

TOWARDS SUSTAINABILITY OF THE SOUTH AFRICAN ROAD NETWORK

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ABSTRACT

Since we live in a world of dwindling resources, of all types it is essential that road engineers in their design and construction activities, provide infrastructure in a sustainable fashion.

This paper examines some of the factors influencing the sustainability of roads in the South African context, of which perhaps the four most important are:

- Appropriate and efficient institutional arrangements including sound governance
- Sound management of the road network – from planning through to eventual operation
- Availability of adequate resources – especially financial and personnel
- Conservation of natural resources and of the environment

The paper concludes that a paradigm shift in road provision together with strong leadership within road authorities is needed to begin to provide long term sustainability of road infrastructure in South Africa.

INTRODUCTION

Vast sums of money have historically been, and are currently on an annual basis, being invested in the South African road network – an asset of some R1trillion in extent. Additionally roads are a very significant catalyst for economic and social development in any country. For these reasons at least it is essential that the road network should be provided in a sustainable manner. We live in a world which is rapidly outgrowing its resources of all types, primarily because of the inexorable growth in population and the consequent deleterious effects on our living patterns. It behoves us therefore as professional engineers, and in this context road engineers, to provide infrastructure which makes least demand on these resources and which is also provided in a sustainable, efficient and effective fashion. Unfortunately evidence exists that this is not universally the case in South Africa.

In most countries throughout the world investment in roads accounts for a major part of governments' stock of capital and constitutes the dominant means of transportation; However despite their importance many road networks throughout the world, especially in Africa, are poorly managed and badly maintained, and thus not sustainable. "Almost without exception they (roads in Africa) are managed by bureaucratic roads departments", who have in general mismanaged the road assets under their control". (Heggie and Vickers1998:7-16).

Calvo (1998:10) lists five closely related symptoms which she suggests are the cause of this lack of sustainability viz., unclear responsibilities, the lack of an adequate and comprehensive integrated planning systems, insufficient and uncertain funding, inadequate capacity and inappropriate design standards and methods. To an extent these match the issues which detract from the sustainability of much of the primary road system in South Africa.

South Africa has a road network approaching three quarters of a million kilometres in extent, with an asset value exceeding one trillion rand with an annual budgetary allocation

of some R46 billion to develop and maintain it (Kannemeyer, 2012). Roads are indisputably “big business” and as such deserve sound and effective management to ensure sustainability of the network. Twenty, or so years ago, it was pointed out that if road authorities in South Africa were to be successful in meeting the challenges facing them in the light of the limited resources pertaining at that time “it would be necessary to pay greater attention to the concepts of strategic management and road management systems in order to ensure sustainability of the road network (Mitchell, 1991:32). Unfortunately, judging by the condition of much of the network, this message does not appear to have been heeded by some of the road authorities in South Africa.

Another reason for ensuring that our road networks remain sustainable is that roads play a significant role in the economic and social development in any country. Perkins et al (2005:218) have shown that over a fifty year period the development of (good) roads has exhibited a strong “forcing effect” on GDP growth in South Africa. Added to this the Moving South Africa strategic framework for transport in South Africa has stressed the need for good roads as a catalyst for the much needed social development in the country (Department of Transport, 1999). This points to the need for sustainability in the provision of road networks, especially in the African continent where excess road user costs because of the poor conditions of the roads amounted to some 12 billion Rand per annum at the turn of the century (Heggie and Vickers, 1998:1).

This paper examines some factors which need to be addressed to ensure that roads are provided in a sustainable manner

THE CONCEPT OF SUSTAINABILITY

The concept of sustainability is very closely linked to the preservation of the environment – however it embraces a wider concept than this. Reference to dictionaries elicits statements such as: “keep going over time”, “maintain and prolong”, “avoidance of the depletion of natural resources”, and “meet the needs of the present generation without compromising the ability of future generations to meet their needs”. Insofar as it applies to roads the International Road Federation suggests that it relates to the effective planning, design, construction, operation and maintenance of (good) roads to conserve resources (IRF, 2012). This paper adopts the IRF philosophy and suggests that the prime factors influencing the sustainability of roads in South Africa are,

- Appropriate institutional arrangements for the execution of the roads programme,
- Sound management of the road network to facilitate sustainability of our roads,
- Sustainable and adequate resources, especially financial and personnel, and
- Preservation of the environment in the construction and maintenance of roads.

