UNIVERSITY OF KWAZULU NATAL

THE ECONOMIC EFFICIENCY OF TOLLING ROADS IN SOUTH AFRICA

By

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CONFIDENTIALITY CLAUSE

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To whom it may concern

RE : Confidentiality Clause

Due to the sensitive nature of some of the subject matter contained in this report, it would be appreciated if the contents of this paper remain confidential and not be circulated for a period of five (5) years.

Yours sincerely

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This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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Date...16 SEPTEMBER 2004

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This dissertation is the result of my own independent work / investigation, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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ABSTRACT

South African infrastructure has traditionally been funded through general government budgets and dedicated taxes and fees rather than tolls. However since the early 1980's, the South African Government has adopted a strategy of tolling portions of the national road infra-structure either through PPP's or toll routes owned by the SANRA.

This paper investigates whether the approach of tolling the road infrastructure together with the financing, construction and maintenance of roads by means of PPP's is the most efficient economic manner to finance such endeavours.

A case study analysis of TRAC, a concession toll road project, highlights the theoretical economic inefficiencies which are primarily present in relation to marginal operating and external costs, misallocation of resources, the costs of collecting tolls, contractual efficiency as well as the efficiency in raising capital.

The decision to toll routes, albeit theoretically economically inefficient, is however contextualized when viewed against the funding needs of Government, particularly in light of the fact that the South African government will continue to experience severe funding shortfalls for road maintenance, rehabilitation, and construction. However, highway needs are increasing yet public funding sources are constrained by limited resources together with spending priorities in other areas.

Ostensibly the decision to toll a route is not based on theoretical economic efficiency issues but rather on a strategy to lessen the financial burden on the state by freeing up more money with the implementation of toll roads. This strategy thus allows the state to maintain those roads funded through the national fiscus by tolling certain routes and thereby continue to maintain and expand the road infrastructure with the given financial constraints.

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CHAPTER ONE : INTRODUCTION

1.1 BACKGROUND

1.1.1 Introduction

South African infrastructure has traditionally been funded through general government budgets and dedicated taxes and fees rather than tolls. Fisher and Babbar (1995) estimated that in most industrial countries 90% or more of the road infrastructure is funded by governments. Similarly, in developing countries, governments often bear the entire cost. However, the limited resources available via traditional government funding sources has led to an increasing global interest in state and private toll roads as an alternative way of meeting road infrastructure needs. This has led to a trend towards greater private participation in infrastructure development; a trend that is becoming firmly established in many developed and developing countries.

Due to a lack of adequate road funding in South Africa, the road network has been in a state of decline since the late 1980's. This has led to the Government adopting a strategy of tolling national roads and more recently, embarking on a private-public-partnership (PPP) strategy in order to finance the construction and maintenance of the road infrastructure. This "off balance sheet" financing mechanism translates into concessioning sections of the national road network, whereby a concessionaire funds the design, construction, financing, operation and maintenance of this section for a thirty year period - during which time a toll fee is charged to recover the associated costs. Currently there are 3 PPP concessionaire companies operating on the SA national road network and the government intends to continue with this strategy wherever roads can be operated and sustained as private businesses (www.transport.gov.za). The South African National Roads Agency (SANRA) is currently evaluating five new PPP projects, two of which have reached the project development stage. Seemingly there is, however, growing public resistance towards this strategy and the tolling of roads in general, with concerns that a policy of this nature is economically inefficient and may in-fact restrict economic growth. In addition, it has been argued that tolling is un-equitable and a select minority are being "taxed" for the same service that is been given "free" to the majority of road users (www.users.nac.net).

The subject of this paper is thus an investigation of whether the approach of tolling the road infrastructure together with the financing, construction and maintenance of roads by means of PPP's (and associated tolling of motorists), as adopted by the South African Government, is the most efficient economic manner to finance such infrastructure.

The intention of the dissertation is to analyse the economic impacts of un-tolled roads versus government financed toll roads versus privatized toll roads. Alternative strategies to road funding will also be reviewed and discussed.

1.1.2 Role of road infrastructure in economic development

The subject matter of this paper necessitates upfront clarification of the economic significance of constructing and maintaining a road infrastructure. Driver (1999) posits that not only is it intuitively understandable that infrastructure contributes to economic development, but that it is also theoretically rational. However, a central issue Driver questions is whether infra-structure can be a leading factor in stimulating economic growth in underdeveloped regions.

The Road Transport, Livability and Sustainable Development paper presented by the Association Mondiale de la Route World Road Association (PIARC, 2003, p11) indicates that "Economic development is the first positive impact of road construction. All actors in the political and economic world agree on this point, even though no specific theoretical tools are available to measure the impact of road infrastructure on economic development." Schiller (2000) indicates that a way of reducing the costs of supplying goods and services, and thereby enhancing global competitiveness, is to improve the nation's infrastructure. Today, both research and facts highlight the connection between road development and economic development. It is therefore not surprising that the nature of road policies adopted in different countries are so closely tied to the development level of these countries.

In Switzerland, peripheral road links have ended the social and economic isolation of remote regions, thus stimulating investment in these regions. In Cuba, roads are having a positive impact on the economy, mainly through the development of tourism and agricultural production (PIARC, 2003).

Because roads can open up isolated regions and facilitate balanced land use planning, they also function as a tool for social development. Accessibility to educational facilities, health facilities, jobs, the transportation of goods to isolated regions – these are all factors fundamental to social progress.

The PIARC report sums up the social efficiency value of roads: "In the Queensland region, it is recognized that roads have major social benefits and enable equality of opportunities to be converted into equality of results" (PIARC, 2003, p16).

It thus becomes increasingly apparent that a country pursuing accelerated economic development requires strategic national road networks that will facilitate increased trading of goods and the mobility of persons. The priority of government authorities should therefore be to build a network of fast, safe roads between the main economic centers in their countries. This strategy is integral to ensuring a cornerstone of economic development.

The PIARC report (2003) indicates that many of the least wealthy countries (Greece, the Czech Republic, Hungary, Latvia, Mexico, Romania, Slovakia and Slovenia) are implementing policies in favour of rapidly extending their road network to support necessary economic development. The division between those countries for which road building programs are a vital economic priority and those for which there are limited road building, is also reflected in their respective road maintenance programs. The latter countries have a network in poor condition, often under-designed, and their priority goes to primarily rehabilitation work. Because many of these countries have lacked sufficient funding for regular maintenance in recent years, their national networks are dilapidated and unable to accommodate the increased traffic.

Countries that do not face this predicament are able to devote more resources to improving the service and quality levels of the existing network (PIARC, 2003). They no longer reason in terms of investment and infrastructure development, so much as in terms of service rendered to users and the general public. In developed countries, road policy is therefore no longer concerned with the rapid expansion of infrastructure but rather with its integration into a more general sustainable development policy that emphasises quality of life and the level of service offered to the public by road infrastructure.

According to the Department of Trade and Industry (DTI) approximately 85% of all South African freight is conveyed by road. Further to the above, it is estimated that 80% of South Africans depend on public transport - of which 75% of commuters travel by mini-bus taxi (S.A. Business Guidebook, 7th Edition, 2002/2003). The above figures provide an indication as to the importance of having an efficient and well maintained road infrastructure system in order to move both people and goods across the country. Furthermore, the economic importance of providing an efficient and well maintained road infrastructure was recognized by the SANRA CEO when Mr. Nazir Ali acknowledged "It is a well known fact that roads serve both economic and social functions, and maintaining an efficient road infrastructure in South Africa is crucial for future growth and development" (Engineering News, May 2003, pg 4).

1.1.3 History and structure of the South African Roads Authority

According to the SANRA website (www.nra.co.za) the first Roads Board was established in 1935 and it commenced with six members; four representing the provinces and two appointed by the Minister of the Interior. Although it was assumed that provincial members would act "in the national interest", the board quickly became ineffective, since the provinces expected their representatives to promote local interests only – not those of the road users as a whole. In 1948 the board was replaced by another entity, the National Transport Commission (NTC), comprised of seven members, of which not more than three members could be public servants and the rest being appointed by the then Governor General on grounds of their experience in transport. However, all the employees of the NTC were serviced employees of the Ministry of the Interior. In 1971, with the promulgation of the National Roads Act, 1971 (Act 54 of 1971), the board was given the status of a body corporate and the members enlarged to eleven, of which not more than four could be persons from the public service and the remaining appointed by the State President. Although this board worked better than the previous board, it led to a large and controversial freeway program and to a large surplus in the road fund. With the fuel crisis in the 1970's, the concomitant slump in fuel sales led to a decrease of some 65% (in 1973 Rand-real terms) of the income derived from the fuel levy. This in turn ultimately led to the abolition of the fuel fund in 1988. In 1988 the Commission was replaced by a statutory body, namely the South African Roads Board (SARB) consisting of 8 members who included members representing local government, the engineering profession, road users, industry and commerce. This board functioned effectively and it was the private sector members – with their knowledge of business – who helped initiate South Africa's toll road program using funds raised on the domestic capital market. In fact, the public-private board worked so well that in 1995 membership was further extended to 12 members to include more private sector representatives and a representative from academia.

