Project of expert and training system for extreme situations on railways

Zdenek Dvorak, Jozef Majercak and Ladislav Novak
University of Zilina, Slovakia
Content:
1. Introduction of UNIZA
2. New project PETSES
3. Solved projects
• **1953** – University of railway transport, Prague
• 1959 – University of transport, Prague
• **1960** – moving to Žilina
• 1978 – University of transport and communications, Žilina
• **1996** – University of Žilina (next UNIZA)

![Map of Slovakia showing Žilina](image)
UNIZA has 7 faculties:

- of operation and economics of transport and communications
- of mechanical engineering
- of electrical engineering
- of civil engineering
- of management science and informatics
- of special engineering
- of humanit science
People on UNIZA:

- 660 Academics
- 145 Research workers
- 10 500 Students /102 Foreign /652 PhD.
- 260 Accredited study programs
Faculty of operation and economics of transport and communications

Departments of:
• Road and Urban Transport,
• Railway Transport,
• Air Transport,
• Water Transport,
• Communications,
• Economics,
• Quantitative Methods and Economic Informatics

Faculty’s mission:
High quality education, science and research in the field of engineering, operational, technological and commercial-economic disciplines of transport and communications for prospective careers of our students.
Faculty of special engineering

Departments of:
• Crisis Management,
• Fire Engineering,
• Security Management,
• Technical Sciences and Informatics,
• Research Department of Crisis Management.

Faculty’s mission:
To prepare university educated managers and experts for solution of crisis situations in all spheres of human life.
The main aim of the **Project of expert and training system for extreme situations on railways** (next PETSES) was to design and to develop of expert and training system for managing railway transportation in extreme infrastructure situations. Designed parts were oriented on:

1. operating before and during extreme extraordinary situations - such as technical faults, fires, floods, explosions and terrorist attacks,

2. supporting protection of critical transportation infrastructure.
Planned results were oriented on:
1. To design a behavioral model of people in narrowed spaces, with focus on internal and external factors

2. To project the most probable scenarios of various extreme and emergent situations (explosions, fires, floods)

3. To develop a software training tool and specific training methodology

4. To propose recommendations of real decision support system in daily practical use
Short history of our similar railway projects:

1. Simulation of railway transport in crisis situations - project ASTRA
2. Risk identification in railway transport of dangerous goods
3. Critical infrastructure protection in transport sector

Donor: ŽSR
1. Simulation of railway transport in crisis situations - project ASTRA

3. Solved projects
2. Risk identification in railway transport of dangerous goods

Threats identification

Human influence
- Maintenance
- Law system and people

Natural influence
- Means and infrastructure
- Transport technology

Donor:

3. Solved projects
2. Risk identification in railway transport of dangerous goods

As results:
List of possible initial events

3. Solved projects
2. Risk identification in railway transport of dangerous goods

Method used before Threat – Hazards Tree Analysis (HTA)

- Initial event
- Threat identification
- Damage of health, property and environment
- Measures for reducing the threat
- As results: the List of threats

- 2. Risk identification in railway transport of dangerous goods
- 3. Solved projects

Diagram:
- EE
- Without escape
- EXPLOSION
- FIRE
- EXPLOSION
- Without FIRE
- ESCAPE
- Without FIRE
- Explosion
2. Risk identification in railway transport of dangerous goods

Method used post Threat – Event tree analysis (ETA)

Initial event

Start of accident

Occurring of extraordinary situation (RID)

