SEMP main document V2

Contents

1 References

[1] Europe's Rail Governance (October 2022)

EU-Rail Governance Handbook Oct. 2022 ; and SP Input D7_SC5_Governance_final_draft_02 / D7_SC5_Governance_final_draft_Annex_A_Working_Circles

[2] Proposal for Specific Contract N°1 Implementing the Framework Contract (FWC) EU-...

Proposal for Specific Contract N°1 Implementing the Framework Contract (FWC) EU-RAIL.OP.01.22 – LOT 2 (SC 2.1) – Focus on System Pillar Engineering Core Services - Central Modelling Service (CMS) – Annex 3 Indicative description of CMS

[3] System Engineering Management Plan (SEMP v1)

[4] Milestones as per the Request for Services for CMS deliverables for the firs...

Milestones as per the Request for Services for CMS deliverables for the first 12 months

[5] System Engineering Guidebook for Intelligent Transportation Systems

https://www.fhwa.dot.gov/cadiv/segb/files/segbversion3.pdf

[6] "EU-RAIL and Harmonization" for the Standardization and TSI Input Plan, Version 1

SPG-STG-D-SPG-086-01 - 20230604 EURAIL and Harmonisation Version 1.0.docx

[7] ERJU PRAMS Plan

ERJU PRAMS Plan

2 Glossary of Terms and Abbreviations

The glossary should provide a unified list of terms, abbreviations, definitions, and references to be used for SP deliverables.

This glossary should be accompanied by a process for creating, updating, and maintaining the consolidated glossary.

SEMP Annex A - Abbreviations Roles and Teams of SEMP V1 defined a preliminary abbreviation, acronyms and specific roles used in System Pillar organisation units. The consolidation of list of terms and abbreviations is ongoing for SEMP V2. This list of lists includes :

- SEMP Annex A - Abbreviations Roles and Teams
- SUBSET-023 for UNISIG ERTMS/ETCS Glossary
- Complementary to SUBSET-023, a ERTMS/ATO GLOSSARY has recently been released by X2RAIL in V1.11 as part of TSI2022 (not yet publicly avalable)
- The ERA Vocabulary / Ontology
- 3GPP maintains a compendium of terms and abbreviations in 3GPP TR 21.905
- ETSI maintains a list of all terms and abbreviations defined in its publications in TEDDI
- UIC maintains RailLexic online (RLO)
- RNE has a Glossary of Terms Related to Network Statements
- RCA maintains a list of terms and concepts (attached)
- Terms and definitions of of EN 50126

This list is not exhaustive, and is further detailed in Concept Paper - Glossary and Terminology **[**Open**]**

3 Purpose and scope of the document

The purpose of the document

The purpose of this document is to support EU-Rail System Pillar in their System Engineering activities by providing guidelines, rules and best practices. The System Engineering Management Plan (SEMP) should be considered as a handbook by SP for all relevant design activities. **[**Open**]**

3.1 Purpose and scope of System Pillar

The purpose of SP

As explained in SPPR-3245 - [1] Europe's Rail Governance (October 2022), the purpose of SP is to develop a unified operational concept and a functional, safe and secure system architecture, with due consideration of cyber-security aspects, focused on the European railway network to which Directive 2016/797 applies, for integrated European rail traffic management, command, control and signalling systems, including automated train operation which shall ensure that research and innovation is targeted on commonly agreed and shared customer requirements and operational needs, and is open to evolution. **[**Open**]**

System Pillar is part of the EU-Rail organization as presented in the following figure.

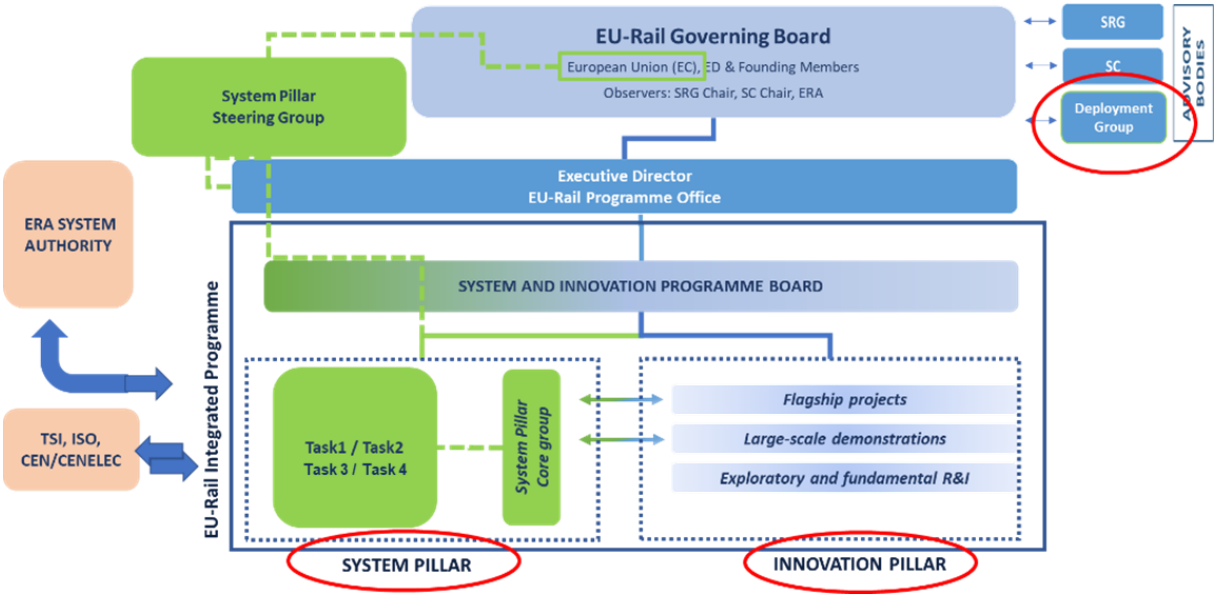

Figure 1 EU-Rail Organisation

The sector involvement and decision process

The sector involvement and decision process is described in SPPR-3245 - [1] Europe's Rail Governance (October 2022) .

[Open**]**

Mirror group responsibilities and guideline

The mirror group responsibilities and guideline of tasks and domains of System Pillar is described in the Mirror Group Guideline **[**Open**]**

Expected deliverables of System Pillar

As defined in SPPR-5891 - [6] "EU-RAIL and Harmonization" for the Standardization and TSI Input Plan, Version 1, the main expected deliverables of System Pillar are for:

- Technical Specifications for Interoperability (TSIs) and associated documents, for example subsets, Application Guides, or
- Input for European Standardisation,
- System Pillar publications

The deliverablers pers system on system level 5 are defined here: System Pillar Deliverables **[**Open**]**

Overview of EU-Rail System Pillar tasks, domains and their interactions

The following diagram presents the current overview of EU-Rail System Pillar tasks, domains and their interactions by using Business Process Model and Notation BPMN standard and backward analysis: determining

inputs (processes, tools and teams) from main expected deliverable of System Pillar.

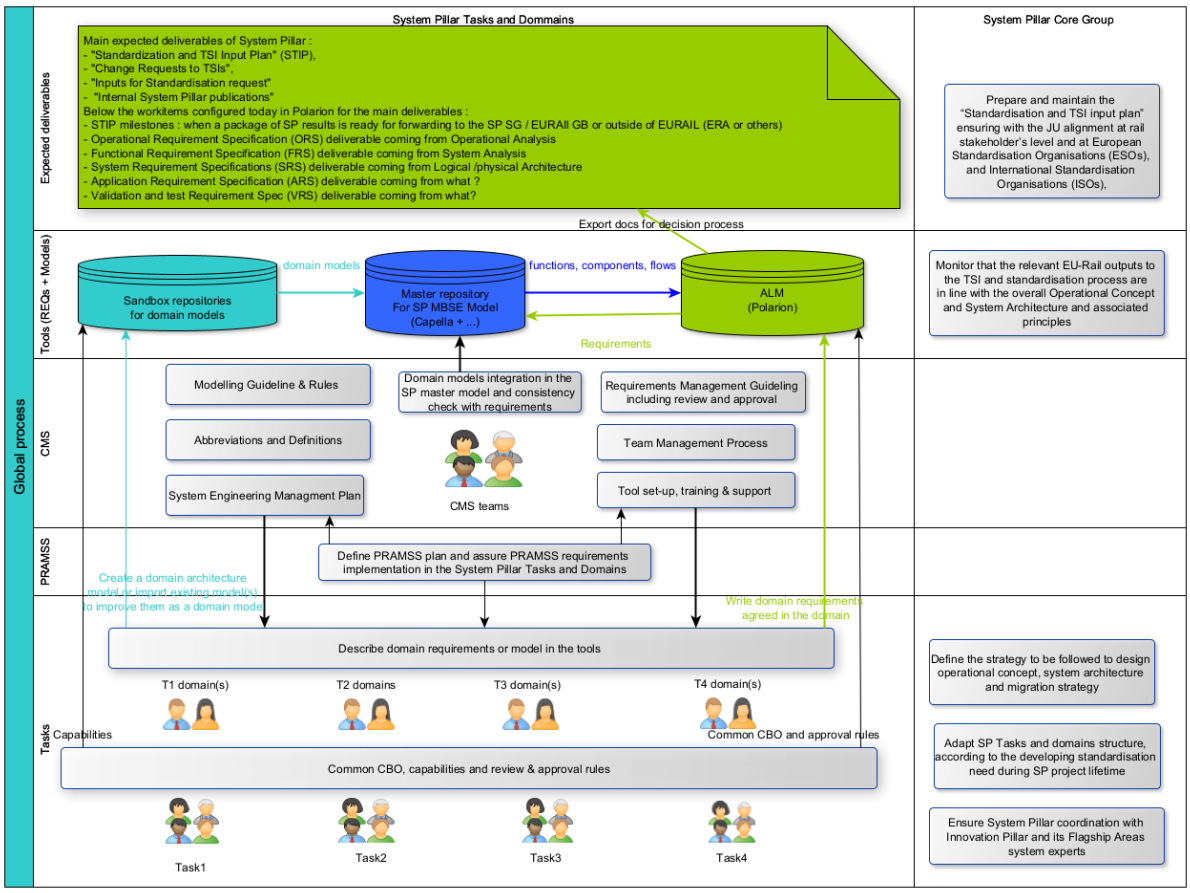

Figure 2 Figure Overview of EU-Rail System Pillar tasks, domains and their interactions

