Deliverable 2.4
Demonstration Strategy

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1. Executive Summary

This document forms Deliverable 2.4 “Demonstration Strategy” of FP1 MOTIONAL Project. Its purpose is to present a strategy of how to set up and perform demonstrations. The strategy acts as a guideline for FP1 Motional work packages starting in December 2024 (M25) and provides templates for deliverables in the demonstration phase (M25-M43).

The deliverable proposes to divide the work related to demonstrations into four phases: Specification, Implementation, Execution and Evaluation. The four phases help the demonstrating partners to structure their work. The different demonstration events required, open for people outside MOTIONAL, are also defined and described. The interaction between Workstream 1 and Workstream 2 is also presented, as well as Workstream 2’s contribution to other Flagship Projects.

2. Abbreviations and acronyms

Abbreviation / Acronym	Description
AI	Artificial Intelligence
ATO	Automatic Train Operation
B2B	Business to Business
CCS	Command Control and Signalling
C-DAS	Connected Driver Advisory System
DSS	Decision Support System
ETCS	European Train Control System
FA	Flagship Area
FP	Flagship Project
GoA	Grade of Automation
HF	Human Factor
HiL	Hardware-in-the-loop
HL3	Hybrid Level 3
HMI	Human-Machine Interface
IAMS	Intelligent Asset Management System
IM	Infrastructure Manager
JU	Joint Undertaking
KPI	Key Performance Indicator
Maas	Mobility as a Service
MAWP	Multi-Annual Work Programme
NG	New Generation
PI	Performance Indicator
PTO	Public Transport Operator
PRM	Person with Reduced Mobility
RBC	Radio Block Center
RDS	Railway Data Space
RNE	Rail Net Europe
SCI	Standard Communication Interface
SP	System Pillar
TCR	Traffic Capacity Restriction
TMS	Train Management System
TPE	Train Path Envelope
TRL	Technology Readiness Level
TSI	Technical Specification for Interoperability
UC	Use Case
WP	Work Package
WS	Workstream

3. Background

The present document constitutes the Deliverable D2.4 Demonstration strategy in the framework of the Flagship Project 1 – MOTIONAL as described in the EU-RAIL MAWP [2].
The main objective of the FP1 MOTIONAL project is to improve the flexibility, efficiency, resilience, and capacity adaptation of the European rail network to support the development of a Single European Rail Area. This involves the development of functional requirements, specifications, and solutions for future European Traffic Management, including common network management, train planning, operations, automation and mobility management.

The target solution of the project is a dynamic network and traffic management at the European scale built upon a harmonized functional system architecture for agile, borderless, mixed-traffic operations and integration of Rail with other transport modes. The benefits of the project can be numerous and include the extension of capacity planning at the European level, enabling automatic management of cross-border rail traffic, improving service offers, operations, capacity utilization, and the information and distribution of multimodal offers, enhancing the competitiveness of rail-based mobility chains.

To achieve the project objectives, the project is divided into our four Workstreams that will work on different areas, namely:

- WS1.1 Planning systems and processes including cross-border;
- WS1.2 Integration of TMSs and processes including cross-border traffic management;
- WS1.3 Integrate Rail with other transport modes;
- WS2 Digital enablers.

In previous deliverables from MOTIONAL:

- D2.3 Use Cases for planned technical developments of the project – was focused on the describing the functionalities to be developed within the project;
- Some deliverables described the general goal of the demonstrators of each sub-group:
    - D3.1 Mapping against scope, specification of technical enablers, high-level use cases, high-level requirements, high level design for demonstrators in WPs 4-9
    - D10.1 Mapping against scope, specification of technical enablers, high-level use cases, high-level requirements, high level design for demonstrators in WPs 11-18
    - D19.1 Specification Report of Enablers 18 – 27

This deliverable focuses on setting a demonstration strategy, to enable all work packages to have a common understanding of the demonstration and a structure to build up their respective deliverables from.

4. Objective/Aim

The objective for this deliverable is stated in the Grant Agreement [1] the following two sentences:

- *This deliverable will cover a plan to set up and perform demonstrations, including timeline, alignment, dependencies.*
- *The strategy will act as a guideline for the project WPs and provide templates.*

One important aspect is to provide a coherent structure for all demonstration events and deliverables. This gives all demonstrating partners in MOTIONAL good prerequisites to prepare their demonstrations. Well-structured deliverables also help all stakeholders to understand the results and identify findings of their interest.

Another important aspect is the content of D2.4 gives possibilities for progress monitoring and follow-up both at WP-level, Workstream and project level. This helps the whole project to keep its promises, both on time and quality.

This deliverable focuses on WS1, since WS2 does not perform any demonstrations. Chapter 8 describes the WS2 contributions to the planned demonstrations of WS1.

5. Demonstration overview

In chapter 5, all demonstrations in FP1 MOTIONAL are presented briefly, which gives an overview of the total content. There are in total three tables, one for each Workstream (1.1-1.3).

5.1. WS 1.1 demonstrations

The demonstrations in WS 1.1 are presented in Table 1.

Table 1. Demonstrations in WS 1.1

Demo no.	Short description	TE	Related use case	Partici-pants	Infra manager/ location/data provider
5.1	Cross-border scheduling	TE1	UC-FP1-WP3-17	MERMEC	Civitanova-Albacina (to be agreed with RFI/FS)
5.2	Handling both, national and cross-border traffic with focus on cross-border freight trains. Supporting methods how to identify residual capacity Sweden – Norway. International co-ordination of residual capacity in an early ad hoc stage	TE1	UC-FP1-WP3-7, UC-FP1-WP3-8, UC-FP1-WP3-9	TRV A.E. KTH	Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
5.3	Interfaces for interaction with external national or central planning applications; cross-border planning including short-term planning and process improvement among actors	TE1	UC-FP1-WP3-1, UC-FP1-WP3-2, UC-FP1-WP3-3	HAC	Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
5.4	Collaborative yard capacity planning	TE6	UC-FP1-WP3-10, UC-FP1-WP3-11, UC-FP1-WP3-12, UC-FP1-WP3-13	TRV A.E. RISE	Malmö freight yard Trafikverket
5.5	Improved capacity allocation and new processes. Integration of new planning processes and the production of standard reports.	TE1, TE2	UC-FP1-WP3-4	HAC	Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
5.6	Integration of traffic management system with network capacity planning. The feedback loop between planning and operation will be jointly	TE2, TE6	UC-FP1-WP3-5	HAC	Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor

	demonstrated with WP11 (task 11.3)/ WP12 and WP 13/14.				
5.7	Integration of network capacity planning with yard and station capacity planning. Integration of nodes and lines using specified interfaces	TE6	UC-FP1-WP3-6	HAC	Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
7.1	Demonstration of algorithms for generating strategic timetables	TE4	UC-FP1-WP3-22, UC-FP1-WP3-23, UC-FP1-WP3-24	NSR NRD A.E. SINTEF DLR	NSR NRD
7.2	Demonstrate how a planner can interact with an optimisation-based timetable planning tool to resolve conflicts in the annual planning process	TE4	UC-FP1-WP3-21	TRV A.E. RISE	Part of Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
7.3	Timetable optimiser and decision support system for adjusting the annual timetable on a line or network level based on the activities of subtask 6.3.1	TE3	UC-FP1-WP3-25	HAC	Part of Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
7.4	Demonstration of algorithms for planning of planned maintenance work for the entire Dutch network. Cancellations and alternative routes will be considered.	TE3	UC-FP1-WP3-19	NSR	NSR
7.5	Demonstrate the use of short-term planning algorithms for re-scheduling trains in case of TCRs at the Alnabru-Malmö line	TE3	UC-FP1-WP3-18	TRV A.E. LIU NRD A.E. SINTEF	Part of Malmö - Oslo Alnabru (software) Trafikverket NRD/BaneNor
7.6	Demonstrate the use of algorithms for inserting short-term train paths in a planned timetable	TE3	UC-FP1-WP3-29	SNCF	SNCF
7.7	Demonstrate the use of short-term planning algorithms that identify and solve conflicts by different means	TE3	UC-FP1-WP3-26	INDRA	INDRA

7.8	Demonstrate functionalities for short-term planning for rescheduling timetables in case of TCR and managing additions or modifications of new tracks on request	TE3	UC-FP1-WP3-27	STS SINTEF	Genoa Hitachi SCC Area (Ventimiglia-La Spezia-Tortona) Hitachi Rail (STS) Rete Ferroviaria Italiana (RFI)
7.9	Demonstration of algorithms for rolling stock rotation	TE4	UC-FP1-WP3-28	NRD A.E. SINTEF	Part of the Norwegian network NRD
7.10	Demonstration of algorithms for rolling stock stabling	TE6	UC-FP1-WP3-20	NSR	Utrecht Centraal NSR
9.1	Simulate large networks, calibration and validation methodology of simulation model, mainly regarding finding primary delay distribution input (from historical data)	TE5	UC-FP1-WP3-31, UC-FP1-WP3-32	TRV A.E. KTH TRV A.E. LU	Larger part of the Swedish network Trafikverket
9.2	Demonstrate a method to evaluate the robustness of a crew plan by a new simulation tool. The simulation focuses on delay propagation between trains by shared crew members.	TE5	UC-FP1-WP3-42	NSR A.E. SISCOG PR	All trains of NS within the Netherlands NSR
9.3	Demonstrate a method for processing the historical data and implement the delay distribution into RailSys for stochastic models	TE5	UC-FP1-WP3-32	SNCF	Trafikverket SNCF
9.4	Simulate how the timetable behaves with different topology networks	TE5	UC-FP1-WP3-43	INDRA	
9.5	Determining the capacity, wear and energy effects of: ATO, TPE, C-DAS, TMS, HL3, NG Brake on mainlines and shunting/stabling actions	TE7	UC-FP1-WP3-41	PR NSR	Schiphol-Amsterdam Zuid-Almere-Lelystand (and a branch to Hilversum) ProRail NS
9.6	Methods to determine the capacity effect of ETCS HL3	TE7	UC-FP1-WP3-30	SNCF	SNCF
9.7	Update timetable considering C-DAS driver mode and determine the effects in capacity	TE7	UC-FP1-WP3-44	INDRA	INDRA

9.8	Create mixed operational plans taking into consideration the hour of the day or the area where the track is placed	TE7	UC-FP1-WP3-36, UC-FP1-WP3-37, UC-FP1-WP3-38, UC-FP1-WP3-39	CAF	Bilbao Line 3 Data provider: CAF
9.9	Analyse the effects of C-DAS on capacity and energy consumption taking into account the effects of onboard communication and positioning	TE7	UC-FP1-WP3-46	CEIT	
9.10	Modelling of system effects of different GoA. Modelling effects from introducing ETCS HL3 on lines with dense traffic. Modelling effects from varying adhesion conditions and introducing new generation braking system.	TE7	UC-FP1-WP3-40, UC-FP1-WP3-45, UC-FP1-WP3-47	TRV A.E. KTH	Multiple lines in Sweden and Norway Trafikverket NRD/BaneNor
9.11	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety	TE7	UC-FP1-WP3-33, UC-FP1-WP3-34, UC-FP1-WP3-35	TRV A.E. VTI	Scanmed, corridor B Trafikverket

5.2. WS 1.2 demonstrations

All demonstrations in WS 1.2 can be seen in Table 2.

Table 2. Demonstrations in WS 1.2

Demo no.	Short description	TE	Related use case	Partici-pants	Infra manager/ location/ data provider
12.1	Interfaces TRL 5 from the communication Platform to the Timetable Management Applications and to the Traffic Control (RBC, Interlocking).	TE8, TE10	UC-FP1-WP10-01 UC-FP1-WP10-03 UC-FP1-WP10-02	ATSA	ATSA

12.2	Integration solution for the data exchange and storage system (data lake) allowing the exchange through interfaces, data quality assessment, and metadata generation. This solution will be used for integrating disparate decision support systems.	TE9	UC-FP1-WP10-04	PKP	PKP
12.3	Interface from TMS Planning system to ATO-TS control module to maximise the energy efficiency of the train operation in a short-term action.	TE8	UC-FP1-WP10-05	STS	STS
12.4	Interfaces from the communication Platform to wayside C-DAS operation system, focusing on speed profiles functionalities.	TE8	UC-FP1-WP10-06	INDRA	INDRA
12.5	Demonstrator based on the interfaces coming from subtask 11.3.5 (implementing interfaces between neighbouring TMSs and IMs) to provide a TMS and IM real-time connection of rail networks focused on cross border traffic management.	TE8, TE9	UC-FP1-WP10-07 UC-FP1-WP10-08	MERMEC	RFI
12.6	TRL 6 interfaces and TRL 5 decision support module for integration and traffic management of two neighbouring TMSs and IMs including cross-border operations (supporting Destination 5 activities).	TE8, TE9	UC-FP1-WP10-09 UC-FP1-WP10-10 UC-FP1-WP10-11	HACON, (ADIF FM)	TRV
12.7	Interfaces for integration of TMS with other services such as station and yard management systems (supporting Destination 5 activities), digital maintenance systems (supporting Destination 3 activities), Passenger Information Services (supporting Destination 6) as well as electric traction systems and crew/ rolling stock management systems.	TE10	UC-FP1-WP10-12 UC-FP1-WP10-13 UC-FP1-WP10-14	HACON, (ADIF FM)	TRV
12.8	Interface of TMS to Yard Coordination System 2.0 in Malmö node. Work connects to WP 4.	TE10	UC-FP1-WP10-15 UC-FP1-WP10-16	TRV	TRV

