control systems to ensure compliance with the established plan (UC3.8).

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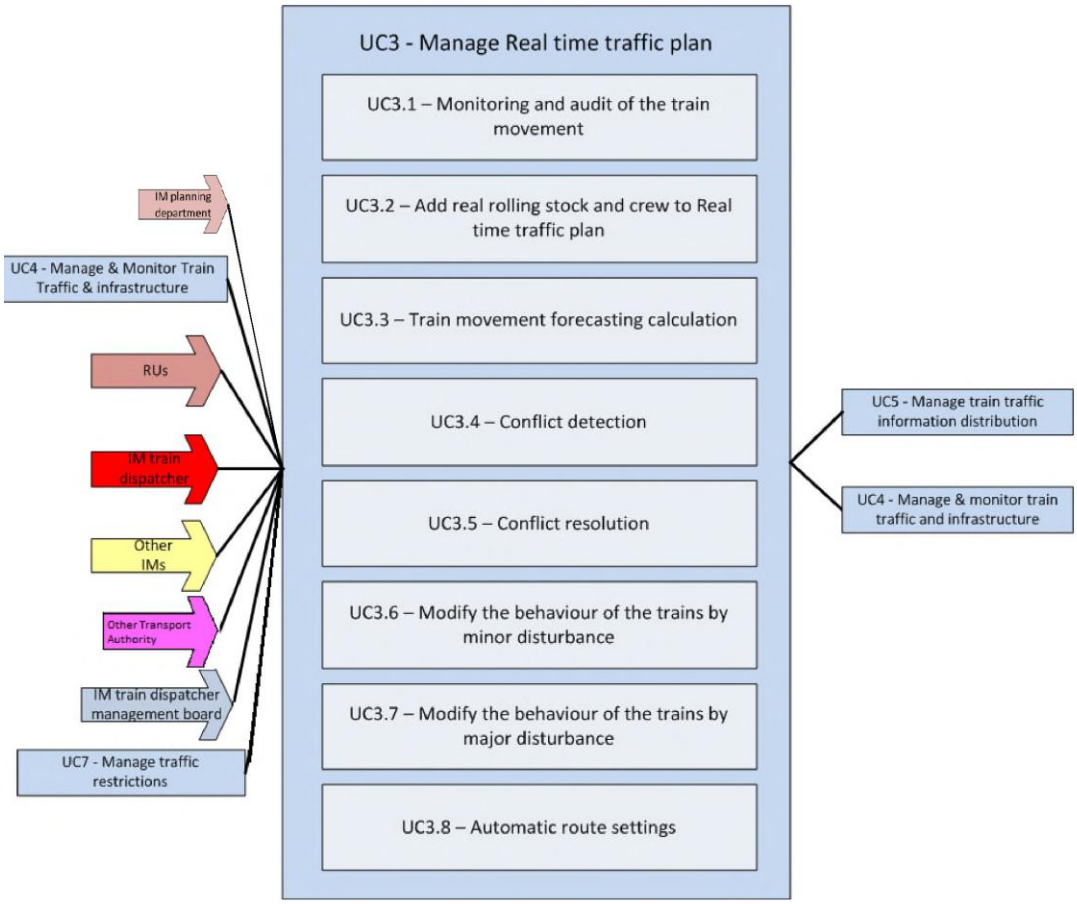

Figure 4.16 – Breakdown of the use case 3

The second level use cases are related as part of the managed real time traffic plan life cycle.

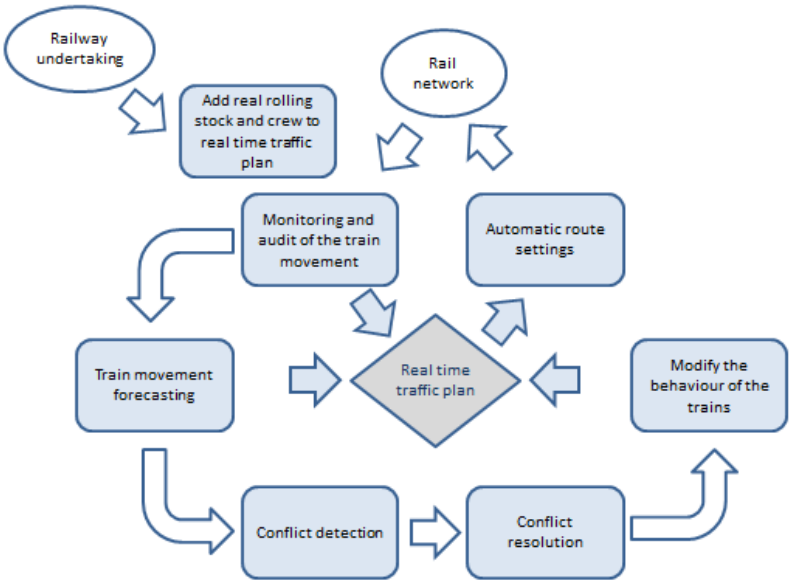

Figure 4.17 – Real time traffic plan life cycle

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The next table represents the matrix between the level 2 use cases for UC3 – Manage real time traffic plan and the actors involved in each one.

Actor/Use case	cases UC3 UC3.1 – Monitoring and audit of the train	UC3.2 – Manage RU train information's to be included in the real time traffic plan	UC3.3 – Train movement forecasting calculation	UC3.4 – Conflict detection	UC3.5 – Conflict resolution	UC3.6 – Modify the behaviour of the trains	UC3.7 – Modify the behaviour of the trains by a major disturbance	UC3.8 – Route setting automation
Actor IM train dispatcher	X		X	X	X	X		
Actor IM train dispatcher manager							X	
Actor IM maintenance crew								
Actor IM planning department			X					
Actor IM temporary restrictions administrator								
Actor IM control systems								
Actor Other Infrastructure Manager			X				X	
Actor Railways Undertaking		X					X	
Actor Driver System								
Actor On-board Control System								
Actor Passengers								
Actor Freight transport users								
Actor Other transport authority							X	

Table 4.4 - Actors for use cases UC3

4.3.3.1 UC3.1 – Monitoring and audit of the train movement

This use case is related to use case 4 – "Manage & monitor train traffic and infrastructure". Use case 4 is responsible for getting all the information provided by the external systems that are responsible for train traffic and infrastructure control. The current use case is responsible for processing this information in order to improve it and add value to be able to provide useful information to the train traffic operators.

This use case is responsible for analysing and processing the raw information to be able to deduce the current position of each train; with this position the system must be able to audit the running of each train along the route, storing the detailed route and the time associated with this running.

All trains must be monitored, which includes:

- Trains running with train paths;

DRAFT – AWAITING EC APPROVAL

- Trains without train paths, such as: shunting movements within a station (e.g. trains between yards and main track stations), approach movements of a traction unit used to rescue a commercial train, etc.;
- Trains that have not already entered into TMS controlled area.

It is important that the system stores this information because it will be used to operate the traffic in real time and it is necessary to analyse this information using offline systems in order to make statistics and indicators of the railway operation.

Part of the actions involved in this use case are related to tracing the relationship between the planned arrival and departures at each station along the planned route and the current position of each train. This process must be able to register the arrival and departure times along the route of all trains that are running. The system shall be able to use current train positions to calculate forecast of the future delays.

The final result of this process is to have an updated real time traffic plan with the train position information and the differences between the actual positions and the plan.

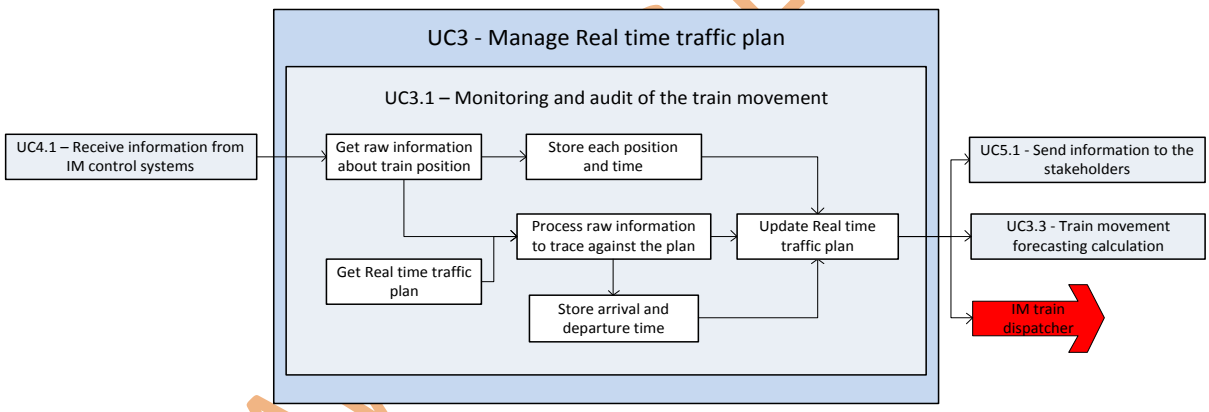

Figure 4.18 – Breakdown of the use case 3.1

4.3.3.1.1 Actors

- **Actor IM train** dispatcher**:** Responsible for monitoring and controlling the traffic. This use case provides the train dispatcher with all information about the current status of the services along the controlled area. The TMS has to provide filtered information to the train dispatcher to try to show the important information, but the system will internally use all information in order to be able to provide this detailed information when the train dispatchers need it.

There are more actors interested in this information but the main consumers of this kind of TMS information are the IM Train Dispatchers.

DRAFT – AWAITING EC APPROVAL

This use case has a relationship with two other use cases. This use case receives the position of trains from the Table 4.5 - Actors for use cases UC4

UC4.1 – Receive information to monitor train traffic and infrastructure status and provides the updated real time traffic plan with the new position of the train and with the deviation times from the use case UC3.3 – Train movement forecasting calculation.

The updated real time traffic plan with all the audited information must be distributed to other stakeholders, that is the reason why this use case has a relationship with the UC5.1 Send information to the stakeholders.

4.3.3.1.2 Processes

The processes involved in this use case are:

- **Get raw information about train position:** This process must get the position of the involved train in real time. The actual accuracy of the train position will depend on the source system that is providing this information. This position can only indicate the field element that is occupied by the train without any reference to a concrete part of the rail network used;
- **Store each position and time:** This process is responsible for storing the obtained real position of the train associated with the current date and time. It is important to store this raw information because it will be used not only in the real time environment but also in the post-analysis phase of the railway operation. This information is stored in the logged plan;
- **Get Real time traffic plan:** This process has to get the updated real time traffic plan with all the associated information. The main aim of this use case is to update the real time traffic plan with new information about the position of a train;
- **Process raw information to trace against the plan:** This is the main process of this use case. This process must know what part of the railway network corresponds to the train position so that it can be traced against the real time traffic plan. This process has to access a topology database to find the location of the field element which is related to the new train position. With this information the process can ascertain whether it is a movement between stations or if it is a movement that can be interpreted as an arrival at or departure from a station;
- **Store arrival and departure time:** This is the audit process. The arrival and departure times at the station for the train involved in a new movement are stored. The system can relate this audit time to the planned time; that is the reason why this information is stored;

DRAFT – AWAITING EC APPROVAL

- **Update Real time traffic plan:** This process has to insert the new position of the train into the real time traffic plan. It is important that the plan has the calculated position to enable comparison. This action will be the trigger for other actions described in other use cases in this level;
- **Calculate deviations:** This process has to calculate the differences between the current position of the train and the planning for the train. This deviation will be used to ascertain if it is necessary to take any action to try to fulfil the plan. These deviations are not stored in the real time traffic plan because they are ephemeral and are only useful at the current time; furthermore these deviations can always be calculated without any reduction in performance because the system has stored all necessary information, including the real position of the train and the plan along the route. These deviations must be always visible to the IM train dispatcher in order to provide the information required to make the appropriate changes to the Real Time Traffic Plan.

4.3.3.2 UC3.2 – Manage RU train information's to be included in the real time traffic plan

This use case has the responsibility of taking into account, in the real time traffic plan, any information coming from the RUs concerning their train. Some information is mandatory regarding EU regulations (see commission regulation (EU) n°1305/2014 of 11 December 2014, while other information can be considered beneficial to the efficiency of the whole system:

- Train composition information **is mandatory:** the minimum elements to be delivered for the message exchange between RU and IM for the purpose of Train Composition are defined in Chapter 4.2.2.7.2 of Decision 2012/757/EU, OPE TSI. During preparation of the train (before departure), the RU must send the train composition to the IM(s) with whom it has contracted a path section. If the train composition is changed at a location, this message must be exchanged once more with information which has been updated by the RU responsible;
- Train ready information **is mandatory:** the elements to be followed are described in the document 'TAF TSI — Annex D.2: Appendix F — TAF TSI Data and Message Model' listed in Appendix I. The railway undertaking shall send a 'train ready' message to the infrastructure manager every time a train is ready to start after train preparation, unless under national rules where the infrastructure manager accepts the timetable as a 'train ready' message;
- **Train resource information** is not mandatory: the rolling stock roster and the train crew shifts, including any restrictions of use, are to be considered in the traffic management. Example: a safety system is out of order, therefore do not permit the re-use of the train on arrival. This information must contain all rolling stock and personnel changes along the route. These changes have to be made at intermediate

DRAFT – AWAITING EC APPROVAL

stations with planned stops. The main aims of including this train resource information in the real time traffic plan are:

- Monitor the real rolling stock that is running along the controlled area,
- Store information for analysis if all rolling stock and drivers are informed by the different railway operators has the correct authorization to run along the route,
- Store information to reference in case of disturbances to the rolling stock rostering and crew shifts.

The main aims of including train resource information in the real time traffic plan are:

- Monitor the crew that is working on each train during the day;
- Store information that may be analysed to detect conflicts in crew rostering.

This use case has to receive all the rolling stock and crew information to store it, associated with each train, in the real time traffic plan. The UC6 – Analysis and tracing of information can use this information to detect possible conflicts. This information is also used for the forecasting calculation in order to take into account the rolling stock characteristics used along the established route.

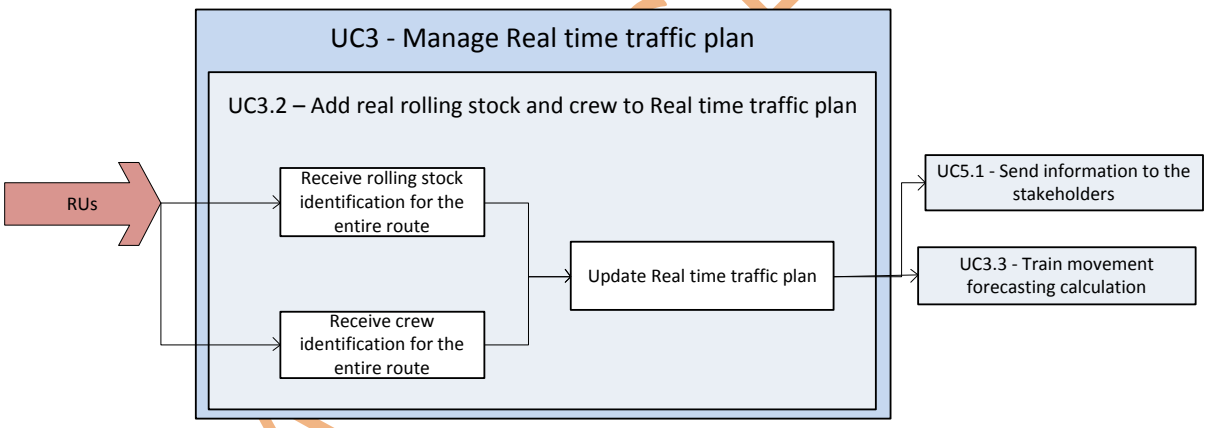

Figure 4.19 – Breakdown of the use case 3.2

4.3.3.2.1 Actors

The actors involved in this use case are:

- **Actor Railways** Undertaking**:** The RU must provide this information because they are responsible for the management of rolling stock and train crew assignment. The train operator companies are the owners of the rolling stock and the crew are part of their personnel.

The information about a new rolling stock assigned to a train may affect the running of the train; that is the reason why this use case has a relationship with UC3.3 – Train movement forecasting calculation.

DRAFT – AWAITING EC APPROVAL

The updated real time traffic plan must be distributed to other stakeholders; that is the reason why this use case has a relationship with UC5.1 Send information to the stakeholders.

4.3.3.2.2 Processes

The processes involved in this use case are:

- **Receive rolling stock identification for the entire route**: This process has to provide the interface to communicate between the different railway undertakings and the TMS. Across this interface these two entities must interchange the rolling stock identification for the complete route. If the rolling stock change along the route it is very important to register this information associated with the station where this change is made;
- **Receive crew identification for the entire route**: This process has to provide the interface to communicate between the different railway undertakings and the TMS. Across this interface these two entities must interchange the crew identification for the complete route. If the crew change along the route it is very important to register this information associated with the station where this change is made;
- **Update real time traffic plan**: This process is responsible for updating the real time traffic plan with the real information about rolling stock and crew for each train informed by the railway undertaking.

4.3.3.3 UC3.3 – Train movement forecasting calculation

The TMS has to provide an advanced forecasting calculation functionality to be able to show the train dispatcher the possible movement of all the trains that are running at any time.

This functionality must be highly configurable to be able to define the expected behaviour of each train. This configuration should allow different behaviours for train groups to be defined based on their physical and commercial characteristics and/or the planned route and should also define specific behaviours for specific trains.

The forecast calculation must be an automatic function that the TMS must do for each train that is running. The trigger to calculate a new forecasting for a train must be one of the followings situations:

- Detect a new train position;
- Detect a change in the train characteristics, like a change in the rolling stock used;
- A change in the planning route, such as a parking track change;
- A change in the planning schedule, like a change of the stop time at a station;
- A modification or a new traffic restriction in the planned route, like a new temporary speed restriction;

DRAFT – AWAITING EC APPROVAL

- An update of the forecast calculated by the train control system of the IM that has a border with the TMS control area, when the train is running along the control area of the other control system and will be running along the TMS control area;
- Changes in the forecast configuration.

It is important for the system to be able to have the current position of each train, not only along the railway infrastructure that is managed by this TMS. It is necessary to know the forecasting of the routes of the running trains along the other railway networks in order to know when trains are expected to run along the TMS control area.

The algorithms used to calculate the forecast for each train must take into account:

- Actual physical characteristics of the train, including all restrictions linked to exceptional transport and dangerous goods;
- Dynamic characteristics of the train;
- Topology characteristics of the route;
- Established route, such as intermediate stops;
- Established schedule for the train;
- Traffic restrictions, like temporary speed restrictions;
- Forecast configuration for each train.

The forecast for each train must be calculated from the last detected position of the train to the established destination. This calculation must take into account all aspects of the plan established at each time for the train, because the objective of the train dispatcher is to try to have the least possible deviation from the established plan.

For trains without a train path, the Dispatcher should be able to add, modify or delete the route planned and the set of physical characteristics to be used for the calculation. These actions can be done at any time by the operator. If this information is missing, the TMS should request it automatically, only once, and sufficiently in advance, from the operator. The calculation is done each time the operator modifies any information.

If no information is available for the given trains, the calculation is done using the current route set, considering the physical characteristics defined by default. In this scenario, the calculation is updated each time a new route is set.

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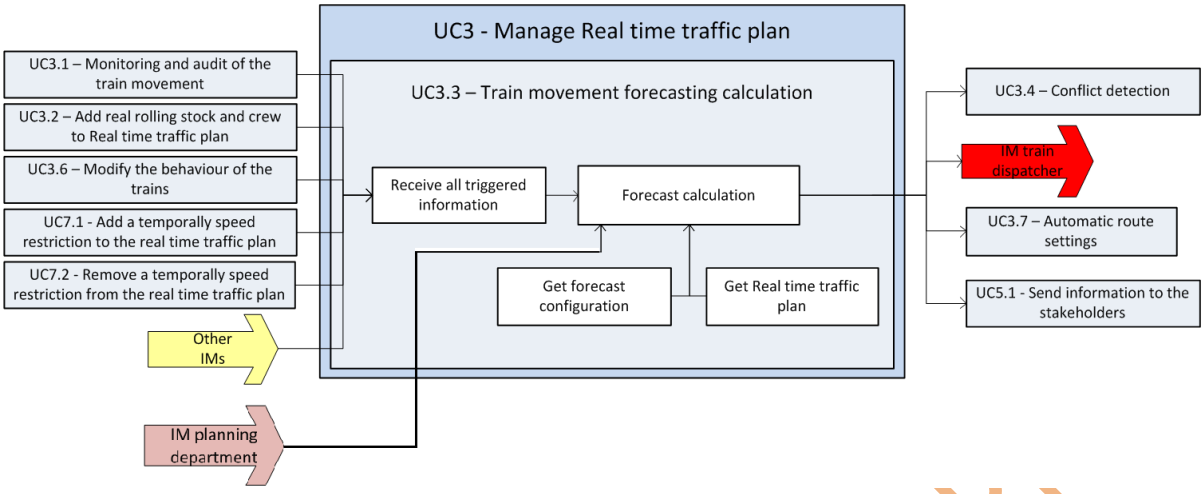

Figure 4.20 – Breakdown of the use case 3.3

4.3.3.3.1 Actors

The actors involved in this use case are:

- **Actor Other Infrastructure** Manager: If the infrastructure borders an area of infrastructure controlled by a different system, it is necessary for the TMS to execute a forecast from the border of both infrastructures to the destination of the train, if that is part of the infrastructure controlled by the TMS, or to the next border with other infrastructure;
- **Actor IM train** dispatcher: Responsible for monitoring and controlling the traffic. This use case provides the train dispatcher with all information about the running forecast of each train along the controlled area;
- **Actor IM planning** department**:** This actor provides the long term plan. One operation of this use case is to generate the real time traffic plan taking into account the long term plan and the exceptions for the current day described in the daily timetable.

To detect the different situations when the forecast calculation must be executed, this use case has to obtain information from use case Table 4.4 - Actors for use cases UC3

UC3.1 – Monitoring and audit of the train movement, UC3.2 – Manage RU train information's to be included in the real time traffic plan or UC3.6 – Modify the behaviour of the trains. This forecast calculation must be executed when there is a modification of the temporary speed restrictions described by Table 4.8 - Actors in use cases UC7

UC7.1 Add or modify a temporary restriction to the real time traffic plan and UC7.2 Remove a temporary restriction from the real time traffic plan.

This forecast information must be used by the conflict detection functionality described by UC3.4 – Conflict detection and by the Automatic router described by UC3.8 – Route setting

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automation. With this forecast information the system and the IM train dispatcher can adapt the current train planning (real time traffic plan) to be able to adapt the train running to try to fulfil the established daily timetable.

The updated forecast plan must be distributed to other stakeholders; that is the reason why this use case has a relationship with UC5.1 Send information to the stakeholders.

4.3.3.3.2 Processes

The processes involved in this use case are:

- **Receive all triggered information**: This process has to obtain all information provided by other processes in order to be able to detect all situations where it is necessary to execute the forecast calculation for each train along the complete route. The triggered situations are any new situation detected that can affect the behaviour of the train along the complete route. This process has to be able to detect these triggered situations to automatically execute the forecast calculation. These triggered situations can be broken down at the following points:
  - Changes in the train position,
  - Changes in the train or rolling stock characteristics,
  - Changes in the established route,
  - Changes in the established schedule,
  - Changes in the restrictions along the route,
  - Changes in the forecasting configuration.
- **Get forecast configuration**: This process is responsible for getting the current configuration for the forecast algorithm. This configuration can define different behaviours of the train, such as patterns to recover delay time. This configuration is used by the forecast algorithm to show the most appropriate and close forecast at each time for each train;
- **Get Real time traffic plan**: All the real time traffic plan information is necessary to calculate the train forecast. This process is responsible for getting this information about the route, the schedule and the rolling stock characteristics associated with each train in order to be able to send the information to the train forecast algorithm;
- **Forecast calculation**: This is the main process of this use case. This is the algorithm calculation that has to take into account:
  - Actual physical characteristics of the train, including all restrictions linked to exceptional transport and dangerous goods,
  - Dynamic characteristics of the train,
  - Topology characteristics of the route,
  - Established route including intermediate stops,
  - Established schedule for the train,
  - Traffic restrictions, like temporary speed restrictions,

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- Forecast configuration for each train.

4.3.3.4 UC3.4 – Conflict detection

A conflict is a situation that prevents the running of a train. These situations can arise due to the impossibility of running a train across a route because of physical incompatibilities or because two trains try to use the same infrastructure resource at the same time.

One of the objectives of planning the personnel is to provide a robust plan to the real time environment without conflicts (example: train crew is on delayed train A, therefore the crew will not be able to be re-used for train B). With this premise, we can assume that the daily timetable is a plan that does not contain any conflict.

During the day, there are mismatches with the trains running that can produce conflicts. These conflicts must be managed to try to minimize the impact of these mismatches.

The TMS must provide functionality that continuously and automatically analyses the real time traffic plan and the train forecasts in order to detect any traffic situation that prevents the running of the trains.

When the system detects a conflict it is necessary to show all of the conflict information to the IM Train Dispatcher. This information includes the trains involved, the kind of conflict, the time of the conflict, the infrastructure resources involved, the priority and the severity of the conflict.

To detect a conflict between a train and the infrastructure it is necessary to analyse:

- The detailed complete route of the train;
- The rolling stock characteristics of the train, dimensions, electrical characteristics, etc. It includes temporary restrictions and any restrictions linked to exceptional transport and dangerous goods;
- Driver credentials;
- The infrastructure characteristics along the route of the train, including permanent and temporary restrictions.

To detect a conflict between two trains it is necessary to analyse:

- The detailed complete route of the trains with all tracks to be used;
- The schedule planned in the real time traffic plan;
- The schedule forecasted in the forecast plan.

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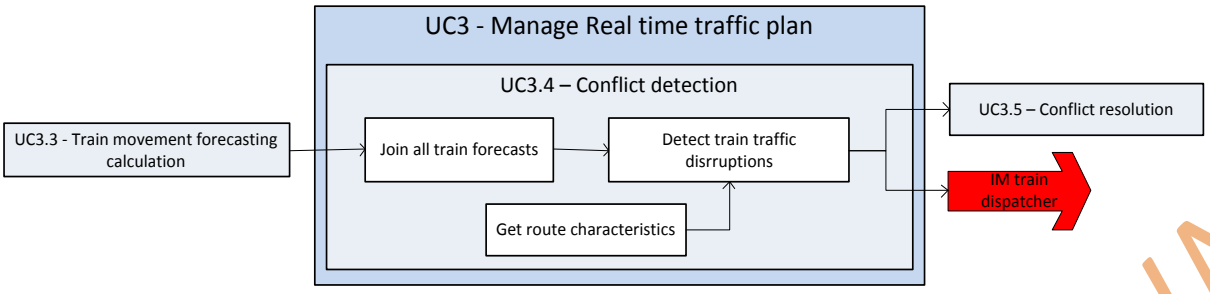

Figure 4.21 – Breakdown of the use case 3.4

4.3.3.4.1 Actors

The actors involved in this use case are:

- **Actor IM train** dispatcher**:** Responsible for monitoring and controlling the traffic. This use case is based on automatic operation of the TMS that provides information to the IM Train Dispatchers. With this information this actor can carry out the most appropriate action to resolve the conflict, automatically with the system or assisted by the IM train dispatcher.

This use case receives the forecast of all the trains that are running by the UC3.3 – Train movement forecasting calculation. The result of this use case has to be provided to the IM Train Dispatcher and to the UC3.5 – Conflict resolution.

4.3.3.4.2 Processes

The processes involved in this use case are:

- **Join all train forecasts:** This process has to receive all the train forecasts, from the current position of each train to the destination planned in the real time traffic plan. It is necessary that this use case is based on the real time traffic plan and not on the daily timetable because the real time traffic plan is the intention of the behaviour of all the trains. This intention is used by this use case to detect conflicts between the trains. The calculation of the train forecast is based on the real time traffic plan that contains the current position of each train and the route to the destination of each train;
- **Get route characteristics:** This process has to get all the characteristics of the planned route from the real time traffic plan for each train. This information will be used by the next process which will compare the characteristics with the train forecast to detect infrastructure incompatibilities;
- **Detect train traffic disruptions:** This is the process that uses all the information, including infrastructure information and train planning (route and schedule) to intersect between all trains and detect conflicts.

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4.3.3.5 UC3.5 – Conflict resolution

This use case describes a functionality that makes it possible to resolve a situation that is making the train running impossible. This use case is executed when the TMS detects a conflict that means that a train does not circulate along the established route.

The conflict resolution of the TMS of the future must be capable of automatically modifying the behaviour of the trains in order to change train routes to try to make it possible to run close to the established plan with the minor delays and deviations from the daily timetable.

The future TMS has to be able to automatically resolve, or at least to reduce conflicts when resolution is not possible. The aim is to maximise the business Key Performance Indicators defined by each Infrastructure Manager (A large set of KPIs were presented in §4 of [In2Rail D7.1]). Train route modifications that are needed in order to resolve conflicts should minimize the overall impact of delays and deviations on the real time traffic plan.

The conflict resolution has to adapt to users' needs and has to be supportive in all possible scenarios. It should be reliable and able to handle smaller conflicts without interaction from the IM train dispatcher. The conflict resolution has to be transparent so that the user is always informed, in a discreet way, about actions taken by the conflict resolution and the reasons for such actions. The users stay in full control as they can configure certain rules for the conflict resolution, e.g. when a certain order between trains has to be kept.

At a minor traffic disruption the TMS must be able to resolve the conflict automatically without the intervention of the IM train dispatcher. This conflict resolution must have enough configuration to be able to execute either in an attended mode or fully automatic mode. The mode of the conflict resolution can be configurable independently for each part of the railway infrastructure. In fully automatic mode, TMS must inform the IM train dispatcher to be able to monitor the complete system.

Attended mode and automatic mode can be enabled and disabled at the request of the Dispatcher. When disabled, the operator can still manually request a conflict resolution.

To resolve a conflict, the algorithm of the TMS uses principles that are defined by the Actor IM train dispatcher manager. Those principles can be configured independently for each part of the railway infrastructure. Principles used can be priority rules indicated in the Network Statement (for example, current priority rules are presented on the Rail Net Europe website http://www.rne.eu/priority-rules-in-operations.html). The ability to use other rules chosen by the Infrastructure Manager, such as local rules, should be possible, as priority rules do not always offer the best capacity solution.

When traffic disturbances generate big problems with train traffic, it is necessary that the IM train dispatcher becomes involved in the situation. In these situations, the conflict resolution

DRAFT – AWAITING EC APPROVAL

functionality must provide different options that optimise different Key Performance Indicators (KPI) based on the Infrastructure Manager own choice. It is recommended that the KPIs chosen are linked to the Performance Management System in use on its network. These options will be different modifications of the train behaviours in order to adapt the running to fulfil the daily timetable with the minor disturbance. The IM train dispatcher will select one of these options to be used and it will be applied to the real time traffic plan.

The different modification options to the real time traffic plan are based on:

- Schedule Changes: Change / adapt the timetable to be met by a train, changing the departure time at intermediate stations, changes in the time of entry into the stations along the way and therefore changes in the running to be performed by the train;
- Changes in the route: Change / adapt the course to be taken by a train, parking tracks used at intermediate stop stations, route tracks used along the route, changes of planned stops.

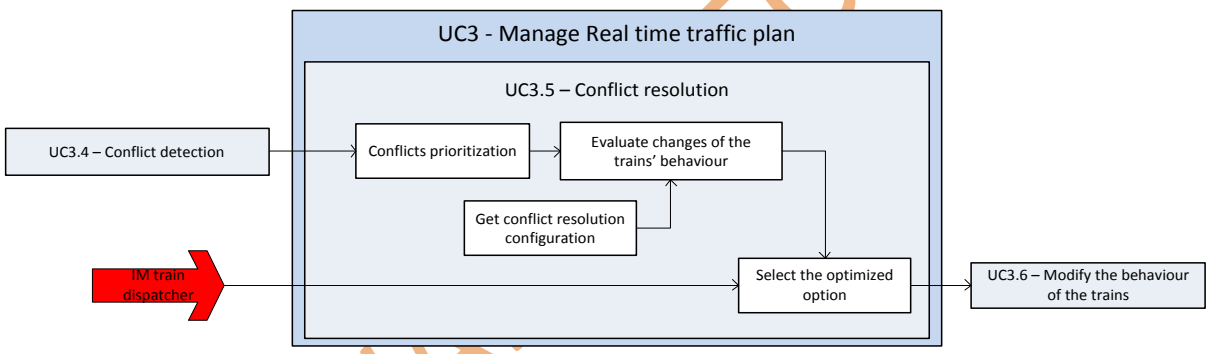

Figure 4.22 – Breakdown of the use case 3.5

4.3.3.5.1 Actors

The actors involved in this use case are:

- **Actor IM train** dispatcher: Responsible for monitoring and controlling the traffic. This use case is based on automatic operation, but in some cases it might be necessary for the IM train dispatcher to take control and select the most appropriate option in order to recover the normal running of the trains along the controlled area.

4.3.3.5.2 Processes

The processes involved in this use case are:

- **Conflict prioritization:** It is necessary to select the most important conflicts, because a conflict that will occur in the next 5 minutes is more important than a conflict that is detected but will occur in the next 2 hours. It is possible that a conflict detected in

DRAFT – AWAITING EC APPROVAL

the long future (hours ahead) will not occur because the situation that is producing the conflict may change, but a conflict forecast for the near future must be treated by the TMS or by the IM Train Dispatcher. This process has to make this prioritization to select the most important conflicts. In the end the TMS has to provide possible solutions to solve all conflicts, but in the order established by this process. It is important to take into account that a conflict resolution can indirectly solve other conflicts detected; that is the main reason to order the conflicts from the most important to the least important;

- **Get conflict resolution configuration:** This process gets the conflict resolution configuration established by the Actor IM train dispatcher or by the Actor IM train dispatcher manager. This configuration must provide the definition of the KPI used to optimise the possible solutions. The configuration defines the parameters to be taken into account in order to provide rules to select the possible solutions to each kind of conflict, and then select the most appropriate solution in each case;
- **Evaluate changes in the trains' behaviour:** This process has to use the conflict resolution configuration to provide different solutions to solve each conflict. These solutions are based on modifications of the behaviour of the trains defined in the real time traffic plan. This process can propose modifications to the behaviour of each train through the following planning changes:
  - **Schedule changes**: Change / adapt the timetable to be met by a train (real time traffic plan), changing the departure time of travel, changes in the time of entry into the stations along the way and therefore changes in the running to be performed by the train,
  - **Changes in the route**: Change / adapt the detailed route of the train, change the parking tracks or running tracks along the route, change the planned stops.
- **Select the optimised option**: This process must provide an automatic selection of the best solution to adopt. This selection has to be based on the configuration of this functionality. The best solution is based on the KPI that is configured at the system to be optimised at each situation. In a minor disturbance of the traffic, the TMS must provide an automatic solution to select, in this case it is not necessary that the IM Train Dispatcher takes decisions.

In a high traffic disruption, it is necessary for the IM Train Dispatcher to make a decision about which is the best solution to adopt. In this case the TMS has to provide a list of possible solutions ordered by the KPI that is optimised.

The results of this process, which is either independent if it is an automatic operation or assisted by the IM Train Dispatcher, are the modifications to be applied to the real time traffic plan.

DRAFT – AWAITING EC APPROVAL

4.3.3.6 UC3.6 – Modify the behaviour of the trains by a minor disturbance

This use case is responsible for applying the modifications to adapt the behaviour of the running trains when a **minor disturbance** is detected.

These changes can be performed by the Actor IM train dispatcher directly, to try to adapt the running of the trains in order to optimise some KPI, manually resolve some conflicts or as response to a RU request. On the other hand, the TMS can change the behaviour of the trains directly through the automatic conflict resolution execution and determine the optimised changes to apply.

Whether the changes are performed by the system through its automatic features, or if they are made directly by the Actor IM train dispatcher, the main purpose of the changes is to modify the behaviour of the train to try to fulfil the established planning and enforce the daily timetable for the current day.

The different types of modification can be:

- Modify the route:
  - Modify the tracks to use along the route,
  - Modify the schedule along the route, from the origin station to the destination station.
- Modify the stop times at any intermediate station:
  - Modify the running time between stations.

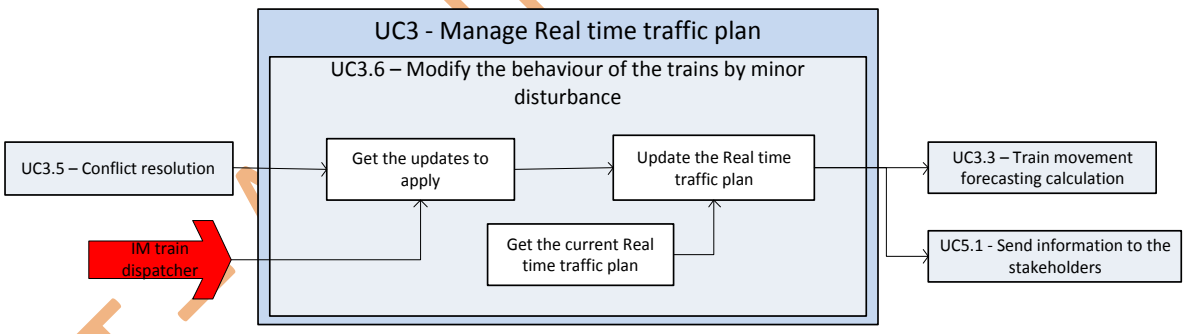

Figure 4.23 – Breakdown of the use case 3.6

4.3.3.6.1 Actors

The actors involved in this use case are:

- **Actor IM train** dispatcher**:** Responsible for monitoring and managing the traffic. When the Actor IM train dispatcher takes control he is able to select the most appropriate option in order to recover the normal train running in the controlled area or in order to attend to a RU request.

DRAFT - AWAITING EC APPROVAL

This use case can be triggered by the UC3.5 – Conflict resolution, when the system automatically decides that is necessary to modify the behaviour of the trains in order to resolve a traffic situation that could produce a traffic conflict.

The result of the modification of the behaviour of the trains is the update of the real time traffic plan; this update will trigger the forecast calculation of the trains involved in the changes and the linked trains; this forecast calculation is described in UC3.3 – Train movement forecasting calculation.

The updated real time traffic plan must be distributed to other stakeholders; this is the reason why this use case has a relationship with the UC5.1 Send information to the stakeholders.

4.3.3.6.2 Processes

The processes involved in this use case are:

- **Get the updates to apply:** This process is responsible for getting the modifications which need to be applied to the trains involved. This process must be able to obtain these modifications providing an interface used by the conflict resolution functionality and must be able to provide a graphical interface for the IM Train dispatchers to select the changes to be applied;
- **Get the current Real time traffic plan:** It is necessary to get the current real time traffic plan so that it can be compared with the changes requested by the previous process. This real time traffic plan has the behaviours of all the trains; with this information the TMS is able to determine which trains are involved in the change requests because a modification of the behaviour of a train can have an impact on other linked trains;
- **Update the Real time traffic plan:** This process is responsible for making all the changes to the real time traffic plan. The result of this process is that an updated real time traffic plan is obtained with the changes requested; this update will trigger the forecast calculation process, and this forecast calculation will trigger the conflict detection process and the execution cycle will follow with the TMS execution loop.

4.3.3.7 UC3.7 – Modify the behaviour of the trains by a major disturbance

This use case is responsible for applying the modifications in order to adapt the behaviour of the running trains when a **major disturbance** is detected.

These changes cannot be performed directly by the IM Train Dispatcher without the approval of the Railway undertaking.

The different kind of modifications can be:

DRAFT – AWAITING EC APPROVAL

- Cancel a train path;
- Modify the train service: Modify the planned stops along the route;
- Modify the train route: modify the origin, the destination or the line used;
- Modify the links between trains, including any connecting trains at any possible stop.

Four types of major disturbances are defined:

- Major disturbance for:
  - A single train needing to be negotiated with a single RU: the expected negotiation is quick,
  - Several trains needing to be negotiated with various RUs: the expected negotiation is longer but there is no need to arbitrate,
  - Several trains needing to be negotiated with various RUs and a body: the expected negotiation is long and arbitration might be required, usually done by IM, in case of incompatibility of the solutions negotiated with each RU;
- Major disturbance requiring the application of a contingency plan applied by the Infrastructure Manager.

There is no "absolute standard" for identifying when a contingency plan must be applied. Therefore, no functions are defined in the TMS for this. This point should be handled by each IM through its own organisation, policy and experience.

Nevertheless, specific KPIs related to “Contingency plan” could be requested by the IM, to identify any significant risks of drift. The following KPIs are proposed as examples:

- Total delay of trains with the possibility of distinguishing the total by line, service, stations, etc.;
- Number of cancelled trains with the possibility of distinguishing the total by line, service, stations, etc.;
- Number of cancelled train stops for a station.

Such KPIs will be analysed by the Actor IM train dispatcher manager to decide whether or not to apply a contingency plan, by considering other elements of the situation, such as the type of infrastructure unavailable (main line closure, main station closure, etc.), the period when the situation occurs (peak period, busy day, etc.), the type of service unavailable (Commuter service, long distance service), the duration of the situation (several hours or days), the number of operational services concerned (e.g. several operating control centre), the history of the network (similar incident having already occurred, etc.), the context of the situation (Political exposure, media exposure, etc.), etc.

Once it has been decided that a contingency plan shall be applied, managers of the dispatcher select an “emergency” timetable. The preparation of the emergency timetable is part of the planning environment, out of scope of the TMS, and is pre-agreed by all actors

DRAFT – AWAITING EC APPROVAL

involved with IMs and RUs. Managers of the dispatcher are responsible for committing the emergency timetable. If required, they have to adjust it, with RUs if necessary, to the current situation. This action corresponds to a selection of trains that RUs are actually able to produce.

While a major disturbance is ongoing, the Actor IM train dispatcher should be able to define a so-called "recovery area" delimited with any elements of the infrastructure (points, routes from signal, platform, stations, etc.). The TMS should consider whether this recovery area is a temporary restriction to detect conflict (UC3.4 – Conflict detection), not usable to propose solutions (ref. UC3.5 – Conflict resolution), or as an area outside the TMS controlled area to monitor trains entering the system (Table 4.4 - Actors for use cases UC3

UC3.1 – Monitoring and audit of the train movement).

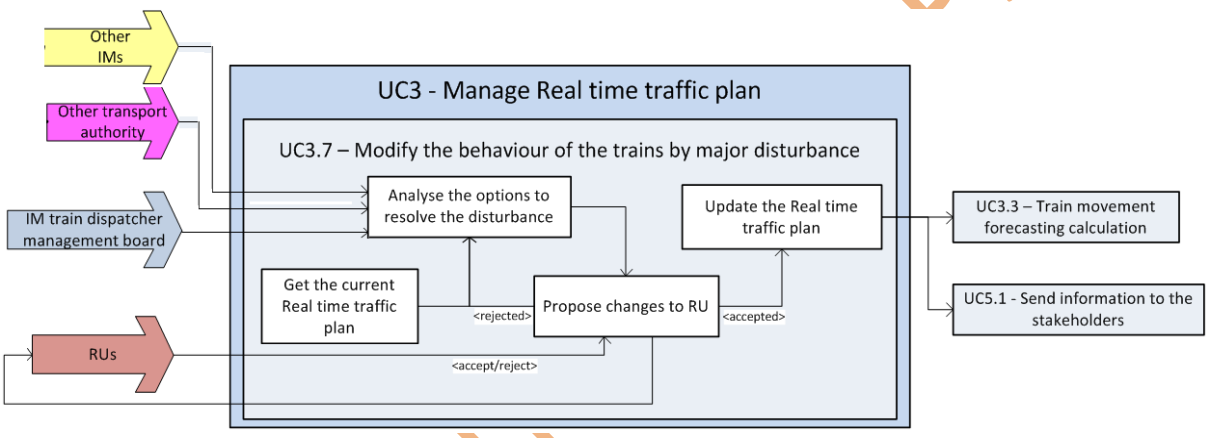

Figure 4.24 – Breakdown of the use case 3.7

4.3.3.7.1 Actors

The actors involved in this use case are:

- **Actor IM train dispatcher** manager: Responsible for the management of the planning for the current day in the real time environment. This actor is the interface with the RUs, and when a major disturbance is detected it is necessary that the manager communicates with the Railway Undertakings in order to make a common decision about the modifications to the trains planning to be able to solve the disturbance;
- **Actor Railways** Undertaking**:** These are the different railway operator enterprises that have to approve the changes to the trains planning for the current day to be able to solve the disturbance;
- **Actor Other Infrastructure** Manager: this actor can be involved in the approval process, before the IM submits a proposal to RU, in case of major disturbance resolution;
- **Actor Other transport** authority**:** provides any information to be considered in major disturbance resolution carried out by the Actor IM train dispatcher manager

DRAFT – AWAITING APPROVAL

(example: capacity availability of an alternative transport mode , final connecting time for passengers, etc.).