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System Pillar Core Group

One of the activities of System Pillar Core Group is to supervise the preparation of the main deliverables including STIP ("Change Requests to TSIs" and "Inputs for Standardisation request") by Tasks and Domains of SP and Flagships Projects of Innovation Pillar.**[**Open**]**

Technical Tasks/Domains and Engineering Services

Tasks/Domains execute the detailed design work (operational processes and requirements, functional analysis and technical
architecture) while the Engineering Services includes PRAMSS assurance and Central Modelling Services to provide and maintain the System Engineering Management Plan (SEMP), requirements management and modelling guidelines and best practices and selected tools support to all System Pillar teams**[**Open**]**

The tooling platform

The tooling platform is the basis for works in the different domains. The current platform includes Polarion for ALM, Capella for MBSE and Sharepoint for general content management system. More tools, such as SysML based tool or simulation tools and distributed version control tool (GIT) should come in the future.**[**Open**]**

3.2 Purpose and scope of SEMP

The purpose of SP System Engineering Management Plan (SEMP)

The purpose of SP System Engineering Management Plan is to define the system engineering guidebook (workflow rules and best practices, methods, and tools usage) for all specification related activities in the System Pillar.**[**Open**]**

An example of V cycle principle on 'system engineering guidebook for intelligent transportation systems.

SPPR-3455 - [5] System Engineering Guidebook for Intelligent Transportation Systems proposed a generic example of vee cycle for intelligent transportation systems

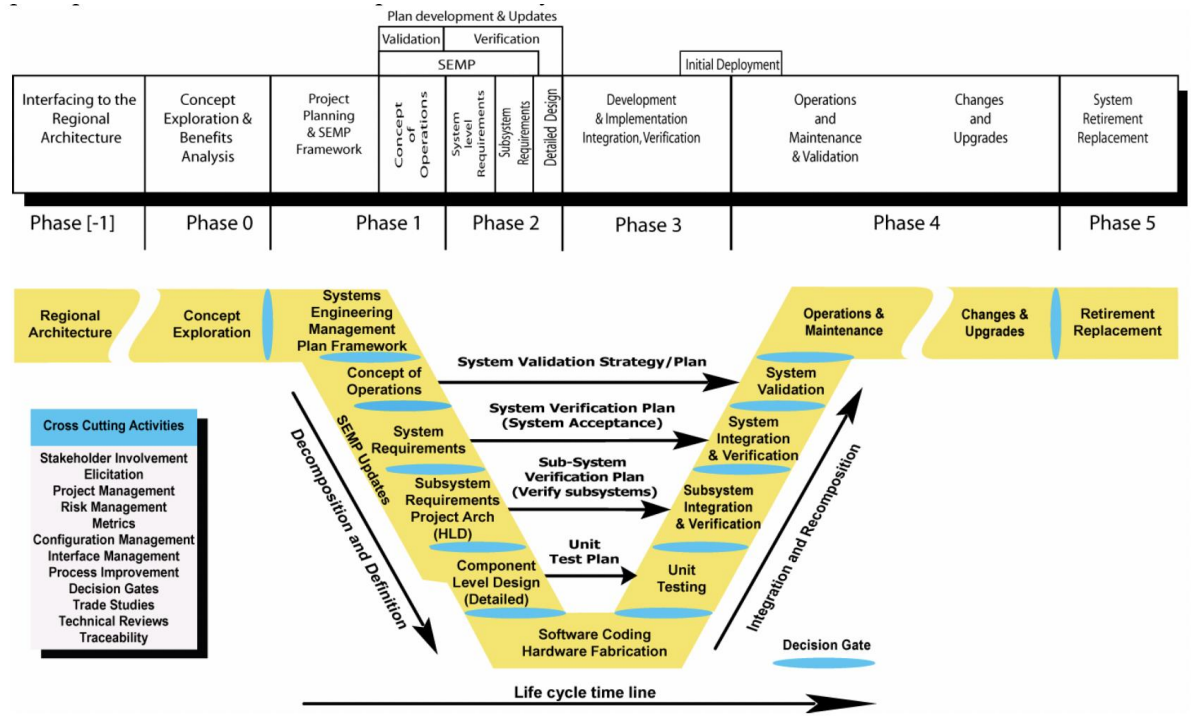


Figure 3 Adapted from the Vee Technical Development Model [System Engineering Guidebook for Intelligent Transportation Systems, US Department of Transportation]

The V-cycle representation of EN 50126-1:2017 (E)

The development of European Railway transportation systems must comply with CENELEC EN50126 standardThe development of European Railway transportation systems must comply with CENELEC EN50126 standard. The proposed V-cycle represention of EN50126 is presented in Figure 4. The top-down branch (left side) is generally called “development” and is a refining process ending with the manufacturing of system components. The bottom-up branch (right side) is related to the assembly, the installation, the hand-over and

then the operation and maintenance of the whole system.

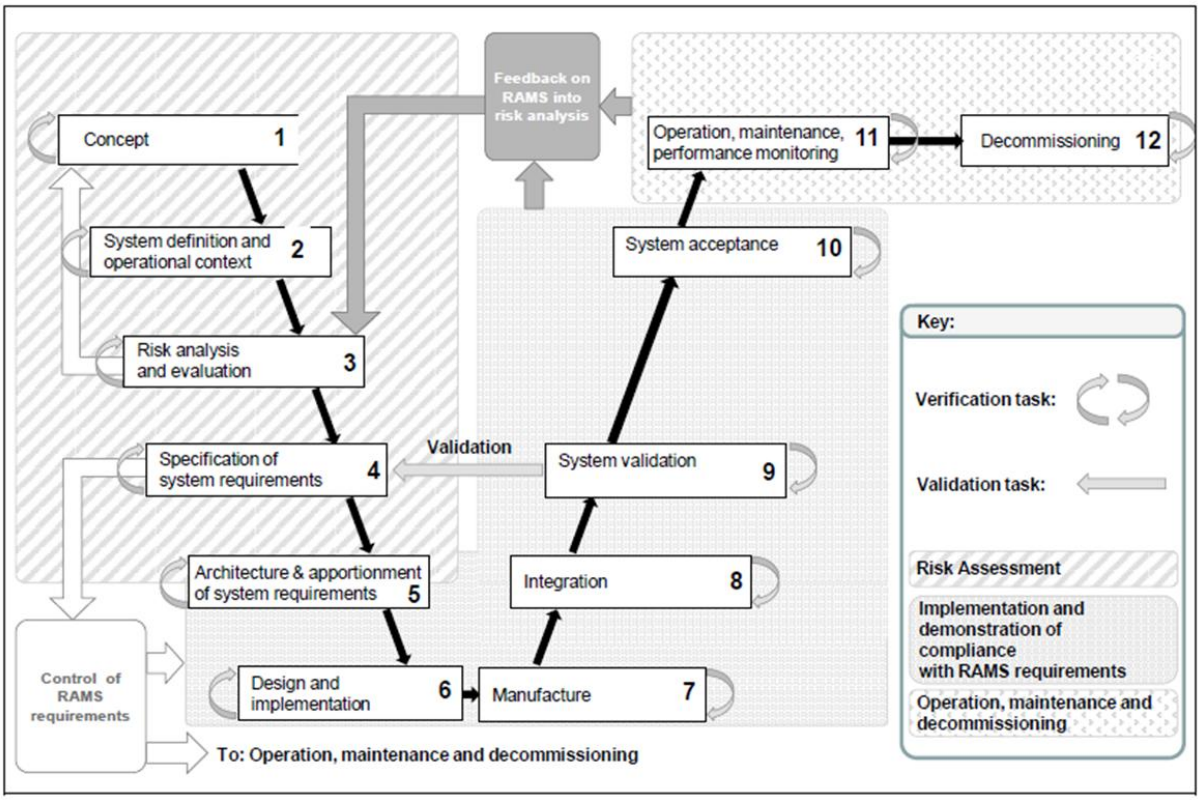


Figure 4 The V-cycle representation of EN 50126-1:2017 (E)

Using MBSE in CENELEC V cycle of EN 50126

Figure 5 presents the classical model-based techniques, including MBSE focused on system architecture, in the V-Cycle of the European Railway standard EN 50126

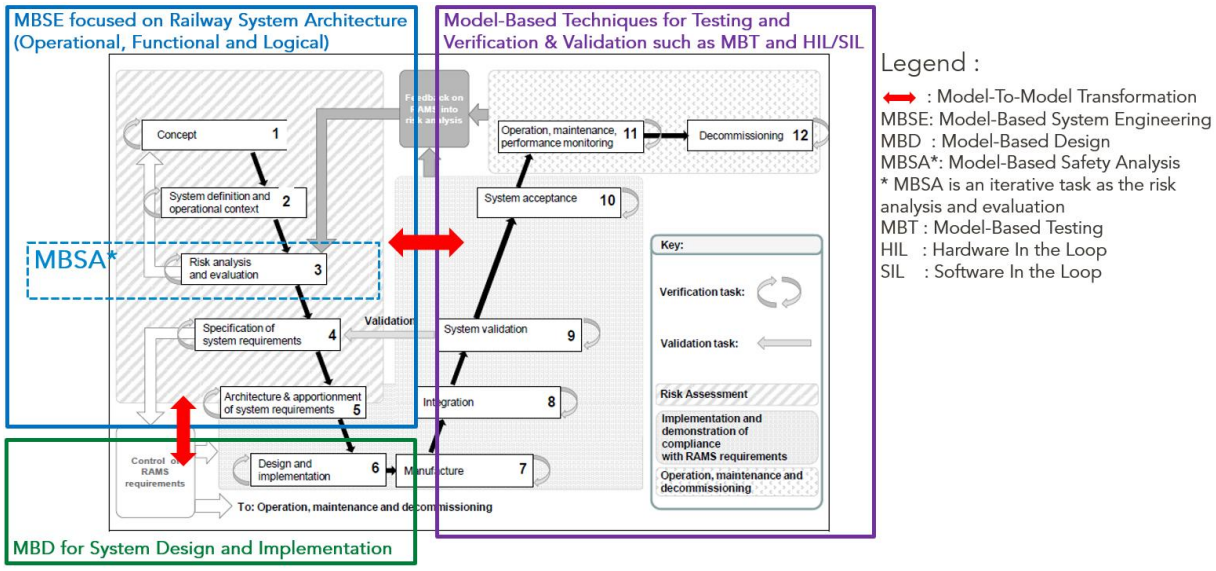


Figure 5 Classical Modeling techniques in CENELEC V cycle of EN 50126 [Towards the Modelling of European Railway System Architecture, Transport Research Arena 2022

4 SP Methodology

The SP methodology is based on system of system approach.

