



# In2Rail



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No: 635900



# In2Rail Mid Term Event

Andy Doherty – Chief Technical Officer  
Facilitated By - Mona Sihota

Submit further questions to: [In2Rail@networkrail.co.uk](mailto:In2Rail@networkrail.co.uk)



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# Project Objectives

The In2Rail project is to set the foundations for a resilient, consistent, cost-efficient, high capacity European network by delivering important building blocks that unlock the innovation potential that exists in Shift2Rail: innovative technologies will be explored and resulting concepts embedded in a systems framework where infrastructure, information management, maintenance techniques, energy, and engineering are integrated, optimised, shared and exploited.



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# Introductions



**Amanda Webster**  
WP1



**Ian Coleman**  
WP2



**Ian Dean**  
WP3



**Anders Carolin**  
WP4



**Federico Papa**  
WP5



**Henk Samson**  
WP6



**Stefan Wegele**  
WP7



**Roland Kuhn**  
WP8



**Carlo Dambra**  
WP9



**Tomas Greif**  
WP10



**Olivier Langlois**  
WP11



**Tom Tivey**  
WP12



**Andrea Demadonna**  
WP13



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## Coordinator

### Infra Managers



### Railway Industry



### Associations



### Consultants



### Research Centres



# Consortium



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# Smart Infrastructure

Sub Project Speaker: Henk Samson



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# Smart Infrastructure



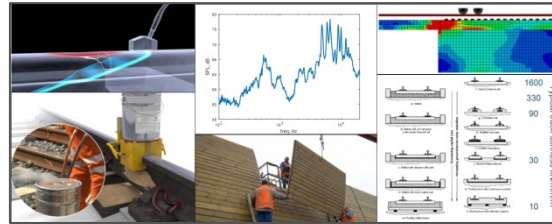
WP2: Enhancing Existing/Developing Next Generation Switch and Crossing Solutions



WP3: Innovative Track Solutions



WP4: Bridges & Tunnels



WP5: Commercial Off The Shelf (COTS) Monitoring



WP6: Maintenance Strategies & Execution



# Smart Infrastructure - Innovative S&C Solutions

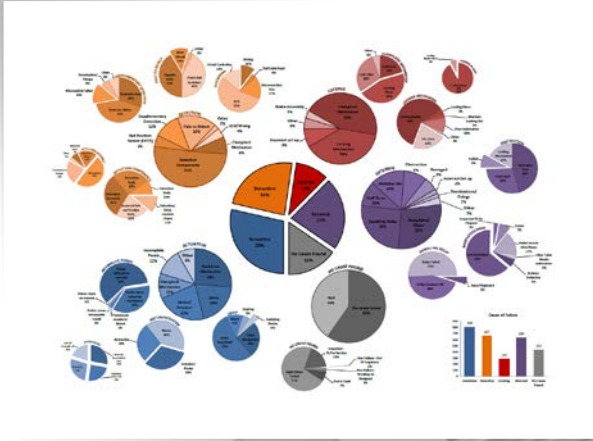
Ian Coleman  
Network Rail



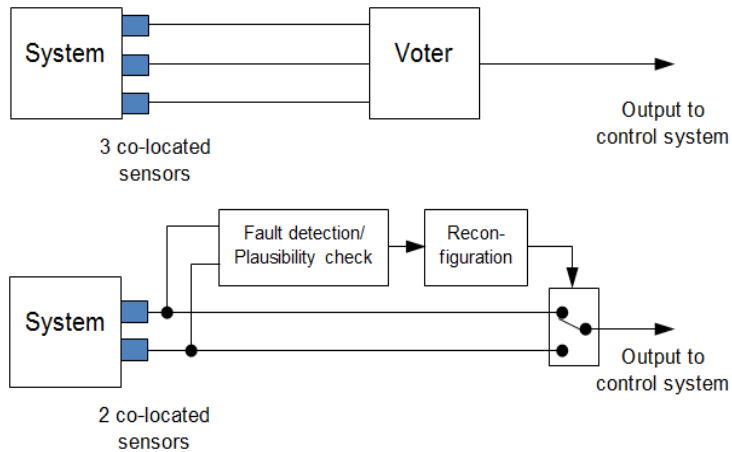
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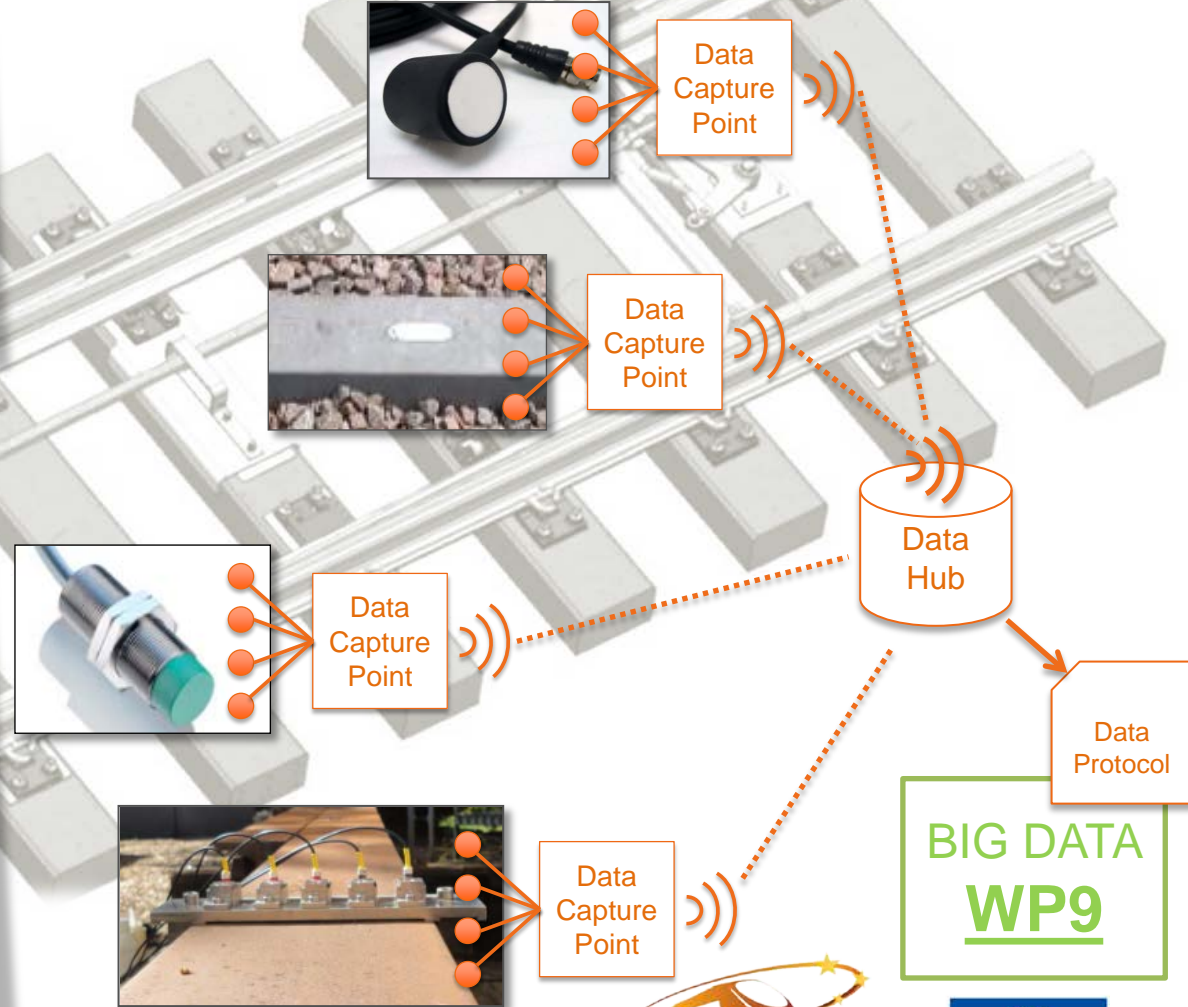
# Enhancing Existing S&C Systems



