Smart phone Road Condition Surveys
- On Low Volume Roads

- IRF Webinar – 20/21 April 2017
- Lars Forslof, CEO/Founder of Roadroid:
- Linkedin: [http://se.linkedin.com/pub/lars-forsl%C3%B6f/28/716/720](http://se.linkedin.com/pub/lars-forsl%C3%B6f/28/716/720)
Where is Sweden?
Well it's spring time – and 8 o’clock in the evening here now

- 100,000 km state roads (20% unpaved)
- 9 million inhabitants
  - 80% of population in south
  - Stockholm - Capital 1.5 million
- Industry
  - Minerals and forest industry
  - Volvo, Scania, Sandvik,
  - IKEA, ABB, SKF, Ericsson
- High level of new innovations
  - as Minecraft, Spotify, Skype, Bluetooth,
- Infrastructure Challenges
  - Low populated areas in north
  - Winters: -30 º celsius and > 1 meter snow
  - Frost heave/thaw in spring
Why survey? – to make actions in time!
Roadroid Accuracy

• University of Auckland
  • Myles Johnston (2013)
  • USING CELL-PHONES TO MONITOR ROAD ROUGHNESS,
  • *Roadroid has an 81% similarity to Laser data* and can represent the roughness felt by a road user to a ‘good’ level.

• The World Bank + University of Pretoria
  • M Schlotjes, A Visser and C Bennett (2014)
  • EVALUATION OF A SMARTPHONE ROUGHNESS METER
  • *...within the accuracy limits of an IQL-3 device of +/- 20 % of the IRI, the equipment satisfied the need!*
  • Roadroid has great potential as a low-cost, practical device for measuring road roughness at IQL-3 level.

• Our own research
  • 75-85% (R2 0,5-0,8) depending on speed, and pavement type.

• OVERALL – ACCURACY ACCORDING TO WB IQL level 3
  • Email lars.forslof@roadroid.com to get this independent reports...
UNIVERSIDAD ANDINA – DECEMBER 2016

DETERMINACIÓN Y COMPARACIÓN DE LA REGULARIDAD SUPERFICIAL DEL PAVIMENTO DE LA CARRETERA CUSCO-URCOS, USANDO TELÉFONOS INTELIGENTES Y EL RUGOSÍMETRO DE MERLIN

Deyse Laura Hirpahuanca
Waikato District New Zealand
- Roadroid compared with Opus NAASRA
Different vehicles – and phones are different
So its possible to calibrate...

- Run system on a ”known” section defined by IQL 1 or 2.
- Run Roadroid in a certain speed (car and phone)
- View result in app survey monitor - Adjust sensitivity
Most Important:
- Collect data to the appropriate level of decision you are making
Capture IRI – and photos
100 m – 1,6 km
Road inventory

Ocular observation

IRI + photos
# Road inventory

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Distance</th>
<th>Speed</th>
<th>Altitude</th>
<th>% Grad</th>
<th>Pavement</th>
<th>Drainage condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-11-25 09:27</td>
<td>-9.106</td>
<td>147.14</td>
<td>100</td>
<td>17</td>
<td>36</td>
<td>1.28</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>2014-11-25 09:27</td>
<td>-9.105</td>
<td>147.14</td>
<td>200</td>
<td>30</td>
<td>96</td>
<td>0.7%</td>
<td>1.17</td>
<td>0.33</td>
</tr>
</tbody>
</table>

**Inventory Parameters**

- **3 - Side slope**
  - VGood: Good, Fair, Poor, Bad
- **0 - Cracking**
  - VGood: Good, Fair, Poor, Bad
- **1 - Flushing/bleeding**
  - VGood: Good, Fair, Poor, Bad

**User configurable 4**
- VGood: Good, Fair, Poor, Bad
- User configurable 5
  - VGood: Good, Fair, Poor, Bad

**Road inventory PNG 2014-11-26**

- **Average pavement**
- **Drainage condition**
Guard rail inspection Montenegro
Capture Video:
- make back office inventory

Upload...

Record...

Make inventory
App for traffic counting

1) Setup
2) Count
3) Transfer and presentation
Wireless Traffic sensor + Roadroid

Low installation cost!!!
- No electricity or data cables
Remote installation
- Install anywhere - needs only 3G.
Avoid damage/theft
- No visible road side installation.
Easy to use
- AADT in Roadroid - link to details.
Live data

http://www.roadroid.com/Map/MapSensor

Traffic volume and speed is also a performance measure.
Simply gather data of your LVR:s!!!