In short, the concept of sustainability insofar as roads are concerned is that of effective road network management within appropriate institutional arrangements for their provision, utilising adequate resources effectively and embracing sound and perceptive engineering practices in sympathy with the environment.

APPROPRIATE INSTITUTIONAL ARRANGEMENTS FOR ROAD SUSTAINABILITY

Over time there have worldwide been various approaches to appropriate institutional arrangements for the provision of a country’s road network. In South Africa the matter is made more complicated because of the fact that at two significant times in our country’s history, 1910 and 1994, political compromise lead to the creation of three levels of government all with strong “original powers” insofar as the provision of roads is concerned – most, if not all other countries have only two (Mitchell, 2009:170-174) . In addition South Africa has a large number of second tier government authorities administering a relatively small inter-city surfaced secondary road network, in comparison with similarly developed countries.

The consequences of this are a reduction in institutional memory and wisdom (defined as knowledge plus experience) within many road authorities in creating a sustainable road network. An informal structured qualitative analysis of the opinions of 20 very experienced roads engineers in the country, conducted by the author, indicates that there exists:

- poor overall network performance, the inability, with some exceptions, to deliver the road programme effectively,
- poor intergovernmental relations, particularly between levels of government,
- lack of professional capacity and expertise,
- inappropriate interference by politicians in executive functions,
- poor financial management of road funds (once again with some exceptions),
- ineffectiveness in addressing the country's overall goals,
- a lack of a concentrated thrust in managing the total intercity road network,
- an “uncomfortable” relationship between the provinces and local road authorities in metropolitan areas and
- the lack of an adequately dominant role in the roads sector by the Department of Transport.

Reform in government, which is sweeping many countries is also apparent in the roads sector worldwide (TRB, 1999:11) where new institutions are being considered which:

- Explicitly define the agency's responsibilities,
- Separate policy and management from the delivery of the road programme,
- Reduce public sector employment, and
- Incorporate performance monitoring.

With this a background (or perhaps baggage in the South African context) where do we start in determining appropriate institutional arrangements for promoting road sustainability (as defined above), in the country? It is suggested that the principles for achieving this are:

- There should be a minimum number of road administrative units,
- Road programme delivery needs to be improved and optimised,
- Cost effective road administration should be pursued – this is an essential,
- The most effective distribution of resources and jurisdictions is a prerequisite,
- Responsibilities need to be clearly defined and performance accounted for,
- Government should play a strategic role in the main, and not try to “do what it cannot do efficiently”.

The institutional and operational arrangements for the provision of roads in South Africa has come a long way and has had various forms, since the creation of the Cape Roads Board which, in 1843 was the first road authority in South Africa (Floor,1985:7), up to the present day with the creation of SANRAL in 1998. In addition the sometimes lack of co-operation or co-ordination between road authorities for the provision of primary and secondary roads in metropolitan and previously city areas has long been a problem and it has been argued that metropolitan road authorities should be given greater road powers, together with commensurate funding for all roads within their area of jurisdiction. This philosophy is in line with the ANC policy guidelines for metropolitan government announced following their December 2012 gathering in Mangaung (Mertens, 2012).

In the light of the current situation regarding the management and condition of much of our road network there is a compelling case for a new paradigm in respect of institutional arrangements for the provision of roads in this country. After all it was Einstein who is reputed as saying that “stupidity consists of keeping on doing the same thing, but hoping for a different result”. Many suggestions including those in the Department of Transport's

document, Road Infrastructure Strategic Framework for South Africa (RISFSA) as well as many World Bank publications have suggested that the approach should be to incorporate market discipline into road provision which would cut wasteful projects, improve operational performance and allocate resources efficiently. The “commercial” approach embraces the “agency” concept, as has been successfully carried out in the case of SANRAL in South Africa, the Roads Agency in the UK and Transit New Zealand, to mention a few.

