



PAVEMENT MANAGEMENT ANALYSIS USING RNET: CASE OF THE FREE STATE PROVINCE

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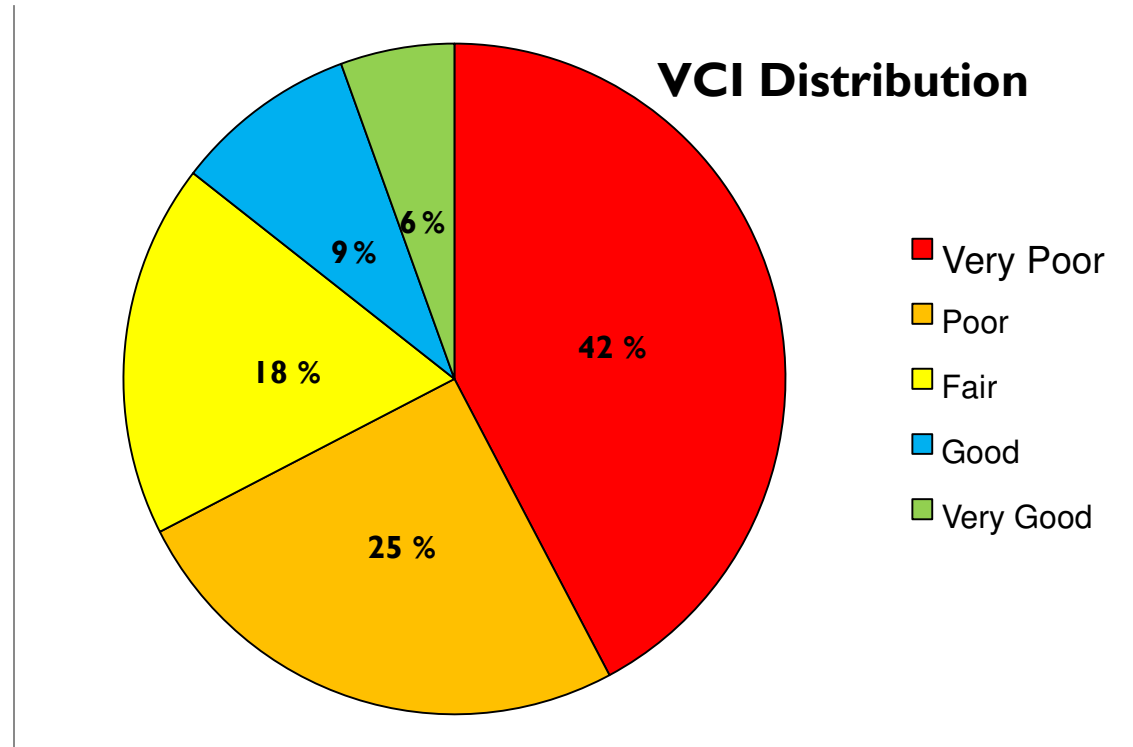
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PRESENTATION LAYOUT

- ❑ Current condition of Free State road network
- ❑ Problem Statement
- ❑ Examples of current trends in the province
- ❑ Solution
- ❑ Data collection and analysis
- ❑ Results
- ❑ Conclusion and Recommendations

Current condition of the Free State Network



Problem Statement

BUDGET ALLOCATION ANALYSIS IN THE FREE STATE

Currently in the Free State, there is **no** specific **software** like HDM4 or RONET that is being used to draft a business plan for short, medium and long term periods, instead to determine the road maintenance budget (for both maintenance and rehabilitation) that will be needed for the next 25 years an algorithm has been developed that simulates the expected behavior of the road network with different budget levels.

Problem Statement (cont')

This **algorithm** is not a true optimization procedure but more of a heuristic method that has been developed based on the experience of the behavior of the road network. To be able to formulate the algorithm there are assumptions that are made of the behavior of the road network as well as the expenditure of the available budget.

