Integrated Safety in the Transport System

Rigobert Opitz

ROC Bernard GmbH (Austria)
rigobert.opitz@bernard-ing.com
Content

Natural Mobility - a challenge
Traffic Safety Theory – to manage the complexity
Kybernetic Werkstatt – to create solutions
Innovative Holistic Approaches
What we need
ASSET – the ambitious FP7 R&D Safety Project
Natural Mobility

Fully Accident Free
(Have you ever seen a bird (collision) falling from the sky?)

Highly Dynamic
(Short reaction time, “Save Swarm Mobility”, short stopping distance)

Very Efficient
(Selfproduction at 30-40 Degree Celsius, low consumption of resources, selfrecycling)

Autopoietc Structures
(Anabolic and Cathabolic Processes create the “Living Adaptive Structures”)

Billions of Tons
Micro (mg) and Macro (Tons) entities

Billions of Kilometers

Billions of Entities

Millions of Years
Development Heavy Transport Vehicle Overload and Safety

Germany 80s after reunification

Japan: Current accident
Involvements in Accidents (per 1000 accidents)

Creating a holistic integrated and efficient safety system incorporating:
- driver support and control
- infrastructure protection and life cycle optimisation
- efficient and safe road transport
by applying innovative technologies, automation of important processes and better cooperation between drivers, infrastructure and authorities. Optimisation by minimal factors with the highest impacts.
Traffic Safety Improvement Programme
Chains of Safety Impacts and Administrations Involved

Example: Sequence of Negative Effects
“Unfair Vehicle Overload”

- **Direct Safety Risk** (tyre failure, slow heavy truck, unstable driving, greater safety risk)
- **Safety Risk** (rutting of roads and skidding)
  - Shorter Road Lifecycle
- **Safety Risk** (construction sites, lane changes, high accident rate)
  - High Costs for M&R
- **Safety Risk** (higher risk taking, frustration of drivers, critical situations)
  - Higher Fuel Consumption
- **Pollution increase** (more usage of energy)
  - Global Heating
- **Unfair Competition** (disadvantages for legal fleet operators)

Negative Social and Economic Impacts
(Transport, Environment and Road Operation)
The Triangle of Safety

EC Objective
50% Reduction until 2010
(now 43,000 people killed and 160 Billion € losses)
Intelligent EuroCar

The Trilogy (3 Columns) for Traffic Safety

Intelligent Road
- Investment: high
- Time Frame: 2006-2010
- Safety Increase: moderate
- Cost efficiency: medium
- Legal Frame: not required

Intelligent Regulation
- Investment: medium
- Time Frame: 2006-2008
- Safety Increase: very high
- Cost efficiency: excellent
- Legal Frame: existing

Investment:
- very high
- medium
- not yet

Time Frame:
- 2010-2015
- medium
- not yet

Safety Increase:
- very high
- medium
- not yet

Cost efficiency:
- very high
- medium
- not yet

Legal Frame:
- existing
- not yet
- not required
Holistic Safety Theory
(Dialectic Quadropol Road Safety)

- Driver & Operator (A)
- Vehicle & Traffic (B)
- Infrastructure & Environment (C)
- Regulation & Control (D)

Dynamic Interactions Causing Road Safety
Holistic and Integrated Safety Concept
(Dialectic Quadropol Road Safety)

Dynamic Interactions Causing Road Safety

A) Driver & Operator — Infrastructure & Environment
- Driver/Operator needs and uses infrastructure (for driving, transport and travelling)
- Driver pollutes environment (energy consumption, exhausting pollution)
- Driver uses resources of environment
- Driver recognises pollution (polluted city) and reacts
- Infrastructure influences driving (road design, condition, traffic signs, signalling, restraint)
- Infrastructure depends on environmental conditions (frost, thaw, humidity, ground conditions)
- Driver has to consider these
- Environment influences driving (snow, rain, darkness, ice, fog, humidity)
- Each individual driver is a perceptual-cognitive entity, aware of the infrastructure and environment