In April 1998, the SARB was replaced by the SANRA, a Limited Liability Company under the Companies Act, governed by a Board of Directors consisting of eight members, six representing the private sector, one being the CEO of the Agency and one representing the Department of Finance.

The South African Government, via the Ministry of Transport, is the sole shareholder and owner of the SANRA. The Board of Directors of the SANRA is accountable to the Minister of Transport (PIARC, 2003).

The purpose of the SANRA is to maintain and develop South Africa's 7 200 km National Road Network and to manage assets with an estimated value of more than R38 billion (Sunday Times, Business Times, February 27 2004). The enabling Act (The South African National Roads Agency Limited and National Roads Act. 1998, Act No. 7. 1998) charges the SANRA with the following principal tasks:

- Strategically plan, design, construct, operate, rehabilitate and maintain South Africa's national roads;
- deliver and maintain a world class primary road network to South Africa;
- generate revenues from the development and management of its assets;
- undertake research and development to enhance the quality of South Africa's roads;
- advise the Minister of Transport on matters relating to South Africa's roads; and
- upon request from the Minister of Transport and in agreement with a foreign country, to finance, plan, construct, acquire, provide, operate and maintain roads in that country.

The SANRA's Mission Statement is as follows:

Sensitive to the needs of the Nation, and within our financial capacity, we will provide and manage a sustainable National Road Network which reduces the cost of road transport and promotes economic growth and the quality of life.

Directly, and with our partners, we will:

- ➢ Maintain, improve and expand the national Road Network, in order to contribute to the enhancement of all transport modes;

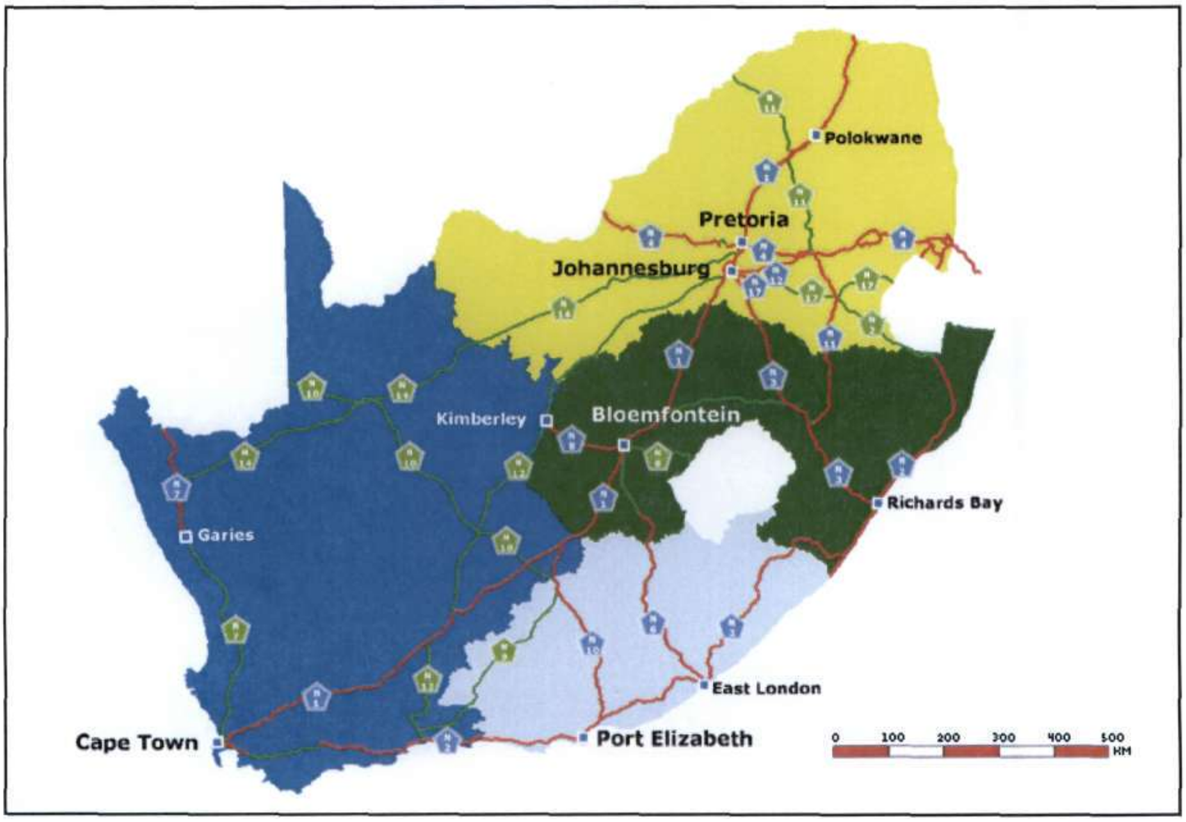
- implement our programs in a manner which enhances the sustainability of the network; and
- inspire innovative and effective research and development.

(www.nra.co.za)

1.1.4 Description of the South African road infrastructure network

South Africa's national road network currently covers 7200 km as illustrated in Figure 1.1.

Figure 1.1: **South Africa's National Road Network**



Currently the SANRA receive a variable allocation of funding from the central government treasury for non-tolled roads and in addition, the agency manages 2 types of toll roads:

- SANRA toll roads which are funded by the private sector loans backed by government guarantees. These tolled sections are managed on behalf of the SANRA by various toll management companies; and
- Toll roads that are financed maintained and operated by private-sector companies through concession agreements with the SANRA.

Of the 7 200 km of the national road network approximately 72% (5 200 km) are un-tolled, 8% (600 km) are tolled and operated and managed on behalf of SANRA and 20% (1 400 km) are operated by concession companies (Engineering News, January 2003). The 7 200 km of national road infrastructure is comprised of 1 400 km of dual carriage way freeway, 440 km of single carriage way freeway and 5 300 km of singe carriage main road with unlimited access (www.nra.co.za).

According to the DTI (2002/2003) South Africa has an extensive and well maintained road network and that "South Africa boasts one of the most modern and extensive transport infrastructures in Africa, which plays a crucial role in the country's economy and is depended on by many neighbouring estates" (SA Business Guidebook, 7th Edition, 2002/ 2003, p254).

1.1.5 History of road tolling

According to the Wikipedia Free Encyclopedia early references to toll routes include the mythical Ferryman Charon charging a toll to ferry dead people across the river Styx. Aristotle and Pling refer to tolls in Arabia and other parts of Asia. In India, prior to 4 BC, the Arthasastra notes the use of tolls. Germanic tribes charged tolls to travelers crossing mountain passes and tolls were used in the Holy Roman Empire in the 14th and 15th Century (www.wikipedia.org).

Although history records tolling dating back to the early ages, according to the UN Statistical Yearbook (2003) modern day road tolling is a relatively new phenomenon and the international trend towards private participation in infrastructure began in earnest in the mid-1980's in the United Kingdom and Malaysia.

South Africa's history of toll roads goes as far back as the 1700's when the governor of the Cape Colony collected tolls to effect repairs to the roads. Tolls were also levied on roads in the former provinces of Natal and Orange Free State up to the end of the 19th century. In 1983, the first modern State owned toll road, the Knysna Toll Road, was opened. A further six toll roads were completed between 1984 and 1988, and in 1996 legislation enabling PPP's in the form of concessioning was approved by Cabinet (www.arrivealive.co.za).

In 1997 Trans African Concessions (TRAC), the first South African privatized toll Concession Company, signed the concession agreement with the Direcção Nacional de Estradas e Pontes de Moçambique (DNEP) and the SANRA, which jointly are termed the Implementing Authority (I.A.) for the N4 route. The route extends from the Gauteng / Mpumalanga border in the West, to Maputo in the East – a distance of 525 kilometers (www.tracn4.co.za).

