C4R

Capacity for Rail

SP4 Advanced Monitoring

Dissemination Workshop, Paris – 10&11 June 2015

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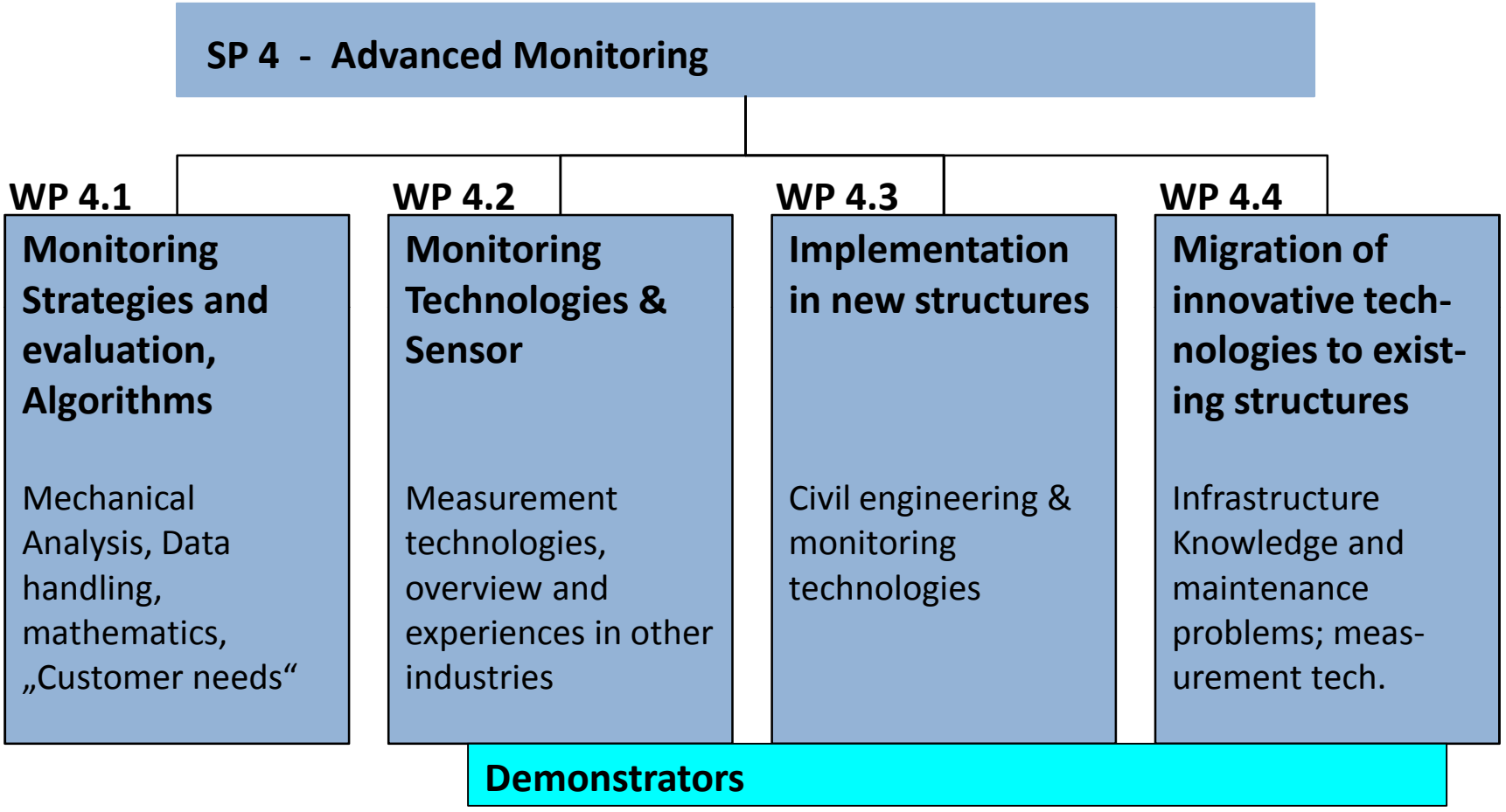
DB NETZE

SEVENTH FRAMEWORK PROGRAMME

SP 4 – Advanced Monitoring

Workpackages and content



General Progress

Steps of the last 18 month …

- Development of a questionnaire for maintenance
- „Wish-list“ for components/systems which should be monitored
- Process for technical and economical assessment
- Definition of requirements for Monitoring Technologies
- Survey of suitable Monitoring Sensors/Technologies
- Application examples for new structures and Retro-fit

