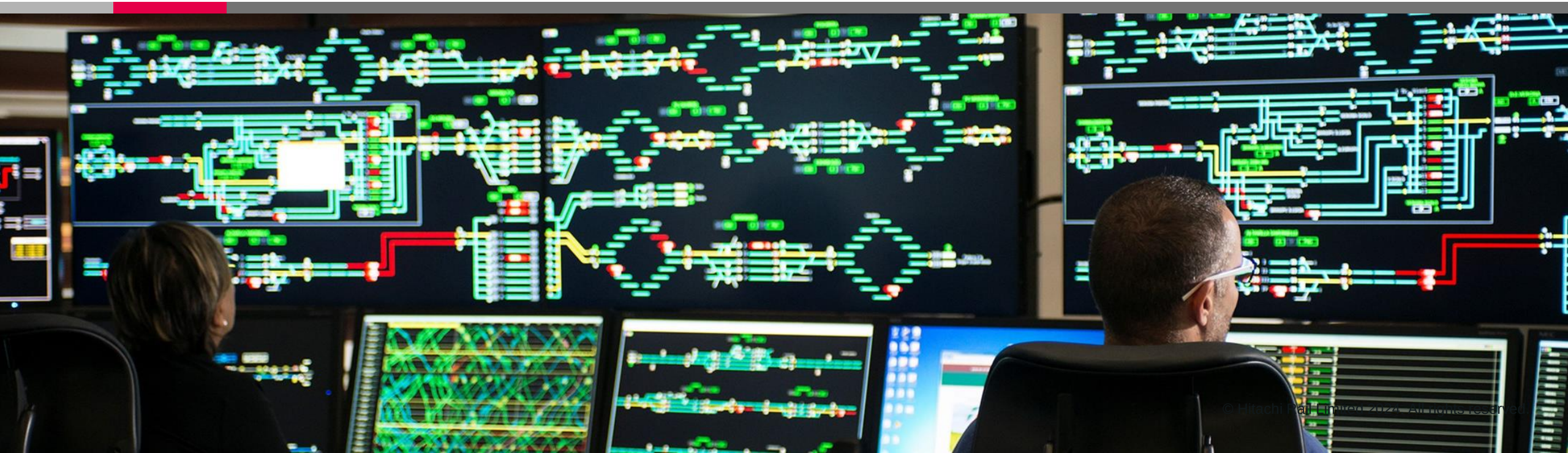
STPA at Europe’s Rail

Felix Schaber, Virtual STAMP Workshop 2024

Hitachi Rail



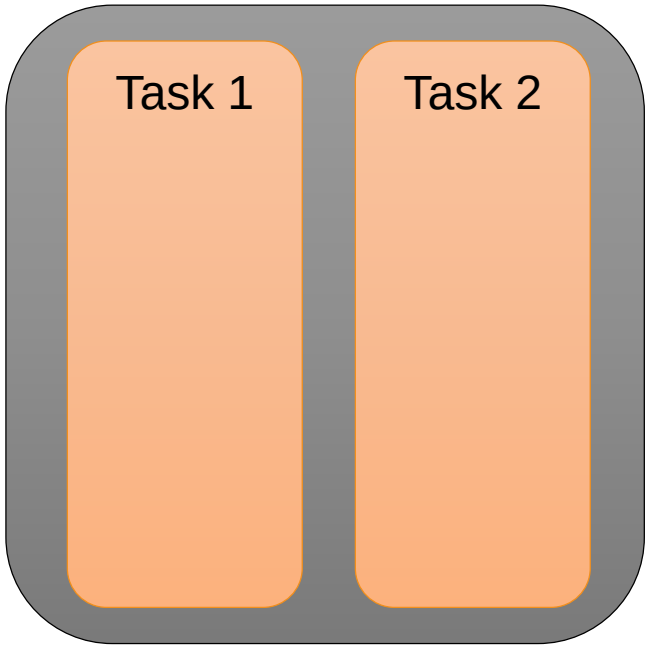
Goals of Europe's Rail

Mission statement

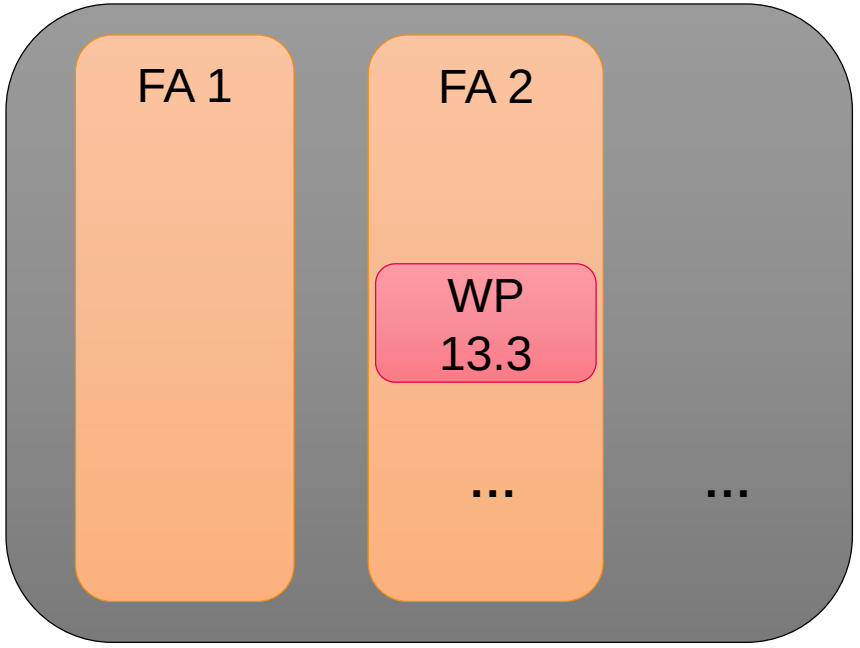
- **To deliver, via an integrated system approach, a *high capacity*, flexible, multi-modal, sustainable and reliable *integrated European railway network* by eliminating barriers to interoperability and providing solutions for full integration, for European citizens and cargo.**

