C4R

Capacity for Rail

Advanced Monitoring

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SEVENTH FRAMEWORK PROGRAMME

SP4 – Advanced Monitoring

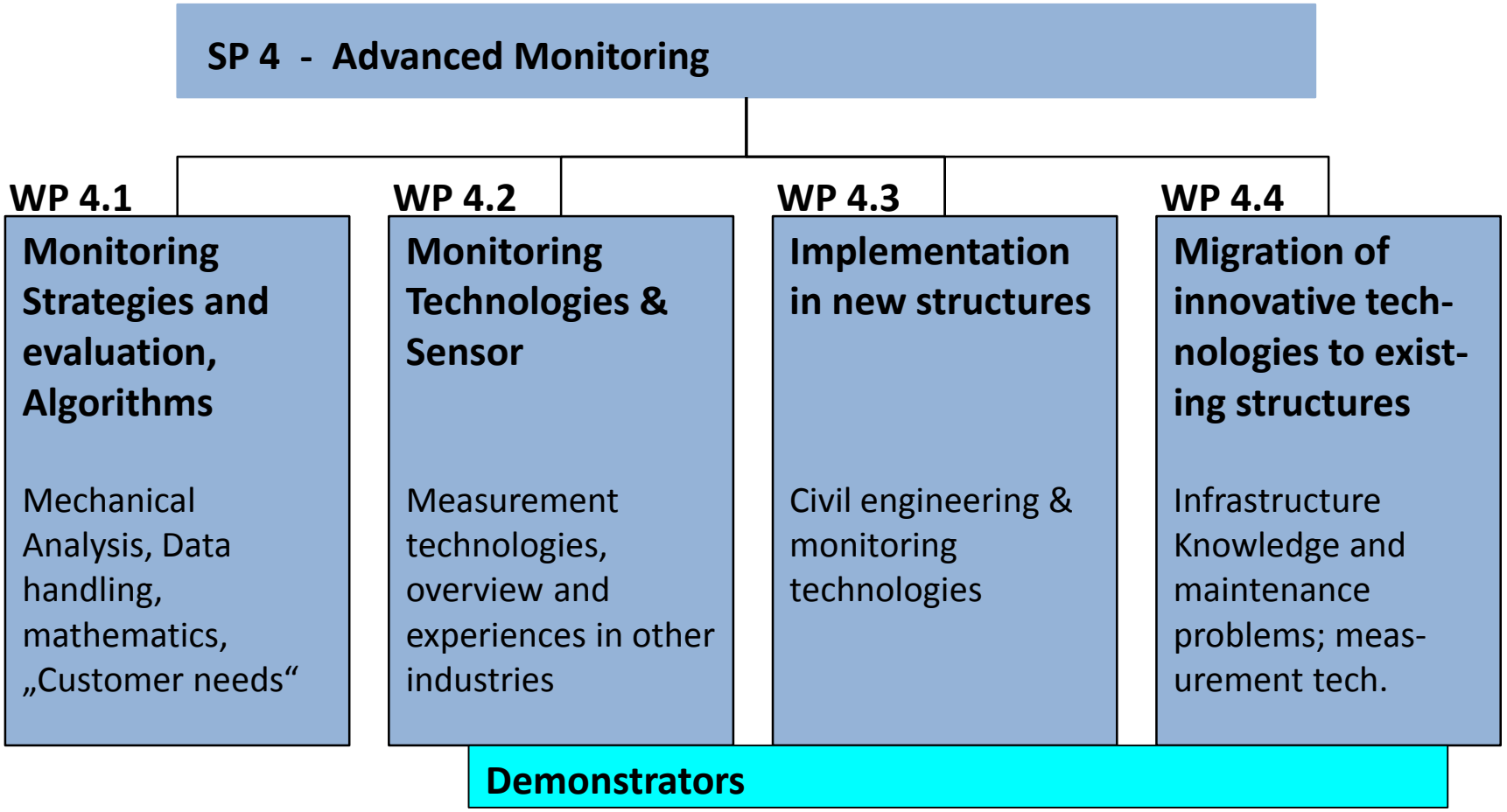
C4R Capacity for Rail

Agenda

- Overview Work packages 4 “Advanced Monitoring”, Objectives
- Monitoring – Diagnosis – Self-Inspection
- Where is monitoring useful?
- Identification of structures and components for monitoring
- Technical & economical assessment within the infrastructure
- Requirements for smart solutions
- Demonstrators