12.9	Interface in view of the future autonomous inspection vehicle for the infrastructure (Destination 3) and its integration with the Intelligent Asset Management System (IAMS). To receive information about asset status and planned interventions and deliver allocated paths to execute inspections and interventions.	TE10	UC-FP1-WP10-17	CEIT	CEIT
14.1	Collaborative DSS for efficient and effective disruption management	13, 14	UC-FP1-WP10-19 UC-FP1-WP10-20 UC-FP1-WP10-21 UC-FP1-WP10-22 (ADIF) UC-FP1-WP10-23 (ADIF)	STS, TRV	TRV, STS, ADIF
14.2	Decision support for rolling stock dispatching	13, 14	UC-FP1-WP10-24 UC-FP1-WP10-25	NSR	NSR
14.3	Collaborative DSS for efficient and effective disruption management	13, 14	UC-FP1-WP10-28-31 UC-FP1-WP10-30 UC-FP1-WP10-31	HACON	TRV, NRD/ BaneNor
14.4	HMI for TMS based on User Experience (UX) Design and user input	TE11	UC-FP1-WP10-26 UC-FP1-WP10-28	TRV, STS, INDRA	TRV
16.1	Linking TMS to ATO/C-DAS for optimised operations “Live” demonstration for the public (or by video) of future TMS-ATO operations, including human factors: • In alignment with FA2 “Mainline demonstration preparation”- a project of a complex network use case including very short headways, disruption, and conflict resolution where TMS and ATO together show their added value, also indicating how this new kind of operation will impact the involved operational actors (train drivers and signallers HF research) by ProRail/NSR. • Testing HF impact when applying in FA2 developed new optimised braking functionality. • In alignment with FA6 test bench demonstration simulation.	TE12, TE15	UC-FP1-WP10-30 UC-FP1-WP10-31	PR, TRV, NSR, KB, ADIF, CAF, MERMEC	PR/NSR

16.2	Human-in-the-loop simulations to test the ATO operational concept in emulated active practice and using tailor-made TMS/ ATO/C-DAS algorithms.	TE12, TE15	UC-FP1-WP10-32	PR, TRV, NSR, KB	PR/NSR
16.3	Prioritized enhancements developed from WP15 for improved efficiency of C-DAS operations from a traffic management perspective.	TE12, TE15	UC-FP1-WP10-35	TRV, PR, NSR, STS	TRV/STS
16.4	Improvement of forecast calculation through TMS and C-DAS integration.	TE12, TE15	UC-FP1-WP10-33	PR, NSR, INDRA, CEIT, STS	CEIT, INDRA
16.5	Prioritized enhancements for improved efficiency of C-DAS operations from a traffic management perspective.	TE12, TE15	UC-FP1-WP10-34	PR, NSR, INDRA, CEIT, STS	
16.6	Performances comparison between C-DAS-C and C-DAS-O architectures	TE12, TE15	UC-FP1-WP10-40	STS	RFI, STS
16.7	ATO – TMS integration platform developed in subtask 15.3.4, implementing possible new requirements and architecture based on FA2&System Pillar specifications regarding ATO / TMS to support the autonomous train operations. Also, testing and demonstrating results the modelling for future operation of traffic regulation strategies (Operational Concept) for improved global behaviour of the traffic under minor timetable disturbances (delays and unfulfilled headways), based on different criteria and taking into account the global situations of the line through TMS – ATO interaction.	TE15	UC-FP1-WP10-39	AZD, PR, STS	AZD, STS

16.8	ATO – TMS integration platform developed in subtask 15.3.4, implementing possible new requirements and architecture based on FA2&System Pillar specifications regarding ATO / TMS to support the autonomous train operations. Also, testing and demonstrating results the modelling for future operation of traffic regulation strategies (Operational Concept) for improved global behaviour of the traffic under minor timetable disturbances (delays and unfulfilled headways), based on different criteria and taking into account the global situations of the line through TMS – ATO interaction.	TE12, TE15	UC-FP1-WP10-36 UC-FP1-WP10-37 UC-FP1-WP10-38	CAF, ADIF	Bilbao Line 3 Data provider: CAF
16.9	Improvement of traffic forecast and operational plan update through TMS and ATO-TS integration.	TE12	UC-FP1-WP10-62	MERMEC	RFI
18.1	Demonstrator for Real Time Conflict Identification & Resolution.	TE17	UC-FP1-WP10-41 UC-FP1-WP10-42 UC-FP1-WP10-43 UC-FP1-WP10-44	ENYSE, ÖBB-INFRA, PR, NRD	ÖBB-INFRA
18.2	Demonstrator specific application to Depots and Terminal Stations environments of Algorithms for Automatic Conflict Detection and Resolution using AI.	TE17	UC-FP1-WP10-45	ENYSE	ÖBB-INFRA
18.3	Demonstrator for Improved Decision Support	TE17	UC-FP1-WP10-46	HACON	TRV
18.4	Demonstrator for Advanced Automation of Real time Operation	TE16	UC-FP1-WP10-47 UC-FP1-WP10-48 UC-FP1-WP10-49 UC-FP1-WP10-50	GTSD	GTSD
18.5	Demonstrator for Advanced Decision Support for Real time Operation	TE17	UC-FP1-WP10-51 UC-FP1-WP10-52 UC-FP1-WP10-53	STS, FS	FS
18.6	Demonstrator for Advanced Conflict Decision Support and Route Setting	TE16, TE17	UC-FP1-WP10-54 UC-FP1-WP10-55	AZD	
18.7	Decision Support for improved traffic management operation	TE17	UC-FP1-WP10-56 UC-FP1-WP10-57	INDRA	INDRA
18.8	Demonstrator for Automation of Real time Operation	TE16, TE17	UC-FP1-WP10-53 UC-FP1-WP10-58 UC-FP1-WP10-59	MERMEC, FS	RFI
18.9	Performance evaluation of optimisation algorithms for local level traffic management in a single region	TE17	UC-FP1-WP10-61	SNCF	SNCF Réseau

5.3. WS 1.3 demonstrations

All demonstrations in WS 1.3 can be seen in Table 3.

