REDUCING THE OCCURRENCES AND IMPACT OF FREIGHT TRAIN DERAILMENTS

Results of the D-Rail project

WP 5 Integration of Monitoring Concepts
D-Rail final seminar, 12.11.2014 Stockholm
Matthias Krüger (DB AG)

Content

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Introduction

WP 5: Integration of Monitoring techniques

Objectives

Integration of existing or newly developed monitoring concepts into railway operation.

Outline development of national and international scenarios for subsequent wider implementation.

Integration of monitoring concepts

Aim

Analyses, development and integration of

- wayside monitoring systems
- onboard monitoring systems
- incl. vehicle identification

with regard to RAMS and LCC optimization

Development of business cases

Participants WP 5

UIC, Infrastructure Manager, Industry, Academics

INTERNATIONAL UNION OF RAILWAYS

Faiveley TRANSPORT

ÖBB Infrastruktur

mermec

DB Mobility Networks Logistics

oltis group

SBB

TelSys

TRAFIKVERKET

TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

Content of deliverables D 5.1 and D 5.2

Aim: Reduction of derailments and their consequences by using data from monitoring systems

D 5.1: Integration and development of monitoring concepts

Prerequisits

- Generic inclusion of different data
- European wide data transfer and storage
- Legal framework
- Assumptions of benefits and consequences

D 5.2: Outline system requirements specification for pan European freight monitoring

WP 1,2,3,4: Which root cause might be influenced?
Which physical parameter?
How precisely?
WP 6: Test results
WP 7: RAMS/ LCC assessment

Specification, Classification, Migration

- Business cases of monitoring concepts
- Allocation of measurement data (vehicle identification)
- Ranking: Types, number, places of systems, etc.
- Intervention concept , roles and responsibilities
- Generic requirements for pan European solution
- Implementation and migration concept
- Future trends

Content

… To be or not to be …

Is it possible to reach the objectives of D-Rail?
… and how?

OBJECTIVES

- Reduce the occurrences of freight train derailments within Europe by between 8 - 12%
- Through understanding and mitigation provide derailment related cost reductions of 10 – 20%
- Improve the competitiveness of freight operation against other transport modes

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Source: M. Robinson, D-Rail Kick Off Meeting, 10/11. October 2011, Paris

How many derailment can be affected by using devices ?

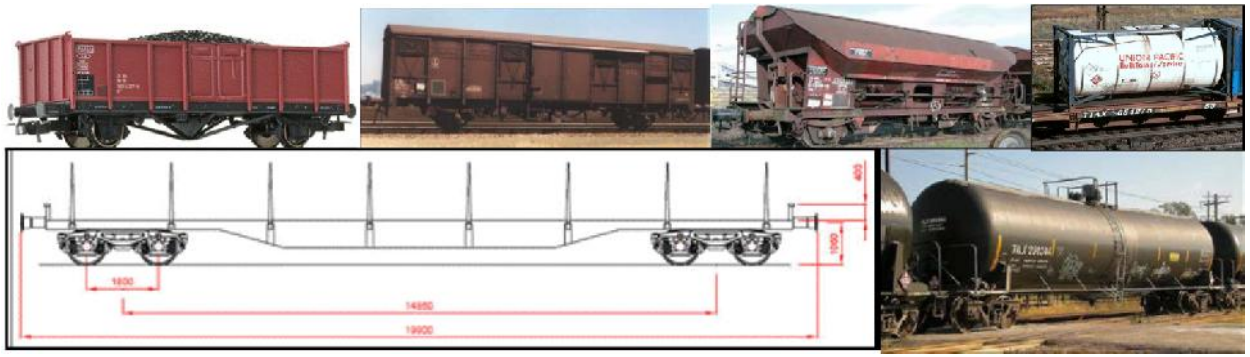
Costs per Cause	Total costs in € (2012 values)	Set of intervention	Impact
1. Hot axle box and axle journal rupture	1,282,575 €	Hot box & hot wheel detector systems	12%
2. Excessive track width	474,966 €	Track geometry measurement systems	8.60%
3. Wheel failure	1,879,471 €	Axle load checkpoints	10.30%
4. Skew loading	833,144 €	Axle load checkpoints	5.95%
5. Excessive track twist	552,627 €	Track Geometry measuring systems	6.58%
6. Track height/cant failure	281,922 €	Track Geometry measuring systems	3.40%
7. Rail failures	587,025 €	Track internal inspection systems (NDT: Ultrasound, Eddy Current, Magnetic flux)	2.87%
8. Spring & suspension failure	1,865,570 €	Axle load checkpoints	5.62%
Average derailment cost for the specified causes	1,094,639€	Total impact from interventions	55%

55% of all severe derailments can be affected by monitoring devices (D2.3, table 2.1)

Future development in railway freight sector

Results from WP 2, which could affect monitoring concepts

- Increase of freight volume by at least 1,53% (/ 1,73% / 2,87%) per year + increase of fleet size
- Commodity split:
  - Increase in volume (tonnes) except machinery, transport equipment goods, metal products and chemicals transport
  - Fuels and building materials will further increase their share
- Six vehicle types, optimized in future but retained