Starting point for the questionnaire

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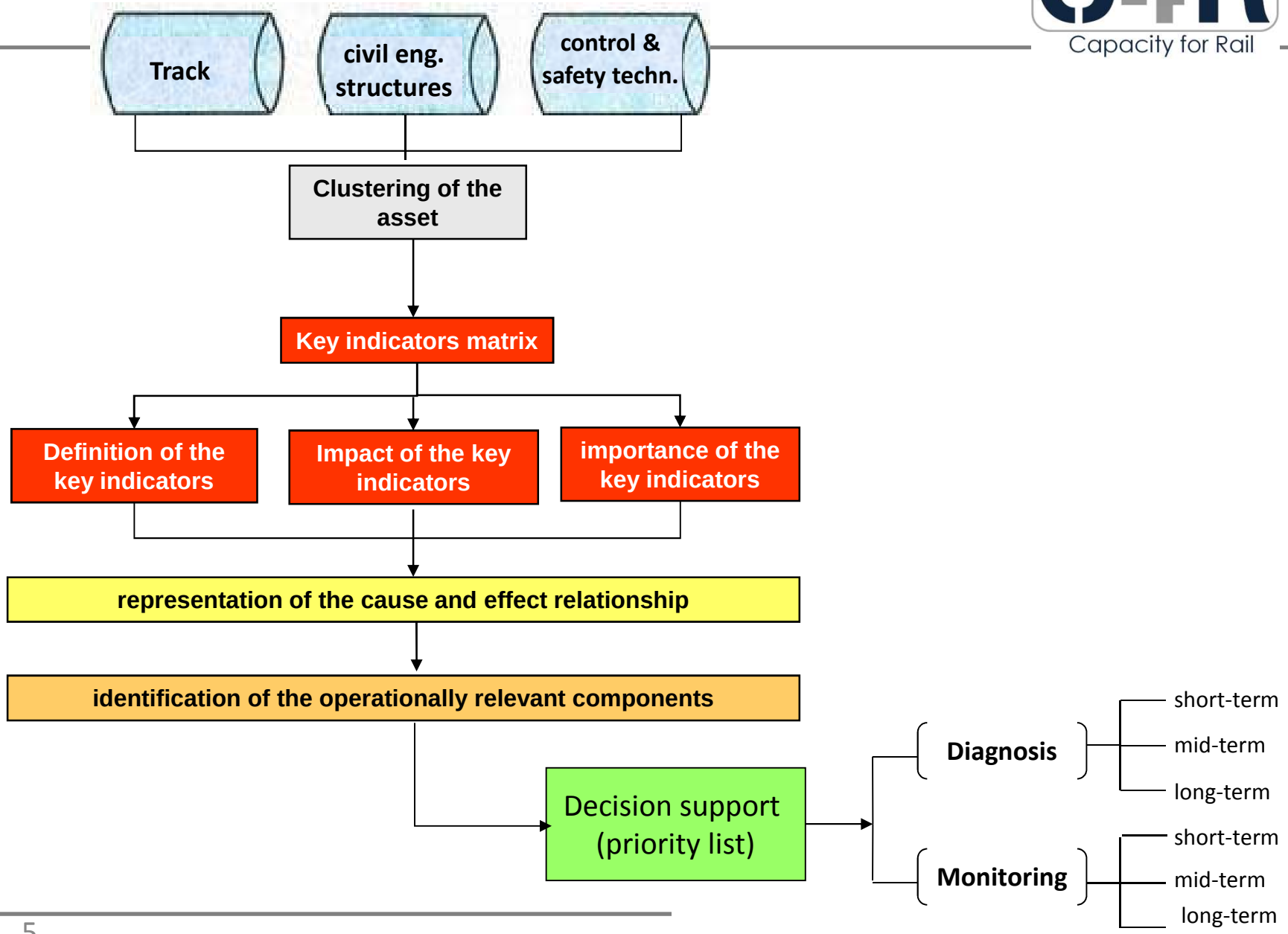
- Target group of the questionnaire are Asset manager and strategists of the railway systems
- Identification of the needs regarding diagnostic and monitoring respectively for short-term, mid-term and long-term perspective
- Create a decision support for diagnostic/monitoring demand based on technical and operational analysis, i. e. to figure out where diagnostic and monitoring respectively is required and to evaluate how much does it cost
- Systems and components of assets for the trades of track, civil engineering structure and control & safety technologies

objective: priority list reg. diagnostic technology and monitoring respectively for new and retrofit components

Description of the flow chart with the necessary steps



Description of the flow chart with the necessary steps

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to identify which asset/ components are concerned

[sheet quantity structure]

Assessment of the relationship between the requirements and key figures (impact of the components on the key figures)