The result of the modification of the behaviour of the trains, approval between the IM train dispatcher manager and the RU, is the update of the real time traffic plan; this update will trigger the forecast calculation of the trains involved in the changes and the linked trains. This forecast calculation is described by UC3.3 – Train movement forecasting calculation.

The updated real time traffic plan must be distributed to other stakeholders; this is the reason why this use case has a relationship with the UC5.1 Send information to the stakeholders.

4.3.3.7.2 Processes

The processes involved in this use case are:

- **Get the current Real time traffic plan:** It is necessary to get the current real time traffic plan to be able to analyse different options to reduce the impact of a major disturbance;
- **Analyse the options to resolve the disturbance:** This process can use the simulated timetable traffic functionality to analyse the impact of the changes to the real time traffic plan in order to decrease the impact of the major disturbance detected. The Actor IM train dispatcher manager is responsible for the analysis process. The result of this process is the best proposal, based on business KPI defined by each IM such as minimum trains modified, minimum delays, minimum trains affected, or other parameters. This proposal must be accepted by the Actor Railways Undertaking of the trains involved in the proposed changes. In certain geographical areas and/or if convention between IMs is established, this solution can be submitted to Actor Other Infrastructure Managers before proposing it to a Actor Railways Undertaking. TMS should help Actor IM train dispatcher managers in considering, as much as possible, the expectations of Actor Other transport authority, in order to offer the best connection possible, whether in train stations for Actor Passengers' door-to-door journey, or freight yards for Actor Freight transport users;
- **Propose changes to RU:** This process is responsible for sending the proposal of the Actor IM train dispatcher manager to all RUs involved**:**
  - If the RUs reject this proposal the Actor IM train dispatcher manager has to try to find other possible solution;
  - If the RUs accept the changes proposed the system must update the real time traffic plan to be able to execute the plan.
- **Update the Real time traffic plan:** This process is responsible for making all the changes to the real time traffic plan. The result of this process is that a real time traffic plan, updated with the accepted changes, is obtained. This update will trigger

DRAFT – AWAITING EC APPROVAL

the forecast calculation process; this forecast calculation will trigger the conflict detection process and the execution cycle will follow with the TMS execution loop.

4.3.3.8 UC3.8 – Route setting automation

Route setting automation is a functionality that a TMS must provide. The main aim of this functionality is to establish the correct route for each running train in time (a train should not stop), based on the dispatcher decisions reflected by the real time traffic plan of the TMS.

The automatic routing module feeds from the forecasting information for each train and from the real state of the controlled field.

The route setting automation has to provide feedback to the dispatcher (e.g. via the Real Time Traffic Plan) so that the IM train dispatcher is kept informed. Important feedback is, for example, when a route has to be set, confirmation that the route has been successfully set and how far the route was set, or when an infrastructure element did not reply.

The steps to route the trains are:

- With the state of the field information the router must detect the trains to be routed;
- With the forecast information the router must identify:
  - The correct route for each train at each moment. This information ensures that the trains run along the route established in the real time traffic plan,
  - The appropriate time to establish the route. This information makes the trains run according to the established schedule in the real time traffic plan.

The result of this process is that the correct command at the correct time to establish the appropriate route is sent to the IM control systems. The final responsibility for the execution of this command is with the IM control systems.

The execution of a route is a task that can take several seconds, because in some cases it is necessary to move several switch points and this operation requires checks and mechanical movements. The TMS must monitor the state of the field in order to detect if the route command is reflected in the field elements to check that the command has been executed; then the route is established.

DRAFT – AWAITING EC APPROVAL

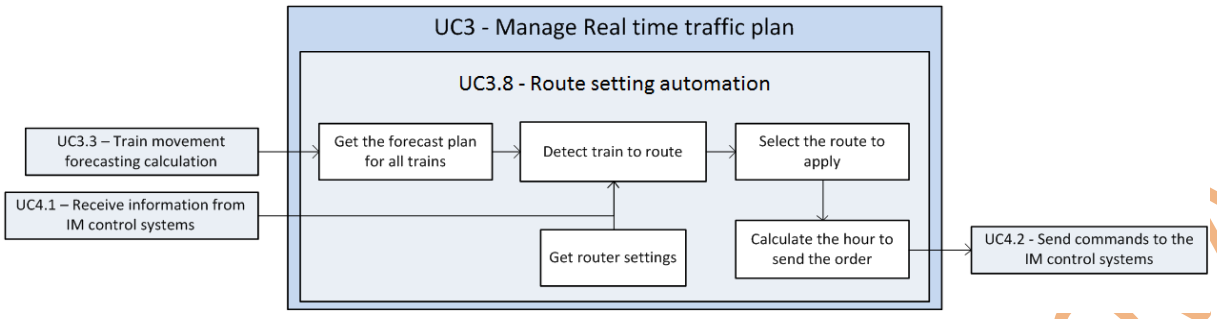

Figure 4.25 – Breakdown of the use case 3.8

4.3.3.8.1 Actors

This is an automatic functionality that the system must provide; for this reason there are no actors involved, but there are some relationships with other use cases described in this document.

To make the automatic routing function possible, it is necessary to know the forecast calculated by the system for each train (UC3.3 – Train movement forecasting calculation), and it is also necessary to know the real state of all the field elements under control (Table 4.5 - Actors for use cases UC4

UC4.1 – Receive information to monitor train traffic and infrastructure status).

The result of this process is the route to be established and the time to execute the route command. This result is sent to the IM control system that is described in the UC4.2 – Send commands to the IM control systems.

4.3.3.8.2 Processes

The processes involved in this use case are:

- **Get the forecast plan for all trains:** This process is responsible for obtaining the result of the forecast calculated automatically by the TMS for all trains that are running. This information is necessary to identify the most appropriate time to execute a route and the route to establish at each time. The forecast has to follow all the decisions taken in the real time traffic plan for the tracks to use by each train; this is the reason why the forecast plan contains the complete route that the trains have to follow to fulfil the established behaviour for each train;
- **Get router settings:** This process has to provide the configuration established for the router functionality. The configuration that has to be available is related to the

DRAFT – AWAITING EC APPROVAL

infrastructure points where the routing function is or is not active, and about which the trains have or do not have active routing settings. With this configuration it is possible to set where the system must take into account the routes and if the operator wants a train to be routed automatically or not;

- **Detect train to route:** This process has to know the complete state of the field in order to detect when a train is approaching an area where it is necessary to make a route for the train. This process has to detect if a train is near a signal that has the route functionality active, then it must check if this train has the automatic route active. If both conditions are met, the train is detected to be routing;
- **Select the route to apply:** When a train is detected for routing, the next step is to identify the necessary route to set to ensure that the train runs along the correct route established in the real time traffic plan. This process has to get the detailed route from the real time traffic plan and detect the appropriate command to send to the IM control system in the correct order to set the route;
- **Calculate the hour to send the order:** When the system knows the route and the correct command to send to the IM control system, it is necessary to know when to send the command. The system needs to know the forecast calculated by the train, and with this information the TMS has to calculate when it is necessary to send the command to the IM control system, taking into account the time that the infrastructure system needs to execute the command and all other necessary actions with the field elements to establish the route correctly.

4.3.4 UC4 – Manage & monitor train traffic and infrastructure

The operations to be taken into account within this use case are all related to the management of the information exchanged between the TMS and control and monitoring of rail traffic and infrastructure systems.

Communication between these systems is bidirectional and for that reason it is treated in this second level of use cases receiving information and sending commands to the control and monitoring of rail traffic and infrastructure systems.

On the one hand the systems responsible for the control and monitoring of field elements must report any detected changes to the TMS, and on the other hand the TMS sends requests to execute commands to the IM control system. The IM control system is the system which ultimately decides whether to execute these commands; the TMS only sends requests for command execution.

DRAFT – AWAITING EC APPROVAL

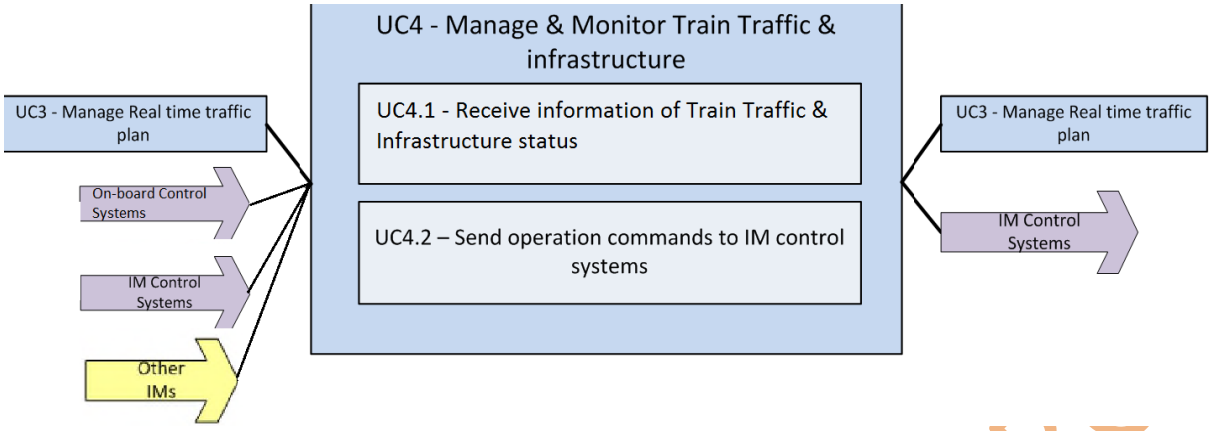

Figure 4.26 – Breakdown of the use case 4

The following table represents the matrix between the level 2 use cases for UC4 – Manage & monitor train traffic and infrastructure and the actors involved in each one.

Actor/Use case	UC4.1 – Receive information to monitor train traffic and	UC4.2 – Send commands to the IM control systems
Actor IM train dispatcher		
Actor IM train dispatcher manager		
Actor IM maintenance crew		
Actor IM planning department		
Actor IM temporary restrictions administrator		
Actor IM control systems	X	X
Actor Other Infrastructure Manager	X	
Actor Railways Undertaking		
Actor Driver System	X	
Actor On-board Control System		
Actor Passengers		
Actor Freight transport users		
Actor Other transport authority		

Table 4.5 - Actors for use cases UC4

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4.3.4.1 UC4.1 – Receive information to monitor train traffic and infrastructure status

This use case is responsible for the reception of all information about the real state of all elements of the infrastructure and about the real position of all the trains under the control area and any information at the border of the control area for all trains which are planned to run but have not yet arrived.

There are three groups of information that this use case must receive:

	From Actor IM control systems	From Actor On-board Control System	From Actor Other Infrastructure Manager
▪ **Infrastructure state**			
○ Complete state of all the elements controlled	✓		
○ Alarms and state of the catenary control system	✓		
○ Alarms and state of track sensors, including ▪ Vehicle Fall Detectors ▪ Cross Wind Detectors	✓		
○ Alarms and measures of meteorological systems	✓		
○ Alarms triggered by other advanced external security systems that detect potentially unsafe situations	✓		
○ Alarms for track geometry ○ Alarms for rail stress	✓		
▪ **Train position**			
○ Current position of each train in the controlled area	✓		
○ Forecasted time at the border of the control area for all trains planned to run but not yet arrived	✓		✓
▪ **Train state**			
○ Alarms and state of any on-board safety sensor such as Hot Axle Bearing Detectors	✓	✓	
○ Alarms and state of any on-board maintenance sensor such as number of passenger in the train		✓	

This use case has to receive information provided by different IM control systems, such as Centralised Traffic Control, Energy Control Systems, Detectors and Sensor Systems, and Meteorological systems. This use case is responsible for providing mechanisms to be able to get all the information provided by these control systems in order to provide this information to the other modules of the TMS in a standardised mode.

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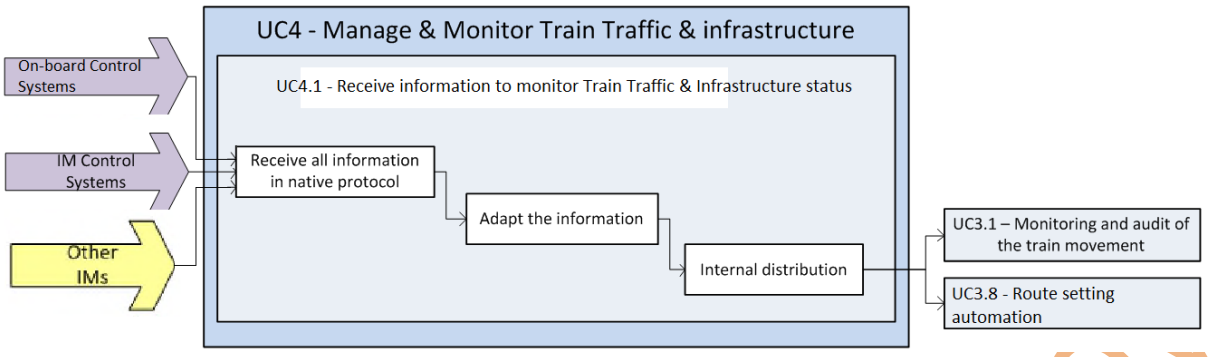

Figure 4.27 – Breakdown of the use case 4.1

4.3.4.1.1 Actors

The actors involved in this use case are:

- **Actor On-board Control** System**:** There may be several On-board control systems that control different aspects of the train: e.g. safety systems such as ETCS, brakes, radio, etc., and systems linked to the train performance through maintenance information. All this information is sent to the TMS to be considered for traffic management;
- **Actor Other Infrastructure** Manager**:** other IM provides information at the border concerning trains which are planned to run on the infrastructure but have not yet arrived, in order to take them in account as much as possible in advance;
- **Actor IM control** systems**:** There may be several IM control systems that control different aspects of the infrastructure, tracks and field elements for traffic control, sensors, energy, etc.;
- **Traffic Control Systems:** The most common system is the Centralised Traffic Control System. This system must provide the state of the controlled elements of the infrastructure and the elements related to the railway exploitation. All this information is sent to the TMS to be analysed and to provide high level functionality to help to the train dispatcher to understand the current state of the controlled area;
- **Energy Control Systems:** These systems are responsible for monitoring and controlling all elements related to the state of the energy at the catenary and all systems involved in the energy supply;
- **Track elements detectors:** These systems provide all the information about the measures and the alarms detected by the sensors that are installed along the tracks. There can be different types of detectors like Hot Axle Bearing Detectors (HABD), Vehicle Fall Detectors (VFD), Cross Wind Detectors (CWD) and any kind of sensors that provide information about the state of exploitation;
- **Meteorological systems:** These systems provide meteorological information captured by the different sensors that are installed along the tracks;
- **Other systems:** All the systems that provide information about the state of the infrastructure and the train traffic exploitation**.**

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4.3.4.1.2 Processes

The processes involved in this use case are:

- **Receive all information in native protocol:** This process is responsible for getting information from all of the IM control systems with their own protocol. This process must provide specific connectors in order to be able to connect to each IM control system;
- **Adapt the information:** This process is responsible for protocol translation from the native protocol of each IM control system to a standard protocol used at the TMS;
- **Internal distribution:** This process must provide mechanisms to be able to distribute the information required by each module or part of the TMS. Each internal module of the TMS must be able to register the information required and this process must provide the correct information to each information subscriber.

4.3.4.2 UC4.2 – Send commands to the IM control systems

This use case is responsible for sending the execution command request to the IM control systems. This use case sends requests and not direct command executions because the IM control systems have the final responsibility for the execution of the commands and can decide not to execute the commands requested, in this case, by the TMS.

The automatic router is one of the TMS functionalities that use this use case in order to establish the appropriate route at the correct time to try to fulfil the real time traffic plan.

To do this, the automatic router must request to execute routes for each train along the route. The Centralised Traffic Control System will attend these requests and will decide if it can or cannot execute these commands at the time requested. This is the flow that the TMS uses to ensure that the real time traffic plan will be fulfilled.

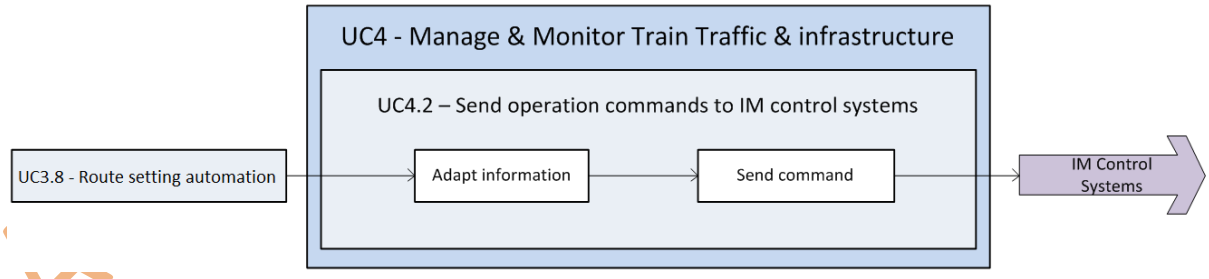

Figure 4.28 – Breakdown of the use case 4.2

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4.3.4.2.1 Actors

The actors involved in this use case are:

- **Actor IM control** systems**:** There may be several IM control systems that control different aspects of the infrastructure. The TMS must modify the state of the field elements in order to ensure that the trains run according to the real time traffic plan**;**
- **Traffic Control Systems:** The most common system is the Centralised Traffic Control System. This system must provide the state of the controlled elements of the infrastructure and the elements related to the railway exploitation, and can control all the elements to change the routes of the trains.

4.3.4.2.2 Processes

The processes involved in this use case are:

- **Adapt information:** This process is responsible for making all the necessary changes to the commands sent by the TMS to the IM control systems. There are two common adaptations that must be taken into account: the protocol transformation from the standard protocol used by the TMS to the native protocol of the IM control systems (if the system does not use the standard protocol), and; complete the command with other necessary information that the IM control system needs to execute the requested command. One example of this is when the TMS makes a request to execute a route command and the Centralised Traffic Control must execute several actions to execute the route. All these changes are the responsibility of this process;
- **Send command:** This process is responsible for the connection with the IM control systems. This process must provide different interfaces to be able to communicate with all systems that control the infrastructure. It must manage the communication protocol to be able to know if each request is sent and if each request is received by the IM control systems.

4.3.5 UC5 – Manage train traffic information distribution

The operations to be taken into account within this use case are all related to the distribution of information to interested parties (stakeholders) who have permission to receive the information, providing each with filtered information according to their needs and according to their individual details.

The main goal of this use case is to provide consistent information to all stakeholders, allowing this information to be filtered for each of them, and defining the level of detail required by each.

The format for information exchange must meet European standards (TAF / TAP TSI).

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The information managed by the TMS is distributed to interested parties who have permission to receive the information. Therefore access control mechanisms for each type of information provided are required.

Each of the stakeholders must be registered in the system as authorised for a particular group of information and with a particular level of detail.

The whole process of information discharge must be supported by mechanisms to ensure the security of information made through administrative procedures that fall outside the scope of this use case.

Once a person is permitted to receive information, the mechanism required for the distribution of information follows the model of subscription-notification.

There are several different types of information that the TMS manages and which can be distributed to different stakeholders:

- Updated real time traffic plan;
- Updated forecast for all trains that are running.

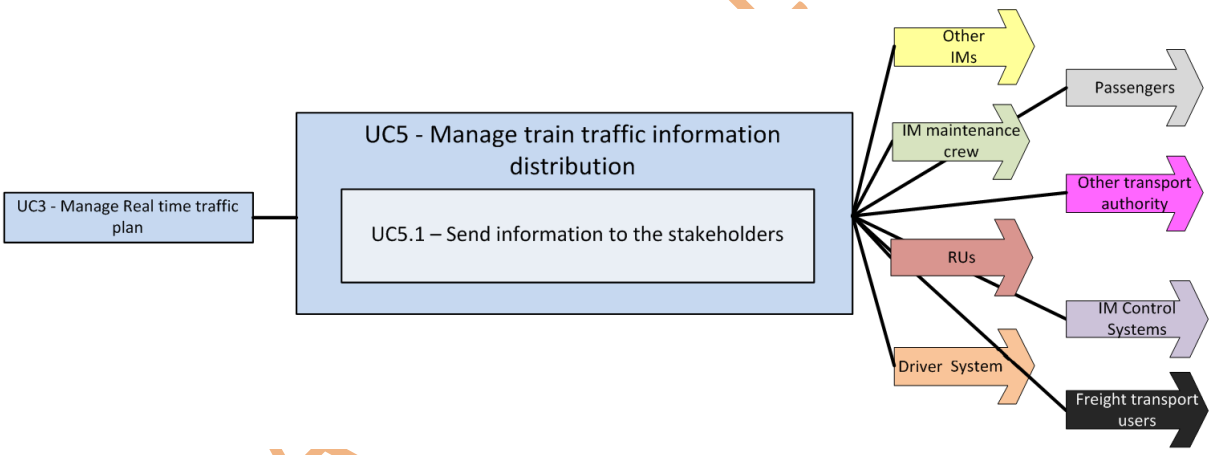

Figure 4.29 – Breakdown of the use case 5

The following table represents the matrix between the level 2 use cases for UC5 – Manage train traffic information distribution and the actors involved in each one.

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Actor/Use case	UC5.1 Send information to the stakeholders
Actor IM train dispatcher	
Actor IM train dispatcher manager	
Actor IM maintenance crew	X
Actor IM planning department	
Actor IM temporary restrictions administrator	
Actor IM control systems	X
Actor Other Infrastructure Manager	X
Actor Railways Undertaking	X
Actor Driver System	X
Actor On-board Control System	
Actor Passengers	X
Actor Freight transport users	X
Actor Other transport authority	X

Table 4.6 - Actors for use cases UC5

4.3.5.1 UC5.1 Send information to the stakeholders

This use case has the main aim of distributing to each stakeholder the information that is managed by the TMS.

A stakeholder must be previously authorised to be able to receive information from the TMS. This authorization is generated by administrative procedures that are outside the scope of this use case. When an authorised stakeholder needs information managed by the TMS, they must send a request to the TMS to subscribe to this information. The TMS must provide mechanisms to allow stakeholders to register for different types of information. When the registration is successful, the TMS will send the information with the level of detail required to the stakeholder. The TMS must provide interfaces to allow a punctual request for information to be made, in order to initialise an external system with the most updated information managed by the TMS. In this use case the information that is sent to each stakeholder is un-synchronous, as the TMS sends each stakeholder the information in real time when it receives or processes the information.

TMS should allow Infrastructure Managers to indicate each piece or set of data which requires human validation before broadcasting the information, in order to maintain control and ensure coherence of the data sent.

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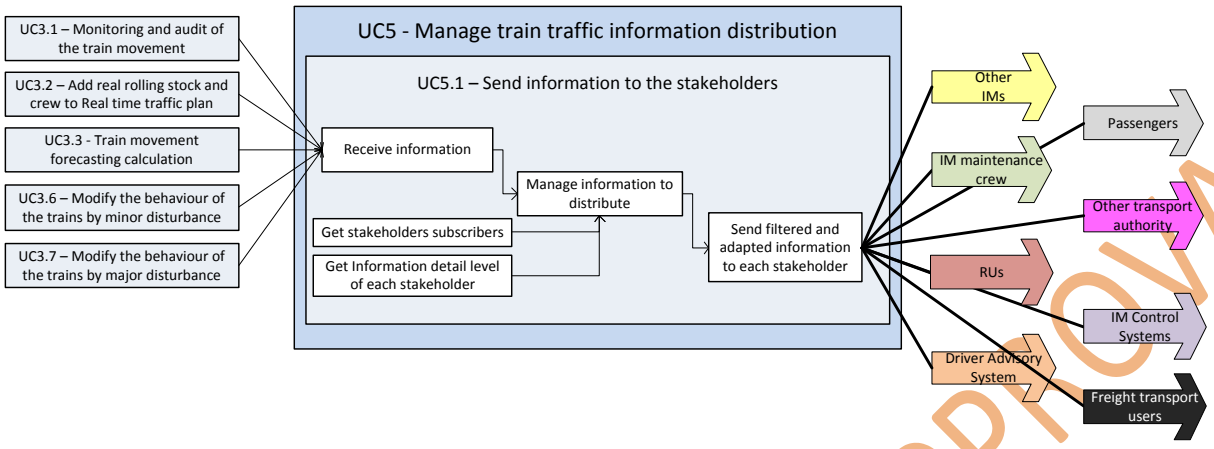

Figure 4.30 – Breakdown of the use case 5.1

4.3.5.1.1 Actors

The actors involved in this use case are:

- **Actor Other Infrastructure** Manager**:** In order to know the real state of the trains that will be running across their infrastructure;
- **Actor IM maintenance** crew**:** In order to know the forecast and the real position of the trains that will run across the maintenance work zone and the time period of the maintenance works;
- **Actor Railways** Undertaking**:** In order to know the real position of their trains and to be able to provide the best and updated information to their customers;
- **Actor Driver** System**:** To be able to give the train drivers updated information of the plan that must be fulfilled according to the objectives of the IM train dispatcher;
- **Actor** Passengers**:** To provide updated information about the real state and the forecasts of the trains;
- **Actor Other transport** authority**:** Control systems of other transport modes. To be able to improve intermodal transport;
- **Actor IM control** systems**:** Catenary control systems. To be able to know the running forecast to estimate the concurrent number of trains at each catenary section;
- **Actor Freight transport** users**:** In order to know the real position of their trains and then be able to provide the best and updated information to their customers.

4.3.5.1.2 Processes

The processes involved in this use case are:

- **Receive information:** This process must provide interfaces so that other modules of the TMS can notify that they have new information to distribute. The TMS modules do not have to know anything about the stakeholders of the information that they

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provide, they only have to send the information to this process. This process provides a standard interface to simplify communication with the TMS modules that manage the information;

- **Get stakeholders subscribers:** This process has to provide the list of stakeholders that are subscribed to receive information. All these stakeholders must be authorised stakeholders that want to receive information of a specific type. Each stakeholder has authorization to be able to subscribe to different types of information. This process has to provide the list of authorised stakeholders that are currently interested in receiving information of a specific type;
- **Get information detail level of each stakeholder:** This process must provide the level of detail for each type of information for each authorised stakeholder. The objective of this process is to be able to provide the same type of information to several stakeholders, adapting it to their specific needs;
- **Manage information to distribute:** This process is the brain of this use case and must decide what kind of information and the level of detail of the information that must be sent to each registered stakeholder when the new information is managed by the TMS. This is an internal module that is isolated from the interface with each stakeholder;
- **Send filtered and adapted information to each stakeholder:** This process has to provide interfaces with each stakeholder to be able to send the information prepared by the previous process. This is responsible for information distribution taking into account all parameters about the specific protocol to use, the cadence of the information (when the stakeholder does not need to receive information in real time), and the format in which to exchange the information.

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4.3.6 UC6 – Analysis and tracing of information

The operations to be taken into account within this use case are all related to the monitoring, analysis, and allocation of responsibilities based on information recorded during the movement of trains along the entire route.

The main goal of this use case is to provide features that allow for a post-analysis based on the movement of trains so that it can serve to conduct studies on the impact of incidents or to discover patterns of movement of trains in order to be able to improve the quality of service offered.

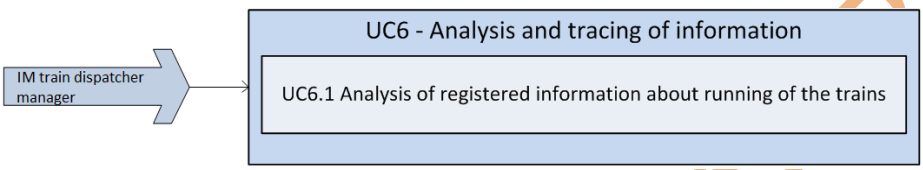

Figure 4.31 – Breakdown of the use case 6

The following table represents the matrix between the level 2 use cases for UC6 – Analysis and tracing of information and the actors involved in each one.

Actor/Use case	UC6.1 UC6.1 Analysis of registered information about running of the trains
Actor IM train dispatcher	
Actor IM train dispatcher manager	X
Actor IM maintenance crew	
Actor IM planning department	
Actor IM temporary restrictions administrator	
Actor IM control systems	
Actor Other Infrastructure Manager	
Actor Railways Undertaking	
Actor Driver System	
Actor On-board Control System	
Actor Passengers	
Actor Freight transport users	
Actor Other transport authority	

Table 4.7 - Actors for use case UC6.1

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4.3.6.1 UC6.1 Analysis of registered information about running of the trains

This process must provide a study environment to be able to charge the information registered at time windows in order to analyse it to make conclusions.

This analysis phase can have different aims, for example:

- Analyse the real timetable and the deviations versus the planning:
  - Analysis of quality of service, study delays, punctuality rates;
- Analyse the use of the infrastructure, infrastructure elements like tracks, switches and platforms:
  - Analysis of the use of infrastructure for early detection of possible failures and planning of preventive maintenance;
- Analysis of the distance for the efficient management of maintenance of the rolling stock;
- Incident analysis for the allocation of responsibilities and the distribution of associated penalties;
- Analysis of energy consumption:
  - Analysis of energy consumption deviations between estimated and actual consumption (for plan amendments, changes in gears used, effects of driving);
- Detect patterns of deviation from maintenance works to allow the time required to be adjusted for each of them, considering each type of maintenance work or the incident that produced it.

The tools used in this use case have to provide advanced mechanisms to filter the information charged in order to be able to use only the relevant information in each case. It also includes a playback functions that permits users to revert to the operational environment through the TMS.

The final objective of this use case is to be able to generate adapted reports that represent the analysis and the conclusions obtained from this analysis.

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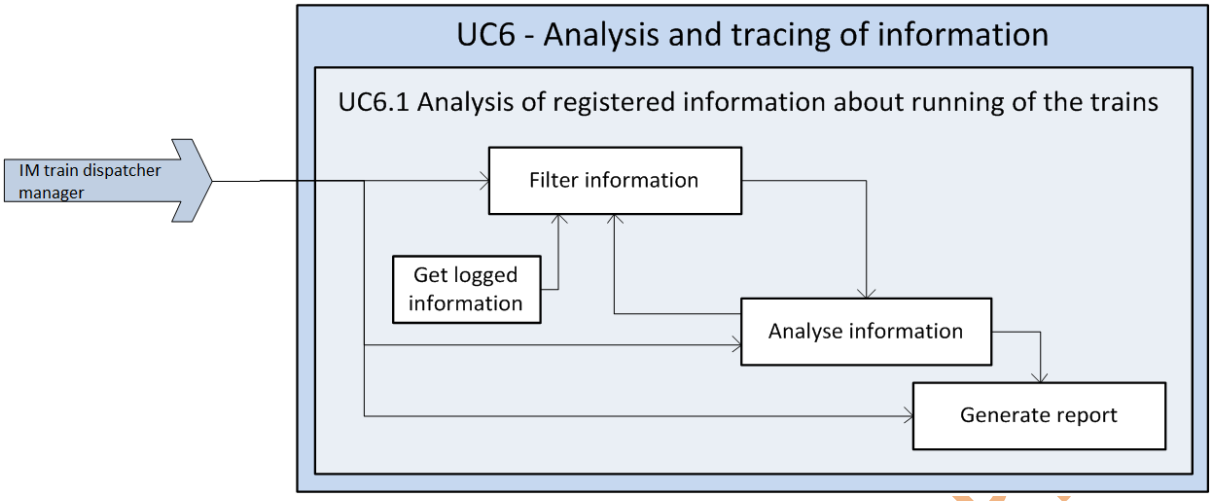

Figure 4.32 – Breakdown of the use case 6.1

4.3.6.1.1 Actors

The actors involved in this use case are:

- **Actor IM train dispatcher** manager: Responsible for the analysis phase, undertaking studies in order to detect patterns, analyse the impact of incidents, measure global deviations, and obtain conclusions from the registered information.

4.3.6.1.2 Processes

The processes involved in this use case are:

- **Get logged information:** This process must be able to get all the information stored in the logger traffic timetable. This could be a lot of information; to limit this operation the system must be able to get all the information inside a time interval provided by the Actor IM train dispatcher manager. This is the time window used in the study environment;
- **Gather information:** This process must offer the possibility for the user to add, modify or create any information logged. Control change functions should log any user modifications and ask the user to provide a reason for the modification. It should be possible to get back any rough data modified;
- **Filter information:** This process must provide advanced filters to extract only the desired information from each case. There must be filters to select a group of types of information, or all the information related to a group of trains, or the information related to a zone of the infrastructure. These filter characteristics must be selected by an intuitive human machine interface. It is important to have powerful filters without having to learn complicated language more typical of programming statements than client applications;

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- **Analyse information:** This process is the main brain of this use case because it is responsible for the analysis of the filtered information in order to provide a conclusion. This process must provide a powerful study environment that makes it possible to add /modify /remove filters, provide different visual representation views of the filtered information, and options to compare information. This environment must provide functionality to complete the information stored at the system with information provided by the Actor IM train dispatcher manager in order to annotate the information to show the conclusions obtained or to underline a group of important information;
- **Generate report:** This process must use all the filtered information, and the information added by the Actor IM train dispatcher manager, to generate reports that show the conclusions obtained by the analysis phase. This process must provide functionality to adapt the format of the reports to the relevant corporate image. This process must provide a list of different types of report that use different information. The Actor IM train dispatcher manager will select which report they want to generate and the system must provide a previsualization of this report, then it can be saved as a file in a standard format**.**

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4.3.7 UC7 – Manage temporary traffic restrictions

The operations to be taken into account within this use case are all related to the management of traffic restrictions that may impact on the movement of trains.

The management of these restrictions is the responsibility of systems which are external to the TMS, but the existence of restrictions has an impact on the movement of trains and therefore must be taken into account by the traffic management system. The asset systems monitoring the infrastructure contribute to providing such information in the system.

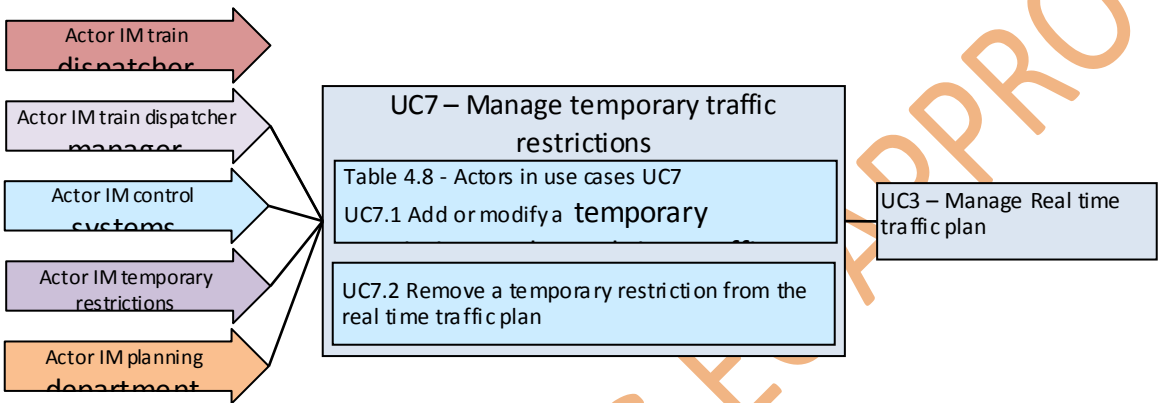

Figure 4.33 – Breakdown of the use case 7

The following second level use cases are identified as relevant:

- Table 4.8 - Actors in use cases UC7
- UC7.1 Add or modify a temporary restriction to the real time traffic plan;
- UC7.2 Remove a temporary restriction from the real time traffic plan.

All the modifications made by traffic restrictions will have an impact on the real time traffic plan management. The TMS must calculate the train forecast taking into account the latest information on traffic restrictions; for this reason this use case is directly related to the UC3 – Manage real time traffic plan.

The following table represents the matrix between the level 2 use cases for UC7 – Manage temporary traffic restrictions and the actors involved in each one.

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Actor/Use case	UC7	UC7.1 Add or modify a temporary restriction to the real time traffic plan	UC7.2 Remove a temporary restriction from the real time traffic plan
Actor IM train dispatcher		X	X
Actor IM train dispatcher manager		X	X
Actor IM maintenance crew			
Actor IM planning department		X	X
Actor IM temporary restrictions administrator		X	X
Actor IM control systems		X	
Actor Other Infrastructure Manager			
Actor Railways Undertaking			
Actor Driver System			
Actor On-board Control System			
Actor Passengers			
Actor Freight transport users			
Actor Other transport authority			

Table 4.8 - Actors in use cases UC7

4.3.7.1 UC7.1 Add or modify a temporary restriction to the real time traffic plan

This use case represents the operation of adding or modifying a temporary restriction to the real time traffic plan in order to take it into account in all the processes involved in the management of the train traffic.

These restrictions are very important for the running of the trains because they can modify train delay. This is why the TMS must use this information for the forecast calculation process.

This process must then trigger the forecast calculation algorithm that is described by the UC3.3 – Train movement forecasting calculation.

It is important to underline that the management of these restrictions is the responsibility of an entity external to the TMS. The IM temporary restrictions administrator is responsible for deciding that a restriction is required and for determining all the characteristics of the restriction. The Actor IM train dispatcher manager is responsible for managing these restrictions in order to include all the changes informed by the restriction administrator.

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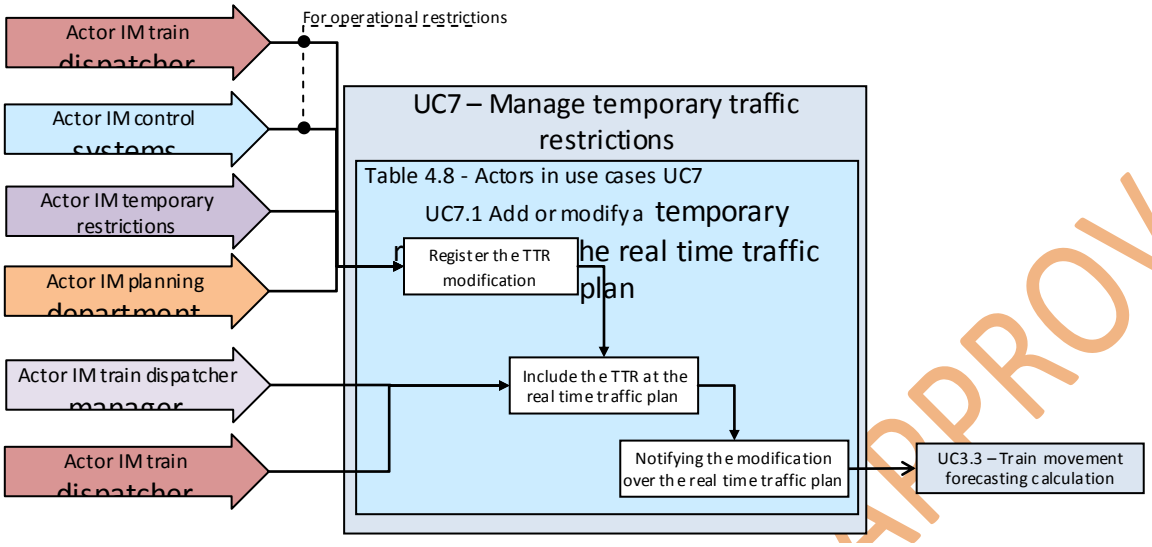

Figure 4.34 – Breakdown of the use case 7.1

4.3.7.1.1 Actors

The actors involved in this use case are:

- **Actor IM planning** department: Responsible to add or modify any infrastructure restrictions that do not have an associated safety level;
- **Actor IM temporary restrictions** administrator: This is the entity responsible for the management of the temporary restrictions. The restrictions will be sent to the TMS so that they can be taken into account in the train management. Responsibility for the existence of these restrictions lies only with this actor;
- **Actor IM train** dispatcher: this actor is in contact with all operators involved in train running. He is responsible for registering any restrictions appearing during operation, of which he has been informed. He is also responsible for managing the restrictions into the TMS. This is one of the actors that makes the modifications over the restrictions managed by the TMS. This actor will use the restrictions information that is registered;
- **Actor IM train dispatcher** manager: when the Actor IM train dispatcher is not available, or a restriction covers an area which is wider than that under the responsibility of a single Actor IM train dispatcher, this actor is responsible for managing the restrictions into the TMS. This is one of the actors that makes modifications over the restrictions managed by the TMS. This actor will use the restrictions information that has been registered;
- **Actor IM control** systems: responsible to transmit any restrictions coming from infrastructure manager system.

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4.3.7.1.2 Processes

The processes involved in this use case are:

- **Register the Temporary Traffic Restriction (TTR) modification:** The IM temporary restrictions administrator, Actor IM train dispatcher or Actor IM control systems notify all the changes in the temporary restrictions. These notifications are included at a mailbox waiting to be processed inside the TMS. This process is responsible for keeping this mailbox updated. All new notifications must be added and then are removed when it is managed at the TMS by the Actor IM train dispatcher or the Actor IM train dispatcher manager;
- **Include the TTR in the real time traffic plan:** This process must provide functionality to include a TTR in the real time traffic plan. A TTR is defined by the following parameters:
  - Temporary parameters:
    - Calendar of application: Define the days that this TTR is active,
    - Time intervals for each day of application: It is possible to define several intervals for each day of application indicated at the calendar;
  - Affected zone: Define the detailed zone that is affected by the TTR. It is necessary to identify the tracks affected by the restriction, the kilometre limits, and route affected;
  - Nature of the restriction and relevant information:
    - For a Speed Restriction: the maximum speed. It is possible to define several speeds to define different speed restrictions for each type of train,
    - Non stopping area,
    - Train restriction access: nature of train (passengers, freight), type of engine possible (electrical or non-electrical), feature of the train (ex. length), signalling available, gauge, and any other point to be defined by each IM;
  - Reason: This is an optional parameter that can be used by the IM train dispatcher to know the reason for the existence of the restriction in order to use it as a reference to decide the most appropriate measure to modify the traffic to reduce the impact of the restriction;
- **Notifying the modification over the real time traffic plan:** This is the process responsible for notifying the TTR changes to the other TMS processes. Include a TTR in the real time traffic plan is an operation that must be taken into account by other TMS processes. The train forecast calculation must take into account these restrictions. The TMS will use the new forecasts in order to detect conflicts and execute all the other internal processes with the most updated information.

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4.3.7.2 UC7.2 Remove a temporary restriction from the real time traffic plan

This use case represents the operation of removing a temporary speed restriction from the real time traffic plan so that the TMS processes do not have to take it into account.

As in the previous use case, this process must trigger the forecast calculation algorithm that is described by the UC3.3 – Train movement forecasting calculation.

