Railway Simulators at the German Aerospace Center –Testing, Research and Development

Speaker: Niels Brandenburger

German Aerospace Center

Research Institution

- Aeronautics
- Space
- Energy
- Transport
- Defense and Security

Approx. 8000 employees across
33 institutes and facilities
at 16 sites in Germany

Total income 2015: 891 Mio.€
(research, operations, management)

Space Agency

German Aerospace Center

Research Institution

- Aeronautics
- Space
- Energy
- Transport
- Defense and Security

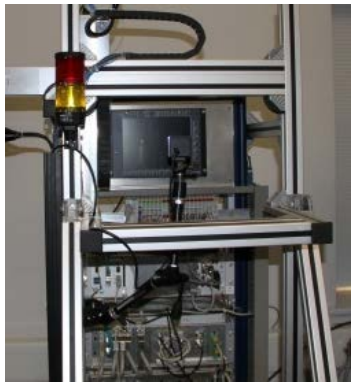
- Surface Transport
- Human Factors Division in Berlin/ Braunschweig, Germany

Space Agency

Agenda

- **Introducing our simulation facilities**
  - RailSite
  - RailSet
  - Modular Mockup Rail
- **Current areas of work**
  - Human factors research
  - Prototyping of assistance systems
  - Specific training concepts
- **Future directions of development**
  - Train protection functionalities
  - 3D visualisation
  - Future Workspaces
  - Training

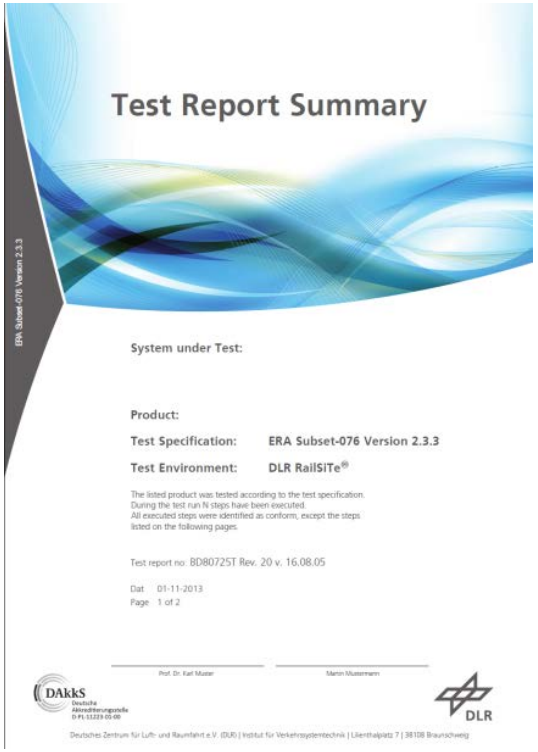
Introducing the RailSite



- RailSite simulates ETCS railway operation (Baseline 2/ 3)
  - Interlocking
  - Radio block center
  - Onboard unit
  - Driver machine interface

- Every part can be replaced by the real component for conformity testing of that component

- This ETCS simulation provides the computational framework for our train simulators


Test Report Summary

ERA Subset-076 Version 2.3.3

System under Test:

Product:

Test Specification: ERA Subset-076 Version 2.3.3

Test Environment: DLR RailSiTe®

The listed product was tested according to the test specification.
During the test run N steps have been executed.
All executed steps were identified as conform, except the steps
listed on the following pages.