Escape of transported dangerous materials

YES

NO

Initial event

Post THREAT

Damage of health, property and environment

Measures for reducing the threat

As results: the Tree list of threats

3. Solved projects
2. Risk identification in railway transport of dangerous goods

**Individual risk - IR**
= number of death injuries per one passenger and km,

**Society risk - SR**
= number of death injuries in comparison to number of transported passengers

<table>
<thead>
<tr>
<th>Transport</th>
<th>IR - number of death injuries per 100 milion passangers and km</th>
<th>SR - number of death injuries per 100 milion passanger hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>0,06</td>
<td>1,4</td>
</tr>
<tr>
<td><strong>Train</strong></td>
<td><strong>0,1</strong></td>
<td><strong>6,0</strong></td>
</tr>
<tr>
<td>Car</td>
<td>0,4</td>
<td>12,4</td>
</tr>
<tr>
<td>Ship</td>
<td>0,8</td>
<td>16,0</td>
</tr>
<tr>
<td>Plane</td>
<td><strong>0,04</strong></td>
<td><strong>20,0</strong></td>
</tr>
</tbody>
</table>

Source: Přibyl, P.: Analýza a řízení rizik v dopravě
2. Risk identification in railway transport of dangerous goods

Possible damage of property at railway

<table>
<thead>
<tr>
<th>Number of accidents and Train*Km</th>
<th>Počet nehôd a vlakových kilometrov</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of accident</td>
<td>Typ nehody</td>
</tr>
<tr>
<td>Year</td>
<td>Rok</td>
</tr>
<tr>
<td>Collisions</td>
<td>Zrážky/kolízie</td>
</tr>
<tr>
<td>Derailments</td>
<td>Vykoľajenia</td>
</tr>
<tr>
<td>Level crossing accidents</td>
<td>Nehody na úrovňových križovatkách</td>
</tr>
<tr>
<td>Fires in RS</td>
<td>Požiare v dráhových vozidlách</td>
</tr>
<tr>
<td>Others</td>
<td>Iné/Iní</td>
</tr>
<tr>
<td>Total</td>
<td>Spolu</td>
</tr>
<tr>
<td>Train*Km (MLN)</td>
<td>Vlakové kilometre (v miliónoch)</td>
</tr>
<tr>
<td>N° of fatalities, train<em>Km and Passenger</em>Km</td>
<td>Počet usmrtených osob, vlakových kilometrov a osobo-kilometrov</td>
</tr>
</tbody>
</table>

Source: Vocabulary to ERA tabs
2. Risk identification of railway dangerous goods transportation

**Index of toxic hazards**
- surface water,
- underground water,
- soil,
- biotical part of environment

**Index of vulnerability of environment**
- surface water,
- underground water,
- soil,
- biotical part of environment

The result is sum of indexes

**Conclusions**
The identification of risk sources gives lists of:
- threats,
- initial events,
- possible damages.

Source: Methodics of VŠB TU Ostrava
3. Critical infrastructure protection in transport sector

- **Donor:** SLOVAK RESEARCH AND DEVELOPMENT AGENCY

- The main goal of the project is creation and development of broad basis of theoretical knowledge necessary for making optimal decisions in the process of creating strategic and conceptual documents in the field of the SR critical infrastructure protection with emphasis on critical infrastructure in transportation sector (next CIT). Important aims:
  - **Study 1** - Assessment of security environment in relation to critical infrastructure protection
  - **Study 2** - Public administration competences in protection of CIT
Project outputs:

- **Model 1** - General model of risk management in critical infrastructure protection
- **Model 2** - Model for objective risk management of the CIT elements
- **Model 3** - Model of rescue services activities in CIT critical points
- **Model 4** - Model for solving economic impacts of possible losses
- **Methodology** – Methodology of object protection of CIT elements
- **Methods** – updated statistical methods for evaluation the performance of selected CIT elements
Brainstorming - what do we need?

- Political support
- New regulations and standards
- Suitable and actual methods and methodology
- Development and implementation of technology especially ICT
- Implementation of expert information systems
- Improving the quality of employees

Document 1626 EU from 21st Dec 2010

The aim til 2014: „European strategy - five steps towards a more secure Europe“
Thank you for your attention

Contact to the authors:

Zdenek Dvorak, professor – zdenek.dvorak@fsi.uniza.sk,
Jozef Majercak, professor – jozef.majercak@fpedas.uniza.sk,
Ladislav Novak, assoc.prof. – ladislav.novak@fsi.uniza.sk