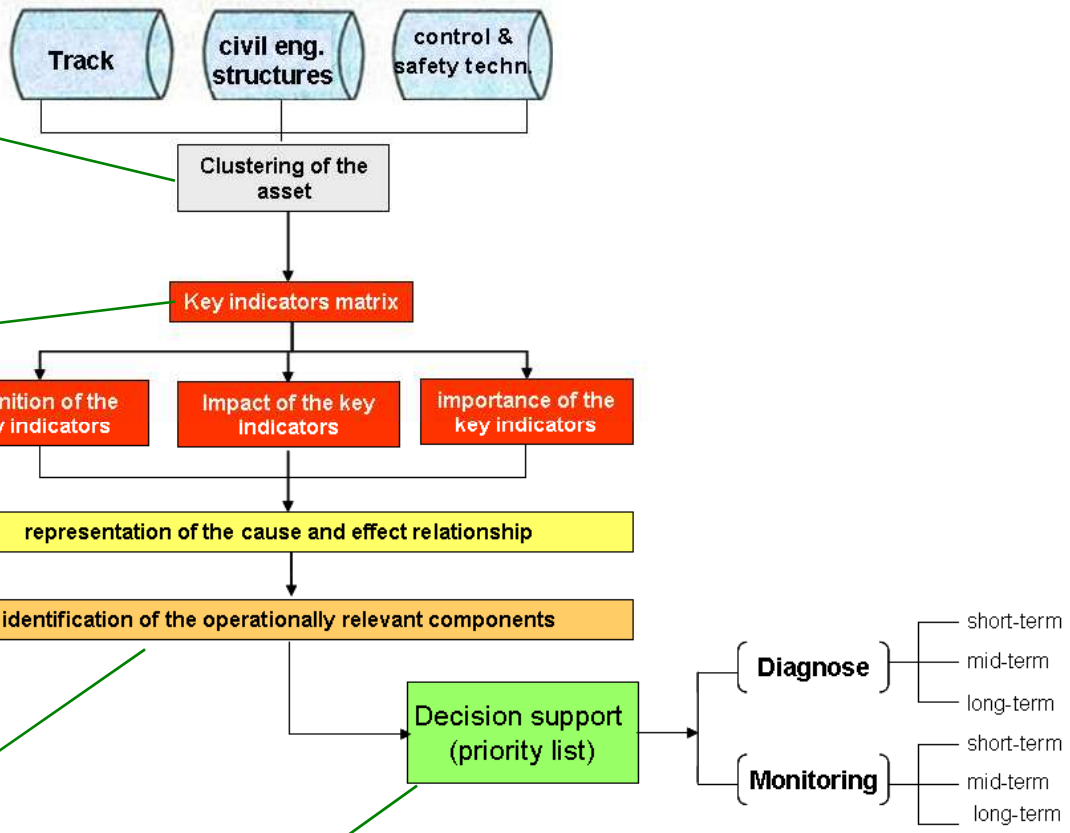
[sheet key indicator matrix]

Identification of the relevant causes and future requirements

[Ishikawa diagram]

particular important components in terms of causes and future requirements (where the negative impact can be mitigated my diagnostic/monitoring?)

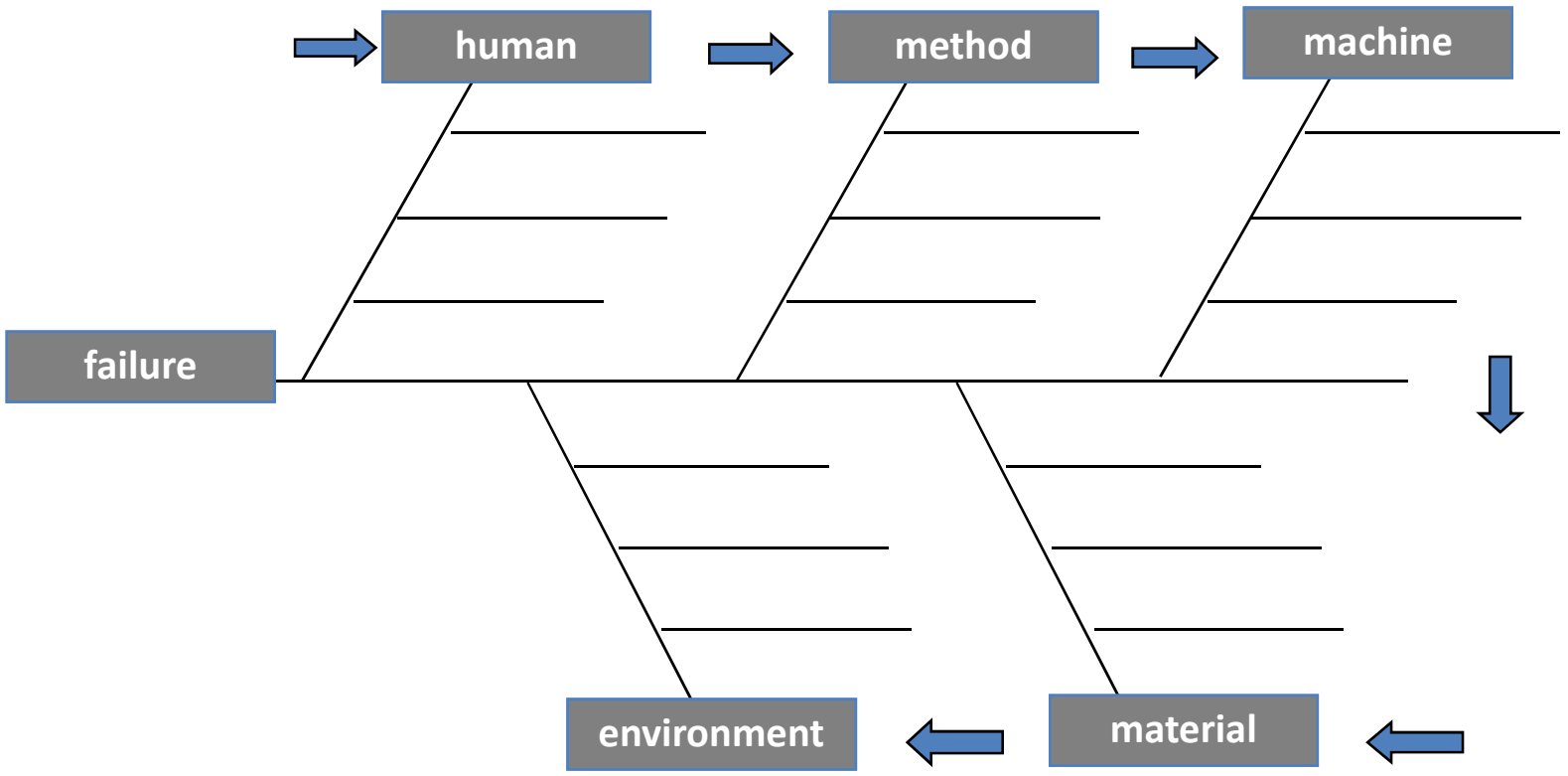
[sheet operationally relevant comp.]