## FAILURE ANALYSIS



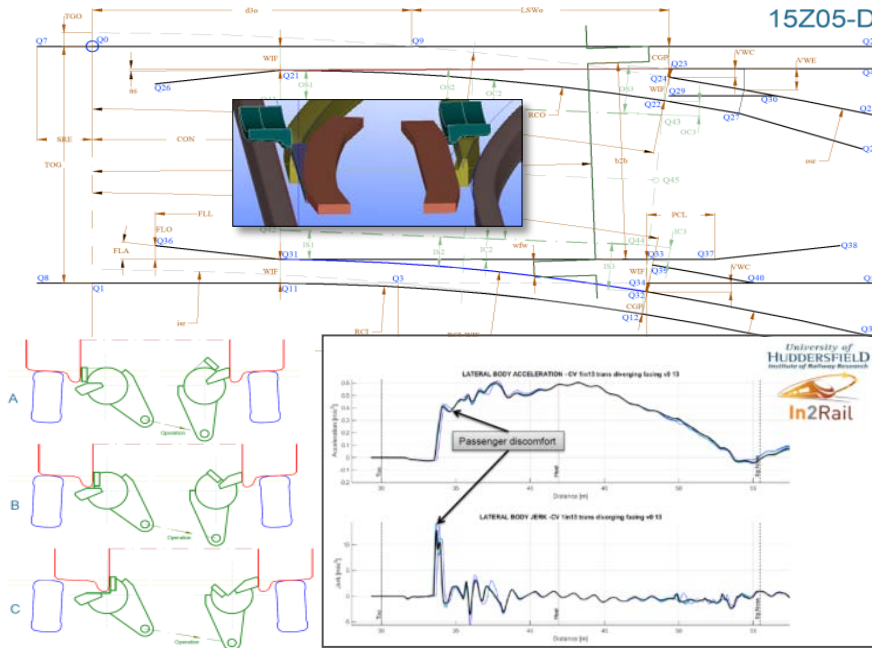
## SYSTEM REDUNDANCY DESIGN



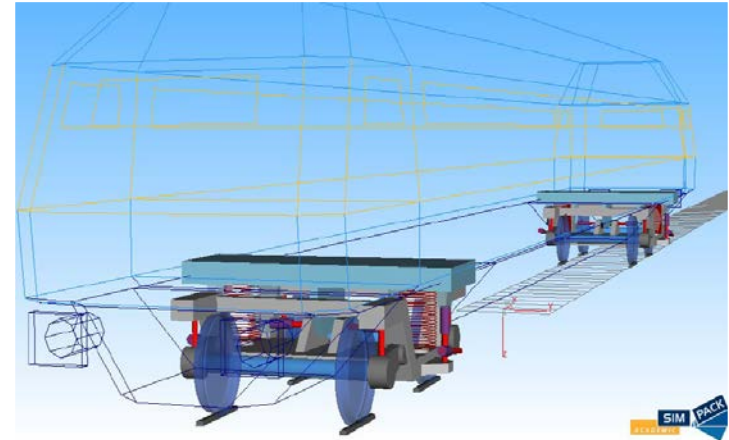
**BIG DATA**  
**WP9**



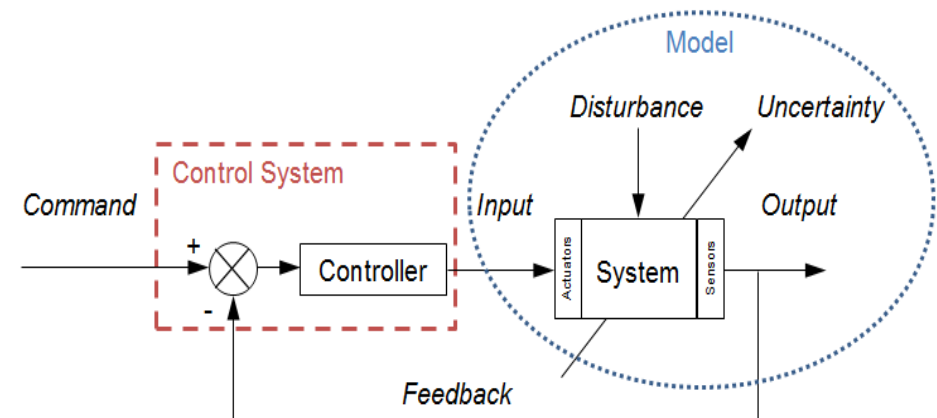
# Next Generation S&C Systems



## NOVEL S&C CONCEPTS



## WHOLE SYSTEM APPROACH



## REDUCING COMPLEXITY

## ADVANCED CONTROL SYSTEMS

# Smart Infrastructure - Innovative Track Solutions

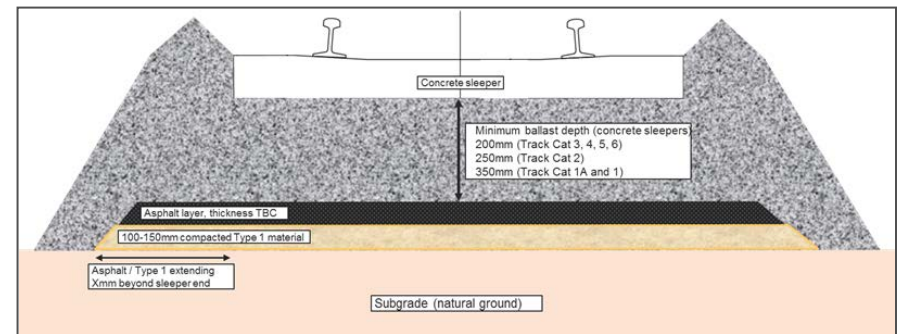
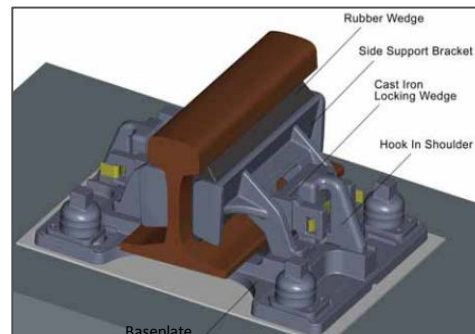
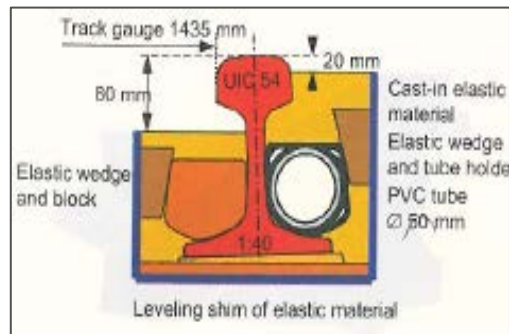
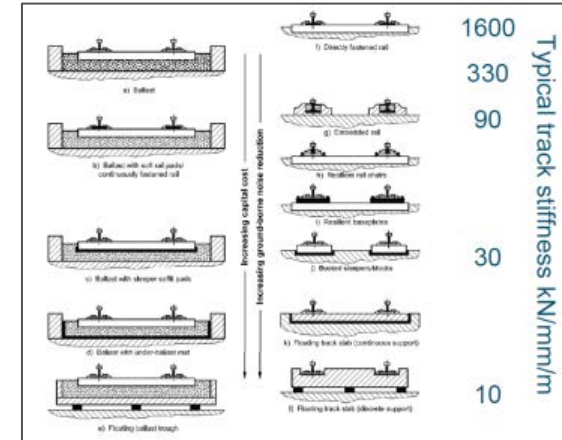
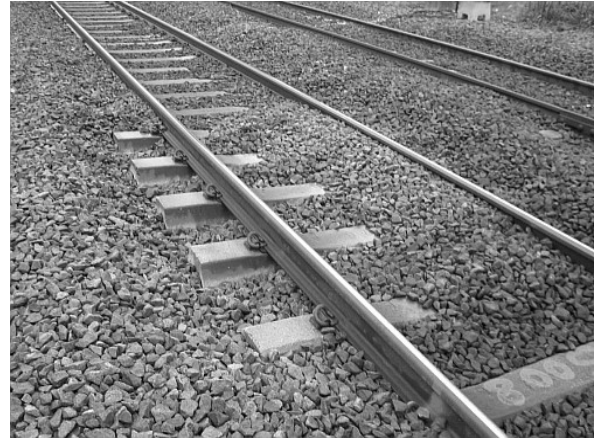
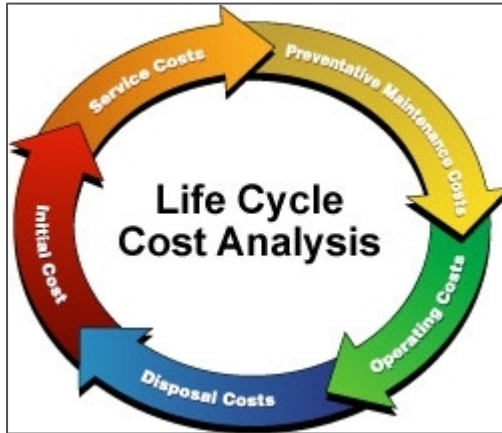
Ian Dean  
Network Rail



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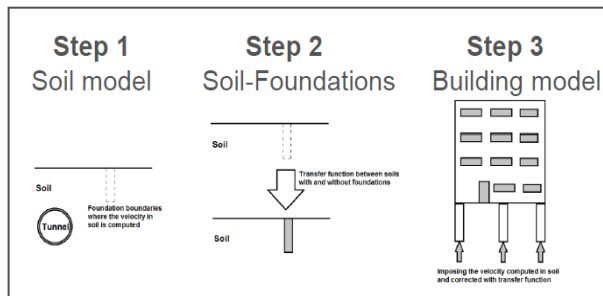
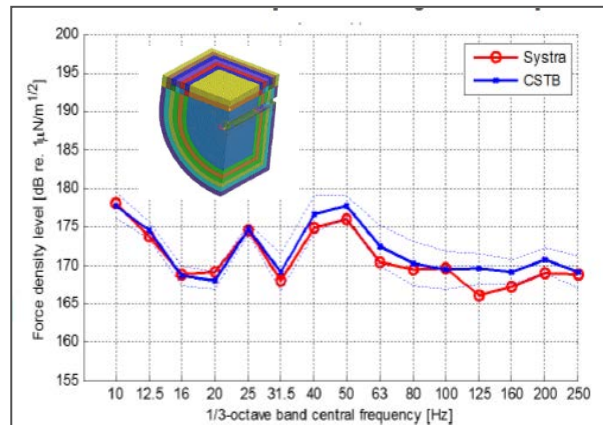
# Innovative & Optimised Track Solutions



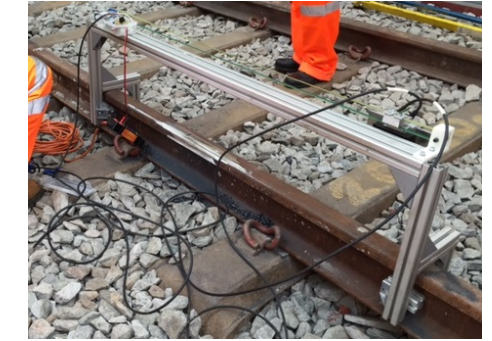
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# Solutions to Common Track Problems

