Taking the Namibian Road Management System to the next level

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SCOPE OF PRESENTATION

1. INTRODUCTION NAMIBIA
2. BACKGROUND TO THE ROAD SECTOR REFORM AND INTRODUCTION TO THE RMS
3. DATA COLLECTION, ANALYSIS AND EXAMPLES OF OUTPUT
4. NETWORK INTEGRATION MODULE (NIM)
5. TAKING THE NAMIBIAN RMS TO THE NEXT LEVEL
6. FUTURE DEVELOPMENT
7. CONCLUSION
1. INTRODUCTION - NAMIBIA

- Area of 825,418 Km²
- 34th biggest country
- Least densely populated country in the world (2.5 persons per km²).
- Average ann. rain fall 500mm; population 2mill
- The GDP ~ US$ 12 billion, with inflation rate of 5% per annum.
- 1US$=11.0 N$=South African Rand
- Independence from South Africa in 1990.
- 1st Country in Africa to use electronic voting system for elections– Nov 2014
Namibia Road Referencing System (RRS)

- Town

National Road Network (9) by road type

- BITUMEN (7,165.2 km)
- GRAVEL (25,921.0 km)
- EARTH (11,541.2 km)
- SALT (304.3 km)
- PROC_ONLY (1,445.9 km)

Total: 46,377.6 km

Source: RRS - Roads Authority, network date period 2011-07-11 to 2013-10-31
1. Road Sector Reform 1995-2000
2. All work of the RA to be outsourced
3. To manage the RA on commercial principles
4. Decentralisation principle versus centralisation
5. RCC to break up in to many SMEs
6. Road User Pay Principle - economically warranted roads
7. New construction – non economical/social roads government
Allocate funding to Roads Authority and local authorities

Plan, design roads and manage maintenance and construction work

Allocate funding to Roads Authority and local authorities

Pay Road User Charges

Maintain and Construct Namibia’s roads

ROADS Contractor Company And Private Contractors

Road Users Enjoy Quality Roads

The wheel turning towards the functioning, management, maintenance and construction of Namibia’s road network.
Challenges

1. Management of the Road Network
   - Lack of sufficient funding
   - Large network versus revenue

2. Balanced Distribution of Available Funding
   - The Balance between preservation and development
   - 60% of rural Namibians do not have access to a road (2km)

3. Institutional Challenges

4. Environmental challenges – climate change; flood - draught
Introduction

• PURPOSE OF THE RMS
  - Record and update road infrastructure asset information
  - Assist the RA in strategic and tactical planning
    • Identification
    • Quantification
    • Prioritisation of projects
    • Budgeting
An Integrated Road Management System (RMS) is an all encompassing framework, including both information processing and human resources, for the integrated management of the road network, including the determination and optimization of economically warranted projects, programmes, strategies and budgets, for both development and maintenance.
Most Important Sub-Systems

- Road Referencing System (RRS)
- Traffic surveillance System (TSS)
- Pavement Management System (PMS)
- Unsealed Road Management System (URMS)
ACTIVITY FLOW IN ROAD MANAGEMENT

DATA

MANAGEMENT

Inventory

Condition survey

Condition description

Deterioration modeling

Prioritization & Optimization

Presentation to Management/Board/stake holders

Final prioritization

Fund allocation

Project Planning

Detailed investigation and design

Maintenance/rehabilitation or upgrading

Project Planning

Data

MANAGEMENT
3. DATA COLLECTION, ANALYSIS AND EXAMPLES OF OUTPUT
Regular Condition Assessment

- Condition assessment
  - Profile
  - Deflection
  - Visuals
Traffic Counters
# Visual Assessment Data

## General

<table>
<thead>
<tr>
<th>Condition</th>
<th>Degree</th>
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</thead>
<tbody>
<tr>
<td>Texture</td>
<td>VF</td>
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<tr>
<td>Binder</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Bleeding</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Aggregate Loss</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Edge Breaking</td>
<td>0, 1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>Riding Quality</td>
<td>VG, G, F, P, VP</td>
</tr>
<tr>
<td>Skid Resistance</td>
<td>VG, G, F, P, VP</td>
</tr>
</tbody>
</table>