B) Driver & Operator — Vehicle & Traffic
- Driver/Operator operates, uses and steers vehicles
- Many drivers with different vehicles, different objectives and behaviour form traffic dynamics
- Operators influence drivers' behaviours (time frame, loading)
- Operators depend on traffic conditions (best travel time, shortest distance)
- Vehicles depend on vehicle conditions (reliability, safety, capacity, economy)
- Vehicle conditions depend on operator maintenance and repair checks

C) Vehicle & Traffic — Regulation & Control
- Vehicle safety conditions have to be regulated
- Vehicles and traffic are controlled by police according to regulations
- Traffic is regulated by signalling
- Levels of traffic control have to be reasonable to achieve reasonable adherence to regulations

D) Regulation & Control — Infrastructure & Environment
- Regulations are projected by infrastructure (speed limit sign, access, limits)
- Regulation partially protects environment
- Infrastructure has to be controlled (system state, wear and tear)
- Control and access can depend on environmental conditions (Ozone, CO2, pollution)

E) Vehicle & Traffic — Infrastructure & Environment
- Vehicle uses and influences infrastructure (wear and tear)
- Vehicle loading can result in failure of infrastructure (road, bridges)
- Vehicles depend upon and influence environment
- Vehicles pollute environment
- Traffic impacts environment (polluting, energy resources)
- Traffic uses and influences infrastructure
- Traffic is dependent on and influences environment
- Infrastructure impacts vehicle and traffic capacity
- Traffic flow conditions depend on infrastructure condition

F) Driver & Operator — Regulation & Control
- Driver has to know and follow regulations
- Regulations have to be understandable and practical for drivers
- Driver is a key central figure for following safety regulations
- Operator has to know and follow regulations
- Regulations have to be understandable for operators
Consulting an Administration: Mission for a „Road Traffic Safety Commission“

**TCc Administration Set up**

1. Consider most important Safety Elements
2. Analyse main Interdependencies
3. Create adequate Administration
4. Create adequate covering Processes
5. Find “BEST TOTAL SOLUTION”
6. Practise “BEST TOTAL SOLUTION”

**TCc Administration Key issues**

1. Need of an Integrated Solution
2. Lean and efficient Administration
3. Effective & Strong Organization
4. Competent Key Experts and Skills
5. Embedded and Harmonised
6. International Links & Interactions
Holistic & Kybernetic Approach – Avoid Defizits

A) Wrong Objectives – don’t solve single problems, create an overall optimization, avoid repair measures without any strategy, plan needs in a visionary and pragmatic conception

B) Isolated System Analysis – system analysis has to be performed network based and not for isolated or single data, consider the composition of elements (Gefüge), intercheck the principles for creating an arrangement (Ordnung) with feedbacks, limits, consider hidden parameters. Define the different “universes” from clustering, relations, relevancies up to interlinked processes. Try to find, describe and analyze the kybernetic character of traffic safety
Holistic & Kybernetic Approach – Avoid Defizits

C) Irreversible Focusing – don’t concentrate only on one main item, which obviously looks as key aspect. Don’t forget parallel implications, impacts, effects and processes. Practice dialectic interactions for each pair. Look on the consequences of these parallel effects.

D) Unconsidered Side effects – by linear and casual thinking often focusing is the main affect, parallel issues and consequences often are not recognized or considered.

E) Over-Compensation – first steps are done with care, if effects are not directly or in time visible, a strong “putting in question” and “over-enforcing” followed possibly by fully braking is practiced.
Holistic & Kybernetic Approach – Avoid Defizits

F) Tendency to Authoritarian Measures - the power of being able to change a system, or the belief to understand the system leads often to a “dictator behavior”, which is for complex system not the best. Same is valid for “Gigantism” and personal prestige or “Narcismus” of managers

G) Kybernetic versus Linear - kybernetic strategies are not so common accepted compared with simple linear measures due to missing understanding of the complexity. But the reality is “Complex” and “Dynamic” and includes often many interlinked processes requiring a holistic and integrated view and a kybernetic approach for optimization and stability

H) Avoid dissymmetric Strategies - fight not against symptoms, avoid wrong objectives and irreversible focusing, consider side pass effects.
ASSET Road

ASSET vision
The ASSET vision is to substantially contribute to safe and sustainable transport by linking road traffic and safety information from all essential system elements. Improving driver awareness and behaviour is a key issue.