## Noise & Vibration



## Rail Head Repair



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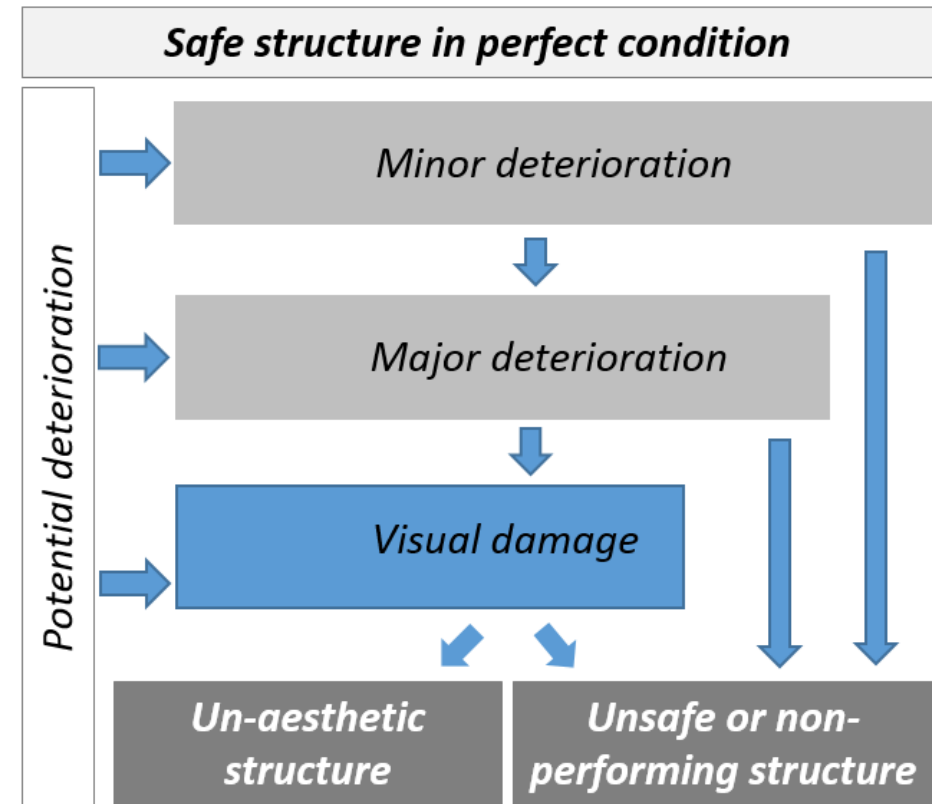
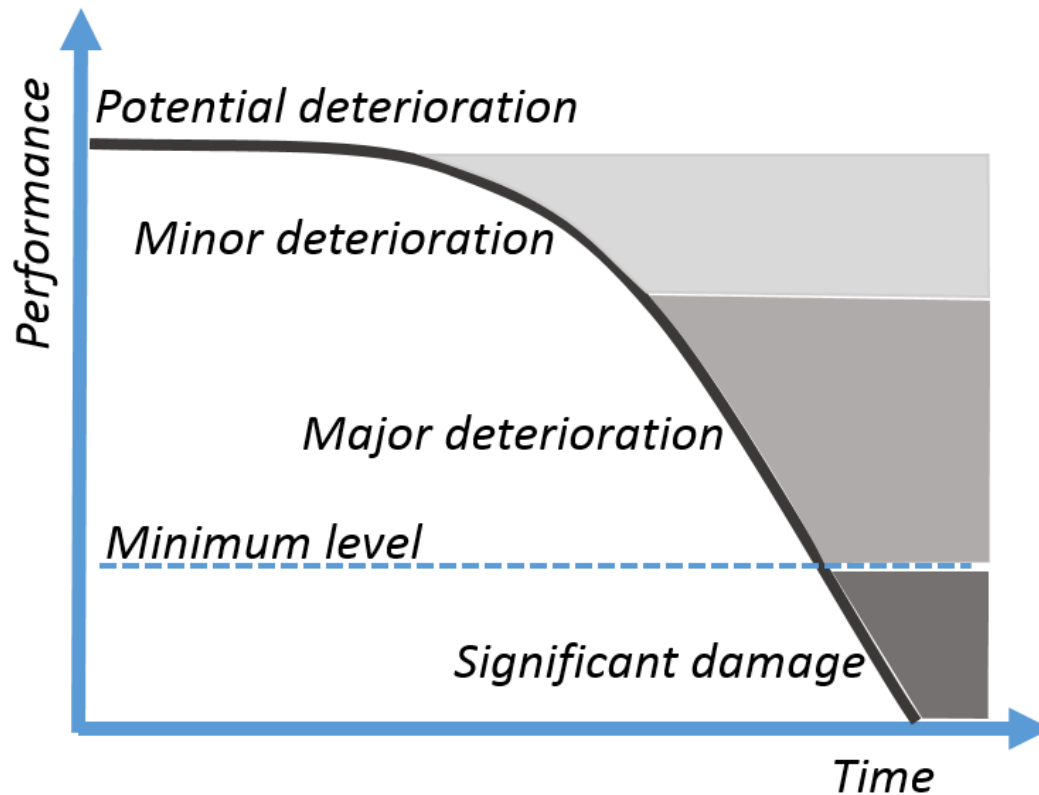
# Smart Infrastructure - Bridges & Tunnels

Anders Carolin  
Trafikverket



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# Bridges and Tunnels Deterioration



# Precision, Accuracy and Frequency can compensate for each other



✓ *Precision*  
× *Accuracy*



× *Precision*  
✓ *Accuracy*



× *Precision*  
× *Accuracy*



✓ *Precision*  
✓ *Accuracy*



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# Smart Infrastructure - Commercial Off The Shelf (COTS) Monitoring (thermal stress and track geometry)

Federico Papa

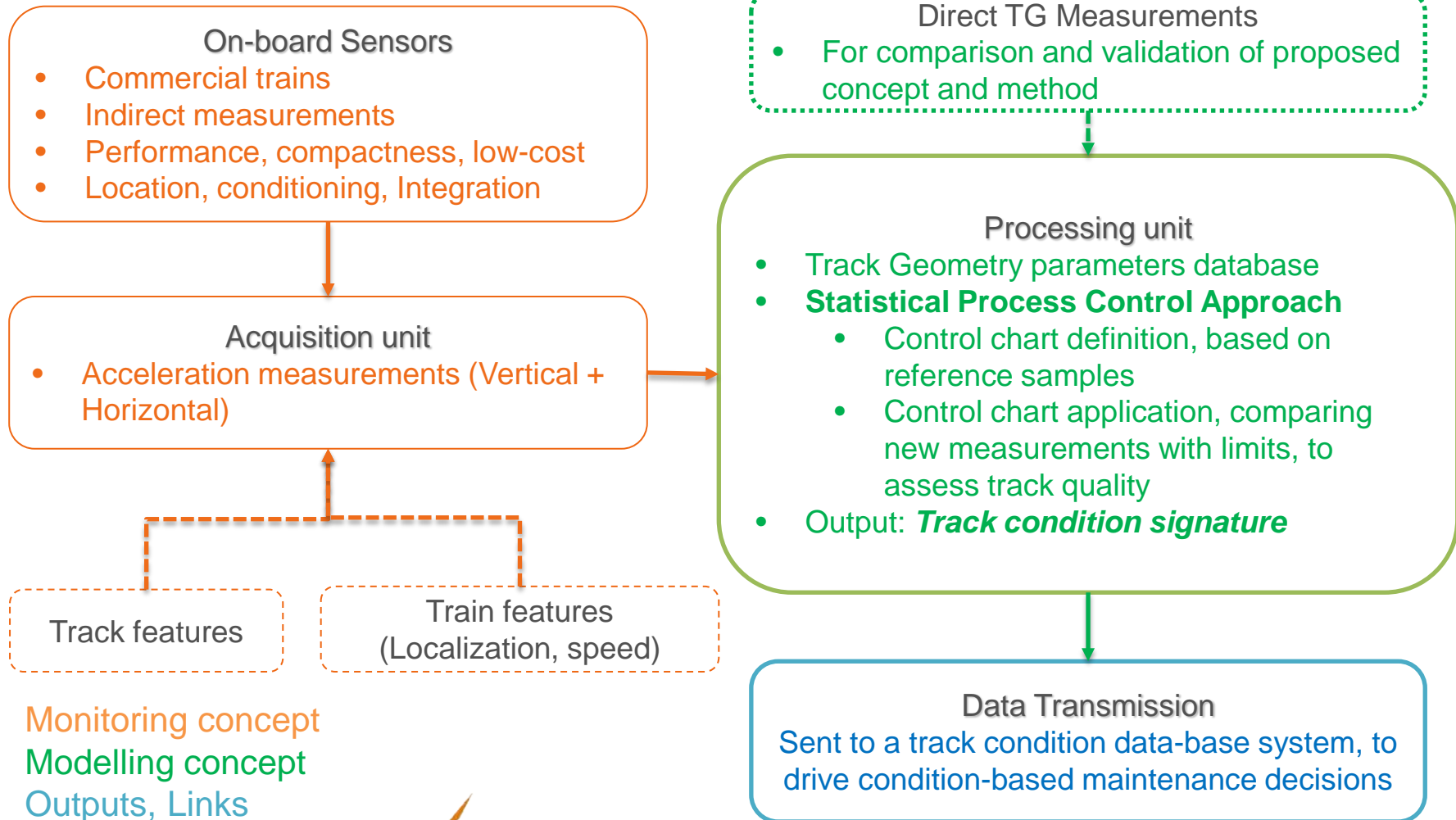
Ansaldo STS



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# Track geometry monitoring

Concept for innovative monitoring of track geometry used to perform the track condition analysis using accelerometers



Monitoring concept  
Modelling concept  
Outputs, Links



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# Thermal Rail Stress Monitoring Concept

