Recent Innovations in the Management of Irish National Roads

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NRA Pavement Management System

• dTIMS version 8 (now v.9)
• Implemented in 2011/2012 – improvements ongoing
• Data Repository
• Location Referencing System
• Condition Data
• Structure Data
• Age
• Surface Type
• Traffic
• Maintenance History
Georeferenced Data

• ESRI ArcGIS is at the centre of all management systems in NRA
• All data collected is georeferenced and mapped to new Location Referencing System (LRS) defined in 2012
• Every video frame is georeferenced, all stored in cloud and on NRA servers (optimised for cloud access)
• Android apps developed for access and portability of video
• Plug-in app for video viewing within ArcGIS
Data-Transfer Tool

Welcome to the GIS-PMS Data Interface. Please login with your User-ID and your Password.

User-ID: [Input User-ID]
Password: [Input password]

Login  Cancel

Please select the data to be transferred:

- Transfer Road Network Data into dTIMS CT
- Transfer GIS Data into dTIMS CT
- Transfer dTIMS CT data into GIS database

GIS-Database  dTIMS CT  PMS-Database
PMS Network Surveys

- Full network 1 direction each year
- Skid Resistance
- Ride Quality (IRI)
- Macrotexture
- Rut Depth
- Geometrics
- Video
RSP-General View
Network Surveys post 2012

- Crack Detection
- Crack Types and widths
- Ravelling
- Detailed Cross section (4000 points, 1mm accuracy)
- Ground Penetrating Radar (pavement thickness)
LCMS

- Laser
- Crack
- Measurement
- System

2.2m
Sub-networks

National network is not homogeneous.

• Ranges from brand new fully engineered motorway to legacy pavements

• Management of the network needs to recognise this variability in order to manage intelligently

• Concept of Sub-networks introduced to address this
Sub-networks

• Network is either Engineered or Non-Engineered/Legacy

• Engineered pavements divided into Motorway/Dual Carriageway or Single Carriageway

• Legacy pavement network divided into High, Moderate and Low traffic
Sub-networks – Practical Implications

Different Allowable Levels of service i.e. Different definitions of Very Good/Good/Fair etc

<table>
<thead>
<tr>
<th>IRI</th>
<th>Subnet 0</th>
<th>Subnet 1</th>
<th>Subnet 2</th>
<th>Subnet 3</th>
<th>Subnet 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>V Poor</td>
<td>&gt;3</td>
<td>&gt;3.5</td>
<td>&gt;5</td>
<td>&gt;5</td>
<td>&gt;7</td>
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<tr>
<td>Poor</td>
<td>2.5 to 3</td>
<td>3 to 3.5</td>
<td>4 to 5</td>
<td>4 to 5</td>
<td>5 to 7</td>
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<tr>
<td>fair</td>
<td>2 to 2.5</td>
<td>2.5 to 3</td>
<td>3.2 to 4</td>
<td>3.2 to 4</td>
<td>4 to 5</td>
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<tr>
<td>Good</td>
<td>1.5 to 2</td>
<td>2 to 2.5</td>
<td>2.7 to 3.2</td>
<td>2.7 to 3.2</td>
<td>3 to 4</td>
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<tr>
<td>V. Good</td>
<td>&lt;1.5</td>
<td>&lt;2</td>
<td>&lt;2.7</td>
<td>&lt;2.7</td>
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<table>
<thead>
<tr>
<th>Rut Depth</th>
<th>Subnet 0</th>
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<th>Subnet 3</th>
<th>Subnet 4</th>
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<tr>
<td>V Poor</td>
<td>&gt;9</td>
<td>&gt;9</td>
<td>&gt;15</td>
<td>&gt;15</td>
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<tr>
<td>Poor</td>
<td>6 to 9</td>
<td>6 to 9</td>
<td>9 to 15</td>
<td>9 to 15</td>
<td>15 to 20</td>
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<tr>
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<td>5 to 6</td>
<td>5 to 6</td>
<td>6 to 9</td>
<td>6 to 9</td>
<td>9 to 15</td>
</tr>
<tr>
<td>Good</td>
<td>3 to 5</td>
<td>3 to 5</td>
<td>4 to 6</td>
<td>4 to 6</td>
<td>6 to 9</td>
</tr>
<tr>
<td>V. Good</td>
<td>&lt;3</td>
<td>&lt;3</td>
<td>&lt;4</td>
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<table>
<thead>
<tr>
<th>LPV3</th>
<th>Subnet 0</th>
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<th>Subnet 2</th>
<th>Subnet 3</th>
<th>Subnet 4</th>
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<tbody>
<tr>
<td>V Poor</td>
<td>&gt;4</td>
<td>&gt;5</td>
<td>&gt;6</td>
<td>&gt;7</td>
<td>&gt;10</td>
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<tr>
<td>Poor</td>
<td>3 to 4</td>
<td>4 to 5</td>
<td>4 to 6</td>
<td>5 to 7</td>
<td>7 to 10</td>
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<tr>
<td>fair</td>
<td>2 to 3</td>
<td>3 to 4</td>
<td>3 to 4</td>
<td>3.5 to 5</td>
<td>4 to 7</td>
</tr>
<tr>
<td>Good</td>
<td>1 to 2</td>
<td>1.5 to 3</td>
<td>2 to 3</td>
<td>2 to 3.5</td>
<td>2 to 4</td>
</tr>
</tbody>
</table>
Sub-networks – Practical Implications

Different deterioration model parameters

\[ IRI_t = IRI_{t-1} + (a + b \cdot ESAL_t \cdot 10) \]

\[ RD_t = A \cdot \text{cumESAL}_t^b \]

\[ LPV3_t = LPV3_{t-1} + a \cdot ESAL_t \]