Overview of the Work packages

Work packages and content



Overview of the Work packages

Objectives in SP4 Advanced Monitoring

- Identifying components and systems critical for operation/deterioration of the railway infrastructure that should be monitored. Technical & economical assessment

- Identifying key operational parameters that govern deterioration of selected key components, translation of measured data to deterioration predictions for these systems

- Identifying and evaluating of sensor and energy harvesting technologies, communications. Development of smart solutions:
  - small, energy independent, accurate, intelligent , Wifi -

- Translation of the innovative measurement technologies into *railway-tailored* solutions for predictive maintenance, decision support, operational support and safety. Plug&Play. Retro-fit.

Evolution steps

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)

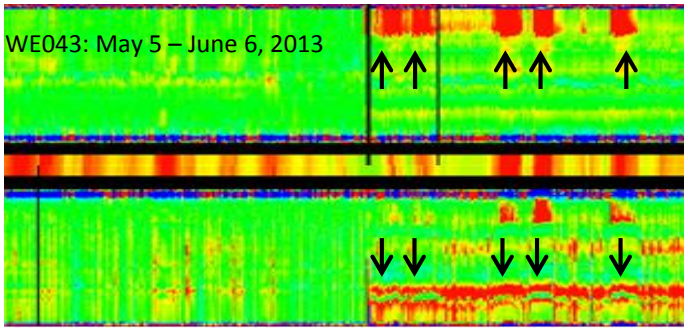
  Measurement or visual assessment of safety relevant behaviours. The measurement accuracy must be at least 10-times better than the value in the specification. (1,0 mm → 0,01 mm)