## Ground-based info (TMS)

Traffic forecast

Vehicle types

Weather info

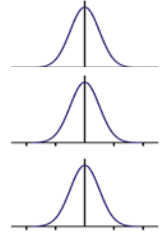
Critical site  
Register/records

## Probabilistic risk-based model

Stress Free Temperature

Lateral Resistance

Track Geometry



On-board  
continuous  
measurement:  
Rail Temperature  
+  
Geometry

Decision threshold identification

Decision-making

Dispatching



Maintenance



# Smart Infrastructure - Maintenance Strategies & Execution

Henk Samson  
Strukton



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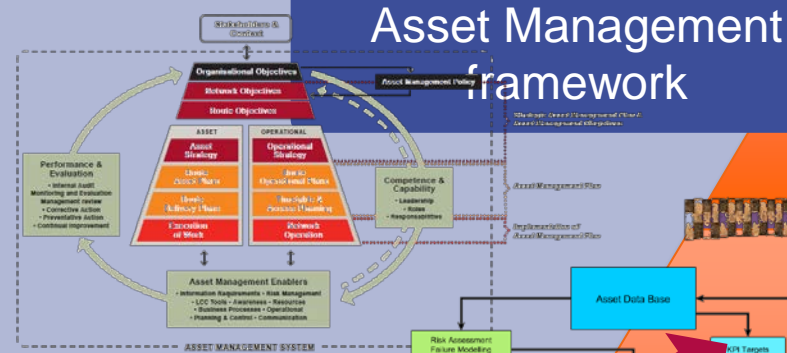
# WP6 – Overview

Strategic

Tactical

Operational

Asset Management  
framework



Maintenance Modelling

Dynamic model Track

Maintenance Modelling

Dynamic model Switch

Condition & Risk-based  
Maintenance Planning

Maintenance Execution

High performance tamping



# WP6 - High Performance Tamping

## Track geometry inspection

→ Decision about maintenance



Track recording car

*During train-free periods !*

## Pre-run track alignment

→ Input data for tamping machine



Track surveying car  
or  
Manual track surveying



*Relevant possession time  
and cost in both cases !*

## Maintenance - Tamping

→ Restoring of track geometry



Tamping machine

*Relevant possession time  
and cost !*

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# Smart Infrastructure - Questions & Answers

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# Lunch

13:00 – 14:00

Please return to the room ready to start at 14:00



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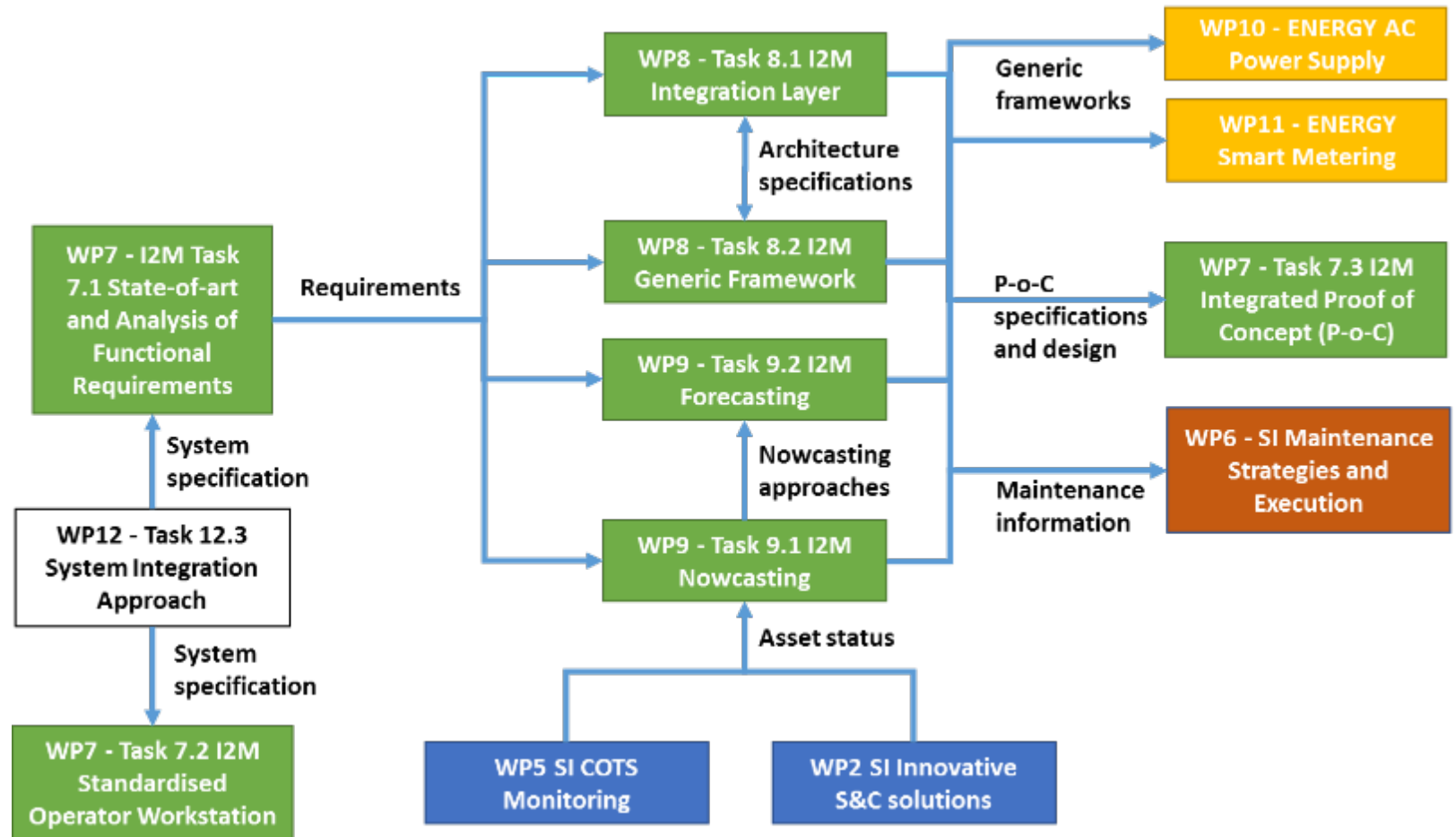
# Intelligent Mobility Management

Sub Project Speaker: Carlo Dambra



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# Intelligent Mobility Management (I2M)



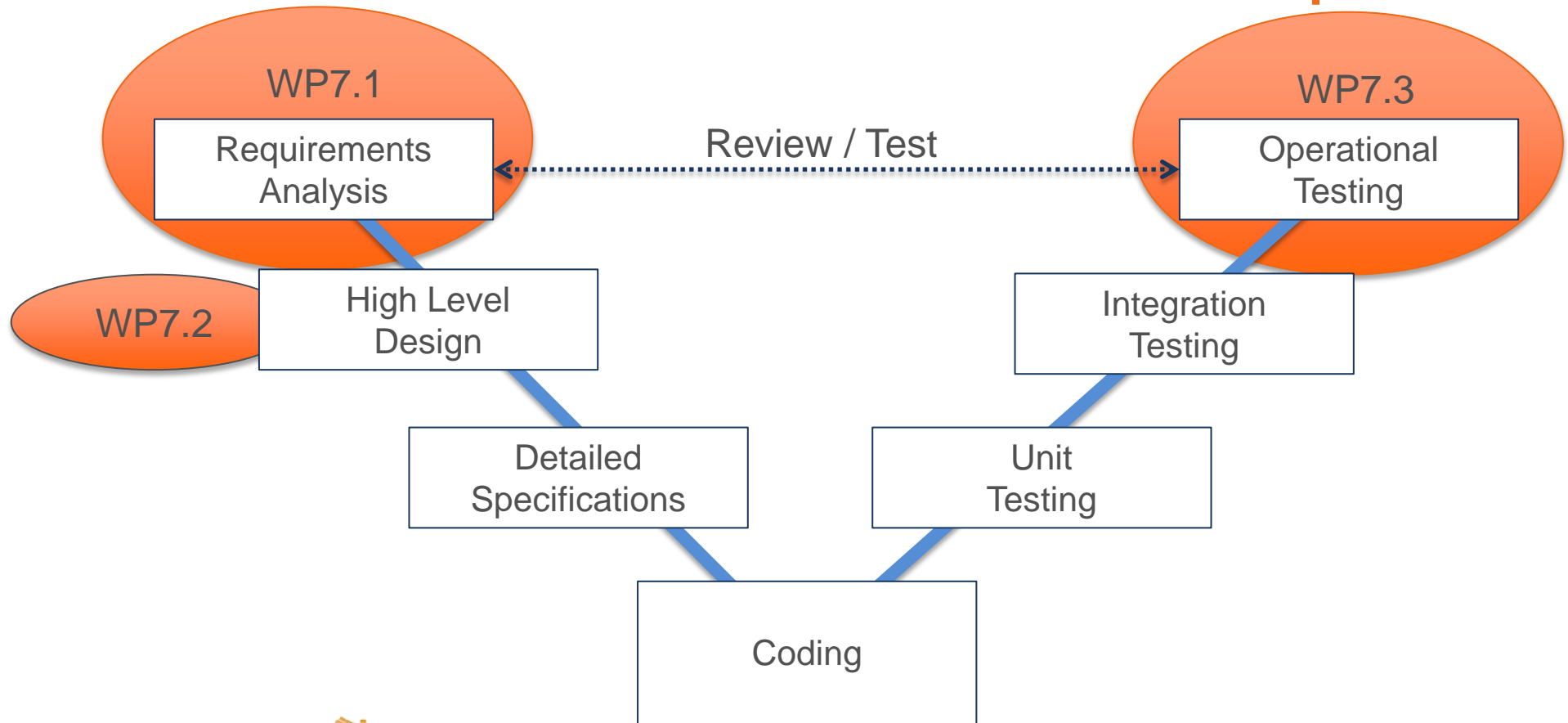
# Intelligent Mobility Management (I2M) - System Engineering

Stefan Wegele  
Siemens



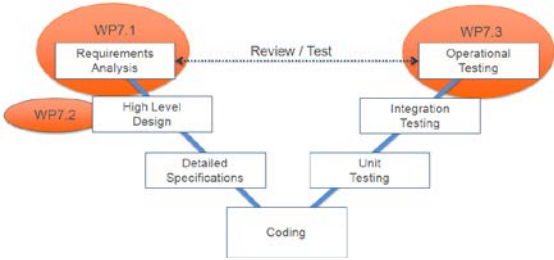
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# V-Model Software Development