The system of systems approach is used inside the System Pillar to recursively refine the structure of the architecture down to the level of subsystems. The following figure shows the decomposition of a system of systems on one consistent example spanning 5 levels of refinement. Level 5 is the actual subsystem layer and is visually integrated into the bottom layer in the following figure to be able to show the relationship to logical components.

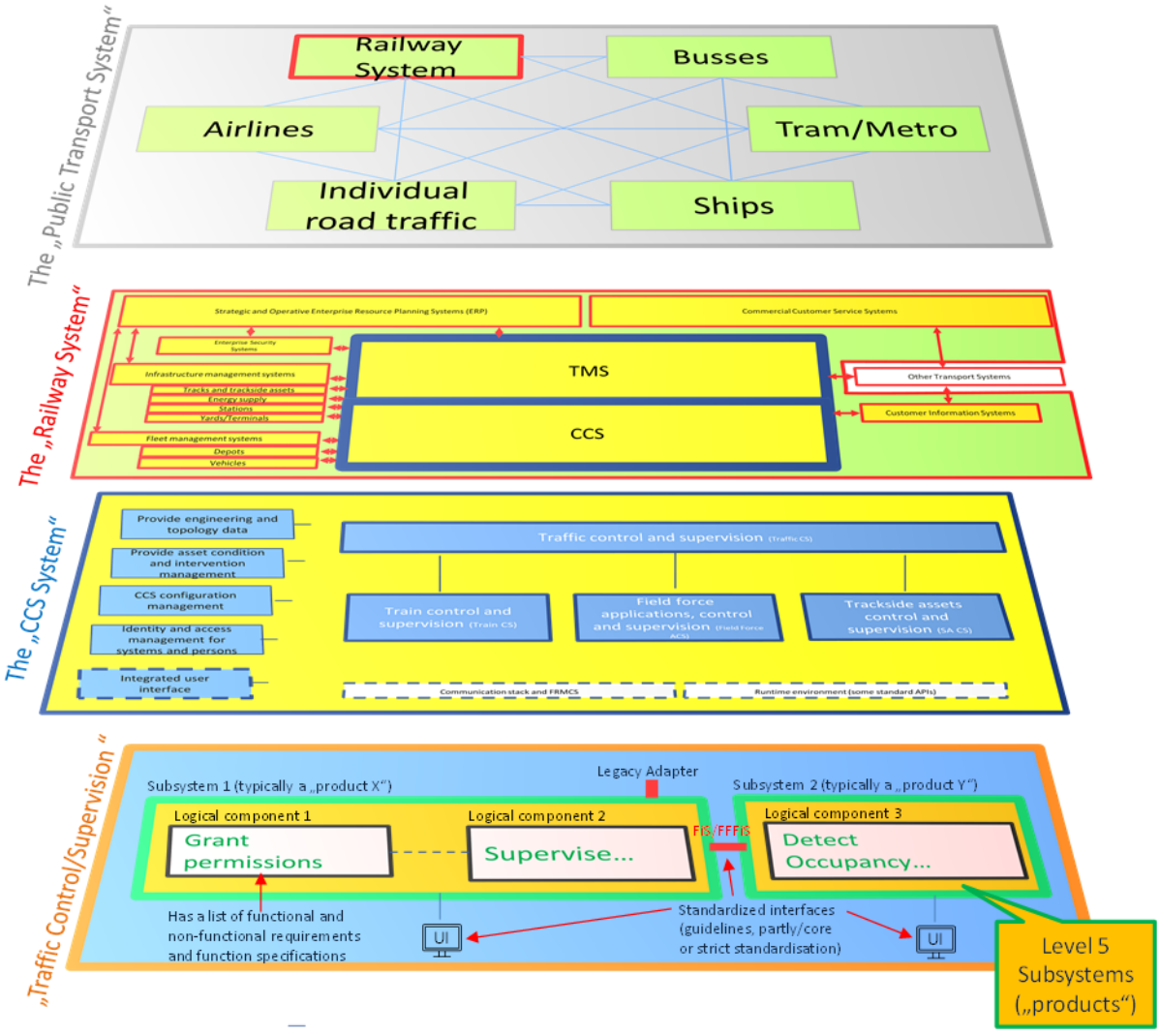


Figure 6 System Level 1-5 view, the content is based on indicative CCS/TMS example described in Annex B

Four architecture concepts of SP

As defined in the SEMP Annex B, the four architecture concepts of SP (Operational Analysis, System Analysis, Logical Architecture and Physical/Subsystem Architecture) is based on MBSE ARCADIA SPPR-5911 - Arcadia (AFNOR XP Z67-140 standard) for Architecture Analysis & Design Integrated

Approach. The subsystems on system level 5 shall be specified in SPPR-5912 - SysML (Systems Modelling Language) (Cf. SPPR-5485 - Scope and usage of SysML Tool). **[**Open**]**

Viewpoint driven approach: Requirements, need analysis, architecture building

Arcadia stipulates a viewpoint-driven approach (as described in SPPR-2684 - ISO/IEC/IEEE 42010-2011) and emphasises a clear separation of need analysis, requirement engineering and architecture building, as illustrated in Figure 7.

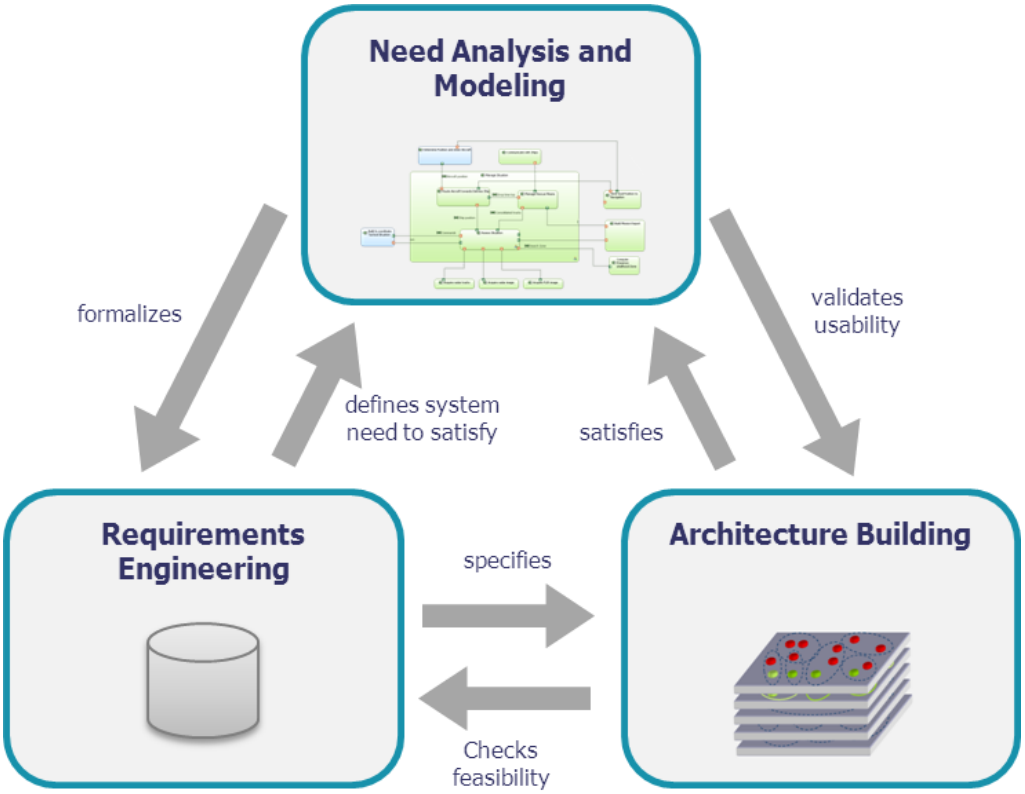


Figure 7 Viewpoint driven approach [Augmenting requirements with models to improve the articulation between system engineering levels and optimize V&V practices', INCOSE International Symposium, 29: 1018-1033]

[Open**]**

Architecture developpement phases

The viewpoint driven approach complies with some technical processes (stakeholders requirements definition process, requirements analysis process, architecture design process) of ISO/IEC/IEEE 15288:2015 standard by deriving four generic phases of architecture development; operational analysis, system requirements analysis, logical architecture and physical architecture, as illustrated in

Figure 8.