TRADITIONAL POINT DIAGNOSTICS

DIANA

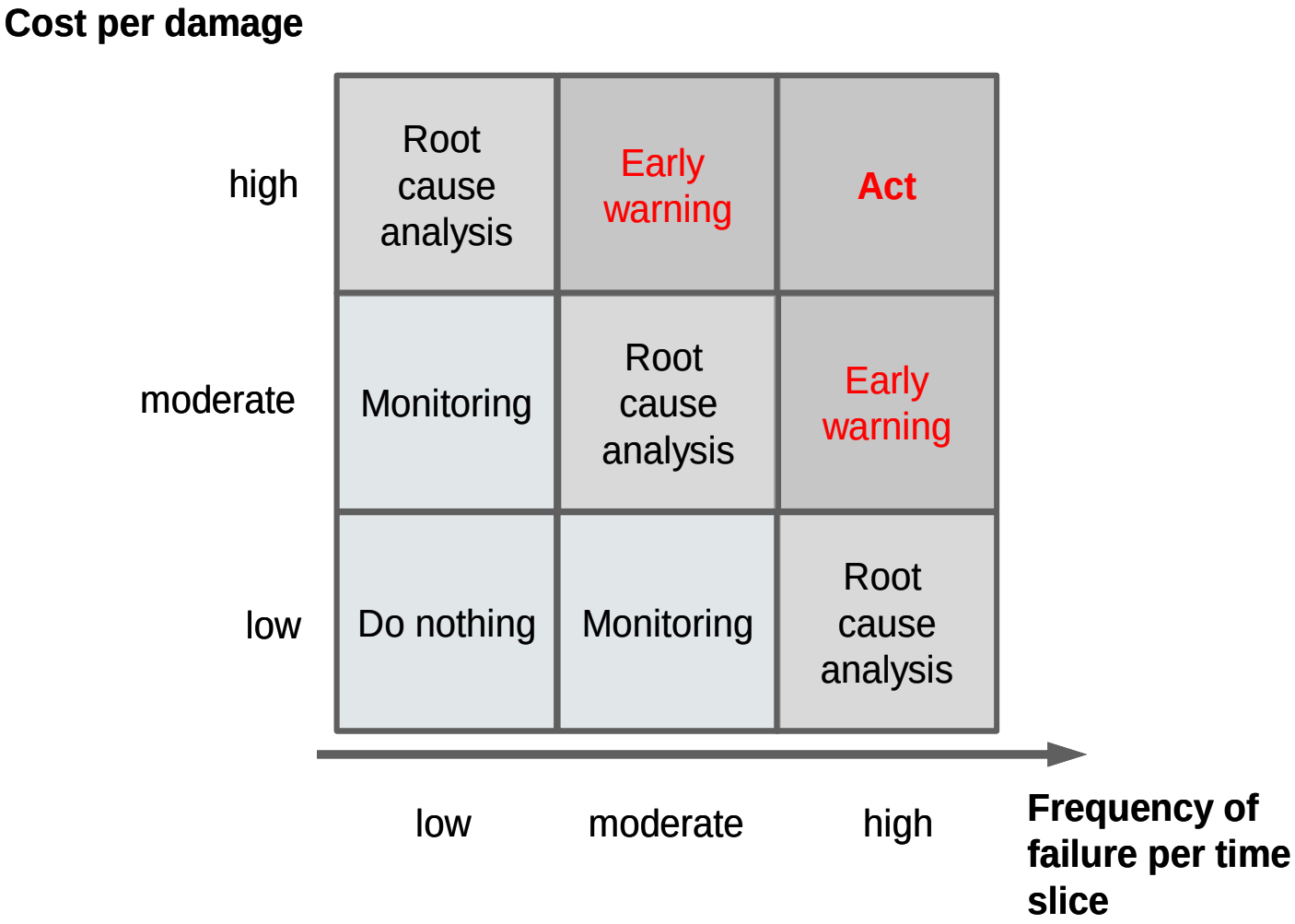
LONG-TERM POINT MACHINE BEHAVIOUR

Example: Point machine temperature-induced anomalies



Note: Proprietary point diagnostic system reports no error

Where is monitoring useful?



Identification of structures and components for monitoring

The main objective is to reduce the number of technical disruptions and delay minutes as well as reducing the related life cycle costs of the e.g. 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, e.g. switch (which switch category gets e. g. a heating system or closure compartment cover) or **diagnostic** to fulfill performance requirements
- Development of a strategy for the preventive maintenance and implementation concept
- Target-actual comparison regarding the equipment standard sharply outlined on the component/system