## Cracking, Pumping, Potholes, Patching and Deformation

<table>
<thead>
<tr>
<th>Cracking Type</th>
<th>Degree</th>
<th>Extent / Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surfacing</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Longitudinal: WP</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
</tr>
<tr>
<td>Longitudinal: Clay</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Transverse</td>
<td>0, 1, 2, 3, 4, 5</td>
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<tr>
<td>Block</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
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<tr>
<td>Crocodile</td>
<td>0, 1, 2, 3, 4, 5</td>
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<table>
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<tr>
<th>Distress Type</th>
<th>Degree</th>
<th>Extent / Occurrence</th>
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<tr>
<td>Pumping</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>59</td>
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<tr>
<td>Pothole: Surfacing</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
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<tr>
<td>Pothole: Structural</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
</tr>
<tr>
<td>Patching: Surfacing</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
</tr>
<tr>
<td>Patching: Structural</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>27</td>
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<tr>
<td>Deformation: Surfacing</td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0</td>
</tr>
<tr>
<td>Deformation: Rutting</td>
<td>Max depth mm</td>
<td>25, 100</td>
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## Road Measurements

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value 1</th>
<th>Value 2</th>
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<tbody>
<tr>
<td>Deflection</td>
<td>640.00</td>
<td></td>
</tr>
<tr>
<td>Riding Quality</td>
<td>5.73</td>
<td>3.19</td>
</tr>
<tr>
<td>Rut Depth</td>
<td>10.00</td>
<td>9.00</td>
</tr>
</tbody>
</table>
Pavement History

NAMIBIA PAVEMENT MANAGEMENT SYSTEM
PAVEMENT STRUCTURE

Road: M0087  Date: 2014/08/31

STRIP MAP

PAVEMENT STRUCTURE

Year
Class (mm)

Distance (km)
60 69 78 87

2013
SL2
(15)

1997
SR
(5)

2014
S L2
(15)

1982
G4
(150)

1982
G4
(150)

1982
G4
(150)

1982
g6
(150)

1982
g6
(150)

1982
g6
(150)

1982
g6
(150)

1982
g6
(150)

1982
g6
(150)

1982
g6
(150)

1982
g7
(150)

1982
g7
(150)
### Results

**Current Condition - Pavement structural condition**

<table>
<thead>
<tr>
<th>Namibia Road Categories (2014/07/31)</th>
<th>Structural Condition Distribution (Condition)</th>
<th>Page 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Namibia</strong></td>
<td><strong>LEGEND:</strong></td>
<td></td>
</tr>
<tr>
<td>48316142 m²</td>
<td><strong>VERY GOOD</strong></td>
<td></td>
</tr>
<tr>
<td>6340.6 km</td>
<td><strong>GOOD</strong></td>
<td></td>
</tr>
<tr>
<td>54%</td>
<td><strong>FAIR</strong></td>
<td></td>
</tr>
<tr>
<td>31%</td>
<td><strong>POOR</strong></td>
<td></td>
</tr>
<tr>
<td>9%</td>
<td><strong>VERY POOR</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Trunk Roads</strong></td>
<td></td>
</tr>
<tr>
<td>33657967 m²</td>
<td><strong>Main Roads</strong></td>
<td></td>
</tr>
<tr>
<td>4412.5 km</td>
<td><strong>District Roads</strong></td>
<td></td>
</tr>
<tr>
<td>4%</td>
<td><strong>2%</strong></td>
<td></td>
</tr>
<tr>
<td>54%</td>
<td><strong>57%</strong></td>
<td></td>
</tr>
<tr>
<td>31%</td>
<td><strong>31%</strong></td>
<td></td>
</tr>
<tr>
<td>9%</td>
<td><strong>8%</strong></td>
<td></td>
</tr>
<tr>
<td>2%</td>
<td><strong>2%</strong></td>
<td></td>
</tr>
<tr>
<td>2%</td>
<td><strong>0%</strong></td>
<td></td>
</tr>
<tr>
<td>43%</td>
<td><strong>30%</strong></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td><strong>43%</strong></td>
<td></td>
</tr>
<tr>
<td>7%</td>
<td><strong>20%</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Namibia Pavement Management System 2014/09/08*
Results