In May 1999 the SANRA awarded a further concession contract to the N3 Toll Concession (Pty) Ltd (N3TC) for the design, construction, financing, operation and maintenance of the 418 kilometers of the N3 highway between Heidelberg and Cedara (www.n3tc.co.za).

In October 2000 the SANRA signed the most recent Concession Contract for the Platinum Toll Highway with Bakwena Platinum Corridor Consortium (BPCC). This project consists of a 95 km section of N1 running from Pretoria Northwards to the town of Warmbaths and a further 290 km section of the N4 running Westwards from Pretoria to the Botswana border (www.bakwena.co.za).

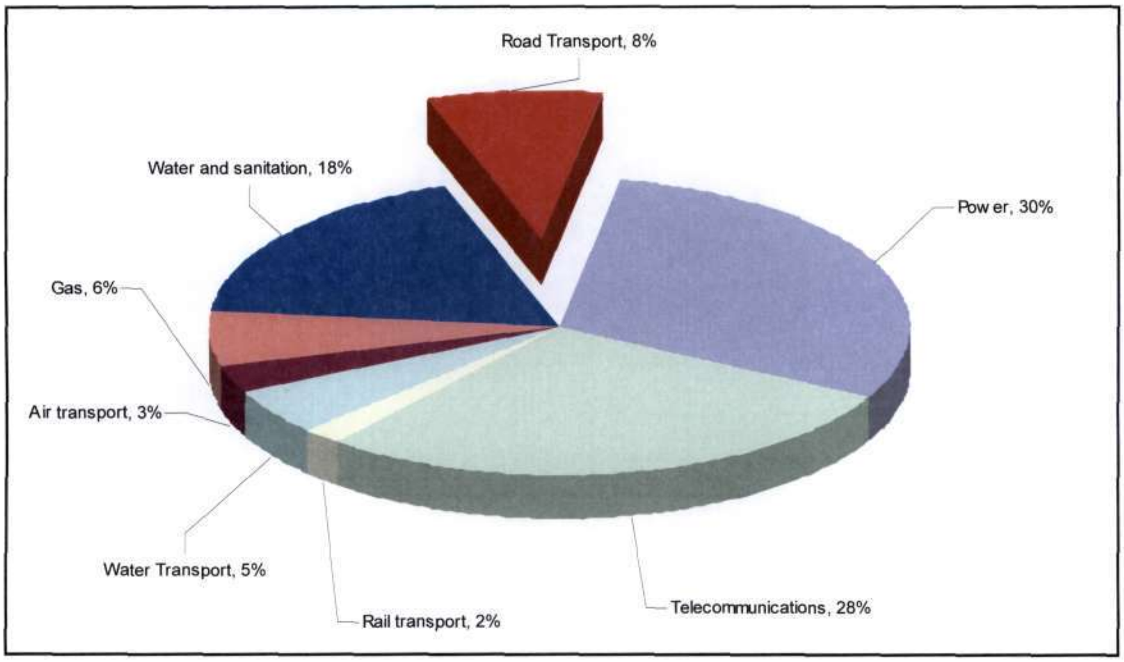
To date no further concession projects have been awarded.

1.1.6 History of PPP's

Project finance, or limited recourse lending, as a technique for financing large capital-intensive projects, is well established. It has its origins in mining and rail development over the last century but it really took off in the US for resources transactions in the 1960's. These techniques were then "imported into Europe in the late 1970's for a string of large project financings for North Sea offshore oil" (Tinsley 2000, p1). However, project financing is a technique that was seldom used in infrastructure development, largely because governments funded these developments themselves. It has subsequently become more common as governments around the world, constrained by limited financial resources, seek alternative ways to deliver essential services. Merna and Owen (1998) describe the trend towards concessions as having begun in the mid-twentieth century in the USA, corresponding to a growth in financial markets and their ability to finance complex projects. The UK's Private Finance Initiative (PFI) (on which the South African PPP structure is closely based) introduced a formal structure for harnessing private sector resources to provide public services. Examples of early PPP's in the UK include the Channel Tunnel, the Second Severn Crossing, the Dartford Bridge, the Skye Bridge, the Manchester Metrolink, and the London City Airport (Merna and Owen,1998).

The use of private finance in infrastructure projects is now growing worldwide. Merna and Owen (1998) cite upcoming PPP type projects in Asia, the USA, Mexico and Australia; the sectors most in need of development being water, roads, air transport and power. Fisher and Babbar (2003) state that the World Bank estimates that private toll road development accounts for 8 percent of the $60 billion annual market for private infrastructure projects worldwide. The 1996 PPP's investments per sector are illustrated in Figure 1.2.

Figure 1.2: **Private infrastructure projects, by sector**



Source : Fisher and Babbar (2003, p2)

In line with this international trend, the South African government's PPP program is aimed at making "PPP's a viable service delivery option for government departments" (National Treasury, 2001b, p5).

1.2 AIM

Since the mid 1980's the SANRA and the South African government have embarked upon tolling certain sections of the national road network. This strategy has developed into the formation of concession contracts whereby PPP companies are now financing the design, construction, operation and maintenance of the national road on a concession basis for a period of 30 years. In order for the PPP's to re-coup these costs, tolls are collected over the concession period life. There is however, growing public resistance to toll roads and the debate often cited is the economic efficiency of a toll road. Furthermore, the reasoning for economic efficiency of initiating PPP strategies within the road industry is a highly contentious issue.

The aim of this paper is to firstly determine the logic behind the SANRA and governments 'tolling' strategy and thereafter determine whether tolling is economically efficient. Furthermore, the impact of PPP's and whether this strategy positively impacts on the economic efficiency will be investigated.

Alternative tolling and road financing mechanisms are also investigated in order to determine if other methods and strategies are more or less economically efficient than the one in question.

1.3 METHODOLOGY

Relevant literature, in conjunction with using TRAC as a case study, will form the primary research resources for this project. The focus of the project is on the economic benefits and efficiency of tolling by the State and PPP's. Pertinent literature will be used to identify factors that impact on the economics of tolling and thereafter an analysis of TRAC as a case study will further highlight the economic considerations.

The outcome of this study shall determine whether the SANRA and the South African government have embarked upon an economic efficient approach in financing road infrastructure and whether or not the economics of this strategy are desirable. It will also determine whether there are alternative strategies currently employed elsewhere, that may prove to be viable solutions in the South African context.

1.4 LIMITATIONS OF THE STUDY

Due to dissertation constraints and a lack of readily available information, it was not possible to assess additional case studies in order to determine and compare the economic efficiencies or inefficiencies of tolling. In addition, information relating to toll roads under the management of the SANRA was not accessible. Furthermore, there is a lack of localised empirical values which are required to determine economic merit related to several of the efficiency issues. It is also not possible to assess the accident rates of TRAC versus that on the national road network due to the lack of statistics available in South Africa. Thus it is impossible to compare this component of marginal external costs between un-tolled versus tolled routes.

The conclusions reached are therefore based solely on the literature reviewed and the case study appraised and may thus be limited. Finally, despite stringent attempts to remain objective, it is worth noting that the author is employed by TRAC and hence, an unavoidable degree of bias / subjectivity may have been introduced into the interpretation of evidence.

1.5 STRUCTURE OF THESIS

Chapter one provides background to the subject of this paper. It describes the policy taken by the SANRA and indicates the economic necessity of government constructing and maintaining a road infrastructure. The history of the roads governing authority and national road infrastructure as well as a background to tolling and PPP's is discussed.

Chapter 2 examines the relevant literature and focuses on the economic factors requiring consideration when debating the efficiencies of un-tolled versus state tolled versus PPP tolled roads.

Chapter 3 discusses the relevance and structure of a case study, whilst Chapter 4 reviews the economic factors raised in Chapter 2 by using TRAC, the first PPP concessionaire in South Africa, as a case study.

Chapter 5 will focus on alternative funding and tolling mechanisms.

Finally, Chapter 6 will review the findings of this analysis and identify any lessons that have become apparent.

