Digital operations for enhanced performance and capacity in European railways

Introduction

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Network Rail
Background: EC Objectives

EC White paper on transport (2011) set objectives to be achieved by 2050

- Improving competitiveness by increasing mobility and removing barriers
- Reduce EU dependence on imported oil and cut carbon emissions by 60%

- No more conventionally-fuelled cars in cities
- 40% use of low carbon fuels in aviation 40% cut in shipping emissions
- 50% shift of medium distance IC passenger and freight journeys from road to rail and waterborne transport
**Background: EC Roadmap to achieve 2050’s objectives**

- **2020**
  - EU Framework for multimodal transport information, management and payment system
  - Complete modernisation of Europe's air traffic control system. Completion of the European Common Aviation Area

- **2030**
  - 30% of road freight over 300 km shift to rail or waterborne transport
  - Functional EU-wide core network of transport corridors (TEN-T) including intermodal facilities

- **2050**
  - more than 50% of road freight shift to rail or waterborne
  - connect all core airports and seaports to the rail network (possibly HS)
  - High Quality – High Capacity for TEN-T network
Criticalities: Rail network saturation

Massive increase pax and freight demand

- Poor customer satisfaction
- Poor performance

Network capacity saturation

- Reduced robustness
- Reduced resilience

Decreased timetable stability

- More frequent faults
- Higher maint. costs

Over-use of railway assets

Source: European Environment Agency
Criticalities: Example of current situation in UK

Britain is running out of space for the trains it needs
- Britain’s railway carries twice as many passengers as it did just two decades ago.

- Key routes are overcrowded, nearly a quarter of all commuters travelling into London are reported as standing.

- A billion extra journeys is expected to load the network by 2030. At the same time, more space for freight trains is needed, which shift £30 billion of goods annually saving 76% of CO\textsubscript{2} emissions w.r.t road alternative.

Official forecast by NR for the DfT, source www.digitalrailway.co.uk
Possible solution

Enhancing current railways with advanced technologies and optimised operations

This is expected to provide:
- Higher **Capacity**
- Improved **Robustness**
- Better **Resilience**
- Increased **Affordability**
- Full **Automation**
- Enhanced **Adaptability**
Objectives of C4R

Improving Capacity, Robustness, Resilience, Affordability, Automation and Adaptability of railways by:

- Setting up a vision for the railways in 2030 and 2050
- Developing innovations for enhanced infrastructure and operations
- Assessing the impact of developing technologies with on-track demonstrations and multi-criteria analyses
Innovations of C4R

C4R innovations include step changes to:

- Infrastructure design,
- Construction and maintenance, including advanced monitoring
- Operation management
- Incident recovery through real-time data management
- Freight operations, with a particular focus on trans-shipment and improved performance of rolling stock
Similar C4R innovations in UK National development programme “DR”

The Digital Railway (DR) is a UK National programme which will deploy infrastructure enhancements and advanced technologies to increase capacity, improve connectivity and reliability of the UK railway network.
Project structure breakdown

**SP5 - Migration**
- **State of art**
- **Vision**
- **Roadmap**
  - Scenarios for smooth migration from now to 2050

**2020**
**2030**
**2050**

**SP1 - Infrastructure**

**SP2 – New concepts for efficient freight**

**SP3 - Operation for enhanced capacity**

**SP4 - Advanced monitoring**

**SP6 – Dissemination and management**

Assessment of the full sustainability of the developed solutions

Demonstration

Recommendations, roadmap
Project structure breakdown

SP1 - Infrastructure

SP2 – New concepts for efficient freight

SP3 - Operation for enhanced capacity

SP4 - Advanced monitoring

SP5 - Migration
  State of art
  Vision
  Roadmap

Scenarios for smooth migration from now to 2050
Assessment of the full sustainability of the developed solutions
Demonstration

SP6 – Dissemination and management
Capacity for Rail

SP1 Infrastructure
To develop new concepts for railway track of the future, in view of potential application for mixed traffic, but also very high speed.

