SAFEWAY2SCHOOL:

This presentation summarises the EU funded SAFEWAY2SCHOOL project, the aim of which is to design, develop, integrate and evaluate technologies for providing a holistic and safe transportation service for children, from their home door to their school.

Dr Anna Anund

Presented at Curtin - Monash Accident Research Centre
March 2011
Dr. Anna Anund

Perth March 2011
School transport in Europe

- Europe - millions of children travel to and from school every day (TIS, 2004)

- Examples from countries:
  - Sweden – 250 000 children in age 6-16 year
  - Poland – 700 000 children
  - Italy – 450 000 children

- Mixed system
  - Right to school transport
  - Regulations
  - Financing
  - Vehicles used for transportation (bus, taxi, boat, train....)
Fatality rate among children 6-14 years old

Source: IRTAD, Fatalities /100 000 inhabitants

IRTAD - Mean Fatality rate 2003 to 2006 - Children 6-14 years old

Source: IRTAD, Fatalities /100 000 inhabitants

COUNTRY

Perth 2011
Example from France: Children (6-16 years old) involved in a home to school transportation crash distributed on age and gender.

Source: France database BAAC 2003-2006
Another example - Sweden

Source: VTIS (STRADA) 1994-2001

Perth 2011
Pre-pilot in Sweden

- 2 buses
- 2 + 5 drivers
- 130 children
- Kristianstad

Perth 2011
The needs

- A more detailed and coherent crash statistics within the EU.
- Adapting new technology to school bus transport, regarding:
  - Driver support systems
  - Bus stop inventory and route planning tools
  - Bus marking and signing
  - “Intelligent” bus stop marking and signing
- Uniformed guidelines, training and policies
A Holistic approach from door to door

1) The way to the bus stop
- Safety area

2) At the bus stop
- Light when children are close
- Communication bus/children/road users

3) Entering
- Warning sign on the bus
- V2V communication
- Door safety
- External speakers
- Passenger detection
- In-vehicle communication

4) During the trip
- Seat belt reminder
- Alco lock/ISA
- Rooster seat
- Information addressed to child exit

5) Exiting
- Warning signs on the bus
- V2V communication
- Door safety
- External speakers
- Passenger detection
- In-vehicle communication

6) At the bus stop
- Light when children are close
- Communication children/bus/road users

7) The way from the bus stop
- Safety area

8) Final destination
- Arrival notification to parents
SAFEWAY2SCHOOL - AIM

To combine a wide range of technologies on localization, route planning, route guidance, vehicle to infrastructure and on-board systems and sensors, short-range and GPRS communications, etc; in order to solve holistically the issue of safe transportation of children from their door to the school and vice-versa.
SAFEWAY2SCHOOL – To do

- Route planning for school buses, to guide them through areas of low traffic, avoiding black spots.

Real-time route guidance, taking into account dynamic traffic data, as well as the arrival and estimated arrival of children at the bus stops.

- “Intelligent” bus stops that understand the position of children and school buses and transmit relevant info and warnings to both actors.

- School bus position tracking and monitoring and a parents’ notification system, when children are on-board the school bus.
SAFEWAY2SCHOOL – To do

- Safety enhancement applications for bus drivers (eg. speed monitoring and safety belt usage for the school bus, while travelling).

- Warning systems for surrounding vehicles on the existence of stopped school buses or/and children waiting/boarding/deboarding.

- Training schemes for school bus drivers, children, parents and all drivers, for optimal use of the developed systems and children safety enhancement in general.