CHAPTER TWO : LITERATURE REVIEW

2.1 INTRODUCTION

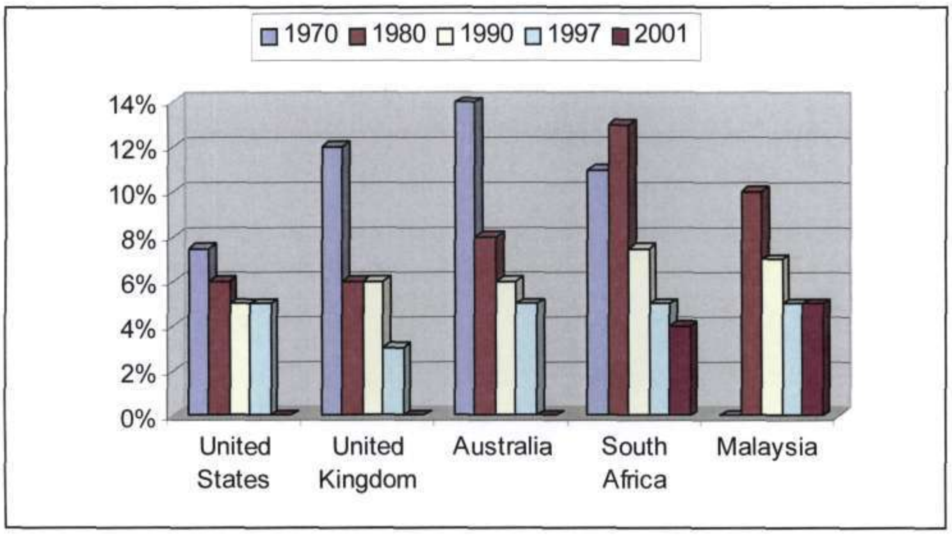
This chapter reviews the backlog of road infrastructure in South Africa as well as the fiscal policy of the South African government. Thereafter the economic principles and theory relating to the efficiency of a state and PPP toll road versus an un-tolled road are reviewed.

2.2 INFRA-STRUCTURE BACKLOG

South African infrastructure development is taking place against a backdrop of radical political change since 1994. The demands on the new government for social and economic upliftment are immense. According to the Minister of Finance, Trevor Manuel, the balance of spending on social needs versus infrastructure development needs to be carefully managed as "the curve that describes the decay of inadequately maintained infrastructure becomes dangerously steep if relative neglect persists beyond a few years" (www.nra.co.za). It is under these pressures that government is trying to pave the way for lenders and investors to finance long-term infrastructure development.

According to the National Treasury (2001a, p5) "South Africa faces daunting challenges in the delivery of public services and infrastructure. Although the government has implemented a range of infrastructure delivery programs that have significantly increased access to services, large backlogs remain." These shortages occur in areas such as water, sanitation, roads, electricity and telecommunications. According to Macquarie Africa (2003, p28), the government has estimated that it would cost up to R170 bn ($23 bn) to eradicate this infrastructure backlog over the next ten years. Of this, it is estimated that some R60 bn alone is required for the roads sector. However, over the past 35 years there has been increased pressure on governments to lower taxes and still provide essential services such as health and welfare. This has forced governments to reorder their priorities and to spend less on infrastructure development. The trend of spending less money on infrastructure is evident when looking at Figure 2.1. In all of the countries referred to, except for the USA which started from a low base, infrastructure spending by government has more than halved since 1970.

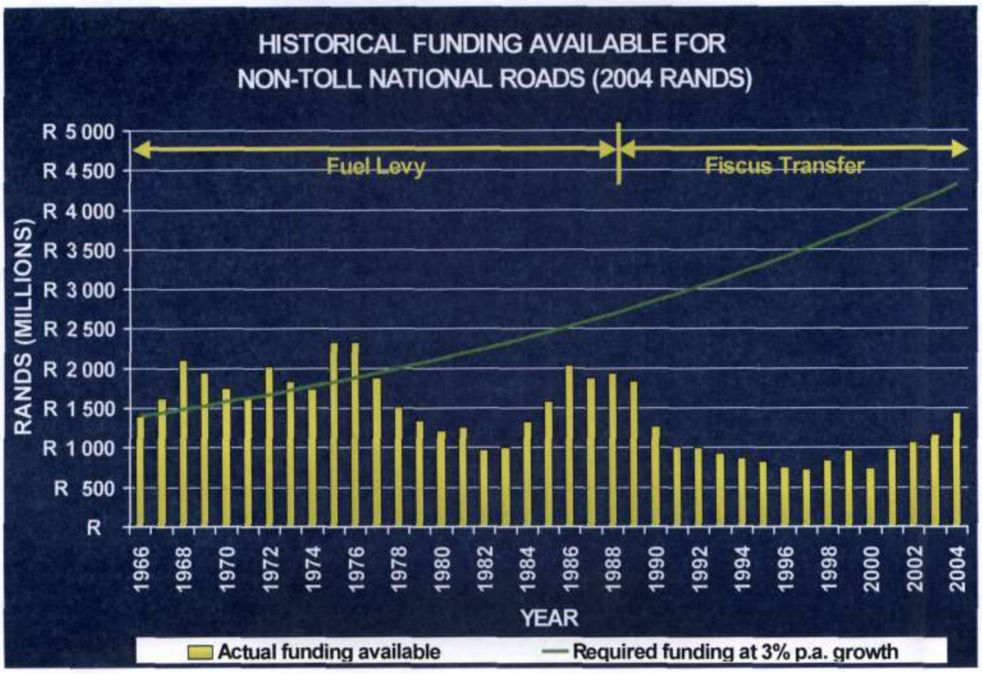
Figure 2.1: **Government infrastructure investments as % of total outlays**



Source : Macquarie Africa (2003, p20)

The backlog of the national road infrastructure is further evidenced when viewing Figure 2.2, prepared by the SANRA and provided by Mr. Louw Kannemeyer. As indicated in Figure 2.2, there was a surplus in the government funding for roads between the mid 1960's to the mid 1970's. This resulted in a boom in the road construction industry and a large proportion of South Africa's highways were built during this period. However, with the fuel crisis in the 1970's, a slump in fuel sales occurred which led to a decrease of some 65% (in 1973 Rand-real terms) of the income derived from the fuel levy which ultimately led to the abolition of the fuel fund in 1988. The revenue generated from the fuel levy was thereafter transferred into the central government fiscus. The gap between the required funding and the funding available to maintain and construct the national road network began in the late 1970's due to the fuel crisis and has subsequently widened since 1988. The funding gap continues to grow and it becomes abundantly clear that the required state funding to maintain and construct new national road facilities is not obtainable.

Figure 2.2: **Historical Funding available for non-toll national roads**



Source : Louw Kannemeyer, SANRA

A solution that has been identified to bridge the widening funding deficit gap is the use of public private partnerships (PPP); a concept which Project Finance magazine (March 2003, p49) maintains the South African government has borrowed heavily from the PFI in the United Kingdom. By incorporating this strategy to maintain the road infrastructure, the SANRA has endeavored to lessen the state's financial burden by freeing up more money in order to maintain those roads funded through the national fiscus.

2.3 SOUTH AFRICAN GOVERNMENT'S FISCAL POLICY

From the preceding chapter it is apparent that the State has not allocated sufficient funding towards the maintenance of infrastructure. Furthermore, it is apparent that the government has embarked upon a privatization process. The economic reasoning underlying the government's lack of spending on road infra-structure is discussed below.

Governor of the South African Reserve Bank, Mr. T Mboweni, was quoted as saying in his speech to the Economic Society of South Africa, "Expanding government expenditure was financed either through higher taxation or increased borrowing and this process tended to crowd out the private sector. Monetary and fiscal policy was not always synchronised. Persistently large deficits and an increasing ratio of government debt to gross domestic product gave rise to expectations of stubborn inflation, even in the face of relatively firm monetary policies. The private sector could not do much about generating employment and the ever-higher levels of taxation and borrowing weakened the opportunities for wealth creation.

The new government committed itself to creating an open economy in the belief that South Africa's future lay in being a competitive participant in a globalised environment. In recent years the new South African Government has changed the focus of trade and industrial policy to the pursuit of employment-creating growth through improved international competitiveness. Government has concentrated on improving supply-side flexibility and moved away from demand-side interventions. The tariff structure was rationalised and import surcharges were abolished. Moreover, it was decided that effective price stability would become an important component of macroeconomic policy. Monetary policy had to focus on price stability, while government began to bring fiscal policy into line by limiting public-sector borrowing and public-sector debt to levels that could be sustained in the medium to longer term.

The pursuance of fiscal prudence led to a significant improvement in the national government deficit before borrowing and debt repayment, and also in government debt. As a ratio of gross domestic product, the deficit before borrowing and debt repayment amounted to 2,1 % in 2000 compared with 4,8 % in 1994. The total debt of national government as a percentage of total production also decreased from 49,2% in December 1994 to 46.9% at the end of December 2000.