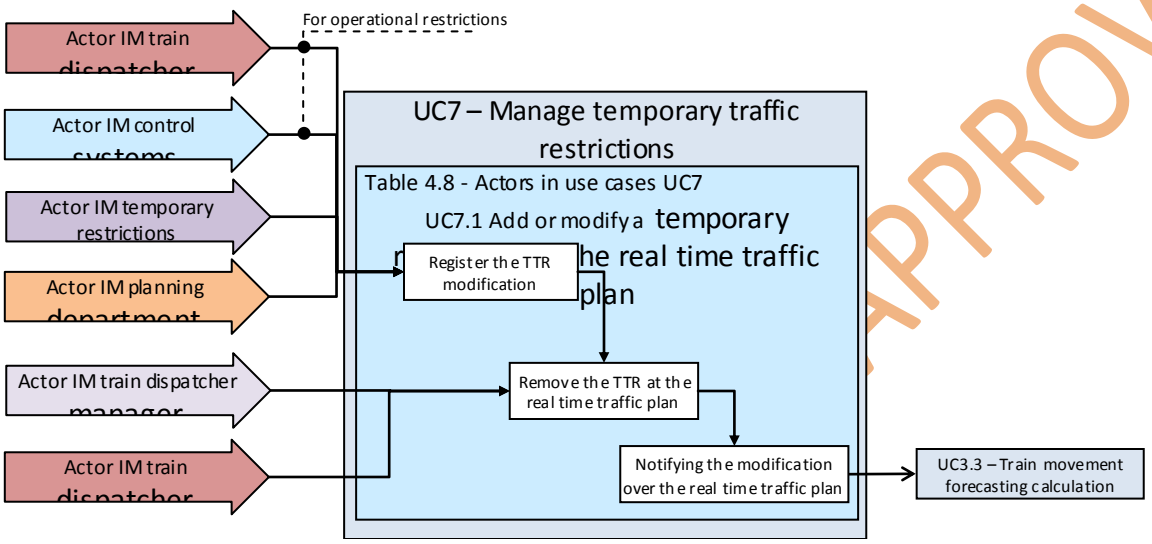

Figure 4.35 – Breakdown of the use case 7.2

4.3.7.2.1 Actors

The actors involved in this use case are:

- **Actor IM planning** department: Responsible to remove any infrastructure restrictions that do not have an associated safety level;
- **Actor IM temporary restrictions** administrator: This is the entity responsible for the management of the temporary restrictions. The restrictions will be sent to the TMS so that they can be taken into account by the train management, but the responsibility for the existence of these restrictions lies only with this actor;
- **Actor IM train** dispatcher: is responsible for removing the restrictions into the TMS;
- **Actor IM train dispatcher** manager: when the Actor IM train dispatcher is not available, or a restriction covers an area which is wider than that under the responsibility of a single Actor IM train dispatcher, he is responsible for removing the restrictions into the TMS.

4.3.7.2.2 Processes

The processes involved in this use case are:

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- **Register the TTR modification**: The IM temporary restrictions administrator, Actor IM train dispatcher or Actor IM control systems notify all the changes to the temporary restrictions. These notifications are included at a mailbox waiting to be processed inside the TMS. This process is responsible for keeping this mailbox updated. All the new notifications must be added to it and then are removed when is managed at the TMS by the IM train dispatcher manager.
- **Remove the TTR from the real time traffic plan**: This can be an automatic process supervised by the IM train dispatcher manager. This process will remove the TTR from the TMS and then the trains will not be affected by this restriction.
- **Notifying the modification over the real time traffic plan**: This is the process responsible for notifying the TTR changes to the other TMS processes. Remove a TTR from the real time traffic plan is an operation that must be taken into account by other TMS processes. The train forecast calculation must take into account the most updated information about the restrictions that are active at all times, this process will notify the TMS process that a TTR is removed, and then the train forecast should not consider this restriction.

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5. Clients' Expectations

5.1 Method

The method was established to identify and define specific requirements that could be formulated for the I2M platform to assist Railway Infrastructure Managers and Train Operating Companies to develop new generation Traffic Management and Passenger Information Systems, and improve rail travel services and quality.

Three different and complementary approaches have been used to obtain a deeper insight into customer expectations.

Functional and non-functional requirements were reviewed with respect to the expectations of these individual groups, resulting in the compilation of a list of potential conflicts and impacts on the specification due to the end-user expectations of the new system.

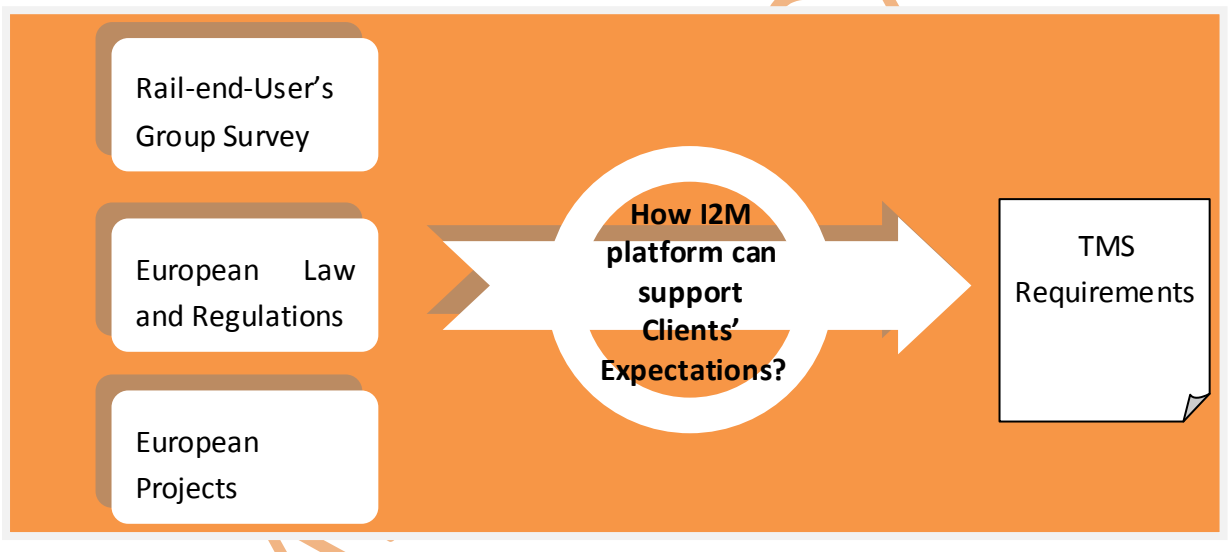

Figure 5.1 – Global approach of the Client Expectation's

5.1.1 Rail-end-User's Group Survey

The survey aims to identify and evaluate customer expectations, with regard to Traffic Management Systems and Transportation Services, focusing on punctuality, reliability and availability to promote seamless and interconnected travel.

In order to set up the questionnaire (final UK version provided in §8.1), Clients' Expectations were defined from academic work and partner experience and knowledge. The expectations were described from the point of view of their relationship with the Train Operating Company and then classified according to the type of journey: distance, time of travel, reason, price, etc.

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The survey was then delivered to a selected group of Customer Associations in Europe (namely in France, Italy, Spain and the United Kingdom). Almost 30 associations were invited to participate in the survey (the detailed list is provided in §8.2).

The results were analysed and reported in an anonymous and aggregated way, so it is not possible to trace individual answers to a single organisation.

5.1.2 European Law and Regulations

The European Commission documents analysed were selected because of their goals, purpose and scope of application. They were read from start to finish to identify the parts of the document that referred to provision of information to rail passengers. Once identified, these parts were analysed in order to understand if any specific requirement could be formulated for the I2M platform.

The issues which relate to In2Rail's I2M platform are those regarding information to passengers. Such information must be provided by RUs, so within In2Rail this should be dealt with in the RU requirements. The documents list the minimum information to be provided by RUs to passengers (e.g. Annex II of the regulation law); it is important, therefore, that the I2M platform is capable of providing RUs with the data necessary to provide such information.

The documents analysed were:

Regulation law 2007/1371/EC of 23 October 2007 concerning passengers' rights and obligations	*This Regulation establishes rules regarding the information to be provided by Railway Undertakings, transport contracts, tickets, the implementation of a Computerised Information and Reservation System for Rail Transport (CIRSRT), liability issues, obligations in case of delay, protection and assistance to disabled persons, monitoring of service quality, management of risks to the personal security of passengers, handling of complaints.*
TSI PRM Technical Specifications for Interoperability for Persons with Reduced Mobility – TSI PRM – published in Official Journal of the European Union number L356/10 – Commission regulation (EU) n°1300/2014 of 18 November 2014	TSI PRM is applicable to the infrastructure, operation and traffic management, telematics applications and rolling stock subsystems, on both conventional rail and high speed networks, to new or renewed infrastructure or rolling stock.

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5.1.3 **European Projects**

One specific previous European funded project, ModAir Grant Agreement n°314348, provided us with a clear view of the current state of intermodality and co-modality in European airports. This project encompassed a larger set of European projects from 1997 to 2012, all of which are described in Annex of the deliverable D2.2 “Descriptive framework of the most relevant variables concerning co-modal passenger requirements”.

This deliverable sets out valuable clients’ expectations that we considered relevant with regard to Traffic Management Systems and Transportation Services, focusing on punctuality, reliability and availability for promoting seamless and interconnected travel.

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5.2 List of Clients Expectations selected

Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
Travel preparation	Being inspired Ease of planning a seamless trip	Integrated trip planner. Before the trip, passengers require quality, reliable and impartial information to enable informed decision making regarding the best travel options to suit their needs. Within this they stressed the role of a single "travel planner" which integrates all intermodal options (including transparency on timings, schedules, minimum connecting times, pricing and travel options etc.).	*Included in ModAir* *Ascertained from Survey* Strong interest in this approach and sales platforms offering different route options, combining various multi-modal connections and comparing a range of carrier companies, for the same start to end points. *Included in ModAir* *Ascertained from Survey* Probably due to the adult age of Organisation members, the preferred media for this was the web service, rather than personal devices. Apart from the obvious "price & time duration", descending from the top, the most desired information is: 1) accessibility options; 2) real-time links to timetables on personal devices based on the customer's criteria; 3) information on and directions to the most convenient connecting services; 4) staff assistance and services available onboard; 5) estimated waiting and transfer times; 6) intermediate stops (location and number); 7) staff assistance and services available at the station; 8) eco-friendly options;	***Req. 1*** The system should be able to know the level of the demand (or the number of passengers in each train and other intermodal carriers) to be able to establish economical KPI for traffic management: this is a prerequisite to allow this kind of integration. ***Req. 2*** TMS shall send, as soon as possible, any changes in planning timetable, including last minute changes (such as delays), to sales platforms, so algorithms for trip-planning can take this into account.
	Availability and ease of "frictionless" buying door-to-door tickets	Integrated trip planner and data integration in the sales platforms, through different sales channels. Easy payment. Integrated ticket.		***Req. 3***: the system should provide powerful algorithms to permit the IM to respond to a VSTR as soon as possible.
	Information availability	Information is well-organized and pre-selected, based on customer's features, to avoid data overload and to maximise the customer experience. Provide early information to passengers about station links and accessibility.		***Req. 4:*** If a VSTR is made while a disruption is ongoing, the system should take this event into account to evaluate the VSTR.
	More immersive shopping experience	Tailored choices for both bundled and unbundled selection. Real time data to optimise connections and modal choices. Multi-channel options (website, customer devices, etc.) updated in real time and		***Req. 5***: the system shall have filters to enable the matching of information based on each receiver's needs.

DRAFT - AWAITING APPROVAL

Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
		aligned. 'Best Buy' functionality with intelligent alternatives (selection process that gives an overview about the ticket options and recommendations to help the customer buy a ticket tailored to their needs). Advanced trip information and trip planners are needed to enable passengers to effectively prepare for their journey (internet, agency).	9) maximise the use of a specific carrier or mode of transport; 10) availability of bike sharing / car sharing / metro / other transportation connections at the destination; 11) availability of other services (hotels, markets, pharmacies, events, etc.) at the destination; 12) specific routes on-demand (not necessarily the fastest or most direct route between start and end points).	
	Last minute booking	Personalised and real time information, e.g. travel options available in real time for a door-to-door trip taking into account disturbances and delays, etc.	*Included in EU law* *Ascertained from Survey* Some definite interest but not felt as a priority. This is probably due to a high number of PRM or adult members responding to the survey, for whom "last minute" booking is not a frequent option.	***Req. 6:*** The System shall be conceived, in terms of interactions with Railway Undertakings' information systems, considering the requirement for RUs to adapt their Computerised Information and Reservation System for Rail Transport (CIRSRT) according to the requirements set out in the TAP TSI (Telematics Applications for Passengers).
	Notification of variations in the 48 hours before the departure time of the trip	Information delivered via push notifications to customers' devices, sug-gesting alternative options or alerts if the duration of the trip will be longer than expected, etc.	*Included in ModAir* *Ascertained from Survey* Strong interest in push notifications which inform the customer before or during the journey that there will be a delay, and which offer alternative solutions, and real-time systems which, in case of delays, send an alternative option to customer devices which matches the original criteria, offers the chance to exchange the combined ticket, and shows the applicable refund.	***Req. 7:*** The System shall provide as soon as possible all information in real time (including forecast information) required for the RU to inform their own client if a disruptive event could affect their train. The information should permit the RU to know if an event will also affect the following day.

DRAFT – AWAITING APPROVAL

Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
	Environmentally friendly public transport options	Eco-driving tools related to TMS lower energy consumption/carbon emissions.	*Ascertained from Survey* Medium, not strong interest	***Req. 8:*** On request, the system should inform drivers of the most eco-friendly trip, considering the current state of the traffic and allowing for a certain amount of increased travelling time. ***Req 9:*** The system should assist the IM dispatcher to restart the traffic in an eco-friendly way after a major perturbation. Example: all trains must not start at the same time even, if the traffic condition permits.
Railway stations	Information on timetables and other means of transportation available	Push notifications to customers' devices indicating the next connection for a door-to-door trip, platform of a train, new available options in real time. The notifications should take into account the customers' preferences and real time data.	*Ascertained from Survey* Generic users were more interested than PRM specific users (PRMs seem to prefer timetables).	None
	Ease of buying /changing integrated tickets at stations	Given the train delay, a customer can change train/means of transportation without losing more time, money or effort thanks to advanced technologies and data integration with the reservation systems. Interactive kiosks in stations for changing reservations.	*Included in ModAir* *Ascertained from Survey* Self-service information desks, with no assistance, do not seem to be appreciated, probably to the adult age of Organization members, or the high representation of PRMs.	None
	Train positioning, intelligent trains and intelligent infrastructure	Integration of service scheduling, real-time traffic management and terminal management systems with customers' own systems.	*Included in ModAir* *Ascertained from Survey* Extremely strong interest about platforms in stations, carriages on platforms, and information on customer devices about platform/station/direction changes.	***Req. 10:*** The System shall provide, in real time and as soon as possible, all information (including forecast information) required for the RU to inform their own client in normal conditions (see req. 5).
	Information on train platform accurate, punctual and available	Interactive kiosks in stations.		
	Accessibility of	Real - time platforming optimization.	*Included in ModAir*	None

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Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
	stations or platforms	Wayfinding: Geo-location (GPS) and the possibility of developing a service in collaboration with Google maps which provides the internal layout of the building to customers' devices and which tracks their movements to assist them in moving around the building. Simultaneous translation: There is an application available for smartphones that translates signage displays, which may be particularly useful for passengers who do not read the local language. Optimisation of the provision of assistance to passengers with special mobility needs.	*Ascertained from Survey* Both facilitating a smooth transition through stations (e.g. clearly defined, spatially efficient routes to optimise the movement of people and luggage) and systems for minimizing queues, are deemed to be a priority by all those who responded. Obviously, avoiding/minimizing physical barriers (e.g. showing on customers' devices the easiest/most efficient routes with luggage, buggies, or wheelchairs) is of interest principally to those PRM who responded. Less interest was shown by generic users in systems that could accelerate security procedures (probably because the acceleration of a procedure was itself suspected as a reduction in security).	
Travel	Information on-board. Trip re-planning	Push notifications to customers' devices indicating the next connection for a door-to-door trip, the platform of a train, or newly available options in real time. They should take into account the customers' preferences. There should be a trip advisor that automatically provides alternative travel options in case of delays.	*Included in ModAir* *Included in EU laws and regulations* *Ascertained from Survey* It is relevant for all users to know the best alternative options in case of certain events, such as delays/disruptions/traffic jams. For generic users, descending from the top, the most desired information seems to be: 1) availability and location of services close to the chosen stop; 2) instructions on how to reach connections on a door-to-door journey; 3) directions, estimated time of arrival, and	***Req. 11:*** The System shall be conceived, in terms of interactions with Railway Undertakings' information systems, considering the requirement of Art. 8 of Reg. 2007/1371/EC "Railway undertakings shall provide the passenger during the journey with at least the information set out in Annex II, Part II ".

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Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
			alternative options for arriving at the final destination from the train stop; 4) platform number of the next train required; 5) a traffic report for roads near the destination stop; 6) availability of bike sharing / car sharing at the chosen stop or nearby and the possibility to book it. For disabled users, the top priority seems to be the platform number of the next train required.	
	Staff on trains	Crew rescheduling tools related to TMS.	*Ascertained from Survey* This is not a question for customers but, from the answers, it is evident that having efficient staff onboard is more of a focus than staff at stations.	***Req. 12:*** The System shall take into account staff availability that may impact the running of the train.
	Technology	Perceiving the advanced technology used to guarantee safety and punctuality. The train belongs to the future and not to the past.	*Included in ModAir* *Ascertained from Survey* From all those who responded, for all types of train, the following are required: 1) "punctuality"; 2) (equally) "safety" and "regularity". Then, "comfort" and "ability to make the best use of travel time (e.g. trains with work/ children zones, bike storage, services/activities on-board, newspapers, on-board entertainment, etc.)" are important for Long Haul, whereas "frequency" is important for Regional services. Adequate "capacity" and "good connectivity" are significant requirements for all.	***Req. 13:*** The System shall integrate in its algorithms for traffic management tunable objectives that IMs could select, both in pre-operational and operational phases. ***Req. 14:*** The system shall show planned, real and forecast train routes, and deliver the necessary algorithms to minimise deviations and optimise net rail use.
	Punctuality and reliability	The train does what is promised.		
	Frequency of trains (regularity for mass transit systems)	-		
	Speed	-		
	Capacity	Traffic management according to occupancy forecasts; data integration.		
	Delay management	Optimization of the information flow to employees.		

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Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
	Safety	IOT/ IOE; predictive analytics and sensors together to improve the accuracy of train positioning and arrival time forecasts.	"Security" was felt to be more relevant for Regional services, whereas "reliability" was felt more relevant for Long Haul services. "Fluidity" (e.g. minimal "dead time" as a train is waiting at red) is not felt as a priority. Remarkably there was a different response by nationality to the "speed" parameter, which is probably due to cultural/historical aspects to be investigated. Although some TOC have experimented with the ideas proposed here in the past, no one confirmed interest in extremely new services on carriages such as shopping/market areas, launderettes, libraries, and reserved areas.	
Post - Trip	Reimbursement in case of delay and complaint-handling mechanisms	Data integration to quantify delays and impute the causes of the delays to the TOCs/IMs.	*Ascertained from Survey* Not a real question for the customer. Customers did show strong interest in the integration of data about delays and their causes, for an automatic passenger refund.	***Req. 15:*** All logged information should be accessible to replay any situation that occurs on the network for all elements which are part of the railway system (train, signalling, etc.). ***Req 16***: The System should provide operational algorithms coherent with contractual relations between IM and RU.
	Feeling listened to. Improvement to next journey.	Collection of data and responses from customers to have feedback, understand customer habits, and ensure that the capacity/frequency of trains is adequate according to demand, etc.	*Ascertained from Survey* Medium-high interest in this approach.	***Req. 17:*** TMS should be easily adaptable to the evolution of contracts between IM and RUs, to ensure consolidation and accessibility for RUs as soon as possible after the information is established.
Intermodality	Connections	Information to passengers about station links and accessibility, access to various modes of public transport (taxi stand, bus stops) to get to and from the station.	*Included in ModAir* *Ascertained from Survey* Felt as relevant. In general, timetables planned to minimize the	None

DRAFT - WAITING FOR APPROVAL

Customer Expectations	Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
		inconvenience of using various modes on a single journey are felt to be more important than interchanges with other transport modes designed to make transfers easy, comfortable and reliable.	
Parking	Information to travelers about car parks.	*Included in ModAir* *Ascertained from Survey* Medium –high interest	None
Availability of through-tickets	Integrated ticket: grouped ticket or so called intermodal ticket with standardised price.	*Ascertained from Survey* Medium interest. The principal interest was in being able to change carrier on the same train.	None
Waiting times	ICT innovations to support passengers´ access to information, including, for example, the use of Minimum Connecting Time tools (MCT).	*Included in ModAir* *Ascertained from Survey* Remarkably different approach by nationality, probably depending on cultural/historical aspects to be investigated.	*See Req. 13*
Redundancy of available alternative services		*Ascertained from Survey* Medium-high interest.	None
Bike sharing		*Ascertained from Survey* Medium interest.	None
Availability of information on customer devices and web based services	Apps.	*Ascertained from Survey* There seems to be a small preference for a web based service, probably due to the adult age of those who responded.	***Req 18***: The System should permit useable information to be produced and broadcast on web-based solutions.
Paper tickets should be phased out and replaced with a single smartcard	Virtual ticket: issuance of door to door electronic ticket by phone or other electronic media.	*Included in ModAir* *Ascertained from Survey* Medium-High Interest	None

DRAFT – AWAITING EC APPROVAL

Customer Expectations	Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
technology that offers interoperability between all transport modes in Europe			
Journeys should be seamless where possible, with easy and guaranteed connections - or viable alternatives if things go wrong	Reliability when switching between modes during the journey is central to intermodal travel. A delay can mean a passenger missing their connection and thus impact on their whole journey with the wider implication of discouraging their choice to travel in an intermodal way in the future.	*Included in ModAir* *Ascertained from Survey* Customers are strongly interested in knowing which connections are affected by delay, and the options for amending the journey as a consequence.	***Req 19***: The System should provide operational algorithms that minimize connecting times, set up in coordination with RU policies. ***Req. 20***: the system should take into account affected connections in disturbance resolution.
Door-to-door journeys are typified by seamless modal changes, with multimodal services available from a single booking	Ticketing requirements are one of the most important requirements according to experts. They indicated the importance of the passenger having a single ticket, a single price, and one-stop shopping for all intermodal bookings.	*Included in ModAir* *Ascertained from Survey* Medium-high interest.	None
Improved interchanges between modes are required to reduce overall travel time and associated risk, with easy-access	Easy access to all relevant intermodal trip information to allow the customer to make the most appropriate travel choice. Standardised information across modes.	*Included in ModAir* *Ascertained from Survey* Medium-high interest.	***Req 21***: The System should provide operational algorithms that take into account the delay on other public transport modes (such as buses, LRT, metro, etc.) that the IM has selected as connected to the railway network. To achieve this, it is necessary to develop policies for exchanging information between different Transport Companies.

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Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
	transport hubs and informative signage			
Information	Real-time information availability	It is important that passengers receive real time information (e.g. delays, works, cancellations, alternative routings and connections) and that this information is accurate and reliable. This point has been highlighted as important by a number of the experts consulted, as it helps mitigate passenger dissatisfaction, stress and frustration brought about by disruptions or unforeseen problems, by eliminating uncertainty, providing reassurance and enabling passengers to make alternative arrangements.	*Included in ModAir* *Included in TSI PRM* *Ascertained from Survey* In general, the most desired information from web pages or on customer devices is (from the top): 1) Forecasted delays; 2) Connections affected by delays; 3) Current delays; 4) Correct platform; 5) Options for amending the journey to avoid inconveniences (e.g. changing mode of transport to avoid shop closure); 6) Train position; 7) Carriage position on the platform; 8) Quickest routes within the station to arrive at a specific carriage, avoid congestion, etc; 9) Options for carrying out the same journey with alternative modes of transport; 10) Additional services (e.g. open shops, markets, pharmacies, hospitals, police station, etc.).	***Req 22***: According to 4.2.2.7.1 2007/1371/EC of 23 October 2007, system shall "provide — Safety Information and safety instructions [...] — Information concerning the route of the train, including information about delays and unplanned stops [...]"
	Client recognition and customization of real time information			None
	Travel information provided on passengers' devices			See req. 18
	Information must be easy to obtain and easy to understand	Information is a prerequisite criterion to choose intermodal trips. Indeed, all passengers need various pieces of information, not only before but also during and sometimes after the trip.		***Req 23***: The System shall automatically identify the main reasons for a delay and evidence them in a way which is commonly understood by all railway actors. After approval of the dispatcher, they should

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Customer Expectations	Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
			offer information to the customer (in a standardized format based on the RU's policies and contracts between the IM and RUs).
Onboard information services			None
Identify real-time train location and distribute this information to passengers. Personal mobile devices could automatically receive updates about train positions and other relevant information			See req. 7 and 18
Real-time multichannel information throughout the journey	Information on delays, cancellations, platform changes, timetable changes, works, any disruptions (strikes, weather) on the train and in stations. Interactive kiosk: standalone desk or an interactive computer terminal that provides up to date information.		See req. 7 and 18
Easy to find out about services and tickets, for example via a journey planner	Virtual ticket: issuance of door to door electronic ticket by phone or other electronic media. Customer service at train station: possibility of buying ticket at the station.		None
Connections are	Reliability when switching between modes		See req. 19 and 21

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Customer Expectations		Examples	Expectation from Survey / ModAir / EU law and regulations	I2M Requirement
	held or reasonable alternatives offered.	during the journey is central to intermodal travel. A delay can mean a passenger missing their connection and thus having an impact on their whole journey, with the wider implication of discouraging their choice to travel in an intermodal way in the future.		
	Security	Information should also be secure. First of all it should be hardened against cyber-attacks and secondly the information should be provided on a personal basis so that third parties are not able to track individuals.	*Included in ModAir* *Ascertained from Survey* Not a question for the customer (it should be taken for granted).	***Req 24***: The System shall be protected from any intrusion.

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6. Conclusions

This document, together with the requirements matrix, will enable an appropriate architectural approach for the integrated TMS to be selected in WP8 and it will assist in drawing specific requirements for single components of the Integration Layer and Application Layer.

The next steps of the development process are shown below.

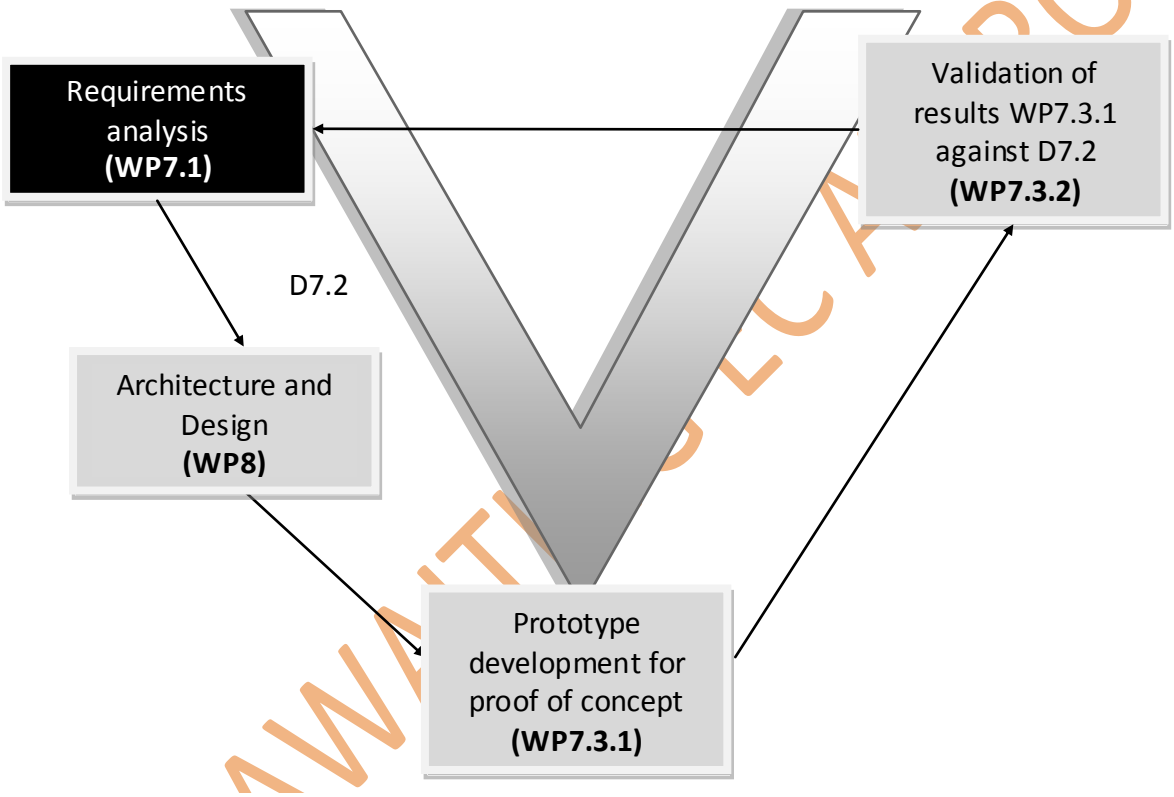

Figure 6.1 – Next steps of the development process in the project

According to the current document, the future TMS will be characterised through:

- Merging planning and management processes;
- Integrated handling of possessions;
- High level of automation using decision support functionality.

The results of the end customer survey can be used for defining parameters in the Key Performance Indicators evaluated in [In2Rail D7.1]. The results of the survey have been made available to the EU IT2Rail project, which is examining related topics.

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[TAF TSI D2] European Commission, Telematic Application for Freight Technical Interoperability Specifications - **Deliverable 2: Definition of the functional and performance requirements and of the associated data necessary to deliver the TAF system (EN),** http://www.era.europa.eu/Document-register/Pages/TAF-TSI.aspx

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8. Appendices

8.1 Clients Expectation Survey

This survey was established in English (version presented here below), Spanish, Italian and French.

Figure 8.1 – Customer Expectations Survey

This survey aims to identify and evaluate customer expectations regarding Traffic Management Systems and transport services, with a focus on punctuality, reliability and availability, to promote seamless and well-connected journeys.

You are part of a selected group of customer associations in Europe (namely in France, Italy, Spain and United Kingdom) asked to participate in the survey.

Completion of the survey is expected to take approximately 45 minutes. There is an option to complete a section of the survey if time is limited.

The survey is divided into 3 broad sections:

- Your expectations (this is the main part of the survey);
- Information about your organisation;
- Further detail about your expectations.

The deadline for completing the survey is the 10th February 2016.

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Before the journey: travel preparation and booking

1 = "not important"
5 = "highly important"

1. **Easiness of planning a seamless journey** *
   How important is multi-modal ticketing, where all segments of the journey can be planned and bought together, from start to end, in line with a "door-to-door" vision (e.g. flight/ferry + train + metro + taxi/car sharing/car pooling + bike sharing + walking)
   Mark only one oval per row.

	1	2	3	4	5
As a web service	◯	◯	◯	◯	◯
On personal devices	◯	◯	◯	◯	◯
At stations	◯	◯	◯	◯	◯

2. **Easiness of booking door-to-door journeys and availability of tickets** *
   How important are the following initiatives:
   Mark only one oval per row.

	1	2	3	4	5
Sales platforms offering different route options, combining various multi-modal connections and comparing a range of carrier companies, for the same start to end points	◯	◯	◯	◯	◯
The chance to also purchase non-transportation offers in the same multi-modal ticket (e.g. hotels, concerts, exhibitions, etc.) and/or to plan your route there (e.g. calculating the train + metro + exhibition entrance time)	◯	◯	◯	◯	◯

DRAFT – AWAITING APPROVAL

3. **Availability of options** *
How important are the following factors to passengers?
Mark only one oval per row.

	1	2	3	4	5
Lower price					
Quicker journey time					
Accessibility options					
Intermediate stops (location and number)					
Specific routes, not necessarily the fastest or most direct route between start and end points					
Estimated waiting and transfer times					
Staff assistance and services available onboard (e.g. bar)					
Staff assistance and services available at the station					
Availability of bikesharing/carsharing/metro/other transportation connections at the destination					
Availability of other services (hotels, markets, pharmacies, events, etc.) at the destination					
A specific carrier or mode of transport					
Information on and directions to the most convenient connecting services					
Real-time links to timetables on personal devices, based on the customer's criteria					
Eco-friendly options and company policies on energy and the environment (e.g. consumption, carbon emissions, etc.)					

4. **Availability of support** *
In case of delays or disruptions, how important would the following initiatives be for rescheduling the whole journey?
Mark only one oval per row.

	1	2	3	4	5
Real-time systems which send an alternative option to the customer's device which matches the original criteria, offers the chance to exchange the combined ticket, and shows the applicable refund.					
Push notifications which inform the customer before or during the journey that there will be a delay, and which offer alternative solutions.					

5. **Last minute booking** *
How important are sales platforms which are real-time and aligned, so that a customer is able to book a journey close to the departure time while also taking into consideration any current delays?
Mark only one oval per row.

1	2	3	4	5

6. **Other**
Please, specify

Page 2

At the Railway Station

1 = "not important"
5 = "highly important"

7. **Availability of information** *
How important are the following sources of information?
Mark only one oval per row.

	1	2	3	4	5
Timetables					
Information desks: self-service, with no assistance					
Information desks: with employees to provide assistance					
Customer devices: push notifications indicating the next available connections, train platforms, and new available options in real time.					

8. **Information about train platforms** *
How important are each of the following:
Mark only one oval per row.

	1	2	3	4	5
Easiness of locating a platform inside the station					
Easiness of identifying the required carriage on the platform					
Real-time information on customers' devices about platform changes, station changes, and directions.					

9. **Accessibility of stations/platforms** *
How important are the following:
Mark only one oval per row.

	1	2	3	4	5
Consistency of platform information in the final 10 minutes before departure.					
Step-free access to platforms					
Step-free access to trains					

10. **Passenger-friendly stations** *
How important are systems, tools and devices which:
Mark only one oval per row.

	1	2	3	4	5
Minimise queues					
Avoid/minimise physical barriers (e.g. showing on customers' devices the easiest/more efficient routes with luggage, buggies, or wheelchairs)					
Facilitate a smooth transition through stations (e.g. clearly defined, spatially efficient routes to optimise the movement of people and luggage)					
accelerate security check (e.g. barcode recognizer for ticket that show customer's ID-photo)					
Row 5					

11. **Other**
Please, specify

During the journey

1 = "not important"
5 = "highly important"

12. **Easiness of buying/changing integrated tickets** *
How important is it that passengers can change train or other mode without losing time, money or effort (e.g. by using advanced technologies and data integration)?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

13. **Automatic forecasting and suggestions** *
How important is the availability of journey information and best alternative options in case of certain events, such as delays/disruptions/traffic jams
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

14. **Offering passengers the best available ticket on board without having to buy a ticket first** *
How important are on-board ticket machines or reading devices for tickets/codes on smartphones etc?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

15. **Intelligent train positioning and infrastructure management** *
How important is the following on-board information:
Mark only one oval per row.

	1	2	3	4	5
Push notifications to customers' devices on certain information.	◯	◯	◯	◯	◯
Instructions on how to reach connections on a door-to-door journey.	◯	◯	◯	◯	◯
Platform number of the next train required.	◯	◯	◯	◯	◯
A traffic report for roads near the destination stop.	◯	◯	◯	◯	◯
Directions, estimated time of arrival, and alternative options for arriving at the final destination from the train stop.	◯	◯	◯	◯	◯
Availability of bikesharing/carsharing at the chosen stop or nearby and the possibility to book it.	◯	◯	◯	◯	◯
The availability and location of services close to the chosen stop.	◯	◯	◯	◯	◯

Page 4

16. **For Urban/Regional Trains** *
How important are the following aspects:
Mark only one oval per row.

	1	2	3	4	5
Punctuality					
Reliability					
Frequency					
Regularity (departure/arrival times)					
Speed					
Capacity					
Safety					
Security					
Fluidity/minimal 'dead' time (e.g. train waiting at red signal)					
Comfort					
Ability to make the best use of travel time (e.g. trains with work/ children zones, bike storage, services/activities on-board, newspapers, on-board entertainment, etc.)					
Connectivity (WiFi and High-Bandwith networks): payable and fast					
Connectivity (WiFi and High-Bandwith networks) free and slow					

17. **For Long Haul/International Trains** *
How important are the following aspects:
Mark only one oval per row.

	1	2	3	4	5
Punctuality					
Reliability					
Frequency					
Regularity (departures/arrival time)					
Speed					
Capacity					
Safety					
Security					
Fluidity/minimal 'dead' time (e.g. train waiting at red signal)					
Comfort					
Ability to make the best use of travel time (e.g. trains with work/ children zones, bike storage, services/activities on-board, newspapers, on-board entertainment, etc.)					
Connectivity (WiFi and High-Bandwith networks): payable and fast					
Connectivity (WiFi and High-Bandwith networks) free and slow					

18. **New uses**
Is there a need to provide new, additional services, particularly for medium/long distance commuters (e.g. shopping/market areas, laundrettes, libraries etc.)? If so, please specify:

_____

19. **Ability to monitor individual carbon use**
How important is the availability of information for choosing the most carbon efficient option?
Mark only one oval per row.

	1	2	3	4	5

Page 5

After the journey

1 = "not important"
5 = "highly important"

20. **Feedback** *
How important is the collection of data and responses from customers to gain their feedback, understand habits, and adjust the capacity/frequency of trains according to demand?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

21. **Delay reimbursement and complaint-handling** *
How important is the integration of data to monitor delays and their causes in order to automatically refund passengers?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

Intermodality

1 = "not important"
5 = "highly important"

22. **Availability of through-tickets** *
How important is it to be able to change the following while using the same ticket:
Mark only one oval per row.

	1	2	3	4	5
Carrier (but same company and mode)	◯	◯	◯	◯	◯
Company (but same mode)	◯	◯	◯	◯	◯
Both company and mode	◯	◯	◯	◯	◯

23. **Waiting times for Urban/Regional trains** *
What is the maximum tolerable waiting time for Urban/Regional trains (in minutes)?

_____

24. **Waiting times for Long Haul/International trains** *
What is the maximum tolerable waiting time for Long Haul/International trains (in minutes)?

_____

25. **Alternative services** *
How important is the availability of alternative services/modes for the same route?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

26. **Car Parking** *
How important is the availability and suitability of car parking near the station?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

Page 6

27. **Bike Sharing** *
How important is the availability of bike sharing near the station?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

28. **Other modes of transport**
How important is the availability of other modes of transport near the station?

_____

29. **Connections** *
For a well designed transport system, how important are:
Mark only one oval per row.

	1	2	3	4	5
Interchanges with other transport modes, designed to make transfers easy, comfortable and reliable.	◯	◯	◯	◯	◯
Timetables planned to minimise the inconvenience of using various modes on a single journey.	◯	◯	◯	◯	◯

30. **Other**
Please, specify

_____

Information

1 = "not important"
5 = "highly important"

31. **Easy communication via passengers' devices** *
How important is it for information to be supported on all popular devices (e.g. smartphones, tablets etc.)?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

32. **Ease of communication with the station or train manager** *
How important is the possibility to communicate with these people in an emergency via an App or other device, both in the station and on board?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

33. **Ease of obtaining and understanding information** *
How important is the identification of a standard terminology and format across different service providers for presenting information to the customer?
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

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Page 7

34. **Availability of real-time information on customer devices and the Internet** *
How important is the provision of the following information?
Mark only one oval per row.

	1	2	3	4	5
Options for carrying out the same journey with alternative modes of transport					
Train positions					
Current delays					
Forecasted delays					
Connections affected by delays					
Options for amending the journey to avoid inconveniences (e.g. changing mode of transport to avoid shop closure)					
Correct platform					
Carriage position on the platform					
Quickest routes within the station to arrive at a specific carriage, avoid congestion etc.					
Additional services (e.g. open shops, markets, pharmacies, hospitals, police station, etc.)					

35. **New technologies to improve interoperability between all transport modes** *
Assuming that paper tickets will be phased out and replaced with a single smartcard, how important would the following be:
Mark only one oval per row.

	1	2	3	4	5
A single smartcard, linked to the customer's bank account, that can operate on all national and international transport networks as a single ticket.					
Using the same smartcard for additional services (e.g. booking a taxi, buying on-board WIFI, etc.)					

36. **Other**
(please, specify)

_____

SECTION B
INFORMATION ABOUT YOUR ORGANISATION: WHO DO YOU REPRESENT?

37. **Your Organisation** *
Please provide the name of the organisation, the address of the headquarters, official telephone number and contact e-mail. If possible, please briefly describe the main activities/areas of expertise of the organisation.

_____
_____
_____
_____
_____

38. **Who completed this survey?** *
Please provide the name, surname and e-mail address. You may also provide a contact telephone number if desired.

_____
_____
_____
_____
_____

Page 8

39. **How many people are represented by the organisation?** *
Please provide an estimated number.

_____

40. **Which country(ies) are represented by the organisation?** *

_____

41. **Which region(s) is/are represented?**
If relevant

_____

42. **Which town(s) is/are represented?**
If relevant

_____

43. **Which of the following areas does your organisation represent?**
If relevant (select one or more answer)
Tick all that apply.

- [ ] City Center
- [ ] Near the City Center
- [ ] On the outskirts of the City
- [ ] Outside the urban area
- [ ] Small town(s)

44. If relevant, specify where

_____

45. **In the areas best represented by your organisation, are mobile information systems available to the public (e.g. electronic information boards, Apps for personal devices)?**
Tick all that apply.

- [ ] Yes, everywhere (on-board and at stops)
- [ ] Yes, but only in some places
- [ ] No

46. If relevant specify where

_____

47. **Do the areas best represented by your organisation have an Urban Mobility Plan?** *
Tick all that apply.

- [ ] Yes
- [ ] No
- [ ] Do not know

48. If relevant specify where

_____

Page 9

49. **Which customers are best represented by your organisation?**
Select more than one answer if necessary
Tick all that apply.

- ☐ Business
- ☐ Leisure
- ☐ Commuters
- ☐ Disabled
- ☐ Other: _____

50. **Which type of journey is the most common among those represented by your organisation?**
Select one or more answer
Tick all that apply.

- ☐ Urban
- ☐ Regional
- ☐ Long Haul
- ☐ International
- ☐ Other: _____

51. **Which type of transport is favoured by those you represent?**
Select one or more answer
Tick all that apply.

- ☐ Individual Car Service
- ☐ Car Sharing Service
- ☐ Bus Service
- ☐ Tram Service
- ☐ Metro Service
- ☐ Train Service
- ☐ Private Air service
- ☐ Public Air service
- ☐ Other: _____

SECTION C
PRECISIONS ABOUT URBAN / REGIONAL JOURNEYS

52. **On average, how many kilometers are travelled per day by those represented by your organisation?**
Tick all that apply.

- ☐ ≤ 10 km
- ☐ 11 - 20 km
- ☐ 21 - 40 km
- ☐ 41 - 60 km
- ☐ > 60 km

53. **Per normal day, how much time do they spend commuting (across all transport modes)?**
Tick all that apply.

- ☐ ≤ 0.5 hour
- ☐ 0.5 - 1 hour
- ☐ 1 - 2 hours
- ☐ 2 - 3.5 hours
- ☐ > 3.5 hours

Page 10

54. **Which mode(s) of public transport is (are) used most for regular/daily journeys?**
Select one or more answers
Mark only one oval per row.

	Walking	Cycle	Motorcycle	Car (private)	Taxi	Car Sharing	Car Pooling	Tram/ Urban Bus	Extra-Urban Bus	Tube	Train	Ferry/ Car-Ferry
From home to workplace/school/university, and the return												
Shop/errands												
Family commitments (e.g. taking children to school, attending a medical appointment)												
Leisure time (e.g. cinema, sport)												

55. Other (specify) and/or comments

_____

56. **Why is a particular mode preferred?**
Select one or more answer
Mark only one oval per row.