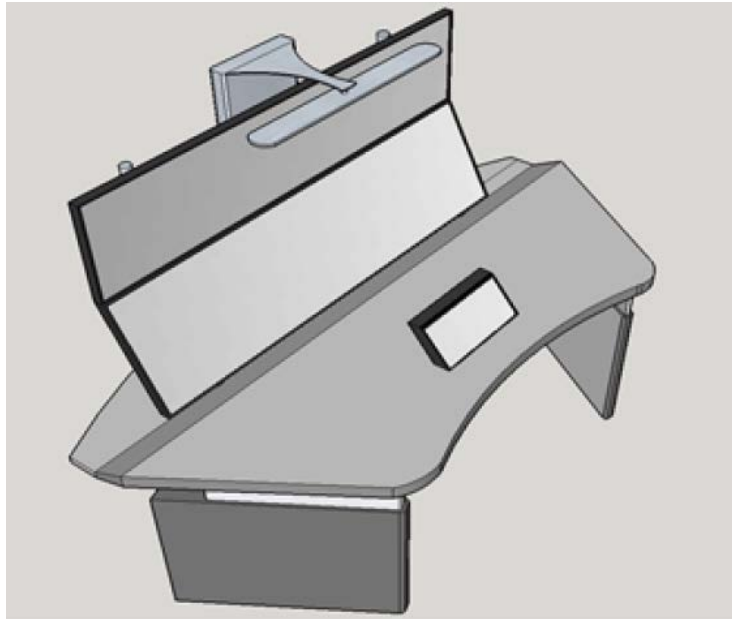








# Design guidelines for a workstation



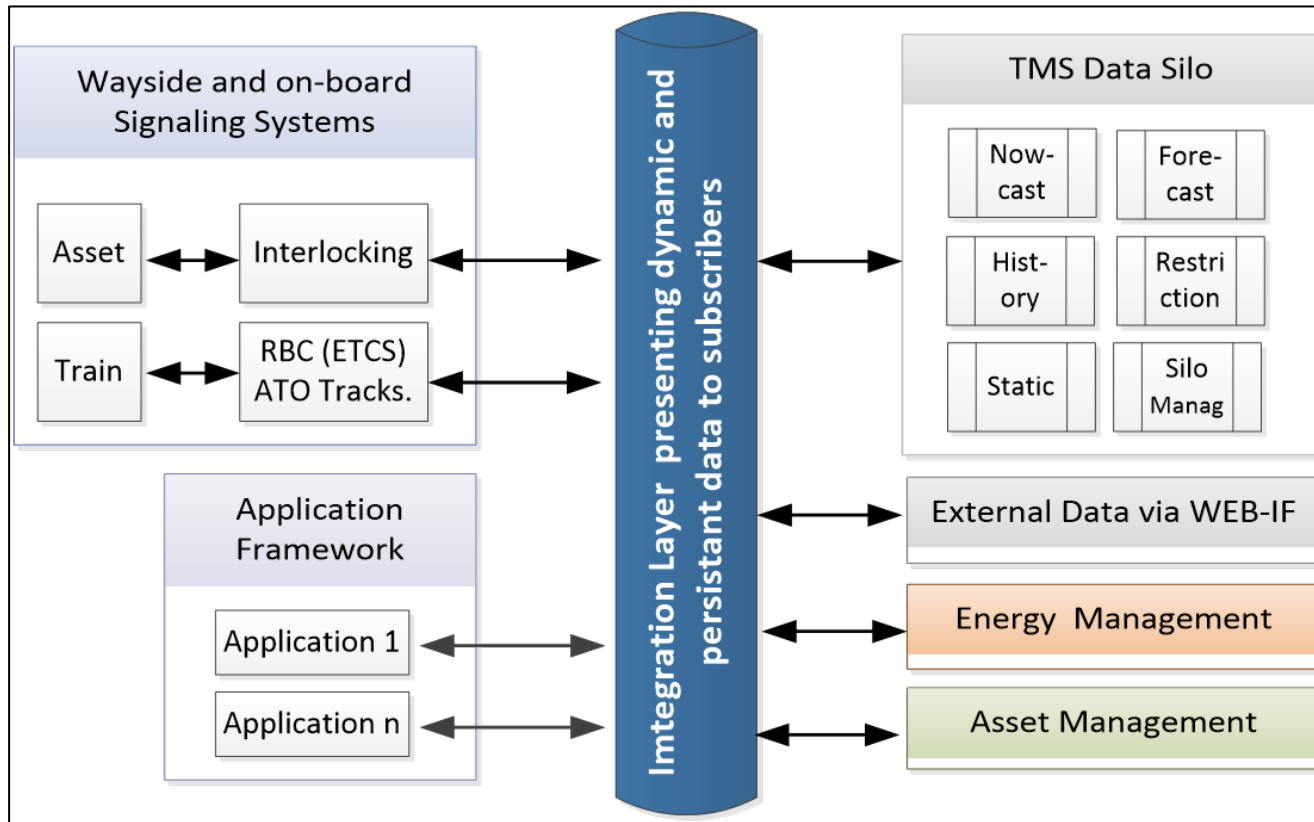
# Intelligent Mobility Management (I2M) - Integration Layer

Roland Kuhn  
Bombardier



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# Intelligent Mobility Management (I2M) – Integration Layer



Standardized  
Data Structure  
Standardized  
Interfaces  
Standardized  
Application Framework

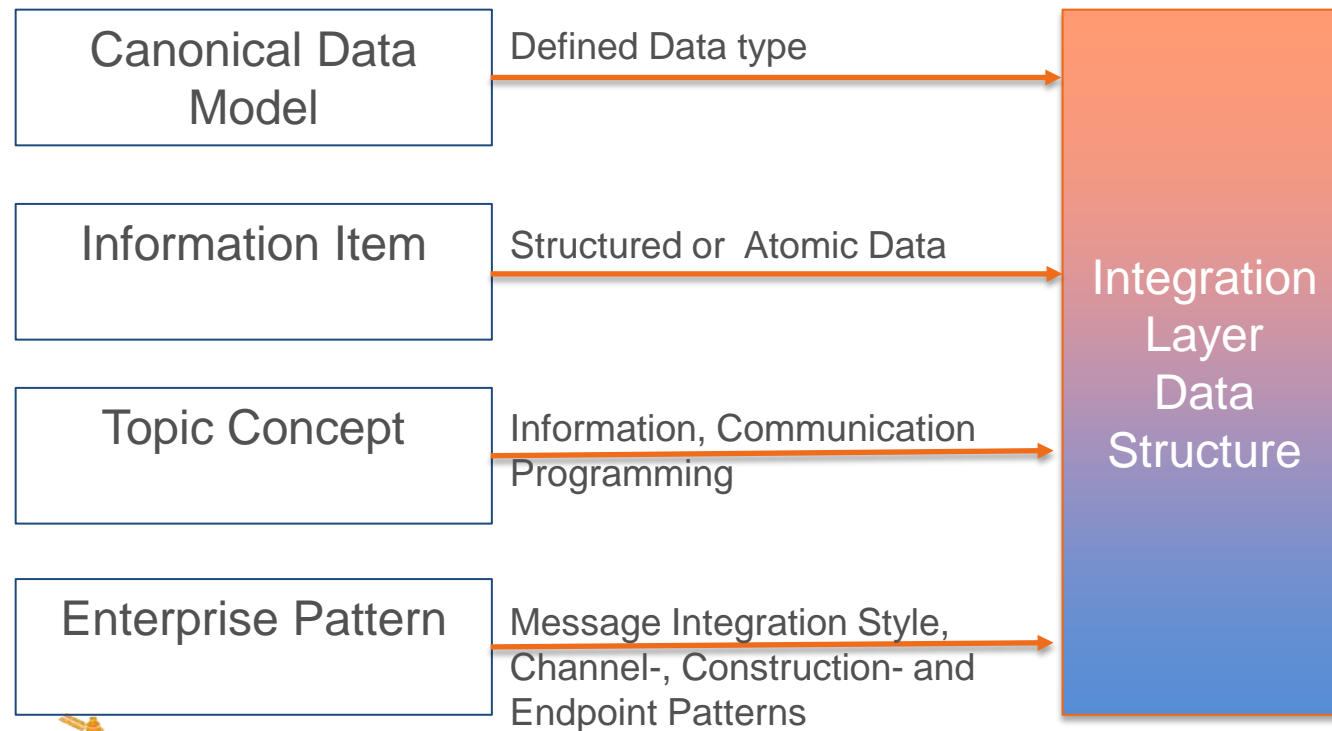
Now- and Fore-Cast  
Asset status integrated  
in automated decision  
process

Legacy Implementa-  
tions can be integrated



# Integration Layer – Design Concept

The design of the Data Structure of Integration Layer revolves around the following concepts





