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Transport Solutions:
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Innovate Mobility, Mobilise Innovation!
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# Capacity4Rail

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

Schmitt, Laurent*, UIC, France
Létourneaux Fabien, Systra, France
De Keyzer, Isabelle, UIC, France
Crompton, Paul, ARTTIC, Belgium

* *lschmitt@uic.org*

# Project ID

- 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

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

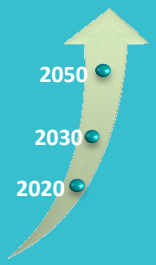
- infrastructure design
- construction and maintenance (including advanced monitoring)
- operation management
- Recovery from disruptions
- freight operations and specification for rolling stock

# Addressing the capacity issue

- **Adding more resources, more infrastructures**
  - Financial constraint
  - Very long term impact
  - Environmental impact
- **More efficient use of existing resources**
  - Optimisation of operating strategies
  - Traffic planning
  - Transhipment procedures
  - Better recovery from traffic disruption
- **Reduction of capacity-consumers**
  - Resilient infrastructure
  - Low maintenance infrastructure
  - Minimum possession for maintenance and inspection
  - Fast renewal and construction
  - Reliable vehicles
- **Improved performance of existing resources**
  - Higher carrying capacity of trains
  - Higher speed of freight trains

# Building on existing research

# Project structure breakdown




**SP5**

**Migra-tion**

State of art

⇩

**Vision**

⇩

Roadmap

**SP1 - Infrastructure**

**SP2 - Freight**

**SP3 - Operation and capacity**

**SP4 - Advanced monitoring**

**Recommendations, roadmap**

Scenarios for smooth migration from now to 2050

Assessment of the developed solutions

Demonstration

**SP6 - Dissemination**

# 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

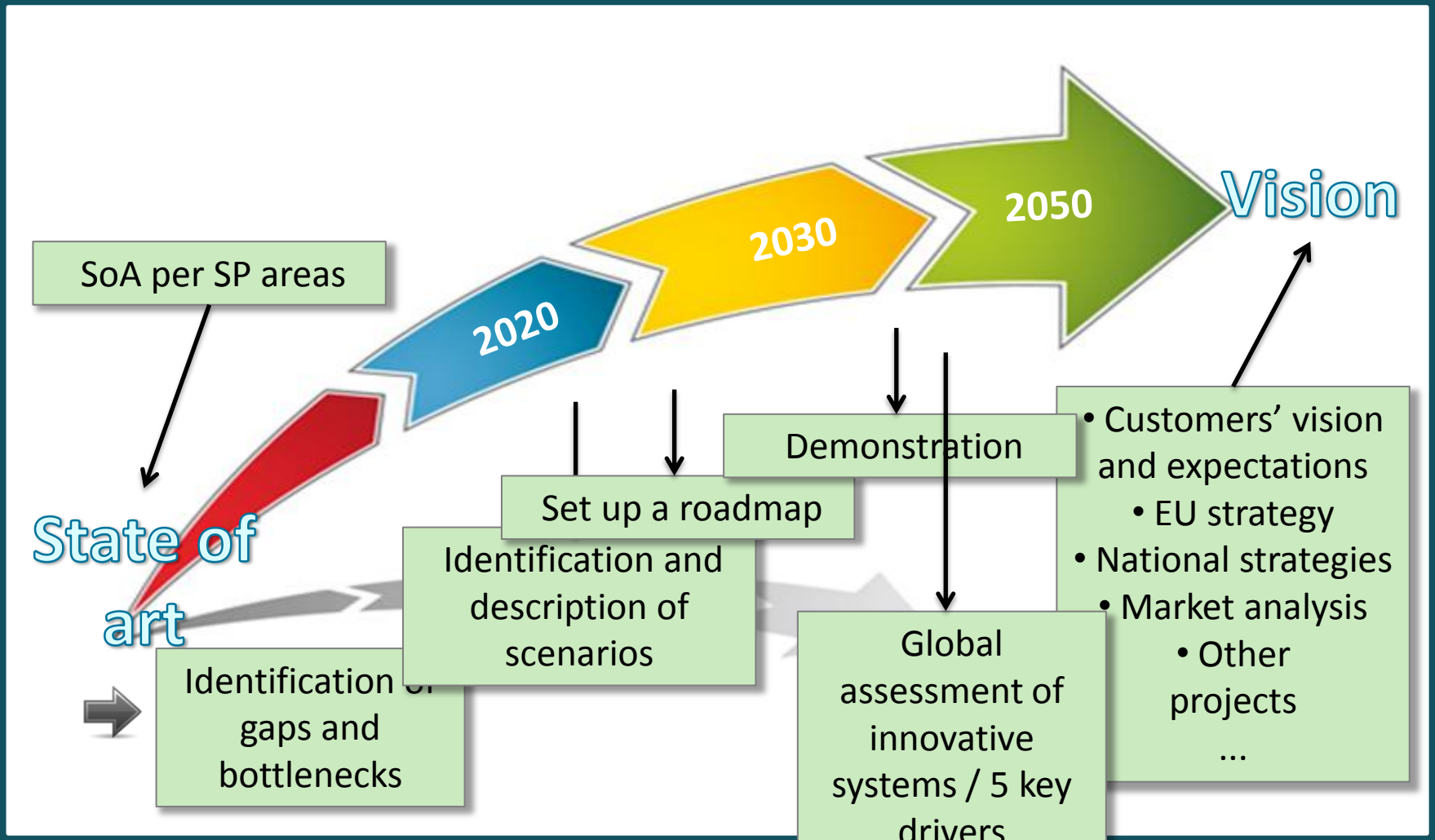
## Resilient

- 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



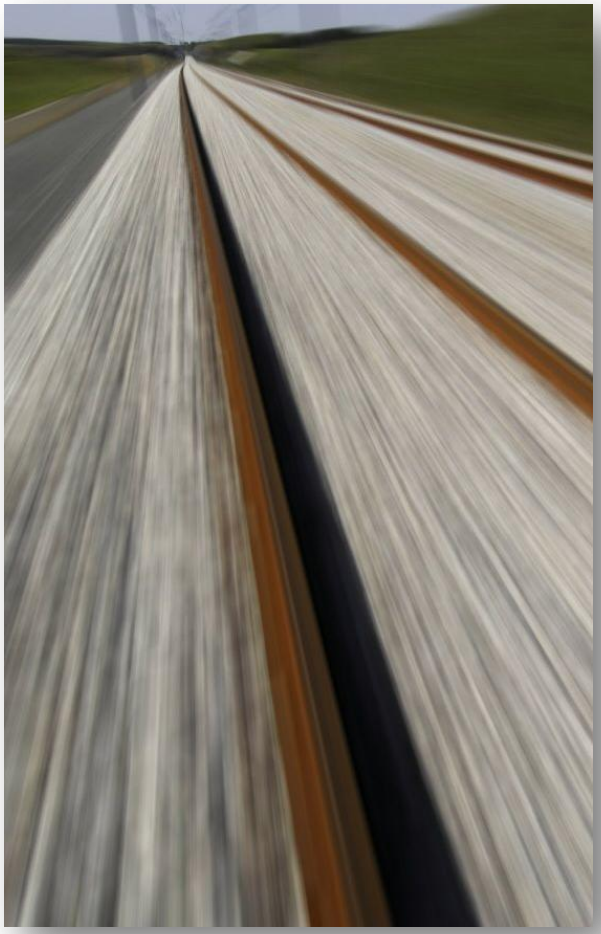
# SP1 – Infrastructure
## New concepts for mixed traffic and VHS