Problem Statement (cont')

One such **assumption** is that the deterioration rate of the roads from one condition category to the next is not linear but simulates the traditional condition curve of a road.

Examples of current trends

The percentage of the budget allocated to roads in each condition category is based on the **assumption** that rehabilitation work are more concentrated on the very poor roads and reseal work are more concentrated on the roads in the poor and fair condition.

Examples of current trends (cont')

The **unit costs** are based on the same unit costs as used in the **CAPEX** spreadsheet. The unit costs are average costs and not linked to level of roads or traffic volumes. Roads that are rehabilitated move to the very good category due to the major improvement in condition. Roads that are resealed only move to the good category as the pavement is not strengthened enough to justify movement to the very good category.

Solution

In order to curb maintenance and rehabilitation backlogs in the province, Road Network Evaluation Tools (**RONET**) will be introduced to obtain the **optimum** maintenance and rehabilitation strategy and related budget.

Solution (cont')

RONET is successfully used to estimate the impact of different funding levels on the future quality and also to estimate the consequences of budget constraints. The primary audience for RONET is **decision makers** in the road sector, for whom it is designed as a tool for advocacy of specific revenue enhancing or cost recovery measures.

Solution (cont')

This software provides an **interface between road maintenance expenditures and needs** with the funding requirements through road user charges. This could be used by road authorities to develop a business case to negotiate and revise road tariffs on a sound basis to curb maintenance and rehabilitation backlogs in the Free State Province.

