

ROAD INFRASTRUCTURE FINANCING IN NAMIBIA: A CHANGE TO SUSTAINABLE ROAD NETWORK MANAGEMENT?

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1. INTRODUCTION

The Southern African Development Community (SADC), currently consists of a membership of 14 countries with an estimated total population of over 200 million. The size of the community together with its existing infrastructure places it in a position to develop into a major economic block on the continent as well as internationally.

With a vision of economic and political integration in the medium to long-term, the SADC Protocol on Transport, Communications and Meteorology under Chapter IV: Road Infrastructure sets the following objectives:

- member states agree to ensure and sustain the development of an adequate road network in support of regional socio-economic growth by providing, maintaining and improving all roads including primary, secondary, tertiary and urban roads, including those segments which collectively constitute the Regional Trunk Road Network in order to:
 - (a) ensure access to major centres of population and economic activity
 - (b) ensure access between ports of entry between member states and harbours of importance to the region
 - (c) minimise total road transport costs
 - (d) preserve assets vested in road infrastructure; and
 - (e) minimise detrimental impacts to the environment

The provisions in the Protocol, have been followed by the organs in member states responsible for the road sector with a view to fulfilling the objectives outlined above. Currently a good number of states have either completed road sector reforms or are in the final stages of completion with the emphasis being placed on the establishment of independent Roads Authorities as agents of Governments for the management of the road networks, with funding from dedicated Road Funds sourcing funding from road user charges. The charging instruments used vary from country to country although the well-known ones are:

- fuel levies
- vehicle licence fees
- road tolls
- abnormal and awkward load fees
- weight-distance charges
- entry fees for foreign registered vehicles
- parking and traffic congestion charges
- overload fees

Prior to the road sector reforms where these have been implemented, road management depended on appropriations from Treasury, where budget allocations for any year depended on the priorities at the time of budget preparation. In most member states, an expanding road network has faced reduced budget allocations in real terms as justification of the financial needs of the network were not easily understood by the decision makers.

This paper reviews road management financing for the Namibian case covering the period before the road sector reforms and the period after the said reforms. The network requirements in the medium term are discussed quantitatively and the effect of the current pavement loading patterns and its effect on the major sections is evaluated in view of the expected pressure on the road user charging system in the medium to long-term.

2. PERIOD PRIOR TO REFORM

Prior to the road sector reform, the maintenance, rehabilitation and development of the road network was funded by appropriations from the national budget. The taxes specific to road users such as fuel levies and vehicle licence fees accrued to the fiscus and therefore had no linkage with road financing. The allocations to the transport sector were not apportioned in accordance with revenues generated by each sub-sector and therefore the road sub-sector competed unfavourably with other transport sub-sectors.

With a total of 46 000 km of trunk, main and district roads comprising of 5 500 km of bitumen surfaced and 40 500 km of unsealed roads complimented by a total of 600 bridges and 20 000 culverts with spans greater than 1.5 metres, the funding levels prior to the reforms resulted in the accumulation of backlog maintenance, which will require major capital injection before a stable regime of road user charges can be attained.

3. ROAD SECTOR REFORM

The reform process in Namibia was accomplished in two phases, the first phase involved a study on road taxation on which the charging instruments are based and the second phase developed the structures required for the commercialisation of the road sector, which included the drafting of the enabling legislation for the establishment of the entities to take over the management of the road network and the management of the Road Fund both independent from the public sector.

The Acts establishing the Roads Authority and the Road Fund Administration made way for the establishment of the two entities as from 01 April 2000. The Roads Authority as an agent of the Minister responsible for transport is responsible for the management of the road network and the Road Fund Administration as an agent of the Minister of Finance manages the Road Fund. Each entity is managed by a Board of Directors that report to the respective Ministers.

4. DEDICATED ROAD FUND

The Dedicated Road Fund sources funds from road user charges based on three basic principles:

- user pay principle: road users pay the full cost of providing and maintaining roads and streets which can be economically justified from a traffic view point
- equity principle: one class or category of road user does not subsidise another
- efficiency principle: charges to promote efficient utilisation of resources

The instruments utilised for the road user charges are fuel levies, vehicle licence fees, abnormal/load vehicle charges, entry and transit fees for foreign vehicles and weight-distance charges. The weight-distance charges are yet to be implemented.

The dedicated Road Fund as provided in legislation, is to fund the maintenance, development and rehabilitation of the proclaimed road network and other support services.

5. ROAD MANAGEMENT FINANCING

The financing regimes prior to the reforms vary year by year as shown for the period 93/94 to 99/00, with peaks registered in the 93/94 and 96/97 financial years. Significant reductions were registered in the last three years prior to the establishment of the entities, as shown in Table 1 in Annexure A.