SP1 is focusing on:

- Developing low maintenance and modular designs of slab tracks for mixed traffic
- Understanding and solving the current obstacles to very high speed traffic (over 350 km/h).
- Analysing the failure mode and developing breakthrough innovative concepts to improve the reliability of switches and crossings.
SP1-Scope and main objectives

- “New track concept generation, selection & design - Slab track concept”
  Amador Quintana – INECO

- “Effect of very high speed on track and bridges”
  Erica Calatozzo, SYSTRA

- “New approach to maintenance based on advanced sensors and monitoring technologies in S&C”
  Edd Stewart, University of Birmingham

- “Understanding root causes of S&C defects and assessing effective remedies”
  Yann Bezin, University of Huddersfield
Capacity for Rail

SP4 Advanced monitoring
SP4-Scope and main objectives

The objective of SP4 is to develop new concepts for railway structural and operational monitoring, in order to enhance the availability of the track, combined with automated maintenance forecasts and a prediction of the structural lifetime.
SP4-Scope and main objectives

- Monitoring strategies
- Monitoring technologies and sensors
- Implementation in new structures
- Migration of innovative technologies to existing structures

✓ “Advanced Monitoring and diagnostics of track infrastructure for predictive track maintenance”
  Gunnar Baumann, DB

✓ “Sustainable strategies for monitoring in slab track”
  Javier Morales, CEMOSA
Capacity for Rail

SP5 System assessment and migration to 2030/2050
SP5-Scope and main objectives

SP5 is drawing the common vision for an affordable, adaptable, automated, resilient and high-capacity railway.

SP5 is developing a ‘roadmap’ to pave the way for the target system.

The SP ensures a whole system approach across the SPs to identify the visions, future requirements and boundaries:

- By identifying the necessary steps
- Developing the migration scenarios
- Improving the tools for assessment
- Assessing of technologies/scenarios
- Identifying the optimal capacity enhancement scenarios
- Performing demonstrations

✓ “Migration strategies for innovative track solutions 2030/2050”

Burchard Ripke, DB
SP2 New concepts for efficient freight systems
SP2-Scope and main objectives

Develop the rail freight system of the future
- Describe today’s and future demand for rail freight.
- Analyse existing/future customer requirements for different goods segments.
- Describe scenarios up to 2030/2050.
- Specify requirements for an efficient rail freight system 2030/2050.
- Conceptually design the rail freight vehicles of the future to enhance capacity.
- Conceptually design transhipment technologies of the future.
- To produce a catalogue on rail freight systems to contribute to the EC goals.
- To suggest standards for fully integrated rail freight systems.
SP3 Operations for enhanced capacity
Developing a set of tools and guidelines supporting decisions across the entire ‘operational process’ chain from strategic planning to real-time traffic management.
SP3-Structure and WP

- STRATEGIC LEVEL PLANNING
- TACTICAL LEVEL PLANNING
- OPERATIONAL LEVEL PLANNING

WP3.1
Capability trade-offs
SP3-Structure and WP

WP3.1 Capability trade-offs

WP3.2 Models for enhanced capacity
SP3-Structure and WP

WP3.1 Capability trade-offs

WP3.2 Models for enhanced capacity

WP3.3 Strategies for major disturbances
SP3-Structure and WP

WP3.1
Capability trade-offs

WP3.2
Models for enhanced capacity

WP3.3
Strategies for major disturbances

WP3.4
Ubiquitous data and architecture

STRATEGIC LEVEL PLANNING

TACTICAL LEVEL PLANNING

OPERATIONAL LEVEL PLANNING
Tools for strategic, tactical and operational planning are provided together with recommendations to pave the way for an improved process for managing disruptions in European railways.

Optimised LoS and QoS during disruptions.
The roadmap to increase automation is given together with the architecture layout to enable data communication among the different systems, traffic control centre, customers and other modes of transport.
SP3 Team

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