Capacity4Rail
Toward a resilient, innovative and high capacity European railway system for 2030/2050

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The overall objective of CAPACITY4RAIL is to increase capacity, availability and performance of the railway system through major step changes in:

- infrastructure design
- construction and maintenance (including advanced monitoring)
- operation management
- Recovery from disruptions
- freight operations and specification for rolling stock

- FP7 – 6th call SST.2013.2-2 topic on “New Concept for Railway infrastructure and operation: adaptable, resilient and high capacity
- Budget 15 M€ (9.9 EU funded)
- Start date: 01/10/2013
- Duration: 48 months
- Partners: 46
- Grant Agreement: 605650
Addressing the capacity issue

- **Adding more resources, more infrastructures**
  - Financial constraint
  - Very long term impact
  - Environmental impact

- **Reduction of capacity-consumers**
  - Resilient infrastructure
  - Low maintenance infrastructure
  - Minimum possession for maintenance and inspection
  - Fast renewal and construction
  - Reliable vehicles

- **More efficient use of existing resources**
  - Optimisation of operating strategies
  - Traffic planning
  - Transhipment procedures
  - Better recovery from traffic disruption

- **Improved performance of existing resources**
  - Higher carrying capacity of trains
  - Higher speed of freight trains
Building on existing research
Project structure breakdown

**SP1 - Infrastructure**

**SP2 - Freight**

**SP3 - Operation and capacity**

**SP4 - Advanced monitoring**

**SP5 - Migration**
- State of art
- Vision
- Roadmap

**SP6 - Dissemination**

Scenarios for smooth migration from now to 2050

Assessment of the developed solutions

Demonstration

**Recommendations, roadmap**

STS N° 23  Laurent Schmitt  TRA2014 Paris 14-17 avril 2014
C4R five key drivers

- **Affordable**
  - Mode of choice for investors and users
  - Optimised CAPEX, OPEX, LCC, transparent and predictable
  - Minimised impact on environment

- **Adaptable**
  - Flexible and extensible, adapted to economical environment
  - Able to cope with daily, weekly, yearly or seasonal variations

- **Automated**
  - To release human resources for high value activities
C4R five key drivers

- **Resilient**
  - Robust – low incidence of failures
  - Able to quickly recover from disturbed conditions
  - Not only dramatic disturbances but also minor deviations

- **High Capacity**
  - Virtually no constraints on operations
  - Can accommodate customer’s demand at any time
  - Tolerates interventions with minimal impact
SP5 – Assessment and Migration

- Customers’ vision and expectations
  - EU strategy
  - National strategies
  - Market analysis
  - Other projects
  ...

- Identification of gaps and bottlenecks
- SoA per SP areas
- Set up a roadmap
- Demonstration
- Global assessment of innovative systems / 5 key drivers
- Identification and description of scenarios

Vision

2050

2030

2020

State of art
Innovative concepts

- Focusing on slab track solutions
- Adapted for future mixed traffic conditions (SP2, 3)
- Cost-efficient design and construction
- Modular design.
- Integrated energy supply and signalling
- Noise & vibrations
- Upgrade of existing
SP1 – Infrastructure
New concepts for mixed traffic and VHS

- Very high speed (>350 km/h)
  - Cross-compatibility with high speed freight
  - Identification of limitations to VHS
  - Noise, vibration
  - Ballast projections
  - Dynamic short term behaviour of VHST
  - Bridge design, transition zones
Switches and crossings

- Prioritisation according to operational failure modes
- Innovative designs minimizing S&C loads and material deterioration
- Automatic monitoring of S&C critical elements
- Resilience to natural hazards
Modern fully integrated rail freight system for 2050

1. Customer-oriented vision within different good segments, to identify future demand.
2. Gap analysis for vehicles, intermodal systems and operation principles
3. Specification of development to be implemented
4. Conceptually design the rail freight vehicles of 2015, 2020, 2030

Identification of gaps and requirements

Better performing wagons
Better performing trains
Better performing freight system
Market needs:
- Continuous dynamic information
- Door-to-door competitive and frequent service
- Reliability

Technological challenges:
- Increasing the speed without decreasing the load
- Improve train manoeuvrability: instant braking and acceleration capabilities
- Intelligent and connected wagons
- Industrialisation of train production -> automatic coupling
SP3 - Operations

- **Capability trade-offs**
  Review of planning and operational approaches

- **Models and simulation**
  Framework for modelling and simulation allowing evaluation of new operational concepts

- **Optimal Strategies**
  Definition of operational strategies for recovery from extreme situations

- **Data Modelling and supporting data architecture**
  for the collection, integration and management of data in operational decision making

Diagram:
- Capacity
  - Today
  - +20%
  - e.g. Traffic Management (Dispatcher Support)
  - 2020
  - e.g. Driver Advisory Systems
  - e.g. Automated Driving

Legend:
- Level of automation of operation
Introducing new technologies for advanced monitoring solutions

- Miniaturisation,
- Low power consumption,
- Easy integration into structures and components,
- Wireless data exchange
- Migration from other industries to railway.

Implementation in existing and new structures
Technology Readiness Levels

Demonstration
- TRL9: Actual system qualified through operation
- TRL8: Actual system qualified through test
- TRL7: System prototype in Operational environment
- TRL6: System prototype in relevant environment
- TRL5: Component validated in relevant environment
- TRL4: Component validated in lab
- TRL3: Analytical experimental proof of concept
- TRL2: Technology concept formulated
- TRL1: Basic principles observed

Further development (e.g. Shift²Rail)

Roadmap for further research
## Projects outputs

### Specifications
- Future slab track systems and new concepts of switches and crossings
- Desirable standards for wagons, locomotives, gauge, infrastructure design, train and infrastructure management
- Use of sensors in railway environments and wireless transmission

### Guidance documents
- Combined rams and cost-oriented design of infrastructure
- Design of flood-resilient track systems and subgrade; bridges for very high speed.
- Optimised slab track and self-monitoring switches
- Freight terminal design - Efficient freight vehicle systems
- Incident and emergency management

### Demonstration
- New concepts of self-monitoring switches
- Innovative slab track system
- Retro-fit monitoring systems on existing infrastructures
The C4R consortium
Conclusion

- **Opportunities**
  - A project bringing together the whole range of rail stakeholders
  - A close link with the past and current research as well as the future Shift²Rail initiative
  - There is a political will and a pressure from customers and public in favour of technical solutions for a better performing railway.
  - Better chance for implementation

- **Challenges**
  - Railway is a complex and sensitive system
  - How to trade-off the requirements of different businesses and traffics?
  - Implementability and migration are key issues
  - Only affordable solutions will drive traffic back to rail
Thank you for your kind attention

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