D25.2: High-level specification of requirements, challenges and a future target state for freight cross-border planning and operations from an operator perspective as input for FP1

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Report contributors		
Name	**Beneficiary Short Name**	**Details of contribution**
Lars Deiterding	Hacon	Lead author; support in the provision of input from the operators
Felix Hildebrandt	Hacon	Executive Summary, Background, Objective, Challenges, Requirements and Future Target State (based on operator interviews), Next Steps
Georg Kroth	Hacon	Support with proof-reading, layout and the adaptation of content
Yves Sterbak	GTS-D	Chapter about relevant projects, support in the requirements and challenges focused on Dynamic Dispatching
Felix Hauser	GTS-D	Support of the above
Kay Gade	DLR	Support in the projects chapter, input of recent/current studies

Reviewers		
Name	Beneficiary Short Name	Details of contribution
Andreas Lischke	DLR	Official Review and Feedback
Johan Carlgren	TRV	Official Review and Feedback

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1 Executive Summary

The aim of Deliverable D25.2 is to identify the challenges, issues, and requirements related to cross-border freight train planning and operation processes. The objective is to support the planned developments in the Flagship Projects FP1 and FP5 by defining the high-level target state and initiatives for cross-border freight train planning and operation. The methodology included gathering of input from operator experts, supported by real-life and hypothetical use cases.

In addition, the deliverable also highlights relevant projects both for FP1 and FP5 regarding cross-border planning and operations. These are Plasa I & II, Yard Coordination System, KV4.0, InGa-Z, FENIX, SIMPLE, Easy Rail Freight, Optiyard, FR8RAIL, R-CDM II and II as well as FR8HUB. For those projects, the knowledge transfer between the flagship projects will take place in the form of joint and dedicated sessions, involving the relevant experts from both FPs.

The major findings from the operator's perspective reveal numerous challenges in cross-border train operations, including differences in path handling and cancellation between countries, diverse systems for border processes, limited transition times at border crossings, lack of a neutral IT platform for path availability, and insufficient information exchange between RUs and IMs. Language barriers, regulatory differences, and coordination challenges among multiple parties further complicate this process.

Recommendations include the need for a centralized platform or direct connected national systems for path creation and management, standardized systems and regulations across IMs, improved communication and coordination between RUs and IMs, investment in infrastructure and capacity enhancements at border stations, implementation of a monitoring system for train arrival and departure times, and harmonized planning and short-term operational processes.

The Deliverable also outlines requirements for planning and operating international train paths, such as seamless data flow, establishment of a European railway information database, harmonized processes for resource management, resource sharing among stakeholders, harmonized rules and data structures for IMs, and improved train monitoring systems.

While the findings provide valuable insights, this deliverable is limited by excluding political issues and the need for further transformation of high-level requirements into specific development needs.

In conclusion, addressing the identified challenges and implementing the recommended solutions through dedicated developments in the scope of FP1 and FP5 will contribute towards the fulfillment of the technical enablers and allow for more efficient and coordinated cross-border train planning and operation processes. This will enhance

transparency, reliability, and resource utilization, ultimately improving the overall performance of international rail transportation operations.

Keywords: Seamless Data Flow; Cross-border train planning and operations; European Railway database; Harmonized processes and coordination

2 Abbreviations & Acronyms

Abbreviation / Acronym	Description
A/D-Yard	Arrival/Departure Yard
ATTI	Agreement on Technical Interoperability
CMR	Convention on the Contract for the International Carriage of Goods by Road
ERA	European Union Agency for Railways
ERFA	European Rail Freight Association
ERJU	European Rail Joint Undertaking
ETA	Estimated Time of Arrival
ETI	Estimated Time of Interchange
FA	Flagship Area
FDFTO	Full Digital Freight Train Operation
FENIX	Federated Network of Information eXchange in LogistiX
FP	Flagship Project
FTE	Forum Train Europe
GCU	General Contract of Use for Wagons
IM	Infrastructure Manager
InGaZ	Intermodale Gate der Zukunft
KV4.0	Kombinierter Verkehr 4.0 (intermodal traffic 4.0)
LRU	Leading Railway Undertaking
MAWP	Multi-annual work plan
NAE	National Allocation Entitie(s)
NCP	National Contact Point(s)
NS	Network Statement
PCS	Path Coordination System
RFC	Rail Freight Corridor
RNE	Rail Net Europe
RSRD	Rolling Stock Reference Database
RU	Railway Undertaking
SERA	Single European Railway Area
SIMPLE	Simplification of Processes for a Logistics Enhancement
TAF	Telematics Applications for Freight Service
TAP	Telematics Applications for Passenger Service
TSI	Technical Specification for Interoperability
TCR	Here: Technical Compatibility Regulation
TD	Train Driver
TIS	Train Information System
TMS	Train Management System(s)
TTR	Timetable Redesign
UIC	International Union of Railways
WP	Work Package
YCS	Yard Coordination System

3 Background

The present document constitutes the Deliverable D25.2 ‘D25.2: High-level specification of requirements, challenges and a future target state for freight cross-border planning and operations from an operator perspective as input for FP1’ in the framework of the Flagship Project FP5- TRANS4M-R as described in the EU-RAIL MAWP and contributes as well to the Flagship Project FP1 - MOTIONAL.

4 Objective/Aim

This document has been prepared to provide a first input and mainly contains the high-level requirements and challenges of the rail transport sector from the perspective of the operators. It also provides FP1 with a high-level overview of relevant projects and studies. In a next step, all input will be matched with the requirements and the knowledge of FP1. Based on the existing content and capabilities, other activities, such the mapping of interconnected processes and systems (relevant for both FP1 and FP5) can be jointly elaborated on the basis of this deliverable.

Ultimately, the final input from FP5 during the specification phase will be provided within deliverable D25.1, which will allow FP1 to match their developments with these specifications. It ensures that the demonstrator Seamless Corridor (WP33 of FP5) features developments both from FP1 as well as FP5. This contributes towards the fulfillment of the technical enablers of Seamless Freight. The necessary next steps are defined in more detail at the end of the deliverable.

5 High-level description of challenges, specifications and requirements for cross-border planning and operations as input for FP1

Within FP1, modules and functionalities regarding cross-border train operation (systems) are developed. FP1 focuses on the main line (for both passenger and freight), whereas in FP5, we focus more on the last-mile/multimodal processes (terminals, yards and connection to other modes) for freight transport. In the FP5 team, we have the expertise of many European operators. Therefore, these operators within FP5 team define the issues, challenges, requirements, initiatives and a high-level target state for cross-border train planning and dispatching/operation to support the development of FP1 (which then are going to be demonstrated later within WP33). Based on this input, FP1 and FP5 will jointly elaborate more detailed specifications towards the dedicated FP1 developments.

While political issues (for example, challenges regarding as lengthy police, veterinary checks, or issues related to immigrants) are also of relevance for the sector, they are not the focus of the deliverable as this is not something that can be addressed within any of the Flagship Projects themselves.

