



ERJU SYSTEM PILLAR

Systems Engineering Management Plan - 01 Main



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Table of contents

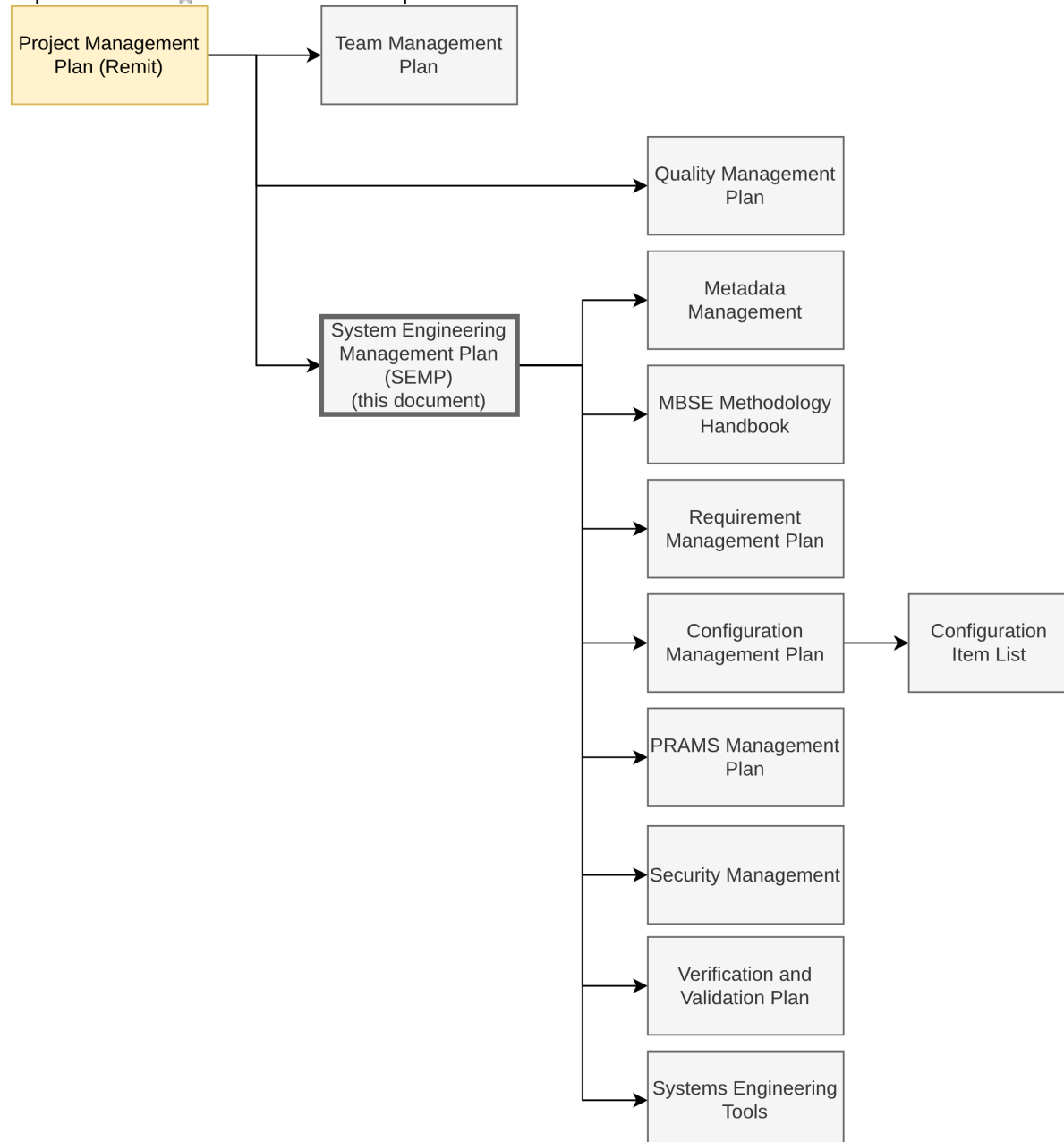
1	Preamble	6
1.1	Purpose	6
1.2	Intended Audience	7
1.3	Document Context	7
1.4	Glossary	8
2	Project Management	9
2.1	Objectives	9
2.2	System Pillar Organisational units and abbreviations	9
2.3	Team management	10
2.4	Roles	10
2.5	System description	11
2.5.1	Role allocation	12
2.5.2	Teams and groups	13
3	Quality Management	14
4	Metadata Management	15
4.1	Glossary usage guideline	15
4.2	Related references, standards and norms	15
4.3	Process-related concept ontology	22
5	System Pillar MBSE Methodology	24
6	Requirement Management	26
7	Configuration Management	26
8	Work Product Reviews and Approvals	26
9	Specialty Engineering Activities and Plans	26
9.1	PRAMS Management Plan	26
9.1.1	Safety activities	26
9.1.2	P-RAM activities	26
9.1.3	HOF activities	27
9.2	Security Management	27
9.3	Verification and Validation Plan	27
10	Systems Engineering Tools	28
11	Appendix	29
11.1	Standards and references	29
11.2	Compliance of SEMP with Standards	29
11.2.1	Compliance with ISO/IEC/IEEE 15288 standards	29
11.2.2	Compliance with CENELEC EN 50126 Standards	30
11.3	Overview of main changes between SEMP versions	32

1 Preamble

1.1 Purpose

The purpose of the Systems Engineering Management Plan (SEMP)


The purpose of this Systems Engineering Management Plan (SEMP) is to outline the systems engineering activities of the EU-Rail System Pillar, by providing guidelines, rules and best practices. This document provides comprehensive processes for requirement management and architecture design. It also references other specialised plans, such as PRAMS plan, relevant in System Pillar project. The compliance of the System Pillar plans with the general system life-cycle processes (ISO/IEC/IEEE 15288) is presented in  SPPR-8952 - Compliance with ISO/IEC/IEEE 15288 standards.



[SPPR-3460]


1.2 Intended Audience

Intended audience

This document is a general engineering and management document according to  SPPR-9200 - System Pillar documentation principle. Its content is valid for all System Pillar domains and tasks of Europe's Rail. [SPPR-9604]

1.3 Document Context

1.3-1 - System Pillar is part of the EU-Rail organization

The governance and processes of the Europe's Rail Joint Undertaking is defined in  SPPR-3391 - [1] Europe's Rail Joint Undertaking Governance and Process Handbook v2.6 (December 2023). This document (System Engineering Management Plan) focuses on technical aspects of the System Pillar.

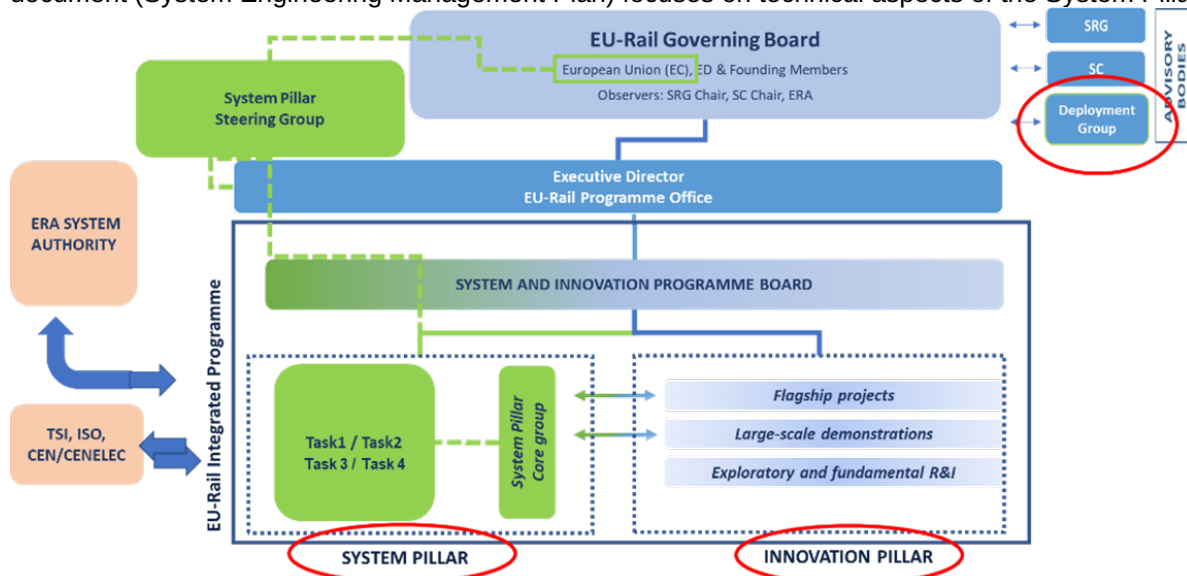




Figure 1 EU-Rail Organisation

[SPPR-3462]

