C4R

Capacity for Rail

WP4.1 Monitoring Strategies and evaluation, Algorithms

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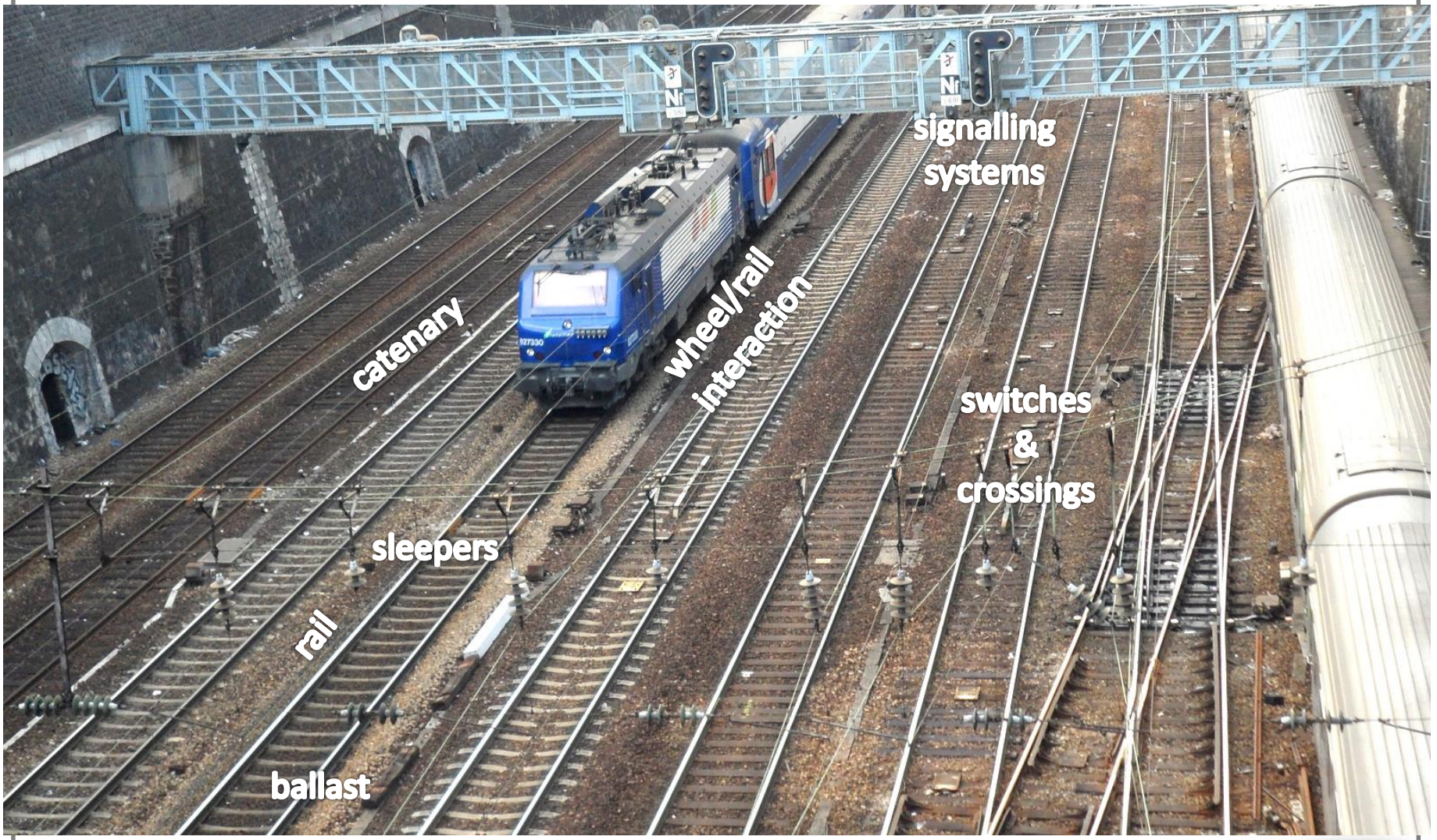
SEVENTH FRAMEWORK
PROGRAMME

SP4 - Advanced Monitoring

Scope



Capacity4Rail SP4

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WP4.1 – Monitoring strategies and evaluation

- Current monitoring procedures
- What to monitor and how to interpret
- Benefits and costs of increased monitoring

WP4.2 – Monitoring technologies & sensors

- Potential sensor, energy harvesting, communications and data integration technologies

WP4.3 – Implementation in new structures

- Design of advanced monitoring system

WP4.4 – Migrating new solutions to existing structures

- Provide retrofit kits

SEVENTH FRAMEWORK PROGRAMME

Task 4.1.1 Critical components and systems

Critical components in railway infrastructure

- Switches, signalling/interlocking, embankments etc.

