Impact assessment method to forecast high speed railway’s punctuality due to technology evolution

Presentation at the 1st International Workshop on High-Speed Rail Socioeconomic Impact

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**Introduction**

**Impact of delays in HSR:**
- Missed train connections
- Potentially productive time is wasted in waiting
- Significant overall delays for the passenger

**Its consequences:**
- Dissatisfied passengers
- Decreasing modal split share of railway usage

- Large number of delay minutes caused by technical failures
- Microscopic simulations to assess HSR punctuality due to innovations mostly complex, expensive and requires huge number of technical and operational details

→ **Simplified methodology** developed as part of the IMPACT-2 project of the Shift2Rail (S2R) initiative
Shift2Rail – facts and figures

**S2R Objectives**

- **Increase reliability & punctuality by 50%**
- Double railway capacity
- Halve life-cycle costs of railway transports
- Contribute to reduction of negative externalities, such as noise, vibrations, emissions & other environmental impacts

**Unique Partnership**

- 28 members
- 343 participants involved from 27 countries
- 92 SMEs
- 84 research centres and universities

To improve punctuality by increasing reliability

Source: www.shift2rail.org
Methodology to forecast HSR punctuality

Baseline scenario

Data input

Future scenario

Shift2Rail innovations

Source: www.shift2rail.org
Methodology to forecast HSR punctuality

Baseline scenario

Future scenario

Data input

Reference scenario:

- SPD1: High Speed
- SPD2: Regional
- SPD3: Metro
- SPD4: Freight

Shift2Rail innovations

Source: www.shift2rail.org

Source: www.pixabay.com
Methodology to forecast HSR punctuality

[Diagram showing the flow of failure scenarios leading to normal operation]

Failure of technical system A
Failure of technical system B
Failure of technical system C

Build-up of delay minutes

Operation in fall-back mode
Normal operation with recovery
Normal operation

Failure handling
Methodology to forecast HSR punctuality

- Failure rates linked to delay minutes based on historic data
  a) related to infrastructure: Infrastructure managers based on established definitions and agreements on the collection of common data in the framework of the Platform of Railway Infrastructure Managers in Europe (PRIME).
  b) related to trains: from the European railway undertakings and infrastructure managers that are actively involved in Shift2Rail

- Improvement data: Decrease [%] of probability of failure per failure cause by S2R Innovations
Implementation of the punctuality model

Key idea of the methodology: Usage of historical data to estimate delay minutes

Input data:
- Annual number of failures
- Failure categories, e.g. failure due to switch or failure due to power supply
- Delay minutes per failure due to technical faults

S2R-Improvements setting up the future scenario:
- % reduction of failures driven by technical innovations

Outcome:
Estimation of the punctuality improvements resulting from improved failure probability due to technological developments
Implementation of the punctuality model

- Delay minutes caused by train failures
- Delay minutes caused by failure category
- Delay minutes caused by CCS, infrastructure, operation failures

15.09.2021 Filiz Kurt - 1st International Workshop on High-Speed Rail Socioeconomic Impact
Benefits and limitations of the punctuality model

The method enables,

... to obtain an initial basis for calculating punctuality without the need to carry out a complex and extensive simulation

... to take into account different impacts of different failures on a specific system (impact of the delay minutes caused by failure on the system)

... to show the punctuality improvement in railway caused by the reduction of number of failures in the system

The method is limited,

... because historical data is collected in a specific system and cannot be transferred to another system without restrictions

... because the method does not take into account interdependencies between failures

... because the method has no control over how the data was measured

... because the method is only applicable if the function of the technical system does not change as well as for technologies for which the assumptions are valid
Objective of the research: developing a simplified approach to estimate the expected impact of proposed and planned technical innovations on punctuality after their implementation for decision makers in the railway sector.

By applying this type of models it is possible to avoid complex simulations.

Essential, a common understanding of data and its collection in Europe, as e.g. found in PRIME, to develop and apply methods such as the punctuality model.

First basis for initial indications for evaluating the impact of technical improvements on punctuality and consequently on passenger satisfaction and thus on the modal split in the high-speed system.
Thanks for your attention!
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