5.1 Current challenges and problems for cross-border planning and operation processes

The following chapter describes current problems and issues for cross-border planning and operations as identified by the operators. They can refer to both operational and procedural shortcomings as well as shortcomings that result in result-in inefficiencies or resource-intensive countermeasures. If a problem or challenge is listed in this subchapter, it does not necessarily mean that it is in the scope of FP1 and/or FP5 to address those issues, such as political issues. For each of the mentioned challenges here it has to be checked both by FP1 and FP5 experts if these challenges can be addressed within the first call of the flagship projects.

Below is a summarized list of the challenges and problems as they were identified by the operators:

- Differences in handling and cancellation of train paths between countries
- Various systems in operation for border processes
- Over-regulation of safety-related requirements
- Standing transition times at border crossings leading to significant delays
- Lack of a neutral IT-supported platform for international train path availability
- Changes to paths not displayed in neighboring systems, leading to coordination difficulties
- Operational stops due to technical specifications and regulations
- Exchange of shipment information limited to RUs, not with IMs

- Data quality issues in shipment information exchange
- Trains not adhering to timetables causing planning issues
- International train paths not used as planned in Southeastern Europe
- Dishonest or delayed communication leading to mutual distrust and blame
- Language barriers and regulatory differences slowing decision-making processes
- Brake tests and technical checks repeated due to lack of communication
- Challenges related to cooperation contracts at border stations
- Limited capacities of IMs at border stations
- Need for terminal and yard operators to maximize infrastructure utilization
- Clear communication and adherence to contracts and regulations necessary
- Investments in infrastructure and capacity enhancements at border stations
- Ideal scenarios in planning not fully accounting for challenges at border stations
- Monitoring system to track actual train arrival and departure times
- Difficulties in coordinating train information flow in cases of large delays
- Ineffective coordination of Technical Compatibility Regulations (TCRs)
- Mismatch between re-routing options and technical parameters of trains
- Low stability of allocated train paths causing disruptions in production plans
- Limited real-time availability of information regarding current train parameters

Cross-border train operations involve various challenges, including differences in handling and cancellation of paths between countries. For instance, in Germany, the train number and path number are the same, so if a path is cancelled, both the train and the path are cancelled[1]. However, in Switzerland, the train number and path number are different, meaning that the train may still run even if the path is cancelled. A cross-border platform or interface is required to enable centralized notification and coordination for path management, including path cancellations to address this issue[2].

Additionally, there are different systems in operation for various border processes, which can further complicate cross-border train operations. Safety-related requirements can also be over-regulated in some cases, exceeding the standard Safety Management System (SMS) and presenting political challenges that should be mentioned, but are out of scope in the context of FP1/FP5.

[1] Comment from Trafikverket: There are already legal requirements in the TAF & TAP regulations on how the train should be objectified in order the avoid this issue. Having the same train number and path number remains from the period before opening up the market and should therefore have been taken care of already by the implementation of the 1st Railway Package in 2001. The solution is in place and is even legally required, but is however not applied due to various reasons.
[2] Comment from Trafikverket: This kind of platform already exists, namely PCS (Path Coordination System), but it's not used to its full potential due reluctancy from both IMs and RUs as well as the difficulties coming from national legal entities regarding the format for the application of capacity.

Moreover, standing transition times of only 2-3 minutes at large border crossings can lead to significant delays of up to 30 minutes and are highlighting the importance of optimizing these transition times to minimize delays and improve cross-border train operations.

One of the main issues is the lack of a neutral IT-supported platform that displays international train path availability. This platform could help railway undertakings (RUs) quickly find available train-paths in case of incidents such as strikes, without having to approach individual infrastructure managers (IMs). The reason for the absence of such a platform is the need to ensure non-discrimination and coopetition in the industry.

However, the push for greater transparency faces resistance from companies that are reluctant to disclose all information. They fear that sharing more data could potentially expose vulnerabilities and provide a competitive advantage to rival firms. While businesses aim to make information accessible to prospective customers, they must also safeguard it from competitors. Therefore, it is crucial to ensure that the information is selectively accessible only to those companies that genuinely require it for their operations.

Another challenge is that changes to paths, such as cancellations, are not displayed in the respective systems of neighboring IMs. This can lead to confusion and difficulties in coordinating transportation processes.

Technical specifications and regulations can also cause operational stops, for example, due to different handling of train tail lights based on national signaling regulations. The activities and impacts on other processes at borders are currently a "black box" and not represented in a single system. This mono-causality applies to both IMs and RUs and can cause delays and coordination challenges in transportation processes.

Finally, the exchange of shipment information, both commercial and operational, currently only takes place between RUs and not with IMs. Furthermore, the data quality of this information, known as "Hermes data quality," is not good, which likely exists with other RUs as well. This can prolong the work of dispatchers and wagon inspectors at border stations and increase the chance of incidents. Furthermore, incorrect data in wagon databases, technical problems with wagons at border stations, and changes in locomotives or train drivers during transportation can create challenges in the smooth execution of transportation processes, resulting in delays and inefficiencies. Improving the exchange and quality of this information could help to streamline transportation processes and improve coordination between all parties involved.

Trains not adhering to timetables can cause issues with planning train drivers (TDs) and locomotives for the next railway undertaking (RU) at handover points or infrastructure managers (IMs) at handover stations. Reasons for train delays can be linked to

- IMs: maintenance works, track closures, speed restrictions, lack of staff at stations, unrealistic timetable planning

- RUs: poor internal planning of TDs and locos, long/delayed handover of trains on border stations; which can in turn also sometimes be connected to the IMs
- the country authority at the border station to a non-EU country or the client: delayed/or even cancelled departure of a train which creates problems with other parties included because it was not communicated on time.

In South-Eastern Europe, international regular train paths are often not used as planned. Trains may change train paths due to cancellations or delays by clients in loading stations, resulting in RUs using internationally planned train paths for ad-hoc trains to avoid cancellation fees. This can create challenges for IMs at borders and difficulties in monitoring trains.

Dishonest or delayed communication between RUs and IMs can lead to mutual distrust and blame. RUs that are not the Leading RU (LRU) or are further down the transport chain may not be informed in a timely manner about potential delays and accurate estimated time of arrival (ETA) of trains, resulting in overly optimistic planning and coordination challenges.

Language barriers, regulatory differences, and the involvement of multiple persons or coordinators in the transportation chain can result in slow decision-making processes and foster distrust among parties. This can cause delays in communication, coordination, and execution of transportation processes.

Brake tests and technical checks may need to be repeated several times due to lack of communication between RUs and IMs. RUs may not trust previous RUs and may redo checks at border stations, even if there is an Agreement on Technical Interoperability (ATTI) in place, resulting in inefficiencies and delays.

In addition, there are challenges related to cooperation contracts at border stations. Each Railway Undertaking (RU) often has its own version of these contracts, and many of them originated from pre-open railway market times. This is particularly evident with state operators. In reality, these contracts may not always be respected, and regulations from Infrastructure Managers (IMs) at stations can be unclear or poorly communicated.

Another challenge is the limited capacities of IMs at border stations. The total number of tracks in stations and marshalling yards has been decreasing over the last decades, at least in Croatia and possibly in other countries as well. This can result in legacy national RUs being favoured, even though the market should be equally open for everyone[3].

[3] Comment Trafikverket: Changes in business arrangements can solve a significant part of the problem. The need of sidings is reduced when the operational responsibility is handed over from one incumbent RU to another at the border station/-s along an international train path, instead of carrying it out as Open Access traffic.