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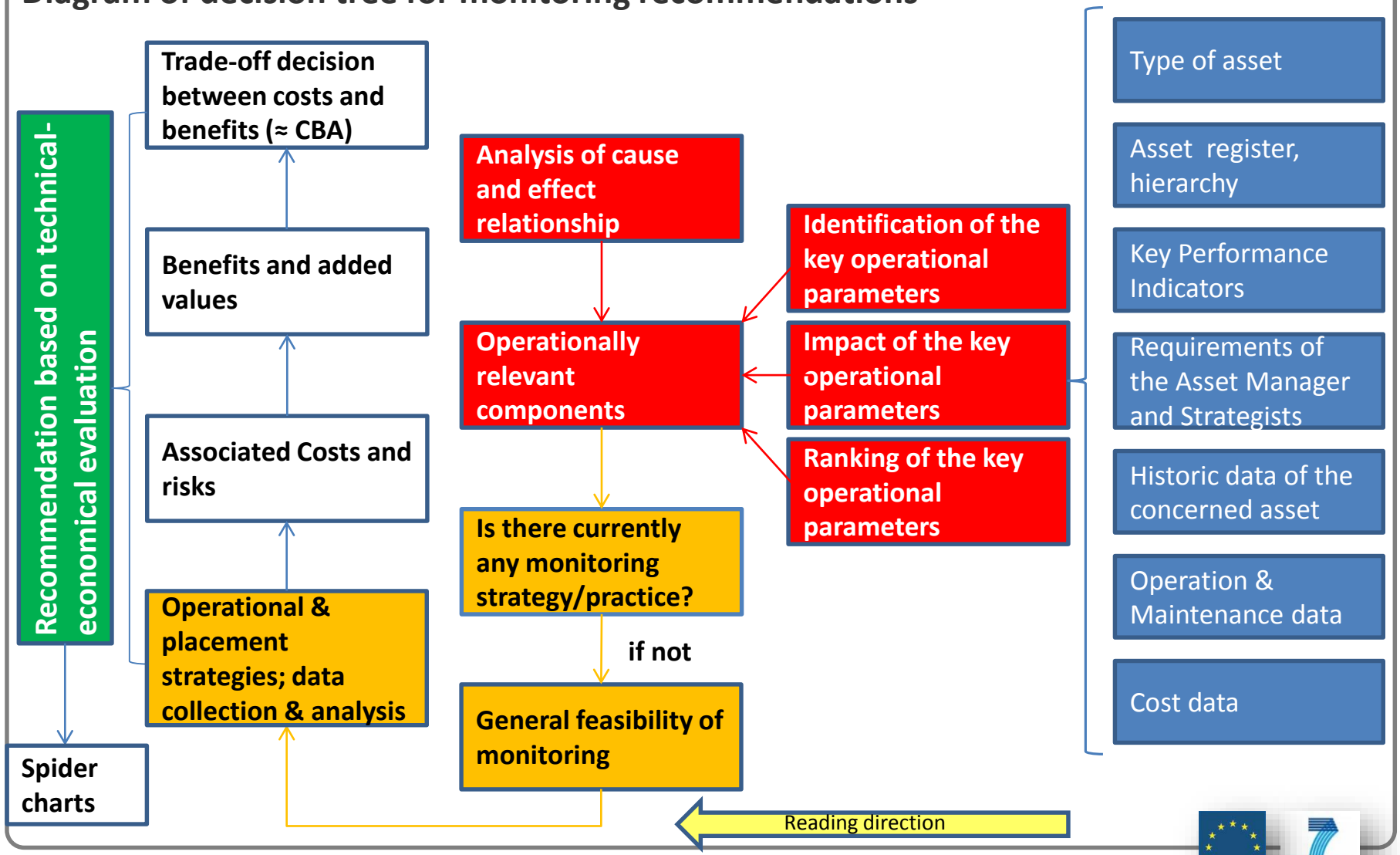
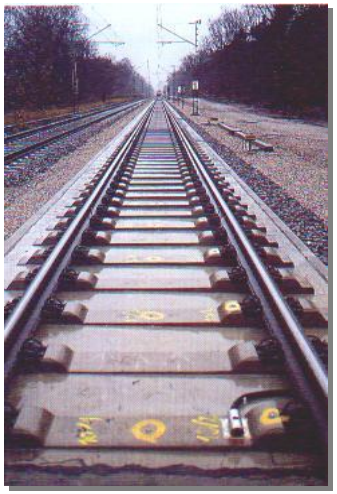
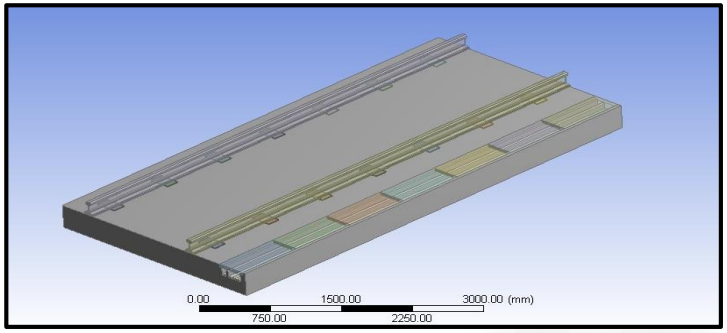
Diagram of decision tree for monitoring recommendations



Monitoring technologies must fullfill requirements of

- Ballasted track
- In-service slab track
- new structures & track constructions





Technologies to be used to develop integrated solutions for next generation railway monitoring and inspection