Test report no: BD80725T Rev. 20 v. 16.08.05

Dat 01-11-2013
Page 1 of 2

Prof. Dr. Karl Muster | Martin Mustermann

DAkkS Deutsche Akkreditierungsstelle D-PL-11223-01-00

DLR

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) | Institut für Verkehrssystemtechnik | Lilienthalplatz 7 | 38108 Braunschweig

Introducing the RailSet

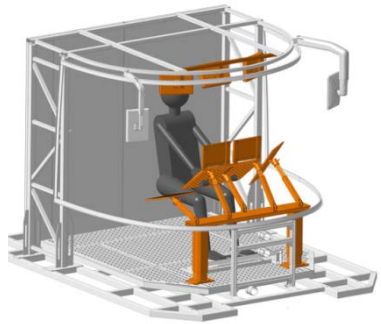
- The train cabin within the RailSite infrastructure
  - Real cabin (BR424)
  - 3 touch displays
  - Front and side windows
  - Inductive NTC/ ETCS (L1/L2)

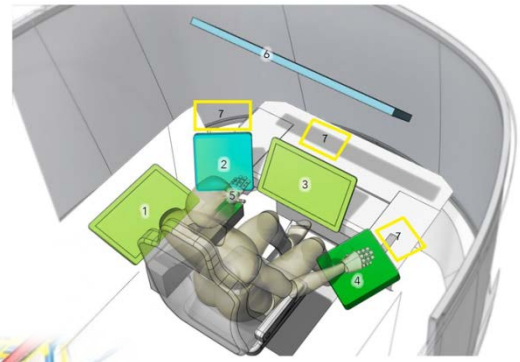
- RailSet is used
  - as experimental setting for human factors research
  - For the evaluation of prototypes (e.g. assistance systems / controls)
  - As training environment

- RailSet logs
  - Driving data, EVC log and panel input parameter
  - Video/ Audio data
  - Eyetracking- and physiological data

Introducing the Modular Mockup Rail

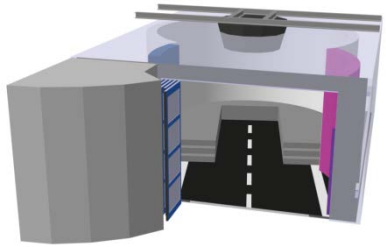
- **Modular Mockup Rail**
  - Modular interior design and display layout
  - Can be used as well in the dynamic as in the and 360° static simulation environment at DLR





- **Goals:**
  - Standardized usability testing of new HMI concepts
  - New configurations can be explored
  - Can be adapted to various training szenarios

- Logging is comparable to RailSet



Current work – human factors research

- What is the influence of automated driving (ATO) on the train driver in high speed railway operation? (Next Generation Train Project)

- **Key characteristics**
  - 26 train driver participated in two groups (ATO / manual driving)
  - 3 hours experiment (400 km/h/ high speed track/ ETCS L2oS), underloading scenario
  - Eyetracking, EEG, ECG, questionnaires, driving performance indicators

- **Main findings:**
  - Slower reactions towards critical events associated with ATO
  - Situation awareness, routine performance and attention allocation not impacted

Current work – human factors research

- Does ATO influence the quality of the situation awareness of the train driver approaching level transitions (e.g. ETCS L2 -> NTC)?

- **Key Characteristics:**
  - 2 hours experiment (280 km/h/ level transitions ETCS L2/NTC)
  - Eyetracking, EEG, ECG, questionnaires, driving performance indicators

- **Main findings:**
  - Let´s see in February 2017

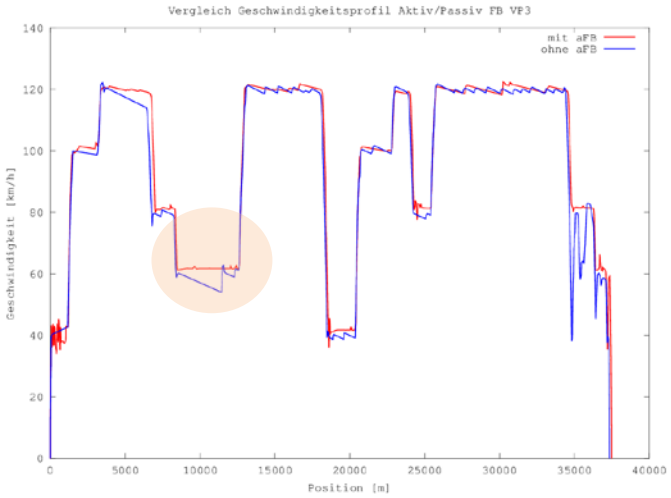
- Findings as such translate into workplace and assistance system design