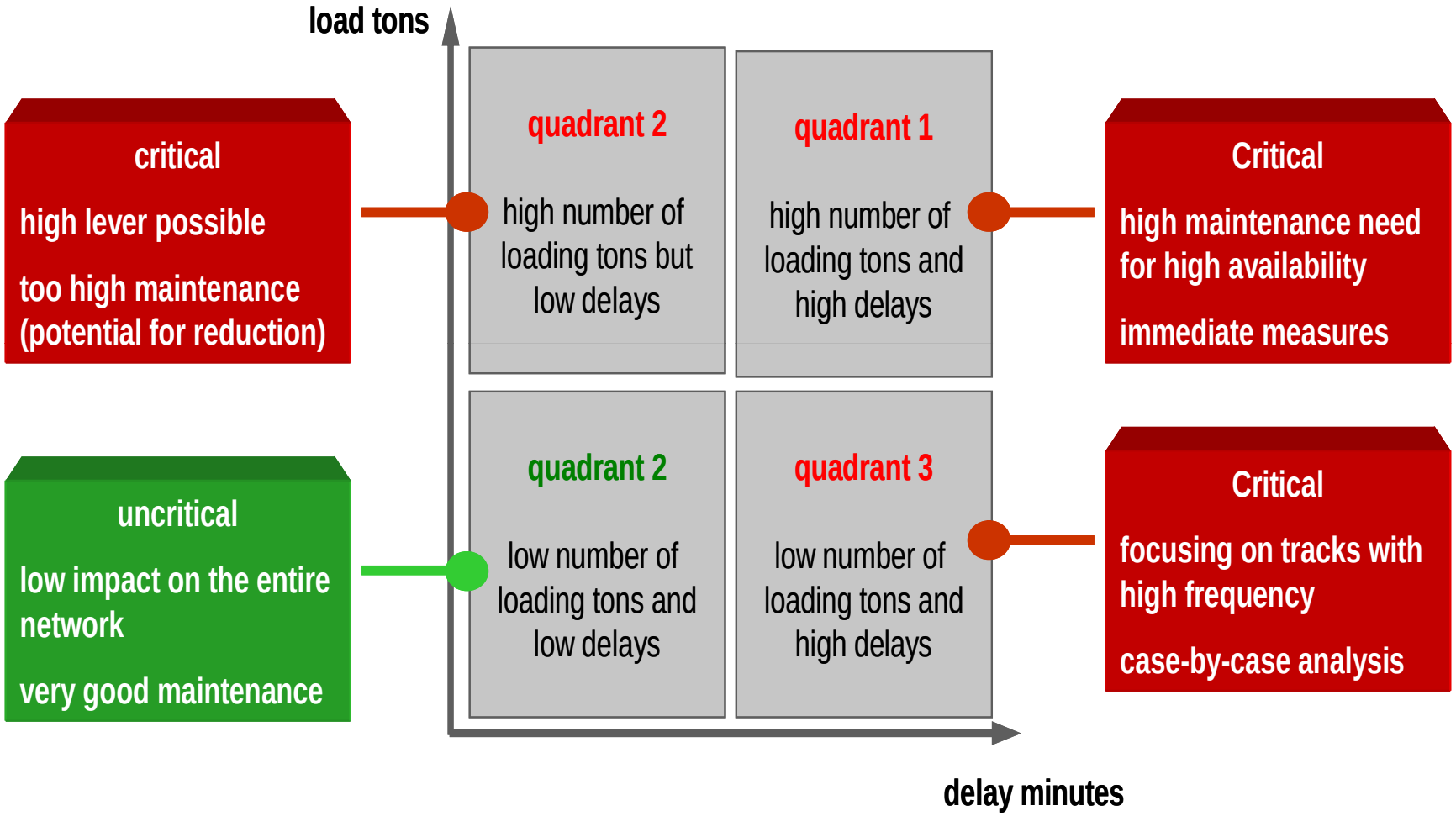
Estimation of the potential reg. diagnostic/monitoring (costs and compliance with the future requirements)