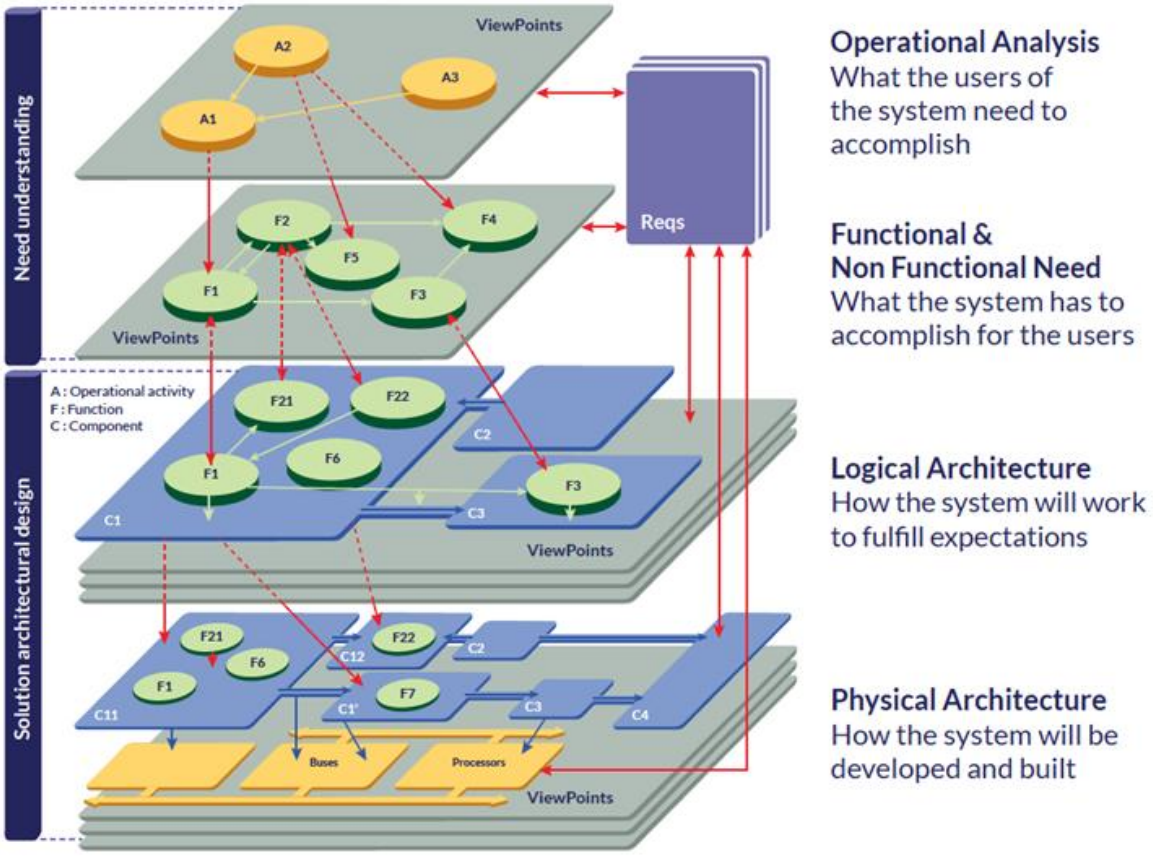


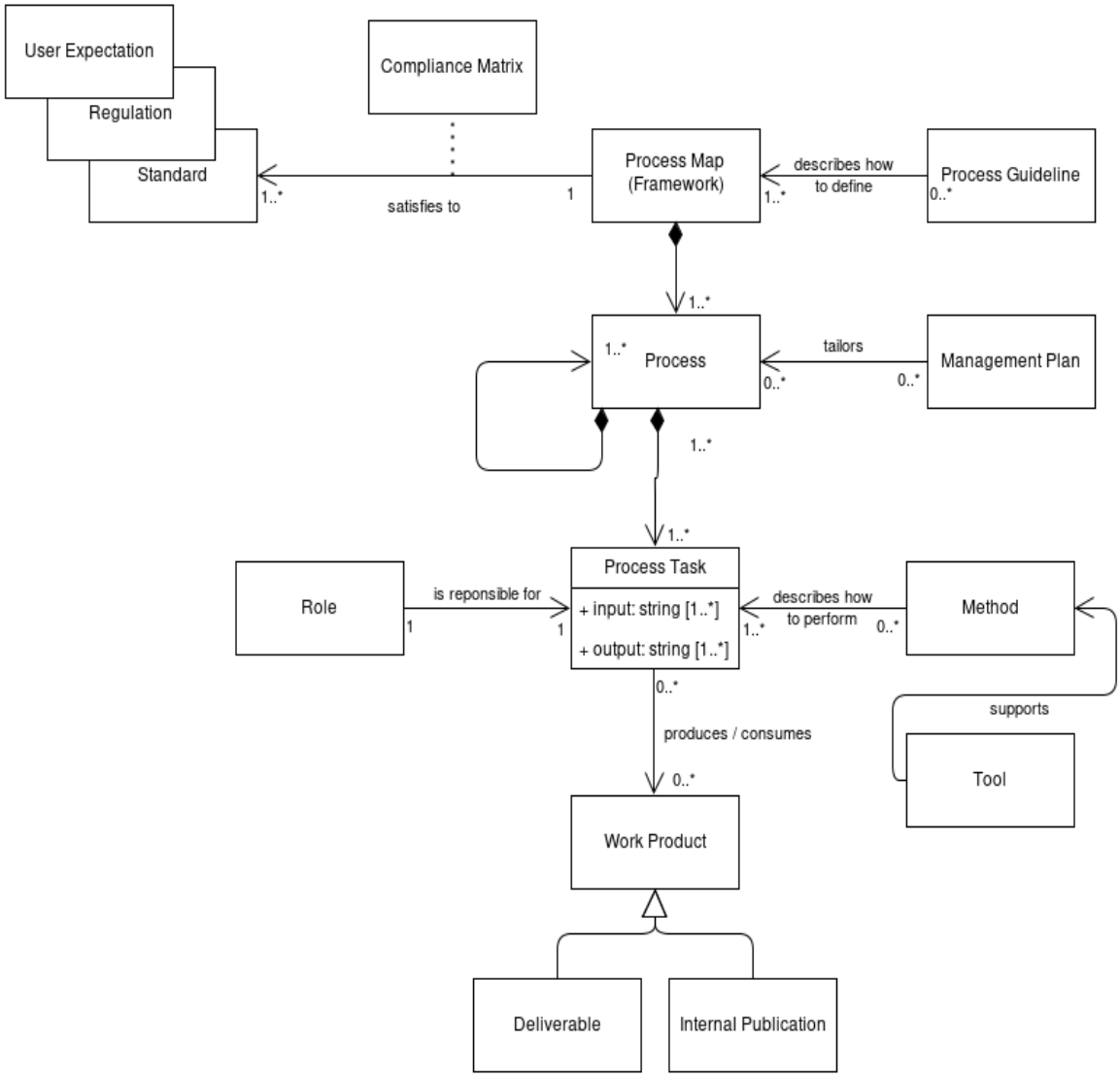
Figure 8 Four perspectives of Arcadia [Arcadia web : https://www.eclipse.org/capella/arcadia.html]

The following section adapts this generic architecture description process for SP context.

5 SP Processes

5.1 Process-related concept ontology

Process-related concept diagram



Process

A set of interrelated or interacting set of cohesive process tasks that transforms inputs into outputs. The Processes require a purpose and outcome, all processes have at least one process task. (Source: ISO9001 and ISO 15288, 4.1.30)

Process Task

Action intended to contribute to the achievement of one or more outcomes of a process.

Method

Method is a grouping of guidance, modelling language, rules, techniques and patterns. Different methods may be available for the same task (e.g. Define stakeholders)

Work Product

An artefact associated with the execution of a process. (Source: ISO 24765:2017 3.4611)

Deliverable
Any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. (Source: ISO 24765:2017 3.1098) (e.g. Requirement Specification)

Internal Publication
Any work product that is not required to be submitted in order to complete a process, phase, or project. (e.g. Viewpoint)

5.2 Problem Definition & Architectural Design

Purpose and scope of the Problem Definition & Architectural Design Process
The main purpose of the problem definition & architectural design process is to provide a shared and agreed set of requirements and an architecture that meets stakeholder needs for an integrated european rail system. This is achieved by defining the problem and designing architectural solutions (Figure 9).**[**Open**]**
Problem Definition & Architectural Design main process overview

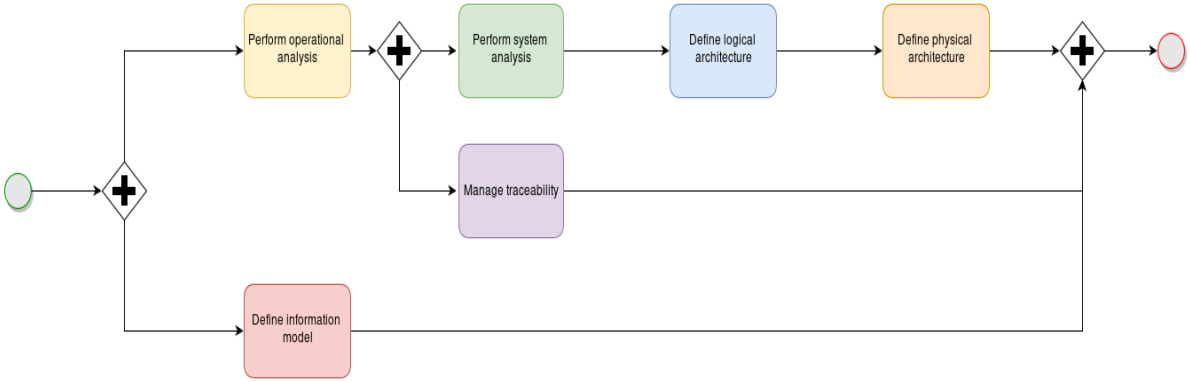


Figure 9 Problem Definition & Architectural Design main process overview

5.2.1 Define Information Model

Define information model
The define information model process is done several times periodically the operational analysis, system analysis, logical architecture and physical architecture. The creation tasks are identical for each modelling level (operational analysis, system analysis, logical architecture and physical architecture) and allow to enrich step by step the deliverables provided by this (i.e. the data dictionary and the glossary of terms). It is a transversal and iterative activity.
Deliverables: Glossary, data dictionary.
Tasks:

- Define terms
- Define the conceptual data model
- Refine the conceptual data model into a logical data model
- Refine logical data into physical data

The task will be refined and described in SEMP v3.
[Open**]**

5.2.2 Perform Operational Analysis

The purpose of SP's operational analysis is to described the harmonized processes around the European railways, so far as to prepare their automation.

