

TCCS SD2 - Operational Analysis

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1 Introduction

SPT2TS-122510 -

This document presents a comprehensive operational analysis of the diagnostic and monitoring activities within railway systems, structured in accordance with SEMP process. This document encapsulates the results of our operational analysis -in the context of SD2-, identifying the key operational entities, and elucidating the capabilities and activities essential for the effective management of diagnostic and monitoring operations in the railway system.

The scope of this analysis is to examine and refine the processes involved in the collection, interpretation, and utilisation of diagnostic data for multiple use cases, which is vital for the continuous monitoring and maintenance of railway infrastructure and rolling stock.

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| Linked Work Items | has parent: SPT2TS-122341 - Introduction |
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2 Operational Entities /Actors

SPT2TS-124993 - The analysis defines the roles and responsibilities of the various stakeholders involved. Each entity's contribution to the diagnostic and monitoring process will be outlined in the next sections, establishing a clear matrix of interaction and collaboration.

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SPT2TS-122460 - Operational Entities/Actors definition:

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| Linked Work Items | refers to: SPPR-2576 - Operational Entity/Actor has parent: SPT2TS-122342 - Operational Entities /Actors |
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Figure # [OEBD] SD2 Operational entities [Operational entities and actor definit...

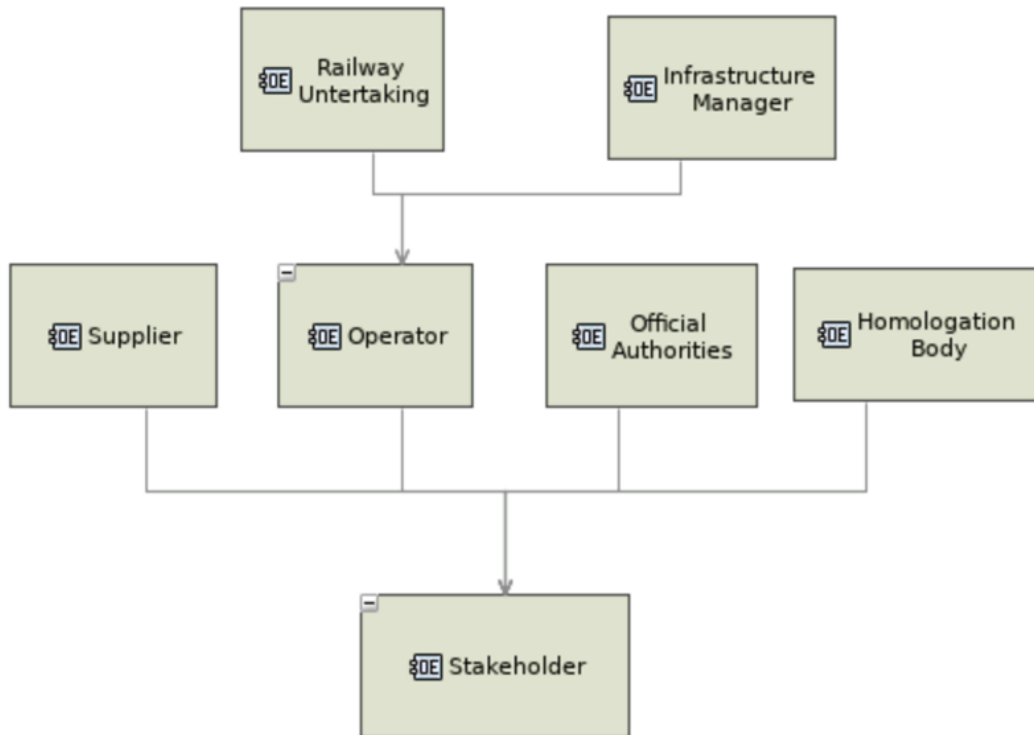


Figure 1 [OEBD] SD2 Operational entities [Operational entities and actor definition]

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| Linked Work Items | relates to: SPT2TS-1434 - The operational epics in this document are addressing the Railway System, with a... relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-125894 - Stakeholder in this context is an individual, organisation or institution that can affect or be affected by the railway system.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122349 - Operator is an institution operating a system through its life-cycle, in context of the document usually an Infrastructure Manager or Railway Undertaking (Train Operator).

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122413 - Infrastructure Manager is the main rail responsible for the operation, planning, development, consistency and enhancement of the national rail network it owns.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122411 - Railway Undertaking is the entity in charge of operating train in safe and available conditions.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122408 - Supplier is a person or company that supplies another company with certain goods. The supplier will therefore provide the company with the inputs necessary for production. The company will use them to transform them into outputs. The final output can be provided directly by the supplier.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122409 - Official Authorities are institutions recognised by National Governments or European Commission.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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SPT2TS-122410 - Homologation Body is an entity accredited in a specific field to analyse and to deliver conformity certificate's to a standard.