- Socio-economic analysis, to identify the optimal business plans, legal schemes and organizational incentives for rapid adoption and wide market penetration of SAFEWAY2SCHOOL system.
Target groups

- School bus drivers.
- Students/children: 6-9, 10-12 and 13-16 years old, with and without disabilities, when they may travel alone from/to school bus, although some applications (e.g. safety belt use) are for all ages.
- Families of the children.
- Infrastructure (i.e. bus stops or bus fleet operators).
- Car manufacturers (OEM’s).
- Authorities (legislators, municipal and school authorities).
- All drivers (i.e. of surrounding traffic vehicles).
## Work package

<table>
<thead>
<tr>
<th>WP No</th>
<th>Work package title</th>
<th>Lead beneficiary No</th>
<th>Lead beneficiary short name</th>
<th>Person-months</th>
<th>Start month</th>
<th>End month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use cases</td>
<td>2</td>
<td>CERTH/HIT</td>
<td>46</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>System specifications</td>
<td>1</td>
<td>VTI</td>
<td>21</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Safest route planning/monitoring</td>
<td>10</td>
<td>MIZAR</td>
<td>30</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>VRUs routing and monitoring</td>
<td>4</td>
<td>Amparo Solutions</td>
<td>9</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>User interface design and development</td>
<td>9</td>
<td>USTUTT</td>
<td>43</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>System integration and technical verification</td>
<td>12</td>
<td>IIID</td>
<td>21</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>7</td>
<td>Pilots evaluation</td>
<td>14</td>
<td>LiU</td>
<td>57</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>8</td>
<td>Dissemination and exploitation</td>
<td>13</td>
<td>CS</td>
<td>30</td>
<td>1</td>
<td>36</td>
</tr>
<tr>
<td>9</td>
<td>Training, application guidelines and proposals for standards and policies</td>
<td>7</td>
<td>Kfv</td>
<td>20</td>
<td>19</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>Project management</td>
<td>1</td>
<td>VTI</td>
<td>14</td>
<td>1</td>
<td>36</td>
</tr>
</tbody>
</table>

Total: 291
WP1 - methodology

A1.1 Accident Analysis
- Literature review
  - Databases: Scopus, TRAX, ITRD, TRIS
- National accident statistics
  - Austria, France, Italy, Poland, Greece and Sweden
- Summative Scenarios
  - The data gathered were summarised and the 5 most frequent accident scenarios were extracted.

A1.2 User and stakeholders needs
- Focus groups
  - Bus Drivers, Pupils, Teachers, Parents
- Questionnaires to experts
  - FERSI members
- Survey B questionnaires
  - Parents, Pupils, Bus Drivers (Web-based, hard copies)

A1.3 Benchmarking and SoA database
- Technologies and systems
- Projects
- Guidelines
- Training schemes
- Ergonomic inspection
- Experts Walkthrough

Workshop & User Forum meeting

Use Cases

Perth 2011
WP2 - System architecture

European ITS Framework Architecture (FRAME) (www.frame-online.net)
User wishes – an example

**As a [role/user] I want [something] so that [benefit].**

<table>
<thead>
<tr>
<th>USER</th>
<th>ASPIRATIONS RELATING TO SAFER TRAVEL TO SCHOOL FOR CHILDREN</th>
</tr>
</thead>
</table>
| School children      | § As a child I want to be seen by the bus driver so that I do not miss the bus  
                      | § As a child I want to know when my bus will arrive in order to be there in time  
                      | § As a child I want passing vehicle to slow down so that I do not get hurt |

From focus groups and workshops

*Perth 2011*
System architecture

Children
- Mobile phones
- VRU transmitters
  - Wireless communication by radio

Road users
- "Intelligent" bus sign
- "Intelligent" bus stop

School buses
- Driver Support System
- Bus unit (BU)
  - Mobile communication (GPRS)

Municipality Office
- Office computer
- Infrastructure database
- Safety criteria

Traffic Control Centre

Parents
- Home computer
- Mobile phone

Traffic training for children and school bus drivers
Inventory tool

Perth 2011
WP3 - achievements

<table>
<thead>
<tr>
<th>ON BOARD BUS</th>
<th>Antenna GSM/GPRS</th>
<th>OBU</th>
<th>Antenna GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="School Bus" /></td>
<td><img src="image" alt="Antenna" /></td>
<td><img src="image" alt="OBU" /></td>
<td><img src="image" alt="Antenna GPS" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SERVER</th>
<th>Reports</th>
<th>DataBase</th>
<th>Servers</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Server" /></td>
<td><img src="image" alt="Reports" /></td>
<td><img src="image" alt="Database" /></td>
<td><img src="image" alt="Servers" /></td>
</tr>
</tbody>
</table>