On the other hand, terminal and yard operators face the challenge of maximizing the utilization of their infrastructure to ensure maximum profitability. Consequently, they opt to scale down their infrastructure assets since it is far more costly to maintain unused capacity than to incur penalties for delayed trains. Implementing a more dependable system with capacity-based planning would result in reduced infrastructure requirements, as the need for buffer times would diminish. In order to encourage operators to expand their infrastructure, a clear and optimistic demand forecast becomes crucial.

To address all these challenges, it is important to ensure clear communication and adherence to contracts and regulations at border stations. Cooperation contracts should be reviewed and updated as necessary to align with the current market requirements. IMs should strive to provide transparent and consistent regulations to all RUs, regardless of their legacy status. Additionally, investments in infrastructure and capacity enhancements at border stations can help to improve efficiency and promote fair competition among RUs in the open railway market.

In the planning of international trains, IMs often rely on ideal scenarios when scheduling border station handover times, without fully accounting for potential challenges such as lengthy police, customs, veterinary checks, or issues related to immigrants. Implementing a monitoring system to track actual train arrival and departure times from specific stations could be beneficial in establishing performance values that can be applied to all trains during the planning process for cross-border sections. This data-driven approach would enable IMs to create more realistic plans, incorporating historical train movements, and enhancing the accuracy and reliability of train scheduling for international rail transportation operations.

In France, when getting a new train number in cases of large delays (>18h), extensive iterations and coordination effort are required to maintain the information flow and to be able to monitor the train. In addition, the coordination process to implement contingency plans (potential technical solution à “Digital Capacity Management”) is very challenging. This is further enhanced by sovereignty and financial issues of the respective countries.

Technical Compatibility Regulations (TCRs) are not effectively coordinated across Infrastructure Managers (IMs), leading to a negative impact on traffic. Furthermore, proposed re-routing options and short-term planning often do not match the technical parameters of the trains, such as length, tonnage, loading gauge, speed limitation, etc. In some cases, even long-term international train planning (path allocation) does not correctly consider the technical parameters of the trains.

Another issue is the low stability of allocated train paths, as short-term adaptations from the IMs may cause disruptions in the production plan and the supply chain of industrial customers, especially for the chemical industry and the transport of dangerous goods. Furthermore, there is limited real-time availability of information regarding current train

parameters, such as customer-loaded wagon weight, different train length, etc. This could potentially be addressed within FP5 (WP28: Intermodal Prediction) with the exchange of terminal data and with IVGs for validating this information (WP29: European Checkpoints).

5.2 Definition of requirements regarding the processes for planning and the operation of international train paths

This chapter lists requirements towards the planning and operation of international train paths from the perspective of the rail operator. Where necessary, these requirements are high-level and will be translated into more precise development needs. This will be done in an iterative and joint process between FP1 and FP5. The result will be featured in the Deliverable D25.1 in the scope of FP5.

To improve the processes for planning and operating international train paths, several requirements need to be addressed. These requirements are summarized in the following list below.

- Seamless data flow and comprehensive coverage: Implement a seamless flow of data and smart data structures to ensure comprehensive coverage for all objects, such as locomotives and drivers, replacing independent data exchange and structures.
- European railway information database: Create a centralized European railway information database to provide knowledge about regional and local conditions, enabling efficient planning and resource allocation.
- Harmonized cross-border resource management: Establish harmonized operational processes for resource management, including shared responsibility and advanced ETA calculation, to optimize resource allocation and enhance coordination among stakeholders.
- Enable resource sharing and provide information: Enable resource sharing among stakeholders by offering slots and specifying required capacity, while also providing publicly available information about services on the railway network to optimize resource utilization.
- Standardize data exchange and improve quality: Develop standards for selective data sharing among companies, harmonize rules and data structures for Infrastructure Managers, and ensure high data quality through clear standards and rules, enabling efficient communication, collaboration, and accurate information exchange.

There should be a seamless flow of data among transportation partners, including ETI/ETA (Estimated Time of Interchange/Arrival), to replace the current independent data exchange with limited mutual relations. A smart data structure for each object in

processes should also be implemented to eliminate the current independent structures and ensure complete data coverage for all objects, such as locomotives and drivers.

To reduce the reliance on individual informed personnel, a European railway information database should be created to provide knowledge about regional and local conditions in stations, terminals, and sidings. Furthermore, harmonized planning for cross-border processes is needed to efficiently allocate resources like locomotives and drivers in both short and long-term horizons, addressing the current lack of coordination.

In addition, there should be an establishment of harmonized operational cross-border processes for resources management, including real-time content of trains and agreement on locomotive and driver usage, which are currently absent. There should also be an implementation of shared responsibility for general ETA, including co-responsibility of Infrastructure Managers, advanced and real ETA calculation in relation to the final customer, and addressing identified or expected difficulties that are currently lacking.

To ensure better utilization of infrastructure capacity, there is a need to enable resource sharing among stakeholders. This can be achieved by offering slots and specifying required capacity in time and space, replacing the current bilateral negotiations. Provision of publicly available information about services on the railway network and booking options is also necessary to optimize resource utilization. Currently, such information is mostly unavailable.

But as mentioned above, it has to be ensured that the companies can decide which of the other companies can see their data. This is necessary to avoid competitive disadvantages. Because this is in contrast to the original aim to provide information to all concerned companies, standards should be developed which data companies have to share depending on their role.

Regarding the current lack of compatibility, there is a need to establish harmonized rules and data structures for all Infrastructure Managers (IMs). This will facilitate standardized data exchange among stakeholders. Moreover, a comprehensive guideline could be developed for each Railway Undertaking (RU) on how to join the “Railway of the 21st century”. This will address the current unclear and non-universal data exchange practices, which are incomparable to other modes of transport and lack transparency.

To improve the efficiency and effectiveness of train monitoring systems, such as RNE TIS, it is necessary for them to have an ex-post analysis function, which allows to evaluate the quality of the transport. In addition, a standardization of the required systems to manage respective (border crossing) processes should be established. This includes a clear overview of the actions carried out on the train at each individual measure and transmission of shipment information. A low-priority requirement, or an optimisation possibility, is a European database on moving/standing transition at border crossings.

In the context of data quality, "high quality" refers to data that is accurate, consistent, complete, and timely available. To achieve a high data quality, it is essential to establish clear standards and rules for data collection, storage, and exchange. This includes the use of common ontologies such as TAF/TAP-TSI, which provide a standardized framework for data exchange across different systems and organizations.

To exchange and validate real-time information about changes in train parameters, it is essential to establish a reliable communication network and data exchange platform. This could involve the use of sensors, tracking devices, and other technologies to capture and transmit data about train movements, status, and other relevant information. The data could then be validated using a range of techniques, including data analytics, machine learning, and human expertise, to ensure accuracy and consistency. Harmonized timetable planning across different IMs can be achieved by establishing common standards and processes for timetable construction and sharing, as well as through effective communication and collaboration between IMs.