Table 3. Demonstrations in WS 1.3

Demo number	Short description	TE	Related use case	Partici-pants	Infra manager/ location/data provider
21.2	Demonstration in Madrid of a MaaS platform for B2B intermodal services	TE18, TE19, (TE20) (TE21)	UC-FP1-WP19-01	INDRA, MDM	Madrid, Spain
21.3	Demonstration in Lodz focused on decision support system for passengers allowing efficient multimodal travel planning	TE18, TE19	UC-FP1-WP19-09 UC-FP1-WP19-10	PKP, PTO	Lodz, Poland
21.4	Demonstration of MaaS Platform for B2B intermodality including reservation and distribution	TE18, TE19	UC-FP1-WP19-01 UC-FP1-WP19-02 UC-FP1-WP19-03 UC-FP1-WP19-49 UC-FP1-WP19-49 UC-FP1-WP19-54	HACON, SQILLS, DB, SJ, DB, CFL	Sweden, Germany, Luxembourg
21.5	Demonstration covering the deployment of financial services (revenue apportionment and settlement) in a multimodal environment	TE18, TE19	UC-FP1-WP19-04 UC-FP1-WP19-05 UC-FP1-WP19-06 UC-FP1-WP19-07	GTSD	Paris?
21.6	Demonstration of a stand-alone version of a Seamless Multi-Modal Management Framework	TE18, TE19, (TE27)	UC-FP1-WP19-08	STS	Italy, Puglia region
23.1	Demonstration in Madrid covering PRM Assistance and hand free solutions that allows seamless validation	TE20, TE21, TE22	UC-FP1-WP19-19 UC-FP1-WP19-20 UC-FP1-WP19-21	INDRA, MDM	Indra Sistemas S.A Madrid
23.2	Demonstration in the intermodal station of Málaga (Spain) of the improved informational system, which encompasses travellers' (specially focused on PRM) information of: accessibility and other relevant elements that can help to improve traveller's experience	TE20, TE22	UC-FP1-WP19-14 UC-FP1-WP19-15 UC-FP1-WP19-16 UC-FP1-WP19-17 UC-FP1-WP19-18	ADIF, Metro de Málaga	ADIF, Metro de Málaga Malaga

23.3	Demonstration in an intermodal hub at Amsterdam of hands-free solution for travellers	TE20, TE21	UC-FP1-WP19-22 UC-FP1-WP19-23 UC-FP1-WP19-24 UC-FP1-WP19-25 UC-FP1-WP19-26 UC-FP1-WP19-27	GTSD	GTSD RCS Amsterdam
23.4	Demonstration in Berlin (Station Südkreuz) of platform-based passenger guidance by an illuminated platform edge connected with real time train data (an additional Demonstration in Leipzig is planned)	TE22	UC-FP1-WP19-28 UC-FP1-WP19-29 UC-FP1-WP19-30	DB	DB InfraGO AG; SIUT GmbH Berlin
25.1.1	Demonstration at FS focused on (a) management of unplanned demand variations, (b) unplanned disruptions and (c) detection of minimum connection time.	(TE18), (TE19), TE26, TE27	UC-FP1-WP19-36 UC-FP1-WP19-37 UC-FP1-WP19-38	STS, FS	FS STS
25.1.2	Demonstration focused on methods of load estimation and prognosis efficiency in transport management decision support	TE23, TE24, TE26, TE27	UC-FP1-WP19-34 UC-FP1-WP19-35 UC-FP1-WP19-41 UC-FP1-WP19-48 UC-FP1-WP19-52	PKP	PKP
25.2	Demonstration in the intermodal station of Málaga (Spain) encompassed in a multimodal environment, focused on a traffic demand predictive systems in order to improve client's experience and operator's decision making through (a) Validation at TRL 5 of long-term demand calculation concept and (b) short-term demand calculation concept at final TRL 6-7.	TE23, TE24	UC-FP1-WP19-31 UC-FP1-WP19-32 UC-FP1-WP19-33 UC-FP1-WP19-51	ADIF, INDRA, Metro de Málaga	ADIF INDRA
25.3	Demonstration focused on (a) validation of long-term demand calculation concept and (b) demonstration of short-term demand forecast combined with the management of disruptions across modes.	TE23, TE24, TE27	UC-FP1-WP19-44 UC-FP1-WP19-45	HACON	HACON & CFL (Luxembourg)

25.4	Demonstration focused on the capabilities of early response to disruptions in Multi-modal mobility	TE23, TE27	UC-FP1-WP19-39 UC-FP1-WP19-40 UC-FP1-WP19-46 UC-FP1-WP19-47	ETRA I+D	ETRA I+D
25.5	Demonstration focused on modelling passenger demand and flow within a Digital Twin using source data such as ticketing information, timetables, frequencies, capacities	TE25, contribution to TE23, TE24, TE26, TE27	UC-FP1-WP19-42 UC-FP1-WP19-43 UC-FP1-WP19-53	GTSD	GTSD
25.6	Demonstration dedicated to fare collection and Automatic Vehicle Location. The demonstration will include disruption management across different mobility modes enabling operators to collaboratively solve the disruption and properly inform passengers.	TE27	UC-FP1-WP19-33	INDRA, PTO	PTO to be defined in 2025

6. Events

There are two main types of events open for people outside of FP1 MOTIONAL: Validation Event and Dissemination Event. For some demonstrations, these two events may be combined into one event. However, they still need to include all content from the definitions in the following subchapters, as well as in chapter 7.

6.1. Validation Event

The main purpose of a Validation Event is to validate the demonstration according to the specified TRL. This usually involves end-users, which may require training material or information in beforehand. The event is usually held in the end-users' home language and may be open only for invited people. During the Validation Event, the demonstration should be thoroughly tested and validated in accordance with the demonstration's goals and the TRL validation criteria. All use cases corresponding to the demonstration should be performed and validated during the session. Preparation steps before the Validation Event are presented in Chapter 7.
One of the goals of the validation event is to create some outputs that can be used for further dissemination of the demonstrations such as:

- Short Videos: These can be used to showcase the demonstration process and results to a wider audience.
- Demo Execution Reports: Detailed reports documenting the execution of the demonstration, including methodologies, results, and any issues encountered.
- Articles: Written articles for publication in relevant journals, magazines, or online platforms to disseminate the findings and impact of the demonstration.
- Presentations: Slide decks summarizing the demonstration process and outcomes, which can be used for future presentations at conferences or meetings.
- Infographics: Visual representations of the demonstration data and results, making it easier to communicate complex information.
- Case Studies: Detailed case studies highlighting the demonstration's impact, challenges, and lessons learned.
- Press Releases: Official statements to inform the media and public about the successful completion and outcomes of the demonstration.
- Training Materials: Documentation and resources developed during the demonstration that can be used for training purposes in future projects.

6.2. Dissemination Event

Each demonstration in every WP shall have a public Dissemination Event. The focus is to present results and explain the contribution and benefits of the demonstration. The event can be physical but also online or hybrid. It is up to each demonstrating partner to decide which type of event that suits their demonstration. Several demonstrations can be clustered together in one joint event in order to reduce the total number of demonstration events (e.g. by WP). The subgroup leaders are responsible for clustering, in cooperation with WP-leaders and demonstration leaders. It can be relevant to organise demonstration event with other Flagship Projects, System Pillar (SP) and/or Rail Net Europe (RNE). One purpose is to further spread results from demonstration, connect and provide benefits to other Flagship Projects. Another purpose is to align and prepare for demonstrations in wave 2. The event shall be open to relevant stakeholders, as well as the Europe's Rail Joint Undertaking (EU-Rail). If the demonstrating partner finds it suitable, the demonstration dissemination can consist of a video recording or written article, preferably presented at a WP- or SG-clustered dissemination event.