Perth 2011
Surrounding traffic information and warning

1. Collection of bus signs from SAFEWAY2SCHOOL-participating countries
2. Development of new signs
3. Design of description based on cooperative system for I-V communication (SAFESPOT project). IBS communication with vehicles by means of a Road Side Unit
WP4 – VRU

Perth 2011
Bus stop inventory tool

Perth 2011
WP5 Methodology

V-Model

ISO 13407

SW2S V-ISO methodology

Perth 2011
WP5 Signs

- Surveys & research constituting international SoA of school bus sign & school bus stop sign

- Design and Prototyping of a sign designed for long distance visual discrimination and interpretation

School Bus Sign (colour / bw / VMS)

Bus Stop Sign
## Innovation: Haddon matrix “door to door”

### Haddon Factors

<table>
<thead>
<tr>
<th>Holistic stage</th>
<th>Human (H)</th>
<th>Vehicle (V)</th>
<th>Physical environment (PE)</th>
<th>Socio-economical environment (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Child</td>
<td></td>
<td></td>
<td>Parent Municipality Office</td>
</tr>
<tr>
<td>1</td>
<td>Child</td>
<td></td>
<td></td>
<td>Municipality</td>
</tr>
<tr>
<td>2</td>
<td>Child Bus driver</td>
<td></td>
<td></td>
<td>Intelligent Bus Stop Other road user</td>
</tr>
<tr>
<td>3</td>
<td>Child Bus driver</td>
<td>Driver support system</td>
<td></td>
<td>Intelligent Bus Stop</td>
</tr>
<tr>
<td>4</td>
<td>Child Bus driver</td>
<td>Driver support system, Bus Sign</td>
<td></td>
<td>Other road user Municipality Office</td>
</tr>
<tr>
<td>5</td>
<td>Child Bus driver</td>
<td>Driver support system</td>
<td></td>
<td>Intelligent Bus Stop</td>
</tr>
<tr>
<td>6</td>
<td>Child</td>
<td></td>
<td></td>
<td>Intelligent Bus Stop Other road user</td>
</tr>
<tr>
<td>7</td>
<td>Child</td>
<td></td>
<td></td>
<td>Municipality Office</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>Parents Municipality Office</td>
</tr>
</tbody>
</table>

**Perth 2011**
Evaluation scenarios

Use cases:

<table>
<thead>
<tr>
<th>Category 1-Routing &amp; Rerouting</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 1.1 Safest route planning</td>
</tr>
<tr>
<td>UC 1.2 Route monitoring and arrival notification</td>
</tr>
<tr>
<td>UC 1.3 Real time re-routing of traffic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 2-Surrounding traffic information</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 2.1 Surrounding traffic information while en route</td>
</tr>
<tr>
<td>UC 2.2 Surrounding traffic warning while for children ingress-egress</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 3-On board systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 3.1 ISA</td>
</tr>
<tr>
<td>UC 3.2 Safety belt checker</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 4-Intelligent bus stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 4.1 Child approach to bus stop notification</td>
</tr>
<tr>
<td>UC 4.2 Child at bus stop notification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 5-Notification</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 5.1 Family notification</td>
</tr>
<tr>
<td>UC 5.2 VRU notification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 6-Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 6.1 Bus driver training</td>
</tr>
<tr>
<td>UC 6.2 Parent training</td>
</tr>
<tr>
<td>UC 6.3 Children training</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 7-Inventory tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 7.1 Inventory tool classification of the bus stops</td>
</tr>
</tbody>
</table>