This improvement in the fiscal position was the combined result of low growth in expenditure and strong growth in revenue. There were significant gains in the collection of income tax and value-added tax as a result of better management and the more efficient practices and procedures used by the South African Revenue Service (SARS)." (Natal University, Economic Issues and Principles Course Notes, 2002).

In addition to the above, South Africa has a relatively low savings pool. Trevor Manuel expressed his concern regarding this issue when he stated that the government is concerned about the lack of savings, as growth in South Africa continues to be dependant on inflows of foreign capital to supplement domestic savings. Manuel made a point of addressing this problem in his budget speech and said that the high interest rates "signaled the importance of improving our savings performance, reducing our reliance on foreign capital flows". (Take a bow Trev, Business Day, Economic Issues and Principles Course Notes, 2002). According to Todaro (2000) the accumulation of external debt is a common phenomenon of developing countries at the stage of economic developments where the supply of domestic savings is low, the current account payment deficits high, and the imports of capital are needed to augment domestic resources. Although foreign borrowing can be highly beneficial, providing the resources necessary to promote economic growth and development, it also has its costs. The main cost associated with the accumulation of a large external debt is debt service. As the size of debt grows or as interest rates rise, debt service charges increase. Debt-service payments must be made with foreign exchange. In other words, debt-service obligations can be met only through export earnings, curtailed imports, or further external borrowing. The risk associated with this is that if the composition of imports change, interest rates rise significantly (causing a ballooning of debt-service payments), or should export earnings diminish, debt service difficulties are likely to arise.

The danger involved in public borrowing is that government could find itself in a debt trap where a rapid rise in the debt-to-Gross Domestic Product (GDP) ratio can no longer be prevented by fiscal measures. The debt-to-GDP ratio increases when the conventional deficit as a percentage of total debt is greater than the economic growth rate. If government has high levels of public debt, it is committed to high annual interest payments.

Because of the high interest payments, even if the government maintains a low primary deficit, the conventional deficit may be large. The increasing debt implies increasing interest commitments, and if the debt is increasing faster than the rate of economic growth, government will have to keep borrowing to service the old debt. Under such circumstances, government's ability to redeem old debt becomes questionable.

When the public no longer believe that government will be able to redeem the debt, they will no longer be willing to lend to it. Thus government will not be able to finance the interest payment through taxation, and it will no longer be able to borrow. Government will effectively be insolvent, and the only way it can redeem its debts would be through money creation. This would mean that the growth of the money supply could no longer be controlled, and hyperinflation could result.

Clearly, the debt-to-GDP ratio will increase if interest rates exceed the growth rate, but will decrease if the growth rate exceeds interest rates. The implication of this is that deficit spending must result in economic growth that exceeds the interest rate, or else contractionary primary surpluses will have to be run in the future in order to avoid a debt crisis.

Government debt as a portion of GDP remained relatively constant from 1980 to 1986, but then increased significantly up to 1996 (www.treasury.org.za). The debt burden has declined marginally in recent years, but interest rates remain relatively high. Interest payments on debt increased as a percentage of government expenditure from about 8% in 1980 to above 20% for the 2000/1 financial year (www.treasury.org.za). Since 1980, the primary deficit has remained around 1% of

GDP in South Africa, and has primarily been negative. The increase in the debt-to-GDP ratio cannot be explained solely by high primary deficits, but rather due to interest rates exceeding growth rates.

For most of the last decade, interest rates have exceeded growth rates. The South African Reserve Bank has maintained high real interest rates to bring down inflation, and at the same time the South African economy has performed poorly. Economic growth has been very slow. The combination of slow economic growth and the high interest rates have resulted in an escalating debt-to-GDP ratio.

The amount of additional tax revenue that can be raised is limited, and so extra spending will be largely debt-financed. Nattrass et al (2000) indicate that because the South African Reserve Bank has maintained high interest rates, the cost of servicing this debt will be high. While interest rates exceed economic growth, South Africa's level of government debt limits the amount of deficit-financed expenditure that can be undertaken.

It thus becomes patent that the government has adopted a contractionary fiscal policy resulting in limited state funding being made available to the SANRA to construct new roads. Thus, in order to maintain the road infrastructure the SANRA has embarked upon a tolling and PPP strategy intended to lessen the financial burden by freeing up more money to maintain those roads funded through the national fiscus.

2.4 ECONOMIC EFFICIENCY OF TOLLING

2.4.1 Background

The government transport policy document, "Moving South Africa" requires that the tolling system be economically efficient. In its overview it proposes that tolls should recover full costs from users. This is elucidated in two parts; the first requires that users be charged for the full cost of their use of infrastructure and operations used, and the full cost of all externalities they generate. The second requires that users not be charged above full costs in order to support infrastructure and operations that do not provide them with benefits (National Roads Agency, Horizon 2010, The Strategic Vision of the South African National Roads Agency for the year 2010).

Litman (1999, p1) states that in the road tolling industry "Economic efficiency is concerned with the use of society resources to achieve maximum net benefit. Road pricing increases efficiency by rationing road capacity with less waste than queuing." Litman further maintains that from an overall economic efficiency perspective, the revenue must be used to benefit society and the greater the benefit, the more economically efficient the program. He also asserts that there is no obligation to allocate any monies profited from tolling to the societal needs of the users paying toll, but rather that profits should be used for broader societal gain.

Baumol and Oates (1998) argue that economic efficiency requires that the price paid by a road user equal the marginal social costs incurred. It requires that each road user pay toll fees equal to the incremental costs that user is imposing. The central thesis is expressed by economists in terms of the distinction between short run and long run marginal cost pricing (www.audit.nsw.gov.au). In this context, short run marginal cost covers both the re-current operating and maintenance costs of the road network and the effects of road use on the environment and other road users. Long run marginal cost includes the financing of the capital investment in addition to the short-run marginal costs mentioned above.

Baumol and Oates (1998) split marginal efficiency into 3 categories:

a) on maintaining the road – marginal operating costs
b) on other road users – marginal external costs
c) for the road itself – amortization / interest on capital expended

Their final caveat is that no group of users should cross-subsidise another.

Parker and Hartley (2001, p2) argue that primary economic considerations when tolling a road relate to:

- The misallocation of resources.
- The costs incurred due to traffic diversion.
- The costs of collecting tolls.
- Contractual efficiency.
- Efficiency in raising capital.

Leiman (2004) indicates that sub-optimal tolling can be described in both partial and general equilibrium terms. In the former sense, tolls are sub-optimal when they fail to fully internalize the externalities generated by users. In the general sense, systemic inefficiency occurs when tolling reduces the efficiency of the transport system as a whole.

Clearly, certain of the points raised above refer to tolling in general whilst others relate to the economic efficiencies of a state versus a PPP toll road. The biggest difference between public and private tolling is in the contractual efficiency and the efficiency in raising capital, since all the other links in the value chain can be contracted to private parties under either a public or a private tolling scheme. The ensuing text investigates and discusses all the economic efficiencies of the points raised in section 3.1 above - be they related to private or state tolling.

2.4.2 Marginal operating costs

Marginal operating costs in terms of road infrastructure can be defined as the additional maintenance cost per vehicle. In order to obtain marginal economic efficiency the pavement damage incurred by a vehicle should therefore be equivalent to the toll paid by such a vehicle. The marginal operating efficiencies relate to both state and PPP toll projects and are discussed hereunder.

In order to determine marginal cost efficiency it is imperative that an understanding of the toll fee structure is understood. All tolls fees are based solely on the number of axles a vehicle has; the more axles – the higher the toll. The toll classification system in South Africa (used extensively throughout the world) is based on a 4-class system with class ones being the cheapest tariff and class 4 the highest. The toll class determination is as follows:

- Class 1 - Light passenger vehicles with 2 axles (includes motorbikes and passenger vehicles towing caravans and trailers)
- Class 2 - 2 axle heavy vehicle
- Class 3 - 3 and 4 axle heavy vehicle
- Class 4 - 5 and more axle heavy vehicle

An analysis of the relative class magnitudes of the tolls at all mainline plazas in South Africa is provided in Table 2.1 (class 1 = 1). The shaded areas indicate the PPP toll plazas whilst the un-shaded areas indicate the State toll plazas.