- Specification, identification and evaluation

Scope

- Sensing, energy harvesting, communications, processing and data integration

Expectations

- Low cost, robust, intelligent, and low power

Near-horizon technologies or technology transfer from other domains

- Not the development of entirely new approaches

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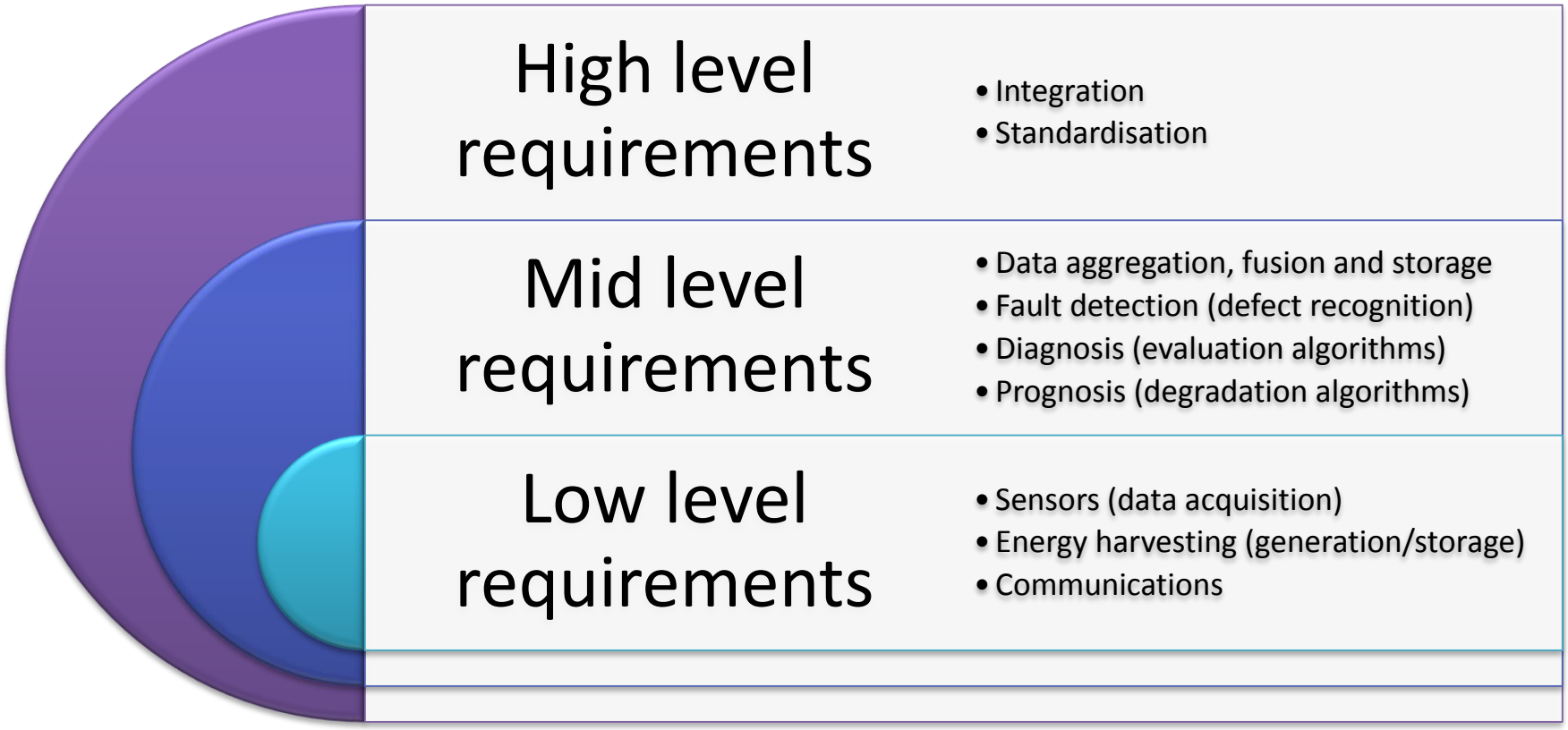
Evaluation at multiple levels