7. Demonstration phase procedures, content and timeline

The FP1 MOTIONAL project consists of four phases, as presented in Figure 1: Specification phase, development phase, demonstration phase and finalisation phase. The focus of this deliverable is the activities during the demonstration phase. The demonstration phase starts in December 2024 and ends in June 2026, as presented in Figure 1. In the demonstration phase, there are in total 31 deliverables, of which 7 are common for all work packages and 24 are work package specific. WP21, WP23 and WP25 have one deliverable each at M30, which aims to describe the demonstration plan and another one at the end describing the results. All other demonstration work packages only have one or several deliverables at the end of the work package (M43), describing both the steps leading up to the demonstration event and the demonstration results. This means that two templates are presented, one for the demonstration plans of WP 21, 23 and 25 and one for demonstration reports applicable to all demonstration WPs (WP5, WP7, WP9, WP12, WP14, WP16, WP18, WP21, WP23 and WP25). Nevertheless, the total content in the work package deliverables is equivalent.

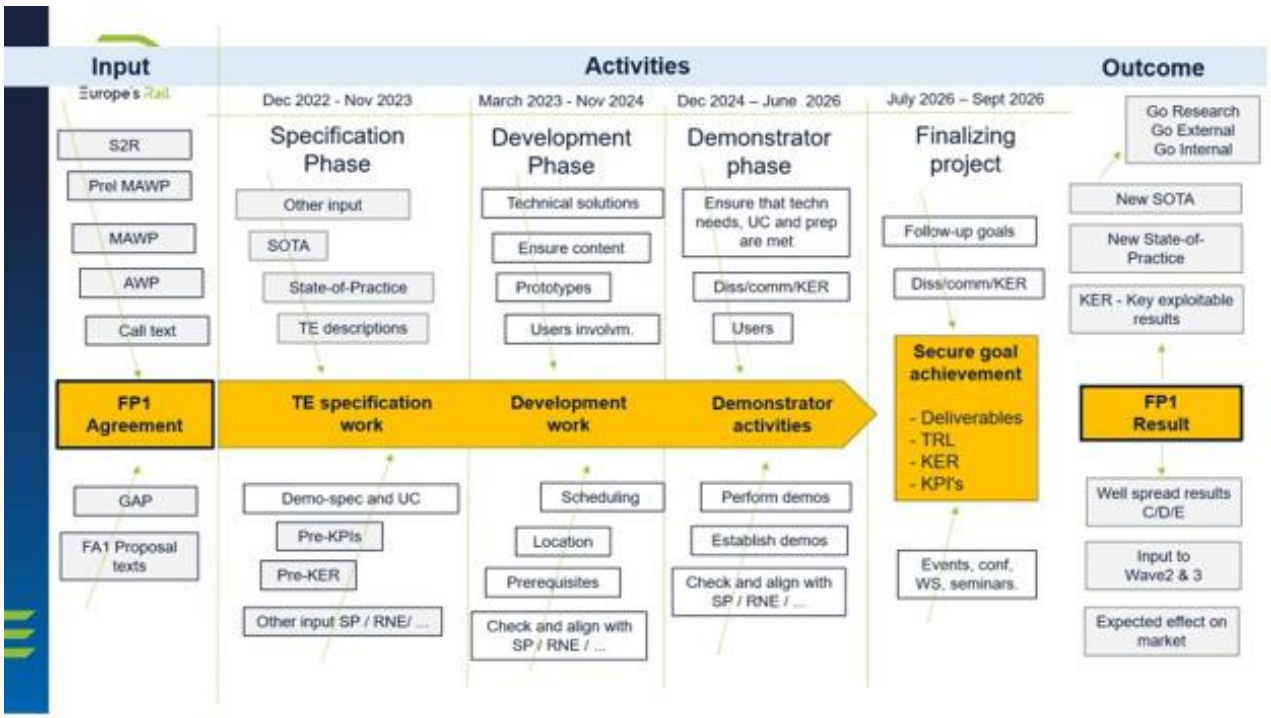

Figure 1. General MOTIONAL timeline and activities.

This chapter shows the demonstration strategy split into four phases that all demonstration work packages have to align with. It then continues by describing how the demonstrations should be reported in a given template and also how the deliverables should be designed.

7.1. Demonstration plan structure

We suggest a demonstration strategy consisting of four phases that all demonstration work packages will follow (Figure 2). For each phase we created a checklist of topics that need to be filled out for each demonstration by the demonstration leader and stored in the respective WP deliverable. A phase can only be finalised once all topics have been addressed. The checklist is an efficient tool to check progress for the management team, as well as the demonstration leader and it also presents guidance that all necessary topics are addressed. In general, all topics of the checklist are mandatory to be discussed for each demo. The demo leader will fill in the actions taken and work done per topic. Additionally, they can decide if certain topics are not applicable to their specific demo. In that case they can simply state "N/A" (not applicable) in the checklist. Information from the filled in templates should be included in the deliverables from all demonstration work packages.