The purpose of System Pillar

As stated in  SPPR-3391 - [1] Europe's Rail Joint Undertaking Governance and Process Handbook v2.6 (December 2023), the purpose of System Pillar 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. [SPPR-3461]


The sector involvement and decision process

The sector involvement and decision process is described in  SPPR-3391 - [1] Europe's Rail Joint Undertaking Governance and Process Handbook v2.6 (December 2023). [SPPR-4103]

Mirror group responsibilities and guideline


The mirror group responsibilities and guideline of tasks and domains of System Pillar is described in the SPPROCESS/10 SEMP V 01_01/Mirror Group Guideline : 722590 [SPPR-5573]

Expected deliverables of System Pillar

As defined in  SPPR-5891 - [6] STIP, 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 deliverables per system level on  SPPR-2016 - System Levels of the System Pillar are defined in *SPPROCESS/Configuration items/Configuration Items : 722590* [SPPR-4489]

Role of 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. [SPPR-3450]

Role of 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 (including Engineering Environment domain and PRAMSS domain) provide and maintain the engineering methods and tools (System Engineering Management Plan - SEMP, PRAMS Plan, modelling guidelines and selected tools) to support to all the System Pillar teams. The roles and teams of System Pillar is defined in  SPPR-11043 - Roles [SPPR-3451]

Engineering Tools

The tooling platform is the basis for works in the different domains. The current used tools is defined in *SPPROCESS/10 SEMP V 01_01/System Pillar Engineering Tools : 722590*. It includes Polarion for requirement management, Capella for MBSE and Sharepoint for general content management system. More tools, such as PRAMS tool, SysML based tool or simulation tools should come in the future. [SPPR-3453]


1.4 Glossary

Global definitions are defined in Definitions < Glossary < Documents & Pages < SPLI (europa.eu)

2 Project Management

2.1 Objectives

System Pillar Objectives

The objectives of System Pillar itself are defined in  Common Business Objectives. Systems Engineering is a trans-disciplinary and integrative approach to enable the successful realisation, use, and retirement of engineered systems using systems principles and concepts and scientific, technological and management methods. The overall goal of System Engineering is to develop and design a system that meets a specific set of requirements (needs). The development activities are governed by systems engineering processes, methods, and tools as detailed in the following chapters of this SEMP.

[SPPR-11762]

In the System Pillar systems engineering supports the following objectives:

- Stakeholder Alignment and Integration:
Meet stakeholder requirements and ensure seamless integration of system elements or with existing systems.
- Cost, Schedule, and Performance:
Deliver the system on time, within budget, and at the desired performance level.
- Risk, Compliance, and Quality:
Mitigate risks, ensure compliance with standards, and maintain high quality throughout the project life-cycle.
- The development activities are governed by systems engineering processes, methods, and tools as detailed in the following chapters. Where applicable, the project team employs model-based systems engineering (MBSE) to support these development activities.

[SPPR-11763]

2.2 System Pillar Organisational units and abbreviations

SPC

System Pillar Coregroup

Economic Analysis

Service from EURAIL to support economic analysis processes in the teams

T2 FieldApps

Task 2: The Field Force CCS Applications Control and Supervision Team

PMO

Program Management Office

T2 Transversal

Task 2: The Transversal CCS Components Team

T2 TrainCS

Task 2: The Train Control and Supervision Team

T2 TACS

Task 2: The Trackside Assets Control & Supervision Team

T3 CMS/TMS

Task 3: The Capacity management / Traffic Management Team

PRAMSS Team

Performance,
Reliability, availability, maintainability,
Security,
Safety

T2 CE

Task 2: The Computing Environment Team

Environment Engineering Team

formerly known as "Central Modelling Service"

T2 Com

Task 2: The Communications Team

T2 TrafficCS

Task 2: The Traffic Control and Supervision Team

T2 MIG

Task 2: The Migration and Roadmap Team

T4 DAC/FDFTO

Task 4: DAC/FTDFTO System Design Team

T2 OD

Task 2: The Operational Design Team

T2 ARC

Task 2: The Architecture and Release Coordination Team

T1 Railway System

Task 1 Railway System

EURAIL GB

EURAIL Governing Board

SPSG

System Pillar Steering Group

T5 HERD



T5 HERD / Task 5: Harmonised European Railway Diagnostics

2.3 Team management

SPPROCESS/SEMP Annex D Processes/SEMP process 01-Team Management : 722590













2.4 Roles













All roles needed for an compliant development are defined and are the leading gu...

All roles needed for an  SPPR-2681 - [EN 50126-1:2017] compliant development are defined and are the leading guidance for the roles within the System Pillar. If a role needs to be modified, the tailoring must be checked and finally confirmed by the  SPPR-10390 - Lead Quality Manager. [SPPR-11434]


The role work items defined by EET are:

The role work items defined by EET are:

-  SPPR-10697 - Task/Domain Lead Railways
-  SPPR-10707 - Task/Domain Lead Suppliers
-  SPPR-10698 - Tool Manager (TOOL)
-  SPPR-5408 - Document Author
-  SPPR-5407 - Document Reader
- In *SPPROCESS/30 SP Metadata Management/Glossary Usage Guidelines : 722590*
 -  SPPR-5417 - Glossary Importer
 -  SPPR-5406 - Glossary user
 -  SPPR-5411 - Glossary Consolidator
 -  SPPR-5410 - Glossary Author
- In *SPPROCESS/SEMP Annexes/Change Control Management : 722590*
 -  SPPR-5817 - Change Requester
 -  SPPR-5818 - Change Manager
 -  SPPR-5820 - Change Responsible Subject Matter Expert

- In *SPPROCESS/10 SEMP V 01_01/Configuration Management Plan : 722590*
 -  SPPR-10515 - Release Manager
 -  SPPR-10396 - Lead Configuration Manager
 -  SPPR-10397 - Configuration Manager
- *SPPROCESS/10 SEMP V 01_01/Quality Management Plan : 722590*
 -  SPPR-10390 - Lead Quality Manager
 -  SPPR-10391 - Quality Manager
 -  SPPR-2653 - Mirror Group
- In *SPPROCESS/10 SEMP V 01_01/Requirements Management Plan : 722590*
 -  SPPR-10728 - Lead Requirements Manager
 -  SPPR-10727 - Requirements Manager
- In *SPPROCESS/10 SEMP V 01_01/System Pillar MBSE Methodology Handbook : 722590*
 -  SPPR-11088 - Model Manager
 -  SPPR-10696 - Systems Engineer as Modeler
 -  SPPR-11183 - Test Engineer
 -  SPPR-11796 - Data Model Integrator
- In *SPPRAMS/Phase 2/ERJU PRAMS Plan : 722590*
 - TO BE COMPLETED
- In Security Plan
 - TO BE COMPLETED

[SPPR-11433]

List of assignment of roles to people for the whole System Pillar may be found at  **All SEMP Allocation Roles**

2.5 System description

System Levels of the System Pillar

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 layers 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.