- Operation processes: define the interactions between the actors of the *railway process*: technical object and people implied in the very mission of railways, i.e. moving *passengers* or *freight goods* from a *station* to another via the rail *infrastructure*.
- Maintenance: define the processes that permit the technical components of the railway system to deliver their function.
- Track integrity & security: Currently, managing obstacles, e.g. trespassers, is not scope of System Pillar. In the future, improvements are expected in order to standardize the technologies matured in the context of the Innovation Pillar.

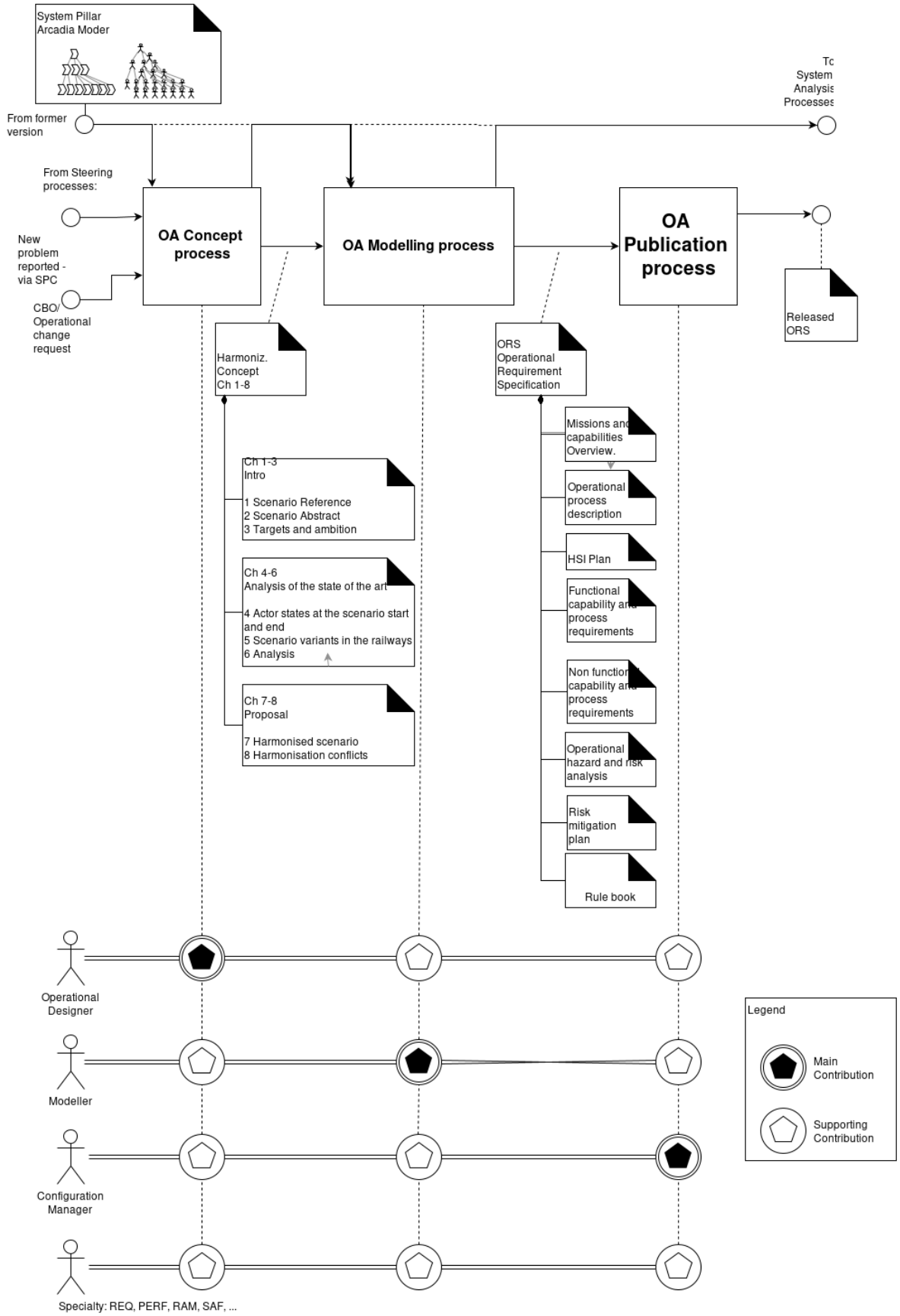
Note about interactions: interactions may be physical: step-in, alight, permitted temporary violation of *clearance gauge* (e.g. at level crossing), replace a component (maintenance). They may be of the perception type: perceive some obstacles. They may be coordinating communication. Lastly, people are expected to assess and control technical components of the system, i.e. interactions may be some HMI. Other types may arise during the project.

SEMP process 02-Operational Analysis are gathered in 3 process sub-groups:

- Preparatoy: SPPR-3581 - OA Concept
- Detailed work: SPPR-3582 - OA Modelling process including SPPR-2234 - P2.4 Define operational capabilities and entities; the necessary quality (meet the need) shall be confirmed by review of SPPR-4035 - ORS Operational Requirement Specification.
- Post-processing:.SPPR-3585 - OA Publication

As illustrated in diagram SPPR-3655, main contributors are the roles operational designers (SPORG-106 - OD), modeller (SPORG-114 - MOD) and for the publication configuration manager(SPORG-100 - CM). According to the process, their contribution may be supporting, or supported by different specialties (SPORG-102 - REQ, SPORG-107 - PERF, SPORG-115 - MIG, SPORG-105 - RAM , SPORG-105 - RAM).

Operational Analysis


System Pillar
Arcadia Moder
From former version
To System Analysis Processes
From Steering processes:
New problem reported - via SPC
CBO/ Operational change request
OA Concept process
OA Modelling process
OA Publication process
Released ORS
Harmoniz. Concept Ch 1-8
ORS Operational Requirement Specification
Ch 1-3
Intro
1 Scenario Reference
2 Scenario Abstract
3 Targets and ambition
Ch 4-6
Analysis of the state of the art
4 Actor states at the scenario start and end
5 Scenario variants in the railways
6 Analysis
Ch 7-8
Proposal
7 Harmonised scenario
8 Harmonisation conflicts
Missions and capabilities Overview.
Operational process description
HSI Plan
Functional capability and process requirements
Non functional capability and process requirements
Operational hazard and risk analysis
Risk mitigation plan
Rule book
Operational Designer
Modeller
Configuration Manager
Specialty: REQ, PERF, RAM, SAF, ...
Legend
Main Contribution
Supporting Contribution

5.2.3 Perform System Analysis

For ontology and definitions, see System Analysis definitions.

During "Operational Analysis", the analysis of the "Wider System Of Interest" has identified several " Operational Entities ". The entities, identified as being in the scope of the design, will be used to define (one or several) "System of Interest". For each of these systems, a dedicated "System Analysis" is required.

System Analysis does not design a specific technical solution but **captures the (functional) needs for the future system** at its border (no internal functional structure). It hence represents a statement of work and not a finished piece of engineering. It is used to rationalise the decision, which operational processes will be performed by the system(s) of interest, and which will not be (these processes then mostly will be either performed by other systems or by human actors and defined as operating rules).

System Analysis will identify

- which set of **System capabilities** are needed to fulfill the "Operational Capabilities" as determined in the operational analysis
- which set of **System Functions** a system needs to provide to realise the set of "System capabilities"
- the f**unctional chains participating to the System capabilities**
- the **data** these functions will exchange,
- non **functional constraints** (typically related to PRAMSS) and their allocation

The **System Analysis** will provide a document called "Functional Requirement Specification" (FRS as defined in System Pillar Deliverables).

Note that revisiting **Operational Analysis** could be required to ensure overall consistency.

System Analysis also checks for feasibility. Iteration back to **Operational Analysis** could be required to adapt what has been required from the system. This could lead to change of functions distribution among systems, change of interfaces, negotiate requirements, ... It is important to revisit the "Operational Analysis" during this renegotiation to ensure consistency among all actors and systems.