Co-funded by the European Union

Europe’s Rail Landscape

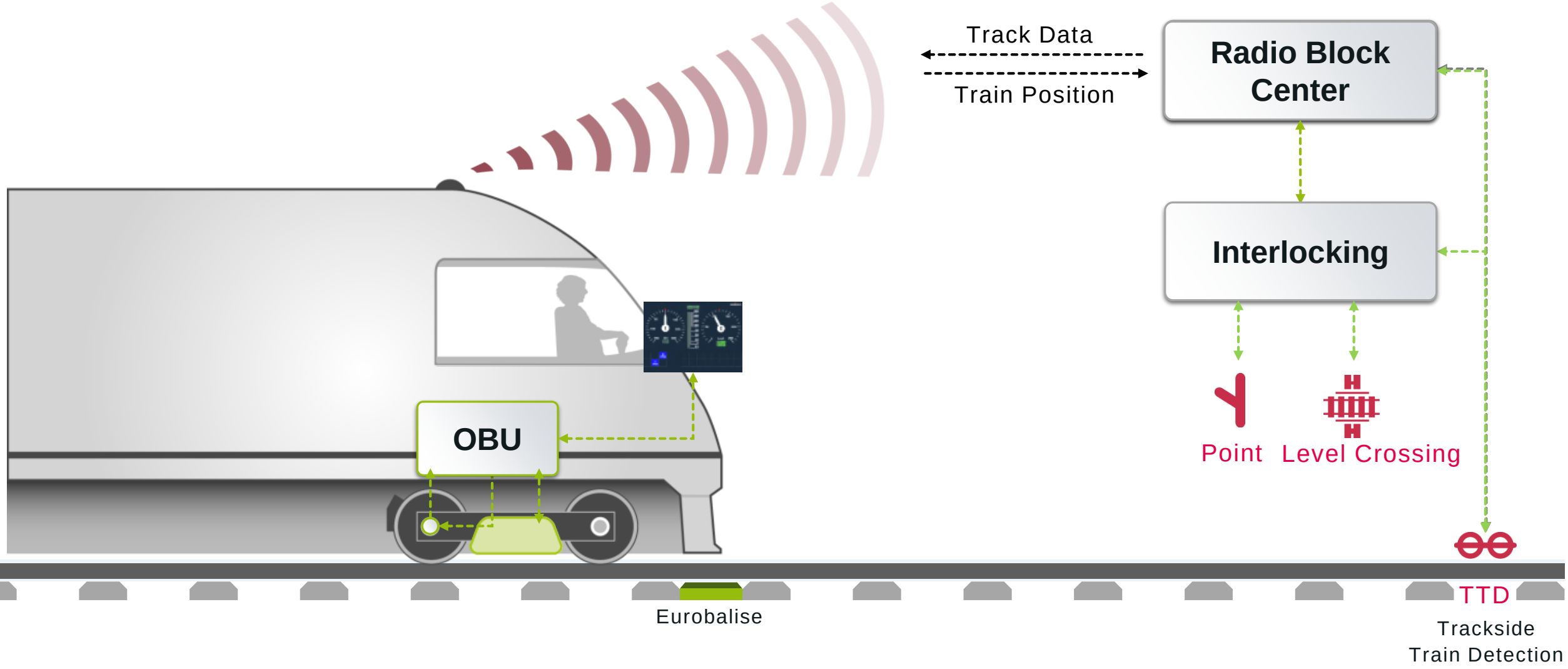


System Pillar



Innovation Pillar

Our Use Case – Moving Block System



Hazard Analysis for Moving Block System

High level of safety assurance

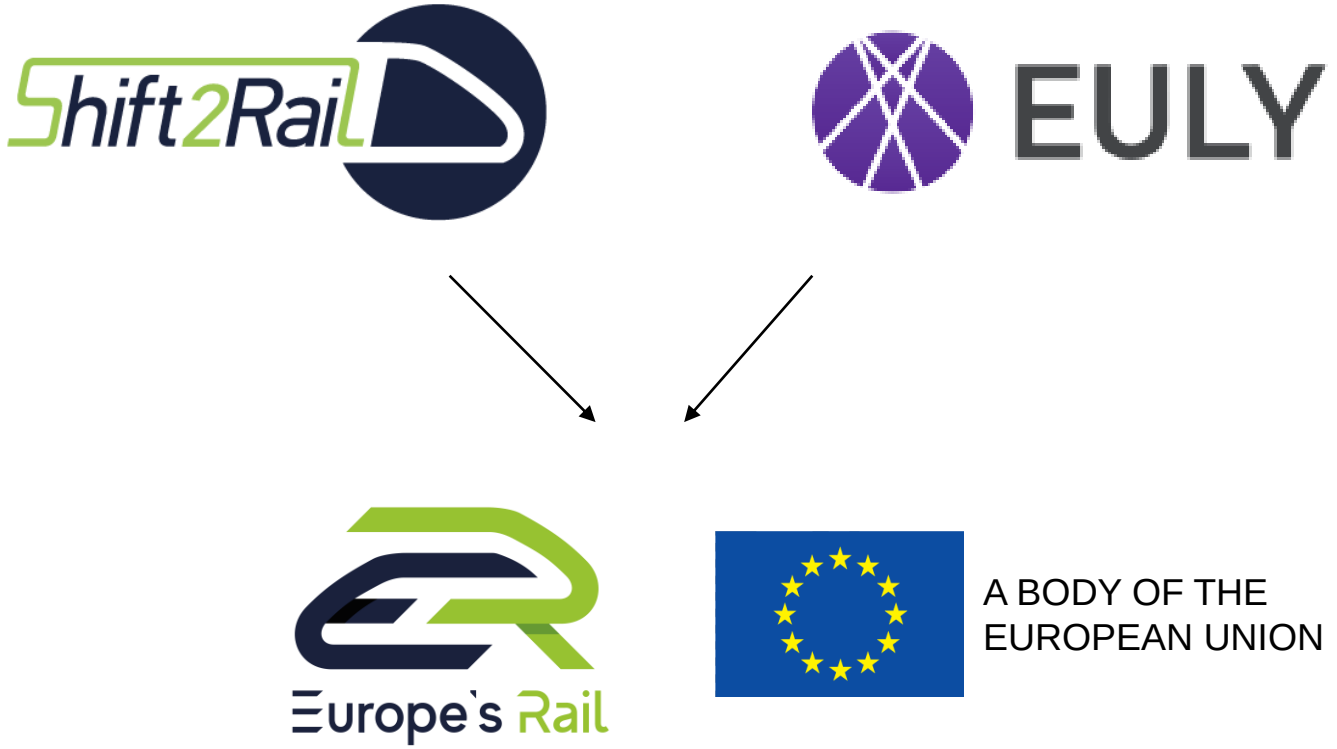
→ Need for comprehensive hazard analysis

Component interaction important for safety

Early stages of design

→ use STPA

System Evolution



Existing requirements

Difference in

System scope

Assumptions about system requirements

Strategy

Perform STPA

Extract solution concepts from requirements

Match loss scenarios to solution concepts

Identify Gaps

Example UCAs

Unsafe Control Action:

[UCA-MBS-16] MBS provides FS MA to OBU when the area reserved for train is not clear of other trains or obstacles [H-1.1, H-2.1]

[UCA-MBS-17] MBS provides MA to OBU when other train or obstacles have insufficient distance from the flank of the area reserved for train movement [H-1.1, H-2.1, H-2.8, H-3.1]

Context

Track occupation (occupied/free/unknown)

ETCS mode (full supervision/on sight/staff responsible)

Type of collision (head-on/rear-on/flank)

Type of vehicle (controlled vehicle/rollaway train)