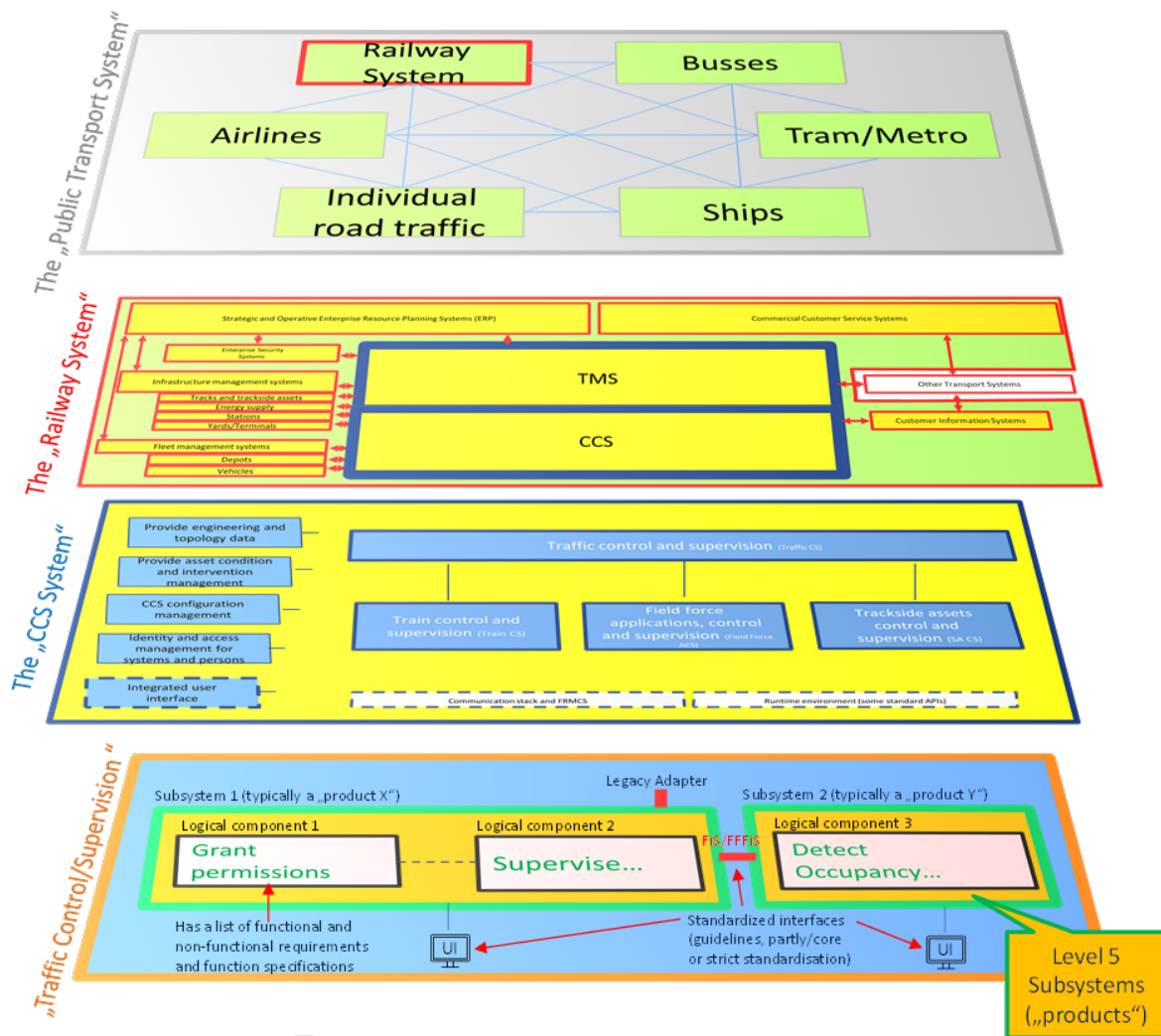


Figure 2: System Level 1-5 combined view

ID	SPPR-2016
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2.5.1 Role allocation

Role Allocation System Level System Pillar Teams

Functional team leads are underlined

Role Allocation

System Level System Pillar Teams

System Level 1,2 („SP Level“)	<u>Coregroup</u>	<u>Engineering Environment Team (EET)</u>	<u>PRAMSS</u>	<u>Task 1</u>
	<u>LEAD</u>	<u>LEAD, REQ, MOD, MET, TOOL, APP, PUB, CM, VAL, QM</u>	<u>LEAD, PERE, RAM, SAF, SEC</u>	<u>LEAD, REQ, OD</u>
System Level 3	<u>Operational Design</u>	<u>Architecture Coordination</u>	<u>Migration</u>	

Role Allocation

	LEAD, REQ, <u>OD</u> , APP	LEAD, <u>ARC</u> , MOD, MET, TOOL, PERF, RAM, SAF, SEC, PUB, CM, VAL, QM	LEAD, <u>MIG</u>
System Level 4/5 („Domain Level“)	T2, T3, T4 System Domain Team (can have any structure, but roles are assigned to single persons) LEAD, REQ, OD, ARC, MIG, MOD, MET, TOOL, APP, PERF, RAM, SAF, SEC, PUB, CM, VAL, QM		

[SPPR-2559]

2.5.2 Teams and groups

Functional Team

A Functional team includes the role owners of the same role. It organises the work allocation and overall results for that role, including the workflows and working methods.

The name of the functional team has a “-F” at the end.

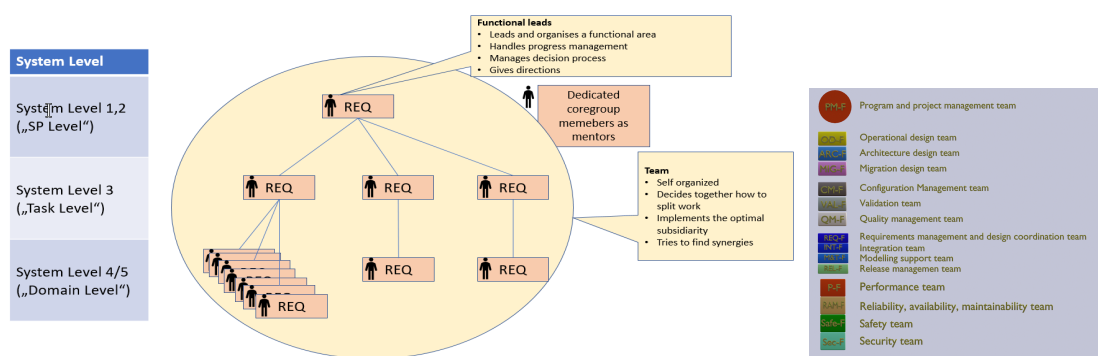
The functional teams form a matrix to the organisational units of the SP.

If an organisational unit has more persons with the same role, one of them can be delegated to the functional team as a "speaker".

Functional teams organise themselves internally. From "outside" (SP processes) the team is addressed as one actor. The worksplit in the functional teams is decided in the team. The functional teams act with the responsibilities and tasks defined by the role it represents. The functional team is lead and moderated by the participant from System Level 1/ (mostly people from the engineering services, see role allocation table).

Functional teams decide in consensus, or escalate to the coregroup.

Example for the functional Team “REQ-F”



[SPPR-2560]

For System Level 1/2: Task 1 contributes content for REQ and OD on SP Level, the...

For System Level 1/2: Task 1 contributes content for REQ and OD on SP Level, the functional teams REQ-F and OD-F (explained in later document) coordinate and host the process for REQ and OD work breakdown and assignment. REQ-F is chaired by the Engineering Environment Team, OD-F is chaired by the Task 2 OD team.

[SPPR-2558]

Work group

A “Work group” is a group (typically with members of two or more system domains) that works on

definitions of processes, interfaces or control loops, that involve different domain teams. This is needed especially for defining interfaces, where always 2-n teams are involved.

Examples:

- ATO-G (ATO Work group, setting system requirements for ATO)
- ETCS-G (ETCS Work group, setting system requirements for ETCS)
- TMS-TrafficCS-G (TMS<>TrafficCS Interface Work group)

A Work group has a defined lead and task. Work groups are initiated by domains or functional teams. Work groups can have their own space in the ALM system and work items can be assigned to them.
[SPPR-11044]

Mirror group

The mirror group responsibilities and guideline of tasks and domains of System Pillar is described in the *SPPROCESS/10 SEMP V 01_01/Mirror Group Guideline : 722590* [SPPR-11047]

3 Quality Management

All quality related activities are described in the *SPPROCESS/10 SEMP V 01_01/Quality Management Plan : 722590*

4 Metadata Management

In the System Pillar context, teams of experts working on different domains and...

In the System Pillar context, teams of experts working on different domains and on different deliverables within the same domain rely for their work on sourcing terms from different terminologies: these terminologies come from various sources including TSIs, EU directives standards, etc... Where not present, new definitions are added by the experts with their own terms. [SPPR-11768]

Without any guideline the risk of many teams working on the same concepts is to...

Without any guideline the risk of many teams working on the same concepts is to obtain a growing number of diverging terminologies which quickly become unmaintainable and ultimately would hinder the delivery of consistent System Pillar deliverables towards Europe's Rail (EU-Rail) Standardisation and TSI Input Plan. [SPPR-11771]

The main purpose of the Metadata Management in the SEMP is to provide a Glossary...

The main purpose of the Metadata Management in the SEMP is to provide a Glossary and Reference Management process with clear guidelines and methods to deal with these aspects. [SPPR-11769]


4.1 Glossary usage guideline

Glossary usage guideline

The guidelines for glossary usage, i.e. creation of entries, searching of entries in the System Pillar Glossary and link to glossary entries, are defined in *SPPROCESS/30 SP Metadata Management/Glossary Usage Guidelines : 722590* .

In case of specific needs for a specific domain, e.g. additional guidelines in writing description, different format for acronym tables, etc.... we strongly recommend to re-use as much as possible the existing usage guidelines and to extend them only for the missing parts. [SPPR-9922]

Example Traffic CS domain glossary usage guidelines

A concrete example of this approach can be found in Traffic CS domain  Guideline Glossary . [SPPR-9923]

4.2 Related references, standards and norms

References usage guidelines

The guidelines for reference usage, i.e. creation of a reference, searching for references and linking references, are defined in *SPPROCESS/30 SP Metadata Management/References Usage Guidelines : 722590* . Achieving a consistent reference management across the System Pillar deliverables would enable identifying linkage between key reference materials and the deliverables the System Pillar is producing, be it in terms of standards and norms or, for example, on particular piece of legislation (including but not limited to TSIs). [SPPR-9921]

The engineering work shall apply to engineering norms and standards, where appli...