Annual monitoring of overlay scheme locations allow models to be updated to reflect “real” deterioration rates
Sub-networks – Practical Implications

Different trigger values for treatments

- Treatments are triggered on maintenance sections when two or more parameters becomes Poor or Very Poor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Subnet 0</th>
<th>Subnet 1</th>
<th>Subnet 2</th>
<th>Subnet 3</th>
<th>Subnet 4</th>
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</thead>
<tbody>
<tr>
<td>IRI</td>
<td>&gt; 2.5</td>
<td>&gt; 3</td>
<td>&gt; 4</td>
<td>&gt; 4</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Rut</td>
<td>&gt; 6</td>
<td>&gt; 6</td>
<td>&gt; 9</td>
<td>&gt; 9</td>
<td>&gt; 15</td>
</tr>
<tr>
<td>LPV</td>
<td>&gt; 3</td>
<td>&gt; 4</td>
<td>&gt; 4</td>
<td>&gt; 5</td>
<td>&gt; 7</td>
</tr>
</tbody>
</table>
Sub-networks – Practical Implications

Different Treatment Reset values

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Parameter</th>
<th>Parameter</th>
<th>Subnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace Surface (Relative Reset)</td>
<td>RD</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>IRI</td>
<td>-2</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td>LPV3</td>
<td>-0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td></td>
<td>CSC</td>
<td>0.6</td>
<td>0.6</td>
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<tr>
<td>Strengthen</td>
<td>RD</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>IRI</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>LPV3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>CSC</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Overlay</td>
<td>RD</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>IRI</td>
<td>1.2</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>LPV3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>CSC</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Reconstruct</td>
<td>RD</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>IRI</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>LPV3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>CSC</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

- Annual monitoring allows reset values to be adjusted to reflect what is achievable on the ground.
- Overlay schemes where target resets are not being achieved on site can be identified quickly.
Pavement Works Programme

• Subnetwork Definitions
• Subnetwork Thresholds
• Percentage above Threshold (PAT)
• Prioritisation based on PATs
• Rolling 3 year programme developed
• Rutting, Ride Quality, Short Wavelength
• Cracking, Ravelling will be added
Percentage Above Threshold (PAT)

- IRI, Rut Depth, LPV3 (short wavelength)

Example: Subnet 3, IRI poor threshold = 4 (250)
100m sample unit with IRI = 6,
\[ \text{PAT} = \frac{100 \times (6-4)}{4} = 50\% \]

Subnet 0, Rut Depth Poor threshold = 6 mm (0.25 inches)
100m sample unit with Rut Depth = 12 mm,
\[ \text{PAT} = \frac{100 \times (12-6)}{6} = 100\% \]
Prioritisation using PAT

- 100m sample unit must have 2 parameters above threshold to be included
- PAT capped at 150% max for each parameter
- Sum of 2 highest PAT values is Representative PAT
- Much better correlation with “local expert” scheme selection when 2 PAT approach is used
- Combination of 100m PAT sample units into final schemes described in the paper
- Approach has been key to acceptance of PMS selected schemes over previous local “bid” system
Project Level Analysis and Prioritisation - dTIMS
Implementation in dTIMS
Management of Skid Resistance

- Division of network into sections/site categories
- Risk Equalisation
- Motorway mainline versus 2 lane road with tight radius bend
- Prioritisation of Investigation based on points below Threshold
- SCRIM machine used for Data
## Site Categories and IL – HD28/11

<table>
<thead>
<tr>
<th>Site category and definition</th>
<th>Investigatory Level at 50km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td><strong>A</strong> Motorway</td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> Dual carriageway non-event</td>
<td></td>
</tr>
<tr>
<td><strong>C</strong> Single carriageway non-event</td>
<td></td>
</tr>
<tr>
<td><strong>G1</strong> Gradient 5-10% longer than 50m</td>
<td></td>
</tr>
<tr>
<td><strong>G2</strong> Gradient &gt;10% longer than 50m</td>
<td></td>
</tr>
<tr>
<td><strong>K</strong> Approaches to traffic signals. pedestrian crossings</td>
<td></td>
</tr>
<tr>
<td><strong>Q</strong> Approaches to and across major and minor junctions,</td>
<td></td>
</tr>
<tr>
<td><strong>R</strong> Roundabout</td>
<td></td>
</tr>
<tr>
<td><strong>S1</strong> Bend radius &lt;250m – dual carriageway</td>
<td></td>
</tr>
<tr>
<td><strong>S2</strong> Bend radius &lt;250m – single carriageway</td>
<td></td>
</tr>
</tbody>
</table>

- Traffic > 250 commercial vehicles / lane / per day
- Traffic < 250 commercial vehicles / lane / per day
## Site Inspection

- Site Location and Use
- Pavement Condition Data
- Collision Data
- Video Data
- All downloaded to tablet app
Summary

• Late Entrant – able to leverage off advances in technology
• Everything fully geo-referenced
• GIS at centre of all management systems including PMS
• Cloud-based image storage and access
• Subnetwork definition crucial for active management
• PAT approach led to acceptance of centralised scheme selection
• Active Skid Resistance Management
Is it working?
PMI Expenditure

Year | Millions (€)
-----|------------
2002 | 60
2003 | 50
2004 | 50
2005 | 70
2006 | 100
2007 | 120
2008 | 100
2009 | 20
2010 | 100
2011 | 140
2012 | 120
2013 | 80
2014 | 60

- Realignment
- Pavement