MoSiS
Model of Safety Layers in the Railway System

Markus Pelz, Stefanie Schwartz, Michael Meyer zu Hörste
About myself

- Dipl.-Ing. Markus Pelz
  - Studies at TU Dresden, at Chair of Railway Signalling and Transport Safety Technology
  - Research assistant at DLR since 2005

- German Aerospace Center (DLR)
  - Institute of Transportation Systems
    - Division Railway Systems - Signalling and Control

- Co-Authors of the paper
  - Dipl.-Math. Stefanie Schwartz
  - Dr.-Ing. Michael Meyer zu Hörste
German Aerospace Center
Institute of Transportation Systems

Residence: Braunschweig and Berlin
Since: March 2001
Director: Prof. Dr.-Ing. Karsten Lemmer
Employees: Presently 100 employees from various scientific disciplines

- Fields of research
  - Automotive
  - Railway systems
  - Traffic management

- Range of tasks
  - Basic research
  - Creating concepts and strategies
  - Prototype development
Contents

- Motivation

- Basics
  - Safety layers
  - Swiss cheese model
  - Accident analysis

- MoSiS
  - Combining accident analysis and Swiss cheese model
  - The way forward

- Theses
Motivation
Motivation
Initial Situation

- Railway system is one of the safest transport systems but...
  *Risks still exist and will always exist!*
  - 17% of all railway accidents happened at level crossings (EU, 2005)\(^1\)
  - 880 killed or seriously injured at level crossings (EU, 2005)\(^1\)

- Problem: Maintaining and improving safety is expensive
- Alternative: Improving safety by using low cost technology

- The aim is to build a model / a tool
  - that helps showing that low cost technology works appropriately
  - that helps increasing organisational and technical safety in the railway system

\(^1\) Eurostat 2007
Motivation
Approaching MoSiS

Steps
- Analysis of railway accidents
- Identification of gaps in the safety concept
- Find safety layers in the railway system
- Close gaps to improve safety

Starting point: level crossing

Model of safety layers (MoSiS) has
- to assist in creating a custom-built, cost-effective safety concept without neglecting safety and
  - helps sustaining low-density lines
  - helps creating new level crossing safety technology
Basics
Safety Layers
Ensuring the Safety of a System

- Every system has a safety concept to ensure a certain safety level
- Risks always exist
- Safety layers exist
  - to protect the system
  - to mitigate hazards and risks
  - to intercept faults and errors
  - to prevent accidents
- Absolute safety is impossible to reach
- Every safety system, every safety layer will have gaps

Diagram:
- Safety concept:
  - safety layers
  - hazards
  - faults
  - errors
  - accidents
  - running system

Deutsches Zentrum für Luft- und Raumfahrt e.V.
In der Helmholtz-Gemeinschaft
Model of Safety Layers in the Railway System - MoSiS > 04 June 2007 > 9
Institute of Transportation Systems > Aerospace technology for road and railway
Swiss Cheese
Visualisation of Gaps and Layers

- Swiss Cheese Model by James Reason
  - Illustrates that it usually takes more than one single failure to cause an accident
  - Slice of cheese = layer of protection / safety layer
  - Holes = gaps

- Path of gaps must go through all safety layers before it comes to an accident
- Path of gaps reveals how the safety concept failed
Accident Analysis
Why do Accidents happen?

- Find out how it came to an accident (e.g. collision of train and car at level crossing (LX))
  - Why did this accident happen?
  - What went wrong?
- Ask for
  - reasons instead of guilt
  - causal factors
- Why-Because Analysis (WBA)
  - rigorous causal reasoning
  - graphical representation
  - easy to understand
MoSiS - Building Model of Safety Layers
MoSiS
Combining WBA and Swiss Cheese

- Analysis of the safety concepts in the railway system
- Identification of gaps by using accident analysis
- Causal factors lead to gaps
- Identified gaps provide a basis for the determination of safety layers
- Describe safety layers – build up MoSiS
MoSiS
The Way Forward

- Recombination of existing safety layers
- Identification of new safety layers
- Combination of existing and new safety layers
- Identification of new safety concepts

- Aim: validation of new safety concepts which use low cost technology

(e.g. applications by means of state-of-the-art camera technology)

(e.g. operational rules, equipment)

New Safety Concept
Theses

- The railway system is one of the safest transport systems we have

- MoSiS is expected to provide the following benefits:
  - Identification of flaws in the railway system
  - Modelling of safety layers
  - Possibility to add, to exchange and to recombine safety layers
  - Possibility to optimise the safety concept in order to reduce costs
  - Possibility to improve safety systems
  - Possibility to validate technology and operational scenarios

- MoSiS will be helpful for realising safety cases
Thank you for your attention!

Any Questions?

Contact:
markus.pelz@dlr.de