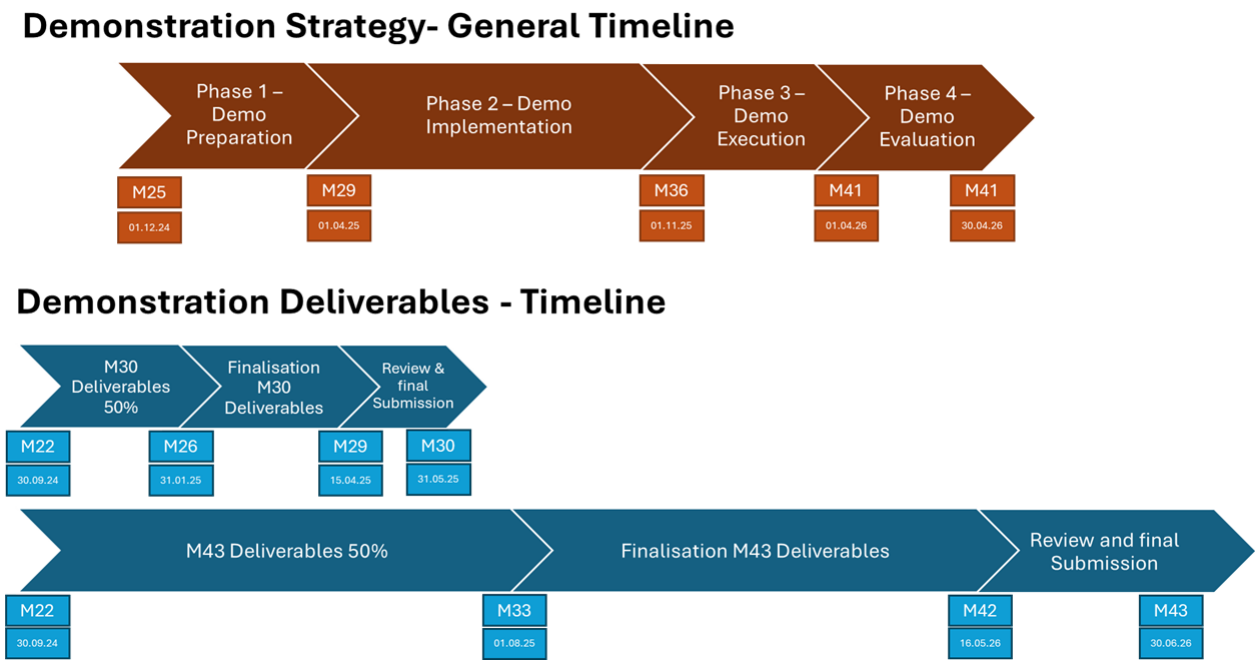

Figure 2. Demonstration Strategy and Deliverable Timelines for demonstration work packages.

We are proposing the timeline (Figure 2) to facilitate finalisation of the deliverables in M43. The four defined phases are shown in sequential order and every phase needs to be finalised before starting the next phase. We suggest the demo preparation between M25-M28, followed by the largest phase of demo implementation M29-M35. After that the Demo Execution can be performed between M36-M40. This leaves sufficient time to cover the Demo Evaluation in M41. This timeline might not align with the demonstration phase listed in the Grant Agreement [1] . Every demonstration leader can arrange their strategy based on their needs, they need to analyse how the timeline below can be adjusted for them, this needs to be documented and aligned with involved partners and other FPs if necessary. Following the suggested timeline below is however, recommended. Progress of the phases will be monitored by the work package leaders and reported during the TMT meetings.

7.1.1. Phase 1 – Demonstration preparation

The preparation phase sets up the demonstration and the related events and activities. All prerequisites should be covered to ensure a successful implementation of the demonstration. For example, a detailed timeline needs to be defined for each demonstration with demo specific activities and milestones, which follows the general timeline. In this section, we describe all preparation steps that need to be taken and clearly documented. When documenting, Table 4 can preferably be used as a template. If any step is not relevant for a specific demonstration, it can be filled with "N/A" (not applicable). A demonstration cannot move to phase 2 until all steps in phase 1 are performed and denoted in this form.

Table 4. Phase 1 activities.

Demonstration number	*Motional-common number of the demonstration, e.g., 10.2*
Short description	*Short description of the demonstration*
Work package	*Work package the demo belongs to*
Partner (s)	*Responsible partner for the demonstration*
Type and location of Validation Event	*Describe which type of Validation Event that will take place, including duration (one day or several?), any specific location and a general timeline for the event. That timeline can be updated if needed.*
Type and location of Dissemination event	*Describe which type of Dissemination event it will be (open/closed and physical/hybrid/online/recorded) and if any other demonstration event will be connected to it.*
Involved stakeholders	*Stakeholders directly or indirectly involved in the demonstration or affected by it.*
Involved end-users	*Describe which end-user groups that will use the demonstrated product/algorithm etc when it is out on market.*
Setup preparatory meetings	*Describe which preparatory meeting that are needed and when they shall take place. The purpose of preparatory meetings is to ensure that the Validation Event runs smoothly.*
Define test data	*Define in detail which test data that is needed. List all data required for the specific test instance(s).*
Define demonstration tests	*Outline the specific tests that will be conducted during the demonstration Validation Event. Include details such as test objectives, procedures, required software or equipment, number of testers and other personnel involved.*
Definition of demonstration outcomes and how to measure them	*Demonstration outcomes need to be pointed out already at phase 1 in order to have time in phase 2 to build possible measure functions and to prepare everyone on how to evaluate.*
Training plan for end-users etc	*Develop a training plan for end-users and other relevant stakeholders for the Validation event. This plan should include training objectives, schedules, materials, and*

	methods (e.g., workshops, online tutorials, hands-on sessions). Ensure that the training is comprehensive and tailored to the needs of the end-users to facilitate smooth adoption and effective use of the demonstrated product or algorithm.
Logistics, installation plan	*Develop a comprehensive plan for the logistics and installation of the demonstration setup. This should cover transportation, installation procedures and setup (of software or equipment), as well as any necessary permits or approvals.*
Communication Plan	*Create a communication plan that details how information about the demonstration will be disseminated to stakeholders, end-users, and the public (e.g., how to acquire demo participants). Include communication channels (social media, news, flyers, events), key messages, and a timeline for the communication activities.*
Master plan (GANTT)	*The master plan/ GANTT scheme can be created in a separate document. If so, please specify a project place link to it.*
Interactions between demos	*Describe which other demos in FP1 that this demo interacts with and fill in the interaction table in the same document (see Table 5)*
Update interaction table with other flagships	*Describe any interactions with other Flagship Projects (including interaction ID) and update the existing interaction table in D2.2.* *A new section will be included in D2.2 to monitor demonstrations in collaboration with other FPs.* *Deliverable 2.2 can be found here* https://projects.rail-research.europa.eu/eurail-fp1/deliverables/ *Interaction ID: ««to be filled»»*

For demonstrations that have interactions with other FP1 demonstrations, it is important to plan and coordinate the interaction. In Table 5, the template for interactions is presented. The template should be filled in for all cross-WP interactions in FP1, in the same document as the demonstration preparation phase. If a demonstration interacts with several demonstrations, the table can be copied and filled in several times. For interactions between demonstrations within the same WP, filling out this table is not needed. The purpose of the template is to set up a good base for cooperation between work packages and ensure that critical dependencies are known and agreed upon.

Table 5. Template for interactions within FP1.

Interaction subject	*Headline for the subject of interaction e.g., "Automatic train operation (ATO)"*
Involved demonstrations	*The ID (demo numbers) of the involved demonstrations*
Short description	*Short description of how the demonstrations interact with each other*
Information flow between the demonstrations	*In the developed demonstrations, will information from one system/algorithm be used in the other? If so, describe all these information exchanges*
Key deliveries	*Are there any key deliveries from one demo to the other to ensure that it can succeed with the demonstration, e.g., a state-of-art description or data delivery? If so, present those.*
Interaction timeline	*General timeline with milestones and deadlines for deliveries between the demos and/or alignment meetings*
Presentation and dissemination	*Will there be common demonstration or dissemination activities? If so, describe them, both when they occur and what you will present.*

7.1.2. Phase 2 – Demonstration implementation

The implementation phase focus is to set up all parameters for the demonstration event. All actions performed in phase 2 should be planned and described during phase 1. The actions do not need to be denoted in a common document but are followed up by each WP-leader. The implementation phase involves the actions presented in Table 6.