Evaluation Scenario:
1: School bus route planning
2: Pedestrian route planning
3: School bus route monitoring
4: Surrounding traffic warning while for children board or disembark
5: Intelligent Speed Adaptation
6: Safety belt checker
7: Child approach to bus stop notification
8: Child at bus stop notification
9: Family notification
10: VRU notification and warning
11: Inventory tool classification of the bus stops
11: Training
# Pilot site: overall

## Haddon’s matrix

<table>
<thead>
<tr>
<th>Test site</th>
<th>Human</th>
<th>Vehicle</th>
<th>Physical environment</th>
<th>Socio economical environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-9</td>
<td>10-12</td>
<td>13-16</td>
<td></td>
</tr>
<tr>
<td>Children with disabilities</td>
<td>Bus driver</td>
<td>Public bus</td>
<td>Purchase bus</td>
<td>Road</td>
</tr>
<tr>
<td>Italy</td>
<td>X</td>
<td></td>
<td></td>
<td>DSS, BS</td>
</tr>
<tr>
<td>Austria</td>
<td>X</td>
<td>X</td>
<td></td>
<td>BS</td>
</tr>
<tr>
<td>Poland</td>
<td>X</td>
<td>X</td>
<td></td>
<td>BS</td>
</tr>
<tr>
<td>Sweden</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>DSS, BS</td>
</tr>
</tbody>
</table>

Perth 2011
Evaluation scenario:

- Usability and impact of the bus sign on the road safety
- Training of bus drivers
Poland

Evaluation scenario

- Surrounding traffic warning while for children board or disembark
- Child approach to bus stop notification
- Child at bus stop notification
- VRU notification and warning
- Inventory tool classification of the bus stops
- Training
Evaluation scenario:

- School bus route planning
- Pedestrian route planning
- School bus route monitoring
- Surrounding traffic warning while for children board or disembark
- Intelligent Speed Adaptation (ISA)
- Child approach to bus stop notification
- Child at bus stop notification
- Family notification
- VRU notification and warning
- Inventory tool classification of the bus stops
- Training
Evaluation scenario

- School bus route planning
- Pedestrian route planning
- School bus route monitoring
- Surrounding traffic warning while for children board or disembark
- Intelligent Speed Adaptation (ISA)
- Child approach to bus stop notification
- Child at bus stop notification
- VRU notification and warning
- Inventory tool classification of the bus stops
- Training
Test of the intelligent bus stop and in-car warning
Measure road users’ behaviour (reaction time, speed, lateral position) passing the bus stop with/without children and children jumping on the road

Perth 2011
Evaluation tools for pilot sites

- **Direct observations**
  - DO1: Speed measurements
  - DO2: Eye tracking

- **Events diaries**
  - ED1: Waiting at the bus stop
  - ED2: Observation of children's safety behaviour
  - ED3: DSS functionalities

- **User surveys**
  - Q1-Q4: Acceptance and Usability for children, parents, bus drivers and transport operators
  - Q5: Quality of Service for bus drivers
  - Q6-Q7: Use interface for children and adults
  - Q8: Usability of training kit
Budget and Deliverable

- 3 year (2009-01-09 to 2012-08-31)
- 291 Person Months
- Total budget: 3 668 737 Euro
- From EC: 2 849 248 Euro
- 42 deliverables (17 are public)
Dissemination – available to day

- Web page: [www.safeway2school.eu](http://www.safeway2school.eu)
- User Forum
- Poster

- Leaflet
Consortium

Swedish Road and Transport Research Institute, Linköping (Coordinator), Sweden

Center for Research & Technology Hellas/ Hellenic Institute of Transport, Greece

National Institute for Transport and Safety Research, France

Kuratorium für Verkehrssicherheit, Austria

University of Modena and Reggio Emilia, Italy

University of Stuttgart, Germany

Mizar Automazione S.p.A, Italy

Motor Transport Institute, Poland

International Institute for Information Design, Austria

Linkopings Universitet, Sweden

Maelardalens högskola, Sweden

Perth 2011
Thank you for your attention!