This will be achieved through an advanced sensor and processing network providing assistance and information for drivers, traffic control agencies and infrastructure operators.

Integral System Solution For Safety

Advanced Safety and Driver Support for Essential Road Transport

Creating a holistic integrated and efficient safety system incorporating:

- Driver support and control
- Infrastructure protection and life cycle optimisation
- Efficient and safe road transport

by applying innovative technologies, automation of important processes and better cooperation between drivers, infrastructure and authorities.

Optimisation of critical factors with the highest impacts.

ASSET Details (planning according the project proposal)

Project duration: 01.05.2008 - 30.11.2011
Project budget: 8.16 Million Euro
Project grant: 6.15 Million Euro

ASSET Consortium

The consortium with its 19 partners is a well balanced mix of universities (7) & research institutes (3), industrial companies (1), SMEs and representation of developing countries (7) and administrations (1) as users. Furthermore, the consortium has partners from India and Tanzania.

<table>
<thead>
<tr>
<th>No</th>
<th>Participant organisation name</th>
<th>Type</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>PTV Planning &amp; Transport Verkehr AG (Coordinator)</td>
<td>UNI</td>
<td>DE</td>
</tr>
<tr>
<td>02</td>
<td>VTI Technical Research Centre of Ireland</td>
<td>研究院</td>
<td>IE</td>
</tr>
<tr>
<td>03</td>
<td>VTISwedish Road and Transport Research Institute</td>
<td>UNI</td>
<td>SE</td>
</tr>
<tr>
<td>04</td>
<td>Universidade de Minas e Regiao Embrapa</td>
<td>UNI</td>
<td>BR</td>
</tr>
<tr>
<td>05</td>
<td>Université de Technologie de Belfort-Montbéliard</td>
<td>UNI</td>
<td>FR</td>
</tr>
<tr>
<td>06</td>
<td>Universität Stuttgart</td>
<td>UNI</td>
<td>DE</td>
</tr>
<tr>
<td>07</td>
<td>National University of Ireland</td>
<td>UNI</td>
<td>IE</td>
</tr>
<tr>
<td>08</td>
<td>Leibniz Universität Hannover</td>
<td>UNI</td>
<td>DE</td>
</tr>
<tr>
<td>09</td>
<td>University of Nottingham</td>
<td>UNI</td>
<td>UK</td>
</tr>
<tr>
<td>10</td>
<td>Technical University of Ilasi</td>
<td>UNI</td>
<td>RO</td>
</tr>
<tr>
<td>11</td>
<td>Bayerisches Staatsministerium des Innens</td>
<td>ADMIN</td>
<td>DE</td>
</tr>
<tr>
<td>12</td>
<td>ROC Bernard GmbH</td>
<td>SME</td>
<td>DE</td>
</tr>
<tr>
<td>13</td>
<td>PNSA Knowledge research in imaging applications</td>
<td>SME</td>
<td>SE</td>
</tr>
<tr>
<td>14</td>
<td>Manfred Hügel Selektionstechnik</td>
<td>SME</td>
<td>DE</td>
</tr>
<tr>
<td>15</td>
<td>FEV ITG GmbH</td>
<td>SME</td>
<td>DE</td>
</tr>
<tr>
<td>16</td>
<td>Clarity Consulting Ltd.</td>
<td>SME</td>
<td>GB</td>
</tr>
<tr>
<td>17</td>
<td>ROC-Airports &amp; Infrastructure</td>
<td>SME</td>
<td>SE</td>
</tr>
<tr>
<td>18</td>
<td>National Institute of Transport (Tanzania)</td>
<td>SME</td>
<td>TZ</td>
</tr>
<tr>
<td>19</td>
<td>NIEL-KTEI Pvt. Ltd. (NITES &amp; KHAII)</td>
<td>SME</td>
<td>IN</td>
</tr>
</tbody>
</table>