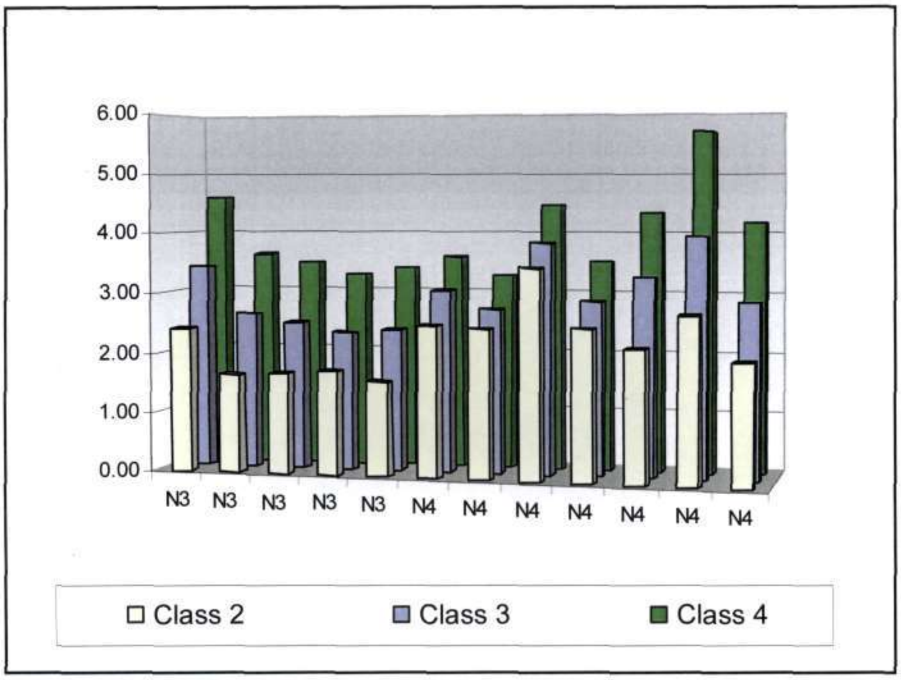
Table 2.1: **Relative magnitude of mainline tolls by vehicle class (class 1 =1)**

Route	Plaza	Class 2	Class 3	Class 4
N1	Huguenot	2.53	4.00	6.59
N1	Verkeerdevlei	2.00	3.00	4.00
N1	Vaal	1.90	2.28	3.03
N1	Grasmere	2.56	2.89	3.89
N1	Pumulani	2.50	2.88	3.56
N1	Carousel	2.71	3.00	3.46
N1	Kranskop	2.50	2.95	4.00
N1	Nyl	1.92	2.28	3.12
N1	Capricorn	2.55	3.10	4.10
N1	Baobab	2.56	3.59	4.62
N2	Tsitsikamma	2.53	6.11	8.63
N2	Oribi	1.92	2.67	4.17
N2	Tongaat	2.00	2.80	3.80
N2	Mvoti	2.73	3.45	5.27
N2	Mtunzini	1.95	2.35	3.10
N3	Marianhill	1.90	2.20	3.60
N3	Mooi	2.41	3.41	4.59
N3	Tugela	1.65	2.61	3.61
N3	Tugela East	1.68	2.47	3.47
N3	Wilge	1.72	2.31	3.28
N3	De Hoek	1.57	2.38	3.38
N4	Pelindaba	1.50	2.17	2.83
N4	Quagga	1.40	1.80	2.60
N4	Swartruggens	2.51	3.04	3.58
N4	Marikana	2.47	2.74	3.26
N4	Brits	3.46	3.85	4.46
N4	Doornpoort	2.50	2.89	3.52
N4	Middelburg	2.19	3.30	4.33
N4	Machadodorp	2.73	3.98	5.68
N4	Nkomazi	2.00	2.90	4.19
N17	Gosforth	2.80	3.20	4.40
N17	Dalpark	2.10	2.60	3.60
Max		**3.46**	**6.11**	**8.63**
Min		**1.40**	**1.80**	**2.60**
Mean		**2.23**	**2.97**	**4.05**
Median		**2.30**	**2.89**	**3.71**

N3TC - PPP (yellow)
BPTC - PPP (green)
TRAC - PPP (blue)

An analysis of the relative class magnitudes of the tolls at all PPP mainline plazas in South Africa is indicated in Figure 2.3 (class 1 = 1).

Figure 2.3: **Relative magnitude of PPP mainline tolls by vehicle class (class 1 =1)**



The statistical analysis of these figures is provided in the Table 2.2 below.

Table 2.2: **Relative magnitude of PPP mainline tolls by vehicle class (class 1 =1)**

Statistic	Class 2	Class 3	Class 4
Maximum	**3.46**	**3.98**	**5.68**
Minimum	**1.57**	**2.31**	**3.26**
Mean	**2.24**	**2.99**	**3.95**
Median	**2.30**	**2.9**	**3.60**

From the above statistics it becomes clear that there is no consistency in the relative magnitude of tolls by class even when comparing PPP's to state toll roads and the various PPP companies against each other. It is thus apparent that on some routes, users of one section of road tend to subsidize users of another.

Further to the above it is also interesting to note the toll tariff per km (based on 2003/2004 toll tariffs) which was obtained from Mr. Alex van Niekerk, SANRA. Typically the toll tariff per kilometer is dependant on the capital cost of the infra-structure - which can vary considerably due to factors such as topography (i.e. may require bridges and tunnels), geometric cross section of the road, soil conditions and hence pavement type, environmental factors etc. The figures in Table 2.3 do however illustrate that a PPP concession toll project is more costly than that funded by the state.

Table 2.3: **Toll Tariff per kilometer (c/km)**

	Toll route	Distance (km)	Toll tariff	Toll tariff per distance (c/km)
	STATE TOLL ROAD			
URBAN	N2 Oribi	50	R 12.00	24.0
	N2 Tongaat	19.3	R 5.00	25.9
	N3 Mariannhill	19.6	R 5.00	25.5
	N4 Pelindaba	13.4	R 2.50	18.7
	N4 Quagga	8	R 2.00	25.0
	N17 Dalpark	18	R 5.00	27.8
	N17 Gosforth	28.8	R 5.00	17.4
	Total and mean of States Roads	**157**	**R 36.50**	**23.2**
	PPP CONCESSION TOLL ROAD			
	N1 Zambezi ramps	4.8	R 4.80	100.0
	Total and mean of Concessions	**4.8**	**R 4.80**	**100.0**
	STATE TOLL ROAD			
RURAL	N1 Verkeerdevlei	186	R 26.00	14.0
	N1 Capricorn	99.7	R 19.00	19.1
	N1 Baobab	107.0	R 19.00	17.8
	N2 Mvoti	22.9	R 5.50	24.0
	N1 Huguenot	23.6	R 16.00	67.8
	N1 Vaal + Grasmere	171.8	R 36.50	21.2
	N1 Kranskop	57	R 19.00	33.3
	N1 Nyl	96	R 24.00	25.0
	N2 Tsitsikamma	27	R 9.00	33.3
	N2 Mtunzini	90.1	R 19.00	21.1
	Total and mean of States Roads	**881**	**R 193.00**	**21.9**
	PPP CONCESSION TOLL ROAD			
	N3 Wilge	97.2	R 29.00	29.8
	N3 Tugela	52.8	R 30.00	56.8
	N3 De Hoek	62	R 21.00	33.9
	N1 Pumulani + Carousel	102.0	R 29.20	28.6
	N3 Mooi	90.0	R 21.00	23.3
	N4 Middelburg + Machadodorp	288.0	R 68.00	23.6
	N4 Nkomazi	144.0	R 31.00	21.5
	Total and mean of Concessions	**836**	**R 229.20**	**27.4**

When viewing marginal costs relating to road maintenance it becomes increasingly important to identify how and why roads degenerate and subsequently require maintenance. For example, sunlight causes a continuous slow hardening of the road action on bitumous surfaces, while the penetration of water into and underneath (due to poor drainage) road pavement layers, can lead to a loss of load-bearing capacity and consequent increased rate of road structure deformation (www.transport.gov.za). However, it is vehicles that are the major cause of road deterioration, especially on heavily trafficked roads. According to the Committee of Land Transport Officials (COLTO) Draft TRH report (1996) every vehicle that passes over a road causes a momentary, very small, but significant deformation in the road structure. The passage of many vehicles has a cumulative effect, which gradually leads to permanent deformation and road surface deterioration.

The damage caused by the passage of any particular heavy vehicle is determined by the magnitude of each of its axle loads, the spacing between the axles, the number of wheels, the contact pressure of the tyres and the traveling speed. In addition, road pavement characterization (i.e. strength of pavement) has a major influence on pavement deterioration (www.transport.gov.za).