The **System Analysis** is organised into 4 process tasks further detailed in SEMP process 03-System Analysis :

- P3.1 Define System scope
- P3.2 Develop System capabilities
- P3.3 Derive system requirements
- P3.4 Conduct reviews

Process diagram of "Perform system analysis" (UML Activity Diagram)

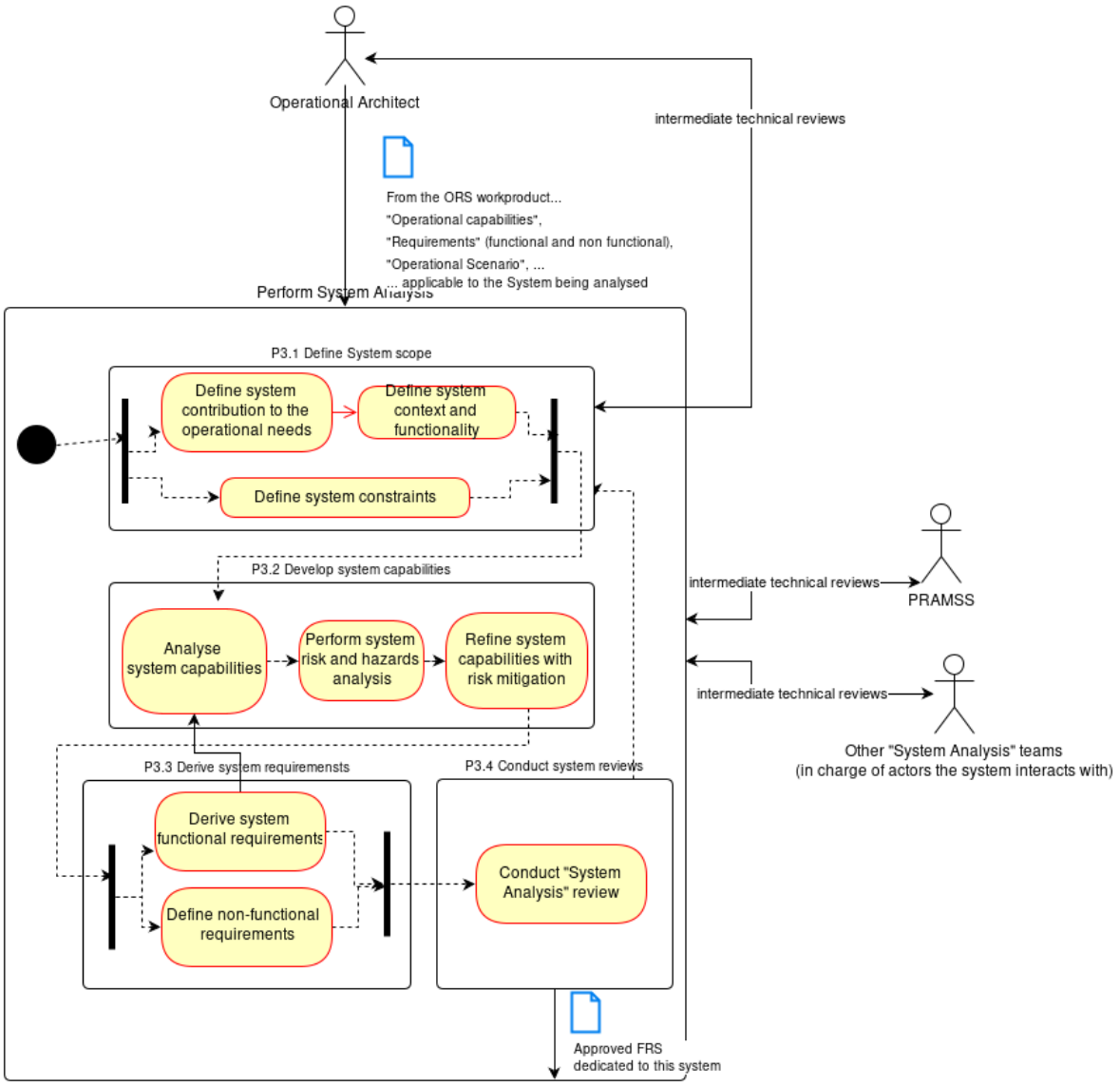


Figure 10 "Perform System Analysis"

5.2.4 Define Logical Architecture

No update from the first version SEMP V1 (Annex D - group 04-Logical Architecture)

SEMP process 04-Logical Architecture

The consolidation will be defined in next iteration of SEMP (SEMP V3).

5.2.5 Define Physical Architecture

No update from the first version SEMP V1 (Annex D - group 05-Physical Architecture)

SEMP process 05-Physical Subsystem Architecture

The consolidation will be defined in next iteration of SEMP (SEMP V3)

5.2.6 Manage traceability

The consolidation will be defined in next iteration of SEMP (SEMP V3) by taking account the concept defined in SEMP V1 (SPPR-2528 - Generic tailoring and assignment rules for workitems)

5.3 Supportive processes

5.3.1 Configuration Management Process

Will be defined in next iteration of SEMP (SEMP V3).

5.3.2 Change Control Management Process

SEMP process 91-Change Control Management Process

P9.1 Change control management process

The purpose of the change control management process is to ensure proper change management of documents that is subject to change control, such as published System Pillar documents. The process ensures effective planning, implementing, and controlling changes within System Pillar to minimise disruption, manage risks, and ensure desirable outcomes while considering the impact and full traceability of changes. This is needed especially for safety-related functionality to express what has been changed by whom and to understand the impact on the whole system. To carry out this process, a Change Control Board (CCB) handles pending change requests by analysing and deciding on implementation proposals. The change control board members are representatives for different disciplines to handle requested changes from different aspects.

Note:

- For changes that target TSIs or European Standards, the CCM process of the respective organisation is applicable.
- The CCM process, as the Review and Approval process, prepares the input to the sector decision process in line with the SP Governance.

Furthermore, this change control management process shall be used for changes to internal not yet published documents or the work items that populate the master database from which outputs are generated.

The process tasks of this process are:

- SPPR-4617 - Request change
- SPPR-5569 - Perform change request quality check
- SPPR-4618 - Perform initial CCB review
- SPPR-4619 - Analyse change and consolidate solution
- SPPR-4620 - Get CCB decision
- SPPR-4621 - Plan and implement change
- SPPR-4622 - Verify change implementation

5.3.3 Review process and approval process

The detailed processes are in the following annex.

SEMP Process 0945-Review and Approval Process

P9.4 Review process

SEMP Process 0945-Review and Approval Process

The purpose of the review process is to provide a structured framework for reviews of Work Product (e.g. live document or work item).

- The review process shall be used prior to formal approval of all work Items of one work product or for unregulated work products. The review is part of the authoring process and is for quality optimisation and reducing the number of comments within the approval process.

The review process is based on ISO/IEC 20246:2017 and the CENELEC standards EN 50126, EN 50128 and EN 50129. The process tasks of the review process are:

- SPPR-4415 - P9.4.1 Prepare and initiate review
- SPPR-4429 - P9.4.2 Perform review and approval training
- SPPR-4427 - P9.4.3 Identify review comments
- SPPR-4428 - P9.4.4 Analyse and react to review comments
- SPPR-4424 - P9.4.5 Implement rework proposal
- SPPR-4419 - P9.4.6 Confirm rework changes
- SPPR-4421 - P9.4.7 Close review

Note: the role Author mentioned in process is the responsible person for a document, a Work Item.

P9.5 Approval process

SEMP Process 0945-Review and Approval Process

The purpose of the approval process is to provide a structured framework for approvals of Work Items (for any set of Work Items, of course also "for all Work Items of a document)".
An approval is a single formal Work Item assessment of a single person based on their own opinion, who is competent to assess a Work Item. An approval is always bound to a Work Item version. Approvals are typically done in the context of baselines that contain certain Work Items with defined versions that describe valid traces.
The process tasks of the approval process are:

- SPPR-5394 - P9.5.1 Prepare and initiate approval
- SPPR-5396 - P9.5.2 Perform approval training
- SPPR-5395 - P9.5.3 Analyse and approve work items and documents
- SPPR-5455 - P9.5.4 Analyse and react to disapproval
- SPPR-5470 - P9.5.5 Implement rework proposal
- SPPR-5474 - P9.5.7 Close and document approval
- SPPR-5471 - P9.5.6 Approve rework changes

5.3.4 Variant Management Process

Will be defined in the next iteration of SEMP (SEMP V3).

5.3.5 Verification and Validation Process

5.3.5.1 Quality Management Process

Quality assurance process

As defined in SEMP V1 (SPPR-1618 - Quality Management) a quality assurance process will be developed and established by the Coregroup, supported by the Modelling Service. It will be defined in the next iteration of SEMP.**[**Open**]**

5.3.5.2 Simulation

Purpose and scope of simulation process

Provides a process framework for Simulation of the SP Systems. Simulation plays a vital role in de-risking the specification prior to implementation.
The process is intended to drive the simulation model implementations, to enable insight into how the specification will be interpreted for development and to validate the specification. The key outcomes of the simulation tasks following this process will involve:

- Validation that the defined project specification sufficiently specifies the functionality and behaviour for the intended purpose in the intended environment with respect to stakeholder needs.
- Discovery of defects and failures in the functionality, including gaps in functionality, behaviour and interfaces.
- To build confidence that the specification is ready.
- Test Cases are defined early and can be used to perform back-to-back assessment between simulation and hardware/software implementation

Simulation process is not part of SEMP v2 it will be defined in a later iteration. Examples for Simulation see EULYNX/SPT2-Trackside Assets CS**[**Open**]**

5.3.6 Document generation and publication process

The rules for documents generation and publication are described in SPPR-5442 - SEMP Annex Z - Documents Publication and Exchange Process .

5.4 Team Management Processes

No update from the first version SEMP V1 (Annex D - process 01-Team Management)

SEMP process 01-Team Management

Foreseen improvement will be defined in next iteration of SEMP (SEMP V3).

6 Guidelines and rules

6.1 Modelling guidelines and rules

Purpose and scope of modelling guidelines and rules

The purpose of the modelling guidelines and rules are to provide a consistent modelling approach inside one or more models used for requirements engineering and architectual analysis / design for system levels 1-5.

- SEMP Annex M - ARCADIA/Capella Modelling Rules provides the rules for Capella models. They contain element and diagram rules including naming convention and detailed instructions of how to structure, maintain and use content of a Capella model. It includes existing rules from previous or current initiatives and projects as inputs.
- SEMP Annex R3 - Rules for writing textual requirements and SEMP Annex R2 - Requirements patterns syntax are covered in the area of modelling rules to enable the creation of requirements inside the architectural analysis and design models.
- SEMP Annex S SysML Modelling Rules provides preliminary rules for SysML models (system level 5). It refers to existing rules from previous or current initiatives and projects as inputs.