The engineering work shall apply to engineering norms and standards, where applicable. This list should be updated over time. [SPPR-2652]

[ISO/IEC TR 24748-1-2010]

Systems and software engineering – Life cycle management – Part 1: Guide for life cycle management

ID	SPPR-2663
Hyperlinks	external reference - https://www.iso.org/standard/50502.html

[ISO/IEC TR 24748-2-2011]

Systems and software engineering – Life cycle management – Part 2: Guide to the application of ISO/IEC 15288 (System life cycle processes)

ID	SPPR-2662
Hyperlinks	external reference - https://www.iso.org/standard/54994.html

[ISO/IEC/IEEE 42010-2011]

Systems and software engineering – Architecture description.

ID	SPPR-2684
Hyperlinks	external reference - https://www.iso.org/fr/standard/50508.html

[EN 50126-1:2017]

Railway applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part 1: Generic RAMS Process

ID	SPPR-2681
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-501261/railway-applications-the-specification-and-demonstration-of-reliability-ava/fa186695/81342

[ISO/IEC 15026-1-2014]

Systems and Software Engineering – Systems and Software Assurance – Part 1: Concepts and Vocabulary

ID	SPPR-2660
Hyperlinks	external reference - https://standards.ieee.org/ieee/15026-1/5663/

[EN 50129]

Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling

ID	SPPR-2682
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-50129/railway-applications-communication-signalling-and-processing-systems-safety/fa187463/84073

[EN 50126-2]

Railway applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part 2: Systems Approach to Safety

ID	SPPR-2680
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-501262/railway-applications-the-specification-and-demonstration-of-reliability-ava/fa187841/81340

[ISO/IEC/IEEE 15289-2015]

Systems and software engineering – Content of life-cycle information items (documentation)

ID	SPPR-2649
Hyperlinks	external reference - https://www.iso.org/standard/66422.html

[IEEE Std 828-2012]

Configuration Management in Systems and Software Engineering

ID	SPPR-2647
Hyperlinks	external reference - https://standards.ieee.org/ieee/828/5367/

[ISO/IEC/IEEE 15288-2015]

Systems and software engineering — System life cycle processes

ID	SPPR-2648
Hyperlinks	external reference - https://www.iso.org/standard/63711.html

[ISO/IEC/IEEE 21839]

Systems and software engineering — System of systems (SoS) considerations in life cycle stages of a system

ID	SPPR-2702
Hyperlinks	external reference - https://www.iso.org/standard/71955.html

[Object Management Group (OMG), BPMN: Business Process Model and Notation standards]

Object Management Group (OMG), BPMN: Business Process Model and Notation standards

ID	SPPR-5894
Hyperlinks	external reference - https://www.bpmn.org/#:~:text=BPMN%20is%20a%20standard%20set,the%20communication%20between%20independent

[ISO/IEC TR 24748-3-2011]

Systems and software engineering – Life cycle management – Part 3: Guide to the application of ISO/IEC 12207 (Software life cycle processes)

ID	SPPR-2667
Hyperlinks	external reference - https://www.iso.org/standard/54995.html

[ISO/IEC/IEEE 24641]

Systems and Software engineering — Methods and tools for model-based systems and software engineering

ID	SPPR-2689
Hyperlinks	external reference - https://www.iso.org/standard/79111.html

[ISO/IEC/IEEE 21840]

Systems and software engineering - Guidelines for the utilization of ISO 15288 in the context of system of systems (SoS)

ID	SPPR-2701
Hyperlinks	external reference - https://www.iso.org/standard/71956.html

[ISO/IEC/IEEE 42030]

Software, systems and enterprise — Architecture evaluation framework ==> to consider later on

ID	SPPR-2700
Hyperlinks	external reference - https://www.iso.org/standard/73436.html

[ISO/IEC TR 90005-2008]

Systems engineering – Guidelines for the application of ISO 9001 to system life cycle processes

ID	SPPR-2665
Hyperlinks	external reference - https://www.iso.org/standard/41553.html

[ISO/IEC 15026-4-2013]

Systems and Software Engineering – Systems and Software Assurance – Part 4: Assurance in the Life Cycle

ID	SPPR-2674
Hyperlinks	external reference - https://www.iso.org/standard/74396.html

[ISO/IEC 15026-3-2013]

Systems and Software Engineering – Systems and Software Assurance – Part 3: System Integrity Levels

ID	SPPR-2675
Hyperlinks	external reference - https://www.iso.org/standard/84444.html

[ISO/IEC/IEEE 42020]

Software, systems and enterprise — Architecture processes ==> to consider later on

ID	SPPR-2697
Hyperlinks	external reference - https://www.iso.org/standard/68982.html

[ISO/IEC 12207 – IEEE Std 12207-2008]

Standard for Systems and Software Engineering – Software Life Cycle Processes

ID	SPPR-2650
Hyperlinks	external reference - https://www.iso.org/standard/43447.html

[EN 50657]

Railways Applications - Rolling stock applications - Software on Board Rolling Stock

ID	SPPR-2694
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-50657/railways-applications-rolling-stock-applications-software-on-board-rolling-fa185995/80874

[ISO 31000, ISO 31073, IEC 62278]

Output format for hazard/risk analysis is based on ISO 31000, ISO Guide 73, and especially EN50126/IEC 62278 (quantitative Risk analysis)

ID	SPPR-2693
Hyperlinks	external reference - https://www.iso.org/standard/65694.html , external reference - https://www.boutique.afnor.org/en-gb/standard/iec-622782002/railway-applications-specification-and-demonstration-of-reliability-availab/xs108711/242993 , external reference - https://www.iso.org/standard/44651.html

[ISO/IEC/IEEE 24765-2010]

Systems and software engineering – Vocabulary

ID	SPPR-2658
Hyperlinks	external reference - https://www.iso.org/standard/50518.html

[ISO/IEC 15026-2-2011]

Systems and Software Engineering – Systems and Software Assurance – Part 2: Assurance Case

ID	SPPR-2659
Hyperlinks	external reference - https://www.iso.org/standard/52926.html

Systems and Software Engineering – Life Cycle Management – Guidelines for Proces...

Systems and Software Engineering – Life Cycle Management – Guidelines for Process Description

ID	SPPR-2656
Hyperlinks	external reference - https://www.iso.org/standard/53815.html

[ISO 21500]

Project Management

ID	SPPR-2678
Hyperlinks	external reference - https://www.iso.org/standard/75704.html

[ISO/IEC 20246:2017]

Software and systems engineering — Work product reviews

ID	SPPR-5422
Hyperlinks	external reference - https://www.iso.org/standard/67407.html#:~:text=ISO%2FIEC%2020246%3A2017%20establishes,maintenance%20of%20systems

[ISO/IEC/IEEE 29148-2011]

Systems and software engineering – Life cycle processes – Requirements engineering

ID	SPPR-2657
Hyperlinks	external reference - https://www.iso.org/standard/45171.html

[EN IEC 62443]

Security for industrial automation and control systems

ID	SPPR-2679
Hyperlinks	external reference - https://www.isa.org/standards-and-publications/isa-standards/isa-iec-62443-series-of-standards

[ISO/IEC/IEEE 16326-2009]

Systems and Software Engineering – Life Cycle Processes t – Project Management

ID	SPPR-2654
Hyperlinks	external reference - https://www.iso.org/standard/41977.html

[TS 50701]

Railway applications – Cybersecurity

ID	SPPR-2676
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/pd-clc-ts-507012023/railway-applications-cybersecurity/eu182648/350947

[ISO/IEC/IEEE 21841]

Systems and software engineering - Taxonomy of systems of systems

ID	SPPR-2698
Hyperlinks	external reference - https://www.iso.org/standard/71957.html

[ISO/IEC 15939 – IEEE Std 15939-2008]

Systems and software engineering – Measurement process

ID	SPPR-2655
Hyperlinks	external reference - https://standards.ieee.org/ieee/15939/4262/

[EN 50159]

Railway applications – Communication, signalling and processing systems – Safety related communication in

transmission systems

ID	SPPR-2677
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-50159/railway-applications-communication-signalling-and-processing-systems-safety/fa164014/37752

[EN 50128]

Railway applications - Communications, signalling and processing systems - Software for railway control and protection systems

ID	SPPR-2699
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/nf-en-50128/railway-applications-communication-signalling-and-processing-systems-softwa/fa166097/37951

[ARCADIA]

ARCHITECTURE ANALYSIS & DESIGN INTEGRATED APPROACH)

Arcadia (AFNOR XP Z67-140 standard)

ID	SPPR-5911
Hyperlinks	external reference - https://www.boutique.afnor.org/en-gb/standard/xp-z67140/information-technology-arcadia-method-for-systems-engineering-supported-by/fa192970/1723