	Walking	Cycle	Motorcycle	Car	Taxi	Car Sharing	Car Pooling	Tram/ Urban Bus	extra-Urban Bus	Tube	Train	Ferry/ Car-Ferry
It is more comfortable												
It is more reliable												
It is more flexible (free from timetable limitations)												
It is more accessible												
It is more secure (e.g. there is less pickpocketing)												
It is safer												
It is cheaper												
It is faster												
It is environmentally friendly												
It has more connections												
It requires less changes in the same journey												
It offers complementary services (e.g. WiFi or bicycle access)												
It is possible to work during the journey												

DR AL

Why is a particular mode preferred?
Select one or more answer
Mark only one oval per row.

	Walking	Cycle	Motorcycle	Car	Taxi	Car Sharing	Car Pooling	Tram/ Urban Bus	extra-Urban Bus	Tube	Train	Ferry/ Car-Ferry
It is possible to carry as much luggage as desired												
It is possible to travel with as many people as desired												
It is possible to carry out leisure activities during the journey (e.g. reading, talking, watching videos)												
It is free from traffic congestion												
Other options are unavailable												

SECTION D
PRECISIONS ABOUT LONG HAUL / INTERNATIONAL JOURNEYS

58. **During an average year, how many times do those represented by your organisation make long-distance journeys, nationally and/or abroad?**
Long-distance is considered to be more than 250 km (e.g. Seville-Barcelona, Paris-Toulouse, Rome-Turin, London-Glasgow, or Genoa-Strasbourg)
Tick all that apply.

- [ ] 0
- [ ] 1 - 5
- [ ] 6 - 10
- [ ] 11 - 20
- [ ] > 20

59. **If > 0 , which mode of transport do they tend to use for which travel purpose?**
Select one or more answer
Mark only one oval per row.

	Car	Bus	Train	Aeroplane	Ferry
Work/study					
Holiday/leisure					
Health					

60. Other (specify) and/or comments

_____

61. **During the last two years, have they travelled abroad at least once?**
Select one or more answer
Tick all that apply.

- [ ] Yes, only in Europe
- [ ] Yes, only outside Europe
- [ ] Yes, both in Europe and outside
- [ ] No

Page 12

62. **If "yes", which mode of transport did they use for which purpose of travel?**
Select one or more answer
Mark only one oval per row.

	Car	Bus	Train	Aeroplane	Ferry
Work/study					
Holiday/leisure					
Health					

63. Other (specify) and/or comments

_____

64. **Why is each mode preferred for long haul/international journeys?**
Select one or more answer
Mark only one oval per row.

	Car	Bus	Train	Aeroplane	Ferry
It is more comfortable					
It is more reliable					
It is more flexible (free from timetable limitations)					
It is more accessible					
It is more secure (e.g. there is less pickpocketing)					
It is safer					
It is cheaper					
It is faster					
It is environmentally friendly					
It has more connections					
It requires less changes in the same journey					
It offers complementary services (e.g. WiFi or bicycle access)					
It is possible to work during the journey					
It is possible to carry as much luggage as desired					
It is possible to travel with as many people as desired					
It is possible to carry out leisure activities during the journey (e.g. reading, talking, watching videos)					
It is free from traffic congestion					
Other options are unavailable					

65. Other (specify) and/or comments

_____

SECTION E

PRECISIONS ABOUT INEFFICIENCIES AND SOURCES OF DISSATISFACTION RELATED TO JOURNEYS

66. **Have any of the following problems been experienced by those represented by your organisation, including regular/occasional, urban/regional and long haul/international travel?**
select one or more answer
Mark only one oval per row.

	Car	Taxi	Car Sharing	Car Pooling	Tram/ Urban Bus	Extra-Urban Bus	Tube	Urban/ Regional Train	Long Haul/ International Train	Ferry/ Car-Ferry	Airline
Traffic congestion											
Strikes											
Delays											
Unpleasant behaviour from on-board staff											
Insufficient service (e.g. lack of service when required)											
Insufficient infrastructure (e.g. disrupted stations or roads)											
Excessive fares											
Inadequate cleanliness											
Excessive barriers											
Inadequate facilities for those with special needs											
Inadequate management											
Inadequate refund or disruption procedures											
Sudden cancellations											
Lost luggage											
Stolen luggage											
Overcrowding											
Overbooking											
Inadequate information about different operators and relevant travel times											
Inadequate level of online resources for booking or payment											
Inadequate information in case of delays/disruptions											
Inadequate assistance in case of delays/disruptions											

67. Other (specify) and/or comments

Page 14

SECTION F

PRECISIONS ABOUT GENERAL RAIL SERVICE FEATURES: HOW IMPORTANT ARE THE FOLLOWING FACTORS FOR INCREASING YOUR USERS' PREFERENCE FOR RAIL TRAVEL?

1 = "not important"
5 = "highly important"

68. **To improve connections between regional and high speed rail services, how acceptable would a "Hub and Spoke" model be?**
"Hub & Spoke" is a type of transport planning approach where passengers travel from regional/smaller stations to a larger central node in order to make long haul/international journeys.
Mark only one oval per row.

	1	2	3	4	5
	◯	◯	◯	◯	◯

69. **Urban/Regional services in cities with more 250,000 inhabitants**
For improving the efficiency and effectiveness of transportation, how important are the following:
Mark only one oval per row.

	1	2	3	4	5
Inter-modality	◯	◯	◯	◯	◯
Availability of connections	◯	◯	◯	◯	◯
Timetables optimised for connecting journeys	◯	◯	◯	◯	◯
Quality:price ratio	◯	◯	◯	◯	◯
Good presence of customer information offices	◯	◯	◯	◯	◯
Call centers (not 24h)	◯	◯	◯	◯	◯
Call centers (24h)	◯	◯	◯	◯	◯

70. Other (please, specify)

_____

71. **Long Haul/International services**
How important are the following:
Mark only one oval per row.

	1	2	3	4	5
A balanced fare system related to timetabling	◯	◯	◯	◯	◯
On-board staff which can assist with additional services and information (e.g. booking a taxi)	◯	◯	◯	◯	◯
Presence of customer information offices	◯	◯	◯	◯	◯
Call center (not 24h)	◯	◯	◯	◯	◯
Call center (24h)	◯	◯	◯	◯	◯

72. Other (please, specify)

_____

73. **For stations**
How important are the following:
Mark only one oval per row.

	1	2	3	4	5
Luggage storage and courier services	◯	◯	◯	◯	◯
WiFi (free and slow)	◯	◯	◯	◯	◯
WiFi (payable and fast)	◯	◯	◯	◯	◯
Call centre (not 24h)	◯	◯	◯	◯	◯
Call centre (24h)	◯	◯	◯	◯	◯

74. Other (please, specify)

_____

Page 15

75. **Public Address systems in stations**
How important are the following:
Mark only one oval per row.

	1	2	3	4	5
Automated voice system					
Human voice system					
Lighting to indicate walkways and areas					
Security cameras in waiting rooms and at ticket booths					
Security cameras in subways					
Security cameras on platforms					
Dynamic screens					

76. Other (please, specify)

_____

77. **Security in stations**
How important are the following:
Mark only one oval per row.

	1	2	3	4	5
Tickets sold by humans rather than ticket machines					
Placing ticket machines in protected areas or in public sight					
Improved provision of CCTV cameras					
Improved lighting					

78. Other (please, specify)

_____

79. **Ticket inspection prior to boarding**
Approximately how many minutes is the maximum tolerable waiting time for pre-boarding ticket inspection?

_____

80. **Other**
(please, specify)

_____

SECTION G
FREE SUGGESTION & OTHER POINTS
Please provide any further information or feedback here.

81.

8.2 List of Rail-end-User Groups

Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
Europe	Global transport service	Multimodal Passengers Services	European Passengers' Federation	*Email*: secretariat@epf.eu *Website:* http://www.epf.eu *Postal adress:* Kortrijksesteenweg 304 - 9000 Gent - Belgium *Phone*: +32 (0)476 85 65 00
Europe	Specific to one rail service	Thalys Passenger Services	Thalys Users (Assoc Voyageurs (Paris Bruxel / Collogn / Amst)	*Email*: info@thalysusers.org *Website:* www.thalysusers.org *Postal adress:* 44 rue du Vallon 1210 - Saint-Josse 99131 BELGIGUE *Phone*: +32 488 46 44 37
United Kingdom	Independent transport user watchdog (nationwide)	Transport	Transport Focus	*E-mail:* - *Web* : www.transportfocus.org.uk *Postal Address:* Fleetbank House, 2-6 Salisbury Square, London, EC4Y 8JX *Phone:* 0300 123 0860
United Kingdom	Campaigning for better rail services for passengers and freight (nationwide)	Nationwide rail passengers and freight.	Railfuture	*E-mail:* passenger@railfuture.org.uk *Web* : www.railfuture.org.uk *Postal Address:* 24 Chedworth Place, Tattingstone, Suffolk IP9 2ND *Phone:* 0117 9272954
United Kingdom	Community rail lines (nationwide)	Nationwide community rail.	Association of Community Rail Partnerships	*E-mail:* info@acorp.uk.com *Web* : http://acorp.uk.com *Postal Address:* The Old Water Tower, Huddersfield Railway Station, St George's Square, Huddersfield. HD1 1JF *Phone:* 01484 548926
United Kingdom	Independent, statutory watchdog for transport users in and around London	London transport	London Travelwatch	*E-mail:* info@londontravelwatch.org.uk *Web* : http://www.londontravelwatch.org.uk *Postal Address:* London TravelWatch, 169 Union Street, London, SE1 0LL *Phone:* 020 3176 2999

DRAFT WAITING APPROVAL

Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
United Kingdom	Independent consumer organisation (Northern Ireland, incl. transport)	Northern Ireland consumers (ind. transport)	Consumer Council	*E-mail:* info@consumercouncil.org.uk *Web* : www.consumercouncil.org.uk *Postal Address:* The Consumer Council, Floor 3, Seatem House, 28-32 Alfred Street, Belfast, BT2 8EN *Phone:* 028 9025 1600
United Kingdom	Trade association representing the transport interests of companies moving goods by road, rail, sea and air (UK)	UK rail freight.	Freight Transport Association	*E-mail:* enquiry@fta.co.uk *Web* : www.fta.co.uk *Postal Address:* Hermes House, St John's Road, Tunbridge Wells, Kent TN4 9UZ *Phone:* 03717 11 22 22
United Kingdom	Leading representative body for rail freight in the UK	UK rail freight.	Rail Freight Group	*E-mail:* contact@rfg.org.uk *Web* : www.rfg.org.uk *Postal Address:* 7 Bury Place, London, WC1A 2LA *Phone:* (0)20 3116 0007
Italy	Generic consumer group	Multimodal Passenger Services	A.N.M.I.C. (Associazione Nazionale Mutilati e Invalidi Civili)	*E-mail:* info@anmic.it *Web: http://www.anmic.it/* *Postal Address:* Via Maia, 10 - 00175 ROMA *Phone:* +39 06 76961196 - +39 06 76900100 - +39 06 7612230
Italy	Generic consumer group	Multimodal Passenger Services	A.N.M.I.L. (Associazione Nazionale Mutilati e Invalidi del Lavoro)	*E-mail:* anmil@anmil.it; presidenza@anmil.it; direzione@anmil.it *Web*: http://www.anmil.it/ *Postal Address:* Via Adolfo Ravà, 124 - 00142 ROMA *Phone:* +39 06 541961 - +39 06 54196203; +39 06 54196204
Italy	Generic consumer group	Multimodal Passenger Services	A.N.P.V.I. (Associazione Nazionale Privi della Vista e Ipovedenti)	*E-mail:* anpvionlus@tiscali.it *Web*: http://www.anpvionlus.it/ *Postal Address:* Via Albenga, 56 - 00183 ROMA *Phone:* +39 06 70614580

DRAFT - WAITING FOR APPROVAL

Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
Italy	Domain linked	Persons with Reduced Mobility	A.S.B.I. Onlus (Associazione Spina bifida Italia)	*E-mail:* presidenza@spinabifidaitalia.it *Web: http://www.spinabifidaitalia.it/* *Postal Address:* 1) Centro Spina Bifida Ospedale Maggiore - Via Gramsci, 14 - 43100 Parma (PR); 2) Via Duomo, 20 - 29020 Settima di Gossolengo (PC) *Phone:* 1) +39 0521 702218; 2) 0523 557596
Italy	Global transport service	Persons with Reduced Mobility	ASSOUTENTI	*E-mail:* segreteria@assoutenti.it; m.alliney@assoutenti.it *Web*: http://www.assoutenti.it/ *Postal Address:* Vicolo Orbitelli, 10 - 00186 ROMA *Phone:* +39 06 6833617
Italy	Domain linked	Persons with Reduced Mobility	CITTADINANZATTIVA	*E-mail:* mail@cittadinanzattiva.it *Web*: http://www.cittadinanzattiva.it/ *Postal Address:* via Cereate, 6 - 00183 ROMA *Phone:* +39 06 367181
Italy	Domain linked	Persons with Reduced Mobility	CODACONS	*E-mail:* ufficiostampa@codacons.org *Web*: http://www.codacons.it/ *Postal Address:* Viale Mazzini, 73 - 00195 ROMA *Phone:* +39 06 3721573
Italy	Domain linked	Persons with Reduced Mobility	CONFCONSUMATORI	*E-mail:* segreteria@confconsumatori.it; ufficiostampa@confconsumatori.it *Web*: http://www.confconsumatori.it/ *Postal Address:* via Mazzini, 43 - 43121 Parma (PR) *Phone:* +39 0521 231846
Italy	Domain linked	Persons with Reduced Mobility	A.N.M.I.C. (Associazione Nazionale Mutilati e Invalidi Civili)	*E-mail:* info@anmic.it *Web: http://www.anmic.it/* *Postal Address:* Via Maia, 10 - 00175 ROMA *Phone:* +39 06 76961196 - +39 06 76900100 - +39 06 7612230

DRAFT AWAITING ECAS APPROVAL

Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
Italy	Generic consumer group	Multimodal Passenger Services	A.N.M.I.L. (Associazione Nazionale Mutilati e Invalidi del Lavoro)	*E-mail:* anmil@anmil.it; presidenza@anmil.it; direzione@anmil.it *Web*: http://www.anmil.it/ *Postal Address:* Via Adolfo Ravà, 124 - 00142 ROMA *Phone:* +39 06 541961 - +39 06 54196203; +39 06 54196204
Italy	Generic consumer group	Multimodal Passenger Services	A.N.P.V.I. (Associazione Nazionale Privi della Vista e Ipovedenti)	*E-mail:* anpvionlus@tiscali.it *Web*: http://www.anpvionlus.it/ *Postal Address:* Via Albenga, 56 - 00183 ROMA *Phone:* +39 06 70614580
Italy	Generic consumer group	Multimodal Passenger Services	A.S.B.I. Onlus (Associazione Spina bifida Italia)	*E-mail:* presidenza@spinabifidaitalia.it *Web:* *http://www.spinabifidaitalia.it/* *Postal Address:* 1) Centro Spina Bifida Ospedale Maggiore - Via Gramsci, 14 - 43100 Parma (PR); 2) Via Duomo, 20 - 29020 Settima di Gossolengo (PC) *Phone:* 1) +39 0521 702218; 2) 0523 557596
Italy	Generic consumer group	Multimodal Passenger Services	ASSOUTENTI	*E-mail:* segreteria@assoutenti.it; m.alliney@assoutenti.it *Web*: http://www.assoutenti.it/ *Postal Address:* Vicolo Orbitelli, 10 - 00186 ROMA *Phone:* +39 06 6833617
Italy	Domain linked	Persons with Reduced Mobility	E.N.S. (Ente Nazionale Sordi)	*E-mail:* protocollo@ens.it *Web*: http://www.ens.it *Postal Address:* Via Gregorio VII, 120 - 00165 ROMA *Phone:* +39 06 398051
Italy	Domain linked	Persons with Reduced Mobility	F.A.N.D. (Federazione tra le Associazioni Nazionali delle persone con Disabilità)	*E-mail:* segreteriafand@anmil.it *Web*: http://www.fandnazionale.it *Postal Address:* n.a. *Phone:* n.a.

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Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
Italy	Generic consumer group	Multimodal Passenger Services	FEDERCONSUMATORI	*E-mail:* federconsumatori@federconsumatori.it ufficiostampa@federconsumatori.it *Web*: http://www.federconsumatori.it *Postal Address:* via Palestro, 11 - 00185 ROMA *Phone:* +39 06 42020759; +39 06 42020763; +39 06 42020755
Italy	Domain linked	Persons with Reduced Mobility	FIADDA (Famiglie Italiane Associate Difesa Diritti Audiolesi)	E-mail: info@fiadda.it Web: http://www.fiadda.it Postal Address: n.a. Phone: n.a.
Italy	Domain linked	Persons with Reduced Mobility	F.I.S.H. (Federazione Italiana per il Superamento dell'Handicap)	*E-mail:* presidenza@fishonlus.it *Web*: http://www.fishonlus.it *Postal Address:* Via G. Cerbara, 38/B - 00147 ROMA *Phone:* +39 06 78851262
Italy	Domain linked	Persons with Reduced Mobility	LEGA ARCOBALENO	*E-mail:* simona.colizzi@alice.it ; b.tescari@gmail.com *Web*: http://www.legarcobaleno.it *Postal Address:* Piazza Plebiscito, 23 - 00019 Tivoli (RM) *Phone:* +39 0774 332918
Italy	Generic consumer group	Multimodal Passenger Services	LEGA CONSUMATORI	*E-mail:* atupertu@legaconsumatori.it ; utenza@legaconsumatori.it *Web*: http://www.legaconsumatori.it *Postal Address:* Via Orchidee, 4/a - 20147 MILANO *Phone:* +39 02 48303659
Italy	Generic consumer group	Multimodal Passenger Services	MOVIMENTO CONSUMATORI	*E-mail:* info@movimentoconsumatori.it *Web*: http://www.movimentoconsumatori.it *Postal Address:* via Piemonte, 39/A - 00187 ROMA *Phone:* 39 06 4880053

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Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
Italy	Domain linked	Persons with Reduced Mobility	U.I.C.I. (Unione Italiana dei ciechi e degli ipovedenti Onlus)	*E-mail:* presidente@uiciechi.it ; segrgen@uiciechi.it ; segreteria@uiciechi.it *Web* : https://www.uiciechi.it *Postal Address:* via Borgognona, 38 - 00187 ROMA *Phone:* +39 06 699881
Italy	Generic consumer group	Multimodal Passenger Services	UNIONE NAZIONALE CONSUMATORI	*E-mail:* info@consumatori.it ; massimiliano.dona@consumatori.it *Web:* http://www.consumatori.it *Postal Address:* via Duilio, 13 - 00192 ROMA *Phone:* +39 06 32600239
Italy	Domain linked	Persons with Reduced Mobility	U.N.M.S. (Unione Nazionale Mutilati per Servizio)	*E-mail:* info@unms.it ; segreterianazionale@unms.it *Web* : www.unms.it *Postal Address:* via Savoia, 84 - 00189 ROMA *Phone:* +39 06 85300526 - +39 06 85300536
France	Global transport service	Multimodal Passengers Services	Fédération Nationale des Associations d'Usagers des Transports (FNAUT)	*Email*: contact@fnaut.fr *Website:* http://www.fnaut.fr *Postal adress:* FNAUT - 32 rue Raymond Losserand - 75014 Paris *Phone*: 01 43 35 02 83
France	Global rail service	All Rail Services	Ass. Française des Amis du Chemin de fer (AFAC)	*Email*: asframcf@yahoo.fr *Website:* http://www.afac.asso.fr *Postal adress:* Gare de l'Est Place du 11 novembre 1918 75475 PARIS CEDEX 10 *Phone*: 01 40 38 20 92
France	Other modal transport	Other modal transport: bicyde	Fédération des Usagers de la Bicyclette (FUB)	*Email*: p.burner@fubicy.org *Website:* www.fubicy.org *Postal adress:* 12 rue des Bouchers 67000 STRASBOURG *Phone*: 03 88 75 71 90
France	Global rail service	Rail Services	Fédération Générale des Retraités du Chemin de Fer (FGRCF)	*Email*: fgrcf@orange.fr *Website:* http://www.fgrcf.fr *Postal adress:* 59 Bld Magenta 75010 Paris *Phone*: 01 40 37 31 21

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Geographical Area	Relevance for the industry (rail)	Domain	Name	Reference
France	Domain linked	Person with Reduced Mobility	Groupement pour L'Insertion des personnes Handicapées Physiques (GIHP)	*Email*: secretariat@gihpnational.org *Website:* http://www.gihpnational.org *Postal adress:* 61 rue du Faubourg Poissonière 75009 PARIS *Phone*: 01 43 95 66 36
Spain	Generic consumer group	n.a.	CEACCU	*E-mail:* ceaccu@ceaccu.org *Web:* http://www.ceaccu.org *Postal Address:* Calle de Fuencarral, 158 28010 Madrid *Phone:* +34 91 594 50 89
Spain	Generic consumer group	n.a.	OCU	*E-mail*: RelacionesInstitucionales@ocu.org Web: http://www.ocu.org/ *Postal Address:* Calle de Albarracín, 21 28037 Madrid *Phone:* +34 91 382 21 40
Spain	Generic consumer group	n.a.	FACUA	*E-mail*: comunicacion@facua.org and internacional@facua.org *Web*: www.facua.org *Postal Address*: c/ Bécquer, 25B - 41002 Sevilla (España) *Phone:* +34 954 902 365
Spain	Domain linked	Person with Reduced Mobility	Comité Español de Representantes de Personas con Discapacidad (CERMI)	*E-mail:* cermi@cermi.es *Web*: http://www.cermi.es *Postal Address:* CALLE RECOLETOS, 1 Bajo; 28001 MADRID *Phone: +34* 91 360 16 78
Spain	Generic consumer group	n.a.	Confederación de consumidores y usuarios (CECU)	E-mail: Web: www.cecu.es Postal Address: c/ Mayor, 45 - 2 CECU-28013 MADRID Phone: +34 91.364.13.84 / +34 91 541 07 22

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8.3 Detailed results from Client Expectations' survey

As a third part of subtask 7.1 of the In2Rail project, a detailed survey was carried out on many aspects of the railway system, including current and future initiatives, based on Customers' perspectives.

The survey was distributed to more than 40 major Customer Associations in France, Italy, Spain and United Kingdom. The aim was to understand how client expectations, mainly those of passengers, could be expressed as a set of functional and non-functional requirements for TMS (and other systems), so that IMs and TOCs can satisfy them. The survey was distributed both as online and paper versions, to allow the Customer Association to respond in its preferred way.

The responses were as follows:

- 5 from France (out of 7 identified & contacted Associations);
- 5 from Italy (out of 25 identified & contacted Associations);
- 3 from Spain (out of 5 identified & contacted Associations);
- 0 from U.K. (out of 7 identified & contacted Associations).

Below is a list of associations which participated in the survey and, in brackets, their significance based on number of members. The number of members (people that annually pay a fee and are registered to each organisation) was provided by each association and/or verified through Web sources where missing or seemingly incorrect.

The total number of customers represented by this survey is around **4.5 million** (n.b., it is generally not possible to determine whether the same person is registered to one or more of the responding organisations).

Slightly more organisations responded from France and Italy than from Spain, and none responded from UK. However, in terms of number of people registered, Spain is greatly over-represented in comparison with the other countries.

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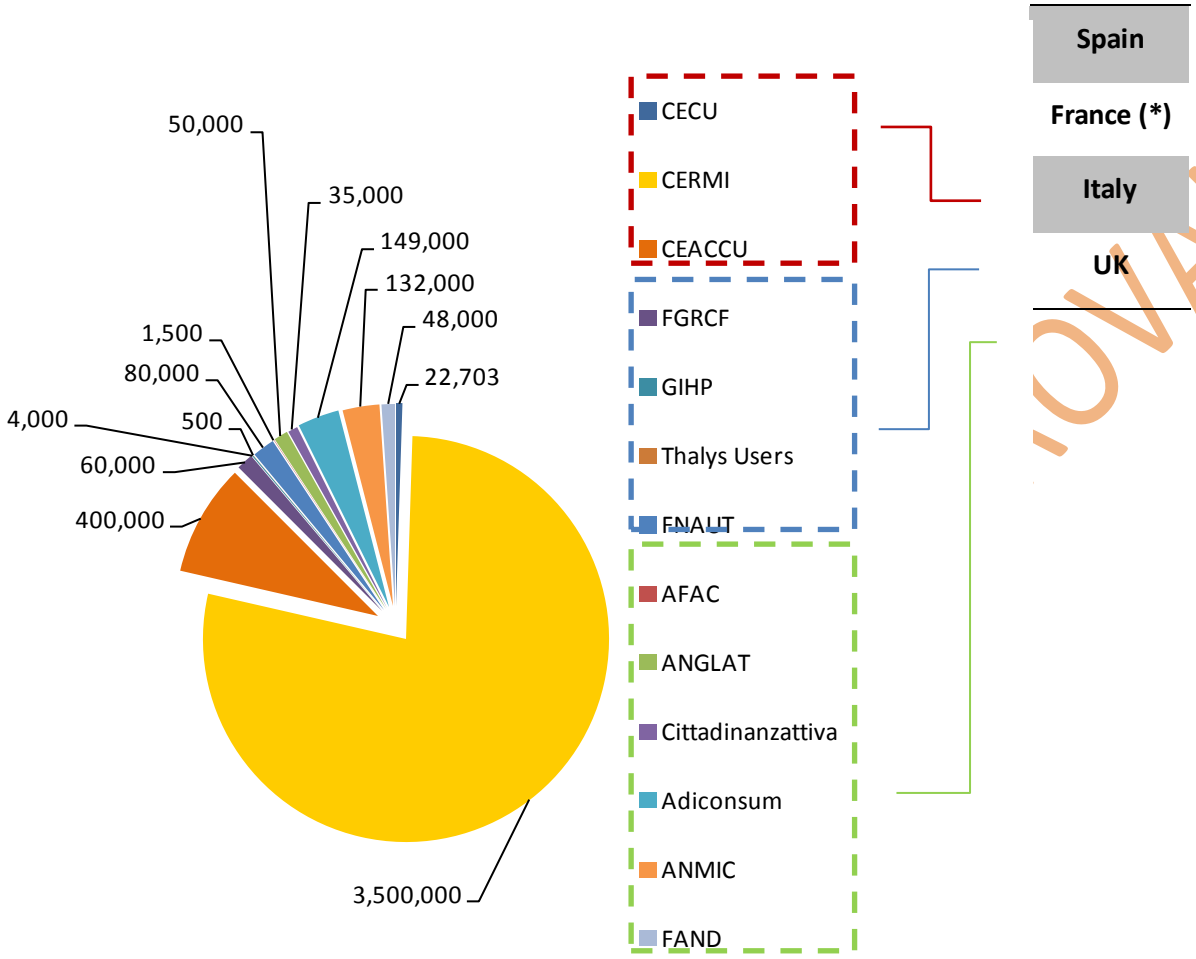

	Nr. of Replies	Represented Customers
Spain	3	3.922.703
France (*)	5	146.000
Italy	5	414.000
UK	0	0

(*) one French-Belgian association included

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Spain:

1. CECU – Confederación de Consumidores y Usuarios (22,703)
2. CERMI – Comité Español de Representantes de Personas con Discapacidad (3,500,000)
3. CEACCU – Confederatión Española de organizaciones de Amas de Casa, Consumidores y Usuarios (400,000)

France:

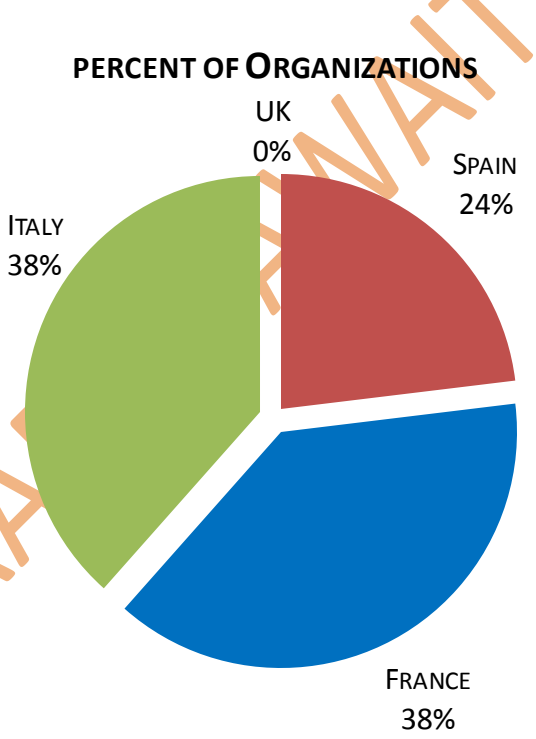
1. FGRCF – Fédération Générale des Retraités du Chemin de Fer (60,000)
2. GIHP – Groupement pour l'Insertion des Personnes Handicapées Physiques (4,000)
3. Thalys Users (500)
4. FNAUT – Fédération Nationale des Associations d'Usagers des Transports (80,000)
5. AFAC – Association française des amis du chemin de fer (1,500)

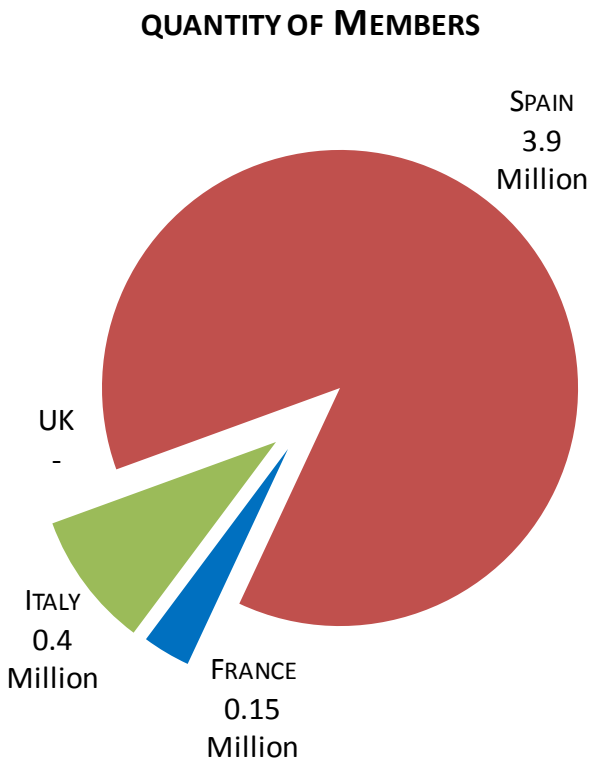
Italy:

1. ANGLAT – Associazione Nazionale Guida Legislazioni Andicappati Trasporti (50,000)
2. Cittadinanzattiva – *tutela dei diritti in ogni ambito, lotta sprechi e corruzione, partecipazione* (35,000)
3. Adiconsum – a***ssistenza e tutela individuale e collettiva*** *ai consumatori ed alle famiglie* (149,000)
4. ANMIC - Associazione Nazionale Mutilati e Invalidi Civili (132,000)
5. FAND - Federazione delle Associazioni Nazionali dei Disabili (48,000)

UK:

No associations responded to the survey.





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It is interesting to note the percentage difference in each country between "Generic Customer" organisations and those specialised for "People with Reduced Mobility [PRMs]".

In this regard, PRMs are strongly represented in Spain, so the Spanish results should be considered as robust evidence of those particular needs. The results from France overwhelmingly represent generic customer expectations, so despite the low numbers, they can be considered as a fair representation of those needs. Finally, the Italian results are the most balanced across the two customer groups, so they can be considered as a representation of both types of needs. Anyway, as will be explored further below, the results from Spain and Italy tended to be similar, whereas those from France were quite different.

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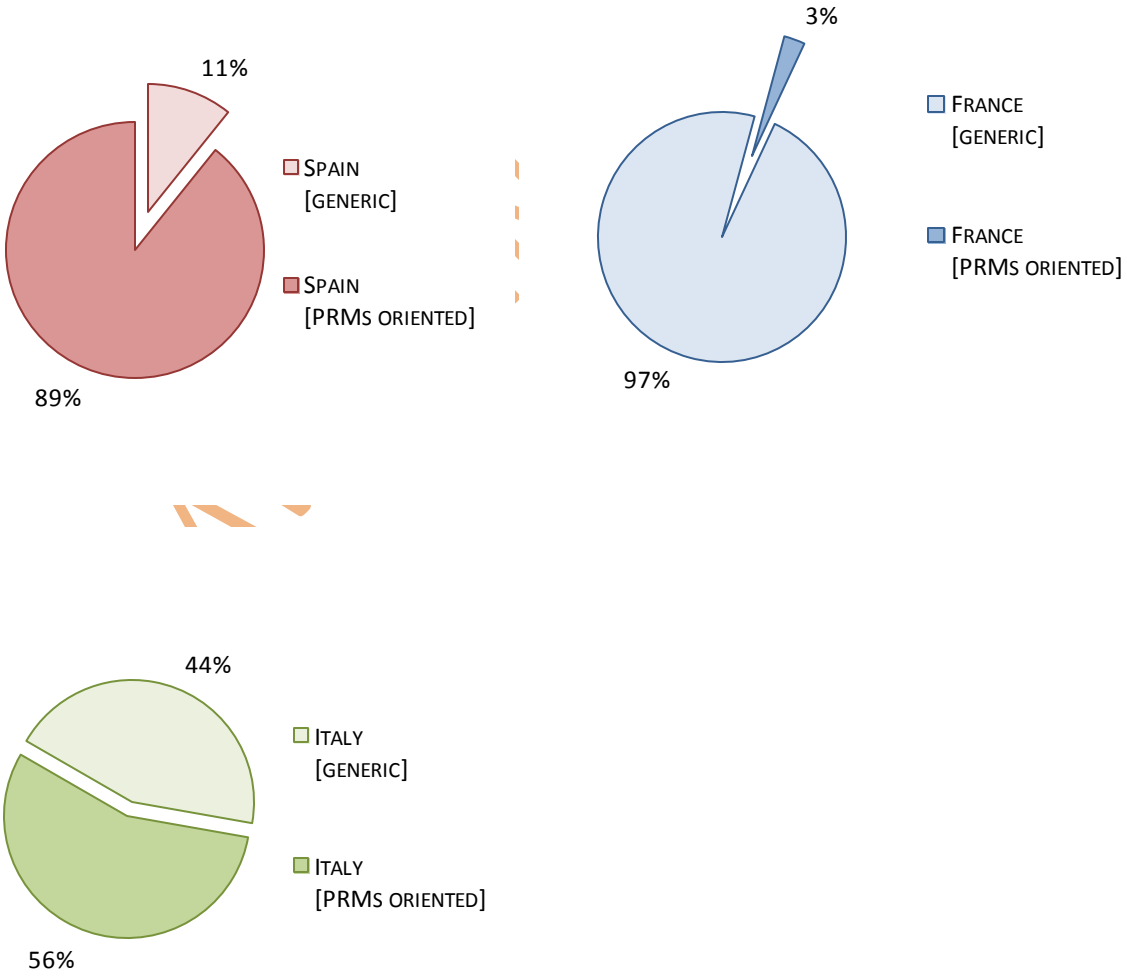
PERCENT OF "GENERIC USER" REPRESENTATION VS "PRMS ORIENTED" ONE



Naturally, it is not possible to exclude certain national tendencies, such as cultural, social or historical patterns. However, in each country, all geographic zones, social status and customer type seem to have been represented, as shown in the graphs below. Considering that the quality, way of life, environment and approaches to mobility are not drastically different between France, Italy and Spain, it is reasonable to assume that national tendencies did not play a significant role in the results. Om the other hand, as mentioned above, the Spanish and Italian results were often quite similar to each other, but different to those from France. This finding would require further study and will be highlighted below where it appears to be very apparent.

STATEMENTS ABOUT MEMBERS COMPOSITION

42. **Which region(s) is/are represented?**
43. **Which town(s) is/are represented?**
44. **Which of the following Urban areas does your Organization represent**?
45. **In the areas best represented by your Organization, are mobile information systems available to the public (e.g. electronic information boards, Apps for personal devices)?**
46. **Do the areas best represented by your Organization have an Urban Mobility Plan**?

It appears that every type of geographical region inside each country has been represented in the survey (only 1 organisation specified just 1 region and 1 city).

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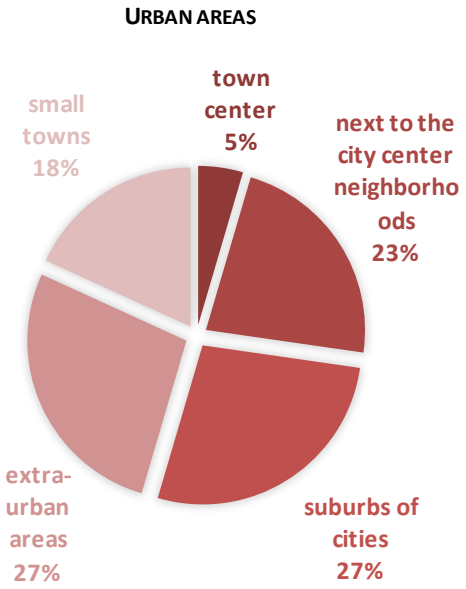
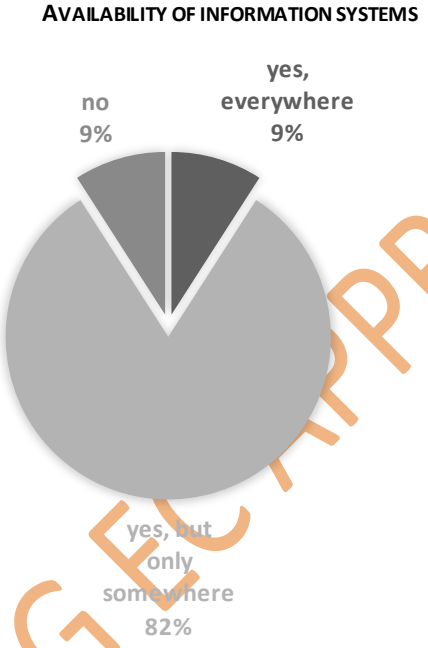
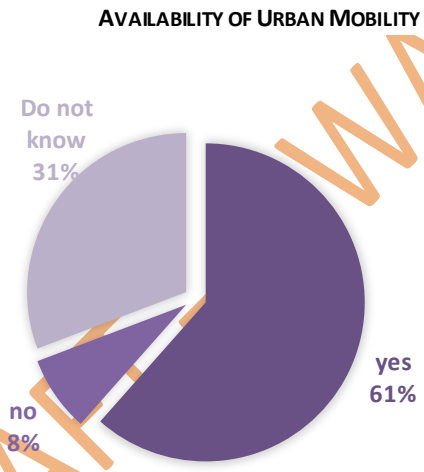
All types of urban areas seem to be represented, with the same environment and no strong evidence of differences between “PRM” and “generic” organisations across each country.







One association specified that it depends by people density. Another one remarked that Urban Mobility Plans are always existing in its best represented areas but not all consider policies for disabled people. Other one cannot be detailed, but they know the

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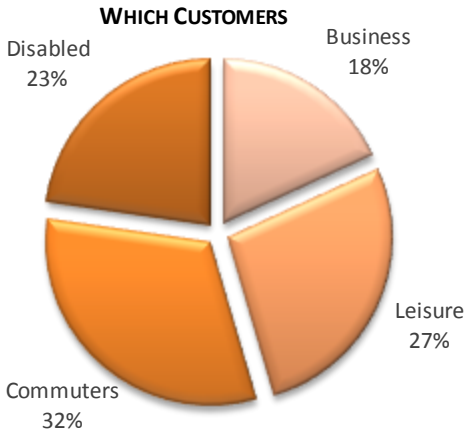
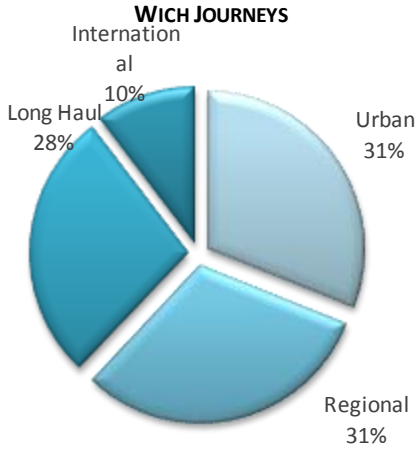
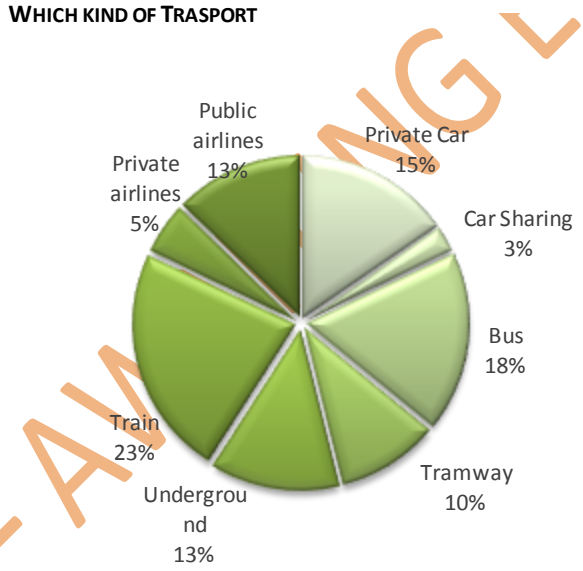
47. Which customers are best represented by your Organization?
48. Which type of journey is the most common among those represented by your Organization?
49. Which type of transport is favored by those you represent?

Again, for these questions, all types of groups appeared to be represented (it was possible to answer more than one choice for each question), with no notable differences between countries, and "PRM" or "generic" organisations.