Although the level of financing from the road user charges is still below “optimum” levels, there has been a relative increase for 2000/01 and 2001/02 as compared to 1997/98 and 1998/99 although all below optimum levels. It had however been predicted before the establishment of the entities that the funding during the first number of years would be below optimum, till such time that the effects of backlog maintenance are cleared through rehabilitation of the older sections of the network. The vision was that a gradual increase in the charges would be implemented to avoid substantial increases in any one year which would be unacceptable by the road users, but achieve a stable and optimum level in the medium to long term. However, with the current rise in construction costs resulting from the depreciation of the Rand (1 Rand=1 N\$) against the major currencies, it is questionable whether the road user charges can be raised to levels that meet the optimal requirements of the network.

6. THE TRUNK ROAD NETWORK

6.1 Age of the Network

The trunk road network of Namibia consists of a north-south link running from the border with South Africa to the border with Angola, and the Trans-Kalahari Highway a west-east link running from Walvis Bay at the coast to the border with Botswana and a third link through the Caprivi Region, known as the Trans-Caprivi Highway. An additional section in the south, links the port in the south to the north-south link some 240 kms north of the common border with South Africa. The layout of the trunk road network is shown in Figure 1 in the Appendix. Of the total 5 500 km of bitumen surfaced roads, the SADC Regional Trunk Road Network covers 3 635 km or 66.1%. The average age based on the first upgrade of bitumen standards stands at 25.8 years, and taking into account the major rehabilitation interventions done on some sections over the years, the average age improves to 23.1 years. The network taken as a whole is therefore serving beyond the typically used design life of 20 years.

Table 2 in the Appendix gives the percentage distribution of the age of the different sections taking into account the major interventions done on the network. The resealing and rejuvenation operations were considered as minor operations that do not add strength to the pavement but rather serve as holding actions for the protection of the underlying pavement layers.

From the table, 37.5% of the RTRN sections or a length of 1 364 km is 30 years and older and 69.4% or 2 523 km are 25 years and older, which will require rehabilitation in the short to medium term.

6.2 Pavement Loading

Overload control operations carried out on the road network at seven strategic locations were also used to determine the level of overloading on the network. The data collected was used to determine the pavement loading in terms of equivalent standard axles (E80's).

Using the annual average heavy vehicle traffic for the road section and the average equivalent E80's determined from the operations, an average E80 equivalent was calculated and adjusted for the seven locations and used as the representative value for the trunk road network for the period after 1990 when Namibia became independent. With the exception of the road sections in the northern areas which were subjected to military heavy vehicle loading, a reduced equivalence per heavy vehicle (2 E80's) was utilised in accordance with the recommendations of TRH4: Structural Design of Flexible Pavements for Interurban and Rural Roads for the period prior to 1990.

The E80 equivalents were calculated from the well-known Liddle Formula for a single axle as follows:

$$F_e = (P/P_2)^n \dots\dots\dots(1)$$

where

- F_e - number of equivalent E80's
- P - axle loading in kg
- n - load equivalency factor
- P_2 - standard axle load for the configuration
 - where $P_2 = 6\ 600$ kg for a single axle, single wheel
 - $= 7\ 600$ kg for separate axles in multi-axle combinations
 - $= 8\ 200$ kg for a single axle, dual wheel

The value of n can vary between 1 and 6 but is commonly taken as 4 in Southern Africa. For shallow cemented pavements sensitive to overloading the n value may exceed 4 and for deep pavements less sensitive to overloading the n value may be less than 4.

The data collected together with the available traffic data on selected road sections was used to determine the average E80 loading per heavy vehicle as shown in Table 3 in the Appendix.

For the heavy vehicles weighed, the E80 loading was calculated using equation 1 and averaged for the relevant road section. Similarly the E80 loading was determined for each vehicle considering the axles to be legally loaded. The values obtained together with the heavy vehicle traffic figures and percentage overloaded vehicles were then used to determine the adjusted equivalent E80 loading, assuming that 50% of the heavy vehicles were return un-laden vehicle trips. The adjusted E80 equivalents for the road sections were averaged to obtain a value for the network.

6.3 Pavement Life

Although the remaining life of a pavement can only be accurately determined through established and developed methods of pavement evaluation, which *inter alia* include visual inspections, rut depth measurements, falling weight deflection measurements, DCP measurements and trial test pits, a rough indication can be obtained through the use of historical traffic, equivalent E80 loading per heavy vehicle and appropriate growth trends to estimate the total pavement loading over a specified period. The E80 equivalent for heavy vehicles on the network and traffic growths were used to estimate the pavement loading of road sections over their lives. Reduced traffic growths were used for the period prior to independence, as entry restrictions were applicable at the time, thereby reducing the number of heavy vehicles on the network. For most sections information is available from studies carried out especially after 1990 when Namibia became independent.

