Overall quality management of road condition monitoring: a case study

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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.
Basic components of a pavement management system

- A digital framework - road asset database
- Prediction models of pavement performance
- Cost and benefit models
- Maintenance standards
- Environmental effects
Can we trust data?

- New built standard
- Acceptable standard
- Treatment
- Treatment or error in monitoring?
Quality aspects
Knowledge and management of the overall quality is a basic need for a well functioning pavement management system

Some quality aspect factors:
• Suitable (adequate) for the mission
• Operational security, safe and sound
• Reliable technical performance
• Maintenance needs
• Impact on environment
• Pros and cons considering competitive equipment’s
• Cost (investment, operation and closure or destruction)
Road condition monitoring

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.
Challenges: new technology and methods such as smart cars (probe vehicles), smartphones, crowd sourcing and Big Data
The use of road condition data

Strategic 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

Roadwork planning

Research and policy studies

Contracts;
Performance control of contractors
Different levels of use for parameters and indicators

<table>
<thead>
<tr>
<th>In field monitoring</th>
<th>In office calculations</th>
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</thead>
<tbody>
<tr>
<td><strong>Technical parameters</strong></td>
<td><strong>Indicators</strong></td>
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<tr>
<td>Transversal profile--&gt;Rut depth</td>
<td>Safety</td>
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<tr>
<td>Longitudinal profile--&gt;IRI</td>
<td>Environment</td>
</tr>
<tr>
<td>Macrotexture--&gt;MPD</td>
<td>Comfort</td>
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<tr>
<td>Curvature</td>
<td>Durability</td>
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<tr>
<td>Slope</td>
<td>Other...</td>
</tr>
<tr>
<td>Crossfall and more...</td>
<td></td>
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</tbody>
</table>

Expert level--> Road managers-->Political-->Public level-->Users
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** no road closures, traffic speed measurements
- **Sustainable** standardized, long term contracts can be 8-10 years
- **Valid** measure desired function
Example from the Swedish Transport Administration’s road and pavement database PMSv3: [www.pmsv3@trafikverket.se](http://www.pmsv3@trafikverket.se)
Major error sources in the monitoring process

- Measuring skills and requirements
- Object localisation and positioning
- Software implementation
- Hardware construction
- Sensor
- Pre-database
- Data delivery
- Format
- Data storage
- Data interpretation and use
Quality approval control parameters
Main responsibility of control and approval

<table>
<thead>
<tr>
<th>Control level:</th>
<th>Main responsibility:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensor</strong></td>
<td>Equipment manufacturer/operator</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Operator/measurement company</td>
</tr>
<tr>
<td><strong>Complete function</strong></td>
<td>Customer/road owner</td>
</tr>
</tbody>
</table>
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
Swedish case study of a successful concept using quality control
Results from 5 % repeated control measurements
Some actions done in Sweden to increase and maintain the quality

• Established standards and descriptions of methods
• A maintenance standard with defined levels for the monitored parameters e.g. for rut depth, IRI and MPD.
• A common coordinate system that support connection and synchronizing of databases e.g. road condition data with accidents data.
• A move to combine road assets into the same database
• Methods for control of received data
• A public available database, PMSv3 giving feedback from local “experts”
Some actions done in Sweden to increase and maintain the quality

- Public available test sections frequently reference measured
- “raw” data (profiles) for each indicator with the “true value” available for implementation tests
Some actions done in Sweden to increase and maintain the quality

- Procurement of monitoring services with emphasis on quality, not just lowest price. (Extra points for better quality in the selection process)
- 5% of the production has to be re-measured and the deviation from production approved
- Random checks by third party
- Requirements on repeated measurements of object/project level works
- Specified method how to do when an approved system is changed during the period it was approved.
- Yearly field tests including comparison with a reference
Conclusions

- The 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 (necessary)
- References equipment needed to support long term stability
- Certification procedures should be encouraged
- Control schemes, daily checks and calibration
- Operator, positioning and data management the major source of errors, implying that resources must be put on data management!
Thank you for your attention!