One PRM association joined "dedicated mini-bus

SECTION A – GENERAL CLIENT EXPECTATIONS ON RAIL SERVICES

✓ **BEFORE THE JOURNEY - TRAVEL PREPARATION AND BOOKING**

1. **Easiness of planning a seamless journey**

How important is multi-modal ticketing, where all segments of the journey can be planned and bought together, from start to end, in line with a "door-to-door" vision (e.g. flight/ferry + train + metro + taxi/car sharing/carpooling + bike sharing + walking)

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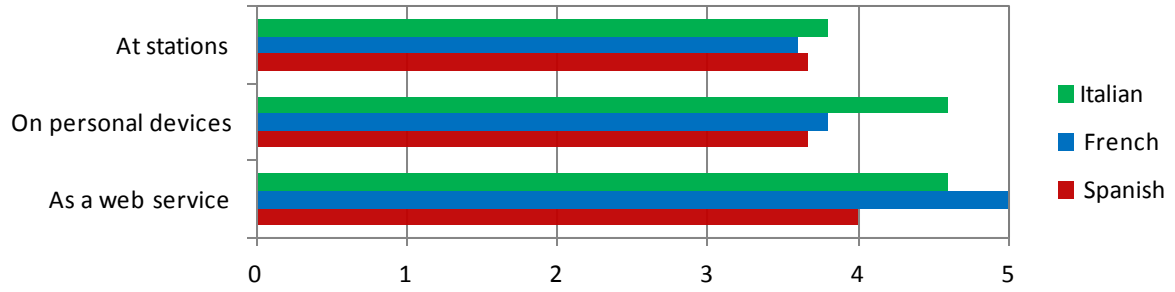
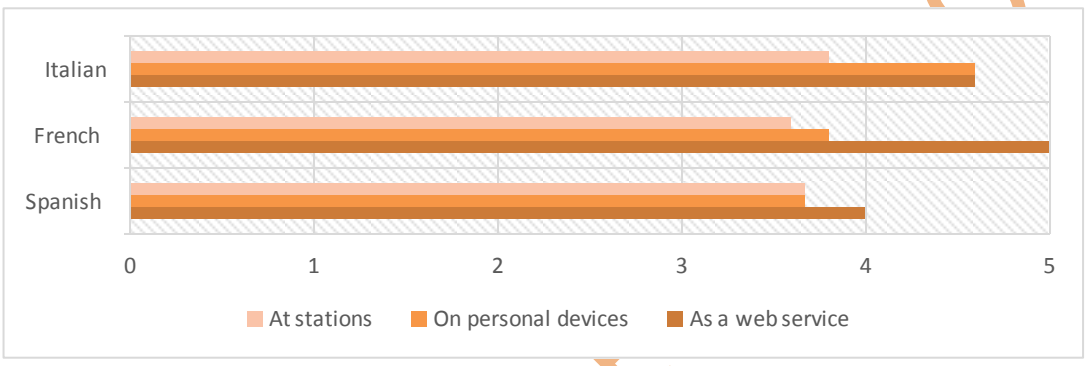
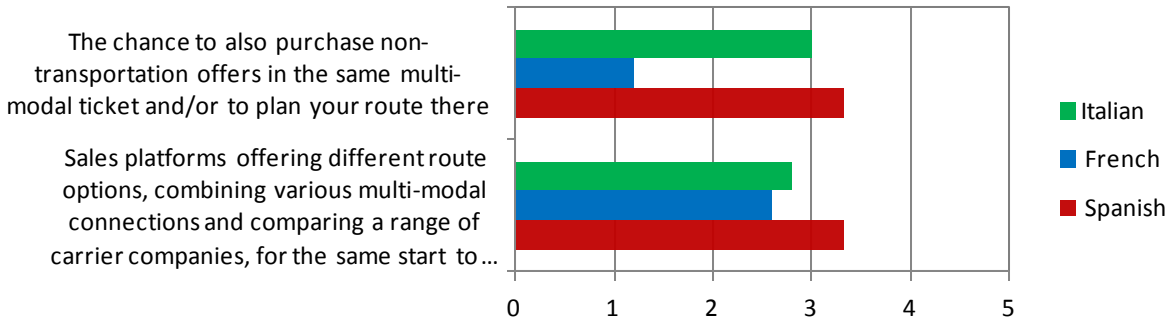
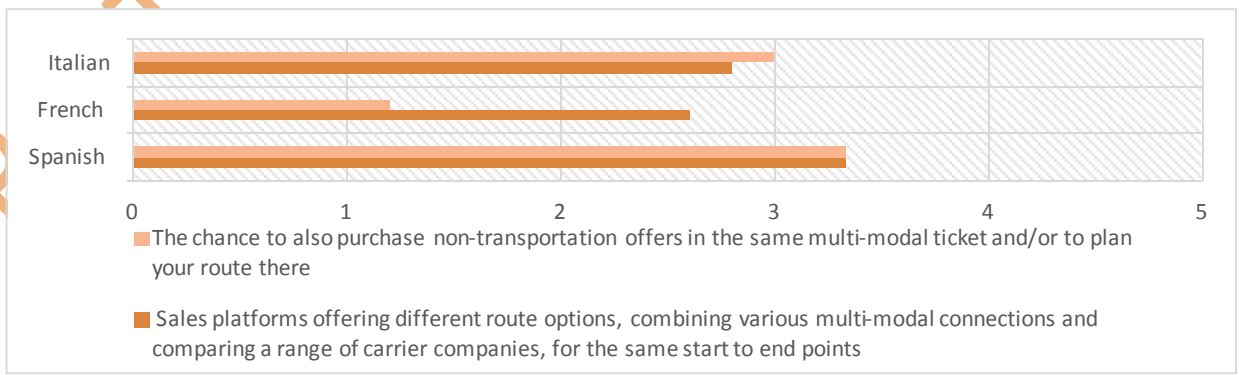




2. Easiness of booking door-to-door journeys and availability of tickets

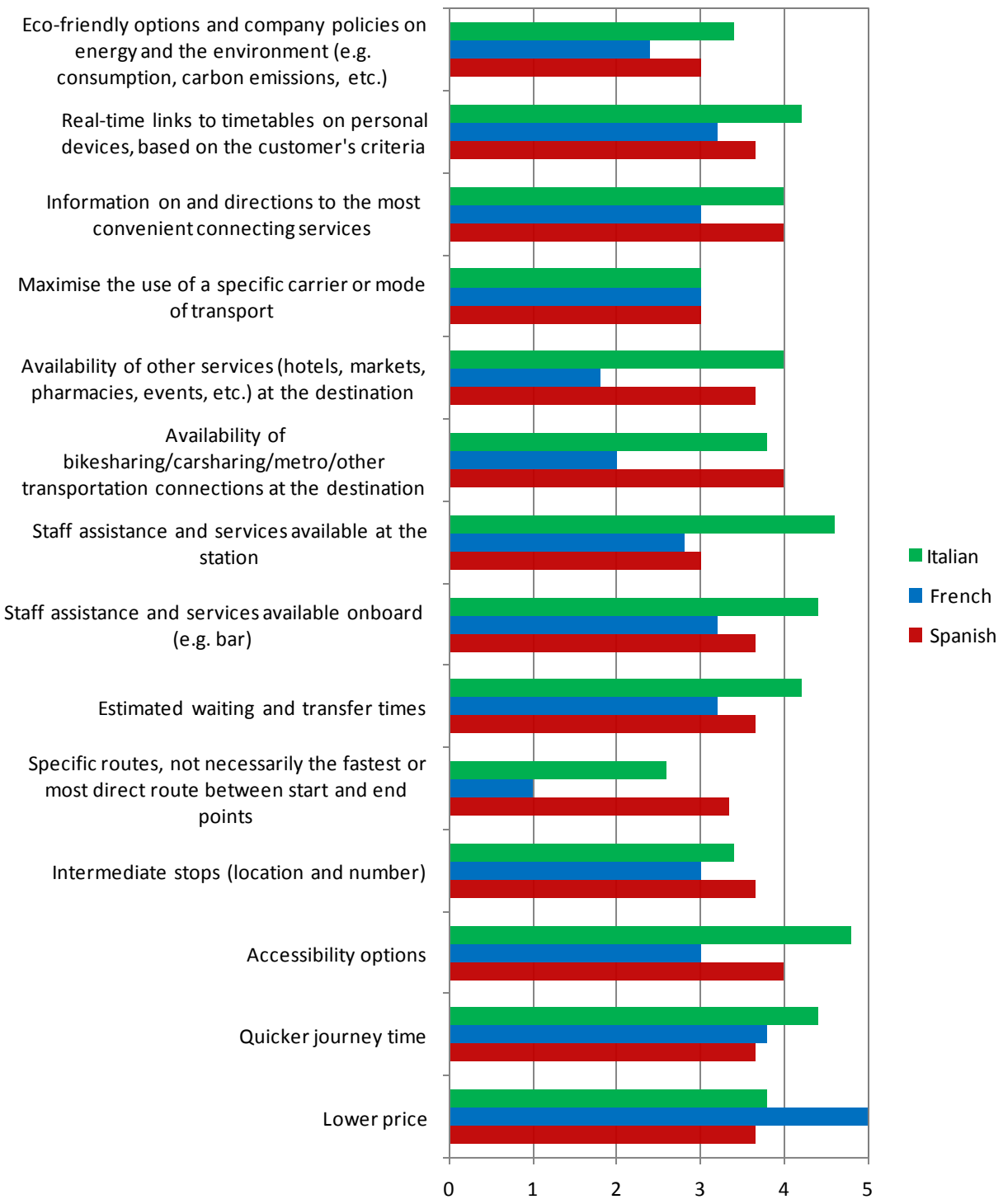
How important are the following initiatives:

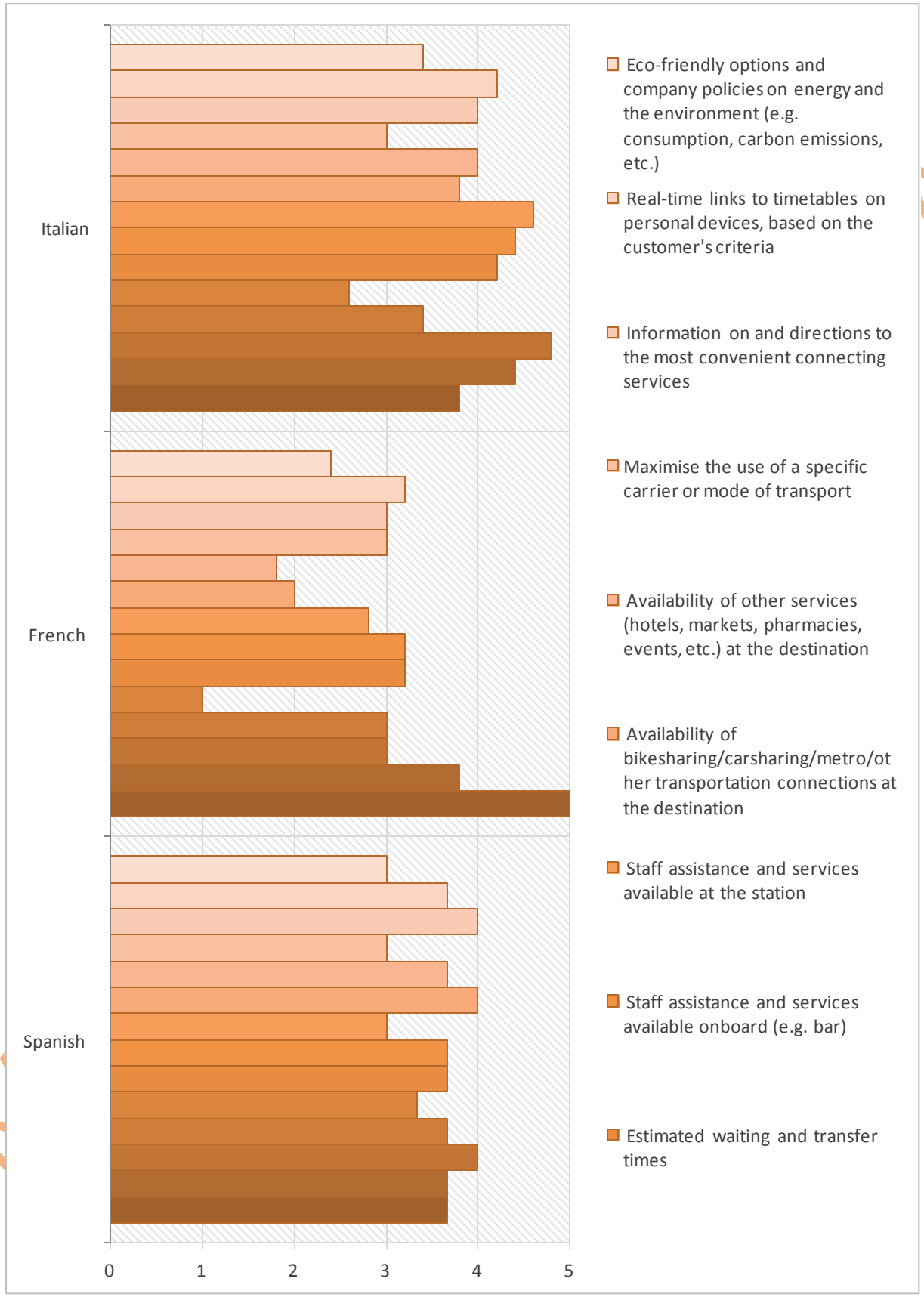




3. Availability of options

How important are the following factors to passengers?




Italian
French
Spanish
0
1
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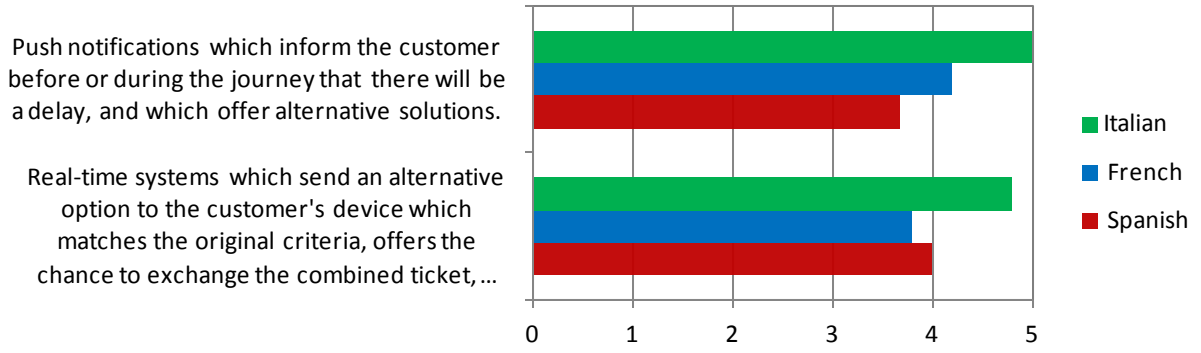
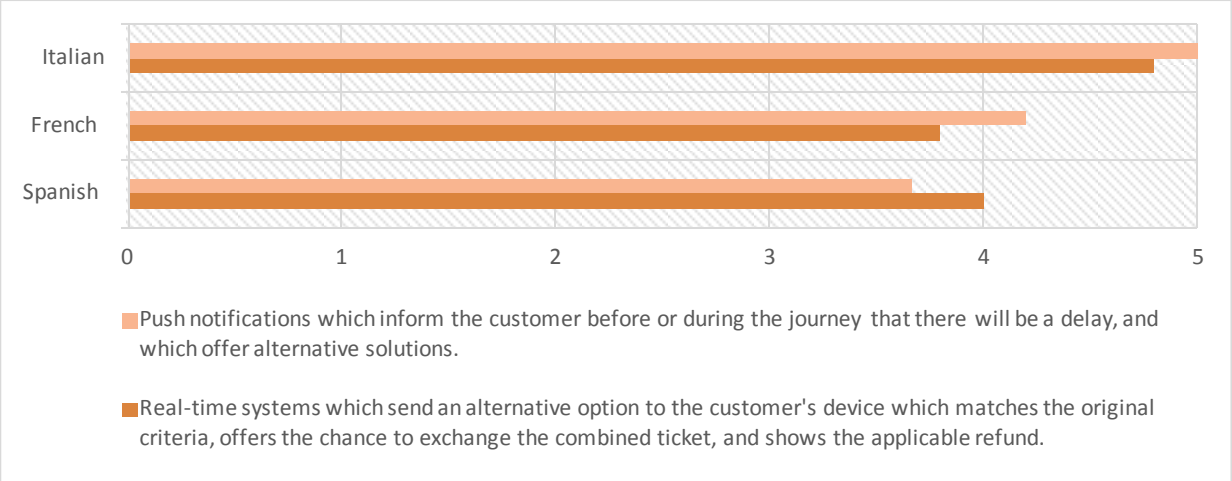
5
Eco-friendly options and company policies on energy and the environment (e.g. consumption, carbon emissions, etc.)
Real-time links to timetables on personal devices, based on the customer's criteria
Information on and directions to the most convenient connecting services
Maximise the use of a specific carrier or mode of transport
Availability of other services (hotels, markets, pharmacies, events, etc.) at the destination
Availability of bikesharing/carsharing/metro/other transportation connections at the destination
Staff assistance and services available at the station
Staff assistance and services available onboard (e.g. bar)
Estimated waiting and transfer times

4. Availability of support

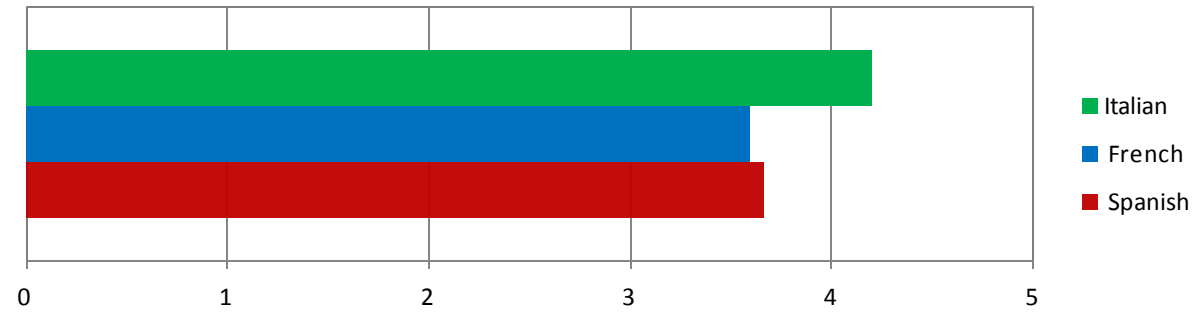
In case of delays or disruptions, how important would the following initiatives be for rescheduling the whole journey?





5. Last minute booking

How important are sales platforms which are real-time and aligned, so that a customer is able to book a journey close to the departure time while also taking into consideration any current delays?



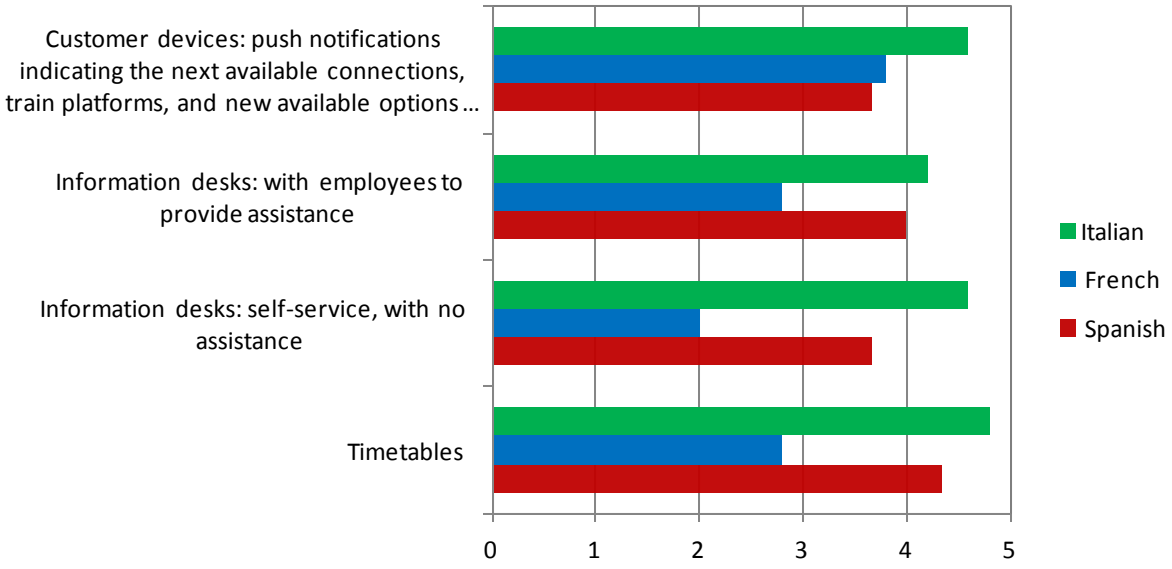
6. *Other*

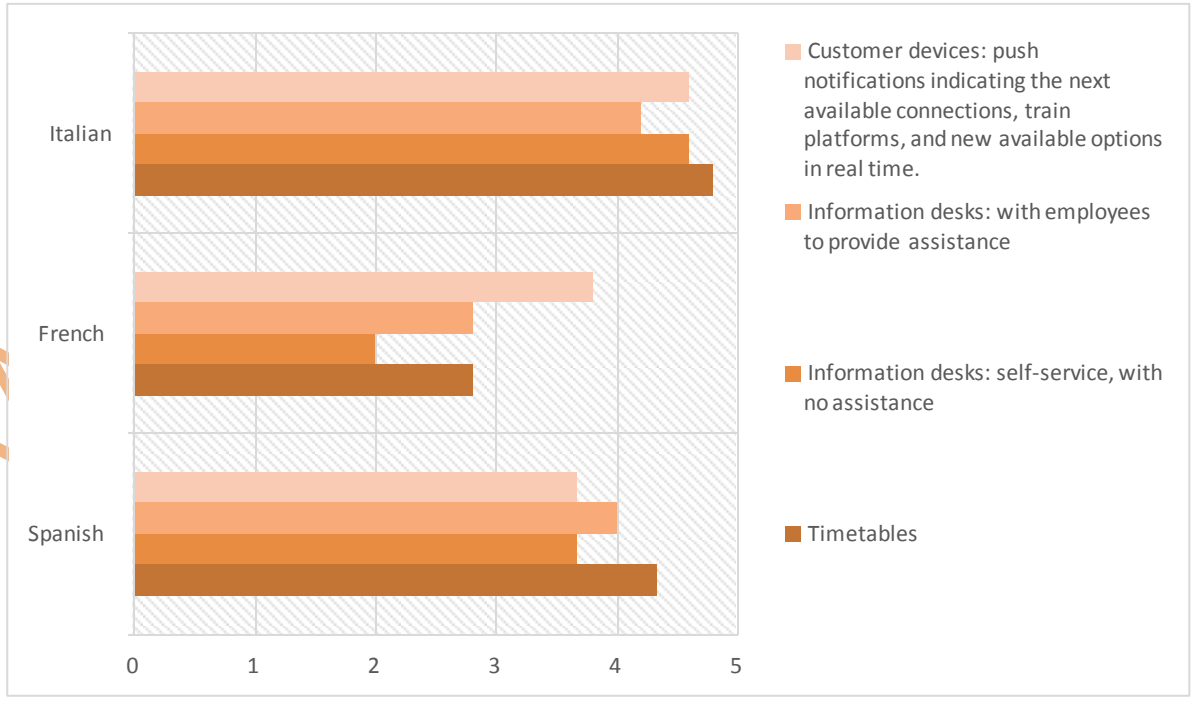
Just one "Generic User" Association replied, remarking as particularly relevant to allow last minute modifications.

AT THE RAIL STATION

7. Availability of information

How important are the following sources of information?





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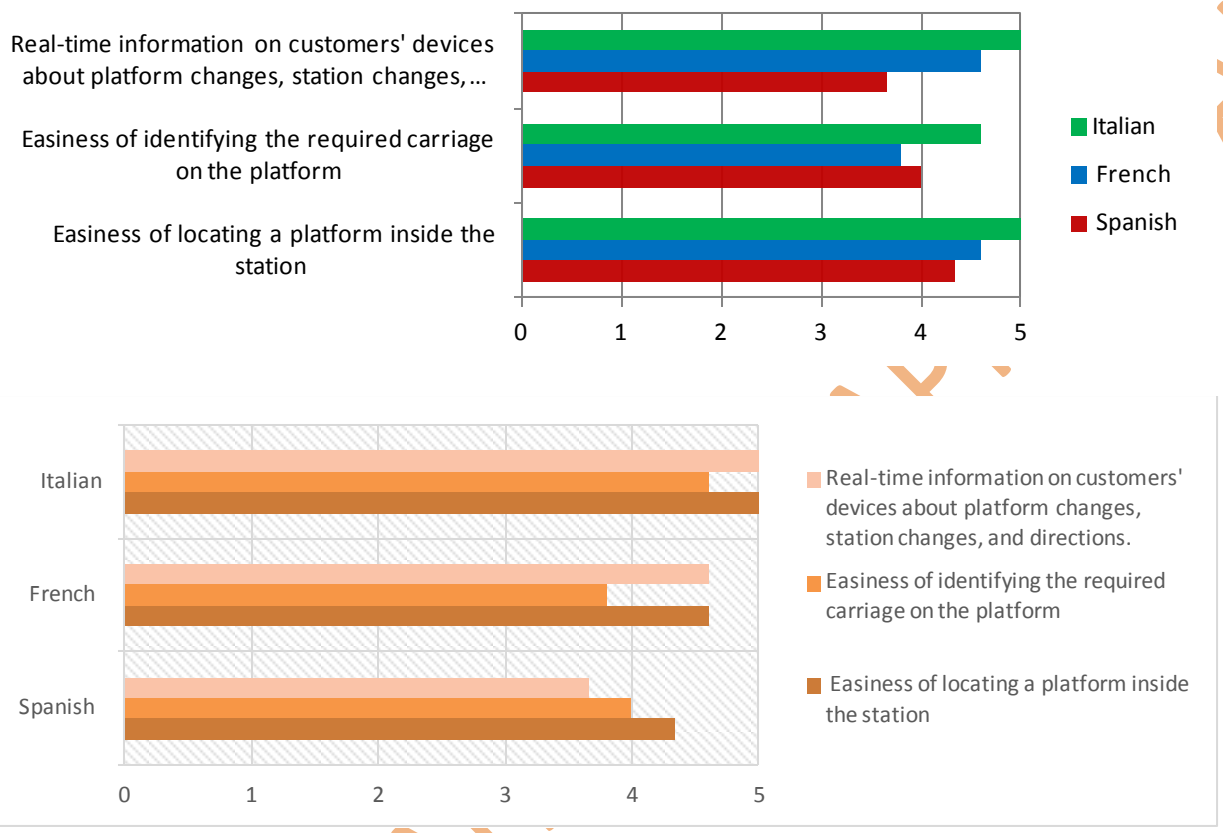
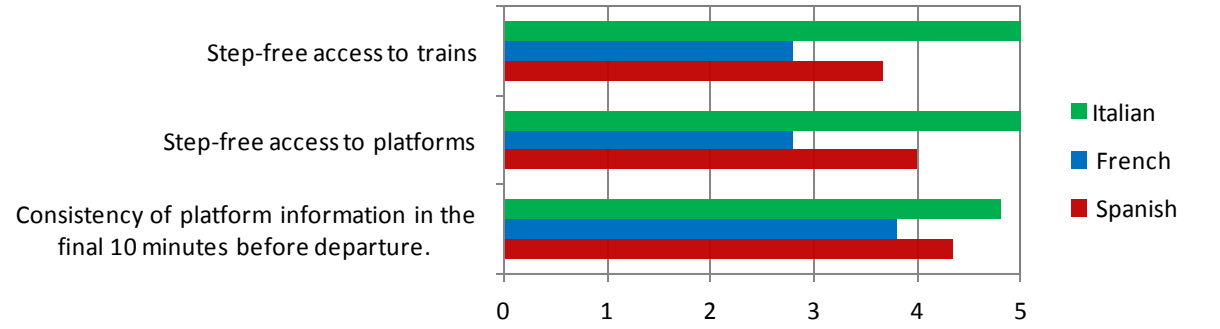
8. Information about train platforms

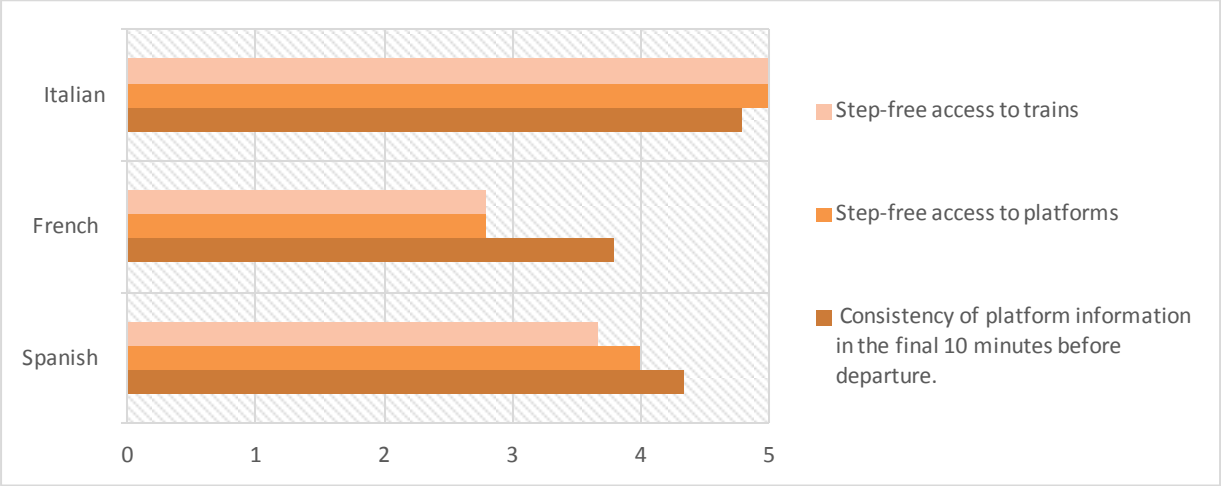
How important are each of the following:



9. Accessibility of stations/platforms

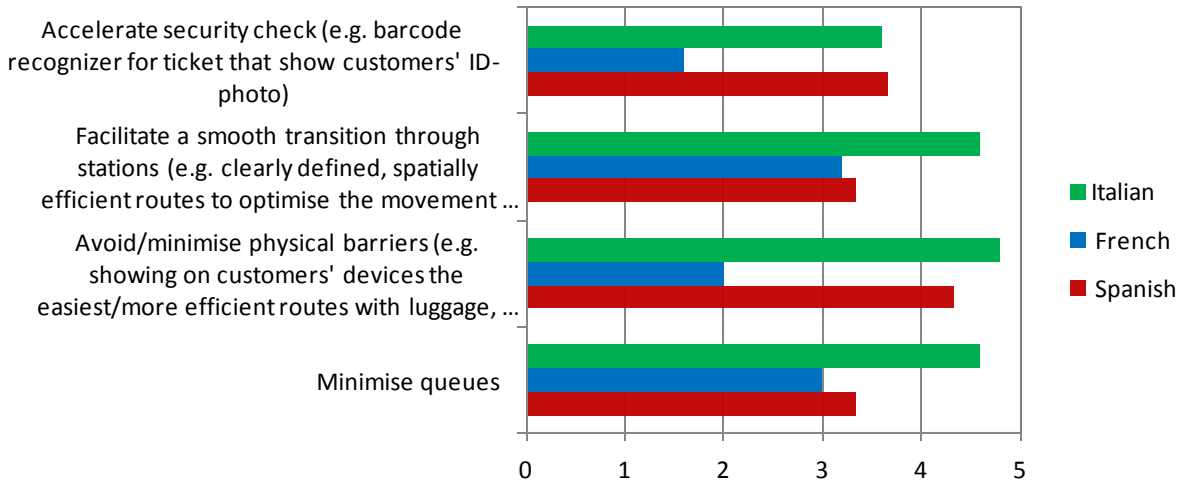
How important are the following:

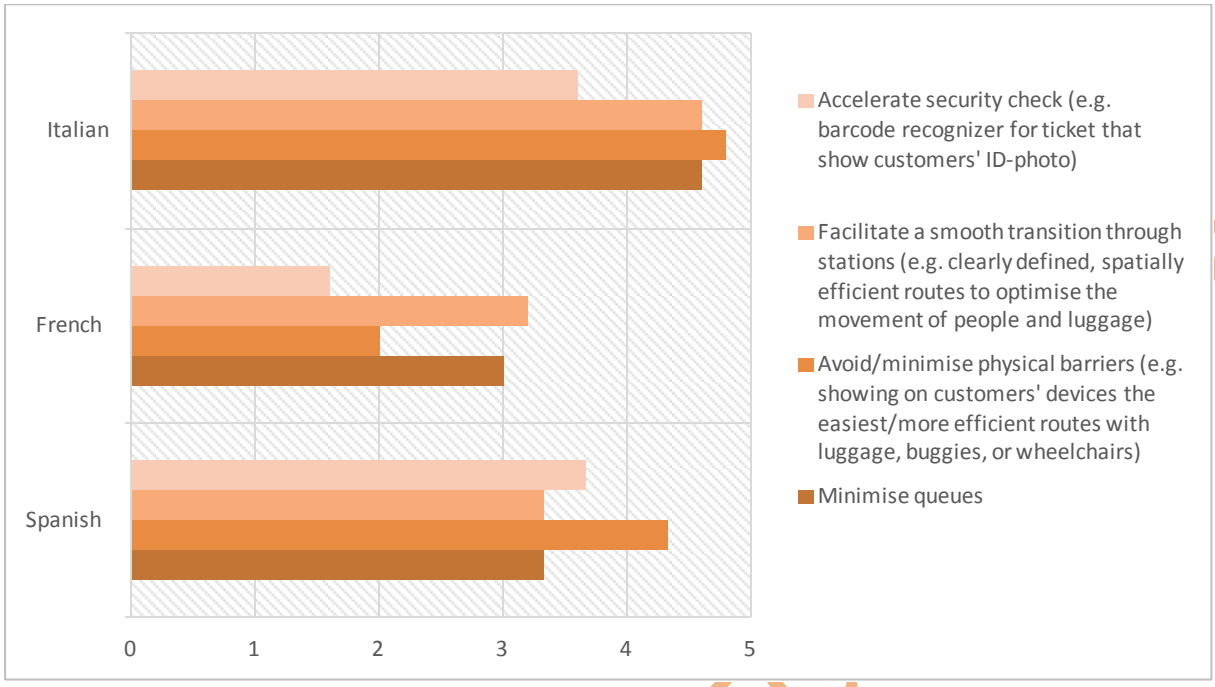




10. Passenger-friendly stations

How important are systems, tools and devices which:





11. *Other*

No Association remarked anything.

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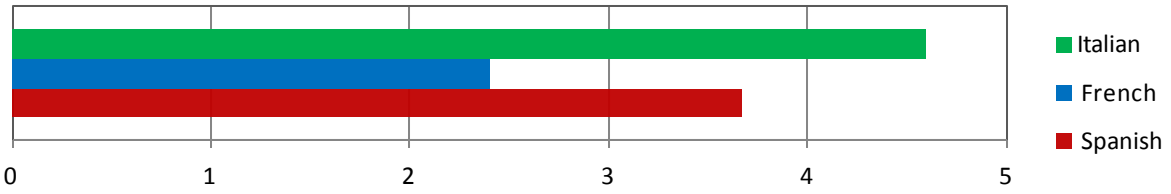
✓ **DURING THE JOURNEY**

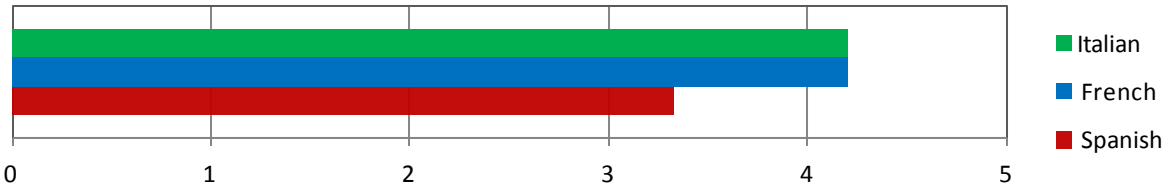
12. Easiness of buying/changing integrated tickets

How important is it that passengers can change train or other mode without losing time, money or effort (e.g. by using advanced technologies and data integration)?



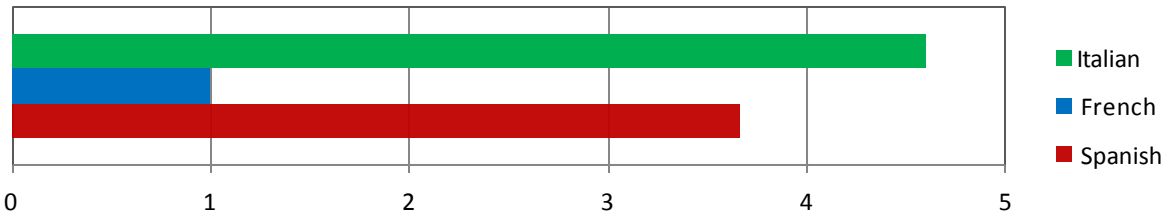
13. Automatic forecasting and suggestions

How important is the availability of journey information and best alternative options in case of certain events, such as delays/disruptions/traffic jams



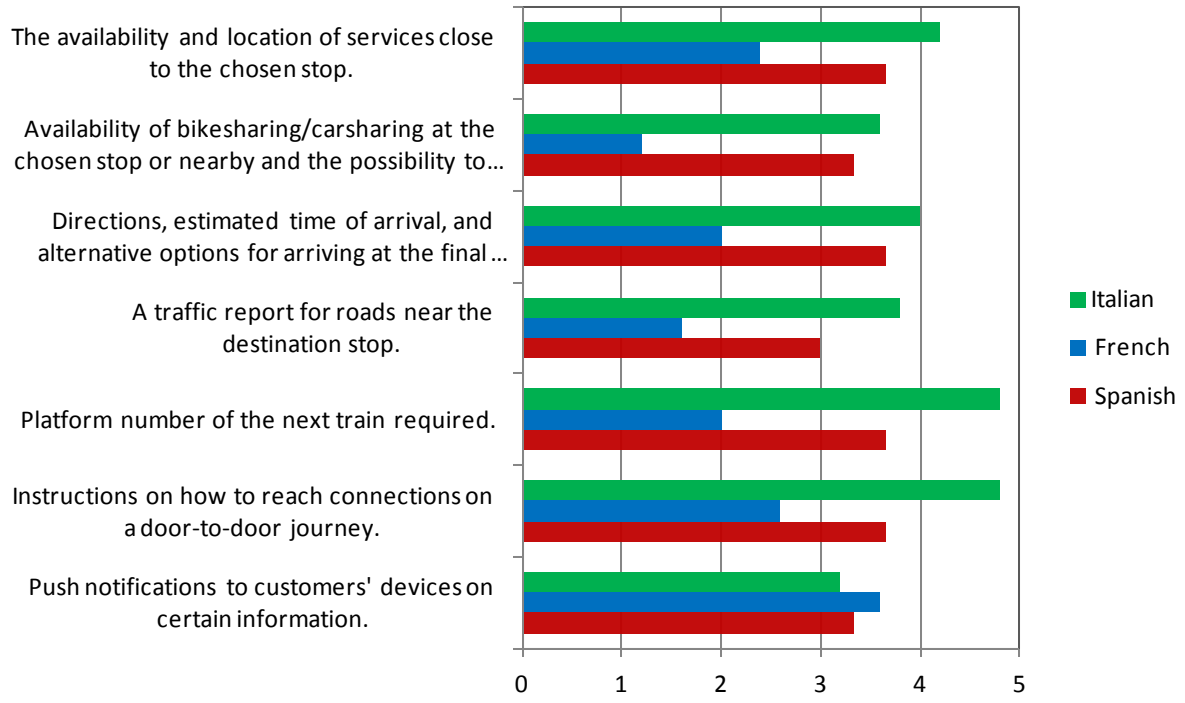
14. Offering passengers the best available ticket on board without having to buy a ticket first

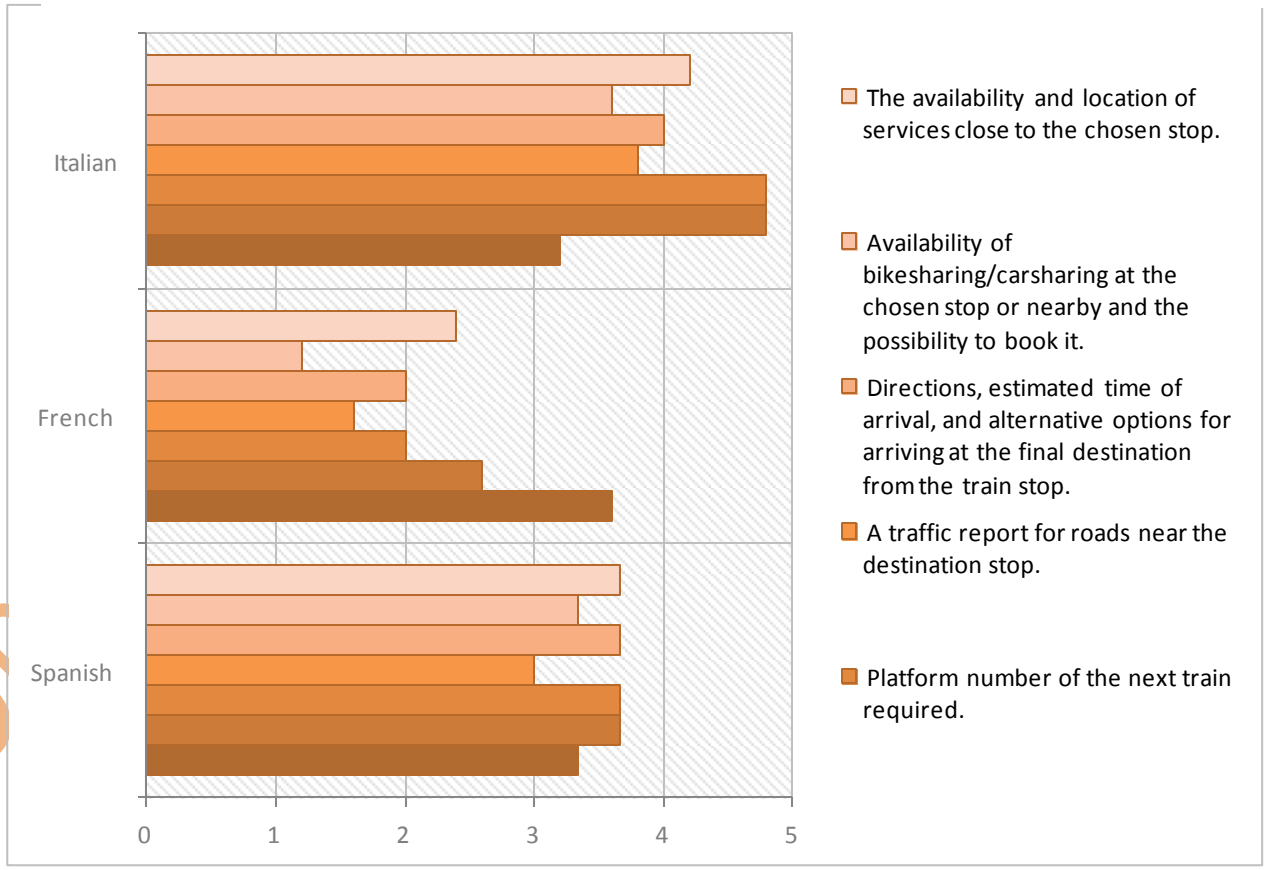
How important are on-board ticket machines or reading devices for tickets/codes on smartphones etc?