Condition

A huge effort was made from 2012 to 2014 in terms of resealing and rejuvenating the higher order roads.
Long Term Impact Analysis

- Remove backlog over 10-year period
- Remaining life of pavements to > 10 years
- Remaining life of surfacings > 5 years

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Impact of Funding Scenarios on Pavement Condition

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Funding Value (FV)</th>
<th>Replacement Value (RV)</th>
<th>Remaining life of pavements</th>
<th>Remaining life of surfacings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>770 077 820</td>
<td>N$ 38 503 891 000</td>
<td>&gt; 10 years</td>
<td>&gt; 5 years</td>
</tr>
<tr>
<td>2</td>
<td>962 597 275</td>
<td>2.000</td>
<td>423 543 000</td>
<td>55</td>
</tr>
<tr>
<td>3</td>
<td>1 155 116 730</td>
<td>2.500</td>
<td>529 429 000</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>1 347 636 185</td>
<td>3.000</td>
<td>635 314 000</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>1 541 120 635</td>
<td>3.500</td>
<td>741 200 000</td>
<td>55</td>
</tr>
</tbody>
</table>

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Namibia Pavement Management System

2014/09/11
Impact of Funding Scenarios on Pavement Condition

Replacement Value (RV) N$ 38 503 891 000

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Funding Value (FV)</th>
<th>(% RV)</th>
<th>Resurfacing (N$)</th>
<th>(% FV)</th>
<th>Rehabilitation (N$)</th>
<th>(% FV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>770 077 820</td>
<td>2.000</td>
<td>423 543 000</td>
<td>55</td>
<td>346 535 000</td>
<td>45</td>
</tr>
<tr>
<td>Yellow</td>
<td>962 597 275</td>
<td>2.500</td>
<td>529 429 000</td>
<td>55</td>
<td>433 168 000</td>
<td>45</td>
</tr>
<tr>
<td>Green</td>
<td>1 155 116 730</td>
<td>3.000</td>
<td>635 314 000</td>
<td>55</td>
<td>519 803 000</td>
<td>45</td>
</tr>
<tr>
<td>Blue</td>
<td>1 347 636 185</td>
<td>3.500</td>
<td>741 200 000</td>
<td>55</td>
<td>606 436 000</td>
<td>45</td>
</tr>
</tbody>
</table>

Namibia

Backlog (N$ million)


Namibia Pavement Management System 2014/09/08
Measurement selection

- Using incremental benefit cost analysis
Funding Requirement

- Realistic funding requirement over the next three to five years

<table>
<thead>
<tr>
<th>FUNDING REQUIRED FOR</th>
<th>Average annual funding</th>
<th>Road length per annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>REHABILITATION</td>
<td>N$ 800 million/annum</td>
<td>200 km</td>
</tr>
<tr>
<td>RESEAL</td>
<td>N$ 500 million /annum</td>
<td>770 km (3 years)</td>
</tr>
<tr>
<td>ROUTINE MAINTENANCE (Estimated)</td>
<td>N$ 234 million /annum</td>
<td></td>
</tr>
<tr>
<td>TOTAL NEED (Surfaced Roads)</td>
<td>N$ 1534 million</td>
<td></td>
</tr>
</tbody>
</table>
PMS Recommendations