This approach focuses on certain “building blocks”, such as:

- assigning roles and accountability definitively,
- involving road users in the management of roads,
- constraining spending to what is affordable,
- stabilizing road funding by securing an adequate and sustainable flow of funds, and
- strengthening the management of roads by introducing sound business practices and managerial accountability (Heggie and Vickers, 1998:1,2).

The practical, or realisable, expression of the above principles insofar as the South African road network is concerned is that:

- All primary intercity roads to be assigned to SANRAL – this is currently the case
- All secondary surfaced intercity roads to be assigned to a roads agency, newly created for this purpose
- All tertiary rural gravel roads with low traffic volumes remain the function of provincial authorities,
- All roads, with the exception of national roads, within the boundaries of metropolitan areas be assigned to Transport Authorities within the metro areas. These transport authorities would however need to be re-constituted to embrace “public ownership or involvement” rather than as currently is the case where they are merely “Council Committee” bodies
- Roads in smaller municipalities should be treated on a case to case approach with the province assisting where feasible.

It is realised that this suggestion will not find favour in certain “political” circles, however if we wish to have a sustainable road network, this “rationalisation” or “re-structuring” of authorities is a significant part of the endeavour. A paradigm shift in thinking on the matter is essential as is tenacity of purpose and political leadership in striving for its achievement. After all, it took 10 years for the recommendations of the Holmwood Commission of Enquiry into the “Roads Problem” in 1925 to be implemented through the creation of the first National Road Board in 1935 (Floor, 1985:3).

MANAGING THE ROAD NETWORK TO FACILITATE SUSTAINABILITY

Context

Some years ago the then head of a provincial roads authority stated that “The failure of provincial roads departments to deliver or to maintain roads has reached crisis proportions. ...and operational activities in all provincial departments are all but stalled.” She went on to further state “The harsh reality of provincial roads departments is: inadequate delivery linked to high administrative overheads, diminished skills levels, inefficient operational functions, entrenched pay scales up to double market rates, and declining productivity and cost effectiveness” (Mitchell, 1999:8). This did not paint a good picture in respect of the management of provincial road networks in South Africa at the time and it is suggested that the position has not improved within many road authorities. To reinforce this viewpoint a publication by the South African Institution of Civil Engineering (Lawless, 2005) makes the following pertinent remarks (amongst others) regarding the state of network management in some road authorities:

- “Strategic planning is lacking in infrastructure delivery. Where proposals are made those in senior positions are not sufficiently skilled to make decisions about the viability of projects. As a result many key projects are not happening and this is impacting severely on the country’s economy.” (Lawless,2005:197)
- “The lack of strategic direction and decision making in transport infrastructure is costing the country many billions of Rand per annum” (Lawless,2005:197).
- “An inhibitor to recovery includes non-technical leaders making decisions relating to engineering departments for which they are not qualified and have no technical experience” (Lawless, 2005:199).

At a meeting of the Roads Pavement Forum in 1999 a senior engineer in one of the provincial roads departments stated “We do not have the ability to properly maintain our road network” (Asphalt News, 2009:29).

It is possible to carry on quoting references regarding the poor state of management in provincial roads departments, and also some local government authorities, however it is suggested that the point has been sufficiently made.

On the other hand however there is clear evidence that the management of the primary road network, by the National Road Agency and at least two metropolitan roads authorities is more than adequate (Automobile Association, 2008; Department of Transport,2006 and the SAICE Infrastructure Report Card, 2011).This last reference states the following regarding the primary road network in South Africa, “SANRAL deserves significant praise for its consistently excellent maintenance and management of national roads”. It is thus obvious that given the necessary leadership and necessary support arrangements, roads in South Africa can become sustainable in the long run.

Integrated and effective road network management for sustainability of the network

Since an efficient road transport system is seen by most countries as an essential pre-condition for general economic development considerable resources should be devoted to providing an efficient and effective management system towards a sustainable road network.