15. Intelligent train positioning and infrastructure management

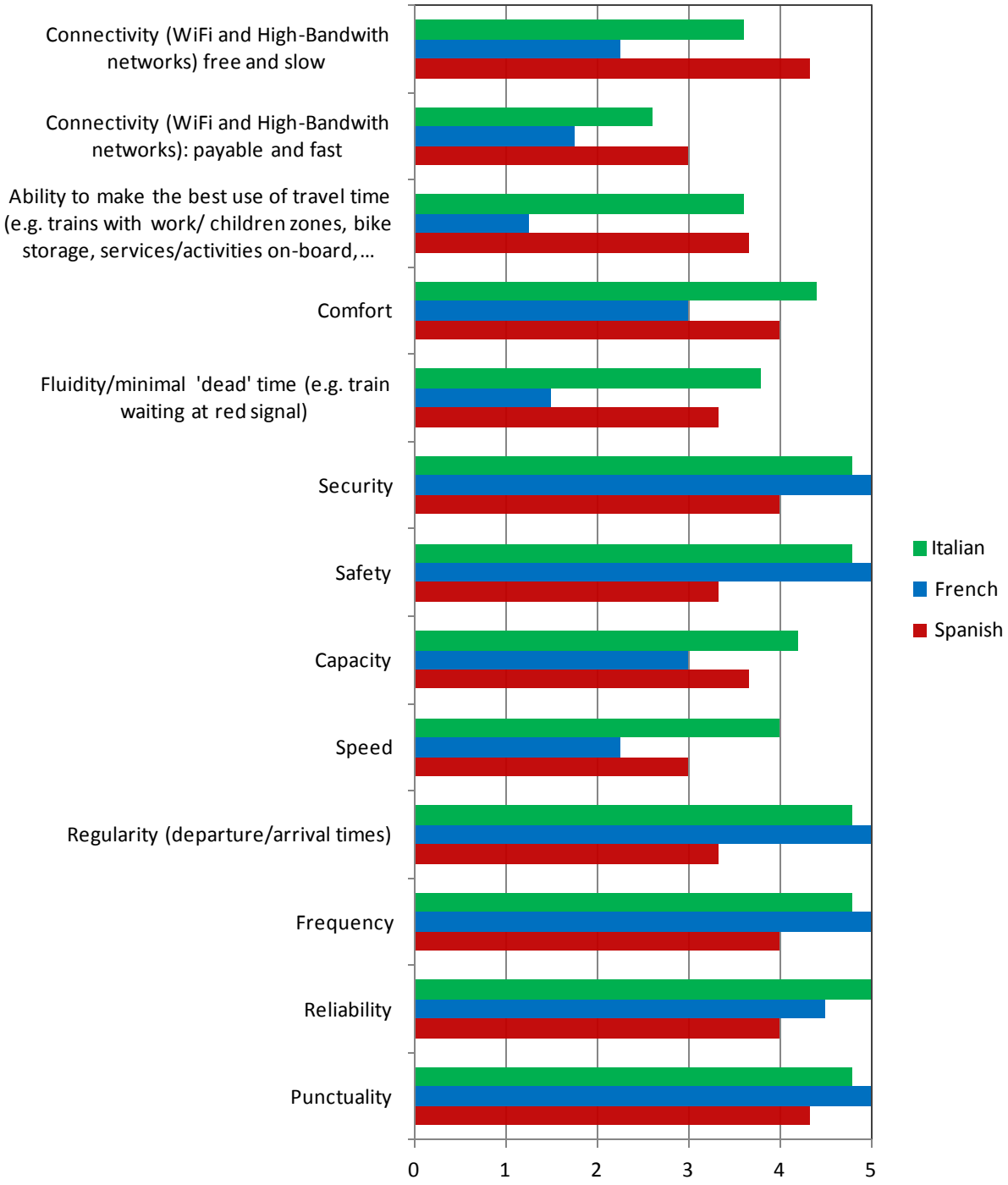
How important is the following on-board information:

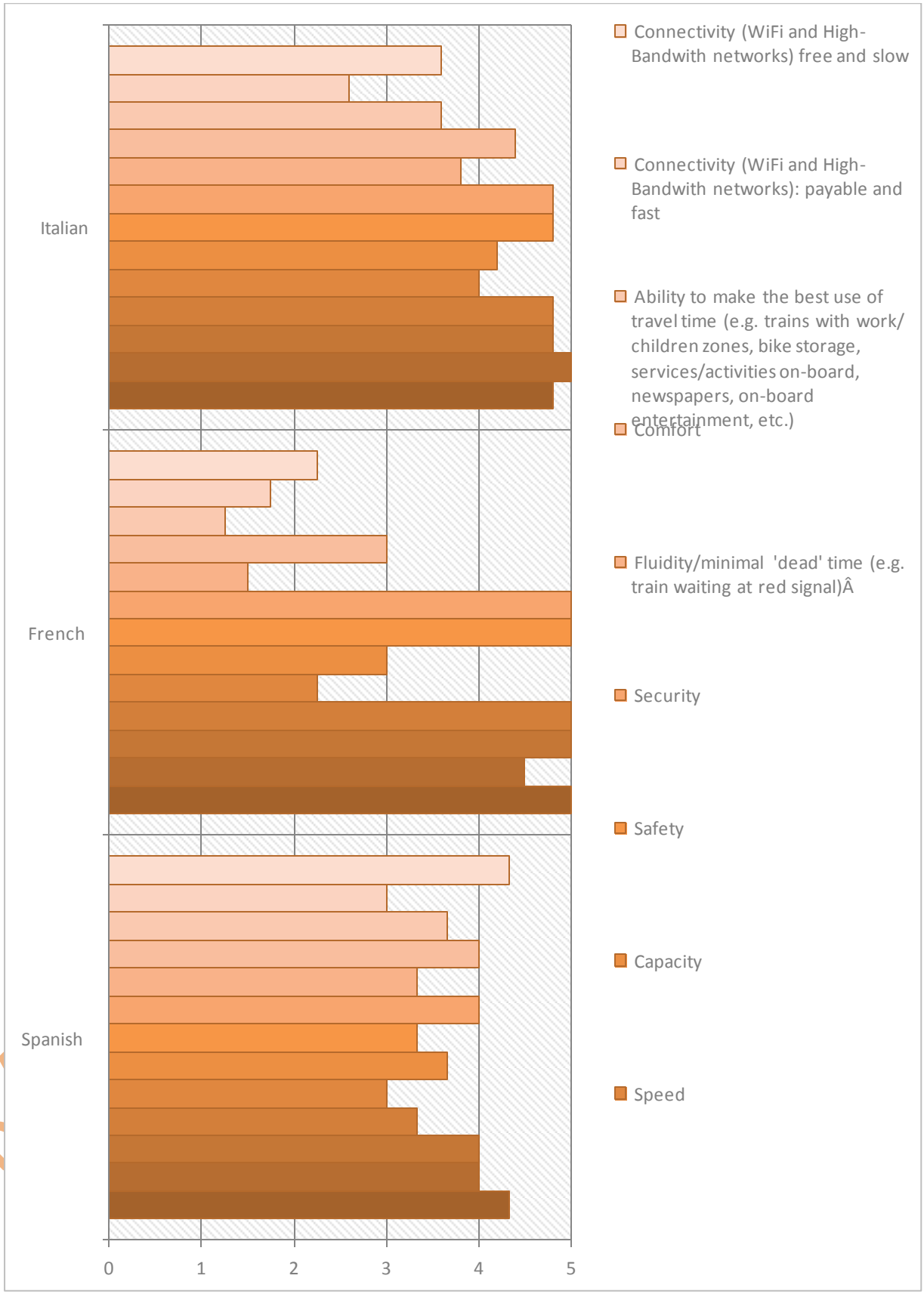




16. For Urban/regional Trains

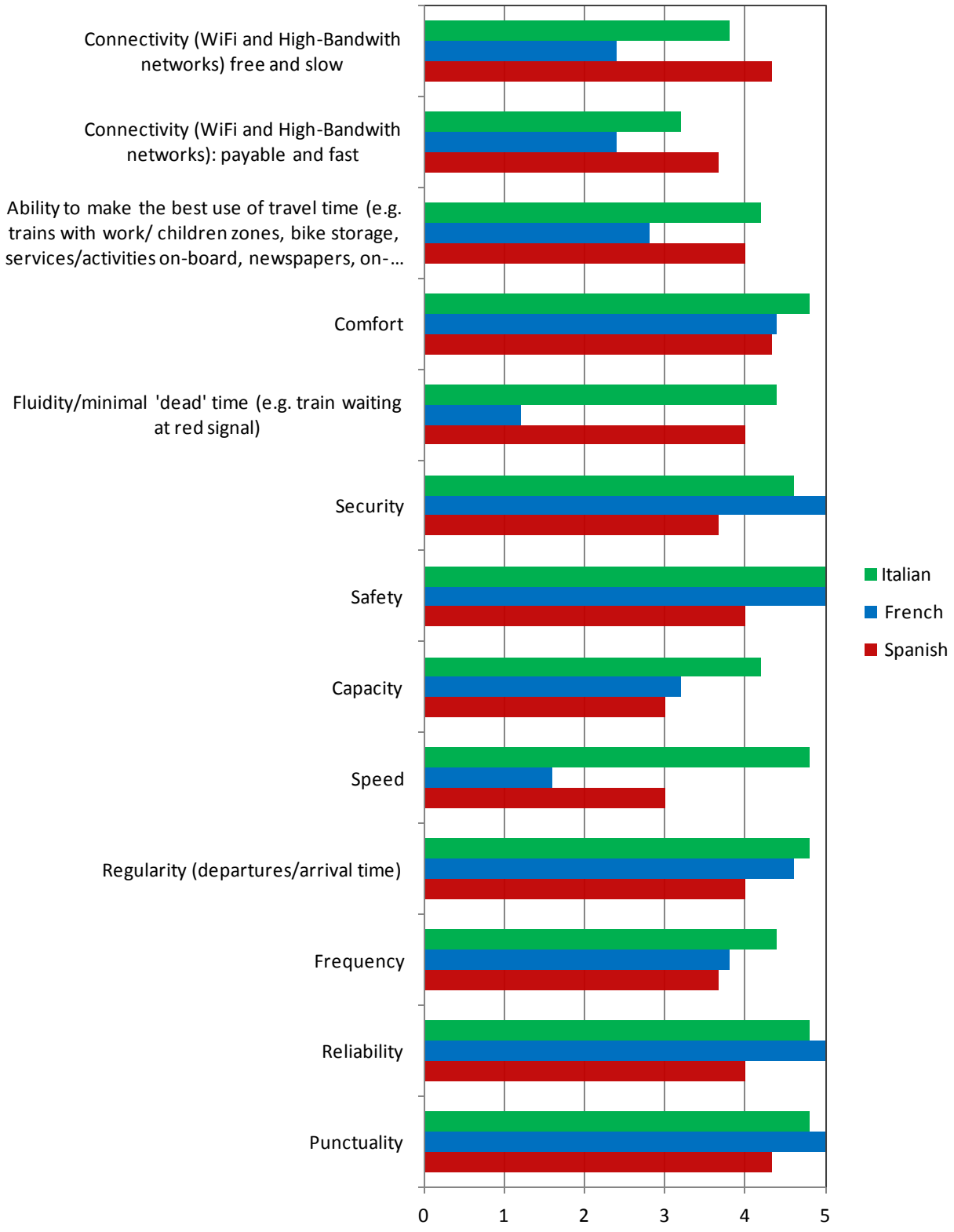
How important are the following aspects:

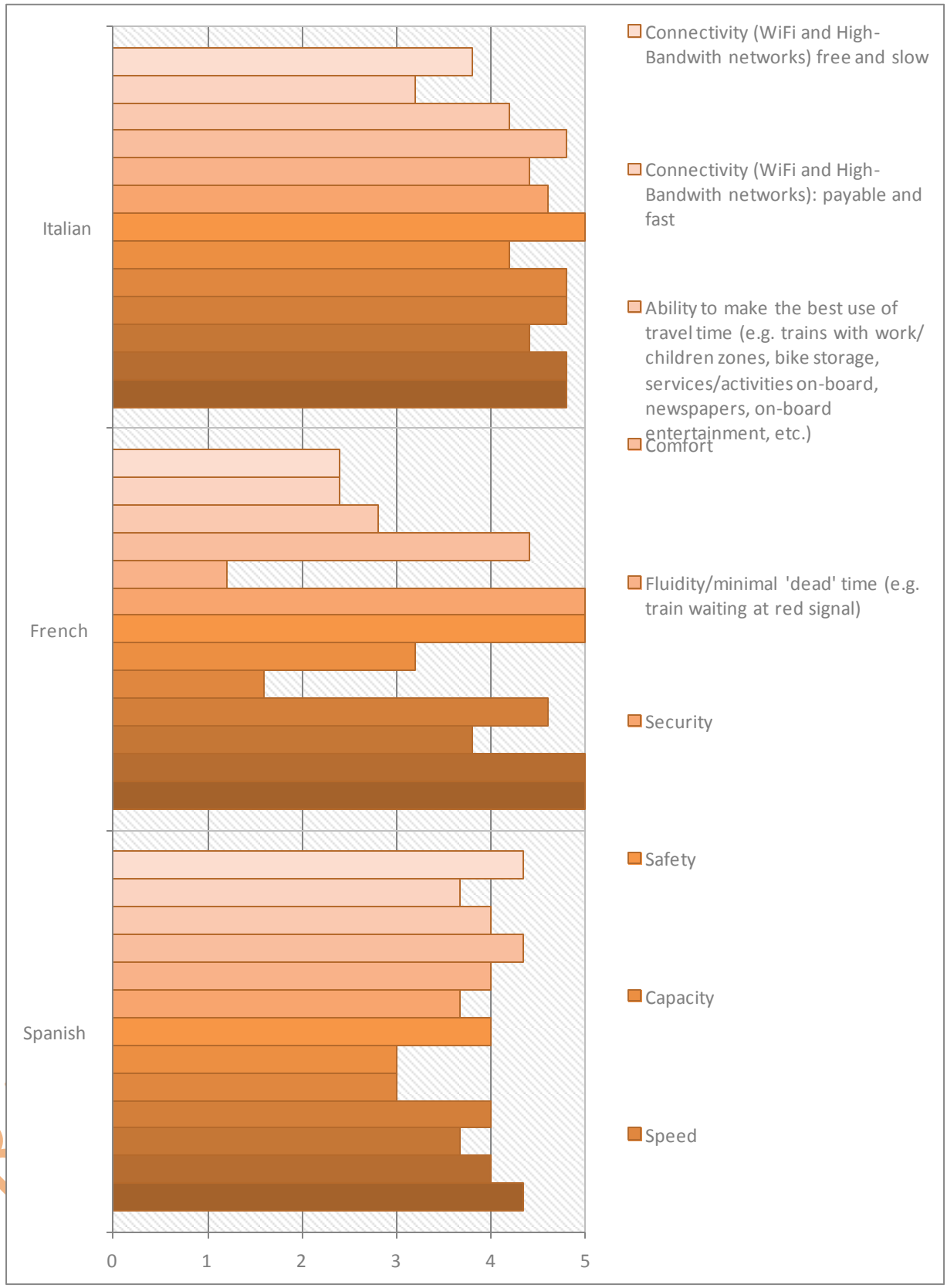



Italian
French
Spanish
0
1
2
3
4
5
Connectivity (WiFi and High-Bandwith networks) free and slow
Connectivity (WiFi and High-Bandwith networks): payable and fast
Ability to make the best use of travel time (e.g. trains with work/ children zones, bike storage, services/activities on-board, newspapers, on-board entertainment, etc.)
Comfort
Fluidity/minimal 'dead' time (e.g. train waiting at red signal)Â
Security
Safety
Capacity
Speed

17. For Long Haul/International Trains:

How important are the following aspects:




Italian
French
Spanish
0
1
2
3
4
5
Connectivity (WiFi and High-Bandwith networks) free and slow
Connectivity (WiFi and High-Bandwith networks): payable and fast
Ability to make the best use of travel time (e.g. trains with work/ children zones, bike storage, services/activities on-board, newspapers, on-board entertainment, etc.)
Comfort
Fluidity/minimal 'dead' time (e.g. train waiting at red signal)
Security
Safety
Capacity
Speed

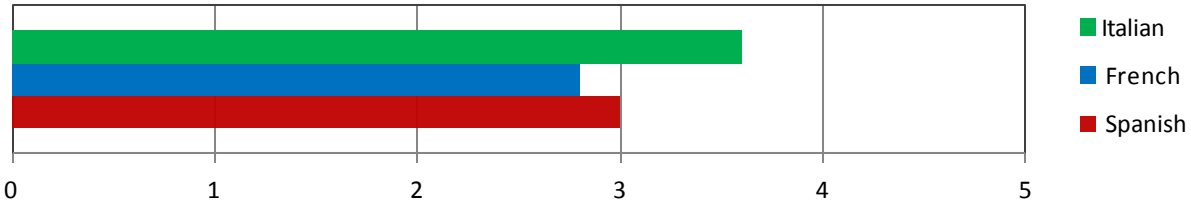
18. New uses

Is there a need to provide new, additional services, particularly for medium/long distance commuters (e.g. shopping/market areas, laundrettes, libraries etc.)? If so, please specify:

Just one "Generic User" Association replied, remarking as interesting to allow to print document on board.

19. Ability to monitor individual carbon use

How important is the availability of information for choosing the most carbon efficient option?



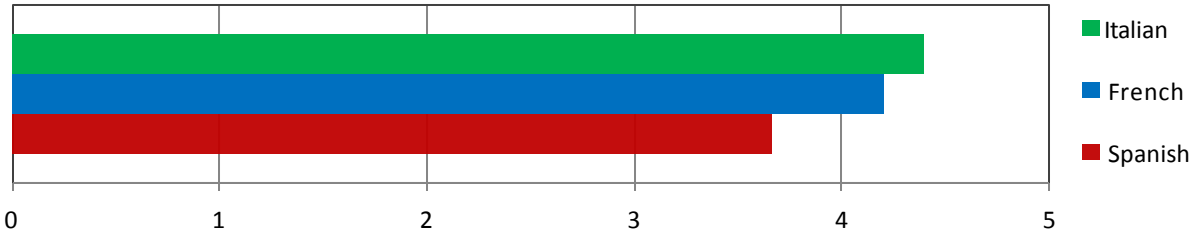
20. *Other*

Just one "Generic User" Association replied, remarking as particularly relevant to guarantee assistance (not better specified) in case of necessity.

✓ **AFTER THE JOURNEY**

21. Feedback

How important is the collection of data and responses from customers to gain their feedback, understand habits, and adjust the capacity/frequency of trains according to demand?



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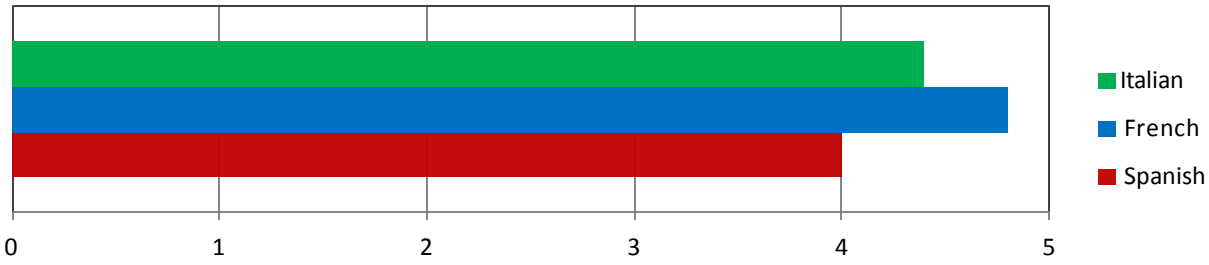
22. Delay reimbursement and complaint-handling

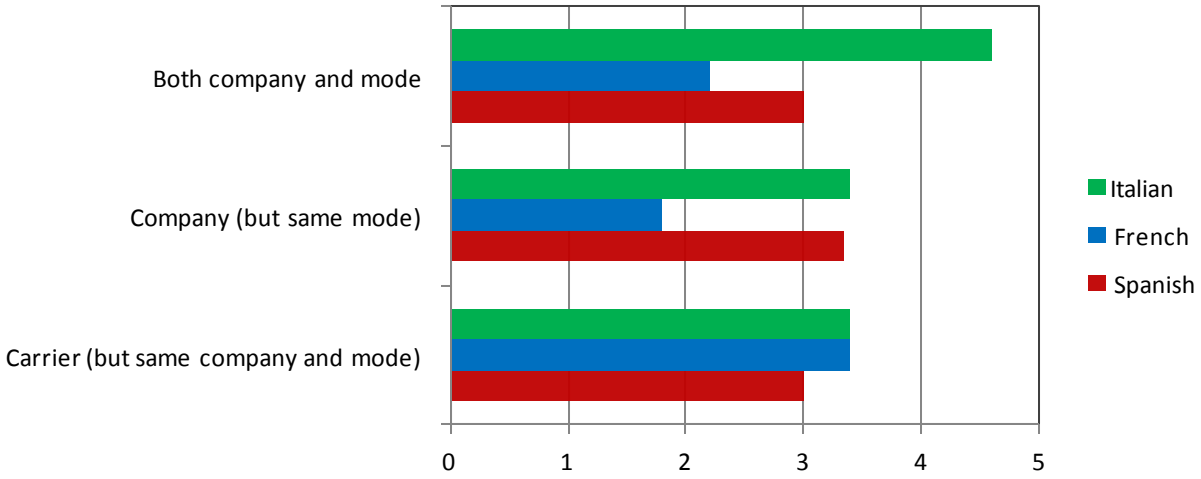
How important is the integration of data to monitor delays and their causes in order to automatically refund passengers?

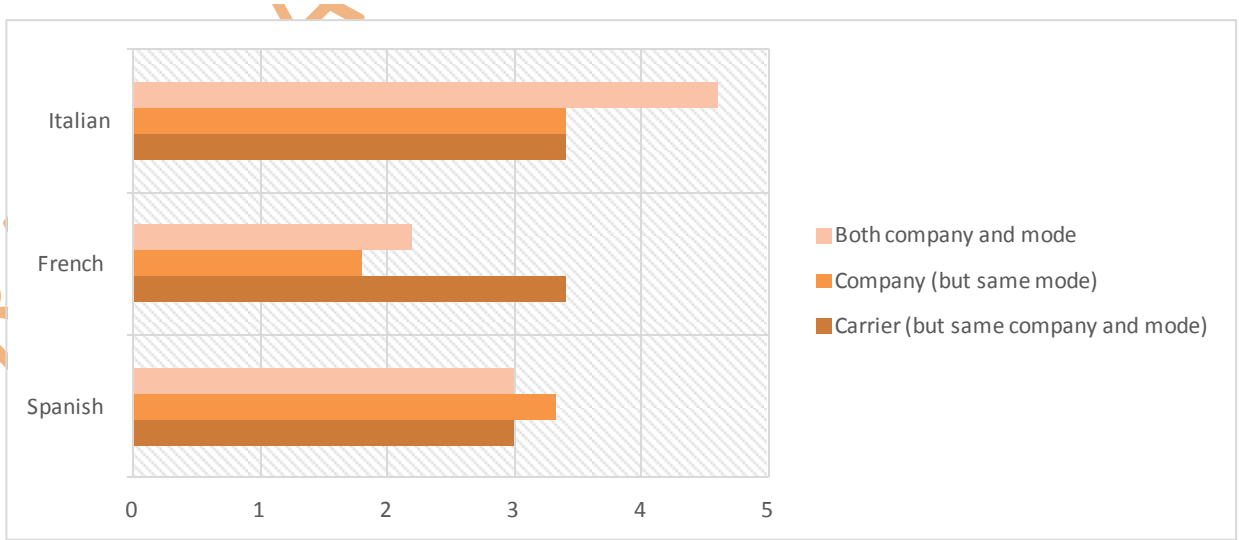


✓ **INTERMODALITY**

23. Availability of through-tickets

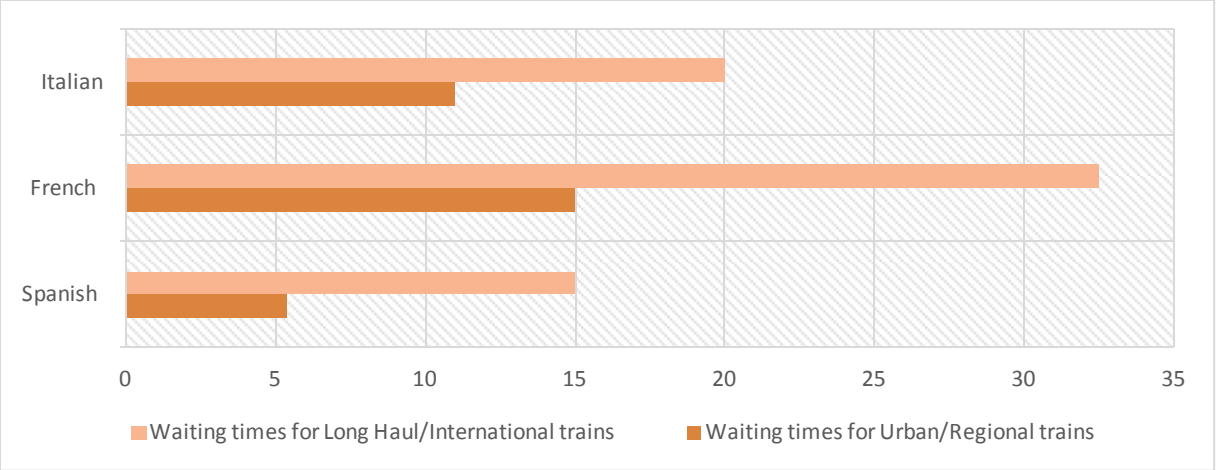
How important is it to be able to change the following while using the same ticket:





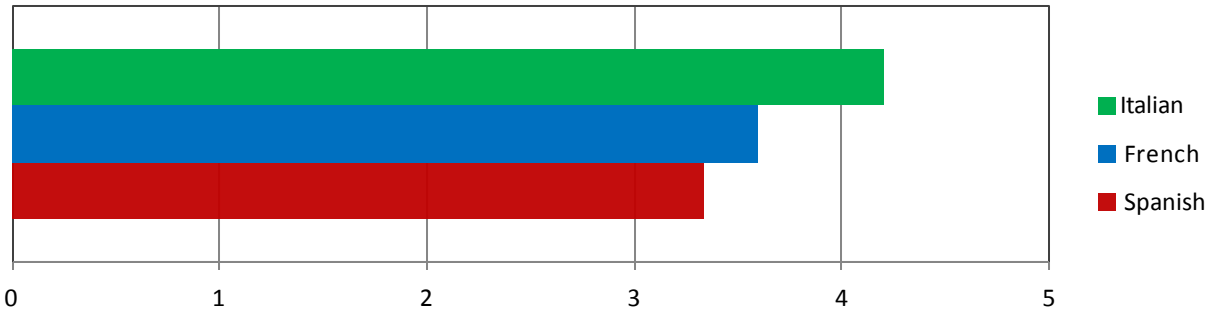
24. Waiting times for Urban/Regional trains, and:
25. Waiting times for Long Haul/International trains

What is the maximum tolerable waiting time (in minutes)?



26. Alternative services

How important is the availability of alternative services/modes for the same route?



27. Car Parking
28. Bike Sharing

How important is the availability of carparking/bikesharing near the station?

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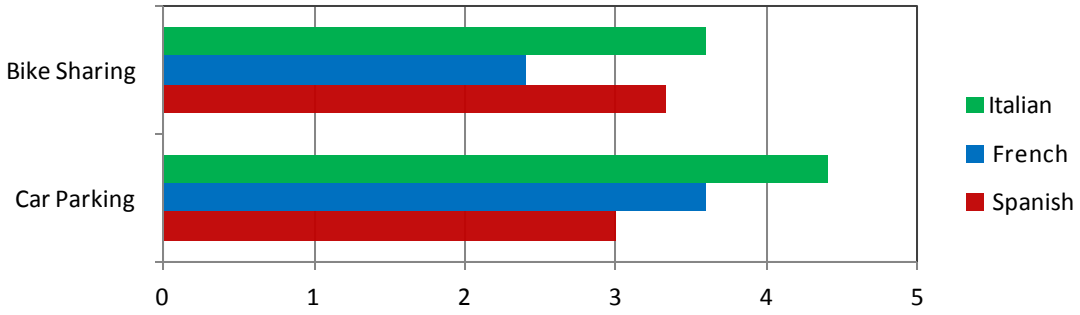

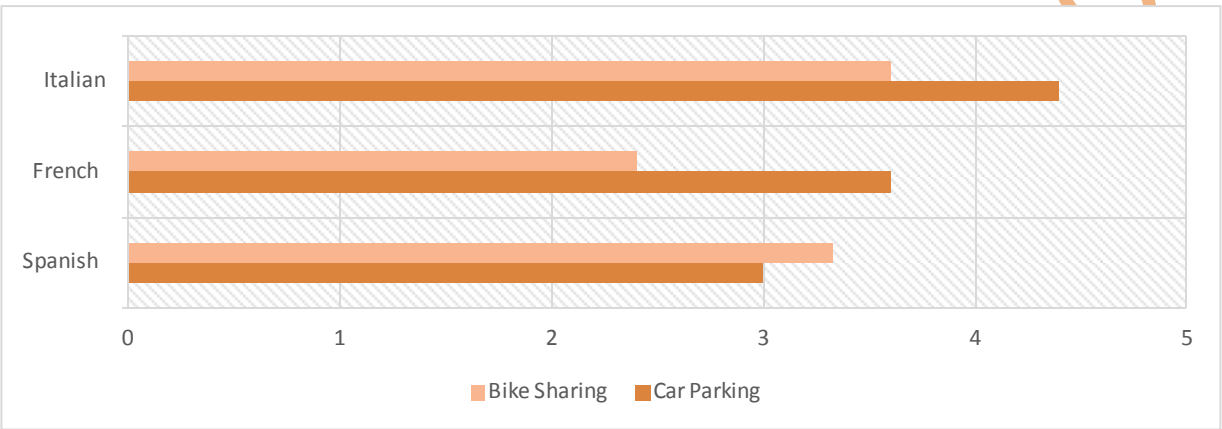

29. Other modes of transport

How important is the availability of other modes of transport near the station?

Only four associations (three of them specialised for PRMs) considered as particularly relevant:

- The improvement of new electric means of transportation,
- The improvement of car assistance for PMRs,
- The deployment of a car sharing service fitted for PRMs,
- The provision of taxi and buses accessible to PRMs.

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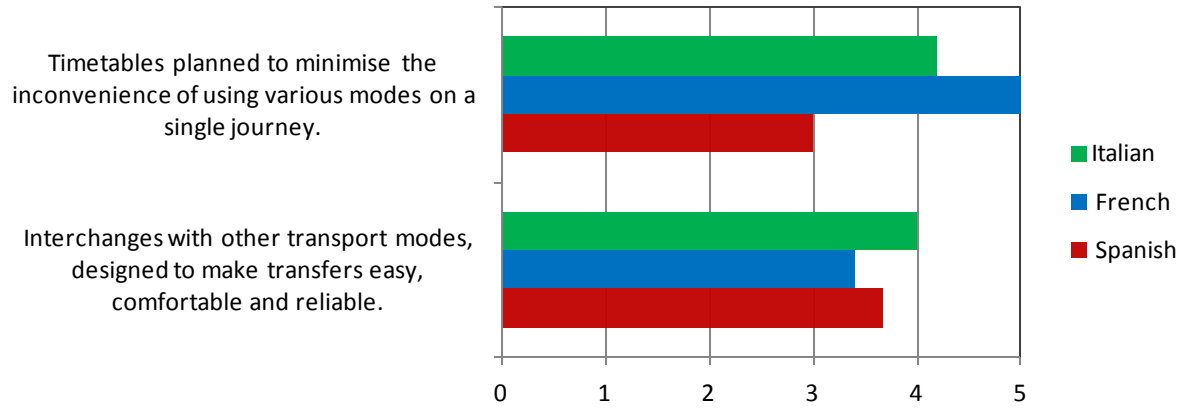
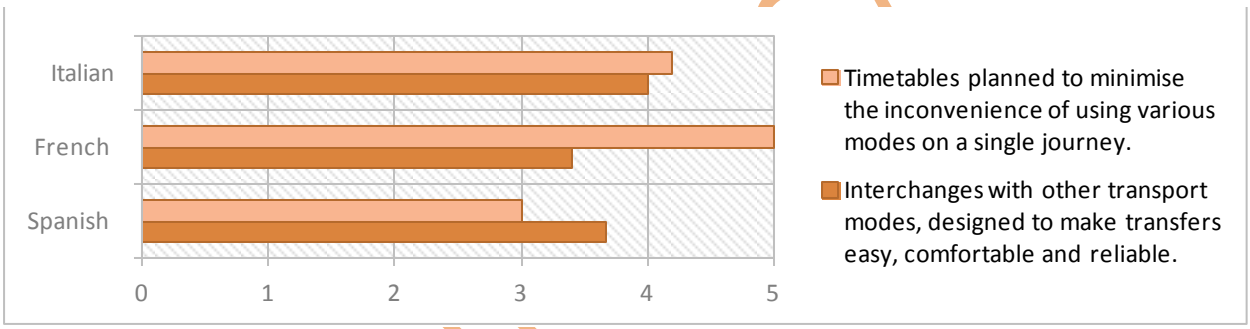
30. Connections

For a well-designed transport system, how important are:





31. *Other*

No Association remarked anything.

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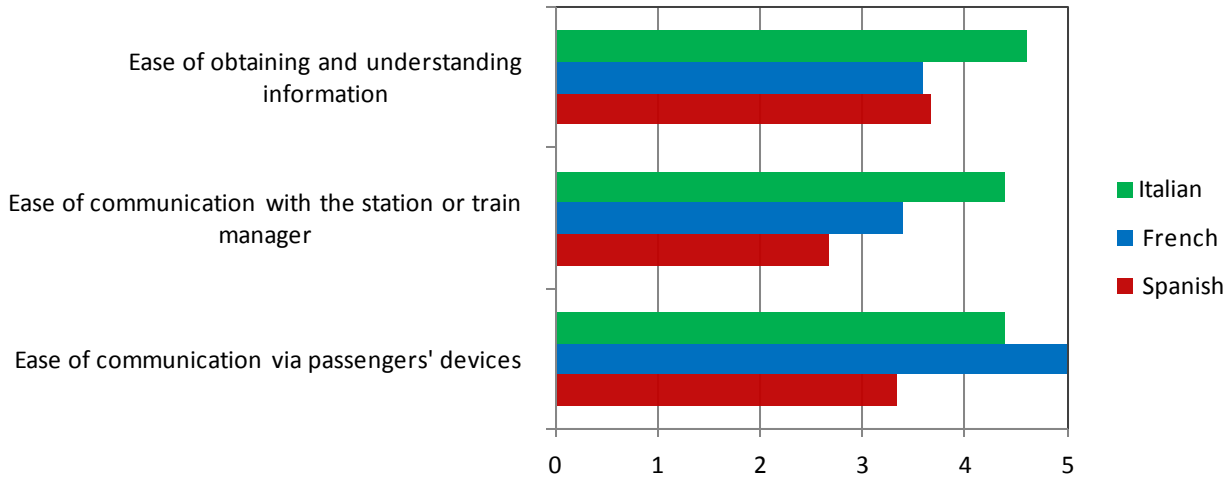
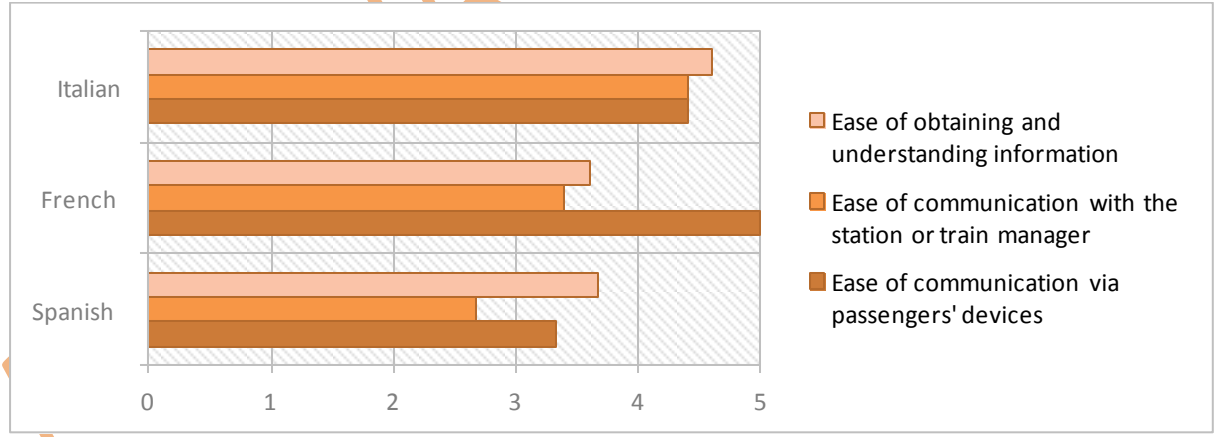
✓ **INFORMATION**

32. **Ease of communication via passengers' devices**
33. **Ease of communication with the station or train manager**
34. **Ease of obtaining and understanding information (creating a standard for terminology and format across different service providers for presenting information to the customer)**





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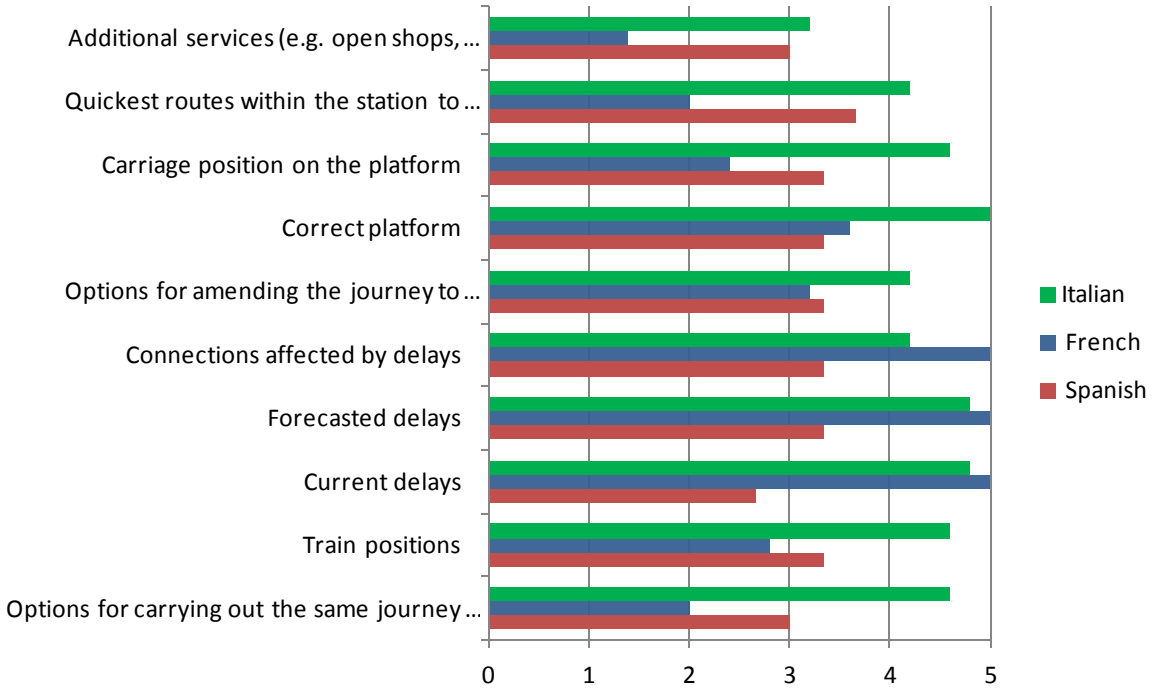
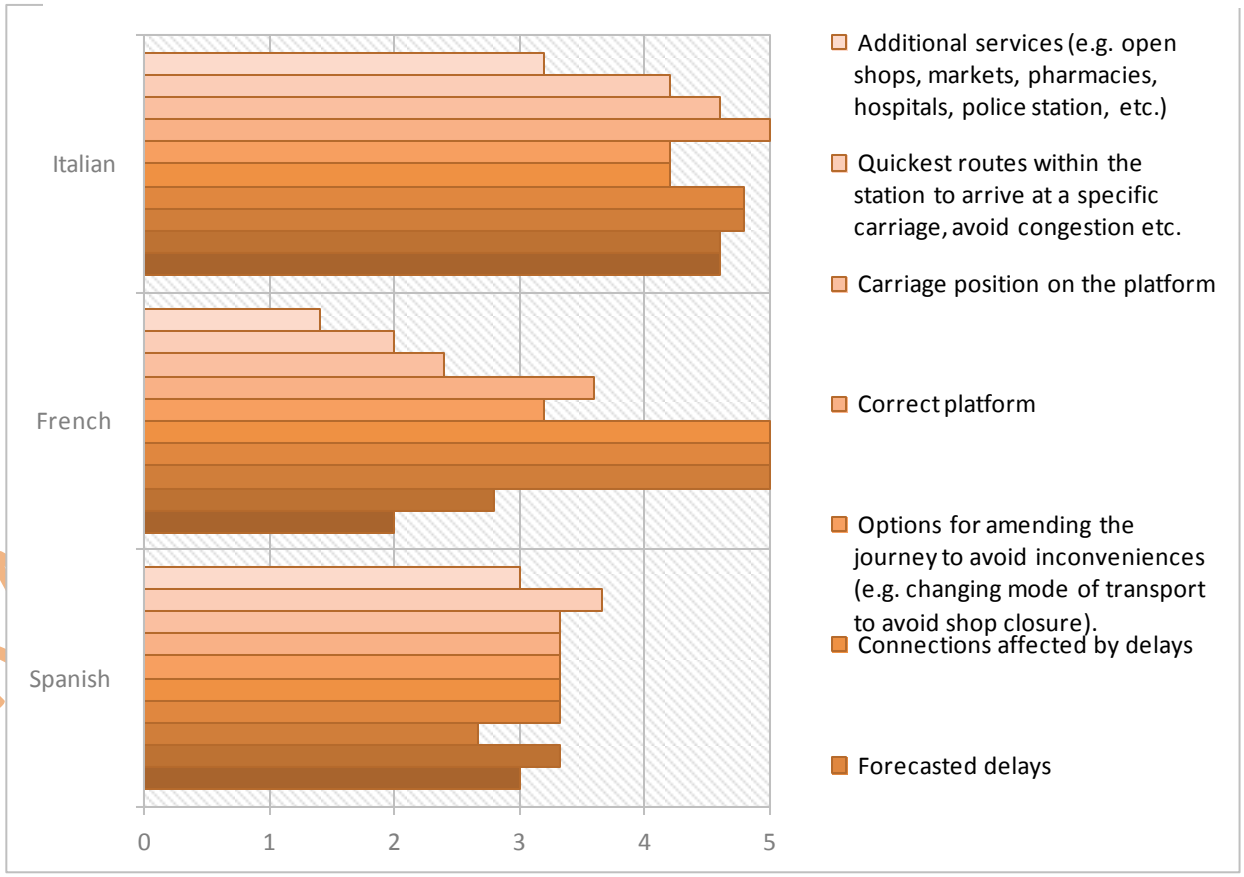
35. Availability of real-time information on customer devices and the Internet

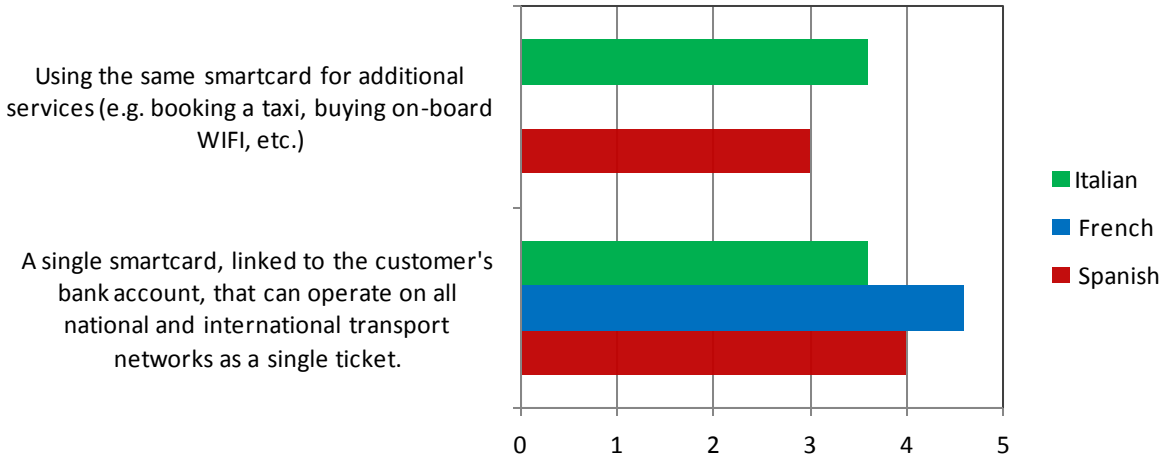
How important is the provision of the following information?





36. New technologies to improve interoperability between all transport modes (*)

Assuming that paper tickets will be phased out and replaced with a single smartcard, how important would the following be:



(*) Nota Bene: for the first proposal, no French Associations responded.

37. *Others*

No comments added.

