Optimising the Operation of Regional Lines

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Cost reduction for non-ERTMS lines?

- **Market potential for non-ERTMS solutions**
  - 30,000 km of infrastructure (from Chart 23b: 16%)
  - 71% of companies run non-ERTMS services
  - 350,000 people on staff are involved

- **Regional railway service is indicatively**
  - a trip of maximum 70km and
  - a transit time of 30 to 60 min

- **Low cost attempt proposed by UIC**
  - less staff
  - simpler infrastructure
  - no costly retrofit of rolling stock
  - train detection / traffic control based on autonomous train localisation & speed measurement
  - GNSS supported driver assistant + movement authority reinforcement on board

**Standard solution based on proven technology for all situations?**

- Figures taken from ERRAC study on „Suburban and Regional Railways Landscape in Europe“, Oct. 2006

**Chart 23b: Total track length in km of infrastructure that is (or is not) part of the European rail system**

- Total track length is about 185,000 km.

**Chart 23a: Percentage of companies running services on rail infrastructure physically, functionally or not separated from the European rail system**

- No separation from European rail system: 36%
- Physical Separation: 35%
- Functional Separation: 29%
The Agony of Choice
Performance vs. Expenditures vs. Workload

The workload of dispatchers increases with traffic and results in a higher number of incidents.

Traffic Management from a central control room will:

- avoid inspectors in each station
- reduce the number of incidents
- reduce the workload when traffic increases

Expenditures for train protection
# What is really needed?

**Requirements Analysis**

<table>
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<tr>
<th>Procedures</th>
<th>Tolerable Hazard</th>
<th>Train Frequency</th>
<th>Passengers per Train</th>
<th>Staff per km</th>
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</thead>
<tbody>
<tr>
<td>Main lines</td>
<td>Green</td>
<td>Yellow</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>Metros</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
<td>Yellow</td>
</tr>
<tr>
<td><strong>Regional lines</strong></td>
<td>Green</td>
<td>Green</td>
<td><strong>?</strong></td>
<td>Green</td>
</tr>
<tr>
<td>Trams</td>
<td>Green</td>
<td>Red</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

Typical qualitative performance parameters:
- **Low**
- **Medium**
- **High**

To be quantified
Which alternative Solutions exist?
Modelling and Instantiation

Example
System functions:
- Route setting
- Interlocking

Rules
Procedures
Responsibility

Points
(+ machine)
(+ control)
switch position info
+ switch lock

Functional level

Operational level

Technical level

maps to

fulfils

fulfils

supports

Technical innovations:
- EBI Star
- EBI Screen
- EBI Drive

Formal model

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Functional Level

Communication with centre

Localisation within the network

Activation of level crossings

Operation of points
Operational Level

Activity diagram for phone block operation

- Examples for required activities according to rules in regulation
  - Find out time for next departure;
  - Find out current time;
  - Find out train number and next train reporting point;
  - Train report – offer;
  - Entry in train record book;
  - ...
Technical Level

- **Communication**
  - Personal
  - Telephone
  - Data radio
  - Interlocking (Operator <-> Operator)
  - Signals (Operator -> Driver)

- **Localisation**
  - Direct view
  - GPS (+ odometer + …)
  - Axle counters / track circuits
  - Balises
  - Lindometer

- **Level crossings**
  - Activating/deactivating
    - Track switches
    - IR connection
    - Data radio
    - Telephone
  - Supervision
    - Signal (via interlocking)
    - Personal
    - Remote
    - Train driver

- **Point / Route setting**
  - Locally operated
    - Manual
    - Motorised
  - Remotely operated
    - Direct
    - Indirect
Technical Level (continued)

- **Automatic Train Protection**
  - Train Supervision
  - Train Protection
  - Brake Interface

Drivers MMI

Radio

Position reference system

Speed and distance unit + Tachometer

Brake interface

Computer unit
Technical Level (continued)

- **Control Centre**
  - System Overview
  - Tracking
  - Traffic Management

- **Driver-Machine Interface**
  - Driver ID
  - Train ID
  - Train configuration
  - Movement Authority
Comparison of Solutions

- Optimising criteria
  - Safety
  - Performance
  - Costs
  - Stress for the personnel

- When applying the same model, various alternative solutions can be compared with regard to the optimising criteria.

- Low cost solutions are possible if
  - technological progress provides equal functionalities at lower cost
  - safe functions may be fulfilled by operational procedures
  - operational procedures are technically supervised
  - a lower safety integrity level can be chosen for technical components as long as the remaining hazard risk is tolerable.
**INTERFLO Solutions**

- **INTERFLO 50**  
  GPS-based train location and information system for train supervision

- **INTERFLO 100**  
  Proven technology for regional main lines

- **INTERFLO 150**  
  Radio-based signalling for regional / industrial lines

- **INTERFLO 200**  
  Enhanced signalling solution for main lines

- **INTERFLO 250**  
  ERTMS Level 1 solution comprising all the trackside products required for main line operations

- **INTERFLO 450**  
  ERTMS Level 2 solution offering speeds over 250 Km/h

- **INTERFLO 550**  
  ERTMS for regional lines
INTERFLO Solutions comprise a variety of products

INTERFLO®
Main line Solutions

- EBI* Screen control room
- EBI Link wayside equipment
- EBI Lock computerised interlocking
- EBI Com radio block centre
- EBI Star Telematic units

- EBI Track train detection
- EBI Switch point machines
- EBI Gate level crossings
- EBI Light signals
- EBI Cab ATC onboard equipment

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Conclusion

- The current approach to develop individual solutions for low traffic density lines is not cost-efficient.

- A better approach would be:
  - Assess the needs of railways for the operation on low-traffic density lines
  - Develop a common model of the regional non-ERTMS railway system
  - Derive the instantiated model of a specific regional line
  - Choose components from the wide range of available products
  - Introduce new technologies like Lindometer or GNSS
  - Compare alternative solutions by the optimising criteria
  - Select the most efficient solution that fulfils the safety targets

Bombardier has a solution available for regional ERTMS lines and is the best partner to go for a solution for non-ERTMS lines.
Thank you very much!

Learn more about our commitment to sustainable mobility on:
www.theclimateisrightfortrains.com