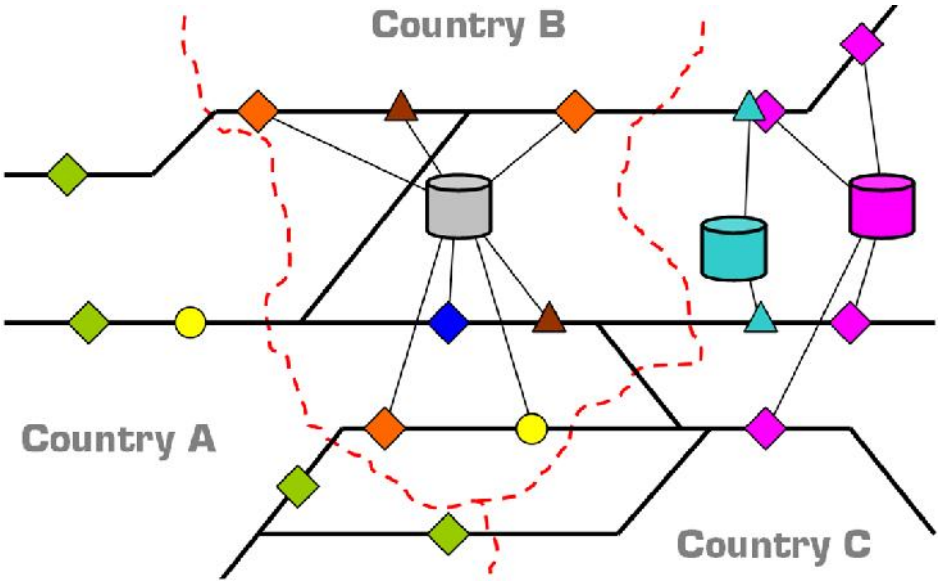
Productivity changes:

- Load factor
- Speed (vs. total train weight!)
- Limit values (e.g. tolerable length of wheel flats)
- Changing brake blocks: from cast iron blocks to composite blocks

How can the existing network used / enhanced?

National based activities in Europe

- Different aims
- Different types of WTMS networks in use
- No harmonized data exchange procedure
- Different intervention concepts



Country A

implementation of at least two different WTMS stand alone systems
No networking functionality

Country B

fully networked WTMS implementation
All systems have a connection to a network center

Country C

For each type of WTMS an independent center

WTMS: Wayside Train Monitoring Device

Investigated scenarios – use cases

In D5.1 and D 5.2 different concepts for WTMS and OMD are developed and assessed.

WTMS are more in focus in the following of this presentation, but basic principles are valid for both

Business cases	Countries with high automation	Countries with low automation
Reasons for installation of additional systems	(a) Protection of dedicated infrastructure components (b) Installation at border stations (c) Loading stations (e.g. harbors)	Installation of first systems
Cross border data exchange between IM	Derailment reduction due to pan European data exchange	Derailment reduction due to few bilateral cases
Data exchange in the wider sense of CSM (e.g. between IM and ECM)	Derailment reduction due to data exchange	No actions

OMD: On-board Monitoring Device
CSM: Common Safety Method
ECM: Entity in Charge of Maintenance

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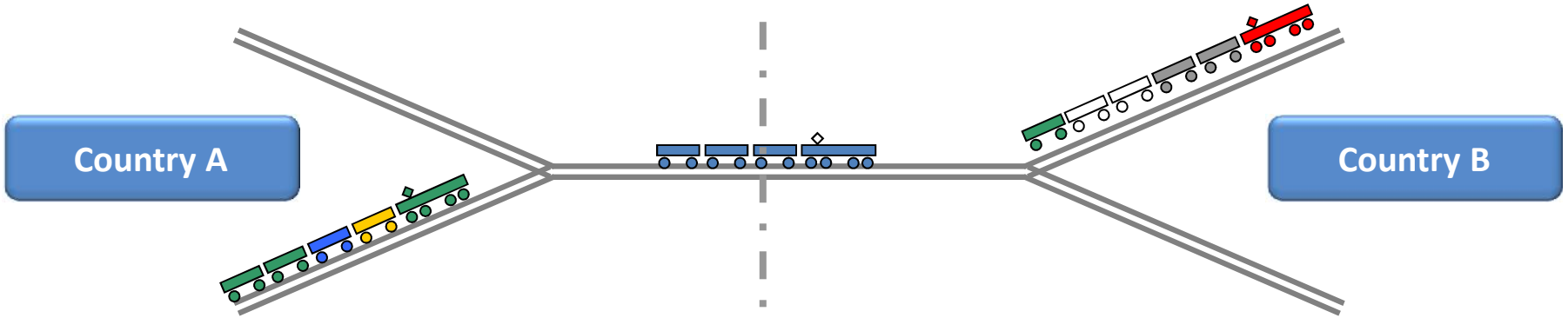
Involved parties and example of data sets



Parties	Railway Undertaker (RU), Infrastructure Manager (IM), Vehicle Owner (VO), Entity in Charge of Maintenance (ECM) National Safety Authority (NSA), Market Authority (MA), End User (EU)

Data

Operation	Date and place of Origin and End, Train ID, RU-ID, Route, Delay
Composition	Number of Axles and Wagons, Total Length and Weight, Locomotive, Train composition, Brake weigth, Lambda (λ), Dangerous goods?
Vehicle	Vehicle Type and Number, Owner, Pay Load/ Gross Weight, Brake weight, Lambda (λ), Customer, Mileage, Timespan until next inspection

Is this list complete? **What is challenging?**

What is challenging?

Combination of different data set

Source: DB AG/M. Vedder, M. Krüger, TRV: G. Ivansson

Data exchange of combined data set

- Operational data
- Monitoring results
- Asset Data

Are there regulations describing that?

Data exchange between stakeholders:

- **Technical specification for interoperability relating to telematic applications for freight subsystem of the trans-European conventional rail system (Commission Regulation EU 62/2006, TAF TSI)**
- **Common Safety Methods for monitoring... (Commission Reg. EU 1078/2012)**
- **Common Safety Methods for supervision by NSA... (Commission Reg. EU 1077/2012)**
- **UIC 917-5: Data transmission rules for IT applications in railways, e.g. used by HERMES, IRS)**
- UIC 419-2: Systematic numbering of international freight trains
- UIC 404-2: Compendium of the data to be exchanged between Railway Undertakings for the purpose of conveying freight traffic
- UIC 407-1 Standardised data exchange for the execution of train operations, including international punctuality analysis

Implementation and operation of Train Monitoring Systems:

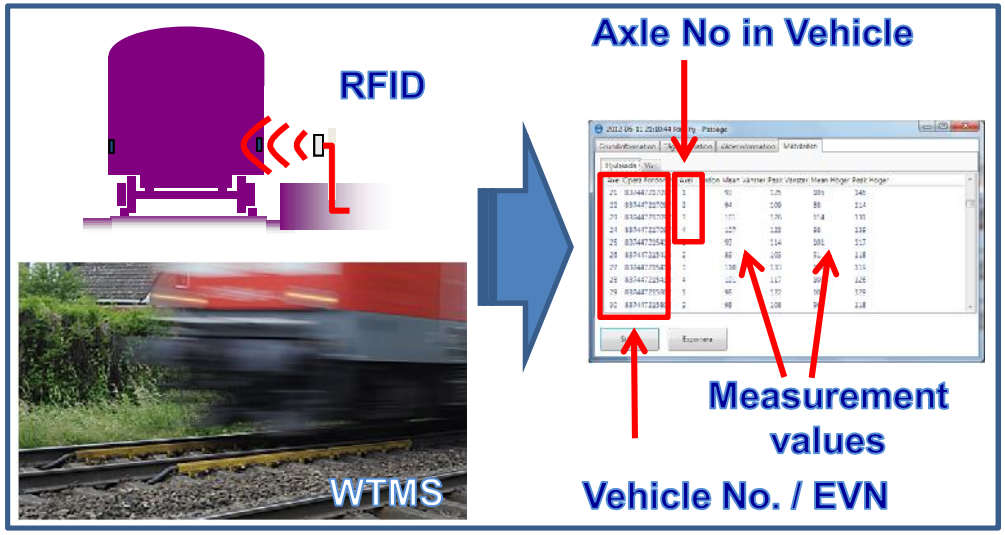
- **Dedicated national legal rules for derailments (e.g. reporting, maintenance, etc.)**
- **Code of Recommended Practice of large RU/IM (e.g. Switzerland, Germany, Austria, Sweden)**
- **Potential for further development of unique legal framework, e.g. as a part of TSIs (e.g. TAF or Rolling stock)**

Many regulations, but none describes the exchange of the combined data set

How to allocate assessment results from WTMS / OMD?

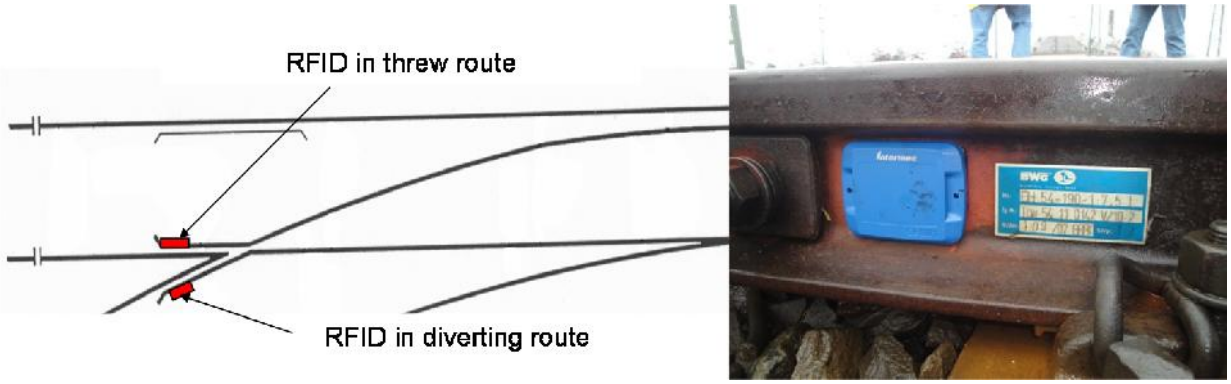
Different acitivities in many countries, but no harmonized solution available

Case 1: Allocation of data from WMTS



Example *RFID in Rail*:
Usergroup, which defined specifications for pan European use in order to tagg spare parts and vehicles