Requirements for smart solutions - Technology Identification Framework

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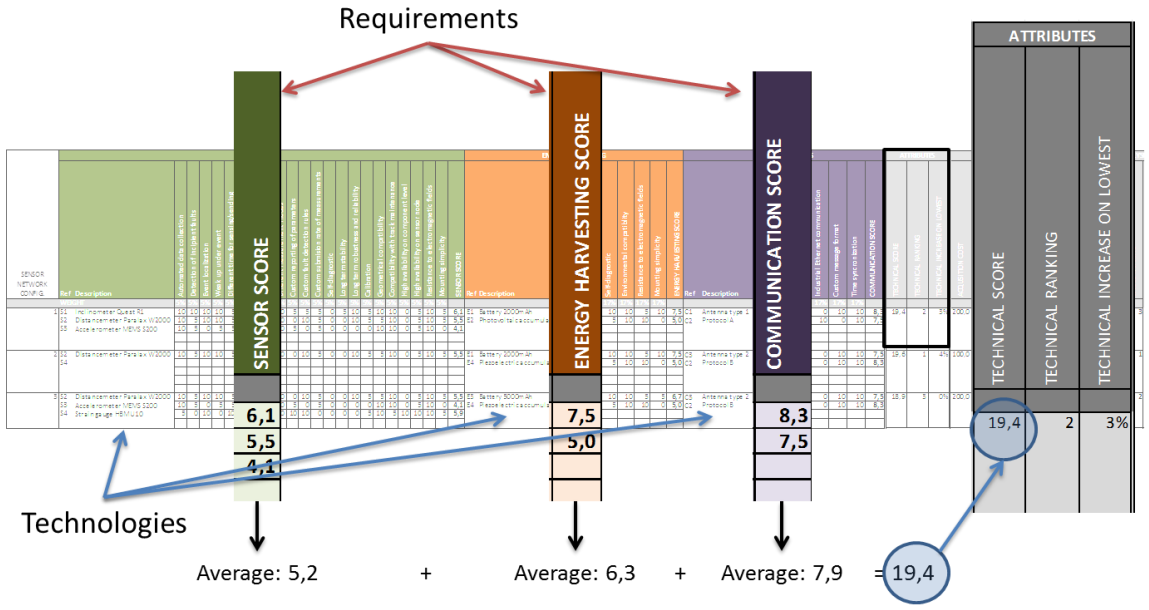
Identified Technologies + Technology Evaluation + Context = Technology to be Developed

Requirement types within a level are grouped



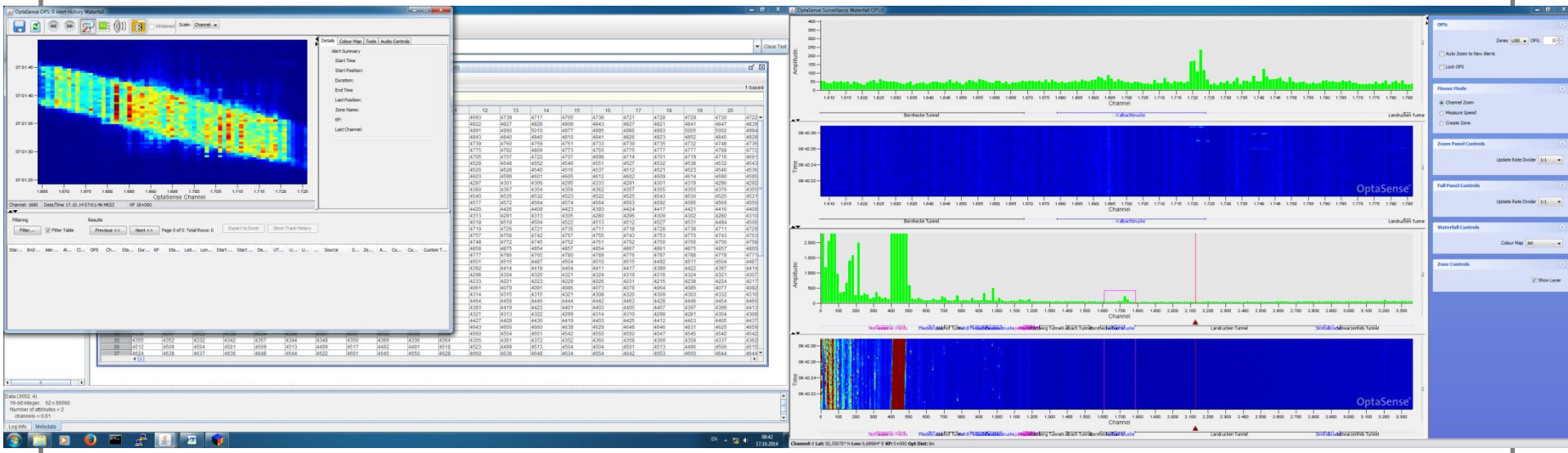
Scores in different requirement categories are collated

- Energy harvesting technologies
  - Identification
  - Evaluation
- Sensors
- Retro-fitting in existing railway, Demonstration