5.3 Qualitative, high-level description of a potential target state for cross-border planning and operations

This subchapter includes a high-level description of a potential target state for cross-border planning and operations. This target state does also not necessarily need to be directly achievable or an outcome of the FP1/FP5 efforts of the first call. This description is summarized below:

- Equal conditions are established, enabling fair railway capacity usage through consistent charge calculation and uniform processes.
- Seamless cross-border processes are achieved through a universal train ID and harmonized planning and resource allocation.
- Data exchange gaps are addressed, ensuring timely provision of transportation information and harmonized handover processes.
- Innovative data exchange structures and unique train identification optimize cross-border planning and resource utilization.
- Technology facilitates real-time information sharing, digital capacity management, and improved data quality for efficient train operations.

The target state for cross-border planning requires the establishment of equal conditions for railway capacity usage in different countries. This can be achieved through the adoption of a consistent method for calculating railway charges and the implementation of uniform processes and rules for requesting, booking, and cancelling paths. It also requires the introduction of a universal train ID for each Infrastructure Manager (IM) to ensure seamless cross-border processes.

To achieve this, short-term path request processes involving multiple IMs must be harmonized, and real-time transport orders should be implemented to standardize

transportation/train offering and acceptance processes between Railway Undertakings (RUs). The coordination in planning the usage of locomotives and drivers among RUs or the establishment of a platform for asset sharing should also be considered.

Missing areas in data exchange must be addressed, such as the timely provision of starting information about transportation (orders) for long-term planning, short-term planning, and ad-hoc planning processes. The harmonization of train handover/takeover processes between operators, including ETI (Estimated Time of Interchange) calculation, and the provision of starting information about transportation (ready for departure from origin station) and related ETI/ETA (Estimated Time of Arrival) corrections should also be considered.

Updates on ETI/ETA corrections throughout the transportation process are necessary, as well as consideration of local operating conditions. To achieve this, the establishment of a central database/access point for requesting local publicly available information, such as the location of entries to sidings, access conditions, and time slots for deliveries, is required.

Finally, innovation in data exchange is necessary, and an innovative data exchange structure for related objects must be developed to ensure accurate information is available in a timely manner. This includes unique identification of trains across different countries and IMs. By addressing this, cross-border planning can be optimized, and railway capacity usage can be improved.

Technology can play a crucial role in supporting the planning of train operations in several ways. Firstly, providing real-time information to the next railway undertaking (RU) in the chain, as well as clients at destination stations, about potential delays would enable them to react promptly and adjust their capacity allocation or slot bookings at stations/terminals accordingly. This could involve having a view-only interface in their IT systems that displays planned train movements and allows for timely adjustments.

Furthermore, technology can be beneficial in addressing data quality issues related to wagon data. Many RUs across Europe face challenges with incomplete or outdated wagon databases, which can impact safety and operational efficiency. Video gates can be utilized to capture images of wagons and provide visual verification of wagon data, helping to overcome data quality issues associated with databases such as RSRD/GCU/EVV/VVR. These images can serve as a reliable source of information, especially when other databases are incomplete or not updated frequently.

The achievement of the Flagship Projects' objectives will enable digital capacity management. Rolling planning would be implemented for short-term train path allocation, although the annual capacity allocation will remain the primary focus.

5.4 Use case examples

This chapter reflects some practical use-cases (provided by ČD Cargo), highlighting some issues and the current situation regarding data exchange.

UC1: Intermodal trains from German ports to Czech (or other) multimodal terminals (CD Cargo)

There are available slots for intermodal trains originating from Hamburg, Bremen, and other locations, destined for inland terminals such as Mělník, Praha-Uhříněves, Česká Třebová, Budapest, etc. There are multiple partners on the German side operating trains within these time slots. The task for these partners is seemingly straightforward, to transport the train from any point in Germany to the Germany/Czech border in Bad Schandau/Děčín. In March 2023, a total of 170 trains were scheduled.

Issue faced by ČD Cargo:

The challenge lies in the realization phase, despite a smooth planning phase. The seemingly simple task for our German partners becomes complex for ČD Cargo due to trains having different destinations, and partners requesting varying resources on our side, such as locomotives and drivers. The information received from partners usually includes only the train number (ID of the slot), which does not provide adequate identification of the real content of the train, i.e., the specific terminal to which the train is addressed.

Current State of Data Exchange:

The data exchange practices vary among individual partners:

- DB Cargo: Provides A40 Consignment Note (without link to train), A31 Wagon Movement (train included but not as a link), TIS/RD Train Movement (list of wagons included but not yet used, with issues related to Train ID), A30 Train Pre-advice (with the right information set but often received too late).
- ITL: Provides A30 Train Pre-advice (with the right information set but often received too late).
- ČD Cargo DE: Faces internal issues with non-standardized data exchange practices, which need to be addressed.

Common Trouble:

A common challenge is the absence of an origin message from terminals in Germany, which could consolidate the data of consignments (intermodal units), wagons, and trains after the train preparation phase. This lack of a comprehensive package of information makes tracking and dispatching on the ČD Cargo side cumbersome.

Requirement:

In order to enhance the realization phase and overall efficiency of intermodal transportation between Germany and Czech Republic, it is imperative to address these data exchange challenges and establish standardized and timely data exchange practices among all partners involved in the process.

UC2: Transport of chemical products from Hamburg port to different Czech terminals (distribution centers)

Situation:

Non-regular transportation of tank wagons from Hamburg port to six Czech terminals poses logistical challenges due to the less-than-ideal location of these terminals in relation to the railway network, limited capacity for unloading, and the need to split block trains into multiple parts for phased delivery. In addition, the redistribution of empty wagons is managed separately, and processing gaps exist between unloading of wagons and their handover for the next loading process. In March 2023, a total of 35 trains were scheduled.

ČD Cargo Issue:

The main challenge for ČD Cargo lies in the planning phase rather than the realization phase. To improve efficiency and streamline transportation, better coordination is required at both the loading and unloading terminals. While there are daily coordination meetings with terminal operators for dispatching on the day of operation, for most terminals, ČD Cargo requires information about the terminal unloading plan in advance, to ensure availability of locomotives, drivers, and other staff.

Common Trouble:

The lack of harmonization in terminal, port, or siding plans among operators poses a common challenge. This hampers seamless coordination and execution of transportation operations, requiring better synchronization among all stakeholders involved.

Requirement:

In order to enhance the efficiency of transportation operations between Hamburg and Czech terminals, it is essential to address the planning processes, establish proactive communication channels for terminal unloading plans, and promote harmonization of data exchange of terminal, port, or siding plans among all operators involved. This will help optimize resource allocation, streamline operations, and improve overall performance in the transportation process.

UC3: Transport Czech automotive to Italian terminals (distribution centre)

Situation:

ČD Cargo is facing challenges in the initial phase of transportation, as there is currently no established process for sending the starting information about transport orders and ETI messages to their Italian partners. In March 2023, a total of 9 trains were scheduled. ČD Cargo is trying to find an Italian partner for a specific use case definition.

UC4: Timetable creation process in Croatia (compared to Austria and Slovakia)

In some cases, the usage of PCS (Path Coordination System) is prioritized for international trains, and these trains may have priority when creating the yearly timetable, at least in Croatia. However, in Slovenia, they still need to order train paths in both the legacy system and PCS (although they are hoping to transition fully to PCS from next year). Both countries acknowledge that discrepancies between planned and realized train movements might occur, especially in the case of Croatia.