[Open**]**

6.2 Requirements guidelines and rules

The purpose and scope of requirements management process

The purpose of requirements management is to ensure product development goals are successfully met. A blended approach has been implemented that mixes the Holistic Requirements Model (HRM) for the requirements derivation, the "Easy Approach to Requirements Syntax" (EARS) for defining the main requirements' types syntax rules and theINCOSE Guide for requirements specific writing rules.
The process is organized as summarized in the following:

- SEMP Annex R1 - Requirements Management Guidelines describes a set of techniques for documenting, analyzing, and agreeing on requirements so that engineering teams always have current and approved requirements.
- SEMP Annex R2 - Requirements patterns syntax provides a small set of structural rules to address eight common requirement problems including ambiguity, complexity and vagueness. The ruleset allows all requirements written in natural language to be translated in one of six simple templates.
- SEMP Annex R3 - Rules for writing textual requirements provides simple rules on writing good textual/natural language requirements.

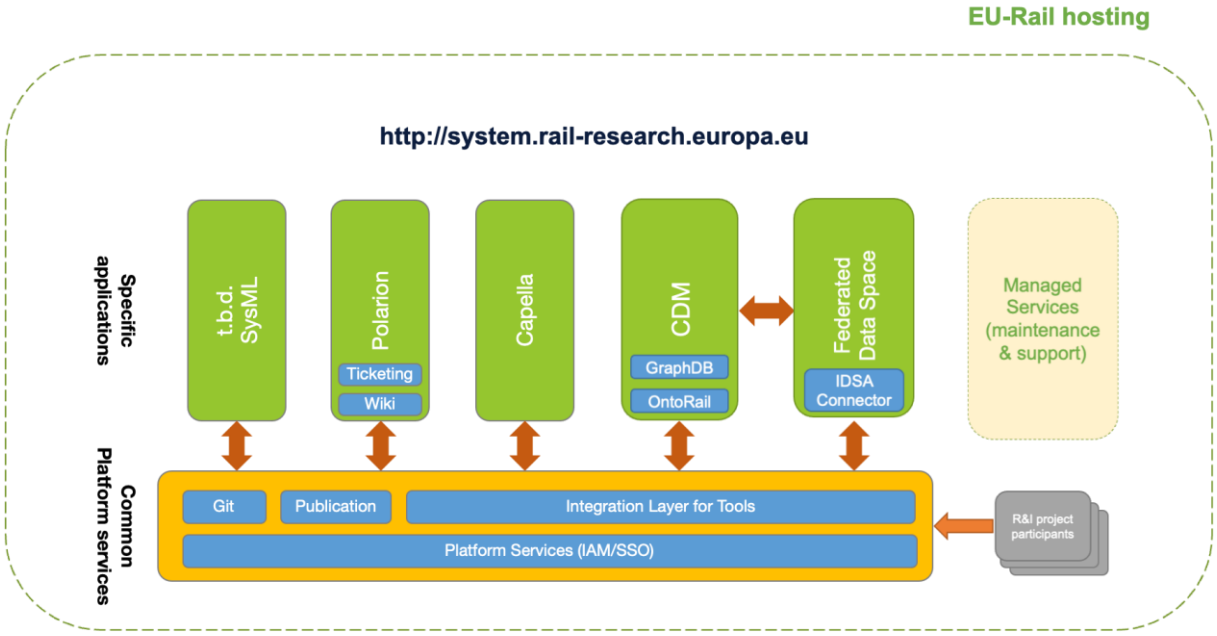
[Open**]**

7 Tools, Training and Support

Improvements Tools compared to SEMP v1

[Open**]**

Overview of tool-platform



[Open]

7.1 ALM/Polarion tool

Scope and usage of Polarion

Polarion is an highly configurable ALM-Tool and therefore will be used in following areas

- Requirements-Management (including traceability and impact analysis) and Reviews
- Planning of deliverables (including use of Kanban and Gantt)
- Ticketing
- Wiki (generic documentation)

This means that for the mentioned areas no other tool will be available.[Open]

Access to Polarion

https://polarion.rail-research.europa.eu/[Open]

Training material for Polarion

SPPR-2856 - Polarion training links [Open]

Each domain needs at least one method and tool specialist

Each domain needs at least one method and tool specialist who is the primary contact for the domain and supports the work and adjustments within (e.g. training, reports) [Open]

7.2 ARCADIA/Capella tool

Access to Capella

https://capella.ertms.be/auth [Open]

Training material for Capella

Capella Training Links [Open]

Requirements to facilitate model integration in master model

One of the task of the SP is to consolidate / integrate models issued from the SP tasks and domain. A means to achieve that is to facilitate access to the models created in former projects to the different domains in the System Pillar. Therefore, the CMS shall provide sandbox repositories from which respective domains may

import existing models for further improvement (essentially deriving from it) or consult existing models as read-only to look up their content (essentially building a new model, albeit taking inspiration).

Each domain needs at least one method and tool specialist (modelling expert) who is included into the work of the domain and supports the formalisation of the model together with domain experts.

While domain experts have only basic knowledge of the methods and rules, the CMS modelling experts provide method and modelling knowledge as a service

All modelling experts will be also part of the CMS mirror group, so that there is a connection to further discuss and improve MBSE methods in System Pillar with all necessary persons.

The domains shall follow the defined methods, processes modelling rules/guidelines and requirement management guideline. In case of limited resources or when something is missing (e.g. template), the members of the different domains can join the CMS mirror group and can help to define the missing documentation (e.g. method, process or guideline).

When the domain model in the sandbox repository is ready for integration into the SP master repository, the domain leads shall inform the CMS leads to integrate the domain mode**[**Open**]**

7.3 Git

There are currently two main reasons for Git:

1. Exchanging models of Capella adding versioning
2. Exchanging (large-)file.

Also the public publication of documents (website) could be implemented using git. But this is not decided yet

Will be defined in next iteration of SEMP (SEMP V3).

7.4 SysML Based tool

Scope and usage of SysML Tool

The SysML tool will be primarily used for the creation, management and maintenance of System-Level 5 models. Of course it can also be used for all other levels but at the current moment Capella will be used for modelling System Level 1-4 and the SysML-Tool only for System-Level 5 If required in specific cases, it can be used to perform simulation-based verification and validation on those models directly.**[**Open**]**

Access to SysML Tool

The SysML tool does not yet exist.

The selection process for the tool is currently ongoing : SysML Tool requirements **[**Open**]**

7.5 Tool(s) Interactions

7.5.1 Capella-Polarion interaction

Overview Capella-Polarion bridge

Polarion and Capella will use a common bridge for exchanging data. This is neither part of Capella nor Polarion but independent. It is currently under development by DB and SBB for their own purpose and will be provided (and used) as soon as possible (Q3/2023). **[**Open**]**

7.5.2 Capella-SysML based tool interaction

Overview

Capella and SysML-Models are to be linked on the selected Arcadia architecture level. To this end, a Capella-SysML-Bridge is planned. More details will follow after the SysML modelling tool has been selected. **[**Open**]**

8 Related standards and norms

The engineering process shall apply to engineering norms and standards where applicable.

The following SPPR-4490 - SEMP Annex Related Standards and Norms shall be used as a working basis. This list should be updated over time.**[**Open**]**

9 Status of the work, open points, issues

This section lists the status of work of SEMP V2 (overview on the change compared to V1 before the review process and major comments/findings from review process), open points/issues and tasks created for SEMP V3.

9.1 Overview of changes between V1 and V2

Changes table between SEMP V1 and V2

V1	V2	Changes
SEMP main document V1	SEMP main document V2	- SEMP V2 is an enhancement of SEMP V1 based on SEMP 1.0 open points and the feedback of some Domains (e.g. SEMP_V1_review_sheet_trainCS_final). - V2 main document has been structured according to the structure of CMS remit doc (purpose & scope of SEMP, glossary, method, process, guideline, tools). - Contrary to SEMP V1 where the annexes are referenced with a screenshot, in SEMP V2 all the annexes (updated appendices and new appendices) are referenced in dedicated sections in the main document preceded by the purpose and scope the annexes. - The SEMP V1 annexes which are not modified in SEMP V2 are marked "No update from the first version SEMP V1 (e.g. Annex D - group 04-Logical Architecture). - SEMP V2 also contains some sections (configuration management, simulation, ...) identifying works to be done in next iterations of the SEMP. - Some major comments/findings from review process (e.g., request of overview of changes, reference of PRAMSS plan in SEMP, etc) have been implemented in SEMP V2

		- Other comments from review process (e.g., publication process of decided documents) have been planned for SEMP V3 : SPPR-5913 - Open points from review process and tasks for SEMP V3
SEMP Annex A - Abbreviations Roles and Teams	SEMP Annex A - Abbreviations Roles and Teams	Minor update : Add of new abbreviations and acronyms (cf. the change history in Polarion History)
SEMP Annex B - Architectural principles	SEMP Annex B - Architectural principles	Minor updade : Cf. the change history in Polarion History + review comments
SEMP Annex C - Workflow concept and rules	No update	New review comments
SEMP process 01- Team Management	No update	No new review comment
SEMP process 02- Operational Analysis	SEMP process 02- Operational Analysis	Major update: Split complete OA between "OA-concept" (kind of polarion-paper only) and "OA-Modelling" processes. "OA-concept" braught to maturity. "OA-Modelling" delayed to V3.
SEMP process 03- System Analysis	SEMP process 03- System Analysis	Major update: Complete rework based on SEMP v1, ARCADIA and Return of Experience from DB
SEMP process 04- Logical Architecture	No update	
SEMP process 05- Physical Subsystem Architecture	No update	
Annex H1 - Operational harmonisation and rule book description method	No update	SEMP V1 Annex H1 is not imported into Polarion
Annex H2 - Operational harmonisation and rule book description	No update	SEMP V1 Annex H2 is not imported into Polarion

example - Start of Mission		
SEMP Annex M - ARCADIA/Capella Modelling Rules	SEMP Annex M - ARCADIA/Capella Modelling Rules	Major update
	SEMP Annex R1 - Requirements Management Guidelines	- New annex describing the Requirements Management Process. - Most comments from review process have been implemented.
	SEMP Annex R2 - Requirements patterns syntax	-New Annex describing requirements syntax patterns. - Most comments from review process have been implemented. -Some still pending, requiring a longer time for analysis/implementation, have been traced in the "Open Points" section.
Annex R - Rules for writing textural Requirements	SEMP Annex R3 - Rules for writing textual requirements	Renaming of Annex R in Annex R3 with a major update. -Most comments from review process have been implemented. - Some still pending, requiring a longer time for analysis/implementation, have been traced in the "Open Points" section.
SEMP Annex S SysML Modelling Rules	No update	
Annex T - Tool requirements	No update	SEMP V1 Annex T was not imported into Polarion
	SysML Tool requirements	New annex reviewed and in the approval phase
	Concept Paper - Glossary and Terminology	New annex + author comments Created as a result of a SP CG task.
	SEMP Process 0945-Review and Approval Process	New annex to make review and approval in Polarion

	SEMP process 91-Change Control Management Process	New annex + authors comments
	SEMP Annex Z - Documents Publication and Exchange Process	New annex describing the SP->IP documents exchange process. Most comments from review process have been implemented. Some still pending, requiring a longer time for analysis/implementation, have been traced in the "Open Points" section.

