Quality management of road monitoring data

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Background

Road pavements comprise a major component of public infrastructure, and are designed to have long service lives delivering safe, smooth, all-weather access for people and goods.

Tools to improve the pavement management, planning and maintenance is continuously developed.

Profilometers is examples of valuable tools to reliable monitor the status or condition of the road pavement assets.
Added value of monitoring

• Ensure that the pavements are providing the expected efficient and safe travel conditions for which they were designed
• Condition of the pavement allows a comparison of the characteristics of the constructed pavement to be made against the design goals
• Information can be used to identify the cause of the problem
• Monitoring can assist in the design of treatments
• Prioritising the application of those treatments in the most efficient manner within operational and budget constraints
• Assess the quality of construction
• Benchmark current condition
• Measure the changes in performance over time, informing the prediction of future condition
• Fulfil requirements to report asset value and indicators of network performance
• Assess the performance of service providers
• Guide the selection of future maintenance and replacement needs.
The use of road condition data

**Long term planning:**
Knowledge of the condition of an entire road network including trend analysis

**Objects and projects monitoring:**
Support in the daily construction and maintenance

**Contracts:**
Performance control of contractors
Long term planning

Strategic level

- Society/Public
  - Global performance index
- Key indices
  - E.g. ride quality, safety

Operational level

- Indicators
  - E.g. IRI, skid number, visibility
- Technical parameter
  - E.g. unevenness profiles, friction, retro-reflexction
Example of road condition database from Sweden; PMSv3: pmsv3@trafikverket.se
Technical parameters and Indicators

**In field monitoring**

**Technical parameters**
- Transversal profile --> Rut depth
- Longitudinal profile --> IRI
- Macrotexture --> MPD
- Curvature
- Slope
- Crossfall and more...

**Indicators**
- Safety
- Environment
- Comfort
- Durability
- Other...

**Key Indices**
- Strategical and Political goals

**Expert level --> Road managers --> Political --> Public level --> Users**
Technical parameters (example from Sweden)

- IRI right and left wheel track
- Rut depth max, left and right 17 and 15 points
- Mean transversal profile
- Crossfall
- Curvature
- Slope (hilliness)
- Position
- Macrotexture (and deviation) left, middle and right
- Megatexture, left and right
- Longitudinal profile left, right and additional right
- Digital front of view picture
Lot of various Profilometers
New technology and methods; Smart cars (probe vehicles) and smartphones

- **GPS**
- **3G/4G/GSM**
- **Accelerometer x,y,z**
- **Light sensor**
- **Magnetometer**
- **Compass**
- **Thermometer**
- **Speakers**

**Additional Sensors:**
- **Cameras**
- **Gyroscope**
- **Pressure sensor**
- **Humidity**
- **Microphone**
- **IR-sensor**

**Smartphone Features:**
- **Bluetooth**
- **Wi-Fi**
Overall quality perspective

The parts in the measurement method that needs special care, operator, hard- and software, ordering and delivering of data including data management.
Error sources in the monitoring process

Measuring skills and requirements

Object localisation and positioning

Software implementation

Hardware construction

Sensor

Object -Pavement

Pre- database

Data delivery

Format

Data storage

Data interpretation and use
Can you rely on the data?

Time (years)

Condition

New built standard

Acceptable standard

Treatment or error in monitoring?

Treatment
Technical parameters and indicators should be:

- **Objective** avoid subjective ratings
- **Reliable** repeatable and reproducible, many operators and equipment's should give the same result
- **Safe** traffic speed operations
- **Sustainable** standardized, long term contracts can be 8-10 years
- **Valid** measure desired function
Quality approval control parameters

- Tested equipment
- Repeatability
- Reproducibility
- True value
- Reference

Parameters: β, α
Main responsibility of control and approval

<table>
<thead>
<tr>
<th>Level:</th>
<th>Main responsibility:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensor control:</strong></td>
<td>Equipment manufacturer/operator</td>
</tr>
<tr>
<td><strong>Application control:</strong></td>
<td>Operator/Measurement company</td>
</tr>
<tr>
<td><strong>Total function control:</strong></td>
<td>Customer/Road owner</td>
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Situation in Europe

Many countries have certification procedures to approve operators including their equipment;
Sweden, Finland, UK, Germany and more

Control procedures before, during and after measurements;
Quality system requirements

Approval procedures;
Accepted reference equipment needed
Swedish case study of a successful concept using quality control
Results from control measurements during contract periods
Reference equipment

- Transversal profile, VTI XPS
- Longitudinal profile, Primal
- Height reference Total station/ Rod and Level

- Position, high accuracy GPS
- Macrotexture, High accuracy profiling
- Cracks Image collection
Conclusions

• Purpose of monitoring sets the requirements!
• Long-term monitoring needs high quality, reliable data.
• Object level monitoring, less important unless performance stated in contracts are involved.
• Standards and specifications are important.
• References equipment needed to make long term stability
• Certification procedures should be encouraged
• Control schemes, daily checks and calibration
• Operator, positioning and data management the major source of errors!
• Resources must be put on data management!
Thank you for your attention!