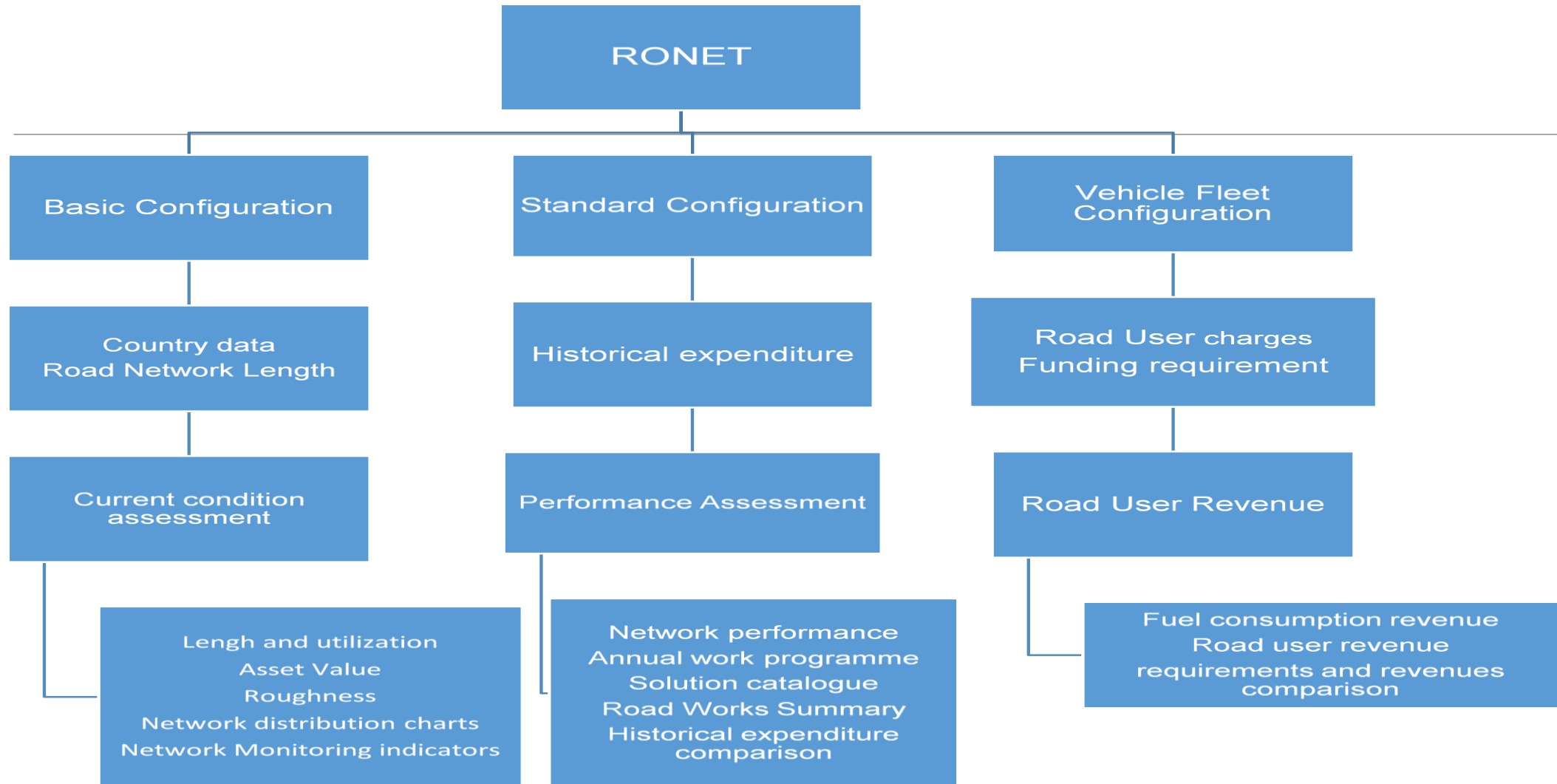
Description of RONET model

RONET is a model designed to assess the **current characteristics** of road networks and their **future performance** depending on different funding levels. RONET **simulates** the future performance of the road network under different road maintenance standards and different levels of funding.

Description of RONET model (cont')

RONET determines the **optimal** maintenance standard for each road and estimates the “**funding gap**”, defined as the difference between current maintenance spending and required maintenance spending.

RONET Flow chart



Data collection

For RONET model to run and give reliable outputs it needs to be populated with the following data:

- Land area in square kilometers
- Total population (million persons)
- Rural population (million persons)
- Gross domestic product (GDP) at current prices
- Total vehicle fleet (vehicles)
- Discount rate (%)
- Traffic growth and pavement width
- Capital road works and unit prices

Data collection (cont')

- Total road network length (km)
- Total paved roads network length (km)
- Diesel consumption (million liters/year)
- Petrol consumption (million liters/year)
- Total accidents fatalities (persons/year)
- Total accidents serious injuries (persons/year)

Data availability

Data needed for this study was available to the researcher from his employer but in the case where data was not available other government departments were consulted.

Data analysis

After the model has been populated with data, it adopts simplified **road user costs** relationships and simplified **road deterioration equations** derived from the **HDM-4** research.

Data analysis (cont')

HDM-4 is an **economic** evaluation module of a Pavement Management System that can perform a strategic evaluation of a network, evaluating a series of road classes similar to what is being done in RNET.

Data analysis (cont')

RONET has comprehensive road deterioration and road user cost relationships, has great flexibility on the way of defining the maintenance, rehabilitation or improvement standards to be evaluated, and performs a budget constraint optimization.

Results

The outputs of this model are the following:

- Network Performance
- Annual Work Program
- Solution Catalog
- Road Works Distribution

Results (cont')