[sheet demand of diagnostic/monitoring]

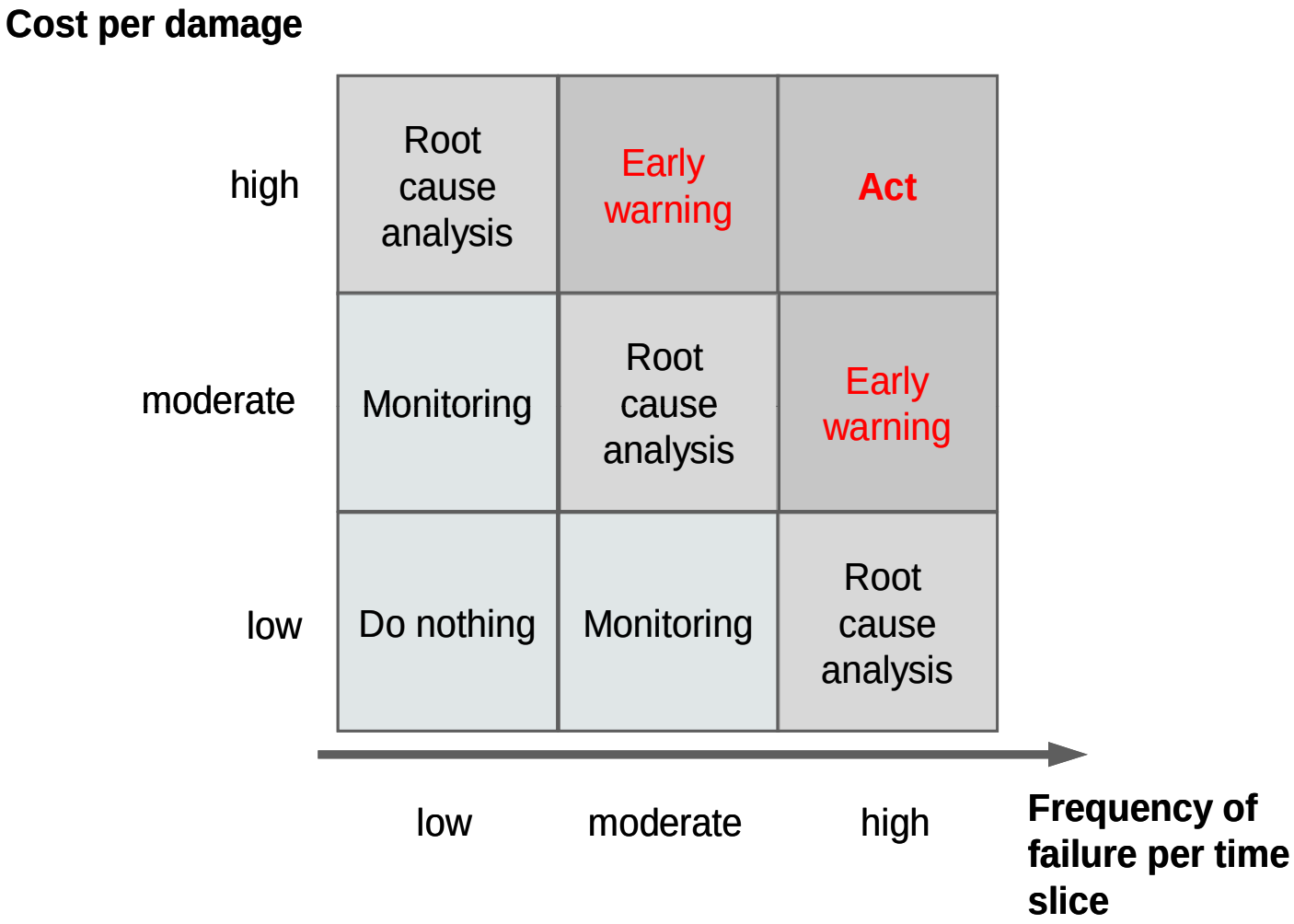
Representation of the cause and effect relationship through Ishikawa diagram



Classification of the switches



Analyses based on the available data



Assessment and decision process

In general, the main objective is to mitigate the number of technical disruptions and delay minutes as well as reducing the related life cycle costs of the switches. In detail, the defined tasks to achieve the objectives are:

- Establishment of simple key performance indicators related to the availability for controlling substantial production means (performance measurement, analysis and monitoring system).
- Classification of all switches on availability criteria
- Definition of equipment standard for the complete system switch (which switch category gets e. g. a heating system, diagnostic or closure compartment cover)
- Development of a strategy for the preventive maintenance and implementation concept
- Target-actual comparison regarding the equipment standard sharply outlined on the switch

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Important differences

Increasing Complexity & Costs

- Monitoring

  Measuring of direct or indirect values to identify unusual product behaviour. (Switches → measurement of the current)

- Diagnosis

  Automatic assessment of measured values. Repeatability ensured by statistic . Clear Knowledge about the behaviour of components or products.