Initial situation

- Equipment “state-of –the-art”?
- Improvements available?

Switches & Crossings

- Classification of switches

Other critical components and areas

Task 4.1.1 Monitoring gaps to be filled

- Low cost monitoring – situation today
  - Small market
  - No standards
  - Not made for severe railway environment
  - Dependant of human intervention
- Energy independence
- Wireless data transmission
  - Wireless trend
  - Standards coming

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Take a step back:

- What would we really want to monitor?
  - assess current status
  - predict future deterioration
  - identify potential issues
  - better plan maintenance and inspection etc.
- Identify crucial parameters, not what is available or achievable!

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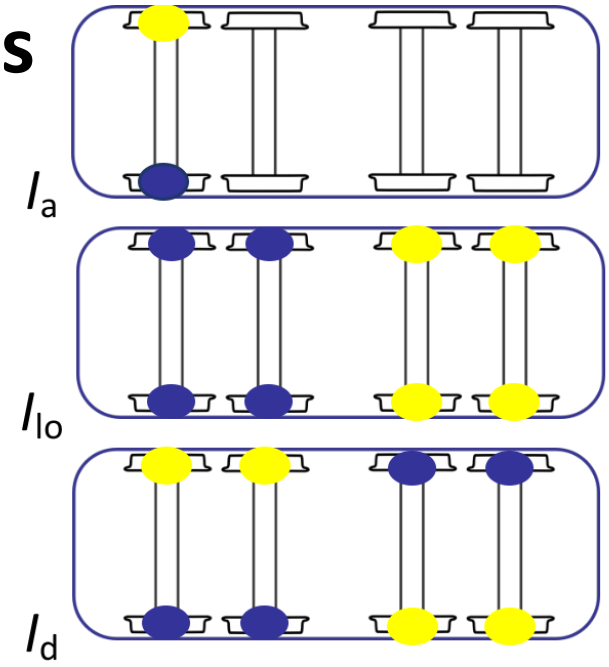
Example: Vehicle characteristics

- Nominal vertical loads
- Impact loads and load imbalances
- Vehicle curving, traction and braking performance
- Wheel profiles
- Overheated wheels and breakdown of bearing boxes
- Noise and vibrations
- Particle emissions



Definition of axial, longitudinal and diagonal load imbalance

Example: Monitoring of railway corridor

- Free space in the load gauge
- Clearance gauge
- Trespassing and animals in track

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Example: Monitoring of track

- Track geometry and stiffness
- Cracks in rails
- Broken sleepers
- Loose fastenings and worn down rail pads
- Monitoring of switches and crossings
- Rail profiles
- Sleeper support
- Ballast condition

WP4.1 – *Reasons for monitoring*

Key performance indicators

- Parameters related to a fully functional operation
- Parameters governing deterioration
- Suitable status indicators

Use of monitoring data

- Evaluation of status (and trends)
- Translation of measured data for use in different models (safety, asset management, deterioration etc)
- Consequences of current operations and prediction of progressive deterioration

WP4.1 – *Reasons – Vehicles*

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Aim of monitoring

- Assure vehicles are safe to operate, avoid operational disturbances and environmental issues
- Aid operators and train owners in operations and maintenance efforts

Example of topic: Wheel and rail profiles

- Key parameters (w.r.t. wear, RCF, flange climbing)
- Status indicators today (e.g. flange thickness) and tomorrow (e.g. full geometry)
- Example of operational systems

WP4.1.3 –Overall approach and implementation of results

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Identification of area or asset to be investigated