### 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

# SP1 – Infrastructure

## New concepts for mixed traffic and VHS

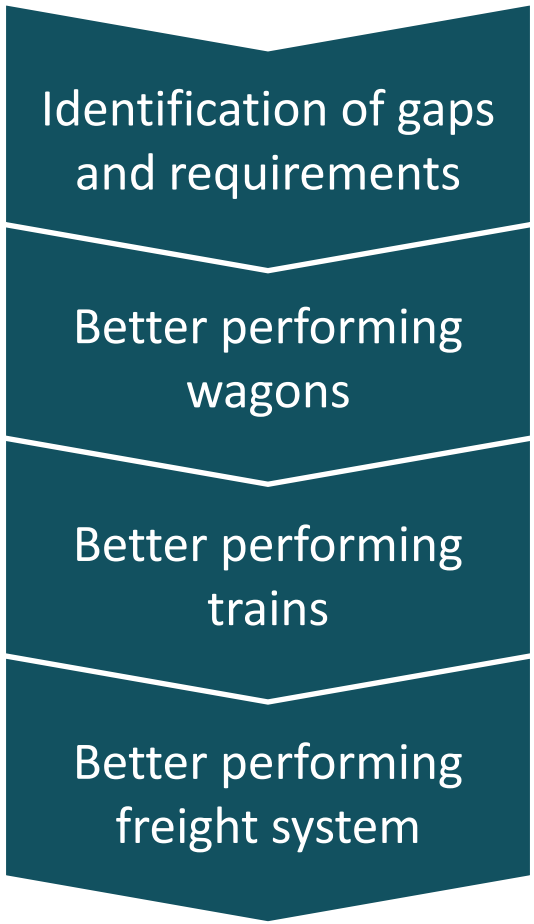
### Switches and crossings

- 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

# SP2 - Freight

- **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

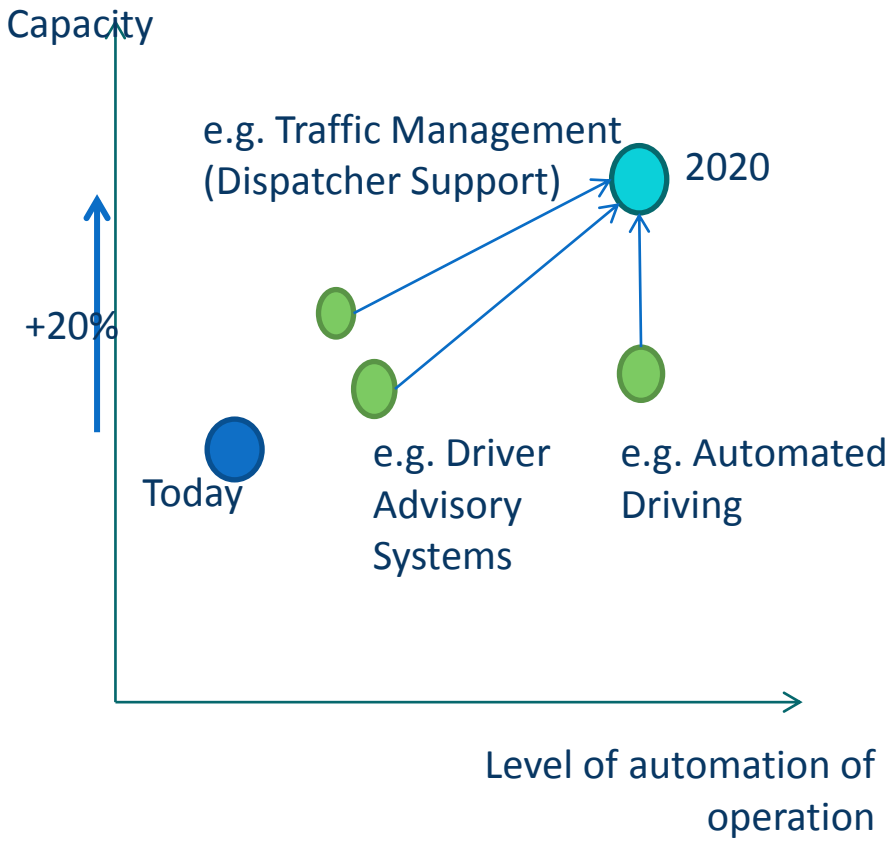


# SP2 - Freight

- **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**

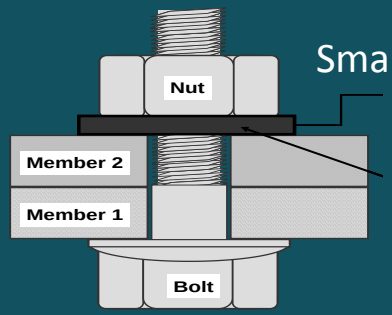
  Definition of operational strategies for recovery from extreme situations
- **Data Modelling and supporting data architecture**

  for the collection, integration and management of data in operational decision making

# SP4 - Advanced Monitoring

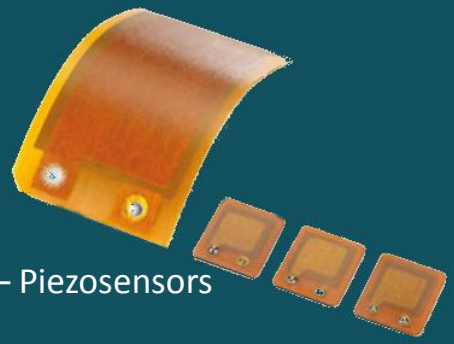
- **Introducing new technologies for advanced monitoring solutions**
  - Miniaturisation,
  - low power consumption,
  - easy integration into structures and components,
  - wireless data exchange
  - Migration from other industries to railway.

- **Implementation in existing and new structures**

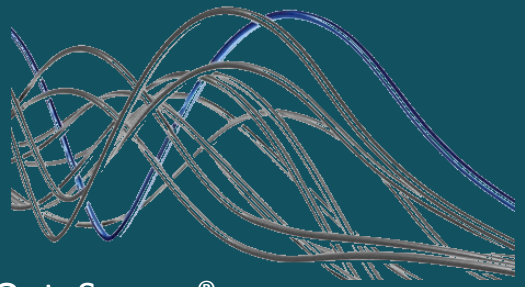



Smart washers

Source: University of Huddersfield



PI – Piezosensors



OptaScense® - sensors

# Technology Readiness Levels

Demonstration

Further development
(e.g. Shift²Rail)

Roadmap for
further research

| | |
|---|---|
| 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 |

# 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

C4R
Capacity for Rail

Collaborative project SCP3-GA-2013-60560

www.capacity4rail.eu

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SEVENTH FRAMEWORK PROGRAMME