- Inspection (Self-inspection)

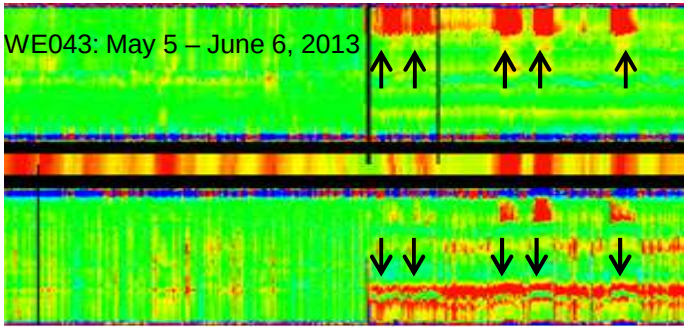
  Measurement or visual assessment of safety relevant behaviours. The measurement accuracy must be at least 10-times better than the value in the specification. (1,0 mm → 0,01 mm)

TRADITIONAL POINT DIAGNOSTICS

DIANA

LONG-TERM POINT MACHINE BEHAVIOUR

Example: Point machine temperature-induced anomalies



Note: Proprietary point diagnostic system reports no error

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Current status for switches

Time scale

- Monitoring

State-of-the-art

- Diagnosis

Current & upcoming technology

- Self-Inspection

Future technology

TRADITIONAL POINT DIAGNOSTICS

DIANA

LONG-TERM POINT MACHINE BEHAVIOUR

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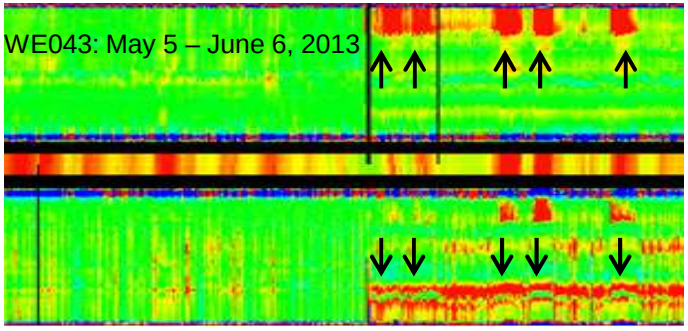

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Open points Example

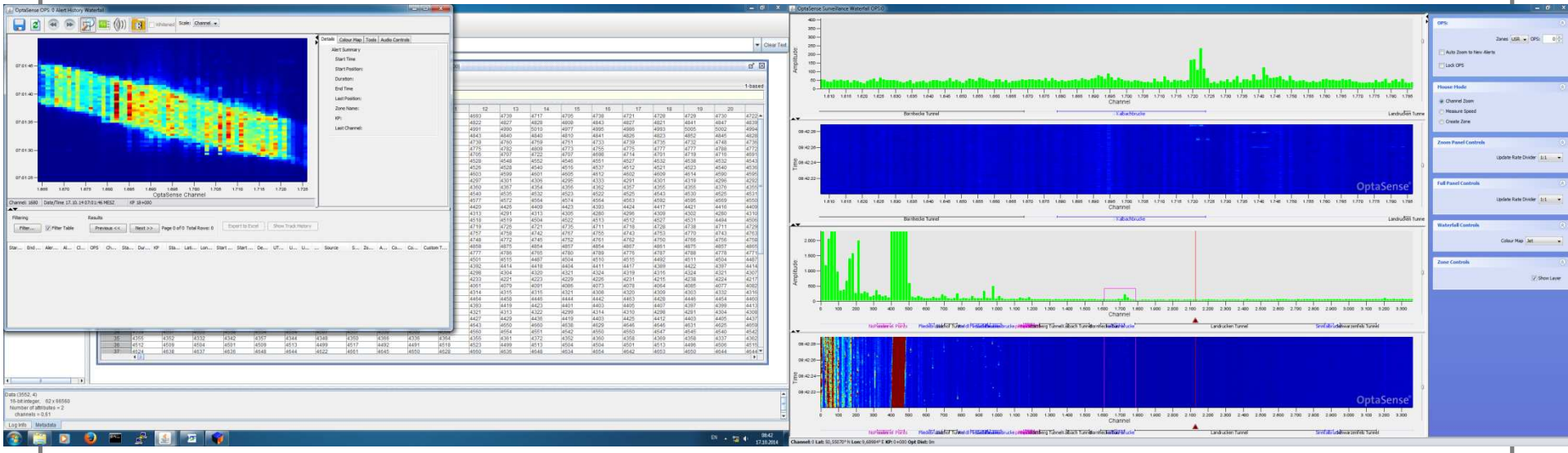
Open points for switches

- Monitoring of Actuating and Locking System is State-of-the-art.

- Necessary is the monitoring of the dynamic behaviour of the switch → Information about track degradation
- Necessary ist the monitoring of the frog for defects – up today identified only by visual inspection

Work progress … searching for added values

- A first evaluation of an „Optasence“-fingerprint of a high-speed line was done and should be analysed by track specialists within the department.