# Intelligent Mobility Management (I2M) - Nowcasting and Forecasting

Carlo Dambra  
Ansaldo STS



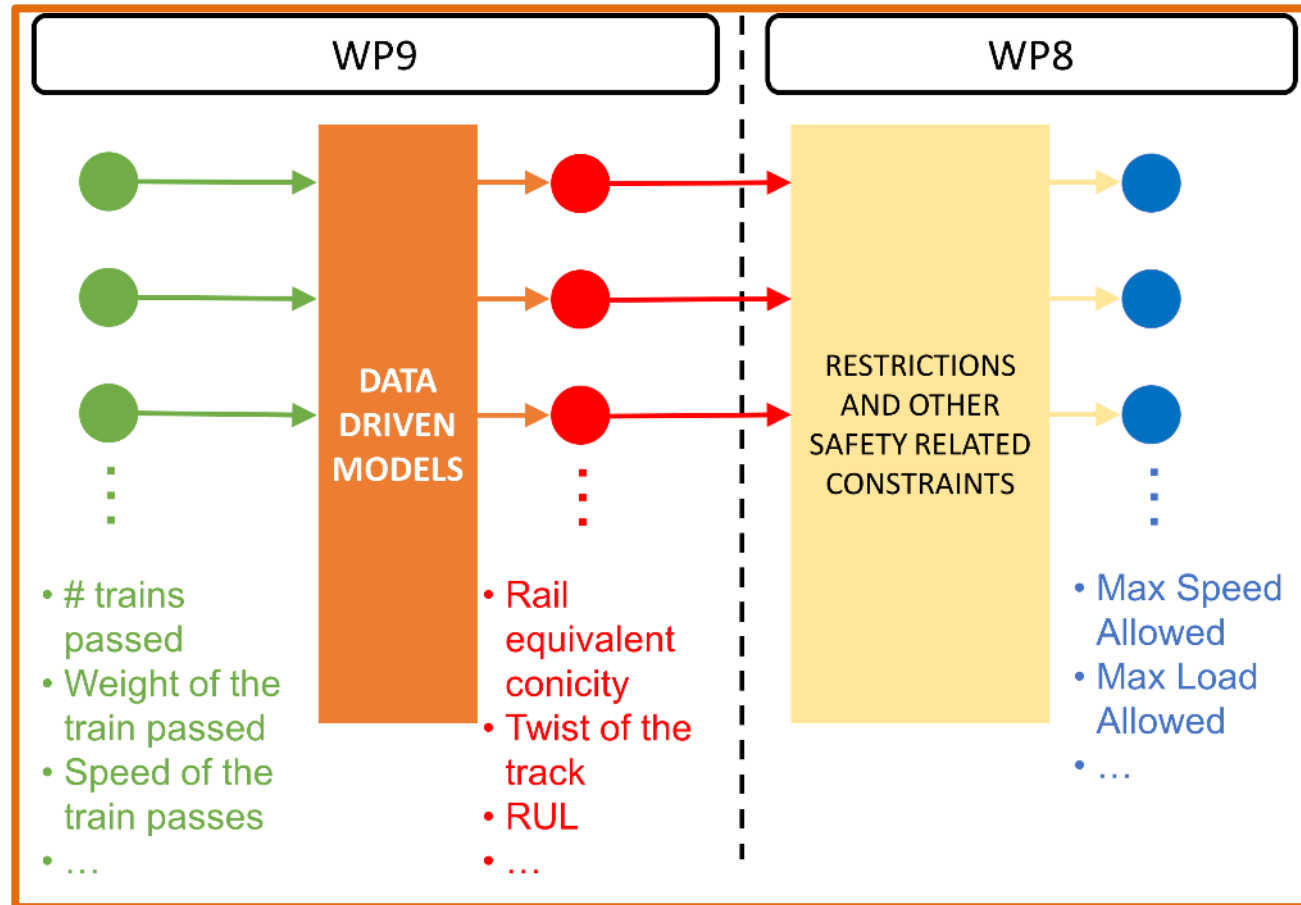
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# Asset status representation

- Model based on:
  - railTOPOMODEL for the rail topology
  - railML for the static information
  - Sensor Model Language (SensorML) for the dynamic information



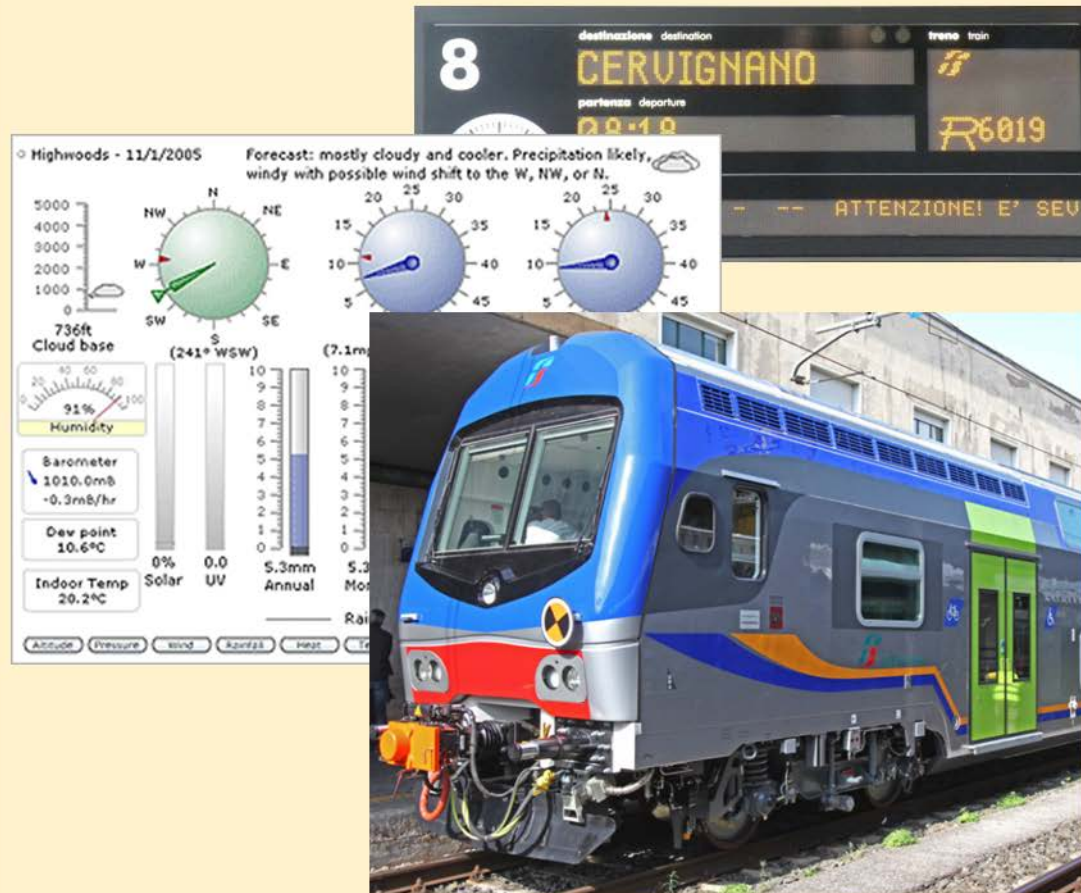
# Nowcasting and forecasting



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# Nowcasting and forecasting



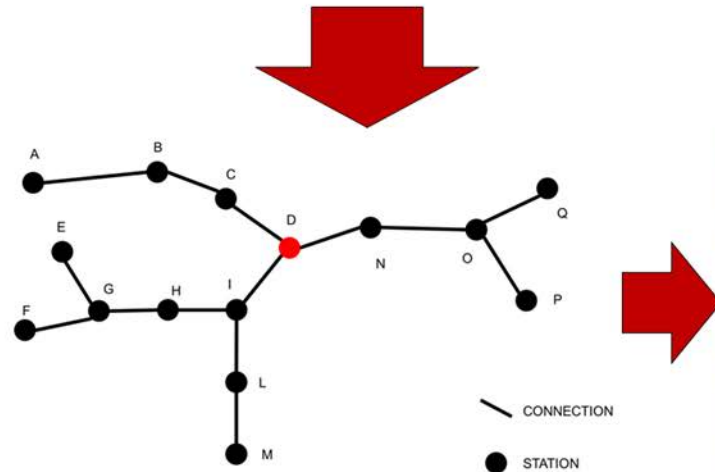
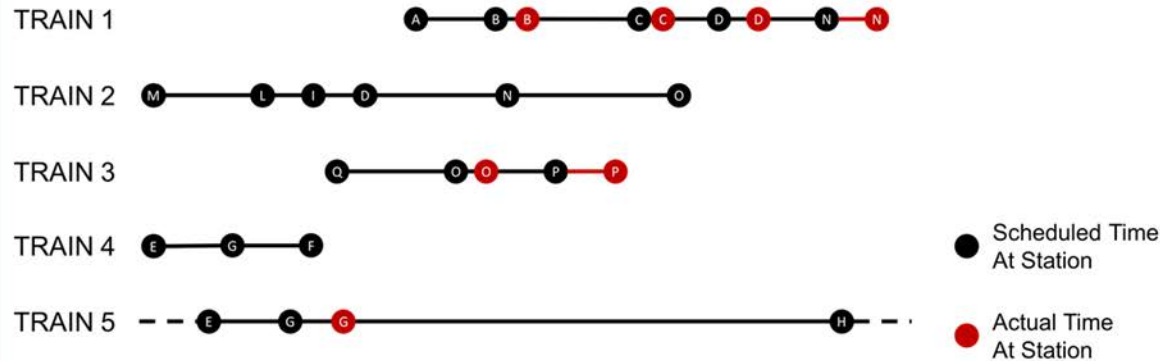
**Nowcasting and forecasting train delays depending on train movements and weather conditions**



# Nowcasting and forecasting

Network Rail

**Nowcast and  
forecast the  
delay  
attribution  
based on  
information  
about train  
movements**



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# Nowcasting and forecasting



**Forecasting possible assets' malfunctions based on**

- 1. maintenance**
- 2. weather conditions**

**Forecasting time to restoration based on repair activity data**

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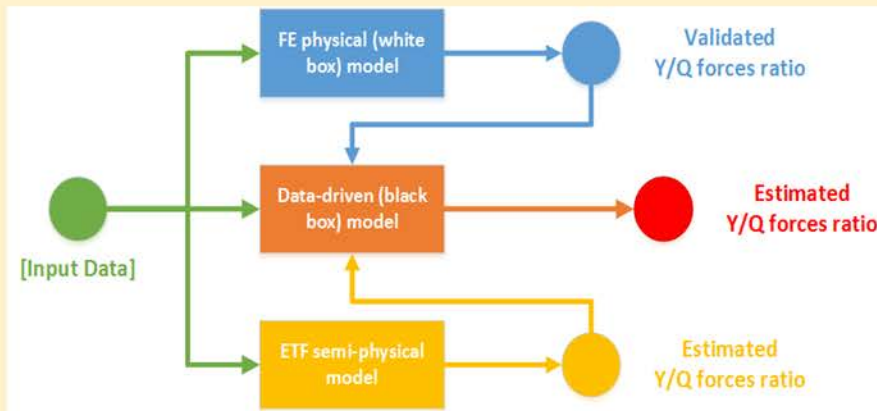