ASSET Contact Persons

Project Coordination: Walter Maibach +49 711 16270-30 walter.maibach@ptv.de
Technical Coordination: Rigobert Opitz +43 316 890923-28 rigobert.opitz@bernard-ing.com
The ASSET approach links the most important safety-related categories into a complete system, generating a number of interdependencies. Key factors for the urgently required increase of safety and transport efficiency are:

- Improving *driver knowledge* and *human behaviour* aspects
- Increased use of modern technologies and *automation* for support and *supervision*
- Introduction of innovative measures for *safe and sustainable infrastructure*
- Application of *modern traffic control* and networking
- Achieving *effectiveness* in the analysis and management of system complexity
Intelligent WIM (Weigh in motion) & Road side sensing (iWIM)

A Weigh-in-Motion (WIM) measurement technique will be enhanced in several applications:

- Enhanced dynamic weight measurement for pavement deterioration models and life cycle
- Highly accurate dynamic weight measurement for detection and automated enforcement of overloaded
- New traffic load flow data parameter to replace ESAL
- Synchronization with wheel inspection (thermal imaging) for fully automatic operation

The next-generation iWIM system (embedded electronics and CAN bus in the road pavement) will be able to measure the weight of individual wheels, axles and tyre pressure with a flat sensor installed in the road.
“LISA“ - Live In-vehicle Smart Assistant

The smart information system can be seen as a intelligent and interactive co-pilot to the driver which provides live feedback for a driver to improve behaviour, e.g., in terms of safe or environment-friendly driving.

EU Driving Regulation Knowledge Base (first roadside - later in-car)
Expert System & Video Clipp/Talk Presentation Tool
HMI: Intelligent and Smart LISA
**Road modelling, Infrastructure Protection and Life Cycle optimisation**

It is known that the mean pattern of force imposed by heavy vehicle fleets on pavement surfaces is repeatable for trucks of similar configurations, known as statistical spatial repeatability (SSR). ASSET will provide predictive models, in cooperate different new sensor data yielding accurate pavement life prediction models which can be used in life cycle optimisation strategies.
**Thermal Imaging (Vehicle Safety Status)**

Ultra-sensitive far-infrared cameras have great potential for detecting the condition of HGV brakes and tyres with a massive reduction in required police time. Here, thermal imaging technology is adapted and a system is developed to automatically detect defective wheels, tyres and braking system. Two operational applications will be designed:

- Permanent installation, installed and synchronized with WIM sensors
- Application in moving traffic for dynamic checks on motorways
The Vehicle of the Future - What we really need

Optimised Vehicle Mass:
Less than 1000 kg - the 1K Car

Automated Driving
Save Swarm Mobility - the AD Car
(better dynamic reaction, kybernetic platooning, short stopping distance)

Very Efficient - 2 Liter max consumption per 100 km - the 2L Car
(Lower production costs, low energy consumption, 2L equivalent)

Energy Flex - the PP Car
(Poli-In Energies (fuel, batterie, gas, solar) - Poly-Out Energie (motor, turbine, E-motor)

Environment Clean - the EC Car
(Lower pollution, lower material resources, lower energy, modular recycling)

300.000 km Garantie
(High Life time and low life cycle costs)
Traffic of the Future - what we really need

HGV: Long Distance Transport from the Road
(Aktive regulated LDT transport modal shift from Motorways to Rail)

Empty Trucks from the Motorways
(30% of HGVs are driving empty - better loading strategies)

Speed Limit 130km/h
(Motorways left lane, right lane 100km/h)

Automated Platooning- Save Swarm Mobility
(Fully safety and better efficiency on motorways)

Driver-Driving according the Rules
(Driver awareness and support for following regulations)

Car-Driving according the Rules
(Automated following regulations by the vehicle entity)

Road and Infrastructure Protection
(Better Roads - Active protection measures against road deterioration)
Let's solve the road transport & safety problems and create the accident free future!