Road network management, like any management activity involves the following tasks:

- Defining activities,
- Planning, design, construction and maintenance activities,
- Allocating resources to meet the authority’s objectives,
- Organising and motivating personnel, including capacity development,
- Controlling work,
- Monitoring and evaluating performance, and
- Feeding back results to seek improvements.

Road network management in the context of this discussion is a system which defines a set of integrated procedures for providing and maintaining a sustainable road network at minimum cost and maximum efficiency. It seeks to integrate all the facets of road activities mentioned above. It should also improve the interaction between the policy-makers and the executive towards a clear delineation of responsibilities. (Mitchell, 2009:185)

Such an approach to integrated road network management in South Africa, based on the general public administration principles identified by Cloete in his rational analytic model for the discipline of Public Administration (Cloete,1981), was postulated some twenty or so years ago by Mitchell and Jordaan (1989) and should be re-visited as a framework for improving road network management.

Whilst significant progress was made in the field of road network management in South Africa during the decades of the 1980s and 1990s (Mitchell, 2009:187), recent observations by amongst others, the World Bank suggest that insofar as Africa as a whole

(including South Africa) is concerned, the situation in respect of adequate management of road networks has deteriorated during recent times. Based on an evaluation in 2005 by the World Bank of road projects representing commitments of some \$25 billion “effective governance” of the road network “received insufficient attention” (Freeman, 2010:8). Freeman (2010) further noted that “politicians the world over prefer the visible impact of a new road over maintenance spending, the benefits of which are not immediately obvious to the electorate”.

Mitchell (1994:5) notes that “whist road management systems are designed to provide real solutions to real problems...., the formulation of the system is largely determined by political, organisational, procedural and technical context in which it is embedded”. It is self-evident that the effectiveness of such a system requires a thorough analysis of its contextual environment in order that it does not become a purely intellectual exercise which usurps reality. It also requires perceptive and strong leadership to ensure that the system is fully implemented. Road management should be seen as an integrated and continual process which optimises the overall performance of the road network over time towards ensuring its sustainability.

SUSTAINABILITY OF RESOURCES

Personnel resources

It is an established fact that South Africa suffers from a major skills shortage, particularly in civil and roads engineering field which has the potential to derail much needed development in the country. This point does not need to be elaborated upon, suffice to say that IMESA has reported that currently (January 2013), at least one Metro authority has no professional engineer on its staff establishment. Also the KwaZulu-Natal roads authority has less than 10% of professional roads engineers in its employ than it had 50 years ago when the workload was considerably less (author’s experience). When taken with the fact that not all the executive heads of provincial road authorities are professional roads engineers, the outlook for the long term sustainability of the road network is frightening.

It can be suggested that the private sector can “fill the gap” – however without adequate professional wisdom (expertise plus experience) in the road authorities to “manage the process”, including providing the necessary leadership including strategic planning, the long term sustainability of the road network will not be achieved. The development of the very effective South African road network during the period from 1935 up to the end of the eighties was, despite generally inadequate finances, driven to a large extent by a corps of competent engineers in the provincial and national road authorities, some of whose names are legend today.

This shortage of adequately qualified technical and professional staff can, and does lead to:

- Indecisiveness in decision making
- Poor work procedures
- Political micro-management
- Lack of good governance
- A deteriorating and eventually crumbling road network
- High accident and death rates as well as high vehicle operating costs as a result of poor maintenance

To overcome the problem a human resource development strategy is essential. This strategy should inter alia:

- Remove political involvement in executive functions and improve the attractiveness of a public sector career in roads engineering by ensuring appointments are based on merit only
- Rebuild “institutional memory” through mentoring schemes by experienced professionals in the roads field
- Consider whether revised institutional arrangements, as discussed earlier in the paper, can assist in solving the problem.
- Embark on a structured capacity development and skills transfer programme, such as is offered by the South African Road Federation
- Make professional registration of roads engineers a mandatory criterion for appointment to senior posts, and encourage registration in the junior posts
- But most of all DEVELOP LEADERS in senior positions in the roads authorities.

