SafeRail – Improving Safety At Railway Level Crossings

IAP Workshop
Für die Erde ins All - Transport & Logistik:
Herausforderungen und mögliche raumfahrtbasierte Lösungsansätze

3. Dezember 2013, Darmstadt

03.12.2013 | R. Grimm
SafeRail - Improving Safety at Railway Level Crossings

An activity within the Integrated Applications Program (IAP) Funded by the European Space Agency (ESA)

Agenda
• Quick Company Overview
• Project Background
• Project Overview
• Overview about Tasks
• Next Steps
SafeRail

Company Overview
COMPANY OVERVIEW

Berner & Mattner Systemtechnik

Key Data
• Foundation: 1979
• Employees: 470
• Locations 7

Portfolio
• Systems Engineering
• Software Engineering
• Safety Engineering

Sectors
• Space & Defence
• Engines & Energy, Machinery
• Transportation, Automotive

Customers
• MBDA, EADS, MAN, MTU, G&D, Siemens, DB, ÖBB, Bombardier, Audi, BMW, Daimler, VW, ESA, DLR, Astrium, Tesat
COMPANY OVERVIEW

Assystem Group

IN PARTNERSHIP WITH KEY INDUSTRY PLAYERS AND ON THE STRENGTH OF ITS BALANCED BUSINESS PORTFOLIO, GLOBAL ORGANISATION AND SOLID FINANCIAL FOUNDATION, ASSYSTEM CONTINUES TO BUILD SUSTAINABLE GROWTH.

2 BUSINESS AREAS
ASSYSTEM DEVELOPS EXPERTISE IN INDUSTRIAL ENGINEERING WITH GLOBAL CHAMPIONS, AT THE CUTTING EDGE OF THE NEEDS OF A DIVERSE MARKETPLACE.

COMPLEX INFRASTRUCTURE ENGINEERING
SUPPORTING BUSINESSES IN MANAGING THEIR INDUSTRIAL INVESTMENTS, FROM INFRASTRUCTURE DESIGN THROUGH TO DEMANTLING, INCLUDING COMMISSIONING, OPERATIONS AND MAINTENANCE.

OUTSOURCED R&D
DESIGNING, BUILDS AND MAINTENING HARDWARE AND SOFTWARE DEVELOPMENT FOR PRODUCTS AND SYSTEMS ADORED AT INDUSTRY SECTORS AS WELL AS NEW TECHNOLOGIES.

INTERNATIONAL PRESENCE
ALL OVER THE WORLD, ASSYSTEM PROVIDES SUPPORT FOR ITS CUSTOMERS' PROJECTS.

GLOBAL WORKFORCE

40% OF REVENUE ACHIEVED INTERNATIONALLY

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Background
Objectives

Improve safety at Railway Level Crossings (RLC)

- Benchmark: Reduce number of fatalities/accidents at RLC
- Requirements: Needs and constraints of relevant users and stakeholders
- Approach: Develop an “Integrated Solution” (Rail/Automotive/Space/ …)
- Method: Road Safety Concept of “5 Es” (Engineering, Education, Enforcement, Encouragement, and Evaluation)

Scope

- Entire Lifecycle of RLC (planning, authorization, operations, ..)
- Any User / Stakeholder: Authorities (Road/Rail), Traffic Planners, Road Users, Rail Infrastructure Manager, Railway Undertakings, Enforcement Bodies, Insurance Companies, Emergency Services, …
- Any kind of RLC: main lines (dense traffic), secondary lines (passive RLCs)
1. Main accident cause: Distraction of Road User
2. Railway safety ignores Human Factors
3. High invest in RLC in Europe (>100 Mio per country per year)
4. Transition in safety ideology from rule based to risk based
5. RLC account for 50% of Rail fatalities
6. RLC account for <1% of Road fatalities
7. Acceptance / Approval of Space Techn. is very difficult for Rail Sector

Comparison of Fatalities per Million Habitants in 2009
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Project Overview
PROJECT OVERVIEW

Project Partners

Berner & Mattner Systemtechnik (Lead, Germany)
- Railway Safety: Software + Systems Engineering
- Automotive: Telematics, Driver Assistance, …

Avanti Communications (UK)
- Satellite Operator

Brimatech Services (Austria)
- Technology Viability Analysis / Stakeholder Involvement

JOANNEUM RESEARCH (Austria)
- Satellite Communication, Earth Observation

TeleConsult Austria
- Precise and Reliable Positioning Systems
PROJECT OVERVIEW

Project Logic

- **Task 1**: User & Stakeholder Analysis & User Requirements Definition
- **Task 2**: State-of-the-Art Analysis & Technology Identification
- **Task 3**: Specification of the Integrated Solution and Associated Services
- **Task 4**: Proof of Concept
- **Task 5**: Economic and Non Economic Viability Analysis
- **Task 6**: Roadmap and Recommendations

**Timepoints**:
- T0: Kick off Meeting with Users (KO)
- T0+3M: 1st Progress Meeting (PM1)
- T0+6M: Mid Term Review (MTR)
- T0+9M: 2nd Progress Meeting (PM2)
- T0+12M: Final Review (FR)
Task 1
User & Stakeholder Analysis & Requirements Definition
TASK 1
Requirements Process

2 Workshops / 25 Phone Interviews

Users / Stakeholders from DE, AT, PL, FR, CZ, …
- Rail Safety Authorities
- Road Safety Councils
- Rail Companies
- Insurance Companies
- Transport Safety Research
- Car Driver Associations

