WP4 road monitoring:
- Monitoring road inventory in real time
- Monitoring of road functionality
Overview

- WP4 tasks
- Task 2 Monitoring road inventories
- Task 4 Monitoring of road functionality
- Conclusions
WP4 – Road monitoring

1. Monitoring road functionality in real time with data collected from vehicles.
2. Monitoring of Road Inventory
3. Identification of Potential Water Ponding
4. Monitoring of structural condition
   ◦ TSD – Traffic Speed Deflectometer
   ◦ GPR – Ground Penetrating Radar
5. Monitoring of surface condition
   ◦ Ravelling
   ◦ Cracking
Road furniture or Equipment (assets):
   Additional facilities of streets and roads, which do not belong to the layered structure of the roadway
Inventories, examples

- Road markings
- Traffic signs
- Street lightning
- Drainage systems
- Other
Monitoring road inventories

- Requirements:
  - Location
  - Condition
  - Completeness
  - Up to date
Measuring equipment
# Situation in Sweden

<table>
<thead>
<tr>
<th>Type of Road Equipment</th>
<th>Positioning</th>
<th>Visual Inspection</th>
<th>Simple Measurement</th>
<th>Hand-Held Light Measurement</th>
<th>Mobile Light Measurement</th>
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<tbody>
<tr>
<td>Road signs</td>
<td>no&lt;sup&gt;2&lt;/sup&gt;</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no&lt;sup&gt;4&lt;/sup&gt;</td>
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<td>Road markings</td>
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<td>no</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Road studs</td>
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<td>no</td>
<td>no</td>
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<tr>
<td>LED emitters</td>
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<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
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<tr>
<td>Delineator posts</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
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<tr>
<td>Road lighting</td>
<td>yes&lt;sup&gt;1&lt;/sup&gt;</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td>Traffic lights</td>
<td>yes&lt;sup&gt;1&lt;/sup&gt;</td>
<td>no&lt;sup&gt;3&lt;/sup&gt;</td>
<td>no</td>
<td>no</td>
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<tr>
<td>Guard rails</td>
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<td>yes</td>
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<tr>
<td>Barriers</td>
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<td>Deer fences</td>
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<tr>
<td>Noise protectors</td>
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<tr>
<td>Glare protectors</td>
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</table>
Tests by TRIMM project

The company Yottas survey vehicle used in the TRIMM tests
Position of masts and poles, and hydrants

Hydrants, black circles reference and purple cross supplier

Mast and poles, black circles reference and green crosses supplier
More can be found in deliverable D4.2
Monitoring of Road Inventory
Road administrators rely on data collected, typically annually, by dedicated “high-tech” measurement devices.

The TRIMM idea is to investigate new measurement techniques that have the potential to provide this data more frequently and with a reasonable cost.
Ride quality is generally defined by the perception of a road user’s driving experience, which is influenced by numerous factors such as pavement unevenness (e.g. vibration, shock), road alignment, and noise in the car, lack of friction and light conditions.
State of the art, a review of existing knowledge

- Sensor in personal cars, smartphones
- INTRO (smart cars)
- Mobi–Roma (smart cars)
- BiFi (smart truck)
- SENSOVO (smart cars and smartphones)
- RoadRoid (smartphone)
- Numerous smartphone applications
Smart cars (probe vehicles) and phones (smartphones)
Tests in TRIMM

- Tests have been done in Belgium, Sweden and Austria
  - In Austria a smart car has been tested
  - In Belgium a smartphone application has been tested
- A questionnaire and test panel have been used
- The sections have been referenced measured
Tests in TRIMM

- The main focus has been on investigation of ride quality (RQ) measurements.
- The new equipment has been compared with traditional evenness measuring equipment and with road users opinions (questionnaire).
- Indicators:
  - IRI, International Roughness Index
  - Wave band indicators (as in France and UK)
  - WLP, Weighted Longitudinal Profile (as in Austria and Germany)
The app used is developed by VTI. It collects data from all sensors and take pictures, all connected to a position by the GPS information. After the measurements a rms is calculated.
Comparing the questionnaire output to the scores obtained by the “VTI app” we can observe some relationship between them. Especially looking at the Swedish tests we believe that the smartphone app is prone to capture an evaluation of “road comfort” as experienced by road users (passengers) when including the macrotexture (MPD) of the road surface.
Method
Using already existing sensors in private cars, smartphones and other probes to collect data on functionality.

Advantages
Large scale data collection (crowd sourcing) on a daily basis over the whole road network enriches the view of the road manager with information about the practical functionality of the roads.

Challenges
The transformation of such raw data into an indicator with a real significance on road functionality for the road manager is not trivial.

More information:
Carl Van Geem c.vangeem@brrc.be)
MONITORING RIDE QUALITY ON ROADS WITH EXISTING SENSORS IN PASSENGER CARS

26th ARRB Conference – Research driving efficiency, Sydney, New South Wales 2014

23–24 October in Brussels
### More info on results from Road monitoring

| D 4.1 | **Identification of Potential Water Ponding** | Leader: IFSTTAR  
Team: IFSTTAR, TRL |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Report on 3D method to quantify water depths and relate to splash / spray, proposed intervention levels (month 25).</td>
<td></td>
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</tbody>
</table>

| D 4.2 | **Monitoring of Road Inventory** | Leader: AIT  
Team: AIT, VTI, YottaDCL |
<table>
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<tbody>
<tr>
<td></td>
<td>Report on automated tools to measure inventory and recommendations for how these should be applied on the network (month 27).</td>
<td></td>
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</tbody>
</table>

| D 4.3 | **Monitoring of structural and surface condition** | Leader: IFSTTAR  
Team: IFSTTAR, TRL, Yotta, LNEC, RoadScanners, Greenwood |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Report on methods developed to measure structural and surface condition, with performance assessment.</td>
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</tbody>
</table>

| D 4.4 | **Monitoring road functionality in real time with probe vehicle data.** | Leader: BRRC  
Team: BRRC, VTI, AIT |
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<tbody>
<tr>
<td></td>
<td>Report on the measurement of road functionality with probe vehicle data, and a proposed route for implementation (month 32).</td>
<td></td>
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</tbody>
</table>
Detailed positioning with GPS coordinates needs to be developed, speed 10 Hz, Accelerometer data with 100 Hz
Normal traffic avoid potholes leading to that the lateral acceleration get more important to use to detect
There are a difference in performance between brands of smartphones. The advice is to use the most advanced
There are advantages to have automatic inventory of road equipment but it needs much more development
TRIMM have shown that it is possible

Thank you
For your attention!