[SysML]

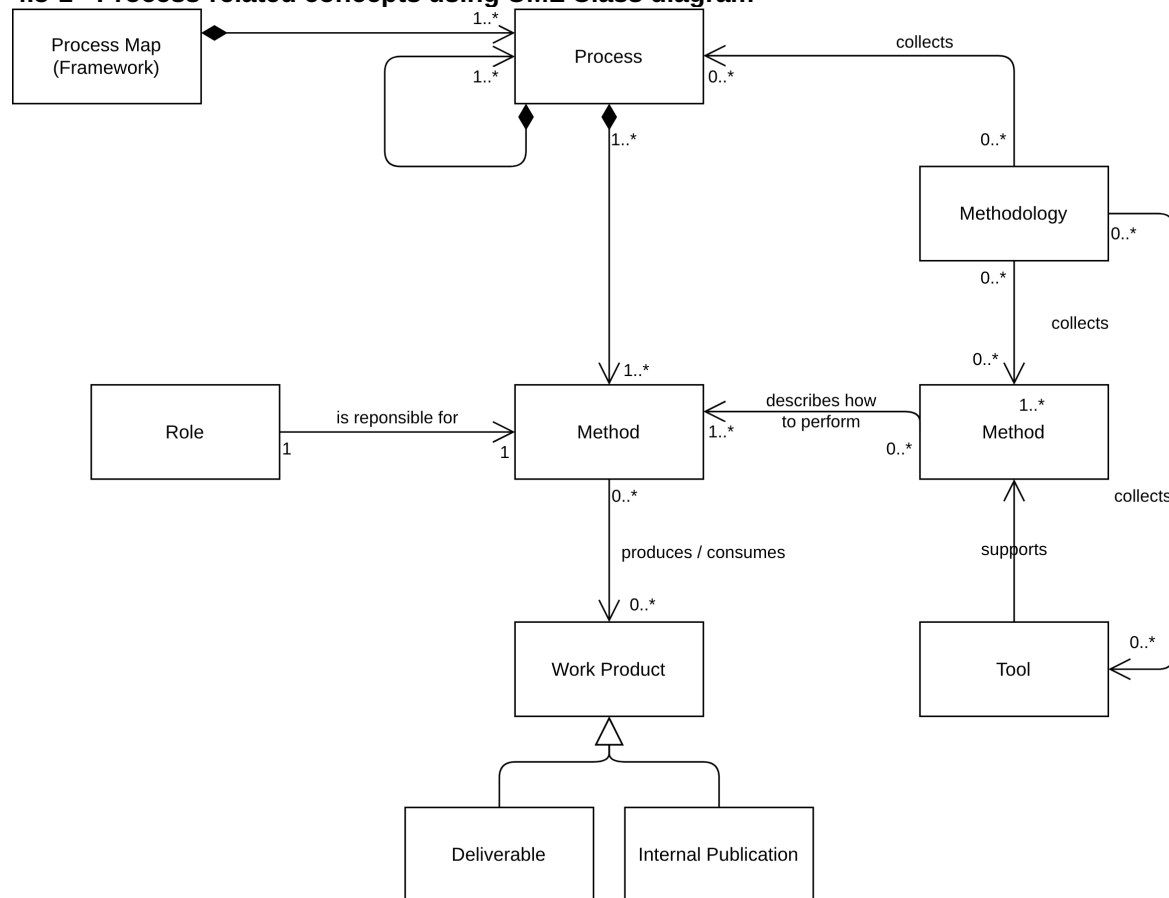
OMG, SysML (Systems Modelling Language)

<https://www.omg.org/spec/SysML/1.6>

ID	SPPR-5912
----	-----------

4.3 Process-related concept ontology

4.3-1 - Process-related concepts using UML Class diagram



[SPPR-4222]

Process Framework

A process framework refers to a structured and systematic approach for designing, documenting, and managing processes within an organisation for a defined scope.

ID	SPPR-7000
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Process

Set of interrelated or interacting activities that use inputs to deliver an intended result.

- Processes require a purpose and outcome, all processes have at least one activity.
- A process defines “WHAT” is to be done, without specifying “HOW” each task is performed.

ID	SPPR-4229
Source Reference	ISO 9000:2015, 3.4.1 ISO 15288:2023, 4.1.30

Process Task

An atomic activity that is included within a process. It is used when the work in the Process is not broken down to a finer level of Process detail.

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

ID	SPPR-4224
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Source Reference	ISO15288 (modified) ISO 19510:2013/OMG BPMN 2.0
------------------	---

Method

A technique for performing a task.

Method is a grouping of guidance, modelling language, rules, techniques and patterns. Different methods may be available for the same task.

It defines the “HOW” of each task. (In this context, the words “method,” “technique,” “practice,” and “procedure” are often used interchangeably.) At any level, process tasks are performed using methods.

ID	SPPR-4225
----	-----------

Methodology

A collection of related processes, methods, and tools.

ID	SPPR-7001
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Tool

An instrument that, when applied to a particular method, can enhance the efficiency of the task, provided it is applied properly and by somebody with proper skills and training.

ID	SPPR-7002
----	-----------

Work Product

An artefact associated with the execution of a process.

ID	SPPR-4226
Source Reference	ISO 24765:2017 3.4611

Deliverable

An input or output of a task that crosses the process boundaries.

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

ID	SPPR-4227
Source Reference	ISO 24765:2017 3.1098

Internal Publication

Any work product that is not required to be submitted in order to complete a process, phase, or project.

An input or output of a task that does not cross the process boundaries.

ID	SPPR-4228
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Role

A role is described by a set of responsibilities. Roles are used to define the responsibilities of tasks, ensuring that individuals or a group of people perform their assigned tasks and contribute to their successful execution.

ID	SPPR-3773
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5 System Pillar MBSE Methodology

Purpose of MBSE Methodology

The System Pillar MBSE methodology is a collection of processes, methods and tools to create and maintain a MBSE model for system analysis and architecture, based on the ARCADIA framework.

- It adheres to the practices from EN 50126-1, CSM-RA and ISO 15288.
- It supports the application of product development process in a model-based context.
- It provides inputs to the requirements management.



[SPPR-9985]

The methodology is defined in the .

The methodology is defined in the *SPPROCESS/10 SEMP V 01_01/System Pillar MBSE Methodology Handbook : 722590*.

[SPPR-11773]

Viewpoint driven approach: Requirements, need analysis, architecture building

To describe the system System Pillar adopted MBSE ARCADIA  SPPR-5911 - [ARCADIA] for Architecture Analysis & Design Integrated method. 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.

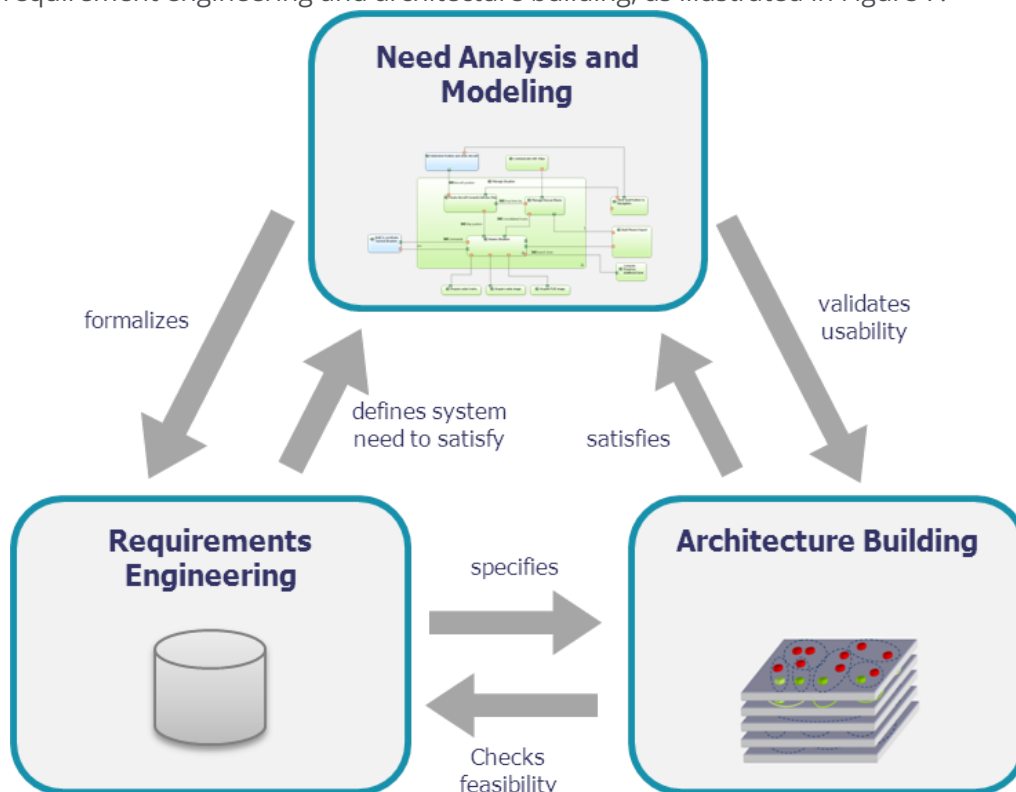


Figure 3 Viewpoint driven approach [Augmenting requirements with models to improve the articulation between system engineering levels and optimize V&V practices', INCOSE International Symposium, 29: 1018-1033]

[SPPR-3466]

6 Requirement Management

All requirements management related activities are described in the .