Case 2: Allocation of data from OMD

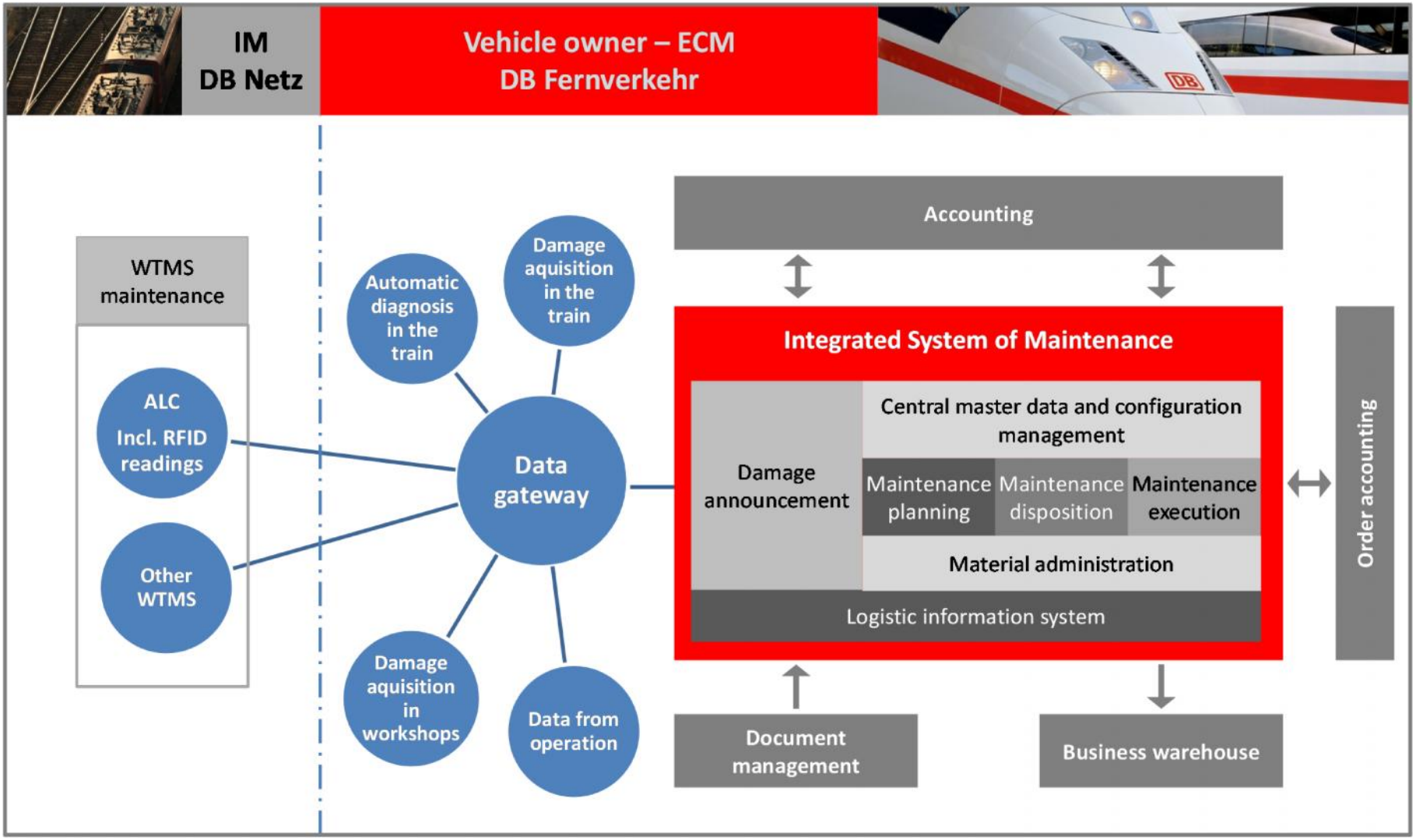


Example of DB:

Using RFID in track for localisation issues of inspection vehicles

Prerequisites for usage: Allocation and asset configuration

Example of DB: Data management for integrated vehicle maintenance



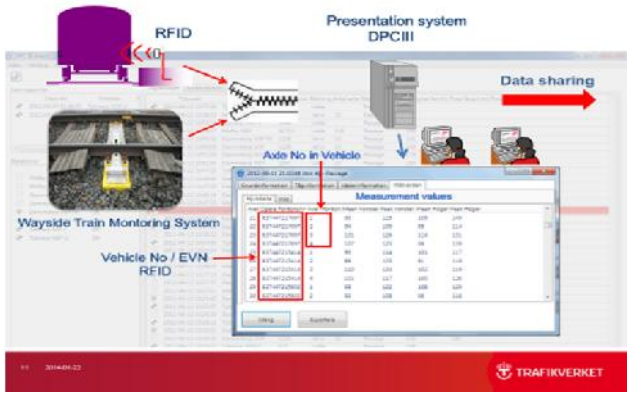
Soucre: K. Wagner, DB Fernverkehr, P.TB (2)

Example from TRV for successful integration

Pilot project e-maintenance: collaboration between IM, RU and ECM in order to reduce the number of exceedings due to peak loads > 350 kN

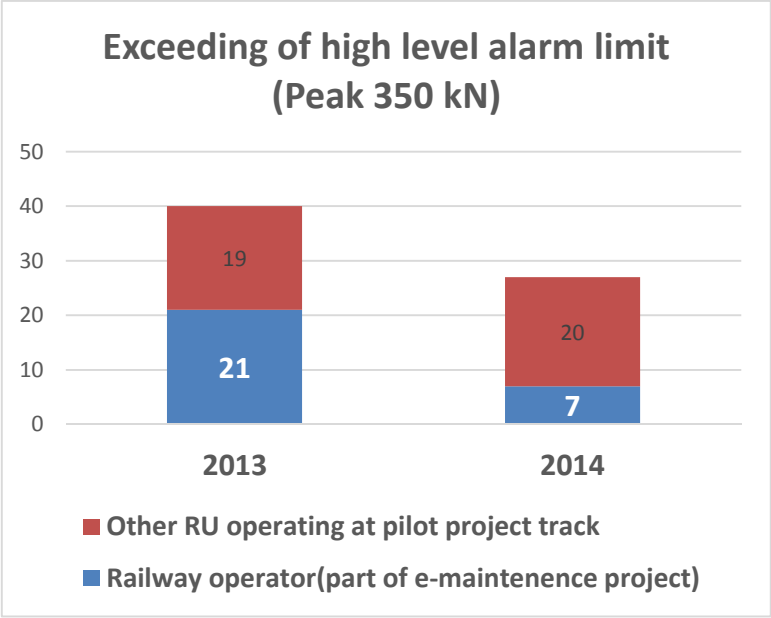
Process

1. IM: Combination of RFID and WTMS
2. Data transfer to ECM,
   labelling of wheels with peak loads
3. IM allowed to travel until final destination
4. ECM took maintenance actions
5. Feedback about maintenance actions and damage size in order to enhance the assessment algorithm



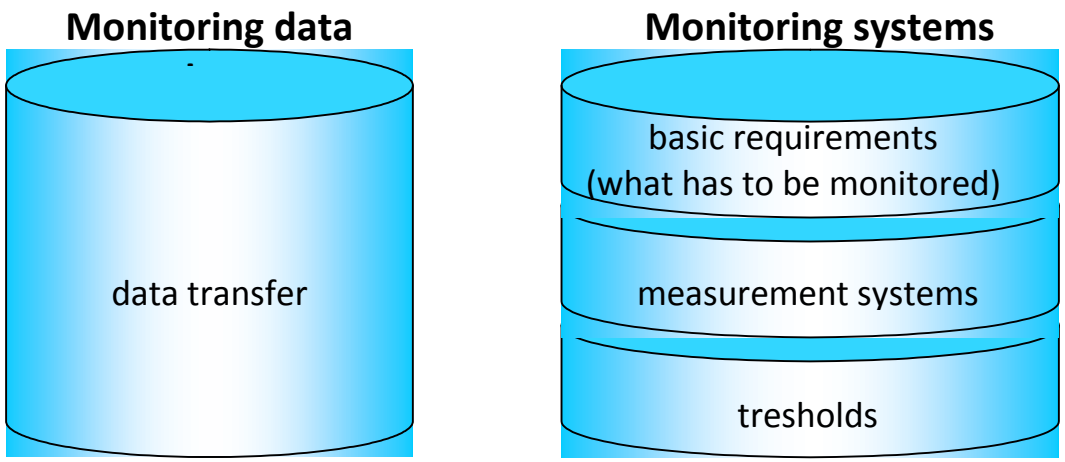
Result for the participating RU:

Reduction of exceedings from 21 to 7 within one year

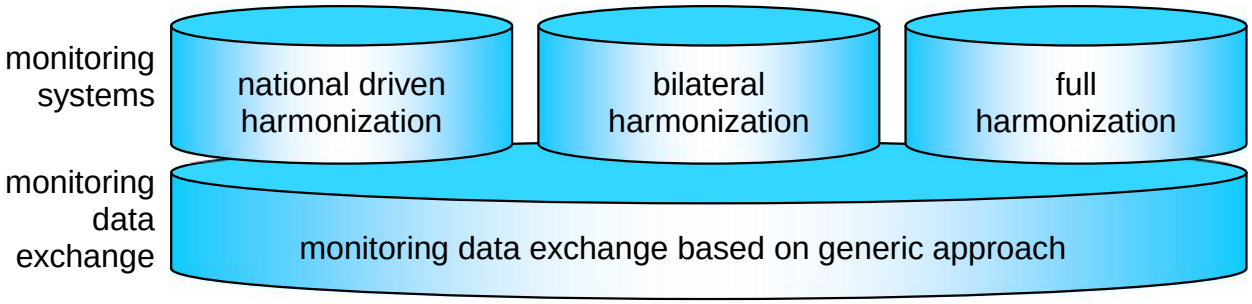


Today‘s data exchange need to be enhanced

Harmonization has two aspects: Data exchange and monitoring systems



Pan European use of monitoring data: three different levels of harmonization



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Generic approach: Interpretation principle

How to **interprete** data coming from different devices and different supplier?

Guiding principle in the conceptual design

- Use of existing monitoring systems (almost) independent of their output
- Open for integration of future systems
- If data is available in different levels of detail, prefer more detailed level
- IMs responsible for data provision
- Data users responsible for (own) interpretation

D-Rail approach: Goals achieved by three kinds of information levels

- **Level I** – Evaluation output and algorithm in an unified format (mandatory)

  always exchange of data AND evaluation algorithm together

  enables data users to modify provided data interpretation (if they want to do)
- **Level II** - Single values for trend analysis (optional, but recommended)

  aggregate each vehicle property to single value to enable trend analysis
- **Level III** - Raw data (optional)

  system specific data, delivered only by request of a data users

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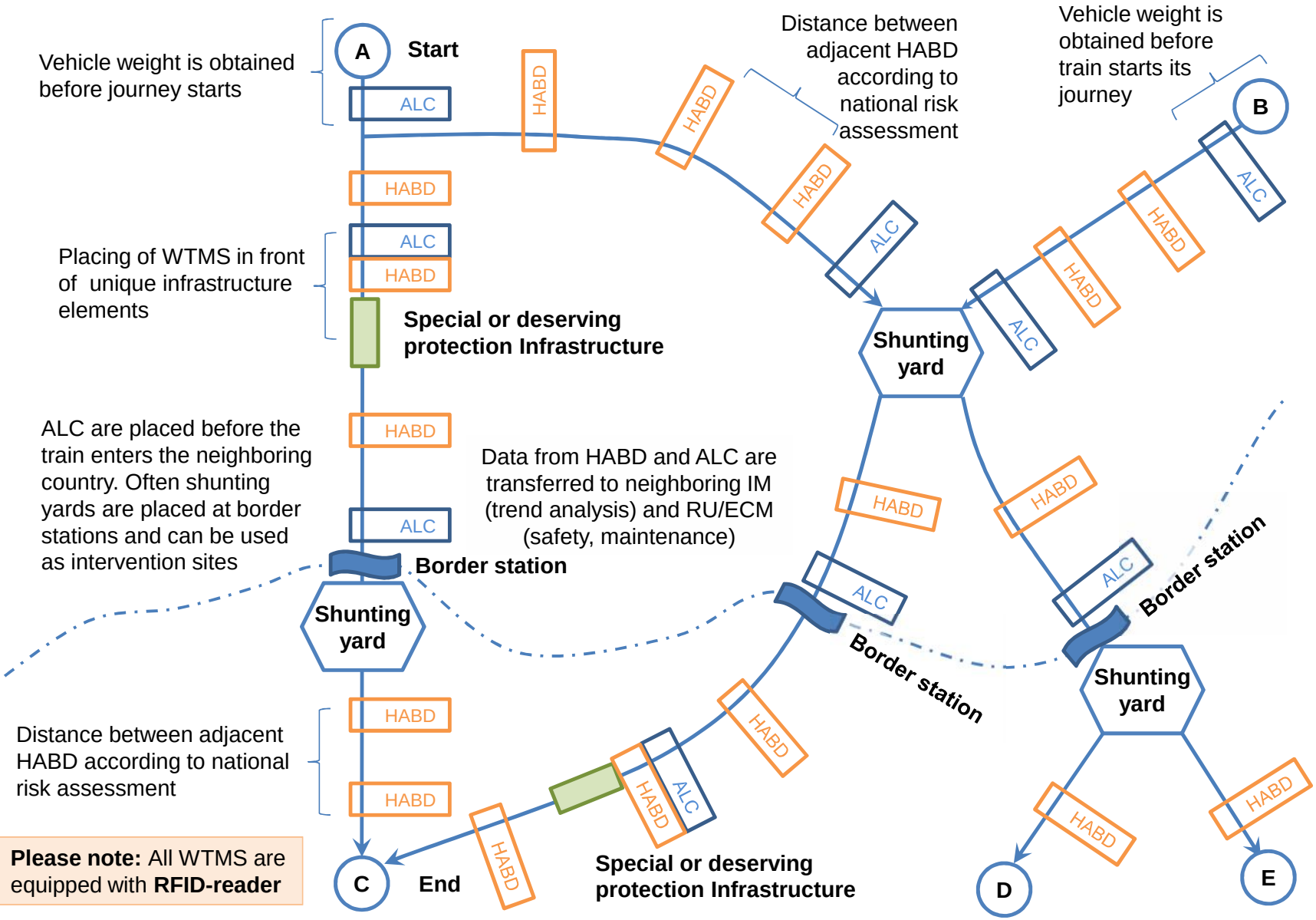
Network of devices