Table 6. Phase 2 activities.

Action	*Explanation*
Recruit end-users	*If end-users are needed for the Validation Event, they should be recruited in this stage.*
Deploy the implemented Software on the demonstration environment	*Install and configure the software that will be used in the demonstration environment. Ensure that it is fully operational and integrated with other necessary systems.*
Deployment of the developed Hardware on the demonstration environment	*Set up and install all hardware components required for the demonstration. Verify that all hardware is functioning correctly and is compatible with the software.*
Collect and process demonstration data	*All data for the demonstration should be collected, if the data is not real-time and therefore collected during the Validation Event (phase 3).*
Validation of demonstration data (if historical data is used)	*All data for the Validation event should be internally validated. If real-time data, similar data should be internally validated, and the collection process should be tested and verified.*
Integration tests	*Integration tests should be performed in order to ensure that all components of the demo work together.*
Develop training materials	*If end-users or outsiders need training material before the Validation Event session, it need to be developed in phase 2.*

Perform installations (if necessary)	*Any installations needed prior to the Validation Event should be performed.*
End user/outsiders validation tests	*Validation tests together with relevant testers are important to ensure sufficient quality before the Validation Event.*
Disseminate upcoming demonstration execution	*Executing of the communication plan from phase 1. Communicate details about the upcoming demonstration events to all relevant stakeholders. This includes sending out invitations, providing schedules, and sharing any necessary preparatory information.*
Implement measures to gather results and KPI measurements	*In order to measure KPIs and quality during the Validation Event, means to make these measurements might be needed. This might require coding or other implementation activities in order to implement the measures.*
Prepare questionnaire and interview guides for stakeholders/end-users	*If interviews or questionnaires are going to be used at the Validation Event, it need to be prepared in phase 2.*

7.1.3. Phase 3 – Demonstration execution

The execution phase consists primarily of the Validation Event and is consequently very short. For some demonstrations, this phase also includes repeatedly internal demonstration runs in order to gather statistics and investigate the demonstrator behaviour in order to be able to evaluate it in Phase 4. The execution phase can for example involve the actions presented in Table 7.

Table 7. Phase 3 activities.

Action	*Explanation*
Software distribution to end users	*If end-users need special software to perform the Validation Event*
End users/outsiders training	*Preparatory session (also known as demonstration kick-off meeting) in order to ensure that all users during the event understand what to do during the Validation Event*
Data collection for demonstration	*If real-time or near-real-time data, it needs to be collected for the experiment.*
Validation Event	*Event with expert users (usually external end-users) where the demonstration is run and validated.*
Data collection for outcome and Performance indicator (PI) measurements	*Collect all data needed for the evaluation in phase 4.*
End-user interviews	*Interviews with the involved parties directly after the Validation Event might be desired for the evaluation in phase 4.*
Demonstration event summaries	*Notes with a summary of the Validation Event is needed both for the evaluation in phase 4 and for the documentation in the deliverable.*

7.1.4. Phase 4 – Demonstration evaluation

The evaluation phase purpose is to conclude the demonstration and present the demonstration results. The evaluation phase can for example involve the actions in Table 8.

Table 8. Phase 4 activities.

Action	*Explanation*
Dissemination Event	*The session where the demonstration result is presented to stakeholders. Could be public/closed event, physical, online or consist of demo video recording.*
Proof of data used	*E.g., historical, real-world, production data. Needed as part of TRL validation.*
Gather and analyse feedback from stakeholders	*Could be questionnaires, interviews, panel discussions etc. The input can be gathered from different stakeholders, for example end users, project members and organisations not using but still affected of the demonstrated feature.*
Evaluation of outcome and Performance indicators (PI)	*To assess if the objectives are reached. Performance indicator evaluation is only necessary for demonstrations that are relevant for that specific PI, which is pointed out in WP1, connected to activities in D1.2 and D1.3.*
Impact assessment	*Analyse and description of which impact the developed demonstration might have for the intended user group.*
Reporting	*Mainly in respective deliverable.*
Dissemination of demonstration results	*Activities for spreading demonstration results, for example conferences.*

7.2. Demonstration reports

This section will provide headlines and required information in the deliverables in WP5–WP25. For WP5–WP18, there is only one deliverable at the end of respective work package. For WP21–WP25, the demonstration reporting is divided into one plan deliverable and one result deliverable. Therefore, the information is a bit different from the information needed for WP5–WP19. The headlines in the following chapters will also be converted into ready-to-use templates available on ProjectPlace.

7.2.1. Deliverable design for demonstration plan deliverables

Work package 21, 23 and 25 have a deliverable each describing the demonstration plan. The deliverables will include the headlines presented below. All work packages are free to use their own structure and include more chapters than those presented here. However, a MS Word template will be created with the topics below included for work packages to use if they want.

- Executive summary
- Abbreviation and acronyms
- Background
- Objective/Aim
- Alignment and interactions between FP1 demonstrations
- Short introduction/recap of each demonstration. Refer to development phase deliverables.
- Demonstration planning – describe planned/performed actions in each phase for each demonstration. The template with phase 1 actions can preferably be used.
    - Preparation phase
    - Implementation phase
    - Execution phase
    - Evaluation phase
- WP Master plan (Gantt)
- Conclusion

7.2.2. Deliverable design for demonstration result deliverables

The deliverables will include the following headlines. All work packages are free to use their own structure and include more chapters than those presented here. However, a MS Word template will be created with the topics below included for work packages to use if they want.

- Executive summary
- Abbreviation and acronyms
- Background
- Objective/Aim
- Alignment and interactions between FP1 demonstrations*
- Short introduction/recap of each demonstration. Refer to development phase deliverables.
- Method/demonstration planning – describe performed actions in each phase for each demonstration*. The templates with phase 1-4 actions can preferably be used.
    - Preparation phase
    - Implementation phase
    - Execution phase
    - Evaluation phase
- TRL validation
    - TRL validation strategy
    - Testing and TRL achievement demonstration results
- Demonstration results
- Evaluation and analysis
- Real-world impact
- Future work/research
- Conclusion

*= For D21.2, D23.2 and D25.2, it can be referred to the planning deliverables. Any changes from the plan there should be denoted in the deliverable.

8. Workstream 2 contribution to demonstrations

Workstream 2 (Transversal Topics) within FP1 MOTIONAL is currently researching generic methodologies and tools that can be used by the demonstrations within EU-Rail. This will be showcased by selected use cases and contributes towards the demonstrations.

8.1. Interactions with FP1

There are multiple potential interactions between Workstream 2 and the rest of FP1 MOTIONAL regarding support of the demonstrations. WP26 is responsible for collecting the use cases in FP1-MOTIONAL and other FPs. The output of the work is stored in the WP26's Use case repository. As a result of that WP, some UCs from WS1.3 have been identified for potential support. WP27 supports the following seven demonstration use cases in WS1.2.