Spatial data:
- Longitud/Latitude
- Altitude (Grade%)
- Speed

Road inventorys:
- Rutting
- Edgebreaks, Drainage
- Culverts etc

Traffic

Road condition:
- IRI
- Photos
- Video

Performance monitoring:
- Map overviews
- Tables
- Charts

Webinar on Low Volume Roads

www.IRF.global

20/21 April 2017
INDONESIA - REGIONAL ROAD Example

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Lengths (Km)</th>
<th>% Stable Condition</th>
<th>% Non Stable Condition</th>
<th>% Target Stable (2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>47.017</td>
<td>94</td>
<td>6</td>
<td>98</td>
</tr>
<tr>
<td>Provincial</td>
<td>46.164</td>
<td>68</td>
<td>32</td>
<td>75</td>
</tr>
<tr>
<td>Region/City</td>
<td>376.102</td>
<td>59</td>
<td>41</td>
<td>65</td>
</tr>
<tr>
<td>TOTAL</td>
<td>469.283</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Indonesia: 34 provinces, 416 Kabupaten, and 98 cities - yet to have a general plan to develop the road network.
- Road length data and road conditions not accurate due to limitations of survey instrument and road conditions.
- Many districts that use visual methods (subjective).
- The Province/Kabupaten/Cities do not have tools for prioritization of road maintenance.
- Government has not had an accountable database of local roads in assessment of proposed programs.
# IRI Collecting methods

<table>
<thead>
<tr>
<th>Level</th>
<th>Method</th>
<th>Tool Example</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Lasser scanner technology</td>
<td>• Hawkeye</td>
<td>• High precision</td>
<td>• Expensive (up to Rp 25 Billion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Data obtained vary not only IRI</td>
<td>• It can not work when it rains / there are puddles on the road</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Interval 10-20 m</td>
<td>• Unable to pass through a narrow street</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Long survey time</td>
</tr>
<tr>
<td>Class 2</td>
<td>Complex profilometer method</td>
<td>• NASSRA / Roughmeter</td>
<td>• Medium precision</td>
<td>• Quite expensive (Rp 100 Million- 1.5 Billion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Long survey time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Only one ruts</td>
</tr>
<tr>
<td>Class 3</td>
<td>Corelation method</td>
<td>• Road Roid</td>
<td>• Low cost</td>
<td>• Sensitive to the age and speed of vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Easy to use</td>
<td>• Sensitive to GPS signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cover large areas in short time (&gt;100 km/day)</td>
<td>• It should be combined with a GPS system that has stronger signal, especially in remote areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Precision 80% of laser method</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Portable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Can be used in all weather/road condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Data in cloud server and used anywhere from web browser (no client needed).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Interval  &gt;20 m</td>
<td></td>
</tr>
<tr>
<td>Class 4</td>
<td>Visual method</td>
<td></td>
<td></td>
<td>• Long survey time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• It should be converted to IRI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Subjective</td>
</tr>
</tbody>
</table>
# JAVA ISLAND EXPERIENCE

**Huge network data collection**

Made within 4 Months!!!

Impossible with other methods

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Kabupaten/Kota</th>
<th>Province</th>
<th>Length Planned (km)</th>
<th>Length surveyed (km)</th>
<th>Percentage (%)</th>
<th>Total Time (day)</th>
<th>Total unit / Mobile phone</th>
<th>Total personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kabupaten Cilacap</td>
<td>Central Java</td>
<td>1.181</td>
<td>964.14</td>
<td>81.64</td>
<td>17</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Kota Surakarta</td>
<td>Central Java</td>
<td>204.22</td>
<td>184.26</td>
<td>90.23</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Kabupaten Pangandaran</td>
<td>West Java</td>
<td>320</td>
<td>275.4</td>
<td>86.06</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Kabupaten Blitar</td>
<td>East Java</td>
<td>261.33</td>
<td>245.01</td>
<td>93.76</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Lampung Selatan</td>
<td>Lampung</td>
<td>1.240.44</td>
<td>1.200.00</td>
<td>99 %</td>
<td>7</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Myanmar: Network level performance

Legend:
- Green < 4 (30%)
- Yellow 4-6 (15%)
- Red 6-8 (13%)
- Black > 8 (42%)
Afghanistan

- Population 32 million
- Wartorne and extremism
  - Russia (79-89), US (01-)
  - Talibans + other extremists
- Many infrastructure programs
- Infrastructure Challenges
  - Difficult and dangerous rural access
  - North mountain winters in north:
    - -10°C and heavy snow falls
  - Melting snow with spring floods
Assets management challenges

• Hard Complications
• Insustatinable funding, fully dependent on international aid
• Corruption/fraud
• Inseque and difficult work

Representatives for NGOs under lethal threat.

• Soft complication
  – An ”Afghan conditions” mind-set
    • Routine/Periodic maintenance
    • Rehlibitation/Reconstruction
"Afghan conditions" mind-set

Road standard

**Good**

Acceptable

**Poor**

Failed

Preffered state for maintenance actions

Current maintenance actions are made when its rehabilitation or reconstruction needed
But also in US Counties...
Download apps:

www.roadroid.com/home/app - 2 month free account!

- Suitable phones: Samsung S5, S7

- Important with a good car mount!
  - https://www.amazon.com/Logitech-Drive-One-Touch-Smartphone-Mount/dp/B00KNU9L1Q/ref=sr_1_2?s=wireless&ie=UTF8&qid=1487941443&sr=1-2&keywords=logitech+magnetic+mount
Thank you for listening!

Lars Forslöf, CEO/Founder of Roadroid - lars.forslof@roadroid.com

AWARDS:
International Road Federation – Global Road Achievement Award 2014
UN World Summit Award – Global Champion 2013
European Satellite Navigation Competition 2012

Videos:
Introduction: https://www.youtube.com/watch?v=BXD2-au5afM
News clip from New Zealand: https://t.co/dVHwLAWlMZ