[Open**]**

9.2 Open points from review process and tasks for SEMP V3

The following open points from review process (tasks created for SEMP V3) complete SEMP 1.0 open points continuously updated.

SCHWAN Nico (commented): Major: Add Task for v3 to define publication process of decided documents (in additional to currently limited scope of Annex Z for SP > IP)
PASCIUTI Federico (replied): I agree with Nico's comment. The exchanging process has the only temporary objective of exchanging documents with IP. Within SEMP V3 a process for the publication of decided documents shall be included.
SANGO Marc (Replied): Task created for SEMP V3**[**Normal, Open, [Assignee(s)], **]**

Johannes Graeber (commented SPPR-4490 - SEMP Annex Related Standards and Norms): A (hopefully automated) process should be defined to find the relevant standards and add new to the list, if not found.
Sango Marc (Replied): This task is created to add this process in SEMP V3**[**Normal, Open, [Assignee(s)], **]**

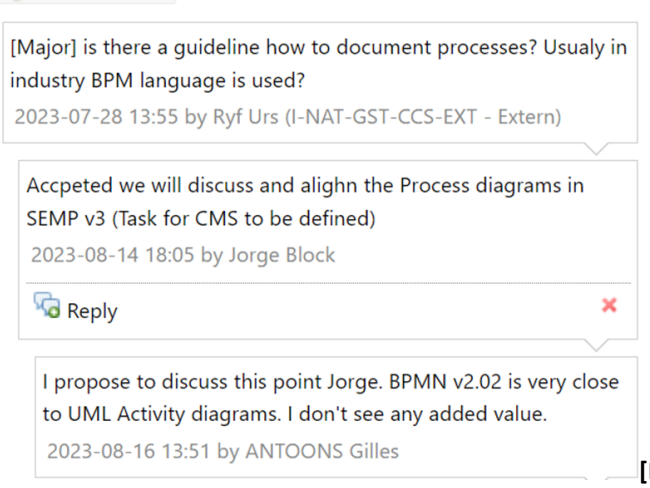
Davinder Bhatia (commented): [MINOR] Picture of System Level 1-5 needs to be updated to reflect the new SP structure including Task 4
Sango Marc (Replied): As described in the caption of the figure, the content is based on indicative CCS/TMS example described in Annex B. But if needed we can discuss this in small group in oder to create a new picture including all the tasks.**[**Normal, Open, [Assignee(s)], **]**

Davinder Bhatia (commented): [MAJOR] How does this relate to the Capella models? How do you know in Capella which models are approved or reviewed? I think we are missing a major element on configuration and release management.
Jorge Block (Replied): Accpeted: Configuration and Release is planned for v3. Capella content will be transfered to Polarion. Then we can use the review and approval process
Sango Marc (Replied): Task created**[**Normal, Open, [Assignee(s)], **]**

Litzen Bjorn (commented): Problem Definition should not be mixed up with Architectural Design. The rest of this chapter describes the Architectural Design. Problem Definition, including refinement of CBO's to stakeholder needs, is currently missing and should be in separate chapter.
Jorge Block (Replied): Problem definition is part of operational analysis. To be discussed for SEMP v3
Sango Marc (Replied): Task created**[**Normal, Open, [Assignee(s)], **]**

Kraft Soenke (commented): isn't the variant management management ensured (inherently) by the use of Polarion? What is needed in addition?
Sango Marc (Replied): To be discussed for SEMP V3. Task created.**[**Normal, Open, [Assignee(s)], **]**

Agree on a common way to **represent processes graphically**. Currently, SA uses UML activity diagram.
We should make official the formalism to be used for next processes to be described. Proposals are UML Activity diagrams or BPMN v2
This point comes from the following comment on appendix D-03



[Normal, Open, [Assignee(s)], **]**

Some terms of Process-related concept diagram (e.g., Process Map, Complicance Matrice, ...) will be defined in SEMP V3)**[**Normal, Open, [Assignee(s)], **]**

Rodrigues Renato (Commented): The training videos are good for users who are already intensively using the tool, to address doubts. It would be very useful to have some very short videos (5m in total) for people:1. using the tool for the very first time, sh owing them how to open and read documents, comments, WI attributes (remember to click "open in document".
2. someone creating content for the first time - main mistakes, limitations, a couple of main tricks (shift click for changing line, etc). Let's call it Just in Time Polarion if we need a memorable title.
Ralf Smolarek (Replied): Agreed. A first introduction for the user is helpful. Of course there is the online help but I agree you might be lost. Should create a task out of it
Marc Sango (Replied): Task created.**[**Normal, Open, [Assignee(s)], **]**

Rodrigues Renato (Commented): There is a chapter needed for SEMP training. Sometime in Oct '22 I have read the SEMP. As I have not used it and had no previous experience to benchmark it against, most of it was forgotten, and I even forgot what was there. Just in Time information is difficult to do, because everyone is at different stages, but we should attempt something in this direction. As domains started using Polarion, it would have been useful to circulate an e-mail saying that the SEMP has some tips on how to deal with comments. Now the need at OD is rather what to do when remit tasks are finished, e.g. how do we move it along? Shall we create relevant engineering work items? How? A simple reminder every now and then would be great... "did you know how to create glossary items? Link to video or doc".
Rodrigues Renato (Replied): Market the SEMP to increase uptake.
Steffen Schmidt (Replied): The SEMP should mainly be a rerference. If you need to do a workstep, and you do not know how, you look into the SEMP. Therefore the next evolution step for the SEMP is good indexing. People should know, what exists, and where to find it in a fast way. Creating such an index (incl. refence to training material) would help a lot. Afterwards we should assure, that everybody knows the index....we can put it on the My Polarion page.
Marc Sango (Replied): The table of content of SEMP V2 provide a good indexing of contents. But a task is created to provide a specific good index (a Market of SEMP V3 :).**[**Normal, Open, [Assignee(s)], **]**

SCHWAN Nico (commented): Major: The decided ambition is not formal proof and validation, it is limited to quality improvement

Randolf Berlehner (Replied): Unfortunately, I don't quite understand the comment. Of course it is also a quality improvement if not an absolute necessity if safety can be ensured by formal proofs in the standard subsystem specifications. On the other hand, formal proof is not the only possibility of quality improvement given by the application of formal methods. The essential background is that in the specification of a subsystem with standardised interfaces, i.e. with bindingly defined externally visible behaviour, it must be ensured that safety is not violated. Surely, manufacturers cannot be expected to implement this defined behaviour and thereby accept a possibly integrated violation of safety. I therefore see the application of formal methods as an important necessity, at least in SP system layer 5.
Nico Schwan (replied): Some background on my comment: We have discussed this topic during the SP Ramp-Up before, also with representatives of the sector, and there was no agreement reached with the stakeholders to use formal proofs for the verification of the specification of the System Pillar. What we did agree is to do model testing of the specification as accepted ambition for the System Pillar.Hence please remove the section from the SEMP v2, we can re-discuss the topic and get sector agreement once the approaches you mention have reached the necessary maturity.
Randolf Berlehner (Replied): I think that model testing is already a step in the right direction. We have had good experiences in EULYNX. Since, as we know, freedom from errors cannot be fully guaranteed through testing, we should not lose sight of the future use of formal methods. Of course, the necessary procedures still have to reach the required level of maturity. However, care must already be taken now when creating the models to make them formal methods-friendly. Good preliminary work has already been done in X2Rail-2/5. Soon the formal methods guidebook developed there will be published and can of course be used in the System Pillar. First, I will remove the section from SEMP v2 as suggested.
Marc Sango (Replied): The Formal Verification section is removed from SEMP V2 and task is created to e-discuss the topic and get sector agreement once the approaches Randolf mentioned have reached the necessary maturity.
Back-up of section removed : Purpose and scope of formal verification process
In contrast to simulation, formal verification methods aim to provide a formal proof of the correctness of requirements (e.g. safety requirements) for the given specification model of the system/subsystem. Since this proof cannot be provided by simulation alone, a strictly formal model is required.
The formal verification process is not part of SEMP v2, it will be defined in a later iteration. Appropriate approaches have been developed in X2Rail-5 WP10. The work will be continued in collaboration with ongoing works, such as WP30 of FP2 / Innovation Pillar.**[**Normal, Open, [Assignee(s)], **]**

Markus Hirt (Commented): I would like to propose a style that is easier for making references inside our documents: See SPPRAMSS-335 as an example: it has [EN 50126-1:2017] as the WI Title and the actual standard's title in the WI Description. Linking it in the document later on will show the Title [EN 50126-1] clearly identifiable as a referenced standard or other document.
Marc Sango (replied): Task created to use this style in the next version of the document SEMP Annex Related Standards and Norms **[**Normal, Open, [Assignee(s)], **]**