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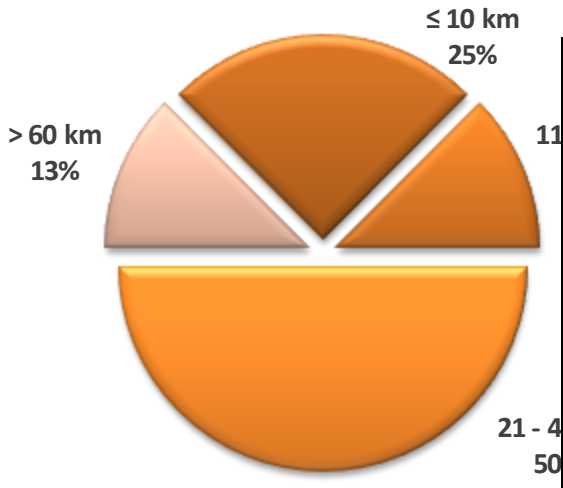
SECTION C – PRECISIONS ABOUT URBAN/REGIONAL JOURNEYS

NOTA BENE: NOT ALL ASSOCIATIONS REPLIED TO "SECTION C".

NOTABLY, DESPITE ANY OFFICIAL STATISTICS, THE RESULTS FROM THIS SECTION SHOW THAT THE TRAIN IS NOT CONSIDERED TO BE THE SAFEST MODE (SEE QUESTION N°53/F, TO WHICH MOSTLY "PRM" ASSOCIATIONS RESPONDED).

THIS SUGGESTS THAT THERE IS AN OPPORTUNITY FOR CAMPAIGNS TO PROMOTE THIS UNQUESTIONABLE BENEFIT OF RAIL TRANSPORTATION WHICH IS EVIDENTLY STILL NOT PUBLICLY RECOGNISED.

50. On average, how many kilometers are travelled per day by those represented by your Organization?



Options Availables	# of replies
≤ 10 km	2
11 - 20 km	1
21 - 40 km	4
41 - 60 km	-
> 60 km	1

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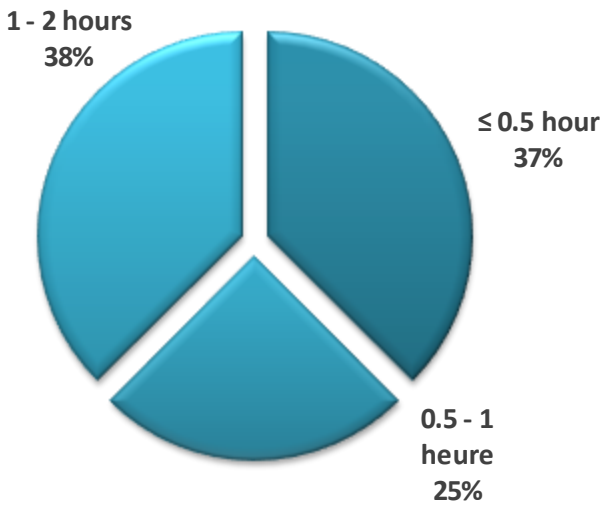
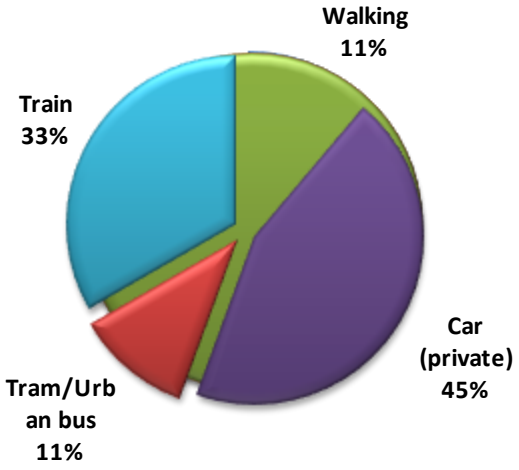
51. Per normal day, how much time do they spend commuting (across all transport modes)?



Options Availables	# of replies
≤ 0.5 hour	3
0.5 - 1 heure	2
1 - 2 hours	3
2 - 3.5 hours	-
>3.5	-

52. Which mode(s) of public transport is (are) used most for regular/daily journeys?

a. From home to workplace/school/university, and the return



Walking	1
Cycle	
Motorcycle	
Car (private)	4
Taxi	
Car sharing	
Car pooling	
Tram/Urban bus	1
Extra-urban bus	
Underground	
Train	3
Ferry/car-ferry	

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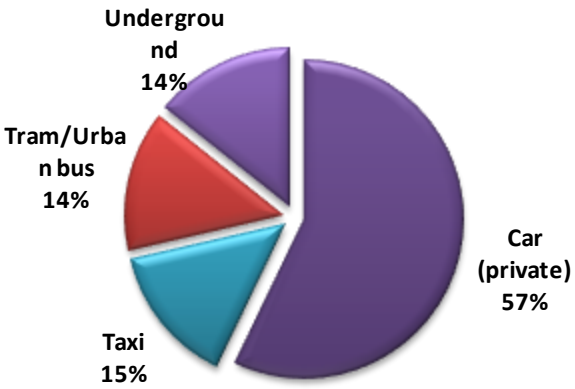
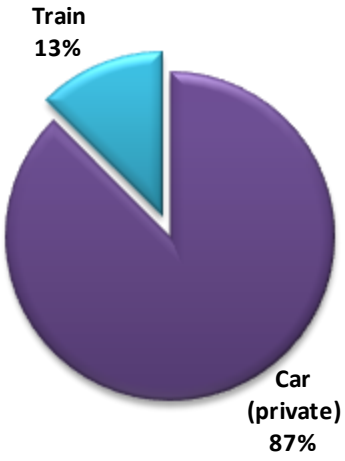
b. Shop/errands



Walking	-
Cycle	-
Motorcycle	-
Car (private)	4
Taxi	1
Car sharing	-
Car pooling	-
Tram/Urban bus	1
Extra-urban bus	-
Underground	1
Train	-
Ferry/car-ferry	-

c. Family commitments
(e.g. taking children to school, attending a medical appointment)



Walking	-
Cycle	-
Motorcycle	-
Car (private)	7
Taxi	-
Car sharing	-
Car pooling	-
Tram/Urban bus	-
Extra-urban bus	-
Underground	-
Train	1
Ferry/car-ferry	-

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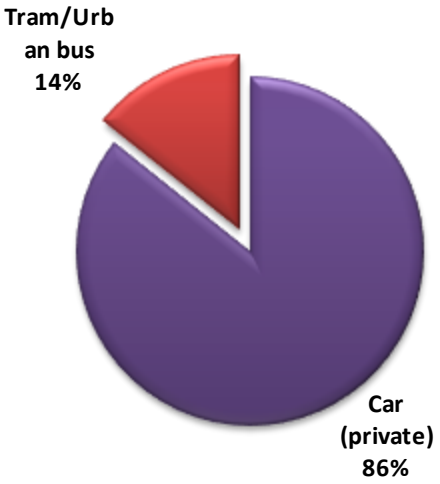
d. Leisure time (e.g. cinema, sport)



Walking	-
Cycle	-
Motorcycle	-
Car (private)	6
Taxi	-
Car sharing	-
Car pooling	-
Tram/Urban bus	1
Extra-urban bus	-
Underground	-
Train	-
Ferry/car-ferry	-

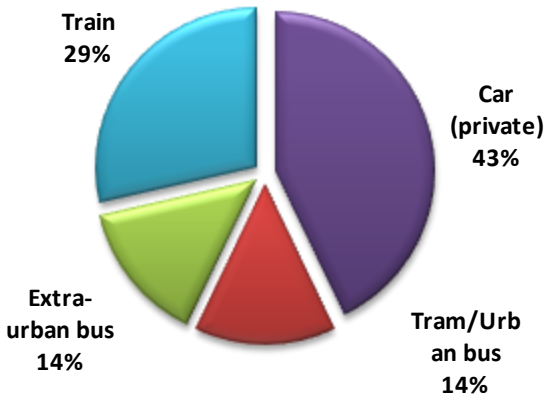
e. Other

Only one PRM association replied, adding "car assistance for disabled" as a used mode.

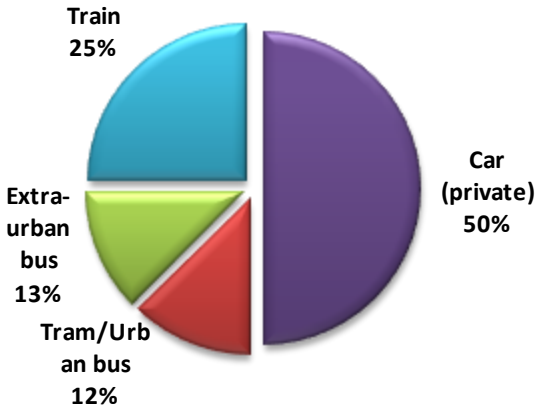
53. Why is a particular mode preferred?

MODAL OPTIONS WERE THE SAME OF QUESTION N°52

a. It is more comfortable



b. It is more reliable



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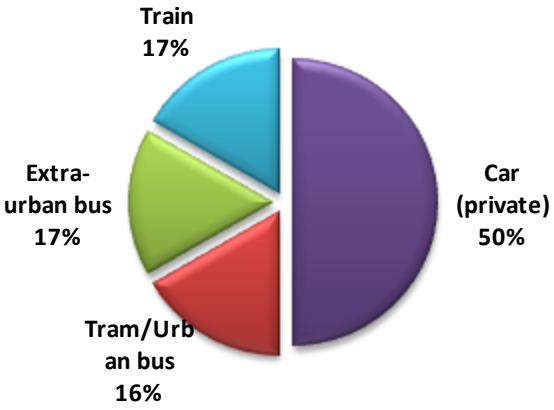
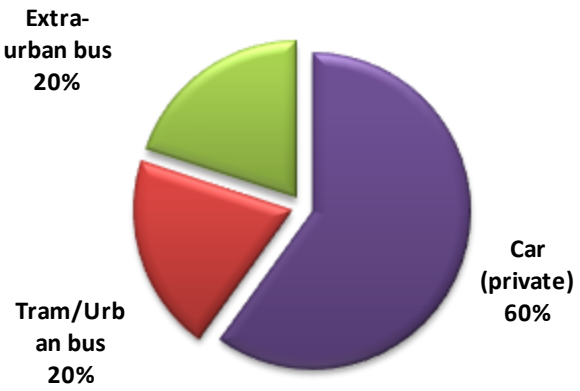
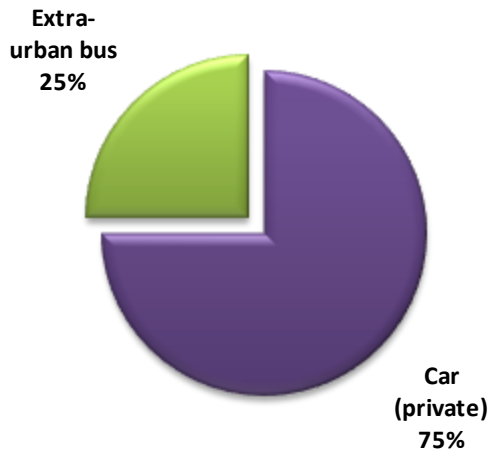
c. It is more flexible (free from timetable limitations)



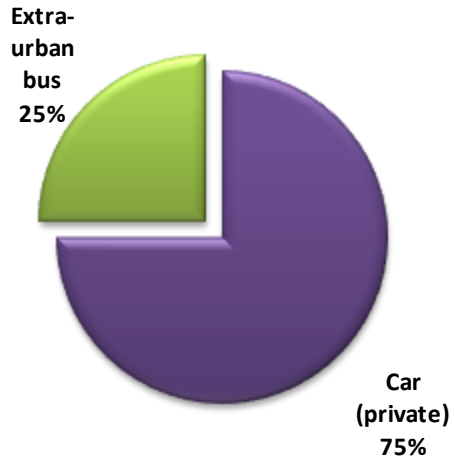
d. It is more accessible



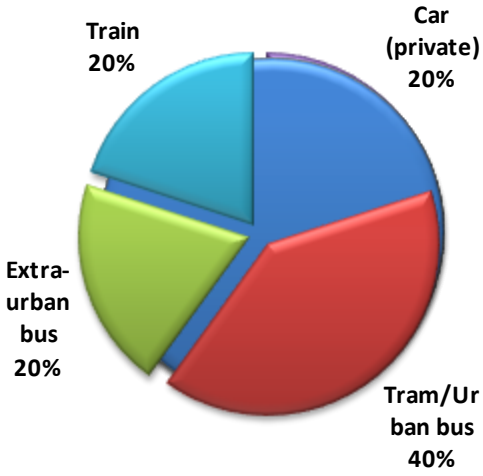
e. It is more secure (e.g. there is less pickpocketing)



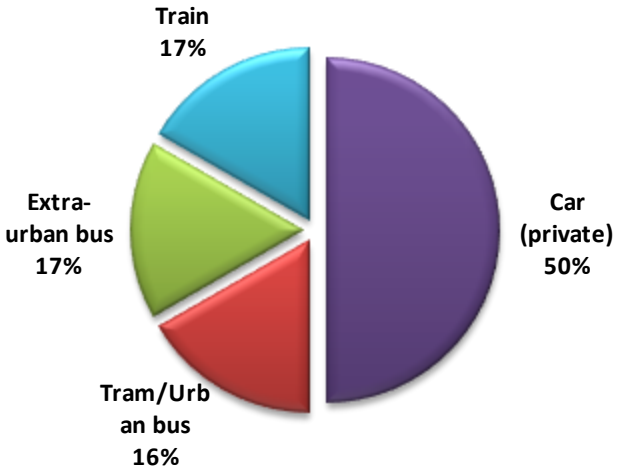
f. It is safer



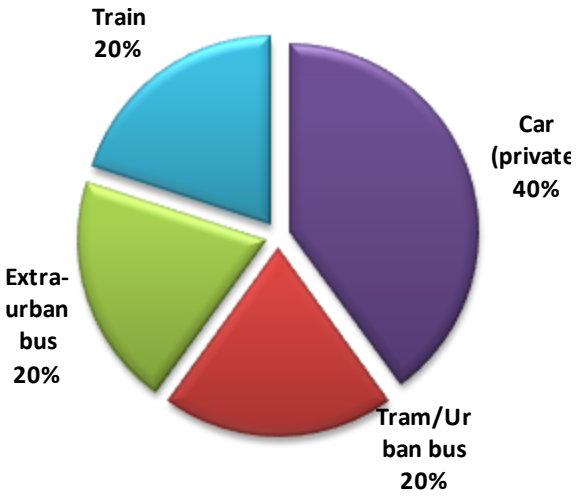
g. It is cheaper



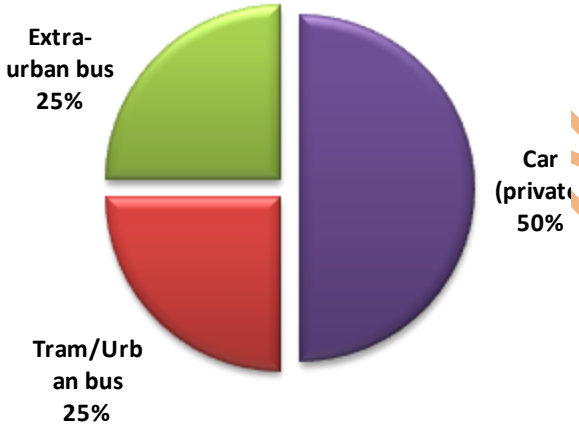
h. *It is faster*



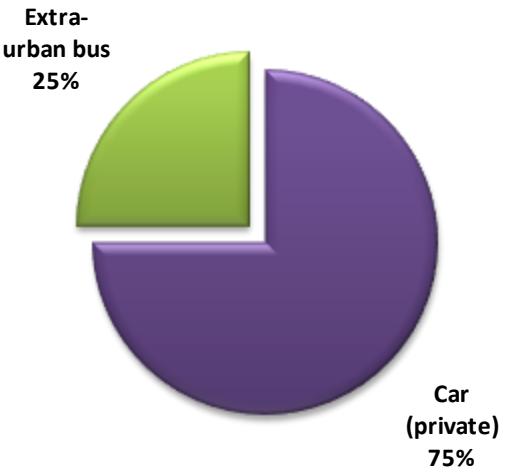
i. It is environmentally friendly



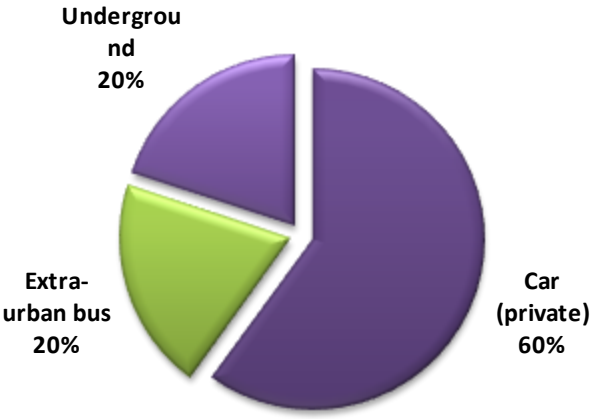
j. It has more connections



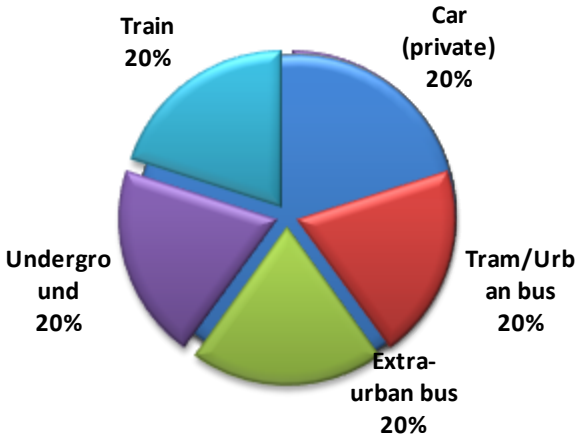
k. It requires less changes in the same journey



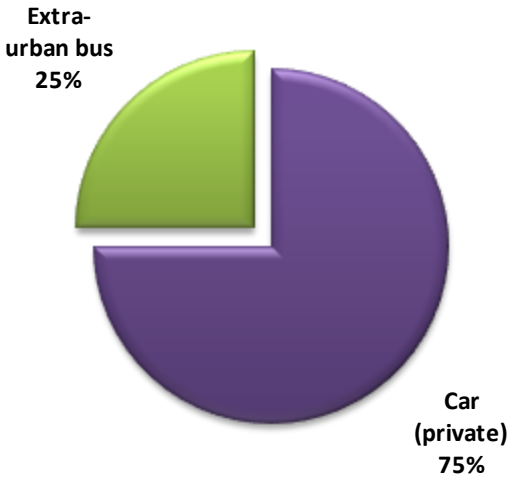
l. It offers complementary services (e.g. WiFi or bicycle access)



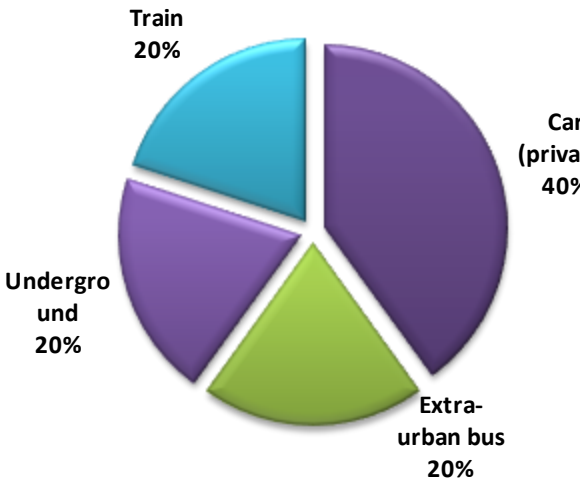
m. It is possible to work during the journey



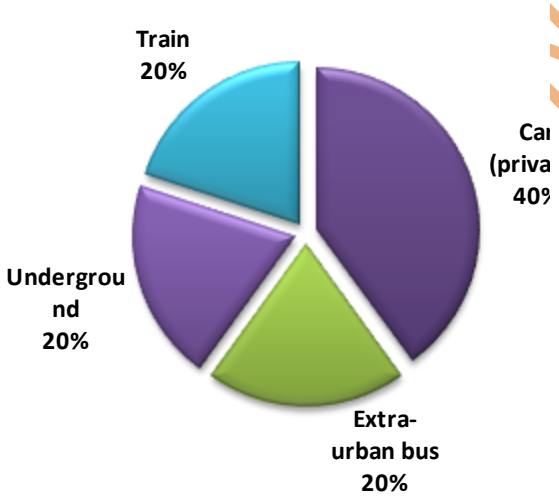
n. It is possible to carry as much luggage as desired



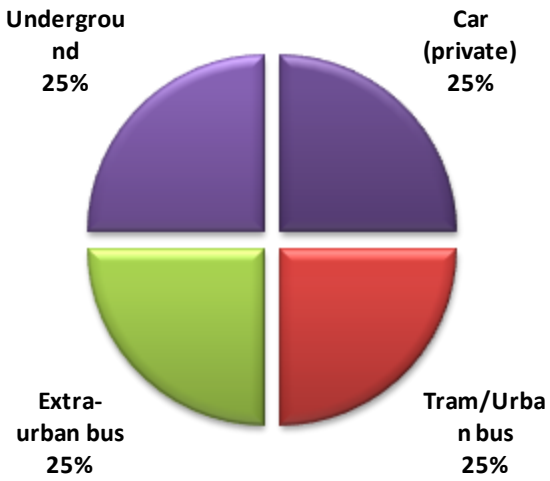
o. *It is possible to travel with as many people as desired*



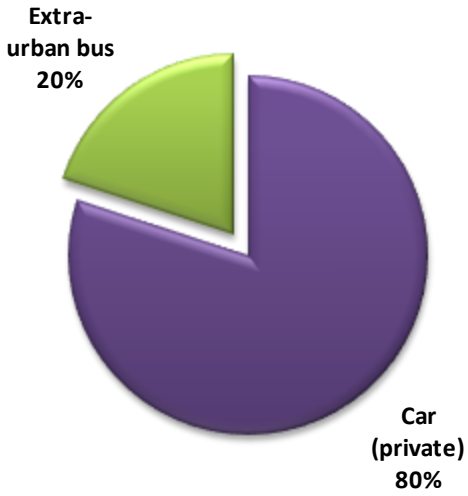
p. *It is possible to carry out leisure activities during the journey (e.g. reading, talking, watching videos)*



q. *It is free from traffic congestion*



r. *Other options are unavailable*



s. *Other*

No Association remarked anything.

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SECTION D - PRECISIONS ABOUT LONG HAUL / INTERNATIONAL JOURNEYS

NOTA BENE: NOT ALL ASSOCIATIONS REPLIED TO "SECTION D".

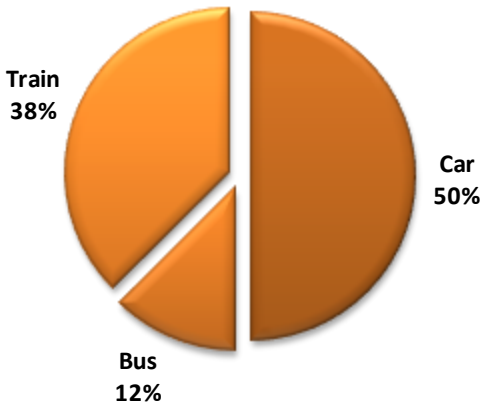
54. During an average year, how many times do those represented by your organisation make long-distance journeys, nationally and/or abroad?

Long-distance is considered to be more than 250 km (e.g. Seville-Barcelona, Paris-Toulouse, Rome-Turin, London-Glasgow, or Genoa-Strasbourg)

Options Availables	# of replies
0	-
1-5	7
6-10	-
11-20	1
>20	-

55. If > 0 , which mode of transport do they tend to use for which travel purpose?

a. *Work/study*



Options Availables	# of replies
Car	4
Bus	1
Train	3
Airplane	-
Ferry	-

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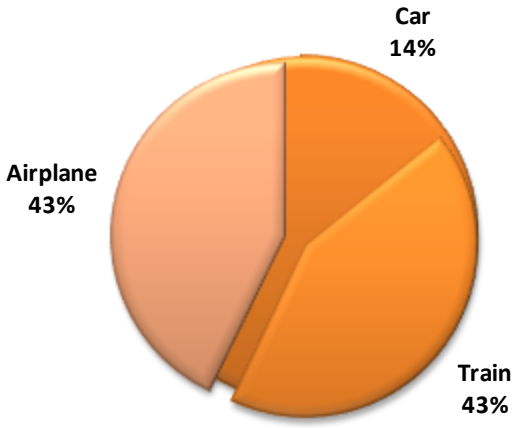
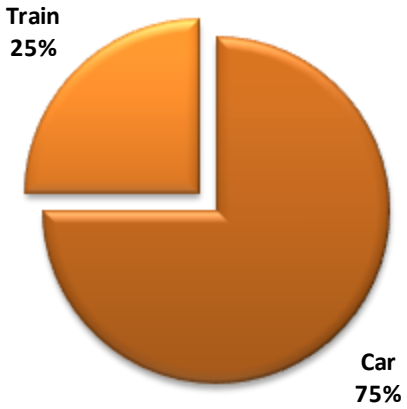
b. Holiday/leisure



Options Availables	# of replies
Car	1
Bus	-
Train	3
Airplane	3
Ferry	-

c. Health



Options Availables	# of replies
Car	3
Bus	-
Train	1
Airplane	-
Ferry	-

d. Other

No Association remarked anything.

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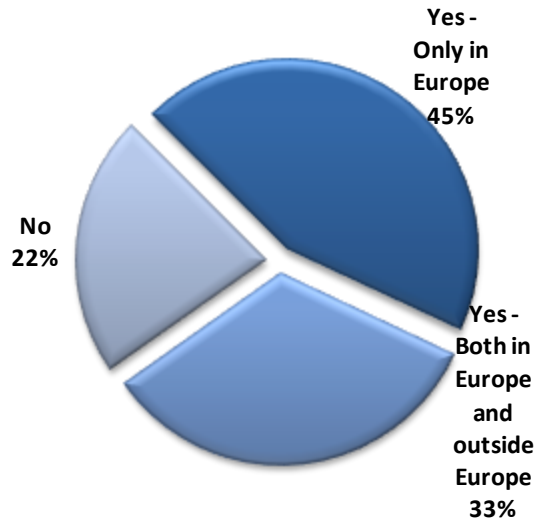
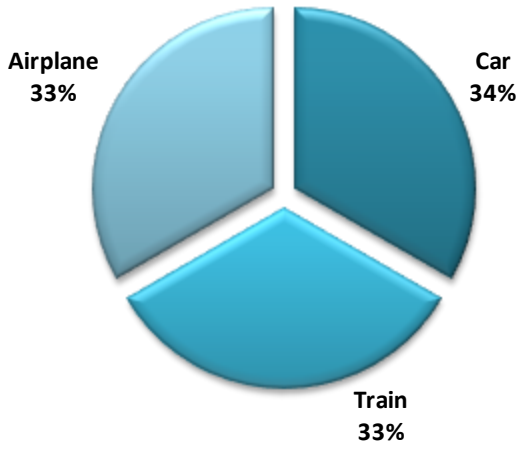
56. During the last two years, have they travelled abroad at least once?



Options Availables	# of replies
Yes - Only in Europe	4
Yes - only outside Europe	-
Yes - Both in Europe and outside Europe	3
No	2

57. If "yes", which mode of transport did they use for which purpose of travel?

a. *Work/study*



Options Availables	# of replies
Car	2
Bus	-
Train	2
Airplane	2
Ferry	-

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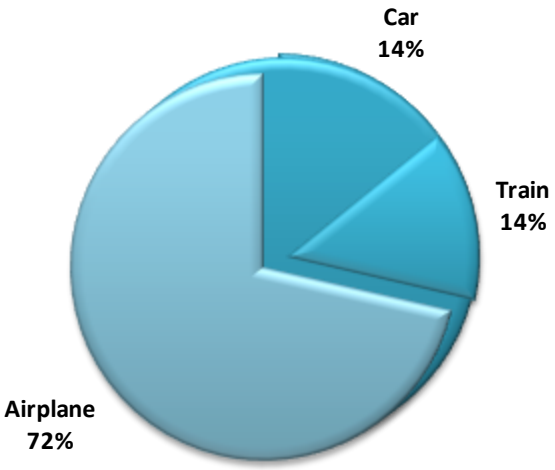
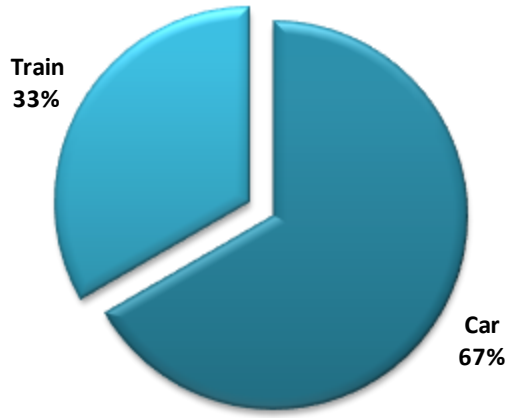
b. *Holiday/leisure*



Options Availables	# of replies
Car	1
Bus	-
Train	1
Airplane	5
Ferry	-

c. *Health*



Options Availables	# of replies
Car	2
Bus	-
Train	1
Airplane	-
Ferry	-

d. Other

No Association remarked anything.

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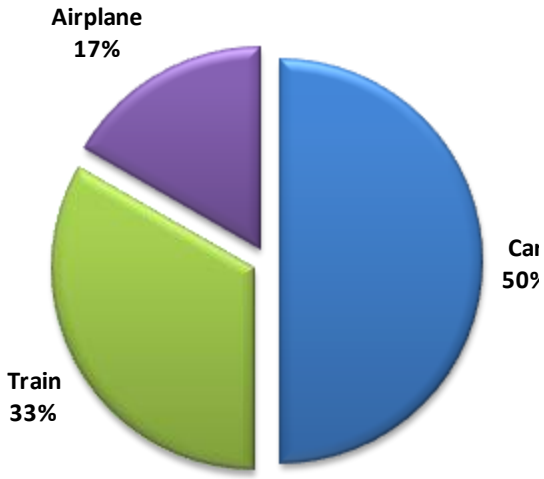
58. Why is each mode preferred for long haul/international journeys?

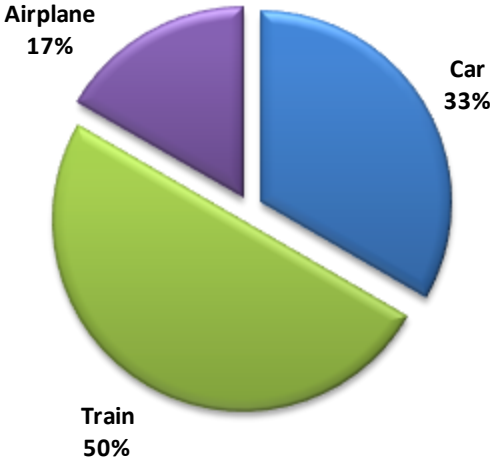
MODAL OPTIONS WERE THE SAME OF QUESTION N°55 AND N°57

a. *It is more comfortable*

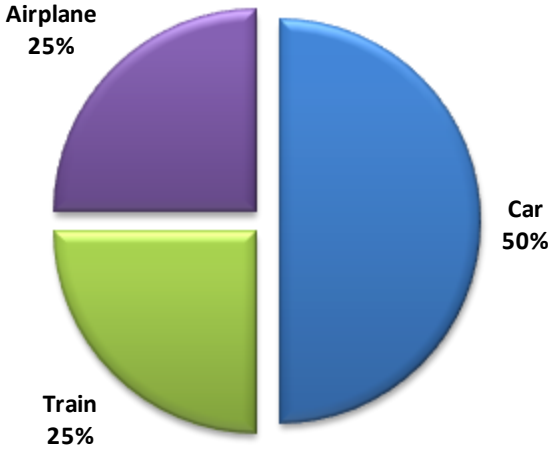


b. *It is more reliable*

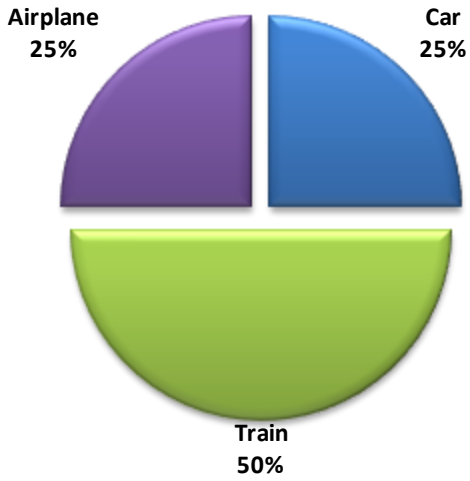
c. *It is more flexible (free from timetable limitations)*



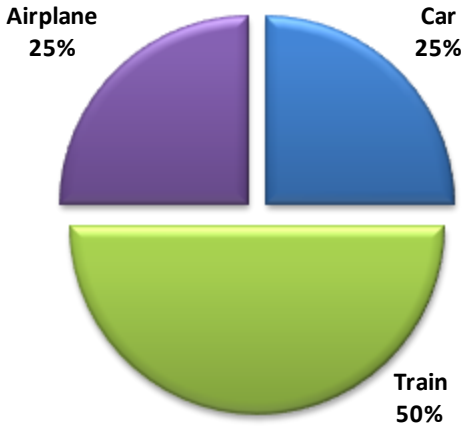
d. *It is more accessible*



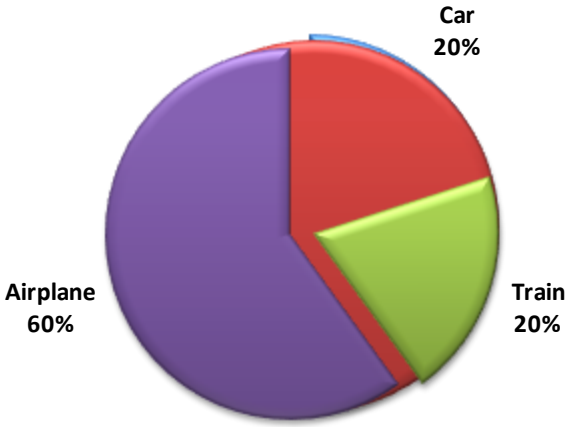
e. It is more secure (e.g. there is less pickpocketing)



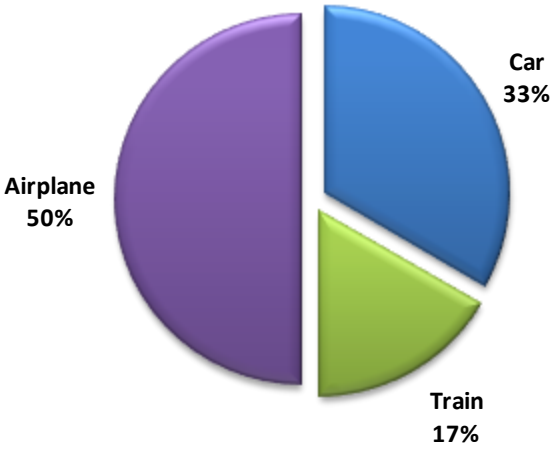
f. *It is safer*



g. It is cheaper



h. It is faster



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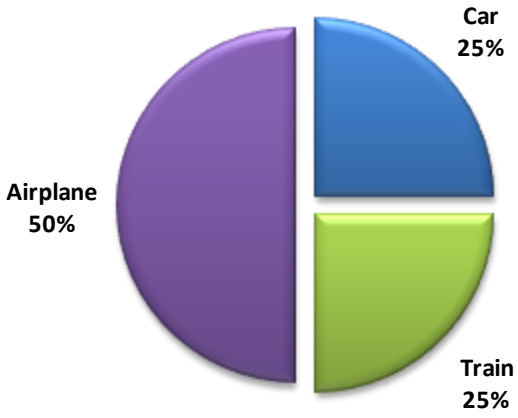
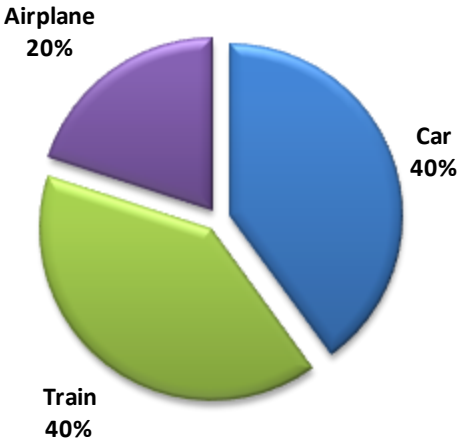
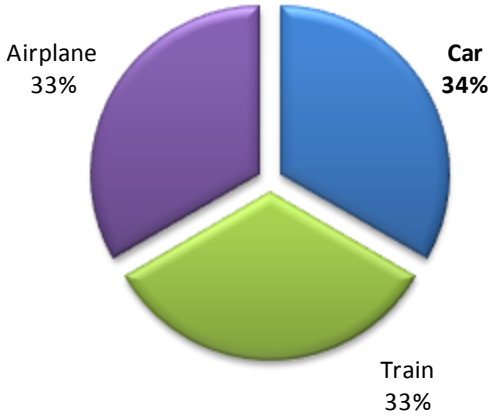
i. *It is environmentally friendly*



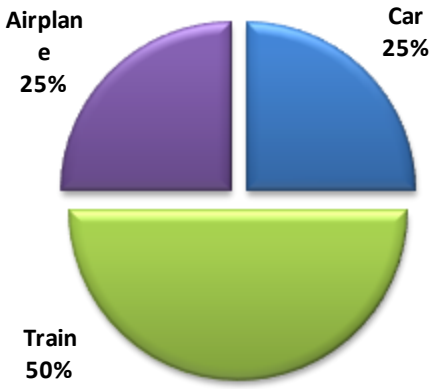
j. *It has more connections*



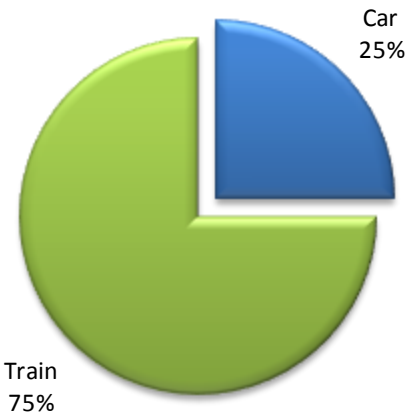
k. *It requires less changes in the same journey*



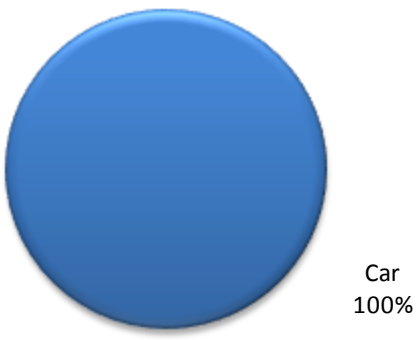
l. *It offers complementary services (e.g. WiFi or bicycle access)*



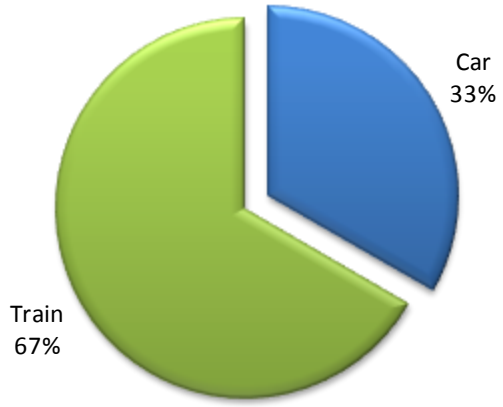
m. *It is possible to work during the journey*



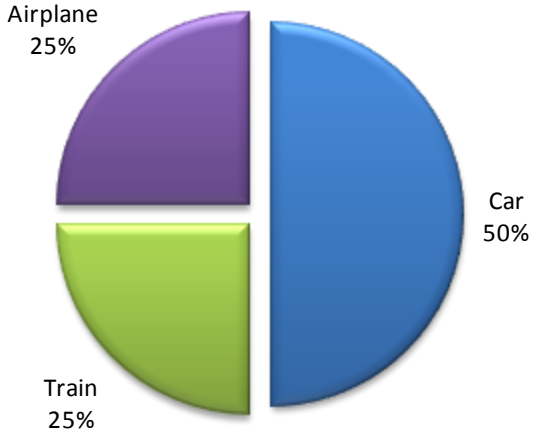
n. *It is possible to carry as much luggage as desired*



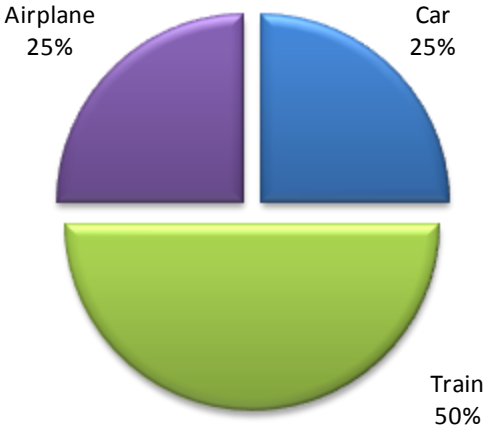
o. *It is possible to travel with as many people as desired*



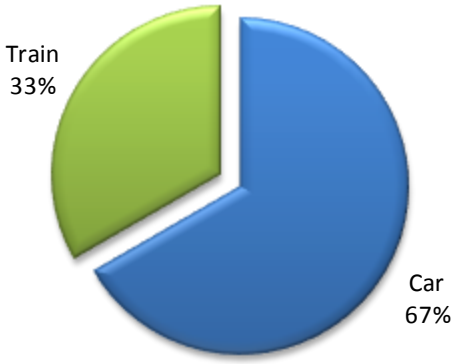
q. *It is free from traffic congestion*



p. *It is possible to carry out leisure activities during the journey (e.g. reading, talking, watching videos)*



r. *Other options are unavailable*



s. *Other*

No Association remarked anything.