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# Nowcasting and forecasting



**Nowcasting and forecasting models able to estimate the risk of derailment in reduced computational time**



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# Intelligent Mobility Management– Questions & Answers

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# Rail Power Supply and Energy Management

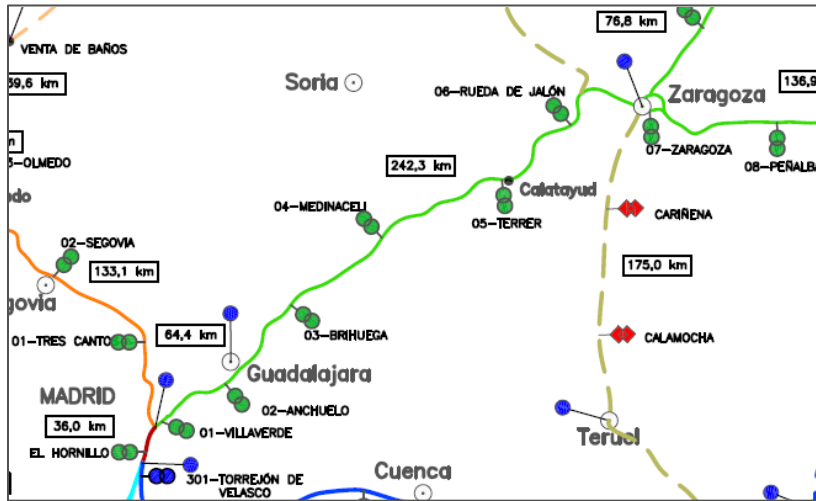
Sub Project Speaker: Olivier Langlois



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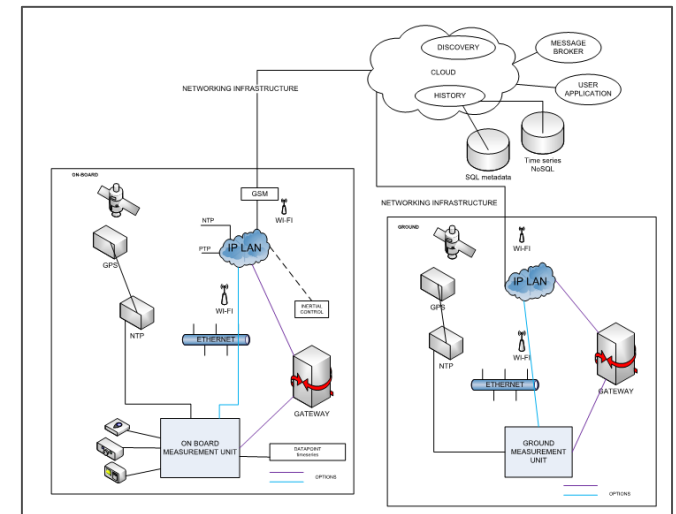
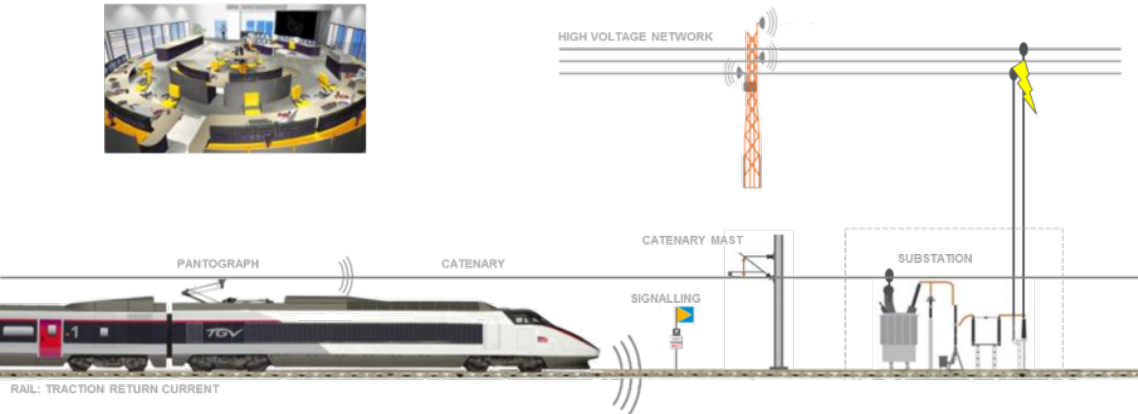


# Rail Power Supply & Energy Management – Progress



WP10: Intelligent AC Power Supply

WP11: Smart metering for energy management



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# Energy Management - Intelligent AC Power Supply System

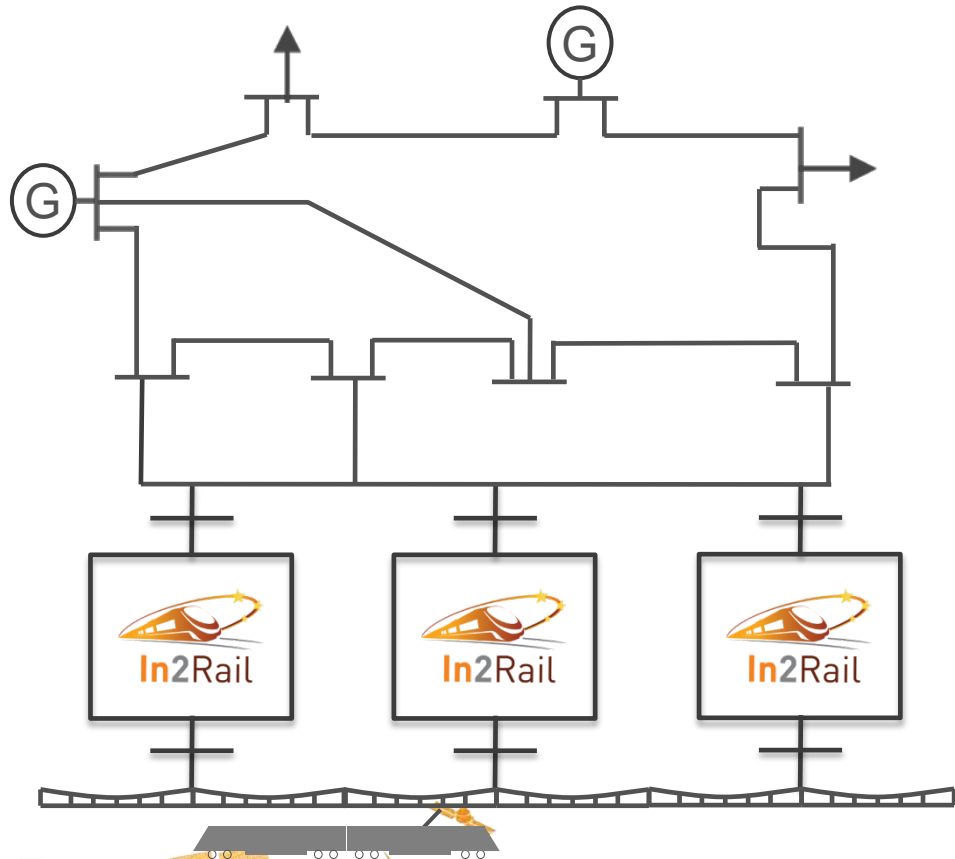
Tomas Greif  
Siemens



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# Intelligent AC Power Supply