One notable difference between Croatia, Slovenia, and Austria is the usage of regular train paths. In Croatia, a train path planned for a specific commodity train can be used for any incoming train independently. In Slovenia, the usage of regular train paths is similar to Croatia on some lines, except for shuttle trains between Koper and Austria where regular daily train paths are used for container traffic. On the other hand, in Austria, regular train paths are only used for certain types of goods, and if those goods are cancelled on a particular day, the train path is also cancelled. If there are deviations or changes to a new train that transports other goods, an ad-hoc train paths are ordered.

Austria has a specific way of working, where trains are expected to arrive at a certain station by a deadline, even if there is enough time to depart from that station at a later time. For example, if a train should depart at 20:00, it is crucial for them that the train arrives at a specific station by, let's say, 16:00. Even if the train arrives later, such as at 17:00, with enough time to depart at 20:00, the train may still be cancelled. This is different from Slovenia, where immediate notification of train cancellations is important for them to cancel loading slots on the terminal.

6 Projects and their relevance towards the related projects addressed in this deliverable

Within the course of the deliverable D25.2, we collectively and closely monitor different projects and initiatives in Europe that have had outcomes on which we can build on in the seamless work packages and in D25.2 specifically on the input for FA1 developments from FA5 and the subsequent demonstration of these developments in collaboration with FA5. The majority of the below mentioned projects are finished or will be finished within the year 2023. The scope of the projects listed below is either towards yards or terminal operations and overall planning, all with an either direct or indirect focus on intermodal transports. The outcomes of the projects below support us to identify the requirements and challenges of intermodal transports and that the joint FA5 project is a key project to increase the modal split across Europe towards more freight on rail. All mentioned projects have been actively pushed by members of FA5. Therefore, we can jointly access the results and set up on these outcomes. FA5 follows a holistic approach that brings together "pre-works" which are realized by the majority of the projects. That means, we start to a certain extend by theoretical outcomes and transform these at an European scale and into operation. A strong and important outcome within the remaining year 2023 is to formulate in detail the interactions and requirements towards FP5. For this purpose, the respective project participants will realize an info session and determine the relevance for FP5. The objective of the ERJU members is to build an ideal symbiosis between the Railway Traffic Management System and Planning with the real needs of intermodal stakeholders. With the objective of preventing incidents disturbing the traffic could be realized if data are known in real time by all involved partners. Therefore, that could be planned from the beginning to avoid conflicts, waiting times or unnecessary connection conflicts and enabling a seamless rail freight transport.

Wherever possible and suitable our common objective is to rely on the European standard Interface TSI TAF/TAP.

The following list might be further increasing and does not reflect any prioritization or order:

P.1: Plasa I & II – Smart Planning

Part of this project is the development of a basic smart planning model through analysis of planning activities in order to identify synergies and trade-offs among current planning procedures. Improving the planning processes of railway operators by developing an integrated smart planning approach, enables the analysis of entire rail networks. Furthermore, cross-border simulations for European corridors and larger networks as a basis for a Single European Railway Area (SERA) should also be enabled. This project was

accomplished within September 2018 – December 2020 and it has a strong impact especially on requirements of FA1. There is a strong focus on simulations in order to optimize planning and therefore to accomplish overall, across borders an optimized time table. This optimization addresses low or no downtimes but at once enough buffer-times to remain flexible for any upcoming incidents. The knowledge transfer will be given by the key stakeholder DB. It is important to take into consideration that 'current planning procedures', currently are subject for significant reforms, i.e. the revision of Reg. 913/2010/EU and the implementation of TTR (Timetable Redesign) - see also chapter 8.

For more infos on PLASA visit:

https://cordis.europa.eu/project/id/730814

P.2: Yard Coordination System (YCS)

YCS should help stakeholders to coordinate their track use in an A/D-yard. YCS contributes as an initial project to the digitization of the marshalling yard and fits with the concept of 'control through planning', which is an important planning and way-of-working approach implemented in projects by the Swedish infrastructure manager Trafikverket. The project was accomplished within Shift2Rail (September 2019 – August 2022). This project is one of the few projects with a clear focus on yard management activities and the synchronization between different stakeholders within a marshalling yard. These project results are an important basis on which we can set up and evolve within FA5. Further important input are the definitions of data to be exchanged and especially the definition of which data are predominantly required by a Traffic Management System (FA1) at the right time. The knowledge transfer will be given, as key stakeholders of the project are partners in the work packages 25 – 32 and follow a strong alignment with FA1 for all Railway Traffic Management System relevant data, interfaces and requirements.

For more infos on YCS visit:

https://projects.shift2rail.org/download.aspx?id=5e101f33-6c1b-4f57-a4d3-aed87293e381

P.3: Kombinierter Verkehr 4.0 – KV4.0

KV4.0 have had the aim to define a digitalized data exchange format and to a certain extend a platform to enable standardized data exchange along the end2end intermodal transport chain. This project brought together many stakeholders from the sector involved such as Kombiverkehr, DB Cargo, Hupac, KTL, SBB Cargo, etc and was funded by the German government. This project was accomplished between September 2017 and August 2020. The definitions of data are a key basis for our joint efforts within FA5. It has

described data to be exchanged and especially which data are predominantly required by a Traffic Management System (FA1) at the right time. The knowledge transfer will be realized by the key stakeholder DB Cargo, who is also a project partner in several work packages.

For more infos on KV4.0 visit:

https://www.kv4punkt0.com/

P.4: Intermodale Gate der Zukunft – InGa-Z

InGa-Z has the aim to standardize processes and procedures in German intermodal terminals with real-time information from the railway network and 'terminal processes of stakeholders, as well to digitalize and standardise the check-in process in intermodal terminals. It builds on KV4.0 and elaborates further this concept. This project was realized by many stakeholders from the sector involved such as DB Cargo, Dubai Port World (DP World), CTH (Container Terminal Herne), CTHS (Container Terminal Halle-Saale), Gartner, Transfracht, Protostellar, Locon, etc and was funded by the German government.

The main challenges are:

- Involve many small and medium sized stakeholders via Interface
- Reduce or ideally eliminate paper exchange
- Data to be inserted only once
- Ensure traceability of goods and means of transport and important events
- Accelerate and standardize processes
- Obtain and share real-time information
- Reduce empty wagons and delays of freight trains
- Optimize movements and tasks in Terminals

It is an ongoing project until December 2023. The definitions of data to be exchanged and especially the definition of which data are predominantly required by a Traffic Management System (FA1) at the right time are a key basis for our joint efforts within FA5. Furthermore, this project focusses already on dynamic information exchange and a dynamic task management especially in terminals. The knowledge transfer will be realized by the key stakeholder Thales/Protostellar, who is also part and in the lead of several work packages.

For more infos on InGa-Z visit:

https://www.eba.bund.de/Z-SGV/Projekte/laufende_Projekte/InGa-Z/inga-z_node.html

P.5: FENIX

The main objective of project FENIX is the development of the first European federated architecture for data exchange serving the European logistics community of carriers, logistics service providers, mobility infrastructure providers, cities and authorities to support interoperability between existing and future individual platforms. The platforms of the FENIX federation will be connected through connectors which will allow the identification of the platforms, the discovery of the available information, and the exchange of this information. The main objective of the project is to design these connectors and the implementation in each platform. FENIX is accomplished (2019 - 2022) and currently the project FENIX 2.0 was started. The output of FENIX is a crucial input and foundation for work package 32 of FA5. Definitions of data to be exchanged and especially the definition of what data are predominantly required by a Traffic Management System (FA1). This will be a key basis for our joint efforts within FA5. The knowledge transfer is given, as key stakeholders of the project are part of the work packages 25 – 32 and follow a strong alignment with FA1 for Railway Traffic Management System relevant data, interfaces and requirements.