The pavement structures used at the time consisted with bases of thicknesses between 100-125 mm on a 125/150 mm sub-bases or on one or two selected layers of thickness between 125-150 mm. These pavements correspond either to ES0.3 or ES1 Pavement Classes. For the pavements 15 years or younger the design loading correspond to the ES3 Class loading as was identified from the as-built drawings. The calculated pavement loading over the lives of the road sections and its comparison as a ratio of the average design loading for the ES1 Class loading for the older sections and for the ES3 Class loading for the new or newly rehabilitated sections is in Table 4 in the Appendix.

7. DISCUSSION

Road management financing prior to 1990 indicates for the 93/94 and 95/97 financial years being above optimum levels and the 97/98 budget below optimum. Although the period after the implementation of the reforms shows levels below optimum as was predicted, there is steady funding of the order of 82 and 78% of optimum for the 00/01 and 01/02 financial years respectively.

The age distribution of the network shows an average age of 21.9 years and therefore serving beyond the commonly used 20-year design life. 69.4% of the network is 25 years and older, 56%, 25 years and older and 37.5%, 30 years and older. A significant portion of the network will therefore require capital injection for rehabilitation in the medium to long term.

The pavement loading patterns as derived from overload control operations indicate E80 equivalents per heavy vehicle higher than those recommended by TRH4: Structural Design of Flexible pavements for Interurban and Rural Roads. Average heavy vehicle overloading, averages at 28.9%, with average loading per heavy vehicle as high as 10 E80's. The adjusted loading taking into account the entire heavy vehicle compliment on the sections considered, gives an average of 4E80's per heavy vehicle.

The estimated cumulative pavement loading in terms of E80's gives a total of 2 230 km or 61.5% of the network as serving beyond its pavement design life, which corresponds to the length of the network older than 25 years determined in Section 6.1. 455 km or 12.5% of the network is nearing the end of its 20 year design life.

However a total of 440 km or 12% is at rehabilitation stage currently, which will reduce the network length in need of intervention in the short-term. The length of network that will require intervention in the medium-term will put pressure on the road user charges, in view

that these have to be adjusted to match the road network requirements. One interesting road section (8/6) is at rehabilitation stage although its cumulative loading is well below the ES1 average pavement loading. Besides having been loaded by military vehicles, records indicate that innovative methods of construction were used, providing the surfacing and the base as one single layer of 70 mm thick laid on a sand sub-base.

8. CONCLUSION

The level of financing prior to the road sector reforms varied according to the priorities at the time of budgeting, although the funding showed a reduced trend during the period. The funding after the reforms has however shown a steady trend although below optimum levels.

The age of the network based on estimated historical pavement loading, shows a significant portion as either serving beyond its design life or nearing the end and therefore will require significant capital investment for rehabilitation which will place significant pressure on the road user charging system especially in respect of clearing the effects of backlog maintenance.

Coupled with the relatively aged network, the effects of overloading are placing additional pressure due to the rapid deterioration of the network and therefore on the maintenance requirements.

The financial requirements in the medium-term to satisfy the network needs suggest sharp increases of the road user charges, which cannot be received favourably by the road users. The question therefore remains whether the funding dedicated to road management as envisaged by the road sector reforms will sustain the network to levels that minimize transportation costs.

REFERENCES

1. Government of the Republic of Namibia, Ministry of Works, Transport and Communication, Department of Transport, 1998, " National Transportation Master Plan, Vol. 2, Road Planning and Budgeting in Namibia".
2. Southern Africa Transport and Communications Commission, 1994, "Overload Control in Southern Africa".
3. Committee of State Road Authorities, 1996, "TRH4: Structural Design of Flexible Pavements for Interurban and Rural Roads".

APPENDIX

Table 1: Road Management Financing (as a ratio of optimum)

	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02
Actual	1.57	0.91	0.98	1.06	0.72	0.76	0.82	0.82	0.78

Table 2: Road Network: Age Distribution: Years

	>30	30 ≤ Age < 25	25 ≤ Age < 30	20 ≤ Age < 15	15 ≤ Age ≤ 10	< 10
Length (km)	1 364	675	484	75	193	844
% of Total	37.5	18.6	13.3	2.1	5.3	23.2
Cummulative %	37.5	56.1	69.4	71.5	76.8	100.0

Table 3: Pavement Loading on the Main Trunk Road Sections

Road No	RTRN No	Daily Traffic	% Heavies	Daily Heavies	Average Weighed/Day	Average % Overloaded	Average E80's/Heavy	Average E80's/Heavy Legal	Adjusted Equivalent E80's
1/1	05	230	24	55	7	20.1	10.0	9.0	4.7
1/5	05	2160	8	127	15	12.2	7.9	6.4	3.4
1/7	05	1150	14	161	44	41.7	9.2	6.8	4.4
3/1	50	230	39	90	6	32.2	9.6	5.7	4.1
7/1	40	1130	15	170	41	20.4	6.3	6.1	3.1
1/11(i)	05	940	15	141	55	37.4	9.6	8.0	4.6
1/11(ii)	05	1400	10	146	22	38.3	7.4	7.2	3.7
Average						28.9	8.6	7.0	4.0

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