Process analysis
&Learning by doing

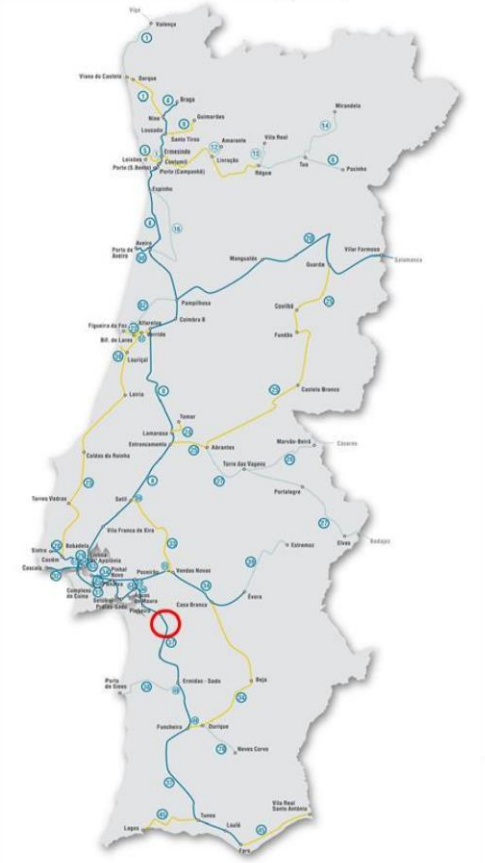
- Migration strategy for individual infrastructure
  - Maintenance process change
  - Work planning, assets, teams

- A first evaluation of an „FOS“- fingerprint of a high-speed line was done and compared with acoustic measurements
- Second evaluation of sensing wear in switches is in progress