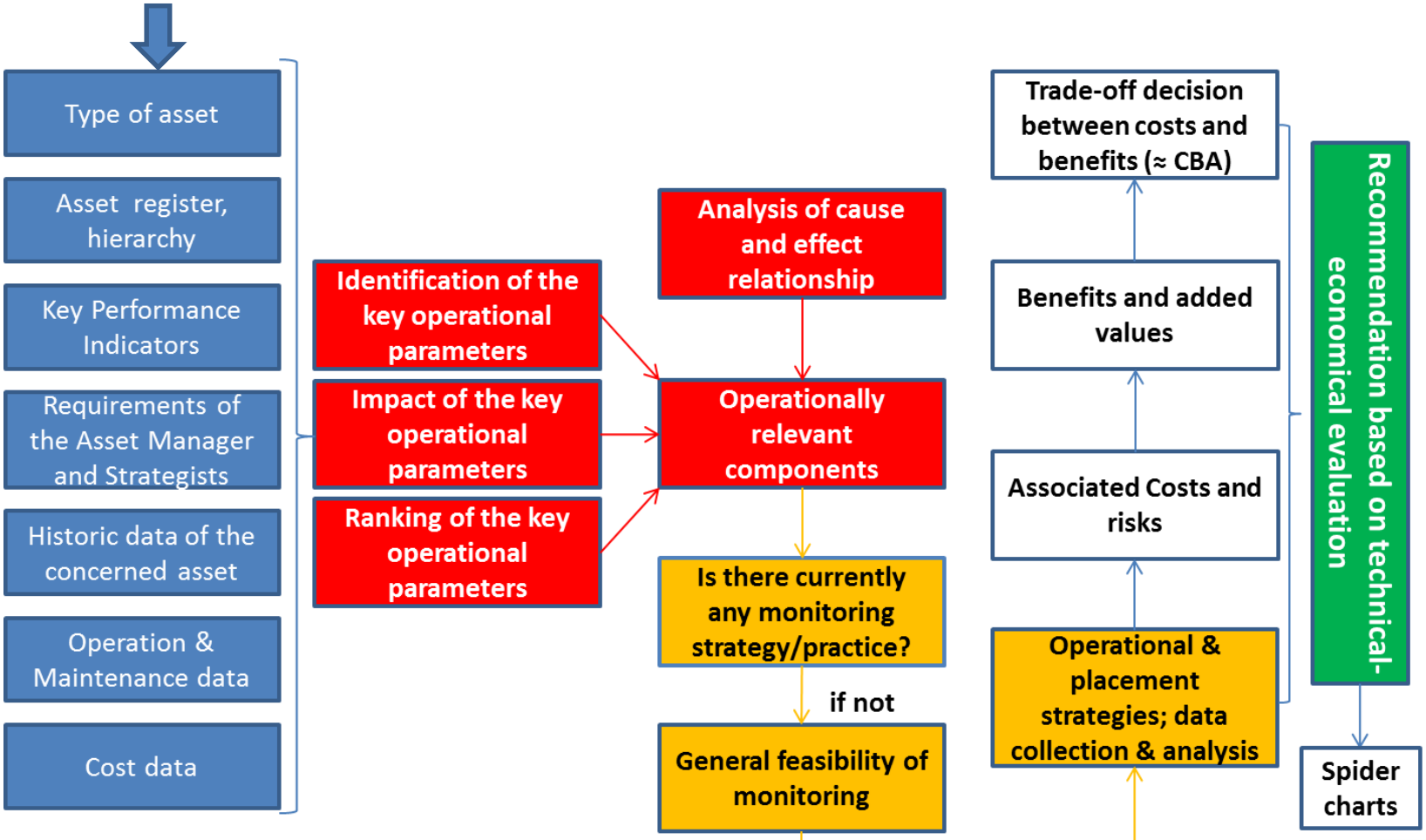

Diagram of decision tree for monitoring recommendations

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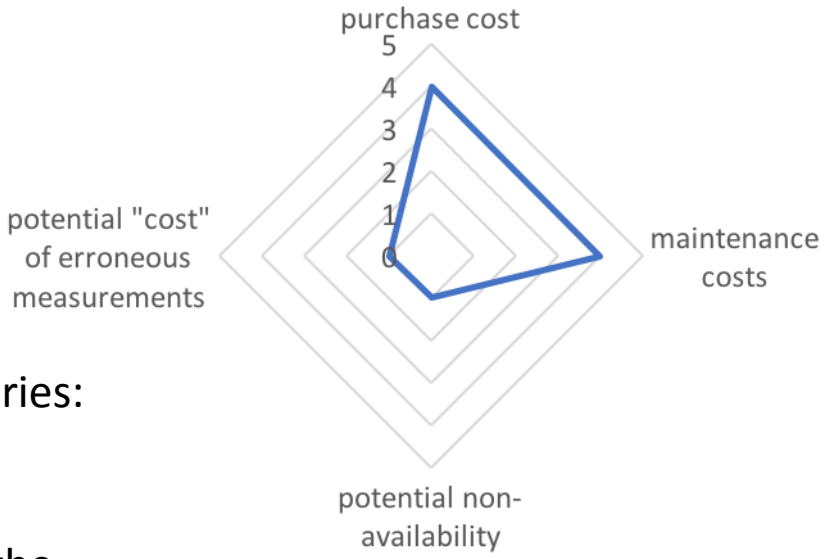
WP4.1.3 –Overall approach and Implementation of results



Here “costs” are divided into the four categories:

- Purchase costs – the cost of buying and installing the equipment
- Maintenance costs – the cost of running the equipment
- Potential non-availability – the cost if the equipment is not functioning; this could e.g. be generated by the need to stop trains
- Potential cost of erroneous measurements – the cost generated by actions due to false alarms

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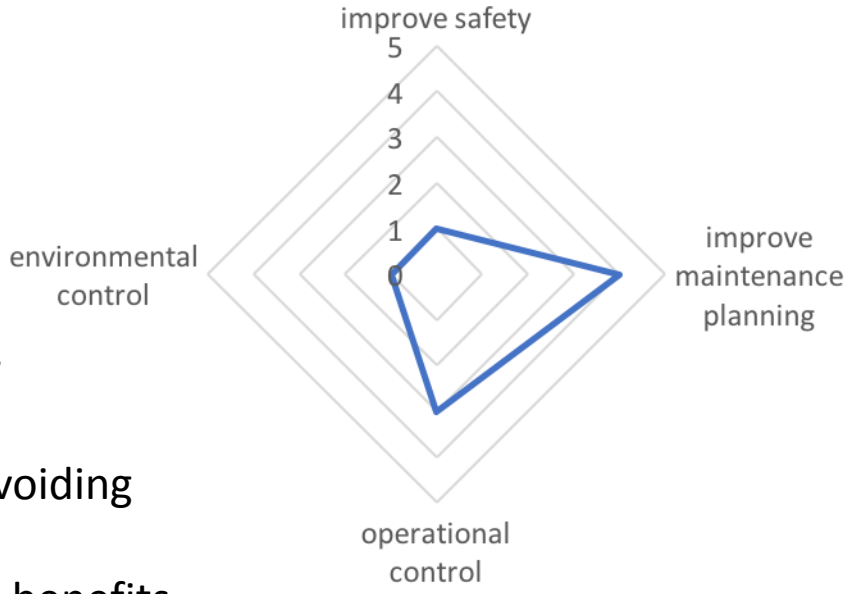
WP4.1.3 –Overall approach and Implementation of results



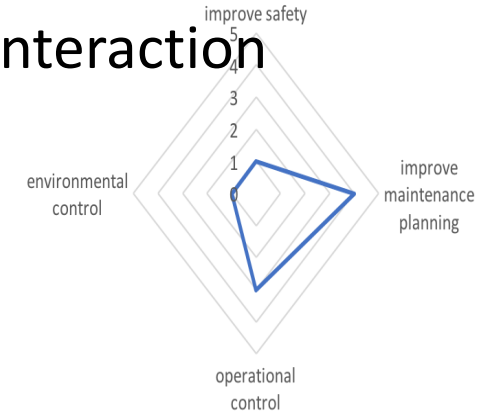
The “benefits” are also divided into four categories:

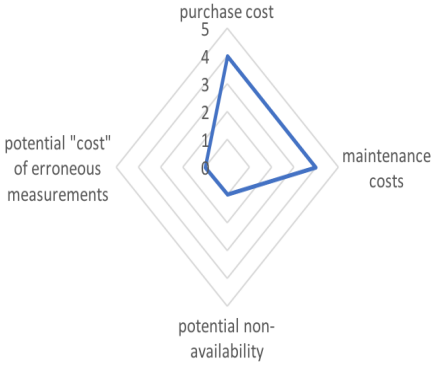
- Improve safety – the benefits from avoiding accidents
- Improve maintenance planning – the benefits from being able to predict maintenance needs
- Operational control – the benefit from e.g. stopping trains that would cause problems
- Environmental control – the benefit from avoiding deteriorating the environment

WP4.1.3 – "Cost" – "Benefit" analysis

Examples of spider charts for all studied areas:

- Monitoring status of vehicles and wheel/rail interaction
  - Nominal vertical load characteristics
  - Impact loads and load imbalances
  - ..
- Monitoring of railway corridor
  - Clearance gauge
  - Trespassing and animals in track
  - ..
- Monitoring of track
  - Track geometry and stiffness
  - Cracks in rails
  - ..
- …





Conclusions - Monitoring potentials

- Trends
  - **Higher speeds** – larger effects of faults and deterioration
  - **Heavier trains** – faster deterioration
  - **More trains** – less time for maintenance
- Challenges
  - **Safety** – railways are safe, monitoring can improve safety …
  - **Reliability** – monitoring can aid a proactive approach …
  - **Environment** – monitoring can ensure and improve …
  - **Costs** – monitoring can improve cost efficiency …

… if the monitoring actions are correctly targeted and information from monitoring is used efficiently

This is shown how it can be done in SP4 ADVANCED MONITORING

Thank you for your kind attention

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