Cooperation between traction network and public grid



grid  
model

→ topology

→ lines model

→ simplified generator model

substation  
model

→ transformer model

→ frequency converter model

→ balancer model

TPS  
model

→ railway power system model

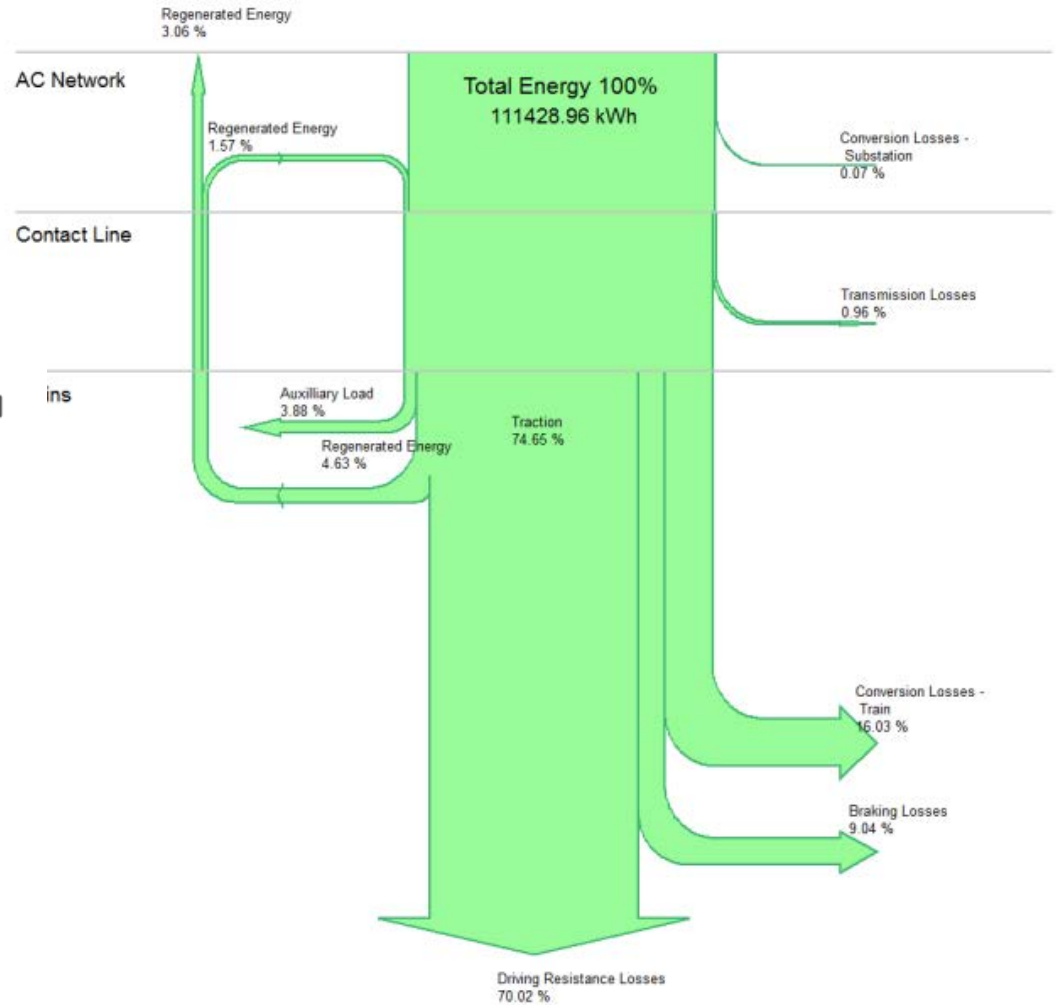
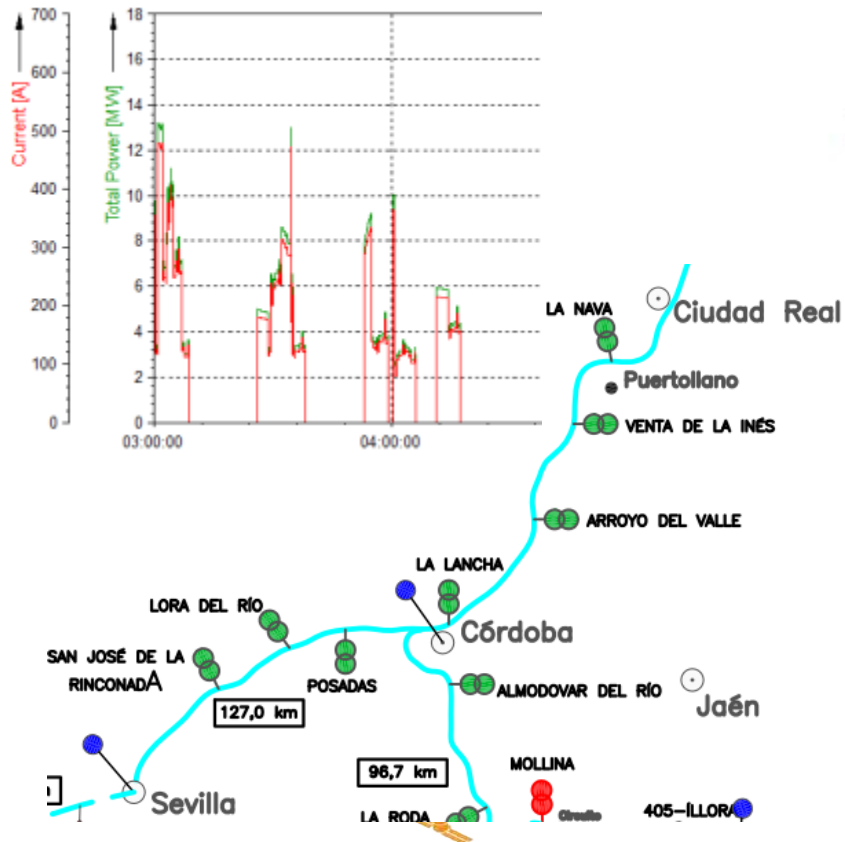
→ train traction system model



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# Intelligent AC Power Supply

## Use cases of ADIF



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# Energy Management - Smart Metering for a Railway Distributed Energy Resource Management System (RDERMS)

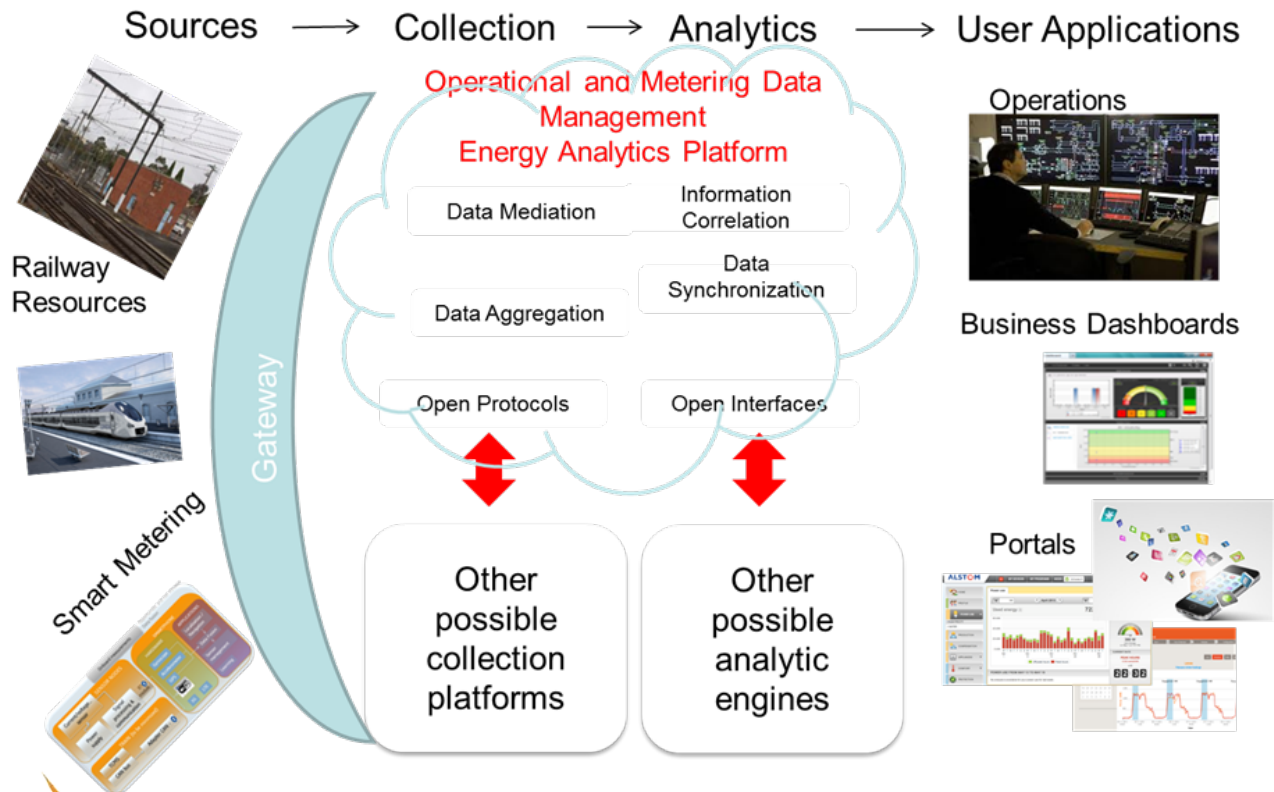
Olivier Langlois  
Alstom



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# Smart Metering

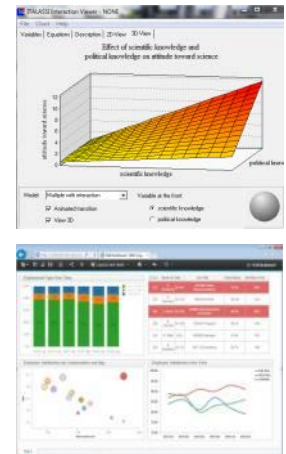
- Aim: design an open system dedicated to the fine mapping of energy flows within the whole Railway System





# Smart Metering

- Experimentation in Reims



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# Rail Power Supply and Energy Management – Questions & Answers

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# In2Rail - Event Summary

Andy Doherty



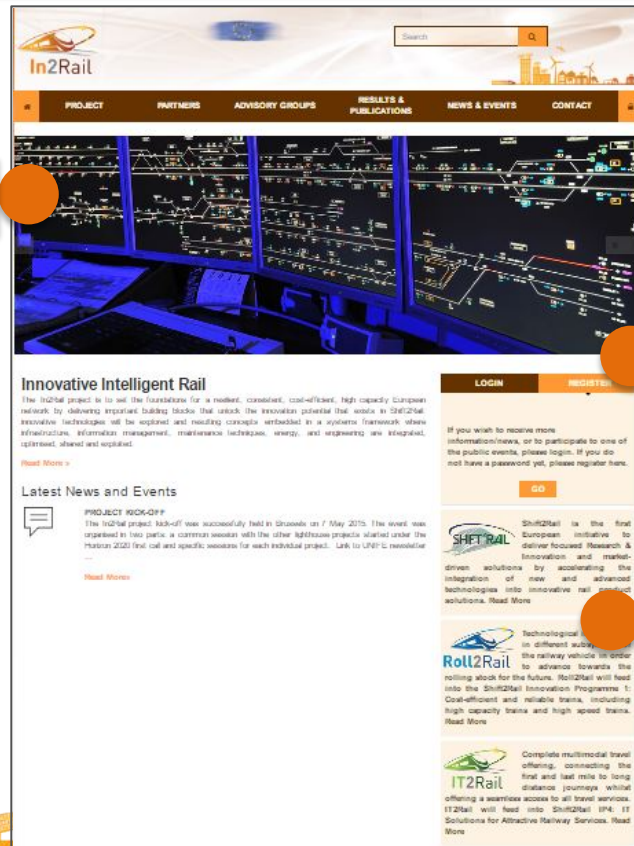
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# More Information Available

## 1. Visit [www.in2rail.eu](http://www.in2rail.eu)

Events



Deliverables

Project description

## 2. In2Rail newsletter



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# Questions

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Maintenance Strategies  
Technology transfer

Radical Innovation

Capacity  
Reliability

New technology

Adaptive control

Low noise and vibration

Smart Infrastructure

Efficient

Switch & Crossings

Sustainable  
Mechatronics

Data telemetry  
Performance improvement

Safe by design

Life Cycle Costs

Rail Power Supply  
and Energy Management

Track

Intelligent Mobility  
Management

Optimisation of Asset Management