- A comparision with acoustic-monitoring is planned for august to identify further signal patterns for RCM purposes.
→ noise, axle counting, hunting, wheel flats … Input SP3

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WP4.3 Implementation in new infrastructures

Dissemination Workshop, Paris – 10&11 June 2015

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SEVENTH FRAMEWORK PROGRAMME

Contents

1. WP 4.3. Overview
2. Design 1 Modular Slab Track
3. Design 2 Ladder Track
4. Next steps and outcomes

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Work Package 4.3. Implementation in new structures

Goal

To design and demonstrate the Advanced Monitoring system to be integrated in the new slab track concepts developed in SP1.

Tasks

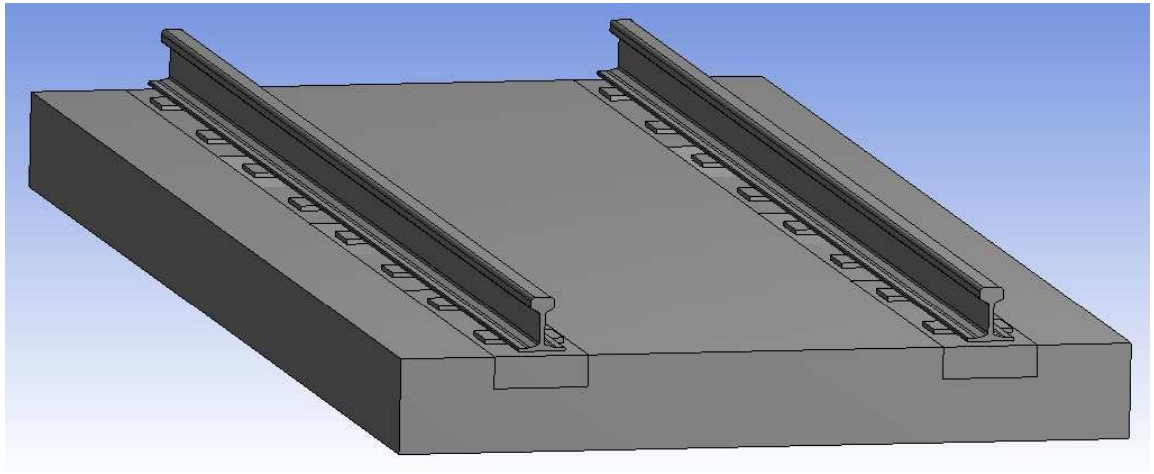
- T4.3.1. Specific monitoring requirements and techniques for the new infrastructure elements
- T4.3.2. Analysis of the interaction/interference between sensors and infrastructure elements
- T4.3.3. Development of procedures for installation, maintenance and replacement of sensors
- T4.3.4. Demonstration of innovative monitoring concepts in new infrastructure

Partners

CEMOSA (leader), Deutsche Bahn, ACCIONA, University of Birmingham, Uppsala University, University of Porto, ADEVICE, TCDD, REFER, EFRTC

Modular Slab Track

RAMS optimised concept



Weak points

- High lateral forces in the stoppers.
- Possible movements in the gap between consecutive slabs
- Loss of tightening force in steel plates fixing the blocks to the slab
- Drainage of the blocks channel and the slab