Financial resources

For ensuring sustainability in the road network, adequate and effectively used financial resources are essential. This facet of sustainability rests on three legs:

- Realistic determination of the optimal quantum of road funds required
- Determination of the appropriate source of road funds
- Efficient use of the available funds

Very often the funding levels requested by road authorities are nothing more than “wish lists” and are not based on realistic integration of physical and financial planning. The last fully integrated and rational “roads needs study” for the South African road network, examining both condition and capacity requirements within the contextual environment, was carried out in 1983. The author is not aware of any comprehensive study since then, though during recent years work in determining overall pavement condition financial needs has been carried out by SANRAL on behalf of the Treasury.

In order to gain the approval of the fiscal authorities for increased funding it is necessary to make a strong case in the face of the many competing demands for state funds – some of which have more emotional impact than roads. Despite the work by SANRAL mentioned above there does not appear to be much evidence of efforts towards determining overall road network needs, including traffic capacity needs through optimising the total road network. It is suggested that it is time for a “hard look” at the optimal road network for the country, and how it should be provided and funded.

There is only one source of funds for roads – the man or woman in the street. The issue is, what is the best way of generating the necessary level of funding, as determined above. The role played by the state in the management of public finance has during the 20th century increased in relation to previous ages when Adam Smith, for example, advocated a pure capitalist economic system. Since that time there has been much debate on the role of, and extent of expenditure by, the State in the provision of public works, including myths and “half-truths” on the efficacy of various income generation approaches.

In the raising of revenue for financing public goods there are two sources generally considered, the user benefit (price) norm and the ability to pay (tax) norm. Both approaches have their respective advantages and disadvantages, and there is not space to discuss them in this short paper. Additionally a feature nowadays of public finance is the growth of “mixed economies” which lean heavily on the private sector for economic development often through public-private-partnerships and road concessioning. If, for example other economic development catalysts such as power, communications and water are provided through a system of user charging, why then should not roads, also an

economic development catalyst, be provided in the same way? It is however important to get one controversial point “out of the way” in this debate. Whilst fuel levies and road tolls are both “user charges”, unless the fuel levies are dedicated to road provision and maintenance, they become a tax, in the same way as tax on any other item of consumption is accruable to the fiscus. Fiscal authorities worldwide stand resolute against the “dedication or “ring-fencing” of such income, since it diminishes their “redistribution of wealth” function, one of the prime functions of democratic government.

For the sake of brevity in this discussion it is suggested that a mixed financing approach to road provision be adopted. “Economic development roads”(where traffic volumes exceed an agreed minimum, say 20 000 vpd) should be financed by the price route (tolling), with “social development and lower volume economic development roads” which provide general access, being financed through the tax route from general government revenues. It is realised that it is not possible to classify provincial roads precisely into one or other of these two classes, however this should be a broad principle only in respect of funding these roads. Where tolling an economic road would lead to unacceptably high tariffs because of insufficiently high traffic volumes, consideration should be given to the “Loan Supportable by Revenue” (LSR) approach where government makes a grant to partially cover the costs of construction or improvement thus reducing the level of tolling necessary. This philosophy was successfully used on many of the existing toll roads in this country.

The third leg of sustainable use of financial resources relates to the efficient use of available funds. This includes aspects such as only employing competent consultants and contractors, effective quality control monitoring of the work, maintaining the road authority’s overhead administrative costs at as low a level as possible (5% to 10%), accurate costing of unit rates and projects, and an appropriate intra and inter authority allocation of resources.

Road maintenance in South Africa is possibly adequately funded at the moment but the actual expenditure is very ineffective and inefficient resulting in significant wastage and unnecessarily high levels of deterioration with the resulting asset loss and non-sustainability of the roads. Treasury is unlikely to increase funding whilst this is the status-quo. It is demanding greater attention to effective road management in order to qualify for government funding. Added to this is the system instituted by the Treasury with effect from 1 April 2013 whereby funds for preventative maintenance of roads will be “ringfenced” from provincial re-distribution, provided certain criteria, such as having an effective pavement management system, are met by the road authority concerned (Kannemeyer, personal communication). The SARF strongly supports this stance. There are many other facets of the efficient use of road funds which need to be considered were there space available in this short paper.