"Pavement deterioration however increases sharply with increases in axle load. On both flexible and rigid pavements, the load equivalence factor for a 20,000-pound (9.07 ton) single axle is about 1.5. Thus, 100 passes across a pavement by a 20,000-pound axle would have the same effect on pavement life as 150 passes by an 18,000-pound axle. The number of axles is also important; a vehicle which has the same gross vehicle mass but has more axles has less effect on pavements. For example a 9-axle combination vehicle carrying 80,000-pounds has less effect on pavements than a 5-axle combination vehicle carrying 80,000-pounds." (Comprehensive Truck Size and Weight Study. Federal Highway Administration, March 1995, Volume 2, Ch 6, p2/3 & 16/17).

According to the Committee of Land Transport Officials (COLTO) Draft TRH report (1996, p22), the formula $F = (P / 80)^n$ can be used to calculate the damage factor:

Where : n = relative damage exponent
F = load equivalency factor
P = axle load, in KN

One can, however, use a common rule of thumb to calculate the damage factor, the "fourth power formula" which suggests that each doubling of axle loading results in a sixteen-fold increase in road damage (Federal Highway Administration. March 1995. Volume 2, Ch 6). Using these guidelines, a 36 ton truck on five axles (toll class four) does as much damage as 10 240 standard two axle cars each weighing 1.8 tons.

Although an illustrative figure of 36 tons has been used above it is also important to note that the maximum gross vehicle mass (GVM) allowable on South African roads is currently 56 tons; this is well above the limit of 48 tons, which was the legal limit in the early 1990's, and far above the 38 ton limit in the USA and SADC countries such as Mozambique and Angola. Overloading on South African roads is a further factor which needs to be accounted for. According to the CSIR's 1997 SA Heavy Vehicle Weighing Statistics Annual Report, overloaded vehicles cause approximately 60% of the damage to roads in SA, representing an estimated damage cost of R600 to R700 million per annum (www.csir.co.za). The report states that during 1997 some 90 000 heavy vehicles were weighed - of which 35% were overloaded, with many of these vehicles carrying 50% to 100% more than was allowed. The CSIR and the Road Freight Association have estimated that between 15% to 20% of all heavy vehicles traveling on the South African road network are overloaded, and that these are responsible for approximately 60% of road damage (www.csir.co.za). From the toll tariff structure highlighted above it becomes apparent that a vehicle laden to the legal limit (or beyond) pays no more than one carrying a far lesser load. It is therefore reasonable to postulate that truckers perceive an economic incentive in to reducing the number of vehicles and loading them more heavily - as this creates a more "efficient" operation. Furthermore, the CSIR suggest that due to intense competition between hauliers, haulage companies who do not overload their vehicles are operating at an unfair disadvantage (www.transport.gov.za)

From the above it becomes apparent that although at first sight tolling appears to address the marginal operating costs by increasing toll tariffs for heavy vehicles, an obvious weakness is that the tolls levied in South Africa are not based on actual axle loading, but on potential vehicle capacity (number of axles). The requirement that no group of users should cross-subsidise another as proposed by Baumol and Oates fails, as light passenger vehicles are clearly subsidizing heavy vehicle users and on some routes, users of one section of road tend to subsidise users of another. Even more central, an increase in the number of axles reduces the damage done by a given load, yet the South African tolling system increases the charge as the number of axles rises. It is thus important to note that the actual loading of a vehicle does not affect the toll paid and a true user-pay toll to determine the marginal operating costs should thus be based on a combination of: loading per axle / number of axles / distance covered. Leiman (2004) suggests that in order to address this in-efficiency in South Africa, heavy vehicles should be tolled according to the distance traveled, the mass of each vehicle and its axle configuration. He adds that this could be achieved by utilizing global positioning systems in conjunction with automatic vehicle identification positioned at various locations on the road network. Although sophisticated systems of this nature currently exist, the development costs of such a system are prohibitive. The German government is in the process of embarking on a similar strategy as proposed by Leiman, however this project was initially shelved after it was reported that the in-vehicle equipment supplier reported a loss of US $875 million resultant from the project. In addition, the German government has lost considerable toll revenue, "estimated to be accumulating at around US $180 million a month" (Traffic Technology International, Feb March 2004, p 16). Although the project has since been resurrected, it does provide insight into the considerable financial capital costs which are required to implement such a system.

If, however, one had to apply the Baumol and Oates economic marginal operating costs and no cross subsidization theory with the current toll tariff strategy in South Africa, it would suggest that if a class 1 vehicle (weighing 1.8 tons) paid a R20 toll tariff, a class four vehicle (weighing 36 tons) should pay in the region of R205 000! Clearly, raising tolls to this level would not be a viable alternative and fails to make economic sense. It is also important to note that although economic theory indicates that tolling heavy vehicles is in-efficient due to the cross-subsidisation of such vehicles by class 1 vehicles, on non tolled routes heavy vehicles do not incur any additional costs compared to light vehicles (with the exception of the increased operating costs of the heavy vehicles). It is furthermore important to note that producers who are paying tolls to deliver their goods to market become less competitive than those delivering a similar product by way of an un-tolled route. This is resultant from the increased transport costs of the latter versus the former. It can be further argued that the increased transport costs are not absorbed by the producer or transporter of the goods but rather that these cost are transferred to the customer. Typically, the customer is a class 1 motorist who is therefore subsidizing the class 4 toll tariffs completely. Hence, any increase to the class 4 tariff would have an associated increase in the cost to the consumer, who is typically a class 1 motorist.

Leiman (2004) also argues that increasing proportions of freight transport has diverted haulage away from rail to road due to the state's failure to recover the marginal costs imposed by heavy vehicles, together with the greater flexibility of road transport. Although this argument is valid, it again raises the question of who would ultimately pay the increased transport costs if a tariff closer to the marginal cost was levied upon the hauliers. It is postulated that this cost would once again be transferred to the consumer.

It could, however, also be hypothesized that the producer paying a toll tariff to deliver his goods to the market will become more efficient in the production of his goods. This is based on the premise that the aforementioned producer needs to be more efficient than the non toll paying producer in order to remain competitive. It could thus be argued that this knock on effect has a positive economic impact on production efficiency.

2.4.3 Marginal external costs

External costs in a road environment are defined as the spillover costs imposed on the broader society (examples include air, noise and visual pollution, environmental degradation, accident costs etc). The marginal external efficiencies relate to both state and PPP toll projects and are discussed hereunder.

Litman (1999) indicates that marginal external costs are associated with the component of the toll that should be an amount equal to the external cost imposed by a vehicle - such as environmental degradation and congestion. Historically such costs were very difficult to quantify and calculate, although values between USA 10 to 30 cents per mile have been proposed by Litman (1999), the IBI Group (1995) and Apogee Research (1994). More recently, Peters and Kramer (2003) derived a total societal cost of toll collection that is expressed as:

$$\text{Total Societal Cost} = AC \times (CC \times FC) \times PC$$

Where:	AC	=	Administrative costs
	CC	=	Compliance costs
	FC	=	Fuel costs
	PC	=	Pollution costs

However, the base figures used in the above calculations are established on US figures which differ significantly from South African figures. It is beyond the scope of this paper to re-calibrate and obtain such efficiencies figures for South Africa.

Baumol and Oates (1988) insist that those who bear externalities should not be compensated for such, but that the moneys raised can, however, be used to ameliorate the problem. Where a major road runs through a residential area, modern engineering can reduce noise ('popcorn' surfacing, construction of berms, etc.). This implies that tolling may be viewed with economic efficiency relating to marginal external costs - provided that the tolls are used to remedy any marginal costs imposed by the vehicles utilizing the toll facility.

However, Peters and Kramer (2003) suggest that increased pollution costs resultant from vehicles having to stop at toll booths forms a significant component of the external costs consequent to a toll road. A study of the pollution costs in the US on the Garden State Parkway toll road indicated that 22.3% of the total societal cost was due to the increased pollution cost (Peters and Kramer, 2003). It is argued that these pollution costs would be negated if there were no toll road as vehicles would not have to stop and hence decreasing the rate of pollution.

Lieman (2004) states that "A Pigouvian approach may not be appropriate for some externalities and vehicle exhaust emissions are among these. If vehicles with serious exhaust emissions are a small minority, then a tax based on average levels of emissions is both unjust and ineffective. The administrative costs of a tax based on the true marginal external cost of the emissions from a vehicle would be too high for it to be feasible. A better answer would be to specify an acceptable standard of exhaust emission and conduct random checks. The penalty for failing the test would vary geographically, low penalties in rural areas, higher ones in urban areas where the value of the externality is greater. However, the costs of such a system may be viewed as prohibitive and this strategy is not applied in South Africa."