All requirements management related activities are described in the *SPPROCESS/10 SEMP V 01_01/ Requirements Management Plan : 722590*. [SPPR-11772]

7 Configuration Management

All configuration management related activities are described in the .

All configuration management related activities are described in the *SPPROCESS/10 SEMP V 01_01/ Configuration Management Plan : 722590*. [SPPR-11775]

The information management defines which kind of project information is stored i...

The information management defines which kind of project information is stored in which repository [SPPR-11774]

Documents are stored in Polarion. Other artefacts are stored either in a Git rep...

Documents are stored in Polarion. Other artefacts are stored either in a Git repository or other databases (e.g. test database). [SPPR-11777]

8 Work Product Reviews and Approvals

The detailed review is defined in .

The detailed review is defined in *SPPROCESS/SEMP Annex W Review/Review Process : 722590*. [SPPR-11776]

9 Specialty Engineering Activities and Plans

Supplemental plans that are required to satisfy product requirements and agreement terms are documented here.

9.1 PRAMS Management Plan

The roadmap of PRAMS activities for SP Domains is presented in the .

The roadmap of PRAMS activities for SP Domains is presented in the *SPPRAMS/Phase 2/ERJU PRAMS Plan : 722590*. [SPPR-11770]

9.1.1 Safety activities

A particular focus is done for the risk assessment activities to be done in Phas...

A particular focus is done for the risk assessment activities to be done in Phase 3 of the CENELEC V cycle. The PRAMS team provides two documents that shall be used by the SP Domains:

-  ERJU Safety Guideline ;
- *SPPRAMS/Risk Assessment/ERJU Risk Assessment Template : 722590*

[SPPR-11765]

9.1.2 P-RAM activities

The P-RAM activities shall take into account the aspects presented in the follow...

The P-RAM activities shall take into account the aspects presented in the following documents:

- *SPPRAMS/02 CBM/Condition Based Maintenance _CBM : 722590*
- *SPPRAMS/01 _PRAM KPI/PERFORMANCE_DEF _PRAMSS : 722590*

[SPPR-11764]

9.1.3 HOF activities

All Human and Organisation Factors (HOF) related activities are described in the...

All Human and Organisation Factors (HOF) related activities are described in the HOF plan *SPPRAMS/03 HOF/Human and Organisational Factor : 722590* [SPPR-11767]

9.2 Security Management

All security related activities are described .

All security related activities are described *SPPRAMS/10 Project management/Code_of_Conduct_v2_3 : 722590*. [SPPR-11779]

Security Information

The cyber security domain is responsible for the creation of a set of specifications for security requirements, that is supposed to deliver utmost stability. Therefore, the set of requirements has a tendency for completeness.

Ideally, the generic security architecture, generic risk assessment and security specs create a one-stop shop / aligned package ready reusable for rail automation projects.

The processes of the Security domain are aligned with the PRAMS domain. The Security domain provides specs for the Innovation Pillar in Europe's Rail.

The output of the cyber security group consists of four documents:

- The Secure Component Specification, a new document based on EULYNX BL4 R2 Eu.Doc 114, UNISIG subset 146 & 147, X2Rail-3 docs and further documents) Purpose of document is a protection profile for rail automation components (IXL, RBC, TMS, object controllers, OBU, Shared Cybersecurity Services,...). It is a Cybersecurity Requirements Specification (CRS) according to IEC 62443-3-2, CLC/TS 50701, and IEC 63452 and compliant to IEC 62443-4-2 and CRA
- The Secure Communication Specification, which is an update of UNISIG subset 146, EULYNX 114, 115 ...) and consists of the Interface specification for the End-to-End security communication layer. In summary its content has the Interface definition for TLS including use-case specific options for encrypted and integrity-only protected connections as well as the Interface definition for the security profile of OPC-UA and HTTPS.
- The Shared Shared Cyber Security Service Specification, a new doc based on EULYNX BL4 R2 Eu.Doc 117, UNISIG subset 146, X2Rail-3/5 docs and further documents) which contains the specification of interfaces to Shared Cyber-security Services of which 8 are defined including interfaces (STS, PKI, IAM, NAC, LOG, UAS, BKP, DNS)
- The Security Program Requirements definitions based on EULYNX BL4 R2 Eu.Doc 114, X2Rail-3/5 best practices and structured following the 62443-2-1) which provide procedural and organisational Security Requirements. The document is a link between Technical and Procedural Requirements and allows to pinpoint decisions (certificate lifetime, physical security, etc.) that must be made by sector in addition to technical capabilities. Purpose is to support the implementation of required process implementation and clarification on responsibilities and supporting the implementation and operation of Security related equipment from the technical specifications.

[SPPR-10161]

9.3 Verification and Validation Plan

All activities related to verification and validation are described in the .

All activities related to verification and validation are described in the *SPPROCESS/Plans/Guidance on Verification and Validation : 722590*. [SPPR-11766]

10 Systems Engineering Tools

The software tools used for the systems engineering activities are presented in...

The software tools used for the systems engineering activities are presented in System Pillar Engineering Tools [SPPR-11778]

11 Appendix

11.1 Standards and references

[1] Europe's Rail Joint Undertaking Governance and Process Handbook v2.6 (December 2023)

"Europe's Rail Joint Undertaking Governance and Process Handbook" v2.6 December 2023

ID	SPPR-3391
Hyperlinks	external reference - https://rail-research.europa.eu/wp-content/uploads/2024/01/ED-DECISION-ED-23-09_Annex_GovProc.Handbook.pdf , external reference - https://rail-research.europa.eu/about-europes-rail/europes-rail-reference-documents/functioning-of-the-europes-rail-ju/

[5] System Engineering Guidebook for Intelligent Transportation Systems

System Engineering Guidebook for Intelligent Transportation Systems

ID	SPPR-3455
Hyperlinks	external reference - https://www.fhwa.dot.gov/cadiv/segb/files/segbversion3.pdf

[6] STIP, Version 1

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

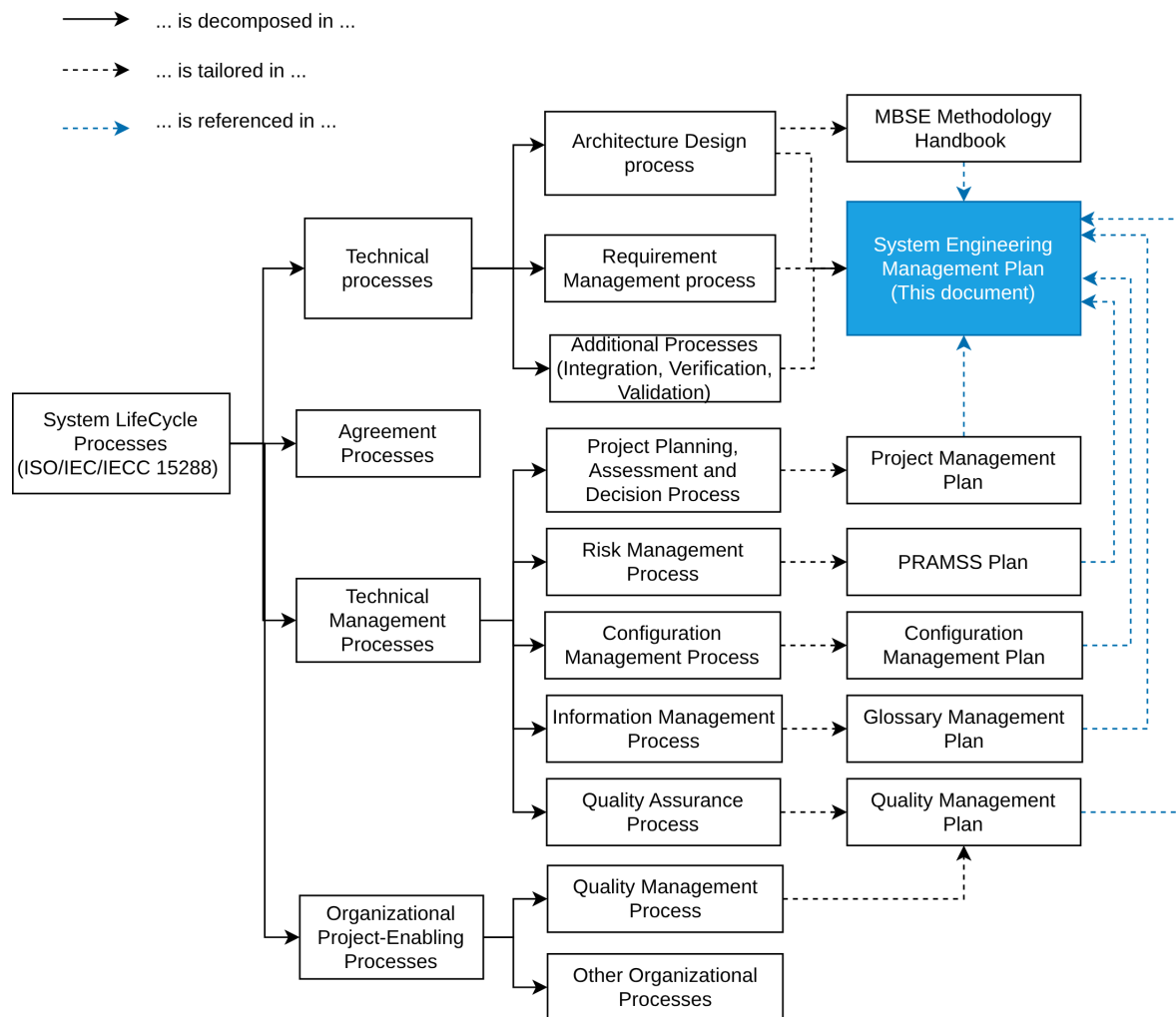
ID	SPPR-5891
Hyperlinks	external reference - SPG-STG-D-SPG-086-01_-_20230604__EURAIL_and_Harmonisation_Version_1.0.docx