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| Linked Work Items | relates to: SPT2TS-1357 - Stakeholder description has parent: SPT2TS-122342 - Operational Entities /Actors |
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3 Operational Capabilities

SPT2TS-123878 - An operational capability is essentially the capability of organisational entities/actors to provide a high-level service leading to an operational objective being reached. In the scope of SD2, the diagnostics and provision of asset condition are the focus and represent the high-level operational need. The ability of the actors involved in our scope - listed in chapter 2- to optimise the observability, maintainability and availability of the railway operations is the operational capability that solves the SD2 needs.

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| Linked Work Items | has parent: SPT2TS-122343 - Operational Capabilities |
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Figure # [COC] Optimise availability of railway operation [Single operational ca...

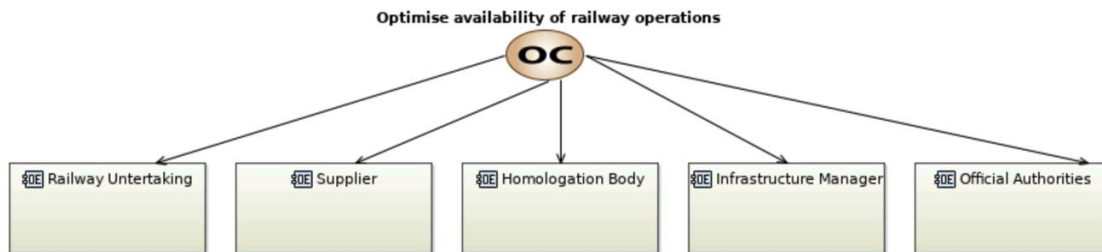


Figure 2 [COC] Optimise availability of railway operation [Single operational capability context]

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| Linked Work Items | relates to: SPT2TS-1347 - Operational Epics (User stories) has parent: SPT2TS-122343 - Operational Capabilities _ has copy: SPT2TS-124465 - |
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SPT2TS-123939 - In this operational analysis context, the main goal is to gain deeper insights into the performance and health of the infrastructure and rolling stock, this objective is enabled by implementing advanced monitoring systems. In this operational capability, observability refers to the ability to collect and analyse real-time data from different subsystems. This enables data driven decision making, proactive issue identification and rapid solution to potential failures. With optimised observability, operators (RUs and IMs) can monitor train movements, track conditions and components status ensuring smoother and more predictable operations. Collected data allows suppliers to gain more knowledge about their products performance in real-world conditions and this supports further product development and design improvement.

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| Linked Work Items | relates to: SPT2TS-1347 - Operational Epics (User stories) has parent: SPT2TS-122343 - Operational Capabilities |
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SPT2TS-123940 - Optimising maintainability covers the improved strategies and practices that results from adopting predictive maintenance techniques, condition monitoring with an interface to asset management systems. This helps to minimise downtime and disturbance/disruption of the railway's operations. This approach supports components repair or exchange before failure, resulting in cost saving and improved reliability.

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| Linked Work Items | relates to: SPT2TS-1347 - Operational Epics (User stories) has parent: SPT2TS-122343 - Operational Capabilities |
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SPT2TS-123941 - Optimising availability aims at providing an accessible and operational railway system. This covers minimising operation and service interruptions, mitigate the impact of failures and incidents, and improving the resilience of the network for a continuous and smooth operations.

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| Linked Work Items | relates to: SPT2TS-1347 - Operational Epics (User stories) has parent: SPT2TS-122343 - Operational Capabilities |
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SPT2TS-123879 - This capability will be fulfilled through the different activities and interactions done by the entities/actors described in next chapter.

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| Linked Work Items | has parent: SPT2TS-122343 - Operational Capabilities |
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4 Operational Activities and Interactions

SPT2TS-123942 - In this chapter the operational architecture diagram represents the organisation, structure, and interactions of the operational entities. It illustrates how the system's operational entities/actors collaborate to achieve the system's objectives and functions. For this document the focus and the system under consideration -in SD2 scope- is the monitoring & diagnostic services. This diagram provides a high-level view of the system's -monitoring & diagnostic services- operational context and different activities performed by the actors to fulfil the operational capability which is to Optimise the observability, maintainability and availability of the railway operations.

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| Linked Work Items | has parent: SPT2TS-122346 - Operational Activities and Interactions |
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Figure # [OAB] SD2 Operational Activities [Operational activity definition and a...