- Transition zone monitoring

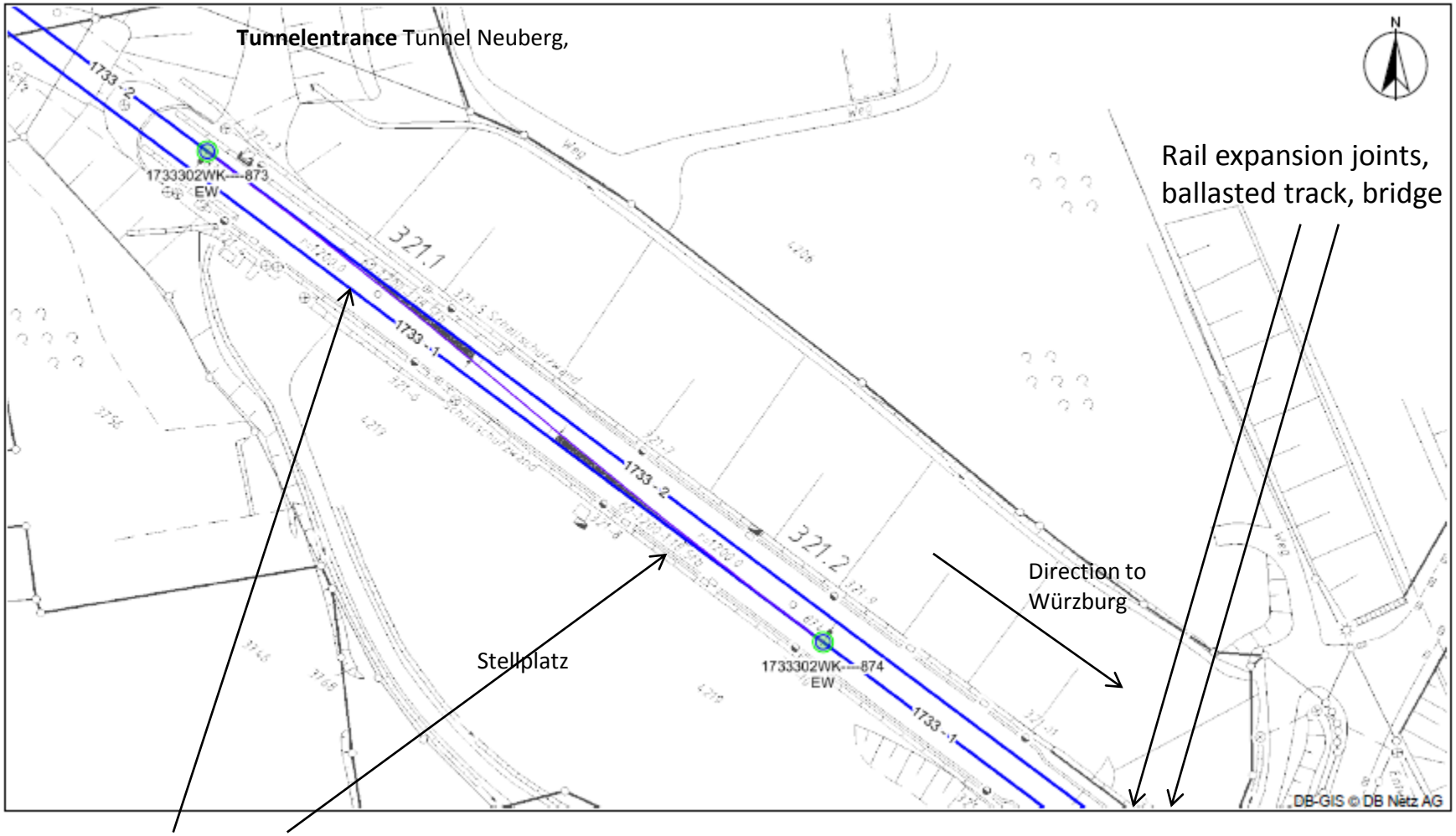
New Sado river crossing



Full Size Demonstrators

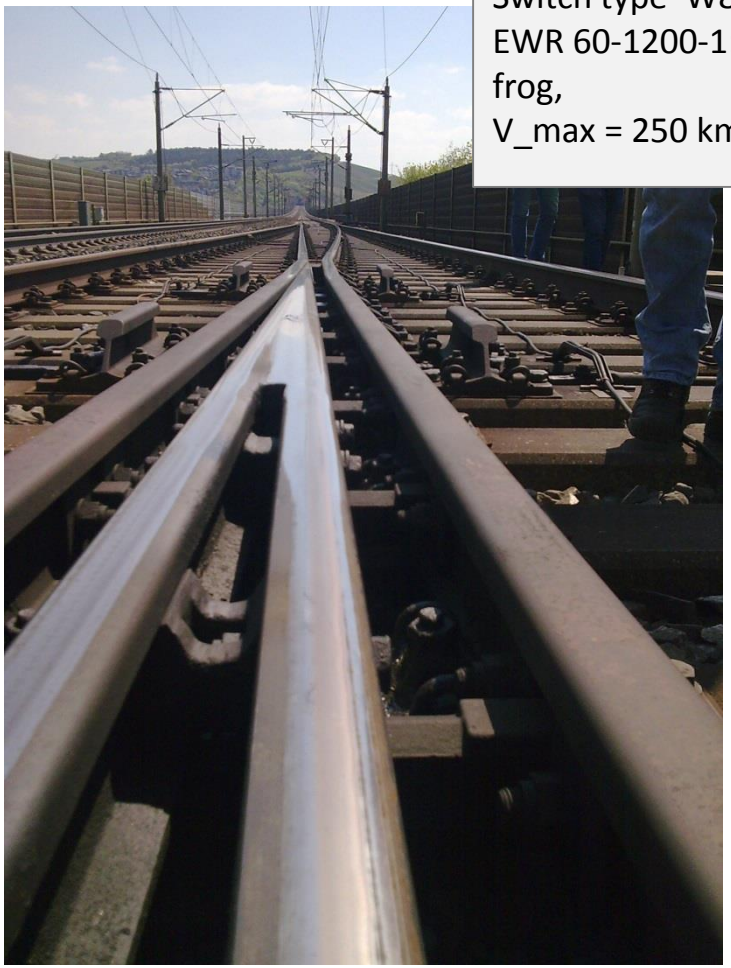
- Transition zone site – Rio Sado

Full Size Demonstrators



Switches W873 & W874, aprox. 7 km north of Hbf Würzburg, Line 1733

Full Size Demonstrators



Switch type W874 & W873, km 321,2:
EWR 60-1200-1:.. , concrete sleeper, movable frog,
V_max = 250 km/h, typ. 230 km/h

Test site advantages:

- Track geometry by wayside monitoring (tilt- sensors)
- Sleeper voids by accelerometer
- Measurements by regular inspection by measurement train all 3 month
- Weekly monitoring by equiped ICE-2 train
- Acoustic monitoring of the switch (class-1 standard)

…any questions?

Thank you for your attention !