11.2 Compliance of SEMP with Standards

11.2.1 Compliance with ISO/IEC/IEEE 15288 standards

Compliance of SP processes with the general system lifecycle processes (ISO/IEC/IEEE 15288)


The ISO/IEC/IEEE 15288 defines the general system lifecycle processes. This document provides comprehensive processes for requirement management and architecture design. It also references other processes relevant in System Pillar project.



[SPPR-8945]

11.2.2 Compliance with CENELEC EN 50126 Standards

PRAMS activities in System Pillar

The planned PRAMS activities in System Pillar according to  SPPRAMSS-349 - [EN 50126-1:2017] is presented in *SPPRAMS/Phase 3/ERJU PRAMS Plan : 722590*. [SPPR-9593]

11.2.2-2 - The V-cycle representation of EN 50126-1:2017 (E)

The development of European Railway transportation systems must comply with CENELEC EN50126 standard. The development of European Railway transportation systems must comply with CENELEC EN50126 standard. The proposed V-cycle representation 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 system integration, validation, the installation, the hand-over and then the operation and maintenance of the whole

system.

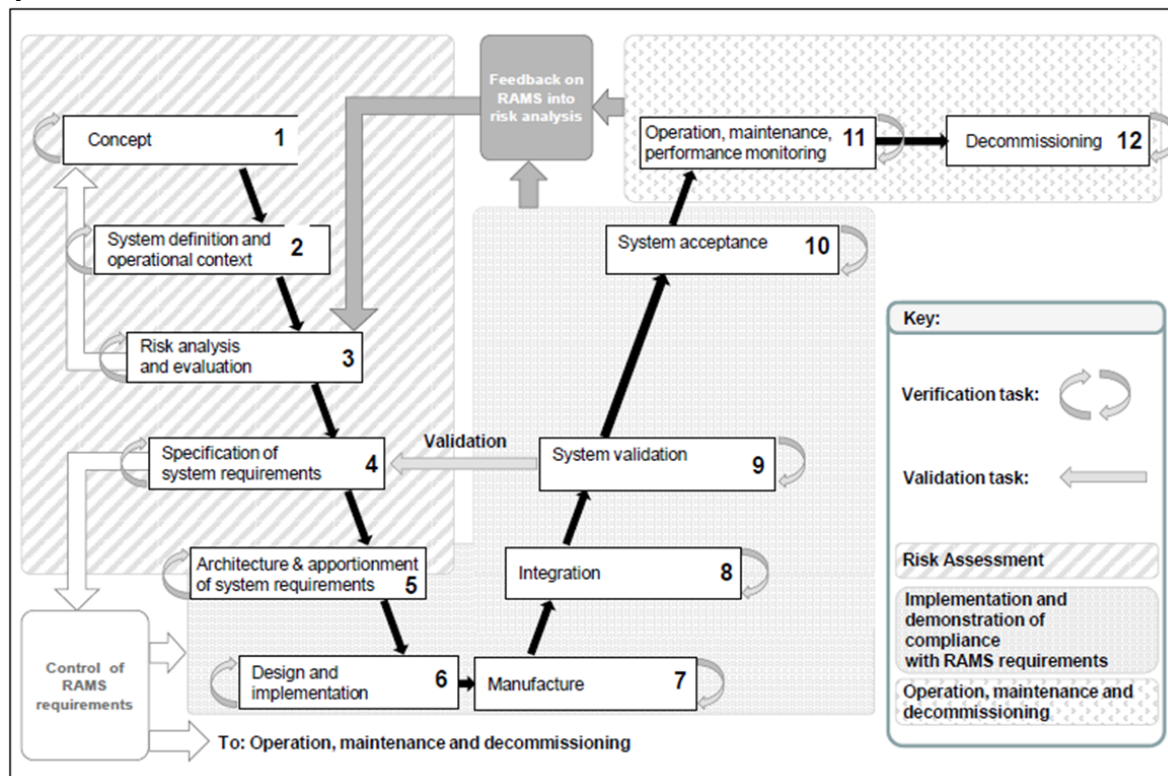



Figure 4 The V-cycle representation of EN 50126-1:2017 (E)

[SPPR-4487]

11.3 Overview of main changes between SEMP versions

SEMP is a collection of SEMP main document (this document) and annexes, which are referenced in dedicated sections of this document.

The baselines of SEMP can be found here /SEMP collections

1. **SEMP V1** was endorsed by System Pillar Steering Group meeting (28/11/2022)
2. **SEMP V2** was approved by System Pillar Steering Group meeting (30/11/2023)
3. **SEMP V3** was approved by domains and SPCG according to SC2.3 (01/10/2024)
4. **SEMP V4** is in "In review by System Pillar". SEM V4 collection report can be found here  Collections Report

Main changes between SEMP V3 and V4

V3	V4	Main changes	Status of V4
SEMP Systems Engineering Management Plan	Systems Engineering Management Plan - 01 Main	SEMP V4 is an enhancement of SEMP V3 based on the remit of the specific contract 2.4 : Chapters updated together with work planning : project management, QMP, CMP, RMP, MBSE handbook, glossary and tool usage guidelines and trainings.	
SEMP Annex A Roles and Teams		Transferred directly in section 2.3 of the main document. minor update	Approved in SEMP V3 (no further actions)
SEMP process 01-Team Management	Systems Engineering Management Plan - Annex 01 Team Management Process	No update	Approved in SEMP V3 (no further actions)
Mirror Group Guideline	Systems Engineering Management Plan - Annex MG Mirror Group Guideline	No update	Approved in SEMP V3 (no further actions)
Configuration Management Plan	Configuration Management Plan	Major update	
	Configuration Management Plan - Annex A System Pillar		

V3	V4	Main changes	Status of V4
	Release Creation Process		
	Configuration Management Plan - Annex B Change Control Management Process		
	Configuration Management Plan - Annex C Document Management Plan, Review and Approval Process		
	Systems Engineering Management Plan - Annex L List of System Pillar Deliverables		
Quality Management Plan	Quality Management Plan	Work in progress	
Requirements Management Plan	Requirements Management Plan	First full consolidated version created for v4 based on earlier input from v3.	
	Requirements Management Plan - Annex R1 Requirements Rules	Major update of the rules for writing requirements.	
	Systems Engineering Management Plan - Annex 03 Requirements Definition Process	Major update of the process based on previous version.	
Glossary Usage Guidelines	Glossary Usage Guidelines	Minor updates mainly related to PWITD workflow	
References Usage Guidelines	References Usage Guidelines	Major update related to usage of Reference wizard for references creation/link	
System Pillar MBSE Methodology Handbook	Systems Engineering Management Plan - 02 MBSE	Major update	

V3	V4	Main changes	Status of V4
	Methodology Handbook		
	Systems Engineering Management Plan - Annex M1 Capella Model Element Rules		
	Systems Engineering Management Plan - Annex M2 Viewpoint Guidelines		
	Systems Engineering Management Plan - Annex 04 Architecture Definition Process		
SEMP Annex T - Tradeoff Analysis	Systems Engineering Management Plan - Annex T Trade-Off Analysis	No update	Approved in SEMP V3 (no further actions)
System Pillar Engineering Tools	Systems Engineering Management Plan - 03 Engineering Tools		
System Concept Template	Template - System Concept		
<i>SPPROCESS/80 Templates/System Definition Template : 722590</i>	Template - System Definition		
	Template - System Requirements Specification	First full consolidated version created for v4 based on earlier input from v3 and task / domain feedback.	