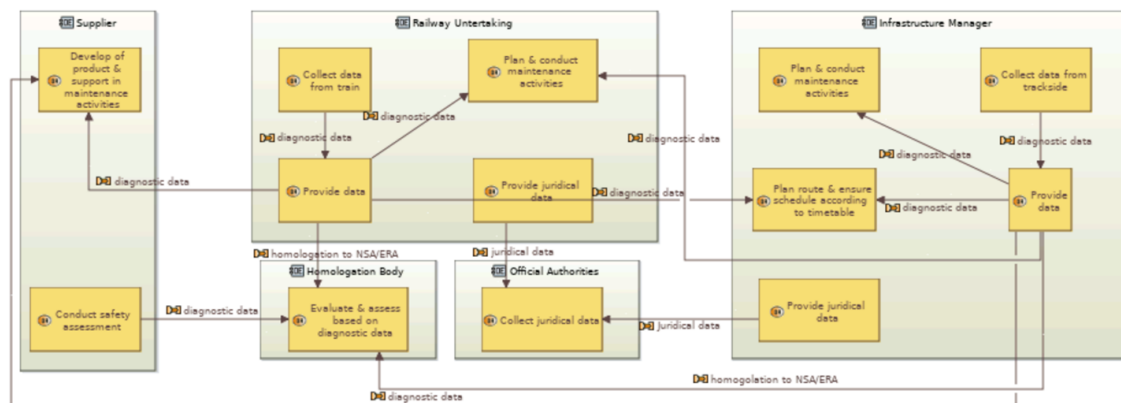


Figure 3 [OAB] SD2 Operational Activities [Operational activity definition and allocation]

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| Linked Work Items | has parent: SPT2TS-122346 - Operational Activities and Interactions _ has copy: SPT2TS-124466 - |
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4.1 Operational Architecture

SPT2TS-124984 - The diagram covers different interactions between the operational entities to cover multiple use cases and involves understanding the specific tasks and functions of each entity within the system:

In this context of the operational analysis, the focus is on the following list of entities:

- Infrastructure Manager (IM)
- Railway Undertaking (RU)
- Supplier
- Homologation body
- Official authorities

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| Linked Work Items | has parent: SPT2TS-124985 - Operational Architecture |
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4.2 Operational activities and interactions

SPT2TS-124987 - Collect data form trackside/train

Both operational entities IM and RU are responsible to collect data from assets under their responsibility. This means for RU is responsible to collect data from vehicle side and for IM to collect data from track side. The collected data from the assets will be used and **provided** for further uses and activities.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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SPT2TS-124988 - Plan and conduct maintenance activities

Both operational entities IM and RU have the responsibility to plan and conduct maintenance activities on their respective assets. Both, IM and RU plan maintenance activities based on diagnostic and monitoring data. This data-driven approach ensures targeted maintenance interventions, optimising the use of resources and minimising operational disruptions.

The actual execution of maintenance activities involves the deployment of technical personnel, tools, and materials to address identified issues. This is done in accordance with the planned schedules and as per the urgency dictated by the diagnostic assessments.

The effectiveness of maintenance activities relies on the coordination between IM and RU, as the status of infrastructure directly affects rolling stock and vice versa. Regular communication and data exchange between these entities ensure that maintenance activities are synchronised, preventing conflicts, and ensuring seamless operations.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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SPT2TS-124989 - Plan route and ensure schedule according to timetable

This operational activity as a responsibility of the IM in the context of this operational analysis is

related to diagnostic and monitoring activities. The provided diagnostic data from both IM (track side) and RU (vehicle side) provide insights to the current state of the operations which is crucial for making informed decisions regarding route allocation and timetable adjustments.

Collected Diagnostic data allows for the adjustment of routes and schedules in response to emerging conditions or failures. And the analysis of diagnostic and monitoring data enables to predict potential failures and schedule maintenance activities in a manner that minimises impact on the predetermined routes and timetables.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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SPT2TS-124990 - Provide juridical data

Juridical data provision is a critical operational activity for IM and RU as it involves compiling and submitting data related to regulatory compliance, incident reports, safety assessments, and maintenance records to the designated official authorities. This activity is fundamental to ensure transparency, compliance with legal standards, and the continuous improvement of safety and service quality of the railway operation.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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SPT2TS-124991 - Develop product and support in maintenance activities

The operational entity supplier in the railway system handles a dual function in the context of diagnostic and monitoring activities. Supplier collects data from its developed products operating under both IM and RU to derive insights that inform the design and development of new products. In addition, Supplier provide support services for maintenance activities including predictive maintenance solutions, spare parts, and technical expertise for root cause analysis.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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SPT2TS-124992 - Conduct safety assessment

The operational entity Supplier is not only responsible for the design and delivery of products but also for ensuring that the products meet safety standards. In this context, the diagnostic and monitoring data support the safety assessment process by providing insights to determine potential risk and proceed to risk evaluation and mitigation. Suppliers are responsible for providing the diagnostic data to the homologation body. This data supports the homologation process, certifying that the products are safe for use within the railway system. In the case of rolling stock, the RU could also conduct homologation process and provide the diagnostic data to the NSA/ERA.

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| Linked Work Items | has parent: SPT2TS-124986 - Operational activities and interactions |
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5 Status of the work, open points, issues

6 Tables

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