Collision speed

…

Relevant solution concepts

Location of controlled trains

Reported Train Position

Reported Track Occupation

→ Train Location

Permitted location of controlled trains

Movement Authority

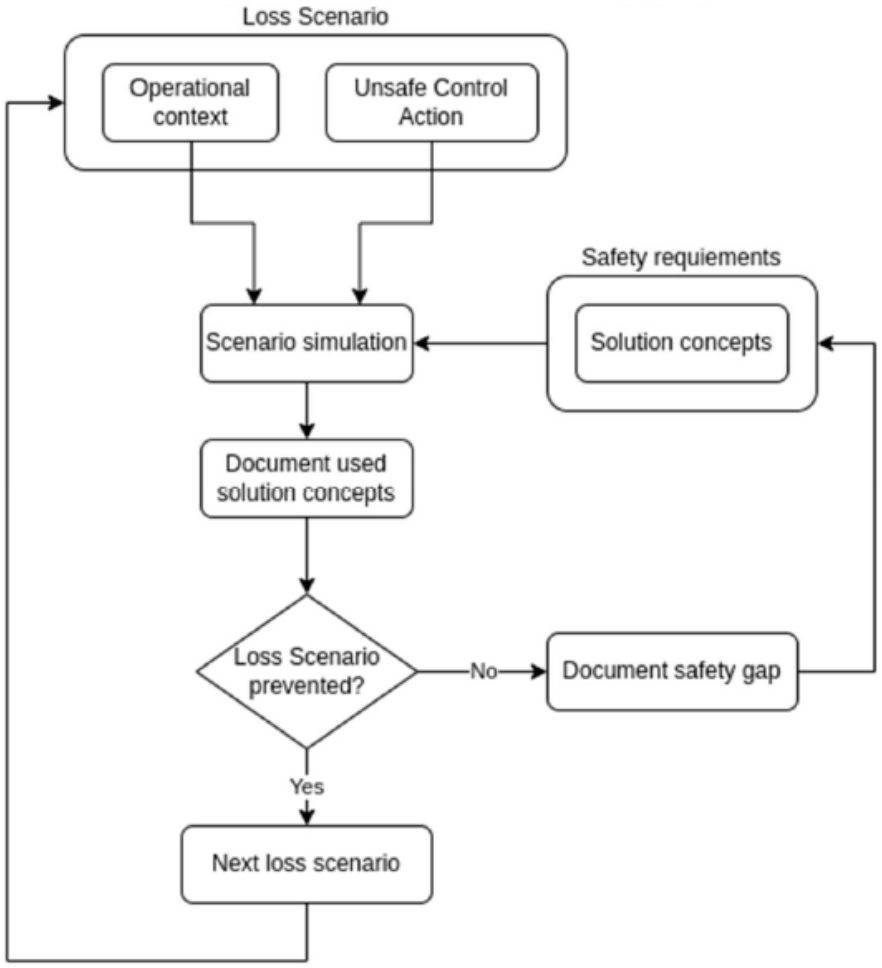
→ Area Reserved for Train

Location of unknown origin

Reported Track Occupation

→ Unresolved Trackbound Object

Linking Scenarios to Solution Concepts



Linked loss scenarios

Leads to loss scenarios with causal factors including:

Coupling of trains

Incorrect train lengths

Train separation

Roll-away after parking of trains

…

Prevention of loss scenarios linked to assumptions

Detection of roll-away trains by trackside train detectors

Received information about the infrastructure (geographical position of tracks, points, etc.) correctly represent physical reality

Validating Assumptions

Explicit sources

Assumptions stated within requirements

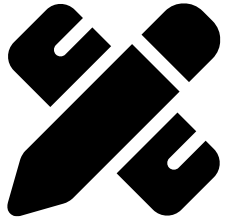
Assumptions stated within STPA

Implicit sources

Design of solution concepts

Responsibilities of other controllers

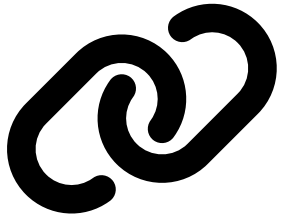
Differences in stakeholder viewpoints



Example Assumption

Assumption:

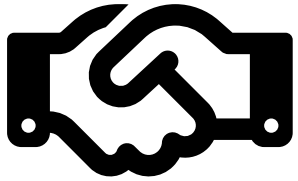
Received information about the infrastructure (geographical position of tracks, points, etc.) correctly represent physical reality



Viewpoints:

Moving block system: cannot validate physical correctness of position

Digital register: relies on infrastructure management data validation



IM data validation: exact process not specified as part of the analysis

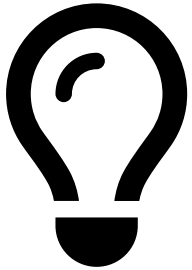
→ Potentially gap regarding data validation

Lessons learned

Context of solution concepts is essential

Implicit assumptions may require reverse engineering

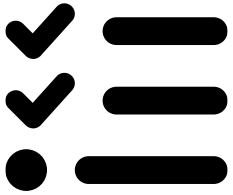
Domain experts greatly help guiding the search for loss scenarios



Operational procedures are critical

Covers areas where feedback is insufficient/too late automated controllers to prevent hazards

→ importance increases with automation



STPA fosters dialog between stakeholders

Makes context and associated assumptions explicit

Helps synchronize viewpoints early in the design process