Table 9. Use cases related to WS2 interactions with WS1

UC_ID	UC Name	Use Case Name	Company
UC-FP1-WP10-05	Detail train timetable for energy saving ATO-TS	Provide ATO-TS with a revision of the train timetable that includes a time reference for intermediate timing points to optimize the train energy consumption.	STS
UC-FP1-WP10-06	Information exchange between TMS and C-DAS TS	Communication between TMS providing the trip information and C-DAS TS system.	INDRA
UC-FP1-WP10-07	Cooperative conflict resolution (Two TMSs)	A train conflict solution shall consider also the possible choices taken by behind the border TMS.	MERMEC
UC-FP1-WP10-08	Exchanging real time train data regarding the border stations.	The TMS shall be able to exchange train characteristic, issues, and forecast information with neighbour TMSs.	MERMEC
UC-FP1-WP10-09	Short-term maintenance needs or accidental situation which requires a pre-alignment of the train journey parts	Short-term maintenance needs or accidental situation detected. Exchange of information between TMSs. Pre-alignment between the parts of a journey including a border. Decision/alignment done before crossing the border.	ADIF FM
UC-FP1-WP10-10	Sending and Receiving train running forecast information	The TMS shall be able to receive forecast information from other sources, e.g., a neighbouring TMS.	HACON
UC-FP1-WP10-11	Pre-aligned decisions cross-border	Aligning decisions by knowing capacity restrictions behind the border (until next node behind the border)	HACON

The output of WP27 is an Engineering toolbox that provides the use cases of Workstream 1.2 with tools, serialized CCS TMS model and SCI specifications. These tools will be provided via the TT GitHub (to be set up) and requirements exchange is currently on plan. The cooperation will continue during the Demonstration phase of the project.

8.2. Interactions with other Flagships

The work in Workstream 2 shall support all Flagships, which are stated in the Multi-Annual Work Programme in Sec. 7.8.1: "*Digitalisation is of major importance for all FAs, hence it is organized as a transversal topic .... The digital enablers ... will serve suitable demonstrations in the FAs.*".

One example where Workstream 2 collaborates with other Flagships is the digital twin of ERTMS, see D28.1 [4] and D28.2 [3] on which the partners CEDEX and DLR are collaborating within the framework of Workstream 2, but also in R2Dato (WP 22,34, 35) and FutuRE (WP7). The subjects of the collaboration are hardware-in-the-loop (HiL) test laboratories for the certification of ETCS on-board units, in which digital engineering data on the infrastructure (track topology and geometry, circuits, axle counters, balises, switches etc.), as well as models of vehicles and their communication components are required. Exploiting the Workstream 2 work, the partners aim to harmonize their HiL environments and interfaces, as well as improve the interoperability between different ETCS components from various suppliers. The results will be used in the FP6-FutuRE demonstration titled "Digital platforms for CCS validation and TSI certification in the regional domain".

In the same manner, the digital twin activities contribute to the "Integrated Demonstration" Task 11.4 in IAM4Rail, in which DLR participates. WP10 and WP11 of IAM4Rail are dedicated to a Multi-Source/Multi-Purpose Intelligent Asset Management application. The IAM4Rail deliverable D11.1 due to M48, entitled "Multi-Sensor/Multi-Purpose Monitoring of Assets" and described as "report and demonstration of Multi-Sensor/Multi-Purpose monitoring of assets, including new methods for existing data, new sensing solutions and integrated platforms for holistic health assessment of track, surroundings, and switches" in the respective Grant Agreement will report on it.

The Rail Data Space (RDS) can facilitate trusted and secure data exchange in the existing Sandbox environment on a selection of demos, thereby potentially offering favourable premises for reaching higher TRLs. All founding members with use cases requiring data exchange between two or more partners could use the Sandbox environment and thus benefit from an easy to scale and trusted data exchange. As an example, the use case of efficient maintenance of rolling stock and/or infrastructure can be used (use case from FP3):
Currently, many vehicles or rail infrastructure are equipped with advanced IoT sensors and robust communication systems. However, the data is often collected and transferred in various formats through costly direct exchange interfaces (e.g., APIs), making it difficult to share, analyse and exploit insights across different companies.

The Rail Data Space technology ensures that relevant stakeholders, including system suppliers, railway operators, and maintenance planners and workshops have access to accurate and timely information.

By facilitating the exchange of comprehensive monitoring data, this integrated approach via the Rail Data Space supports predictive maintenance, optimizes train operations, and enhances safety and reliability. Ultimately, it contributes to a more efficient and sustainable rail network.

9. Conclusions

In FP1 MOTIONAL, we have 74 demonstrations in 10 different WPs. This deliverable has increased the conformity in the project by providing guidelines, templates and formal requirements of the demonstrations. This helps all demonstrating partners to plan and structure their demonstrations.

By structuring the demonstration work into four phases (preparation, implementation, execution, evaluation), we facilitate progress monitoring on work package level, as well as subgroup and project level. The phases make it also easier for all demonstrating partners to divide their work in the coming two years into smaller portions and make them easier to embrace.

By creating the templates already in D2.4, they are ready before the demonstrating work packages start, which means they can be used from the beginning and that no adaptation for already created texts will be needed.

One important aspect of the work in D2.4 is that it is done by a diverse group with the participation of all Workstreams and then reviewed by all demonstrating partners and work package leaders. This open communication and collaboration give everyone that will use these guidelines and templates the chance to contribute to the content. Since the work packages cover a broad range of topics, it is important that all partners feel that the guidelines help them, rather than put up obstacles. Of this reason, the guidelines, templates and requirements are written on a high-level with possibilities for partners to make an interpretation that suits their work. In some cases, it might also be necessary to partly deviate from some of the guidelines, which is allowed if it is clearly motivated. This makes a good combination of giving support to all demonstrating partners and increase conformity, while not to increase unnecessary formalities or hinder practical solutions.

To conclude, D2.4 has built up a plan for the demonstrations in FP1-MOTIONAL and provided templates and guidelines for the project work packages. This will help the project to reach its targets, both time- and quality wise, and make the work easier and well structured.

10. References

[1] Grant Agreement Project 101101973 — FP1 – MOTIONAL

[2] MAWP, Multi Annual Work Plan, https://rail-research.europa.eu/wp-content/uploads/2022/03/EURAIL_MAWP_final.pdf.

[3] Diedrich, O. (2024). *Deliverable 28.2 Methodological Particularities of Use Cases.* FP1-WP28.1 Project MOTIONAL, HORIZON-ER-JU-2022-01, Grant Agreement n°: 101101973, Inernal Report.

[4] Kundrats, A. (2024). *Deliverable D28.1 Summary on other Destinations Digital Twin Use*. FP1-WP28.1, Project MOTIONAL, HORIZON-ER-JU-2022-01, Grant Agreement n°: 101101973, Inernal Report.