Role of evaluation research when moving from lab to production

Pirkko Rämä, VTT
Case
Content

1. Evaluation methods in life cycle of a service

2. Developing applications in TEAM “Tomorrows’ Elastic Adaptive Mobility”

3. Role of evaluation / TEAM apps
   1. Parking
   2. Collaborative ACC

4. Conclusions
From idea to product

Use and Context
- Travel behaviour
- Driver behaviour

Benefits in Mobility
Benefits in Traffic Flow and Efficiency
Benefits in Traffic Safety
Benefits in Environment

Socio-Economic impacts

Towards Intelligent Mobility
Better use of space
### Examples of evaluation studies in life cycle

<table>
<thead>
<tr>
<th>Idea</th>
<th>Plan</th>
<th>Prototype</th>
<th>Pilot Test</th>
<th>Large-scale Demo</th>
<th>Full-scale implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour</td>
<td>Lab tests</td>
<td>Driving simulator</td>
<td>Field study</td>
<td>Interviews, Focus group</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>User observations, interviews</td>
<td>Traffic simulation</td>
<td>Field study</td>
<td>Travel diaries</td>
<td></td>
</tr>
<tr>
<td>Flow and efficiency</td>
<td>Traffic simulation</td>
<td>Expert assessment</td>
<td>Combined driving simulator and field test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Expert assessment</td>
<td>Lab tests</td>
<td>Cost-benefit analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Lab tests</td>
<td>Multi-criteria analysis</td>
<td>Emission modelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-economy</td>
<td>Multi-criteria analysis</td>
<td>Cost-benefit analysis</td>
<td>Emission modelling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Method costs

- Cost-benefit analysis
- Multi-criteria analysis
- Expert safety assessment
- Travel diaries

- Traffic simulation
- Emission modelling

- Driving simulator

- Large-scale field study
- Air quality monitoring

TOWARDS INTELLIGENT MOBILITY
Better use of space
TEAM vision: drivers and travelers are integrated to collaborative transport
TEAM applications

1. Collaborative pro-active urban/inter-urban monitoring and ad-hoc control
2. Collaborative co-modal route planning
3. Co-modal coaching with support from virtual/avatar users
4. Collaborative smart intersections for intelligent priorities
5. Collaborative public transport optimization
6. Collaborative dynamic corridors
7. Collaborative adaptive cruise control
8. Collaborative eco-friendly parking
9. Collaborative driving and merging
10. Green, safe and collaborative driving serious game and community building
11. Collaborative eco-friendly navigation
Short descriptions

1. Collaborative adaptive cruise control
   - Wireless communication V2V and V2I in order to harmonize cruising speed
   - Traffic information (incidents, traffic lights, VMS) and user centric information into account
   - Improved safety and efficiency

2. Collaborative eco-friendly parking
   - Real time information about free parking spaces
   - Parking/leaving detection (press a button/automatic)
   - Cloud based monitoring about availability
   - On street and P-house
Examples of evaluation studies in life cycle

<table>
<thead>
<tr>
<th>Idea</th>
<th>Plan</th>
<th>Prototype</th>
<th>Pilot Test</th>
<th>Large-scale Demo</th>
<th>Full-scale implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Behaviour**
  - Lab tests
  - Driving simulator
  - Field study
  - Interviews, Focus group
  - Travel diaries

- **Mobility**
  - Traffic simulation
  - Field study

- **Flow and efficiency**
  - Expert assessment
  - Combined driving simulator and field test

- **Safety**
  - Lab tests

- **Environment**
  - User observations, interviews
  - Lab tests
  - Emission modelling

- **Socio-economy**
  - Multi-criteria analysis
  - Cost-benefit analysis
Real users in real life

In early phase, understanding user needs, definition of user demand and user benefits

Different types of users in transport system:
Travellers -> Companies -> Operators -> Authorities,

1. Collaborative adaptive cruise control
   • Drivers benefit with an extended foresight range that can better predict density to improve traffic flow
   • Towards automated driving and better management of traffic flow

2. Collaborative eco-friendly parking
   • Drivers can quickly detect optimal parking conditions while cities can allocate parking space more efficiently
   • Traffic management
Examples of evaluation studies in life cycle

<table>
<thead>
<tr>
<th>Idea</th>
<th>Plan</th>
<th>Prototype</th>
<th>Pilot Test</th>
<th>Large-scale Demo</th>
<th>Full-scale implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour</td>
<td>Lab tests</td>
<td>Driving simulator</td>
<td>Field study</td>
<td>Interviews, Focus group</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>User observations, interviews</td>
<td>Traffic simulation</td>
<td>Field study</td>
<td>Travel diaries</td>
<td></td>
</tr>
<tr>
<td>Flow and efficiency</td>
<td>Expert assessment</td>
<td>Combined driving simulator and field test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Lab tests</td>
<td>Emission modelling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Multi-criteria analysis</td>
<td>Cost-benefit analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-economy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Traffic simulations

Input for simulations from results of earlier studies, expert assessment and results from demos in field

Adaptation of the simulation tools

1. Collaborative adaptive cruise control
   - Impacts in traffic flow when driver/vehicle receives information from vehicles upstream

2. Collaborative eco-friendly parking
   - Searching time for a parking place
   - Emissions in searching time
   - Car exposure in city centres
### Examples of evaluation studies in life cycle

<table>
<thead>
<tr>
<th>Idea</th>
<th>Plan</th>
<th>Prototype</th>
<th>Pilot Test</th>
<th>Large-scale Demo</th>
<th>Full-scale implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behaviour</strong></td>
<td></td>
<td></td>
<td></td>
<td>Field study</td>
<td>Interviews, Focus group</td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Travel diaries</td>
</tr>
<tr>
<td><strong>Flow and efficiency</strong></td>
<td>Lab tests</td>
<td>Driving simulator</td>
<td></td>
<td>Field study</td>
<td></td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>User observations, interviews</td>
<td></td>
<td>Traffic simulation</td>
<td></td>
<td>Field study</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>Traffic simulation</td>
<td>Expert assessment</td>
<td>Combined driving simulator and field test</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Socio-economy</strong></td>
<td>Lab tests</td>
<td>Multi-criteria analysis</td>
<td>Emission modelling</td>
<td>Cost-benefit analysis</td>
<td></td>
</tr>
</tbody>
</table>

**Examples of evaluation studies in life cycle**

- Lab tests
- Driving simulator
- User observations, interviews
- Traffic simulation
- Expert assessment
- Combined driving simulator and field test
- Emission modelling
- Cost-benefit analysis
Euro Eco Challenge in field

Combination of approaches to get real user experience
- Demos – citizens
- Test drives and passengers in the equipped cars

Technical testing in different locations

Combinations of data collection
- Interview data to assess
- Focus groups to provide new ideas and suggestions how to develop
- Observations to get insight on driver/user reactions
- Inputs and validation of modelling

Workshops to assess the role of Collaborative adaptive cruise control and Collaborative eco-friendly parking in proactive traffic management
Conclusions

- Important to start evaluation from the very beginning – identify the demand
- Organize evaluation activities for whole life cycle
- Consider costs and reasoning of evaluation activities
- Different approaches in evaluation to reach common users
- Recognize users in different level of the transport system – get full benefit out of the system
- Provide evidence about impacts of the system – up to cost benefit results
- Convince different stakeholders – from consumers to road authorities