Railway industry current trend: Digitisation

UIC point of view

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Dr.-Ing. Marc Antoni
FIRSE – AFFI – VDEI
UIC - Rail System Director
antoni@uic.org
Summary

✓ Digital revolution - new challenge for the Railway industry
✓ UIC Digital Platform
✓ RSD has launched several POC’s → projects & IRSs
✓ RSD on going projects for the railway community
✓ Conclusion
Digital revolution - new challenge of the Railway industry

The today main railway challenges

→ Reduction of 30% in 4 years → cost of operation and maintenance with identical traffic

→ Doubling the traffic capacity on existing network or tracks at the same operation costs – improving the “customers experiences”

→ No possibility to use massive modernisation or renewal investment with acceptable founding rate – improving “asset management”

→ Possibility to use “digital improvement” to create the move:
  → digital to improve the railway performances

→ Moving digital is not a technical issue but a human capital issue!
Digital revolution - new challenge of the Railway industry

How to reach these goals ?

→ Improving operation performances from IM’s and RU’s points of view:
  - automatic train supervision based on continuous accurate train localisation systems – different steps from assistance to full automatic
  - automatic train operation – different steps from assistance to full automatic

→ Upgraded existing Assets using new digital possibilities – ex : Level crossing

→ An adapted Asset management politic on all networks → the railway objectives are shared and targeted

→ Asset management, Security & Safety teams have to contribute together from the early stage of the system definition

→ In all cases : the battle is won or lost at the first stage of the design, especially for digital or critical computerized systems
Digital revolution - new challenge of the Railway industry

Digital trends worldwide

• Ubiquitous internet
• Internet of Things
• Industry 4.0
Digital revolution - new challenge for the Railway industry

Digital trends for Railways

- Interoperability
- Reliability and Capacity
- High-speed rail transport
- Digital signalling
- Predictive maintenance
- Location Based Services
- Customer experiences

Railway can be actor and vector of development of the 21st century
Digital revolution - new challenge of the Railway industry

Cyber security and safety for Railways

• **Safety is the key** – Safety requires Cyber Security

• Digital (especially IoT and Cloud)
  → new vulnerabilities
  → New paradigm for Operation, safety and security:
    - the perimetric defence is not enough anymore
    - depth in defence and endogenous defence are required now

→ Risk is real! Must be a priority - Awareness is a pre-condition –
Definition of that is “acceptable” or not is a preamble
Digital revolution - new challenge of the Railway industry

Social and societal changes

➢ Ubiquitous computing
➢ Blurring
➢ Automation
➢ Smart cities
UIC Digital Platform

Digital Platform missions

Share

Open

Connect

➤ To support the members and their POCs or projects
Our ambition is to facilitate the interactions between two worlds: the railway world and the digital eco-system.

Created in November 2015, The UIC worldwide digital platform is there to support the Railway in this new challenge.

The Digital Platform aims at supporting the digital strategy and activities of its members.

We are actually living what Jeremy Rifkin, the American economist, has named the third industrial revolution which is based on Internet and the use of new energies.
Digital is not only communication and strategy
But also concrete projects

UIC Digital Platform actively supports

Rail system department realization of POC (Proof of Concept)
RSD has launched several POC’s → projects & IRSs

Field of work for railway “in anticipation”

- **Operation**
  - Automatic train supervision – continuous train localisation...
- **Train driving**
  - Intelligent remote monitoring Switch or Level crossing engine...
- **Asset management**
  - Formal method for computerized distributed systems...
- **Critical assets**
  - Broken rail localization - Shunt accelerator for track circuits...
- **Safety**
  - Apps for intelligent guidance of blind customers ...
- **Security**

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Asset management in practice

Main goals:

> Develop specific methods and tools for the lowest whole life and system cost.
  → based on the continuous knowledge of the status, the use of the assets thanks to digital sensors, measurement trains and drones

> Develop specification and procurement methods to minimize the future for the lowest whole life, whole system cost

> Asset management is the art of striving for high performance in a context of “shortages” – individual resource managers are not aware of overall shortages