Literature Studies

Directives / Standards
- EN 5012x
- TSIs
- ISO 26262
- …

Hazard Logs

Accident Reports

Current shortcomings

User Needs / User Requirements

“As a car driver I don’t want to stop”
TASK 1

Users / Stakeholders
User Requirements

Stakeholders

Nominal Operations

Scenarios

Level Crossing Lifecycle

Operational Principles

Constraints

User Requirements

Task 1
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Task 2
State of the Art Analysis & Technology Identification
TASK 2

State-of-the-Art Analysis

Technologies / Solutions
- Positioning Systems
- Communication Systems
- Earth Observation
- Navigation support services
- Road Safety Technologies

Current railway level crossing systems
- Evolution of RLC over time
- Train Control Systems
- RLC Components and Functional Analysis
- Risk Models

Analysis of R&D projects
- Projects related to…
  - Rail Activities
  - Navigation Support Systems
  - Road Signs
  - User Terminals Augmenting
  - Road User Awareness

Critical Analysis

Technology Identification
Technology Identification

User Requirements

Analysis

Gap

Suitable Technologies

TASK 2
Service and System Definition

**Service Definition**

- **Service Requirements**
  - “What is delivered to whom and when?”
  - “How well is it delivered?”
  - “How is the information delivered?”

- **Service Provisioning Chain**
  - Information sources and flows
  - Involved actors
  - Responsibilities of actors

**System Requirements & Architecture**

- **System Requirements**
  - Functions
  - Performance
  - Interfaces
  - Operational environment

- **System Architecture**
  - Technical architecture
  - Sub Systems & Interfaces
  - Design Justification
  - Concept of Operations

**Feasibility Assessment**

**Integrated Service**

Ref.: ESA Guidelines for Service and System Definition
### Selection of SafeRail Services

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Road User assistance functions</td>
</tr>
<tr>
<td>1a</td>
<td>- Comfort assistance functions (strategic routing)</td>
</tr>
<tr>
<td>1b</td>
<td>- Support the situational awareness (Information and Warnings)</td>
</tr>
<tr>
<td>1c</td>
<td>- Active safety (automatic braking, ...)</td>
</tr>
<tr>
<td>2</td>
<td>Wireless Train Detection</td>
</tr>
<tr>
<td>2a</td>
<td>Optimization of closure times</td>
</tr>
<tr>
<td>2b</td>
<td>Cost-effective/affordable upgrade from passive to active level crossing</td>
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<tr>
<td>3</td>
<td>Enable rescue operations in case of permanent break-downs in the hazard zone of level crossings</td>
</tr>
<tr>
<td>4</td>
<td>Reduction of rail traffic suspension due to exceptional road vehicles</td>
</tr>
<tr>
<td>5</td>
<td>Inspection of sight triangles</td>
</tr>
<tr>
<td>6</td>
<td>Support for enforcement operations</td>
</tr>
<tr>
<td>7</td>
<td>Increase safety at level crossings by collecting and analysing of risk factors</td>
</tr>
<tr>
<td>8</td>
<td>Blue Force Rerouting</td>
</tr>
<tr>
<td>9</td>
<td>Improve compliance with traffic rules by detecting temporary and illegal level crossings</td>
</tr>
</tbody>
</table>
## Task 3

### Selection of Integrated Services

<table>
<thead>
<tr>
<th>ID</th>
<th>Service Title</th>
<th>Integ. Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>In advance information for Road User</td>
<td></td>
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<tr>
<td>1b</td>
<td>Hazard warning for Road User</td>
<td>Road User Operations</td>
</tr>
<tr>
<td>1c</td>
<td>Protecting the Road User</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>Reducing closure times</td>
<td>Railway Operations</td>
</tr>
<tr>
<td>2b</td>
<td>Cost affordable level crossing upgrade</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Inspection of level crossings</td>
<td>Maintenance Railway</td>
</tr>
</tbody>
</table>
Examples from Service „Operations“

Content Provider (static data)
Provides static data about
the infrastructure level crossings
and planned train schedules

Content Processor
Edits the received data and passes
the requested one

Telematics Data Provider
Receives information and
passes it to the integrated systems in cars

Road User
Receives the required information and takes advantage of the known in different ways

Content Provider (dynamic data)
Provides data about
the operational situation e.g. real time locations of trains and estimated delays

Trackside (GPS)
- Train speed
- Movement, delays, track changes
- Rail infrastructure
- LC description

GPS Satellite
Telematics Data Provider
Receives information and passes it to the integrated systems in cars

User Terminal
- Pedestrians
- Cyclists
- Train position message
- Position sensing (GNSS Receiver, odometry, data fusion)

Web service
- SafeRail Information Web server
- SafeRail Web services

External Data Sources
DB Data

TASK 3

SafeRail Platform
Exchange Information Services Server

Internet

Satellite, mobile communications

LC Activation / Deactivation, Closure Times, Speed Limitations

Trains/LC

User Terminal
- Car Drivers
- Strategic Routing
- Local hazard warning

Web service
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Task 5
Economic & Non Economic Viability Analysis
Objective

“Identify non-technical aspects which are relevant to a successful implementation of the integrated solution and associated services in a sustainable manner and assess the influence of these aspects on the implementation”

Market Analysis

• Market Segmentation / Size
• Drivers and Barriers
• Competitive Analysis

Cost Benefit Analysis

• Cost Drivers
• Commercial Benefits

Revenue Indicators

Non-Economic Viability Aspects

e.g. Regulatory and Legal Frameworks
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Next Steps
Next Steps

1. Proof of Concept
2. Awareness Event
3. Roadmap and Recommendations
4. Preparation of Demo Phase
Vielen Dank für Ihr Interesse!

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