For more infos on FENIX visit:

https://fenix-network.eu/

P.6: SIMPLE

The project SIMPLE (Simplification of Processes for a Logistics Enhancement) is a platform for the integrated and digital management of data related to freight transport (road, rail and maritime), generated by each stakeholder in the different modes of the supply chain. It includes the digitalization of paperwork along the whole supply chain, including the road transportation (CMRs). The main objective of this platform is to connect all the stakeholders involved in the freight transport by road, rail and maritime. Spanish Government funded this project, which is involving many stakeholders especially in Spain such as ADIF and many ports such as the Port of Barcelona, Sevilla, Huelva and others. SIMPLE is an ongoing project (November 2020 - 2024).

The main challenges are:

- Involve small stakeholders in the digitization of shipments information, as there are many small companies that do not have IT departments, and thus they will need to insert the information not through API integration but using the HMI.
- Legislation does not enforce the use of the platform, so many stakeholders will not digitize the information to be shared.
- Ensure traceability of goods and means of transport and important events.
- Eliminate inefficiencies in current processes.

- Obtain real-time information.
- Enable interoperability between different players and modes of transport.
- Reduce costs.
- Optimize the use of resources.

The output of SIMPLE is a crucial input especially for the workpackages 27-31 as it has a strong focus on optimized data exchanged between terminals and railway undertakings. Furthermore, this project started to define requirements towards optimized data exchange with the Railway Traffic Management System and is as well an important basis for the collaboration between FA5 and FA1.

For more infos on simple visit:

https://service.projectplace.com/#project/28499560/documents/25727929/26045584

P.7: EasyRailFreight

EasyRailFreight is a platform designed and developed by RFI that aims to facilitate the promotion and development of intermodal logistics services, in accordance with the objectives of the European Union related to the decarbonization of transport. The intention is to create an information system for all players working in the logistic chain, to facilitate the matching of supply and demand, to facilitate the acquisition of supplementary services, and to allow a complete view of services on the market. Finally, the platform ensures the tracking of shipments, from origin to destination for all services related to the transport chain. The project has been ongoing since December 2021.

The challenges mainly are:

- Better communication and promotion of available intermodal transportation services in order to improve the efficiency and quality of services offered;
- Improving the quality of information flows to support modal integration and improve the quality and efficiency of the logistics system, increasing its competitiveness;
- Promoting the planning and procurement of door-to-door or terminal-to-terminal services, including first and last mile on road and rail;
- Fostering digitization;
- Maximizing utilization of infrastructure and terminal offerings, resulting in optimized input utilization; increasing intermodal traffic volumes with system benefits in terms of decarbonization, sustainability and competitiveness.

The definitions of data to be exchanged and especially the definition which real-time data are predominantly required by a Traffic Management System (FA1), are a key basis for our joint efforts within FA5. The knowledge transfer will be realized by the key stakeholder RFI, who is also a project partner in several workpackages.

For more infos on EaysRailFreight visit:

https://www.rfi.it/

P.8: OptiYard

This project considers technological aspects of optimizing processes of marshalling yards / terminals and rail link to the network. Futher, this project includes aspects of information systems, data formats and interfaces used in the rail freight sector. The project concerns on existing procedures, sources and the duration of main activities, that have to be realized inside marshalling yards. The output of the analysis is a resume of inconveniences that should be eliminated in the near future. It is proposed to consist a design of an interface for communication between the railway network and the marshalling yard to apply non-interrupted data flow between marshalling yards and surrounding network as a base for optimized decisions.

The universal data interface enables information from network information systems to the considered yard management system.

The main aim of the project was to propose the interface which was:

- universal in EU;
- in accordance with TAF TSI standards;
- usable in different rail environment conditions in different countries.

Therefore, experience and proposed solutions are universally transferable and applicable everywhere else in the European rail system and thus fully respects the achieving the objectives of the project.

OptiYard was accomplished in October 2019. The project is one of the few projects with a clear focus on yard management activities and the synchronization between different yards. Therefore, it is an important basis on which we can set up and evolve within FA5. The definitions of data-exchange and especially the definition, which real-time data are predominantly required a Traffic Management System (FA1), are another important input. The knowledge transfer will be given by the key stakeholder UIC.

For more infos on OptiYard visit:

https://optiyard.eu/

P.9: FR8RAIL II and III

Within certain work packages, both projects were focused on bridging the gap between timetable planning and operational traffic by improving short-term planning for freight traffic including enhanced coordination between yards, terminals, infrastructure managers, and freight rail undertakings. The projects were aimed to develop decision support methods and tools, including a simulation module for analyzing deviations from normal railway traffic and an intelligent planning module for minor timetable modifications. FR8RAIL II was completed between years 2018 – 2022, FR8RAIL III has been ongoing since 2019 with the aim to finalize the project in year 2023. This project has a strong impact especially on what is required out of FA1 as it has a strong focus on simulations in order to optimize planning and reaching overall, across borders as well optimized time table. The optimalisation addresses low or no downtimes, but in the same enough buffer-times to remain flexible for any emerging incidents. The knowledge transfer will be realized by the key stakeholders Bombardier and DB, whose are also project partners in several work packages.

For more infos on FR8RAIL visit:

https://projects.shift2rail.org/s2r_ip5_n.aspx?p=FR8RAIL

P.10: FR8HUB

As one component of the activities of the FR8HUB project, a tool has been developed that supports the dispatcher in rescheduling trains due to late or early departures. New routes can be created and optimized, providing information about the consequences of early or late departures. The updated schedule can then be communicated to the relevant stakeholders. FR8HUB was completed in 2021. The project has a strong impact especially on what is required required by FA1 as it has a strong focus on simulations in order to optimize planning and to accomplish an overall, across borders optimized time table. Optimization is related to no downtimes, but enough buffer-times to remain flexible for any emerging incidents. The knowledge transfer will be realized by the key stakeholder Trafikverket, who is a project partner in several workpackages.

For more infos on FR8HUB visit:

https://projects.shift2rail.org/s2r_ip5_n.aspx?p=FR8HUB

7 Recent/current studies and initiatives as relevant support/input for planning and operations of international border-crossing train paths

The main objective of TAF TSI is to establish a technical framework that facilitates the efficient exchange of information and promotes economically viable transport processes. It encompasses freight services and the integration of different modes of transport, focusing not only on train operations but also on the overall transport services provided by railway undertakings. TAF TSI also has implications for the conditions of rail transport use by various stakeholders, including infrastructure managers, railway undertakings, wagon companies, intermodal operators, and customers. Within this framework, infrastructure managers are responsible for path allocation, train monitoring, and reporting, while railway undertakings are responsible for train operations.