⇒ This needs a “Governance” → necessary conditions but not sufficient for asset managers to operate effectively
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Asset management system

Network strategy

PERFECTLY COHERENT IMPLEMENTATION: from performance needs to works performed

Definition of needs and planning

Production

knowledge

A-15
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Network strategy

Definition of needs and planning

Production

Network Strategy
Definition Network performance targets

Strategies for routes
Definition Performance targets by route

Asset strategies
Definition of technical policies

Planning by route
Planning of medium-term works by route

Sequencing by route
Short-term planning of works by route

Execution of works
Works, reports, performance

Asset management system

_reviews

Target governance landmarks

→ In each stage the need of digital tools given the possibility to manage the process in real time

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Cyber security in practice (ARGUS → TSEG)

Main goals:

✓ Knowing that "invisible" threats condition today’s railway assets, without real consideration by the Railways (IM and RU), but also by the suppliers and the regulation authorities → How we manage “threats and weaknesses” (still existing) in railway infrastructures from the Railway point of view

✓ To provide the right, pertinent, efficient advise to the railways, IM’s and RU’s, to tackle this emerging problematic, especially in the framework of IoT, big data, clouds, black boxes... not only technical, but also operation and human capital aspects

→ This needs “Governance” to operate effectively
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Cyber security in practice (ARGUS → TSEG)

- Safety Target the defender must prevail
- Possible “one-day attack”: too far to be dangerous!
- Remote detection of any intrusion & possible remote countermeasure
- Local Detection of any intrusion & possible local countermeasure
- Safe way for moving the defender soldiers reinforcing the Safety target defence

New paradigm: defence in depth AND endogenous defence

If not:
Adapted reaction is the module is attacked
→ safe reaction regarding the system

If the functional message received is “its topology... correct” regarding the system state of the IXL

Railway specific functional coherence-plausibility check (State machine)
Specifications (functionalities and observatory) formal proven

Specifications

Functional graph
Secu.icy graphs
SIL4 Graph Interpreter

IP signalling network
3 – Operation in practice (→ OpEG)

Main goals: To optimize timetable during maintenance

**INPUT PARAMETERS**  
Maintenance, timetable, vehicle, infrastructure, cost, speed, headway

**OUTPUT PARAMETERS**  
Optimized timetable with minimum delay time

**CONSTRANT**: Headway, route switch, speed limit, permissive delay

**GOAL**: Minimization of total delay time from a given timetable

→ This needs mathematical models and efficient tools
4 – Upgraded existing assets in practice

Shunting booster for track circuits:

- The « booster » control the safe position of the TC relay
- Increasing the safety and reducing cost without high investment
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Upgraded existing assets in practice

Broken rail detection & localisation:

- Increasing the safety and reducing cost without high investment
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Upgraded existing assets in practice

Existing Level Crossing:

How Digital can improve security at level crossings?
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Upgraded existing assets in practice

Train localisation and speed measurement by pseudo Track circuit :
→ to inform in real time the RBCs and the ATSs systems of the real position of the trains to take the right decision

Real time monitoring with artificial intelligence of the Switches, the level crossing engines :
→ to inform the maintainer / predictive and proactive maintenance

Measurement in real time of the “insulation joints” resistance, the signalling cable in operation insulation :
→ to inform the maintainer / predictive and proactive maintenance

Switches position recognition by videos taken by dedicated drones
→ for safety and operation cost reduction in degraded mode

→ And many other examples…
Conclusion

We are in a digital revolution - a new challenge for all the Railway industry – we need to find the “Nash Optimum” for the railway system.

Digital technologies shape the future of track maintenance, of smart operation – there is a real possibility to increase significantly the railway efficiency.

But only if we take into account all the new challenges, especially:
- cyber security and safety demonstration → SSMS
- shortness of the asset life cycle → Modularity
→ to be included in a strong asset management organisation

We are at the beginning of the story!
“Imagination is more important than knowledge”
Albert Einstein

Thanks for your kind attention

Pr. Dr.-Ing. Marc Antoni
UIC Rail System Director
antoni@uic.org