- Road Works Summary
- Historical Expenditures Comparison

NB: These are premature results as the work is still in progress

		Periodic	Recurrent	Road	Road		Net	Average
	Rehabilitation	Maintenance	Maintenance	Agency	Users	Society	Benefits	Roughness
Year	(M US\$)	(M US\$)	(M US\$)	(M US\$)	(M US\$)	(M US\$)	(M US\$)	(IRI)
1	191.6	10.9	4.1	206.7	767.6	974.3	-48.5	7.65
2	22.1	0.4	4.1	26.7	790.2	816.9	151.5	7.63
3	9.6	2.7	4.2	16.4	813.3	829.7	155.0	7.63
4	38.5	19.5	4.2	62.2	834.3	896.5	126.0	7.56
5	0.0	20.1	4.2	24.3	859.3	883.7	174.4	7.56
6	1.5	10.6	4.2	16.4	884.9	901.3	233.0	7.57
7	4.2	5.3	4.2	13.7	913.3	927.0	213.3	7.58
8	0.0	17.9	4.3	22.2	943.8	966.0	219.6	7.60
9	0.0	12.1	4.3	16.4	971.1	987.5	244.5	7.61
10	0.0	7.0	4.3	11.3	1,002.8	1,014.1	267.6	7.63
11	1.8	24.3	4.3	30.4	1,031.8	1,062.1	290.2	7.62
12	16.5	2.2	4.2	23.0	1,056.8	1,079.8	255.6	7.60
13	5.0	7.9	4.3	17.1	1,089.8	1,106.9	307.9	7.60
14	0.0	10.5	4.3	14.8	1,124.7	1,139.4	290.4	7.61
15	0.0	45.2	4.2	49.5	1,156.7	1,206.1	260.8	7.60
16	0.0	8.0	4.2	12.2	1,193.6	1,205.9	320.3	7.61
17	1.8	9.4	4.2	15.4	1,226.5	1,241.9	351.0	7.62
18	0.0	9.4	4.2	13.6	1,265.6	1,279.2	366.8	7.63
19	0.0	6.5	4.3	10.8	1,306.9	1,317.7	408.2	7.64
20	1.7	18.5	4.2	24.4	1,341.0	1,365.4	423.8	7.63
Years 1-5 Total (M\$)	261.8	53.6	20.9	336.3	4,064.7	4,401.0	558.5	
Years 6-20 Total (M\$)	32.6	194.7	63.9	291.2	16,509.1	16,800.4	4,452.9	
Years 1-20 Total (M\$)	294.4	248.4	84.8	627.6	20,573.9	21,201.4	5,011.4	
Years 1-5 Total per Year (M\$/year)	52.4	10.7	4.2	67.3	812.9	880.2	111.7	
Years 6-20 Total per Year (M\$/year)	2.2	13.0	4.3	19.4	1,100.6	1,120.0	296.9	
Years 1-20 Total per Year (M\$/year)	14.7	12.4	4.2	31.4	1,028.7	1,060.1	250.6	
Present Value at 12% (M\$)	256.5	93.8	35.3	385.6	7,745.3	8,130.9	1,583.1	
Average (IRI)								7.61

Example of “Annual Work Program”

Example of “Road Works Distribution” Years 1-5

Rehabilitation Costs (M\$/year)				
Network	Paved	Unpaved	Total	Percent
Primary	10.5	3.5	14.0	25%
Secondary	5.7	11.0	16.7	29%
Tertiary	0.0	7.5	7.5	13%
Unclassified	0.0	0.0	0.0	0%
Urban	14.2	4.5	18.6	33%
Total	30.4	26.5	56.8	100%
Percent	53%	47%	100%	

Periodic Maintenance Costs (M\$/year)				
Network	Paved	Unpaved	Total	Percent
Primary	7.0	0.0	7.0	76%
Secondary	0.8	0.1	0.9	10%
Tertiary	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Urban	0.4	1.0	1.3	15%
Total	8.3	1.0	9.3	100%
Percent	89%	11%	100%	

Conclusions and Recommendations

RONET was initially developed by the World Bank to be used by African countries but was never used, however it has been used successfully in Europe. It is therefore recommended that it must be used in South Africa because it can be used as a decision making tool by authorities when they draft a business case.

Conclusions and Recommendations (cont')

It can assist the decision makers to achieve the following:

- Monitor the current condition of the road network
- Plan allocation of resources
- Assess the consequences of macro-policies on the road network
- Evaluate road user charges revenues

THANK YOU

QUESTION????