The train path allocation process is highly regulated. Based on the European directives and regulations (see Table 1 and Table 2) and – in case there is applicable – also national laws, rail Infrastructure Managers (IM) have the task of drafting and publishing a Network Statement (NS).

Table 1: Relevant Directives of the European Parliament and of the Council

Directives No	**published**	**title**
2012/34/EU	21 November 2012	Establishing a single European railway area
2016/798/EU	11 May 2016	Railway Safety Art. 8 (8)
2007/59/EC	23 October 2007	Certification of train drivers operating locomotives and trains on the railway system in the Community ANNEX VI - 8. language paragraph (2)

Table 2: Relevant Commission Implementing Regulations and one Regulation of the European Parliament and of the Council

Regulation No	**published**	**title**
2015/10	6 January 2015	Criteria for applicants for rail infrastructure capacity and repealing Implementing regulation (EU) No 870/2014

2016/545	7 April 2016	Procedures and criteria concerning framework agreements for the allocation of rail infrastructure capacity
2017/2177	22 November 2017	Access to service facilities and rail-related services
2019/777	16 May 2019	Common specifications for the register of railway infrastructure and repealing Implementing Decision 2014/880/EU
913/2010	22 September 2010	Concerning a European rail network for competitive freight Art. 17(2)

For the timetable 2022, the content of NS is recommended by Rail Net Europe (RNE) – an association of European Rail Infrastructure Managers, serving as an umbrella organisation that 'helps coordinate its Members' international processes in the areas of Capacity Management, Traffic Management, Corridor Management, IT and Sales & Legal Matters' (see: www.rne.eu, last accessed 14-04-2023). This Network Statement template recommends a common structure and is named 'RNE Network Statement Common Structure and Implementation Guide'[4].

Section 4: Capacity Allocation of this template describes all aspects for applicants – these include Railway Undertakings, transport organisations, ports/terminals etc. – covering capacity allocation both for domestic and for international train traffic. The project *Timetable and Capacity Redesign* – or *TTR for Smart Capacity Management* describes the process components including the timeline of capacity planning (see **Figure 1**). The essential components of the process are described more in detail in section 4: part 4.9.2 'Process Components'[5].

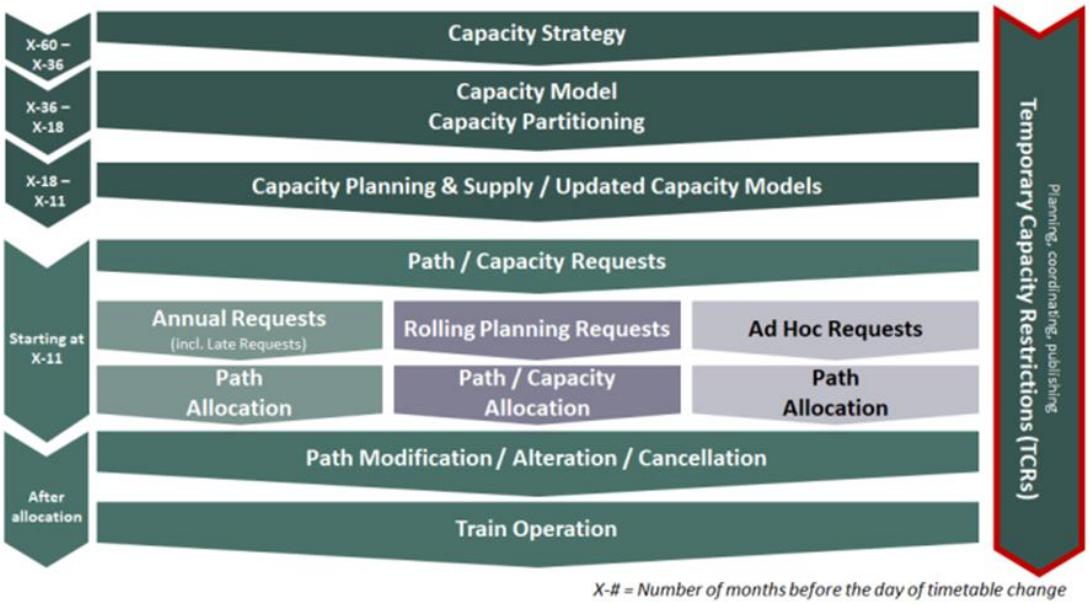
The TTR project is a common project of RailNetEurope (RNE) and Forum Train Europe (FTE) and based on the agreement that changes to these procedures are needed. They are being supported by the European Rail Freight Association (ERFA) and ALLRAIL[6].

[4] https://rne.eu/wp-content/uploads/2022/10/RNE_NS_Common_Structure_TT_2022.pdf, last accessed 14-04-2023

[5] https://rne.eu/wp-content/uploads/2022/10/RNE_NS_Common_Structure_TT_2022.pdf, last accessed 14-04-2023

[6] https://rne.eu/capacity-management/ttr/, last access 14-04-2023

Figure 1: Key elements of TTR process[7]



The capacity allocation process (see part 7.3.2.6 of the RNE Network Statement) is based on the procedure of capacity allocation

- procedure for requesting access or services
- response to requests
- coordination process,
- priority criteria and their application,
- search for viable alternatives,
- conclusion of the necessary agreements

or

- refusal of access.

During the ongoing project work of the TTR project, the scope was expanded by addressing the problems of timetabling for freight costumers:

'As the project progressed, it became clear that the issue wasn't just the lack of an adequate deadline for requesting timetables for freight. The problems were broader, with capacities being unavailable for the entire market – including passenger traffic – when they were needed. The lack of international alignment was also evident, and the provided

[7] RNE Network Statement, chapter 4.9.2, p. 30

paths were not meeting the expected quality due to instabilities caused by temporary capacity restrictions (TCRs)[8].

A part of the extended scope is a User Satisfaction Survey for Rail Freight Corridors (RFCs), that was established as an important tool that helps to measure customers' satisfaction rates. Since 2014, all stakeholders in the logistics chain, including RUs, non-RUs, terminals, and ports, have been invited to participate in the survey. In 2022, a total of 128 companies took part in the survey. The TTR project stated that

'The feedback provided by the users is crucial for improving the quality of the Rail Freight Corridors' products and services and the participants' support is highly appreciated[9].

The FP5-TRANS4M-R project considers that this user feedback as a relevant input to the specifications for seamless planning. The used feedbacks are available as specific results of the individual Rail Freight Corridors[10] and as a summary report[11].