• Visible improvement in the surfacing condition and stabilisation of the structural condition from 2012 to January 2014 – due to effective reseal program
• Still a huge backlog in rehabilitation and reseal
• Recommend
  ▪ Sufficient funding
  ▪ Focus on reseal (periodic maintenance) to extend pavement structural life (Verification of identified projects)
  ▪ Appointments for identified rehabilitation projects
<table>
<thead>
<tr>
<th>Financial year</th>
<th>% of bitumen roads in unacceptable condition: Bitumen (Surfacing Condition/ Structural Condition)</th>
<th>% of unsurfaced roads in unacceptable conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007/2008</td>
<td>8/6</td>
<td>29</td>
</tr>
<tr>
<td>2008/2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009/2010</td>
<td>11/9</td>
<td></td>
</tr>
<tr>
<td>2010/2011</td>
<td>13/9</td>
<td>38</td>
</tr>
<tr>
<td>2011/2012</td>
<td>17/10</td>
<td></td>
</tr>
<tr>
<td>2012/2013</td>
<td>-</td>
<td>58</td>
</tr>
<tr>
<td>Target for NDP III period</td>
<td>10/10</td>
<td></td>
</tr>
<tr>
<td>2013/2014</td>
<td>12/11</td>
<td></td>
</tr>
</tbody>
</table>
Process: Comfortable Speed versus IRI

- **Condition assessment**
  - Visual assessment per 5km segment
    - Accessibility
    - Safety
    - Maintainability
  - Road roughness (estimate)

<table>
<thead>
<tr>
<th>Comfortable Speed</th>
<th>IRI (photo)</th>
<th>Typical Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 – 100 km/h</td>
<td>7.5 – 5 (5.7)</td>
<td></td>
</tr>
<tr>
<td>60 – 80 km/h</td>
<td>10 – 7.5 (8)</td>
<td></td>
</tr>
<tr>
<td>45 – 60 km/h</td>
<td>12.5 – 10 (11)</td>
<td></td>
</tr>
<tr>
<td>≤ 35 km/h</td>
<td>15 (15)</td>
<td></td>
</tr>
</tbody>
</table>
HDM Results

- Economic projects
- Optimisation based on minimisation TTC
Modelling Strategy

Economic modelling (Using HDM4)

Appropriate standards modelling (Using the RA RMS)

Economic projects
- Rehabilitation
- Reseal
- Regravel
- Upgrade to surfaced

Appropriate projects for preservation

Economic + Non-Economic

Total funding requirement
5. TAKING THE NAMIBIAN RMS TO THE NEXT LEVEL

1. Managing skill shortages:
   - only 458 registered Professional Engineers in Namibia
   - less 5% professional registered engineers are women

2. Top management support

3. Continuous training required

4. Models should be continuously improved to pass the test of reasonableness

5. Keep it simple at network level

6. Managing Institutional Challenges

7. Organisational Structure
5. TAKING THE NAMIBIAN RMS TO THE NEXT LEVEL (2)

1. Easy access to all stakeholders
2. Automation of Performance indicators
3. Improved tactical level planning
4. Incorporating “Risk” in prioritisation
5. Incorporating “New Roads” in the prioritisation process; addition of Social Roads
6. Vehicle operating cost models
7. Integrating other relevant systems with the RMS
8. Import of and Quality assurance on as-built information
9. Utilising hand-held devices for visual assessments
10. Asset Valuation and Registry

1. Take data into the field

2. Display and Query your data

3. Edit and create data

4. Check the edits back into ArcGIS
6. FUTURE DEVELOPMENTS

1. Further Systems to be developed
   - Project Control System (PCS)
   - Network Integration Module of IMCS (Phase III)
   - Geometric Management System

2. Refinement to suit changing environment – technology & innovation

3. Data collection continuous exercise

4. Permanent km markers on whole network

5. New challenges such as Climate Change – draught

6. To make RMS information available on web.

7. To integrate other systems such as OMS, AMS - Local Authority PMS
6. CONCLUSION

1. Institutional and legal frameworks in place – make them work.
2. Sharing and networking important not to re-invent the wheel
3. Decision makers to use RMS for sound decisions
4. System developed in a developing country following “Best Practice Criteria”,
   - compatible with international standard
5. RMS important for “Managing Pavements”
6. Improvement of RMS needed.
Thank you!