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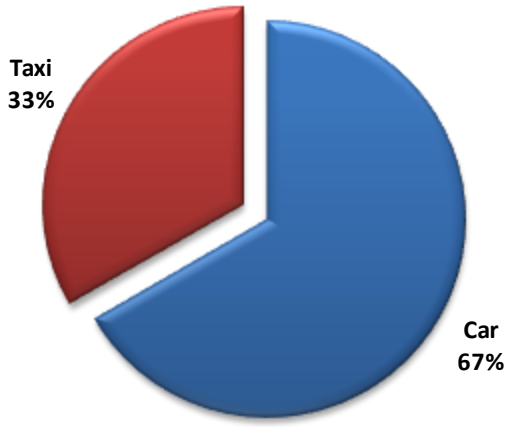
SECTION E – PRECISIONS ABOUT INEFFICIENCIES AND SOURCES OF DISSATISFACTION RELATED TO JOURNEYS

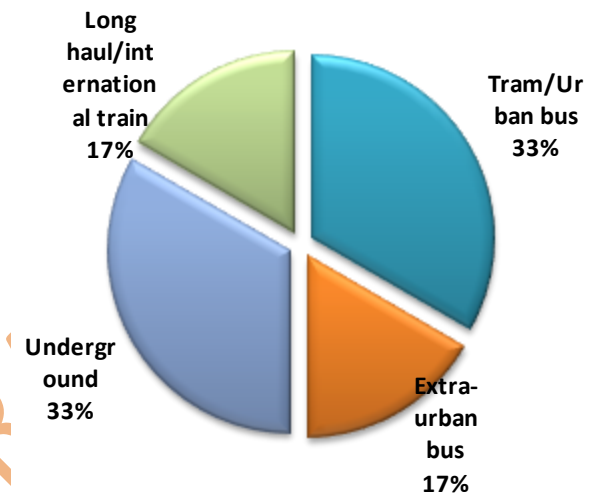
59. Have any of the following problems been experienced by those represented by your Organization, including regular/occasional, urban/regional and long haul/international travel?

a. *Traffic congestion*

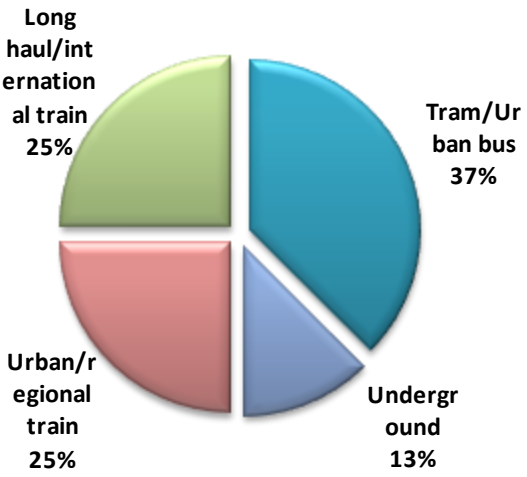


MODAL OPTIONS AVAILABLE
Car
Taxi
Car sharing
Car pooling
Tram/Urban bus
Extra-urban bus
Underground
Urban/regional train
Long haul/international train
Ferry/car-ferry
Airline

b. *Strikes*



c. *Delays*



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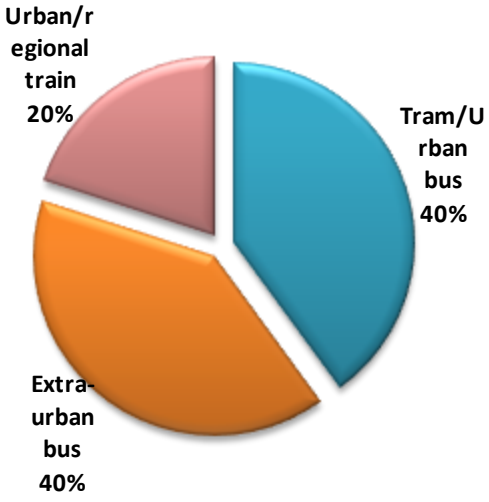
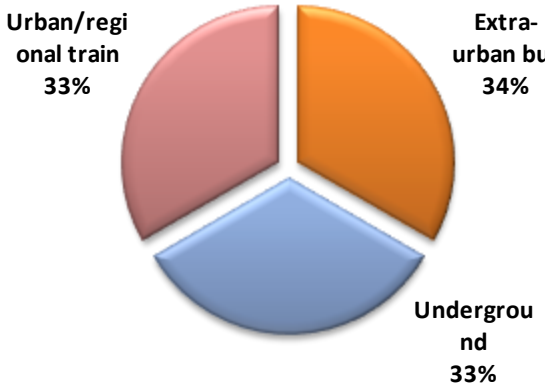
d. Unpleasant behaviour from on-board staff

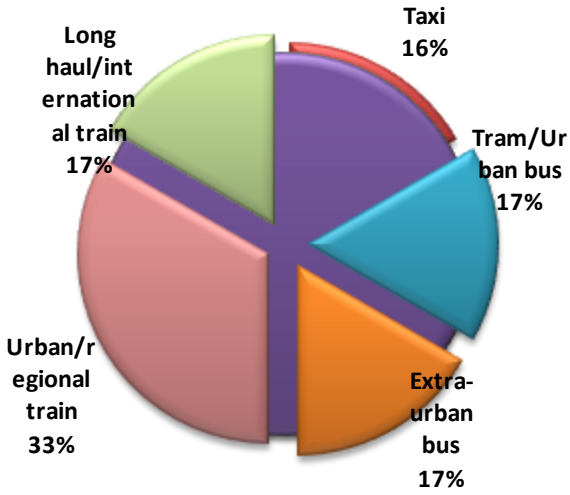


e. Insufficient service (e.g. lack of service when required)

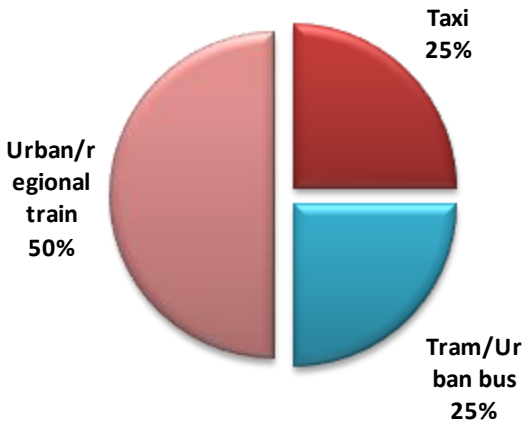
f. Insufficient infrastructure (e.g. disrupted stations or roads)



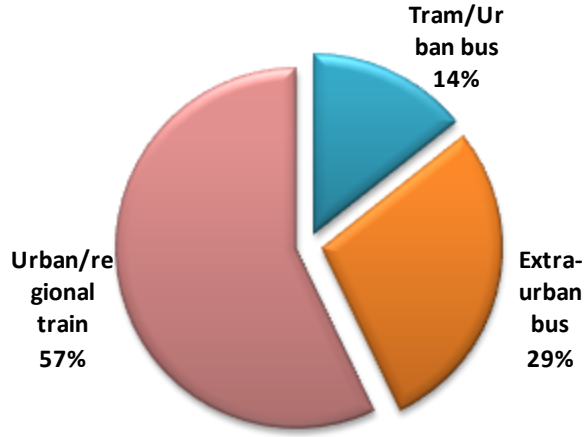
g. Excessive fares



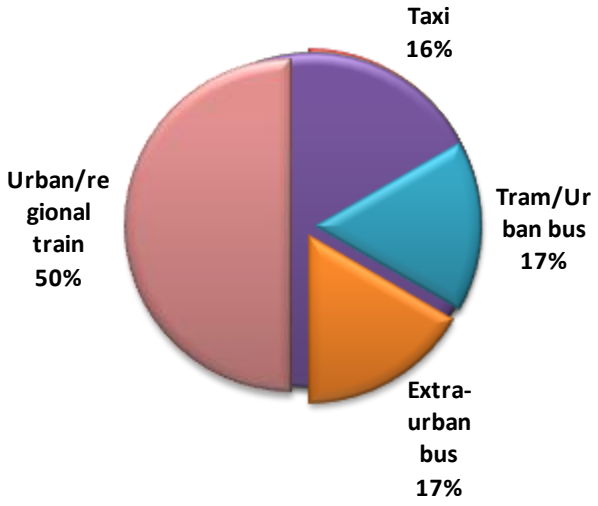
h. Inadequate cleanliness



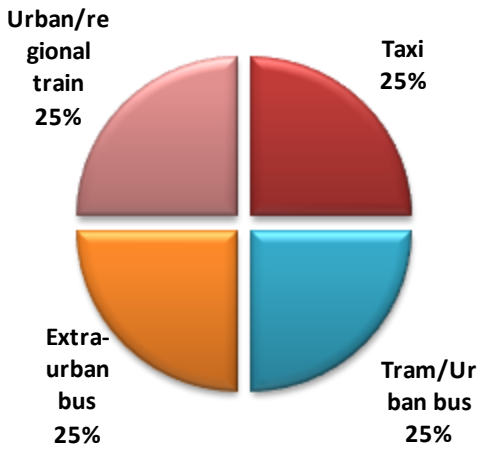
i. Excessive barriers



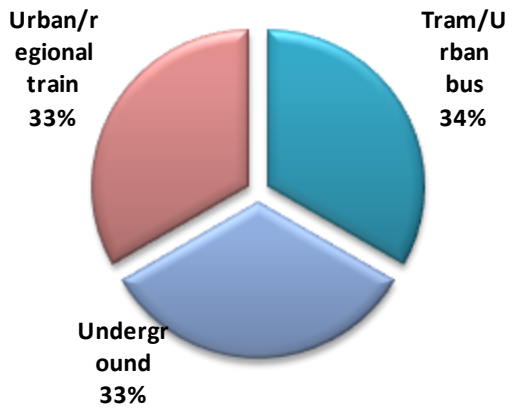
j. Inadequate facilities for those with special needs



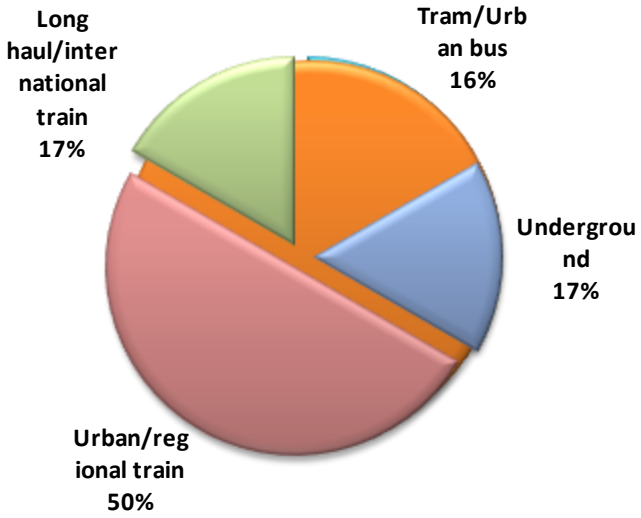
k. Inadequate management



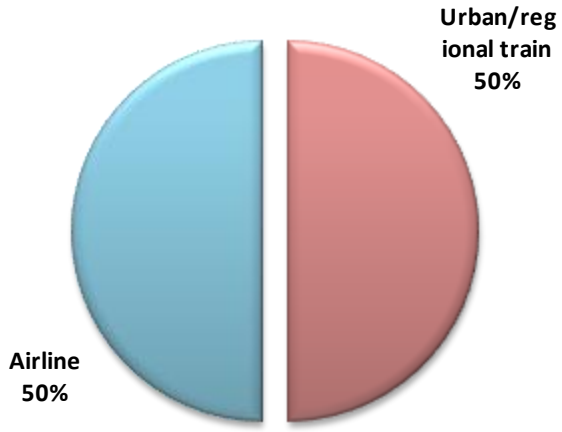
l. Inadequate refund or disruption procedures



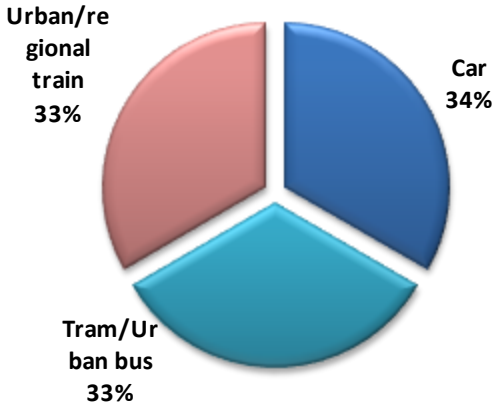
m. Sudden cancellations



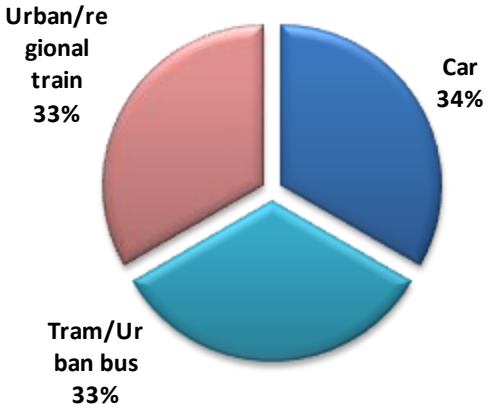
n. *Lost luggage*



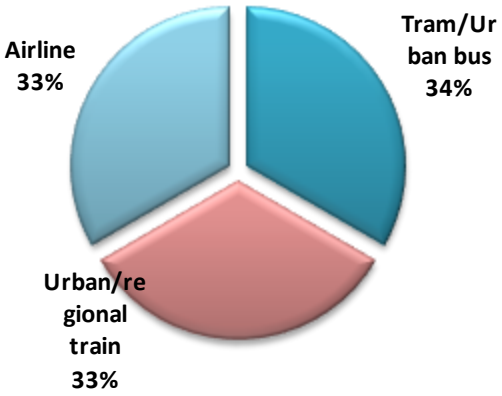
o. *Stolen luggage*



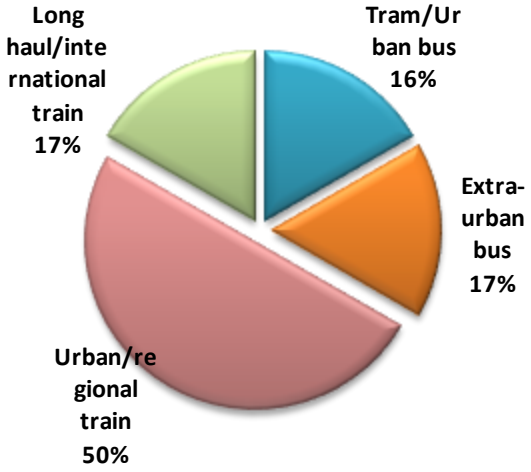
p. *Overcrowding*



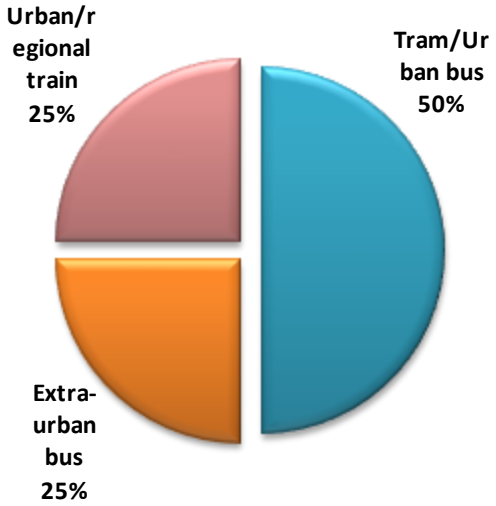
q. *Overbooking*



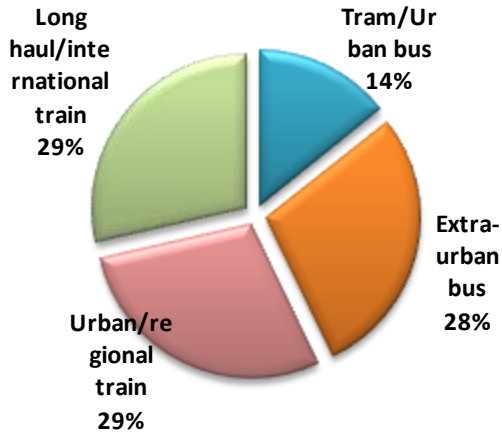
r. *Inadequate information about different operators and relevant travel times*



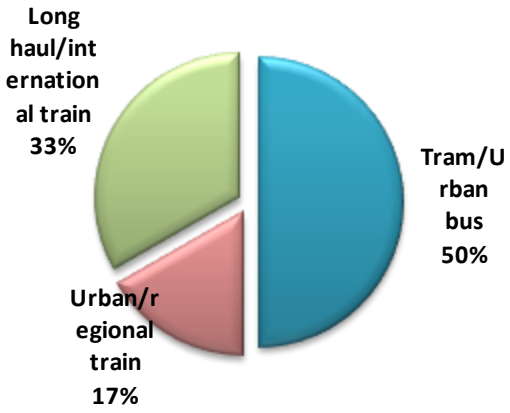
s. *Inadequate level of online resources for booking or payment*



t. *Inadequate information in case of delays/disruptions*



u. *Inadequate assistance in case of delays/disruptions*



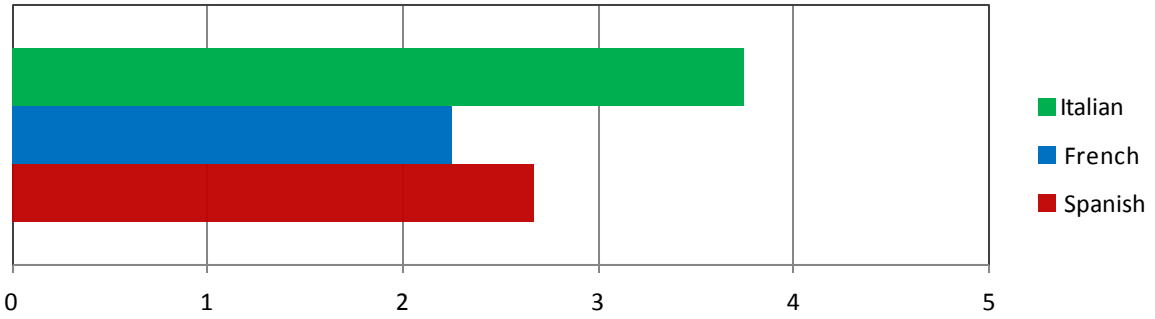
v. Other

No Association remarked anything.

SECTION F – PRECISIONS ABOUT GENERAL RAIL SERVICE FEATURES: HOW IMPORTANT ARE THE FOLLOWING FACTORS FOR INCREASING USERS' REFERENCES FOR RAIL TRAVEL?

60. To improve connections between regional and high speed rail services, how acceptable would a Hub and Spoke model be?

"Hub & Spoke" is a type of transport planning approach where passengers travel from regional/smaller stations to a larger central node in order to make long haul/international journeys.



61. Urban/Regional services in cities with more 250,000 inhabitants

For improving the efficiency and effectiveness of transportation, how important are the following:

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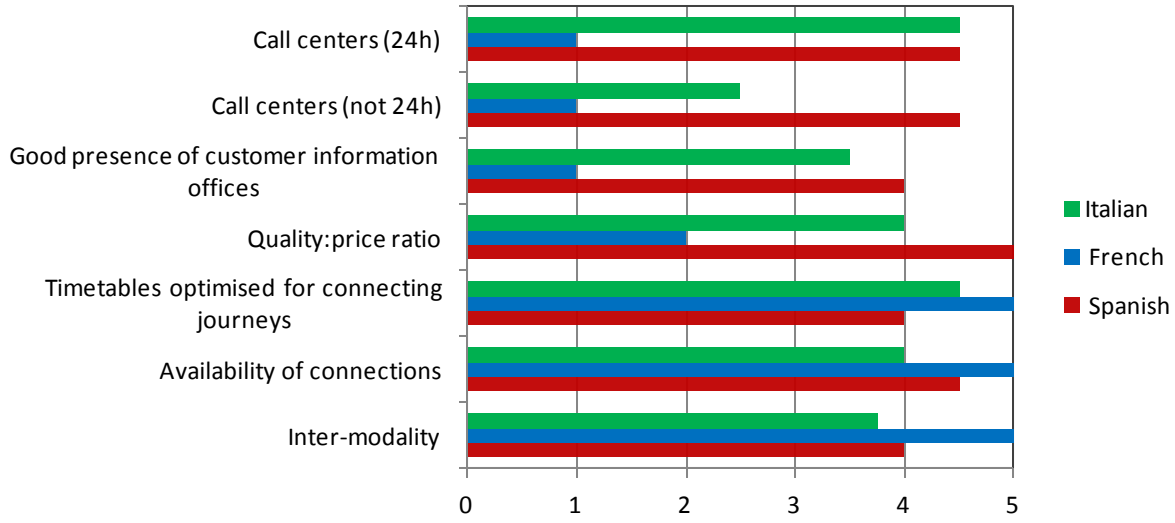

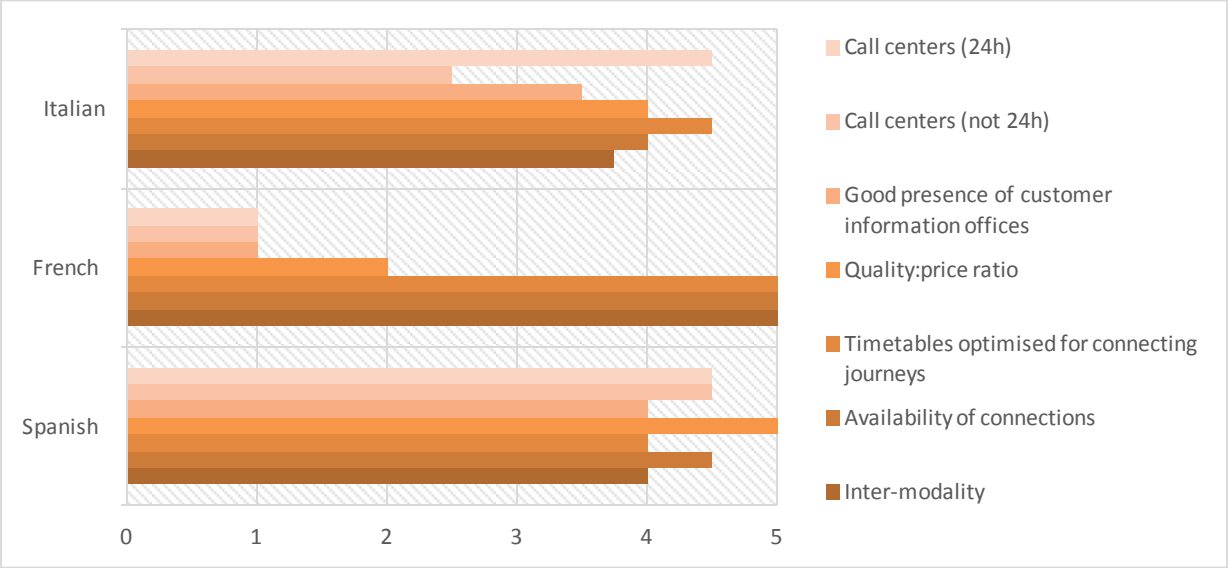

62. Long Haul/International services

How important are the following:

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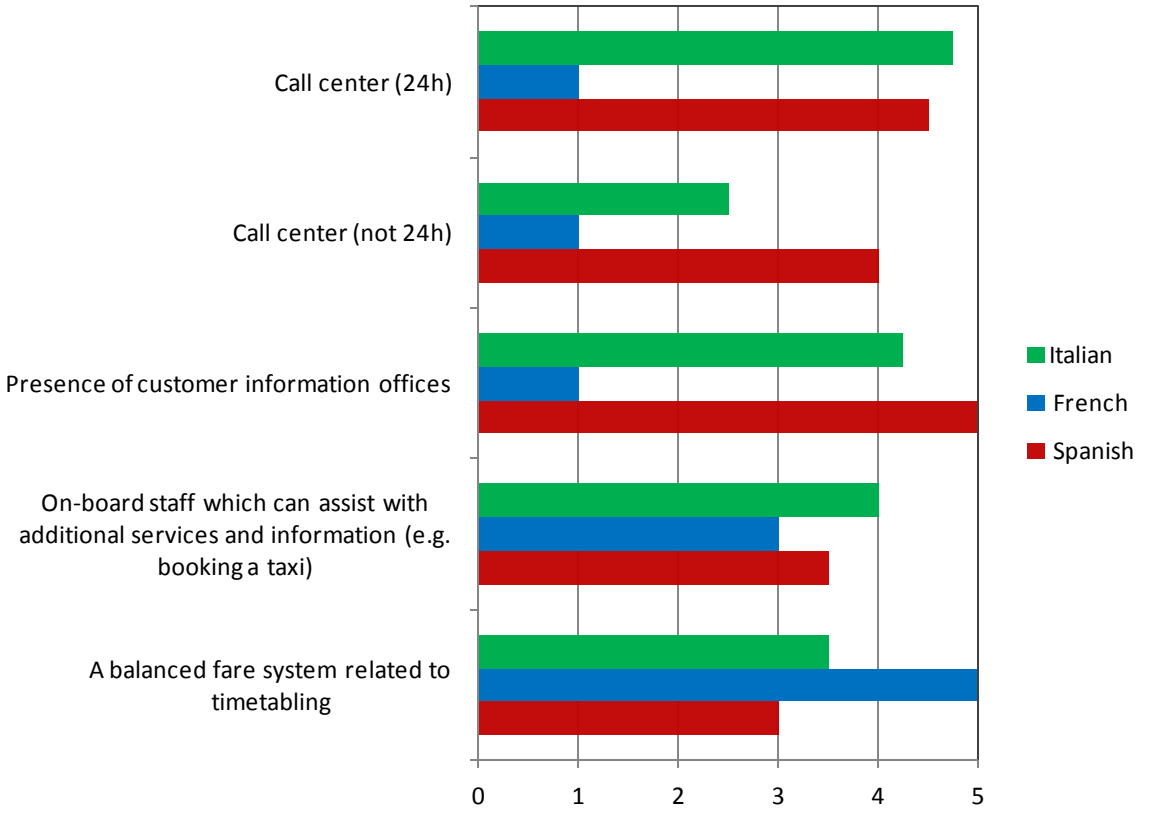
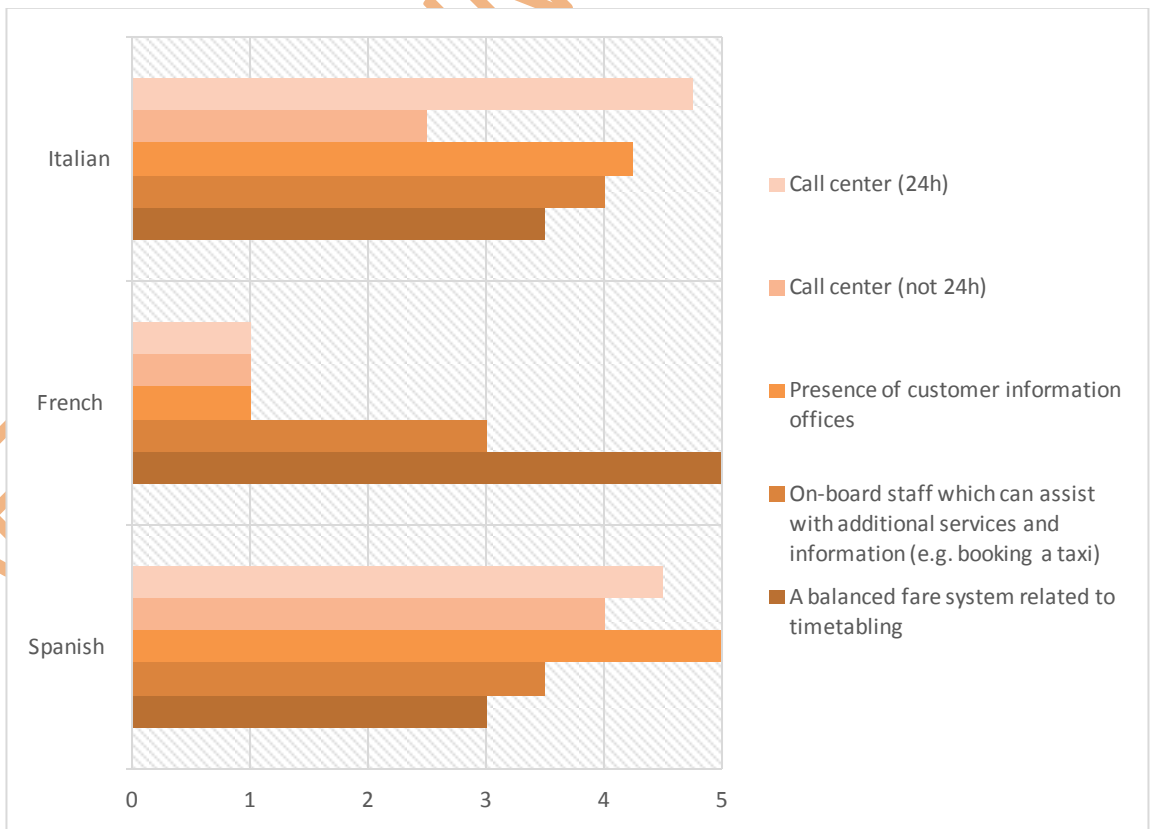

Call center (24h)
Call center (not 24h)
Presence of customer information offices
On-board staff which can assist with additional services and information (e.g. booking a taxi)
A balanced fare system related to timetabling
0
1
2
3
4
5
Italian
French
Spanish


Italian
French
Spanish
0
1
2
3
4
5
Call center (24h)
Call center (not 24h)
Presence of customer information offices
On-board staff which can assist with additional services and information (e.g. booking a taxi)
A balanced fare system related to timetabling

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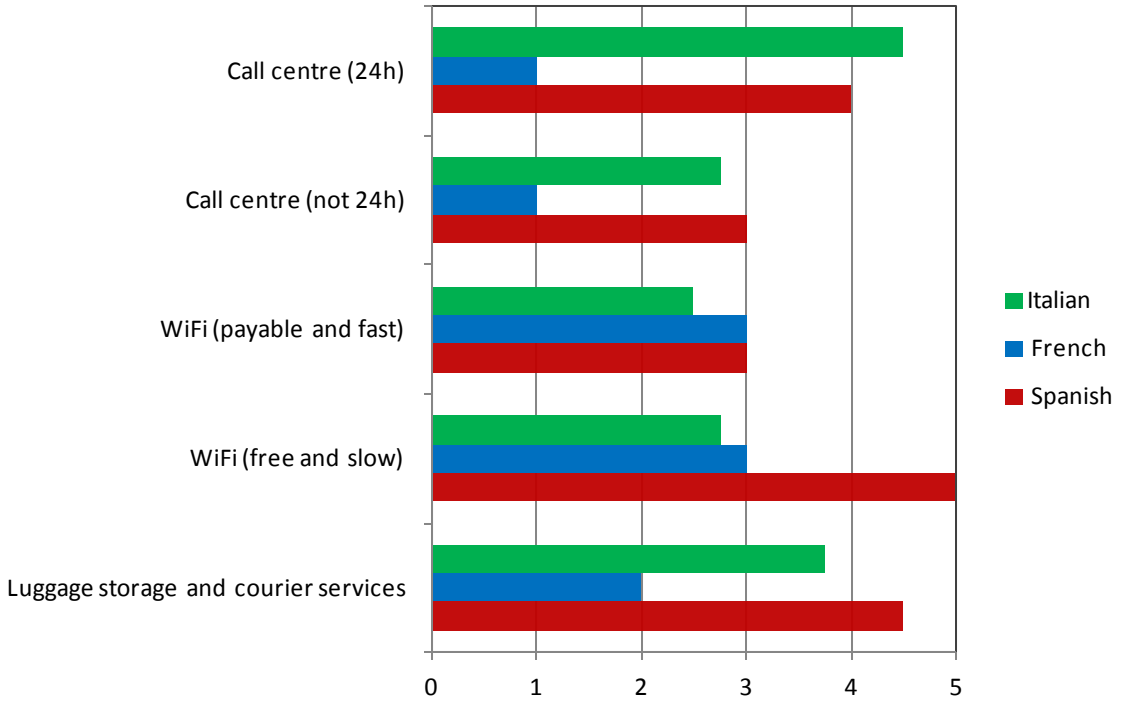
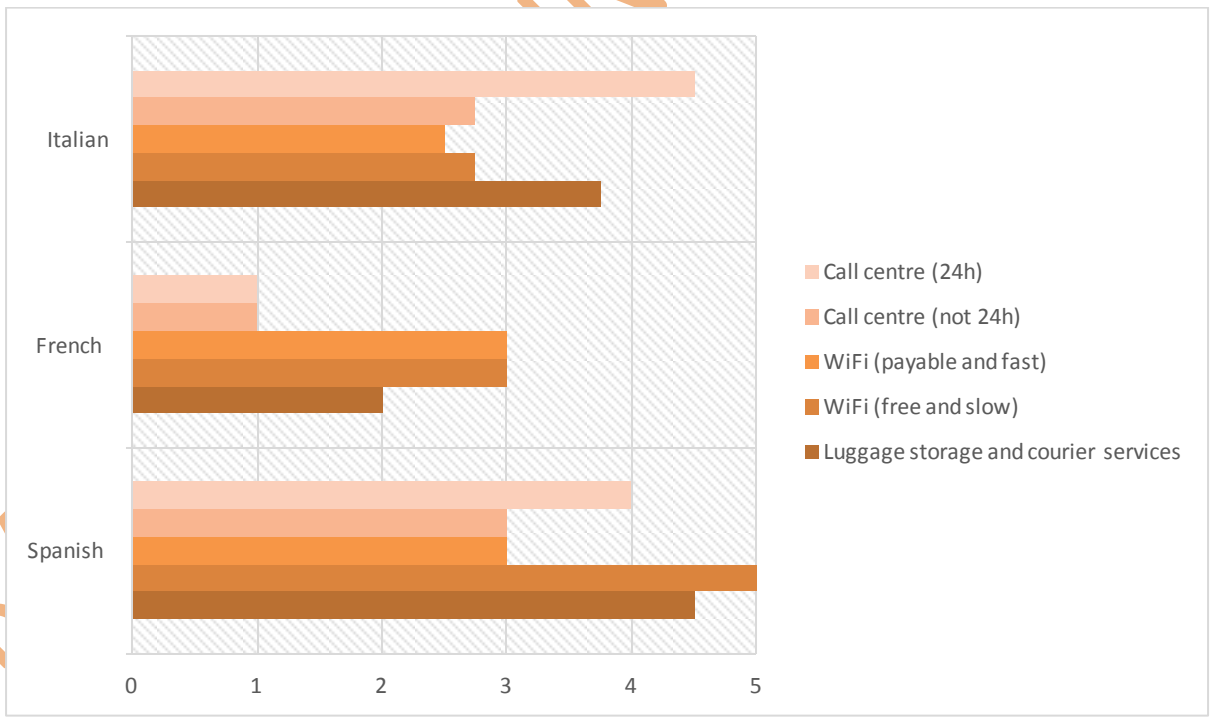
63. For stations

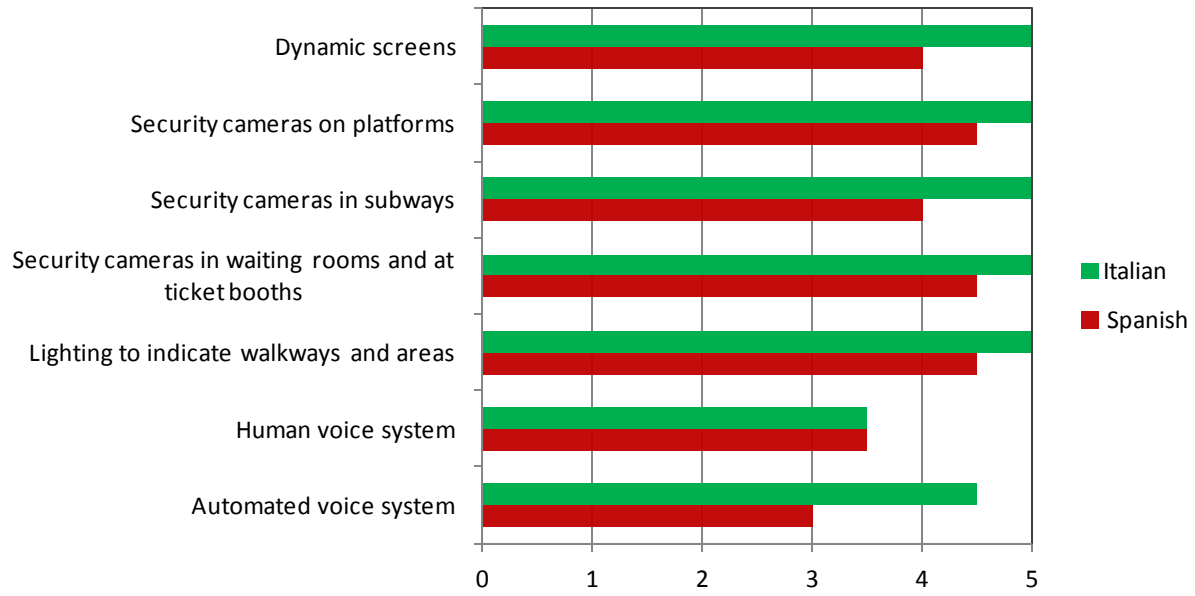
How important are the following:

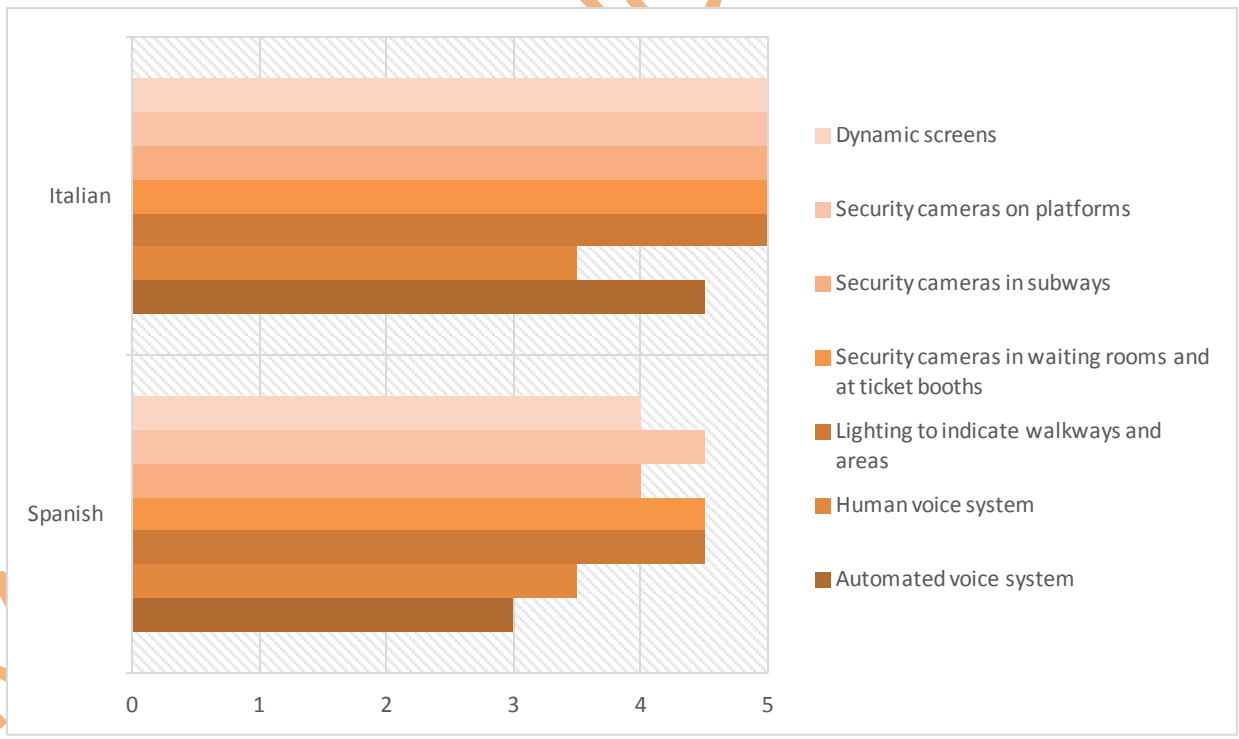




64. Public Address systems in stations (*)

How important are the following:

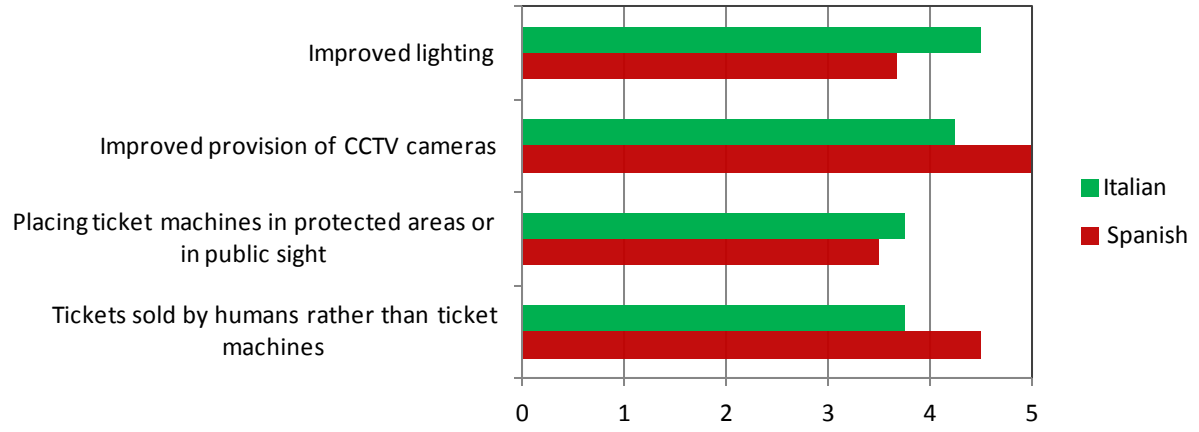


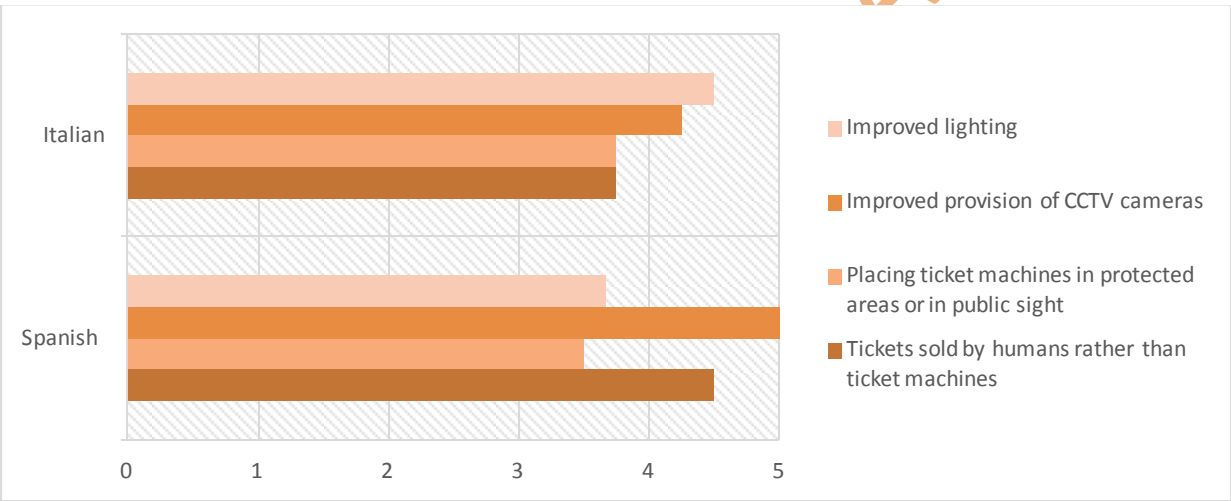


(*) Nota Bene: no French Associations' replies arrived, about this subject.

65. Security in stations (*)

How important are the following:

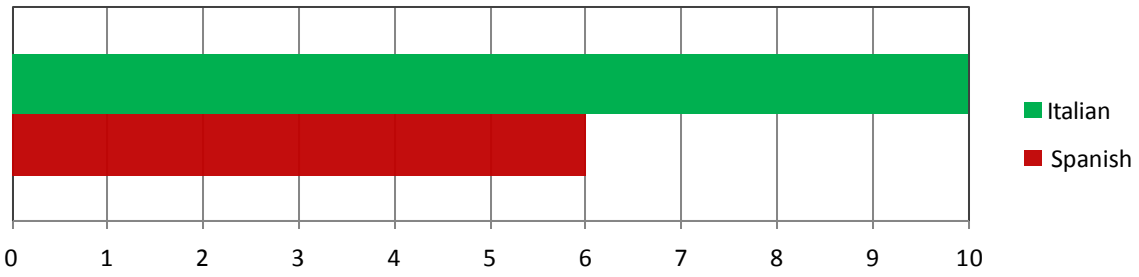




(*) Nota Bene: no French Associations' replies arrived, about this subject.

66. Ticket inspection prior to boarding (approximately how many minutes is the maximum tolerable waiting time for pre-boarding ticket inspection?) (*)

Approximately how many minutes is the maximum tolerable waiting time for pre-boarding ticket inspection?



(*) Nota Bene: no French Associations' replies arrived, about this subject.

SECTION G - FREE SUGGESTION & OTHER POINTS

- ✓ **PLEASE PROVIDE ANY FURTHER INFORMATION OR FEEDBACK HERE.**

ONLY THREE FURTHER REMARKS WERE RECEIVED, ONE PER COUNTRY.

ALL OF THE COMMENTS HIGHLIGHTED HOW IMPORTANT AND SIGNIFICANT CITIZENS FEEL IT IS TO STRIVE FOR IMPROVED RAIL INFRASTRUCTURE ACCESSIBILITY FOR ALL TYPES OF CUSTOMERS, PARTICULARLY FOR THOSE WITH PHYSICAL DISABILITIES.

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