Please note: All WTMS are equipped with **RFID-reader**

Example of SBB: Installation strategy at border stations

WTMS at border stations

Treatment of vehicles on shunting yards at the border station in order to ensure track availability

- Installing of WTMS in a neighboring country
- operating WTMS by SBB or the neighboring IM

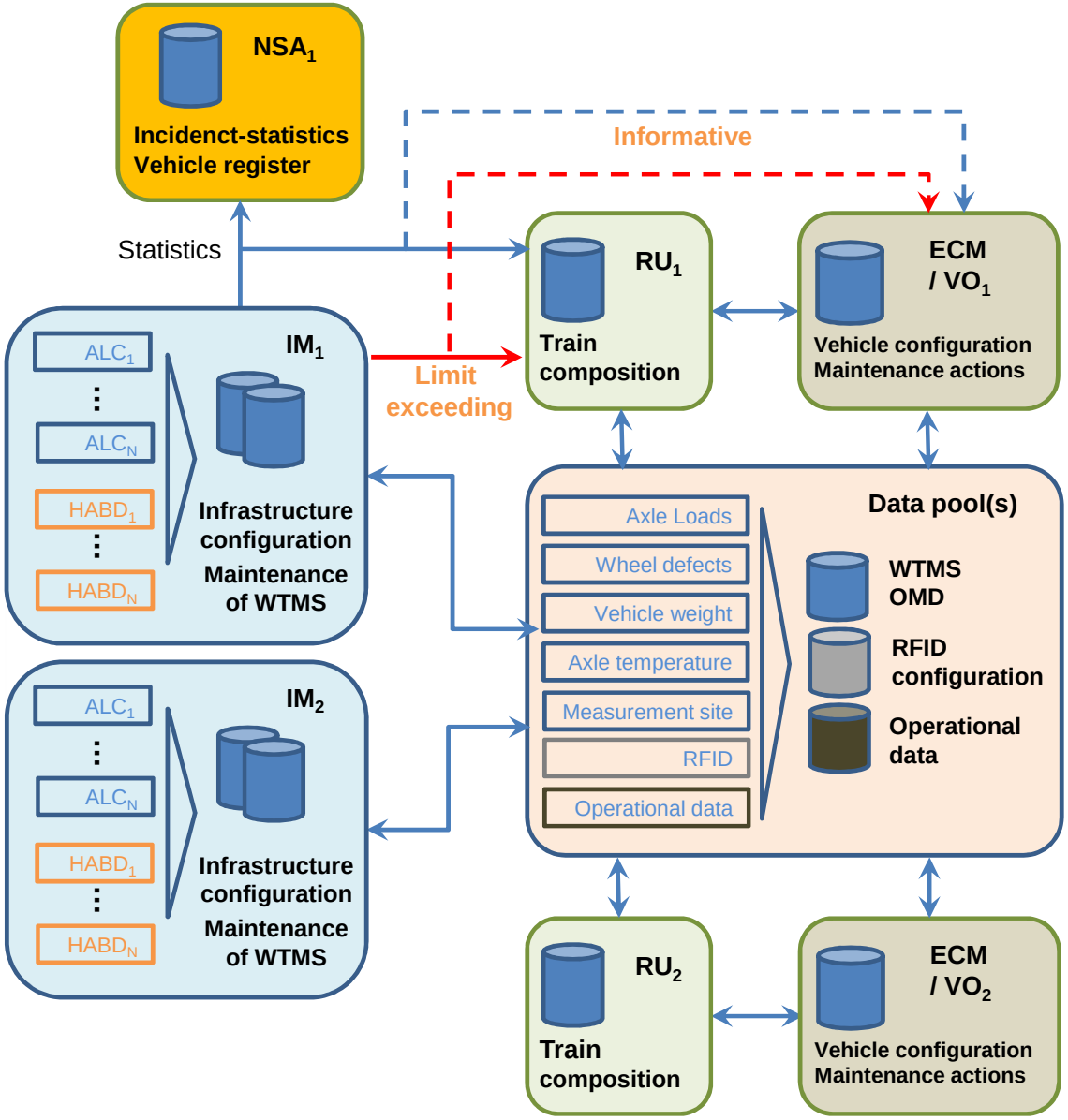
Prerequisites

1. **Central broker provides a connection between national vehicle register and RFID-tag of all vehicles** (key factor for the following point)
2. **The ECM/VO provides information about the configuration of the individual vehicles**. Only then trend analysis or state dependent maintenance of individual vehicle components can be performed, and/or maintenance actions are verifiable
3. **The IM provides information about the configuration of the railway network**
4. **RU provides the train composition including the vehicle ID** before the train gets into service
5. **A unique train operation number, the route and the timetable for the complete journey is generated before the train gets into service.** Not only all involved IM, but also all involved RU have to find an agreement.