V3	V4	Main changes	Status of V4
<i>SPPROCESS/80 Templates/System Architecture Definition Template : 722590</i>	Template - System Architecture Description	First full consolidated version created for v4 based on earlier input from v3 and task / domain feedback.	
	Template - System Interface Description	First full consolidated version created for v4 based on earlier input from v3 and task / domain feedback.	

[SPPR-9926]

Main changes between SEMP V2 and V3

V2	V3	Main changes	Status of V3
SEMP main document V2	SEMP Systems Engineering Management Plan	SEMP V3 is an enhancement of SEMP V2 based on the remit of the specific contract 2.3 (Design and describe the engineering process in the System Pillar according to INCOSE/ISO15288. 6 major updates: 1- The main document is structured according to ISO 15288 standard 2- Some appendices was combined in one consolidated document (MBSE handbook contains architecture design process and modelling rules). 3- Requirement management plan contains a clear traceability concepts between system Pillar deliverables, requirement types and architecture concepts 4- New appendices for quality and configuration management 5- Guidelines for glossary and references usages 6- Speciality engineering activities, such as PRAMS, Security and V&V guidance are also referenced in SEMP.	ready for domain + Mirror Group Approval
SEMP Annex A - Abbreviations Roles and Teams	SEMP Annex A - Roles and Teams	Minor update	SPCG approval completed (no further actions)
SEMP process 01-Team Management	SEMP process 01-Team Management	Minor update	SPCG approval completed (no

V2	V3	Main changes	Status of V3
			further actions)
Mirror Group Guideline	Mirror Group Guideline	No update	Ready as information only for SPCG
SEMP Process 0945-Review and Approval Process	SEMP Process 0945-Review and Approval Process	Minor update	SPCG approval completed (no further actions)
Concept Paper - Glossary and Terminology		The concept has been implemented and the glossary and references usage guidelines are presented below.	
	Glossary Usage Guidelines References Usage Guidelines		ready for domain + Mirror Group Approval
SEMP Annex B - Architectural principles		Is part of SP MBSE methodology as reference	
SEMP Annex C - Workflow concept and rules		Is part of SP MBSE methodology as reference	
SEMP process 02-Operational Analysis		Is part of SP MBSE methodology handbook	
SEMP process 03-System Analysis		Is part of SP MBSE methodology handboo	
SEMP process 04-Logical Architecture		Is part of SP MBSE methodology handboo	
SEMP process 05-Physical Subsystem Architecture		Is part of SP MBSE methodology handboo	
SEMP Annex M - ARCADIA/ Capella Modelling Rules		Is part of SP MBSE methodology handboo	
	System Pillar MBSE		ready for domain +

V2	V3	Main changes	Status of V3
	Methodology Handbook		Mirror Group Approval
SEMP Annex R1 - Requirements Management Guidelines		Is part of REQ managementplan	
SEMP Annex R2 - Requirements patterns syntax		Is part of REQ managementplan	
SEMP Annex R3 - Rules for writing textual requirements		Is part of REQ managementplan	
	Requirements Management Plan		ready for domain + Mirror Group Approval
SEMP process 91-Change Control Management Process		Is part of configuration management plan	
SEMP Annex Z - Documents Publication and Exchange Process		This document is obsele. The document author responsibilities and system pillar baseline is presented in configuration management plan	
	Configuration Management Plan	New appendix	ready for domain + Mirror Group Approval
	Quality Management Plan	New appendix	ready for domain + Mirror Group Approval
	SEMP Annex T - Tradeoff Analysis		Available as educated draft for information

V2	V3	Main changes	Status of V3
SysML Tool requirements	SysML Tool requirements	No update	ready as information for SPCG/SPGSTG

[SPPR-11752]

Main changes between SEMP V1 and V2

V1	V2	Changes
<i>SPPROCESS/10 SEMP V 01_01/221104 SP SEMP V01_01 : 722590</i>	<i>SPPROCESS/10 SEMP V 01_01/SEMP main document V2 : 722590</i>	<ul style="list-style-type: none"> - SEMP V2 is an enhancement of SEMP V1 based on <i>SPPROCESS/10 SEMP V 01_01/SEMP V1 open points : 722590</i> and the feedback of some Domains (e.g. <i>SPCoregroupPublic/00 SEMP Input/SEMP_V1_review_sheet_trainCS_final : 722590</i>). - 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 : <input type="checkbox"/> SPPR-5913
<i>SPPROCESS/10 SEMP V 01_01/SEMP Annex A -</i>	<i>SPPROCESS/10 SEMP V 01_01/SEMP Annex A</i>	Minor update : Add of new abbreviations and acronyms (cf. the change history in Polarion History)

V1	V2	Changes
<i>Abbreviations Roles and Teams : 722590</i>	<i>- Abbreviations Roles and Teams : 722590</i>	
<i>SPPROCESS/10 SEMP V 01_01/Annex B Architectural principles : 722590</i>	<i>SPPROCESS/10 SEMP V 01_01/Annex B Architectural principles : 722590</i>	Minor update : Cf. the change history in Polarion History + review comments
<i>SPPROCESS/10 SEMP V 01_01/SEMP 1_1 Annex C - Workflow concept and rules : 722590</i>	No update	New review comments
<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 01-Team Management : 722590</i>	<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 01-Team Management : 722590</i>	Add of sections 4.7 "Manage Project", 4.8 "Prepare Project Reports" and 4.9 "Define Standardisation and TSI Input Plan (STIP)"
<i>SPPROCESS/SEMP Annex D Processes/ SEMP process group 02-Operational Analysis : 722590</i>	<i>SPPROCESS/SEMP Annex D Processes/ SEMP process group 02-Operational Analysis : 722590</i>	Major update: Split complete OA between "OA-concept" (kind of polarion-paper only) and "OA-Modelling" processes. "OA-concept" brought to maturity. "OA-Modelling" delayed to V3.
<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 03-System Analysis : 722590</i>	<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 03-System Analysis : 722590</i>	Major update: Complete rework based on SEMP v1, ARCADIA and Return of Experience from DB
<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 04-Logical Architecture : 722590</i>	No update	
<i>SPPROCESS/SEMP Annex D Processes/ SEMP process 05-Physical Subsystem Architecture : 722590</i>	No update	
<i>Annex H1 - Operational harmonisation and rule book description method</i>	No update	SEMP V1 Annex H1 is not imported into Polarion
<i>Annex H2 - Operational harmonisation and rule book description example - Start of Mission</i>	No update	SEMP V1 Annex H2 is not imported into Polarion
<i>SPPROCESS/10 SEMP V 01_01/SEMP Annex M ARCADIA</i>	<i>SPPROCESS/10 SEMP V 01_01/SEMP Annex M ARCADIA Capella</i>	Major update

V1	V2	Changes
Capella Modelling Rules : 722590	Modelling Rules : 722590	
	SPPROCESS/SEMP Annex R Requirements/ SEMP Annex R1 - Requirements Management Guidelines : 722590	<ul style="list-style-type: none"> - New annex describing the Requirements Management Process. - Most comments from review process have been implemented.
	SPPROCESS/SEMP Annex R Requirements/ SEMP Annex R2 - Requirements patterns syntax : 722590	<ul style="list-style-type: none"> -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 textual Requirements	SPPROCESS/SEMP Annex R Requirements/ SEMP Annex R3 - Rules for writing textual requirements : 722590	<p>Renaming of Annex R in Annex R3 with a major update.</p> <ul style="list-style-type: none"> -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.
SPPROCESS/10 SEMP V 01_01/SEMP Annex S SysML Modelling Rules : 722590	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
	SPPROCESS/10 SEMP V 01_01/Concept Paper - Glossary and Terminology : 722590	New annex + author comments Created as a result of a SP CG task.
	SPPROCESS/SEMP Annex D Processes/ SEMP Process 0945- Review and Approval Process : 722590	New annex to make review and approval in Polarion
	SPPROCESS/SEMP Annex D Processes/ SEMP process 91- Change Control Management Process : 722590	New annex + authors comments
	SPPROCESS/10 SEMP V 01_01/SEMP Annex Z - Documents Publication and Exchange Process : 722590	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/

V1	V2	Changes
		implementation, have been traced in the "Open Points" section.

[SPPR-5942]