Current work – Prototyping of assistance systems

- **Dynamic control stick** based on side stick from aeronautics
- The dynamic control stick provides
  - haptic backpressure to convey the optimal speed input

- **Goals:**
  - Increased punctuality
  - Decreased energy consumption

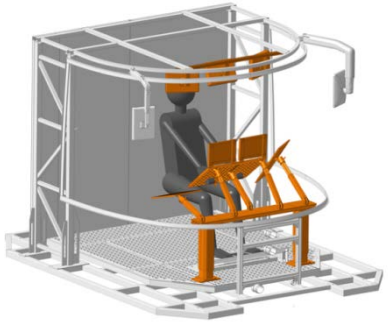
- **Main Findings:**
  - Dynamic control stick helps to stick closer to the speed profile



Current work – Specific training concepts

- Both RailSet and Modular Mockup Rail can be used for training

- The RailSet offers
  - High fidelity environment
  - Standardised training scenarios



- The Modular Mockup Rail offers
  - Highly adaptible environment
  - Dynamic (moving) simulator
  - 360 degree virtual reality
  - Programmable road users

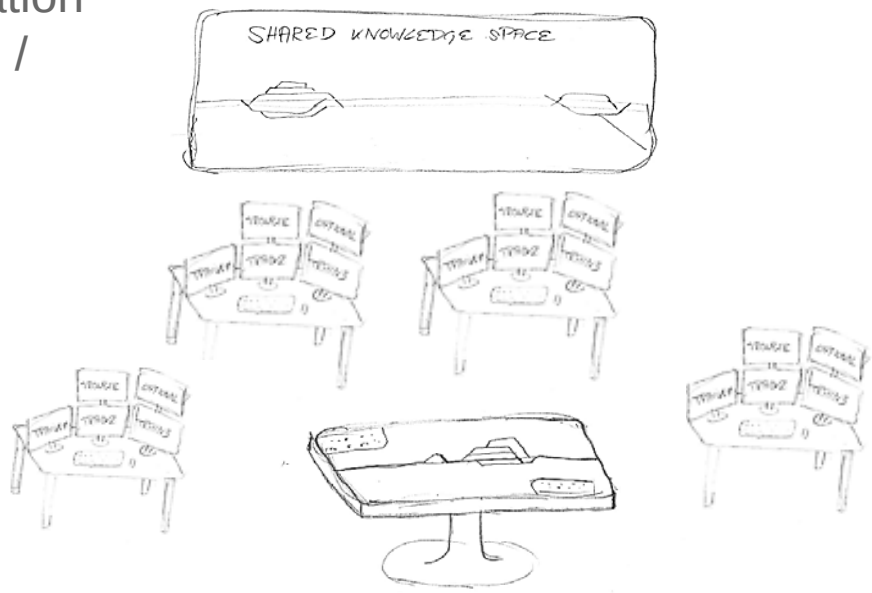
Example:

- Light rail training concepts

Future Directions

- RailSite/RailSet/ Modular Mockup Rail
  - Keep up to date with ETCS development and specifications
  - Improve import of real world 3D models (RailML)
  - Extend scenarios for training for main line operation and light rail

- Build up future train driver workspace
  - for high levels/ grades of automation
  - Remote- control and supervision / tele maintenance
    - Multi-Train, part- time



Conclusions

- German Aerospace Center offers multiple medium/ high fidelity train simulators

- Adaptable to costumer preferences
  - Dynamics
  - Visual information
  - Train protection system
  - Szenarios (light rail to high speed main line operation)

- Simulators can be used for your
  - Scientific research
  - System evaluation and testing
  - Safe prototyping
  - Customized trainings

Thank you your interest!

Thanks for this very interesting conference!

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