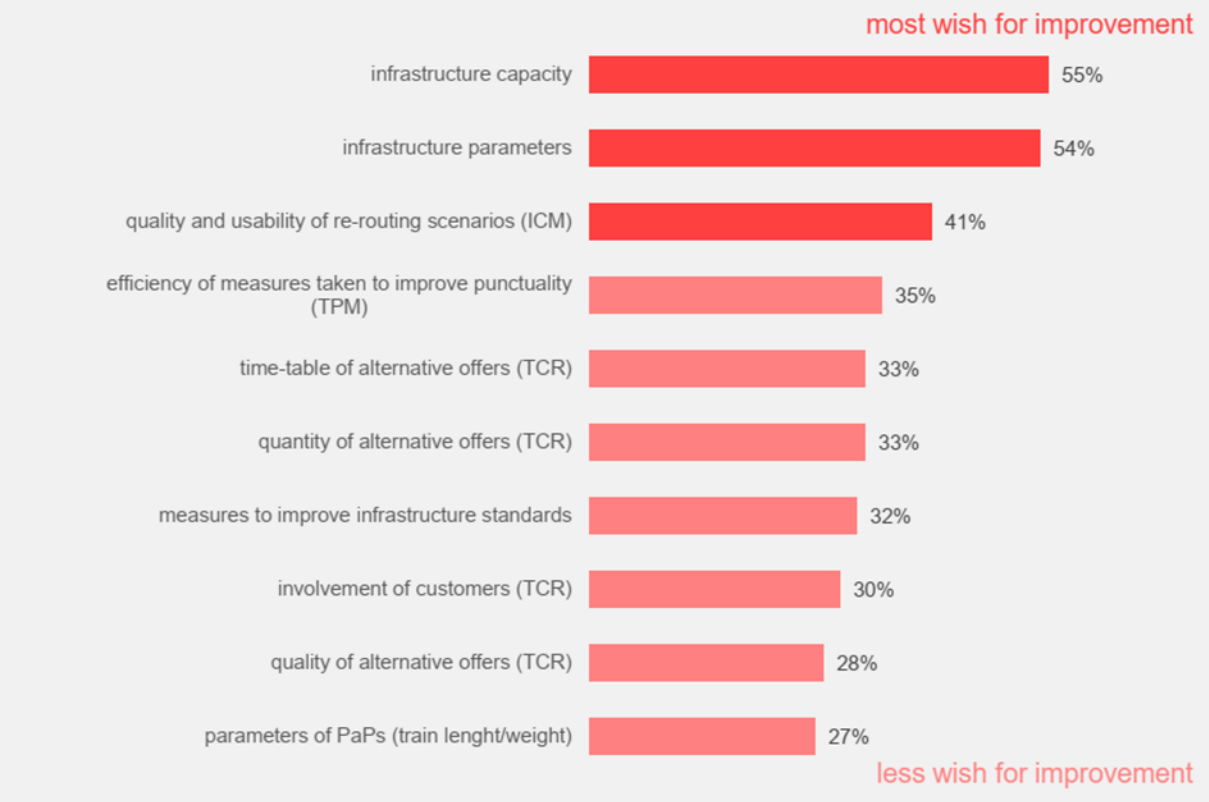
There are concluded three most important topics:

- Infrastructure capacity
- Infrastructure parameters
- Quality and usability of re-routing scenarios (International Contingency Management)

Figure 2 shows the lowest ten topics of this survey which the participants had the most wish for improvement. The results are based on answers by RUs/non-RUs, terminals/ports. This result is based on 60 participants (with input of 119 evaluations due some participants are using multiple Rail Freight Corridors). The results are only based on a relatively small number of interviews. The Rail Freight Corridor specific results might significantly differ from the average. Further, it has to be considered the different sample sizes on every topic.

[8] https://rne.eu/the-ttr-journey-reflecting-on-the-evolution-of-the-timetable-redesign-programme/ ,last accessed 14-04-2023
[9] https://rne.eu/rfc-user-satisfaction-survey-2022-results/, last accessed 14-04-2023
[10] https://rne.eu/corridor-management/rfc-user-satisfaction-survey/, last access 14-04-2023
[11] https://rne.eu/wp-content/uploads/2023/01/RFC_USS_2022_overall-report_publication.pdf, last access 14-04-2023

Figure 2: Lowest top ten topics related to customer satisfaction[12]



Application of TAF TSI in Seamless:

A further request is the use of Telematics Applications for Freight Service (TAF) that are defined as a Technical Specification of Interoperability (TSI). FP5-TRANS4M-R , Seamless should keep the existing data formats and relevant codes in mind for timetable processes. The European Railway Agency (ERA) publishes the relevant TAF TSI documents on a website[13].

The general idea of TAF TSI is that relevant data could be processed in different rail freight applications (e.g. timetabling process) by a common data format to handle data between the different stakeholders. It is obvious that such a format is a starting point for seamless processes including the different timetable planning systems of the European Infrastructure Managers as well as the communication with the applicants.

[12] RFC User Satisfaction Survey 2022 I Overall Report, slide 6, see https://rne.eu/wp-content/uploads/2023/01/RFC_USS_2022_overall-report_publication.pdf, last access 14-04-2023
[13] https://www.era.europa.eu/domains/technical-specifications-interoperability/telematics-applications-freight-service-tsi_en, last access 18-04-2023

Further, National Contact Points (NCP) and the National Allocation Entities (NAE) for Primary Location Codes lists have been updated for 2022 and made available by ERA. The TAF an TAP TSI Bulletin[14] describes the implementation status.

[14] ISSUE SEPTEMBER 2022; source https://www.era.europa.eu/content/taf-and-tap-tsi-bulletin-september-2022_en, last access 18-04-2023

8 Conclusion and next steps for the alignment between FP1 and FP5

This Deliverable marks the first step of the specification and alignment process between FP1 and FP5. This process must be completed with the submission of the overall FP5-TRANS4M-R "seamless" specification deliverable D25.1 in M18. Therefore, on the basis of the operator input as well as the identified relevant projects and other studies/initiatives, the steps towards the completion of this alignment process are defined in this chapter.

Firstly, a knowledge transfer workshop will take place where the herein identified relevant projects will be presented by the experts of the FP5-TRANS4M-R team who were also involved in these projects. Based on the feedback from the FP1 colleagues, dedicated deep-dive sessions for individual projects will be scheduled. There, the detailed content will be discussed on expert level. It will be defined if additional follow-up activities, especially with regards to specification and the definition of requirements, are necessary as part of the alignment process.

Secondly, after the FP1 experts have reviewed this deliverable, a series of joint meetings (independent from the knowledge transfer workshop) will take place, where the content of this Deliverable will be matched against the specification requirements of FP1 (which they need from FP5). If necessary, the operators will give more details and elaboration on the topics that are listed in this deliverable, especially for those items that are defined as focus areas by the FP1 experts.

Furthermore, the draft of the deliverable structure of D25.1 will be shared with FP1. A resulting deliverable deployment plan with detailed working steps towards the results of the specification phase will be presented to FP1 and adapted, where necessary. This is to ensure that all specifications that are needed for the fulfilment of the respective FP1 developments, such as the mapping of interconnected processes and systems (relevant for both FP1 and FP5), are delivered adequately by FP5 and that a risk for potential development delay is mitigated. This is especially relevant, as such a delay could have a chain effect on the demonstration activities for the Seamless Corridor showcase (WP33), which also features elements from FP1.

In conclusion, this Deliverable marks the initial step towards the specification and alignment process between FP1 and FP5. The defined steps for completion of this process, as outlined in this chapter, include a knowledge transfer workshop, deep-dive sessions, joint meetings, and sharing of the draft deliverable structure. These activities aim to ensure a thorough understanding of the identified relevant projects, address feedback from FP1 colleagues, and match the content of this Deliverable with the specification requirements of FP1. By engaging in this collaborative process, we aim to deliver the necessary specifications and mitigate any potential development delays, safeguarding the

progress of the Seamless Corridor showcase and ensuring the seamless integration of elements from both FP1 and FP5.