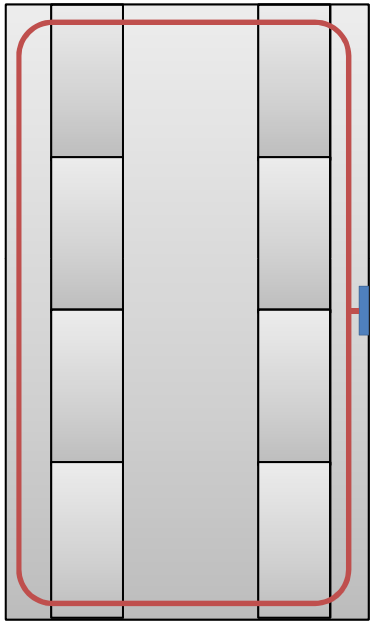
→

Failures modes

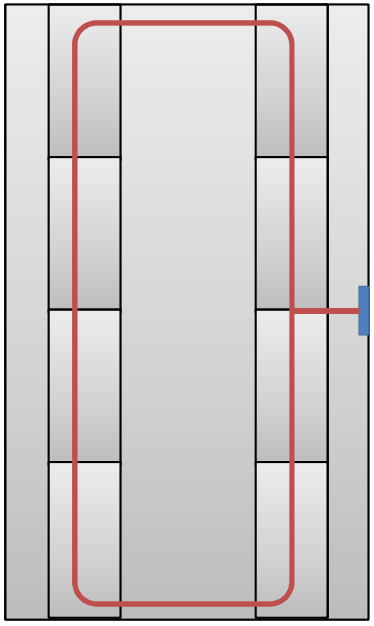
Failure detection methods

Low cost sensors embedded in precast concrete elements

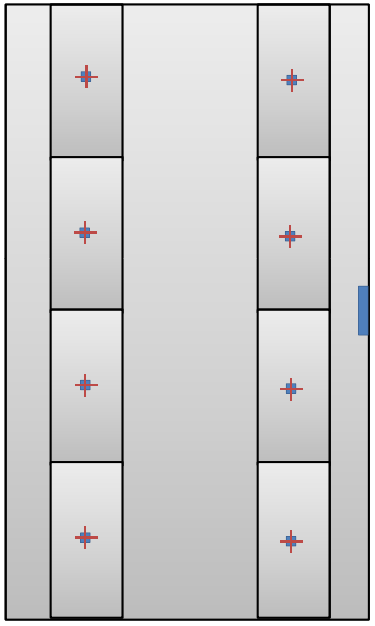
Fiber optic inside the external slab



Fiber optic below the blocks



Accelerometers inside the blocks



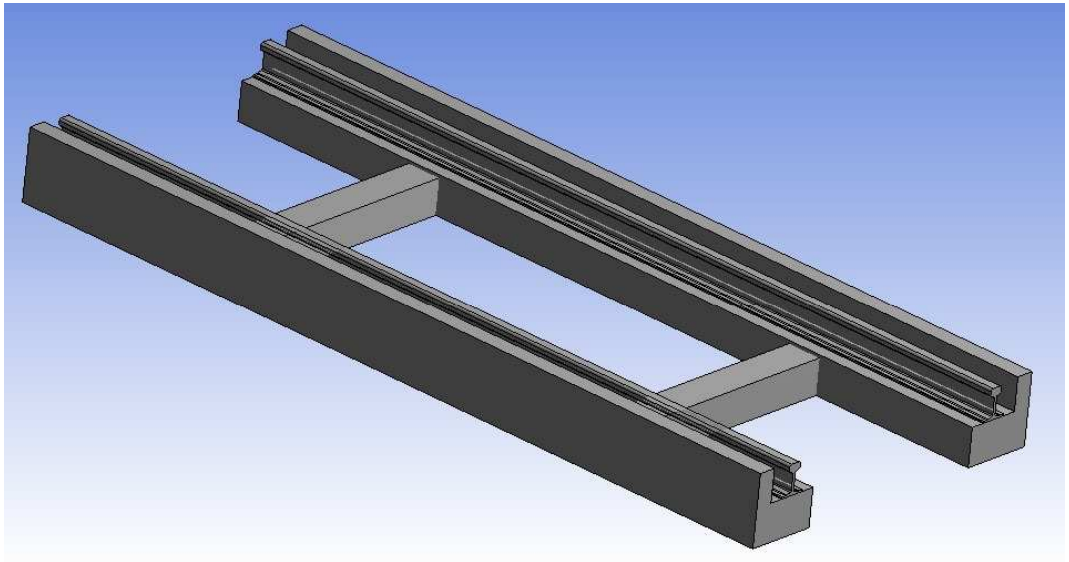
Targets:

- Direct measurement of strains/stresses.
- Movements in the blocks.
- Indirect detection of defects due to anomalies in natural frequencies

Plug&Play monitoring box: Energy and comm.

Ladder Track

LCC optimised concept



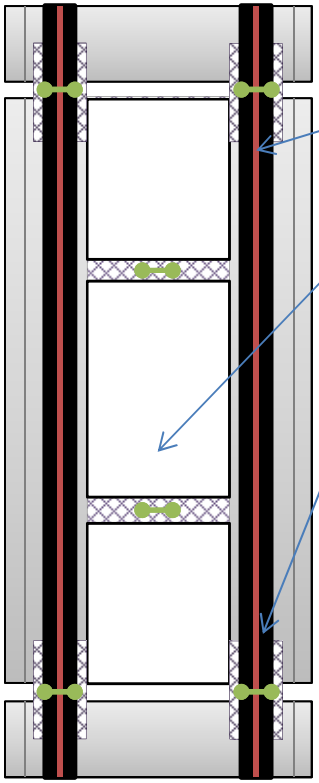
Weak points

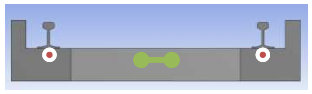
- High bending moments in the transversal sleepers
- High stresses in the transition steel plates between beams
- Drainage between the longitudinal beams

→ Failures modes

Failure detection methods

Continuous rail support -> Continuous monitoring





Fiber optic below the continuous rail pad

Strain gauges at the transversal sleepers

Strain gauges at the transition plates

Targets:

To detect **excesive strains -> high stresses**

To detect **relative movements** between consecutive beams

To monitor **train operation**

No need of monitoring boxes: The fiber optic could be the communication/powering way of the monitoring system.

Next steps

- Analysis of the interaction/interference between sensors and infrastructure elements
- Development of procedures for installation, maintenance and replacement of sensors
- Demonstration of innovative monitoring concepts in new infrastructure, in coordination with SP1

Deliverables

D43.1. Guidelines for installation and maintenance of sensors
D43.2. Demonstration of new monitoring techniques

…any questions?