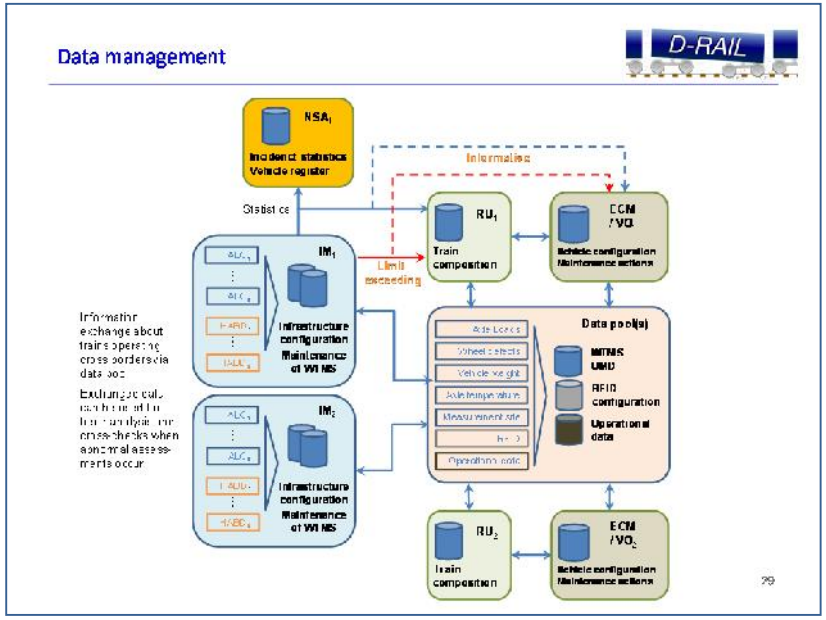
Data management

Information exchange about trains operating cross borders via data pool

Exchanged data can be used for trend analysis and cross-checks when abnormal assess-ments occur



Examples of implementations



Are there some parts already in use?

RU ⇔ ECM: Maintenance regulation VPI 08

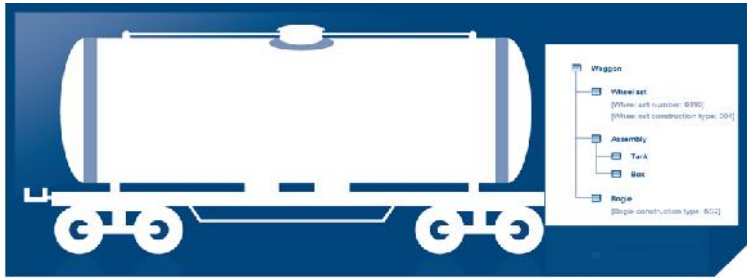
RU_1 ⇔ RU_2: RAILDATA

IM_1 ⇔ IM_2: Train Information System (TIS)

Example 1: Existing communication RU ⇔ ECM

Maintenance regulation VPI 08

Communication platform and vehicle configuration management based on maintenance regulation VPI 08



http://www.comap.sternico.com/vpi08_en.html

Data exchange on the basis of xml-files

```
  <?xml version="1.0" encoding="UTF-8"?>
- <xsd:schema targetNamespace="http://www.vpihamburg.de/vpi08/messages/" xmlns:orders="http://www.vpihamburg.de/vpi08/orders/" xmlns:messages="http://www.vpihamburg.de/vpi08/messages/"
  xmlns:general="http://www.vpihamburg.de/vpi08/general/" xmlns:xsd="http://www.w3.org/2001/XMLSchema" attributeFormDefault="qualified" elementFormDefault="qualified" version="1.01">
      <xsd:import namespace="http://www.vpihamburg.de/vpi08/general/" schemaLocation="../General/General.xsd"/>
      <xsd:import namespace="http://www.vpihamburg.de/vpi08/orders/" schemaLocation="../Orders/Order.xsd"/>
          <!-- Global Structure Start -->
    - <xsd:element name="VPI_Data_Exchange">
        - <xsd:complexType>
            - <xsd:sequence>
                  <xsd:element name="Header" type="messages:HeaderType"/>
                  <xsd:element name="Body" type="messages:BodyType"/>
                  <xsd:element name="Footer" type="messages:FooterType" minOccurs="0"/>
              </xsd:sequence>
          </xsd:complexType>
      </xsd:element>
    - <xsd:element name="VPI_Data_Exchange_State_Update">
        - <xsd:complexType>
            - <xsd:sequence>
                  <xsd:element name="Header" type="messages:HeaderType"/>
                  <xsd:element name="Body" type="messages:StateUpdateBodyType"/>
                  <xsd:element name="Footer" type="messages:FooterType" minOccurs="0"/>
              </xsd:sequence>
          </xsd:complexType>
      </xsd:element>
          <!-- Global Structure End -->
          <!-- HeaderType Start -->
    - <xsd:complexType name="HeaderType">
        - <xsd:sequence>
              <xsd:element name="VPI_version" type="xsd:decimal"/>
              <xsd:element name="Creation_time" type="xsd:dateTime"/>
              <xsd:element name="Interchange_control_reference" type="xsd:integer"/>
              <xsd:element name="Sender" type="xsd:string"/>
              <xsd:element name="Receiver" type="xsd:string"/>
          </xsd:sequence>
      </xsd:complexType>
          <!-- HeaderType End -->
          <!-- BodyType Start -->
    - <xsd:complexType name="StateUpdateBodyType">
        - <xsd:sequence>
              <xsd:element name="currentOrder" type="orders:Order" minOccurs="0"/>
              <xsd:element name="carriedOutActivities" type="orders:Activities"/>
          </xsd:sequence>
      </xsd:complexType>
    - <xsd:complexType name="BodyType">
        - <xsd:complexContent>
            - <xsd:extension base="messages:StateUpdateBodyType">
                - <xsd:choice>
```

VPI: Association of Wagon owner in Germany

Example 2: Existing communication $RU_1 \Leftrightarrow RU_2$

RAILDATA is international organisation of European Cargo Railway Undertakings.