ENVIRONMENTAL SUSTAINABILITY

The promotion of the sustainability of roads through the conservation of natural resources and consideration for the environment, the so called “Green Roads” movement, is a recent concept or philosophy which is gaining support worldwide. In essence it is nothing more than reinforcing sound engineering and environmental preservation practices in road design and construction, which competent engineers should in any case have applied.

Consider this, as quoted by Uken (2012):

- All the ants on the planet, taken together, have a biomass greater than humans,
- Ants have been incredibly industrious for millions of years- yet their productiveness nourishes plants, animals and the soil
- Ants construct houses, farms, dumps cemeteries, living quarters and food storage facilities from material that can be truly recycled
- Ants maintain soil health for the entire planet

- Whilst human industry has been in full swing for a little over a century, it has brought about a decline in almost every ecosystem on the planet

In other words, nature does not have a design and construction problem, people do. Albert Einstein is reputed as having said, "If we are to solve the problems that plague us, our thinking must evolve beyond the level we were using when we created the problems in the first place" So how do we as roads engineers change the way we think and design and build roads which are sustainable? There is much support for the "Greenroads" concept as the way to do this – however as pointed out above this philosophy merely reflects good engineering practice in sympathy with the environment.

It is suggested that there are certain "environmental" pillars for road infrastructure design and construction which need to be continually borne in mind in order to promote sustainability in the roads sector.

These include, but are not necessarily restricted to:

- Design roads to facilitate improved energy efficiency and the reduction of emissions during their operation
- Manage the quality of water used in road construction and re-introduced into streams and the sub-strata. A very good example of this was the construction measures adopted by the then National Roads Board during the construction of the N2 through the Du Toit's Kloof pass some 25 years ago.
- Effective waste management of the material emanating from construction and maintenance operations
- Improved management of the use of construction materials, including the use of indigenous materials where possible. This will inter alia, call for perceptive pavement design moving away from the TRH4 recipe book concept, as is being done in the new SANRAL pavement design document
- Minimise negative effects on biodiversity and ecosystems. Putting it bluntly, what roads engineers in the past considered to be swamps in rural areas, to be filled in with "dump rock" are now regarded as "water-courses which need preservation.

Some examples of what can be done in this respect are;

- More attention to be given to route location for "greenfield" roads in order to avoid valuable eco-systems to promote smooth traffic flow and also to optimise the vertical alignment to reduce excess road user costs.. The current "Ben Schoeman" section of the N1 is a very good example of inadequate optimisation of the vertical alignment (termed "false rise and fall" in vertical alignment). As a mitigating factor however it needs to be said that this section of road was located more than five decades ago in a completely different road operations environment and also its location was influenced by antagonistic discussions regarding its location between engineers from the then National Transport Commission and the Transvaal Roads Department (Floor, 1985:49-61)
- Design roads for minimum maintenance and also taking lifetime road user costs into account, particularly in pavement type selection. Whilst it is mainly relevant to an earlier era, the document on pavement type selection by Freeme, Otte and Mitchell (1980) illustrates the philosophy suggested.
- Design for minimisation of the impact of road construction
- Incorporate innovative approaches to road pavements, such as reduced "energy usage" pavements, warm mix asphalt, pavement recycling, maximum use of indigenous pavement materials, etc.
- Reduce the carbon footprint of construction operations and materials
- Consider much larger pavement design lives than are presently used,

... and much more. The list is only limited by the lack of innovation by design and construction engineers.

CONCLUSION

In order to improve the sustainability of our road infrastructure we will need:

- A paradigm shift in institutional arrangements, adequate and well managed resources and the innovative use of our natural resources
- The application of sound engineering design, construction and maintenance principles and procedures in sympathy with the environment
- Sound and effective management and governance and
- Effective leadership'

But most of all, we need the ability and political will to implement all the proposals made in this paper.

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