It is established as special group of the UIC

http://www.raildata.coop/About.htm

Objective

The objective of RAILDATA is to:

- develop, implement and run IT services, as cost-effectively as possible and in total compliance with the rules governing competition,
- improve data exchanges and thereby
- promote rail freight traffic development between the Railway Undertakings of Europe.

There are presently three applications in production:

- **ORFEUS** (Open Railway Freight EDI System) - consignment note CIM data exchange
- **ISR** (International Service Reliability) - wagon movement and status reporting
- **Use IT** (Uniform System for European Intermodal Tracking and tracing) - intermodal trains status reporting

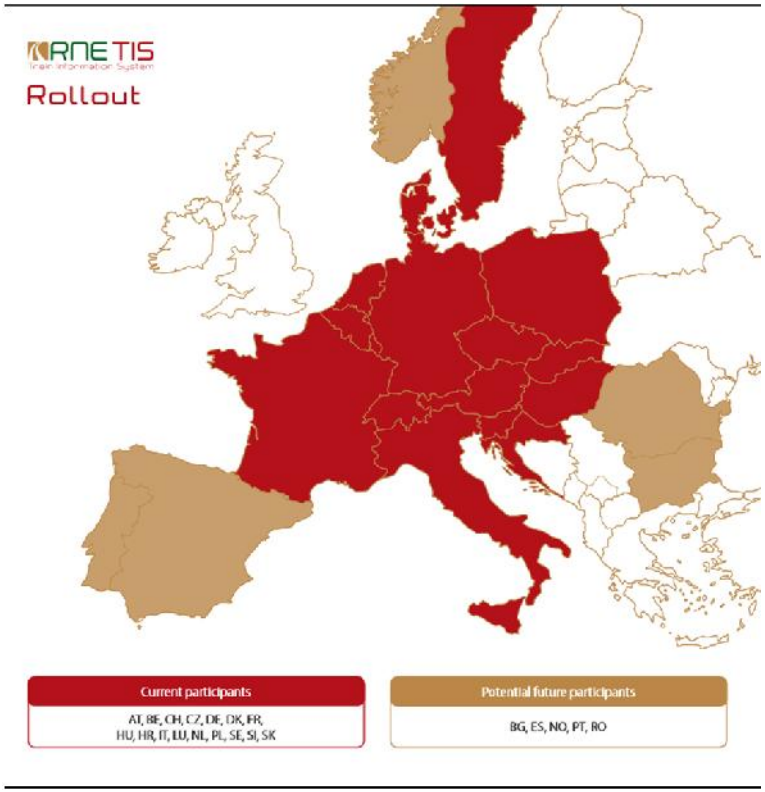
Example 3: Existing communication $IM_1 \Leftrightarrow IM_2$

What is the Train Information System (TIS)?

The Train Information System (TIS) is a web-based application that supports international train management by delivering real-time train data concerning international passenger and freight trains. The relevant data is processed directly from the Infrastructure Managers' systems

TIS Achievements

- 150 000 trains per month
- 6 400 reporting points
- 17 IMs have joined TIS
- Processing/distribution of TAF TSI messages
- Reporting function for Train Performance Management (TPM) has been developed
- System performance and data quality considerably improved
- Data quality has been significantly enhanced
- Access for terminal operators



http://tis.rne.eu/tl_files/RNE_Upload/TIS/2013/TIS_Brochure.pdf

Implementation: Time frame

General

Many of the needed pre-requisites are already available

Limiting factor will be finances (e.g. resources and longterm strategic plans)

Item	Description	Time
New and/or additional devices in countries with a focus on high automation	Enhancing existing monitoring network	10 years
	Replace systems if functionallity is missing (at the end of lifetime)	15 – 30 years
- „ - on low automation	First installations	5 – 10 years
Data exchange and generic approach	Many solutions for data exchange already exist	Within 5 years
Legal framework	Many interlinked regulations have to be enhanced (e.g. European Regulations, TSI, national laws, company rules, maintenance processes)	More than 10 years

Implementation: Estimated costs for software implementation

Example: EU-project Schengen Information System SIS II

Needed solution has many similarities to the aim of D-Rail, e.g.

- Every country has its several generations of passports, some machine readable, some with chips, some with biometrical data, etc.
- National data bases existed before SIS I and SIS II as well as own reading devices
- Different types of national data to be integrated

Solution:

- Central data broker with standardized data exchange
- For safety reason, every country has a national copy of the central data base
- High number of participants with a lot of change requests

Cost estimation for software implementation

Every active partner will increase the budget by 30% => exponential increase

1 active partner => 1 Mio €

5 active partner => 3 Mio €

10 active partner => 10 Mio €

30 active partner => 300 Mio €

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Outcome of D 5.1 and D 5.2

Conclusions

- Proposed reduction is possible
- Strategy for installing of devices will be based on national risk assessment
- Number of new/additional devices depend on LCC assessment (see WP 7)
- Countries with already existing network will increase their number only marginal
- Different activities started already, are useful from D-Rail perspective and have to be merged
- Introducing WTMS and corresponding alarm limits means to shift more and more responsibility and knowledge from RU towards IM. Not all IM are interested doing so
- RU are more focussed on business, but loose their technical competence

Outcome of D 5.1 and D 5.2

Expected impact for 2050 needs actions

- Data have to be used for derailment prevention and have to influence maintenance actions (e.g. state dependent maintenance)
- Proper solutions for investments, e.g.:
  IM installs WTMS, but RU can improve their operation and ECM their maintenance
- Key success factor: change of legal framework is needed, e.g.
  - Clear definition of responsibilities
  - National general railway law has to be enhanced
  - Regulation (EU) N° 1078/2012 on the CSM for monitoring is not sufficient
- Generic approach: Harmonization of data interpretation is needed, in order to incorporate different systems, different measurement values, data types, etc.
- Political and diplomatic wise guidance is needed

Thank you for your attention

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