Moreover traffic congestion is an externality which requires considerable attention. Lieman (2004) indicates that once the traffic on a road reaches capacity, each extra car tends to slow the entire stream of vehicles and thereby increasing the marginal externalities. This marginal impact may however be addressed through a congestion tax; a toll that varies with time of day is a form of peak load pricing. It may also include a specific "rush hour" levy on long or slow moving vehicles that could disproportionately slow traffic (a vehicle's GVM / power ratio and overall length are major factors, as are the gradient of hills and the presence or absence of crawler lanes). To date such congestion taxes have not been introduced on any of the country's toll roads; they do, however, warrant consideration. Leiman (2004) points out that a congestion tax is theoretically more efficient at solving congestion externalities than simple regulations such as allowing even number plates on one day and odd number plates on the next, as effected in Singapore, or precluding cars with no passengers from city centre roads over rush hour, as in Jakarta

When tolling was first introduced in South Africa, a basic premise was that all tolled roads would have un-tolled alternative routes available. However, in 1996 the government passed an act which stated that an alternative un-tolled route was no longer obligatory. Although an un-tolled route is no longer required, there are still many un-tolled alternative routes which motorists can utilise. In addition, many are open-access toll roads that interlink with unmonitored, uncontrolled and un-tolled side roads. Due to the tariff imposed on motorists utilizing a tolled route, many search for an alternative route in order to avoid the tolled section. Theory suggests that rational individuals paying the tolls themselves will use an alternative un-tolled road until the incremental costs of doing so matches the tolls on the main roads (www.audit.nsw.gov.au). However, the reality is that road users do not calculate the real cost comparison of utilizing a tolled or un-tolled route and more often than not the decision is based on emotions and perceptions and not on which route is more cost efficient. Typically, such emotions and perceptions outweigh the economic benefit of using a tolled section of road, resulting in a high proportion of motorists diverting to alternative routes. Moreover where a driver can pocket the money and the company picks up the incremental costs of extra mileage, additional repairs, time etc, the incentive to use side roads is even greater. Garber and Black (1995) indicate that since un-tolled alternate routes are generally narrower, have lighter pavement structures, have steeper grades and are generally in poorer condition, whenever tolling shifts a heavy vehicle to a side road it increases road damage, reduces revenue recovery, slows traffic flows and increases the risk of accidents. Not only does the damage a vehicle does to a road rise exponentially with that vehicle's mass and axle loading, it also rises if the road being used has light foundations, i.e. a road not designed for heavy vehicle use. An article sourced from www.audit.nsw.go.au states that "The search for road users for an alternative route which avoids the tolled road imposes additional costs (e.g. from noise pollution, accidents or other environmental nuisances) on residents and other users in neighbouring areas or streets which would otherwise not experience through traffic."

Further to the above it is argued that tollbooths slow traffic flow and thereby not only increase pollution, but also increase accident risk and noise pollution in the vicinity of the toll plaza (www.audit.nsw.go.au). These costs constitute a significant burden on road users, compared to the use of similar roads without tolls. Although these problems can be mitigated with new technologies such as electronic toll collection (ETC) whereby vehicles are tolled electronically and are not obliged to stop in order to make a payment, all toll plazas in South Africa are still operated manually. BPCC are however the first concessionaire in South Africa to install ETC at some of their plazas, albeit that such plazas have both ETC and manually operated lanes and the ETC is primarily for local commuters.

From the above it is apparent that there is considerable debate as to the marginal economic efficiency of toll plazas. Schiller (2000, p69) elucidates that "whenever externalities are present, the preference expressed in the market place won't be a complete measure of a goods value to society. As a consequence, the market will fail to produce the right mix of output."

Thus, although it is recognized that un-tolled roads create externalities for which costs are not recovered, the above arguments suggest that tolling a route results in larger market imperfections. This is due to the contention that tolling results in a diversion of vehicles to minor roads, resulting in an increase in externalities such as noise and air pollution. In addition it is argued that the efficiency of the transport system reduces as tollbooths slow traffic flow, thus raising the external costs imposed and creating general inefficiency resultant from elevated pollution and accident rates.

However, potential positive economic impacts require consideration. It is suggested that vehicles by-passing toll plazas result in vehicles going through towns that they would normally not have passed through. Although this increases the external costs, a mitigating factor may be an increase in the economic activity of the town resultant from the increased number of motorists, and an associated increase in the demand for goods in such towns.

It can be further argued that provided that strong environmental and social conditions are stipulated in the contractual agreement between the PPP's and the state, there may well be a higher degree of consideration placed on environmental issues. This may be in part ascribed to a function of the state authority being understaffed and consequently unable to provide sufficient attention to such environmental issues.

2.4.4 Misallocation of resources

A central economic concern regarding toll routes relates to the efficiency in terms of the need to achieve the most cost effective and beneficial use of the road network as a whole, following investment in a new road link. The efficiencies of misallocation of resources are similar in both state and PPP toll projects and are discussed hereunder.

Roads and road reserves use up a substantial amount of land. In an efficient market, the opportunity cost of the land should be greater or equal to the price that the landowner has been paid out, to that of the present value of the net revenues the land could have generated. It is however, argued that road tolls have the effect of excluding some potential users from the tolled road link. These road users are either discouraged totally from traveling or continue to use the existing un-tolled section or un-tolled alternative routes. The article sourced from www.audit.nsw.gov.au argues that the resultant outcome of potential users not using the tolled section is an inefficient way of using the land, resulting in a misallocation of resources.

As discussed above, once the capital cost has been sunk in road investment, the costs that users should bear should be limited to the short run costs of operation and maintenance. In addition, road users should cover the environmental costs associated with road use, such as the cost of noise and air pollution. This ensures that overall economic and social welfare is maximized and that no potential user is excluded from facilities whose basic cost should not be increased by the additional road use. A higher level of charge is only justified once the capacity of the facility begins to be exhausted.

However, road tolls are normally set to recoup capital as well as recurrent charges. For a private operator, dependent solely or mainly on road tolls for income, there is no alternative. As a consequence, the effective price to road users is likely to be above the short run marginal cost of road provision due to the inclusion of the cost of capital being incorporated into the toll tariff, thereby resulting in short run marginal inefficiencies. The economic efficiencies of raising capital are dealt with in detail in section 2.4.7 hereafter.

2.4.5 Costs of collecting tolls

The economic efficiencies of the costs of collecting tolls relate to both state and PPP toll projects. The following section addresses this issue. An argument exists that the costs that users should bear should be limited to the short run costs of operation and maintenance and that the cost of collecting tolls should not form part of the operational costs (www.audit.nsw.gov.au). Currently all toll plazas (with the exception of some of those on the Platinum Toll route which are mixed, i.e. ETC and manual mode) in South Africa are operated on a manual basis, resulting in an increased toll cost. This cost is transferred to the road user and thus constitutes a burden on road users, compared to the use of similar roads without tolls. These costs are expected to decline in the future as ETC is introduced into the remaining plazas on the national road.

It can, however, be argued that collecting tolls manually results in job creation and hence results in an increase in economic demand which then stimulates economic activity. Manual toll collection could thus be viewed as a positive economic impact particularly in a South African context in which high unemployment rates are found. It can thus be contested that the inefficiency related to toll collection may be compensated by the increase in economic demand resultant from employing toll collectors.

2.4.6 Contractual Efficiency

It is argued that contractual efficiencies differ significantly when comparing a state to a PPP toll project and discussion relating to the differences follows. According to Parker and Hartley (2001) PPP's involve contracting between government and the private sector under conditions of imperfect information. The last twenty years or so have seen a growth in the economics of contracting literature, and its dominant themes are central to gaining an understanding of the strengths and weaknesses of any PPP deal. The economics of contracting literature is based on transaction costs and according to Cowen and Parker (2003, p.37) these "arise from the costs of seeking out buyers and sellers and arranging, policing and enforcing agreements or contracts in a world of imperfect information". This idea has been popularised by Oliver Williamson since the 1960's (Williamson, 1975, 1985; Williamson and Winters, 1993). Williamson's early theorizing relating to transaction costs was based on the idea of 'small numbers contracting' under conditions of imperfect and asymmetrically distributed information (Williamson, 1975). Three related concepts resulted, namely *bounded rationality*, *opportunism* and asset *specificity*. Bounded rationality implies rational decision-making by buyers and sellers, but under conditions of incomplete information. Opportunism refers to 'the incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, disguise, obfuscate or otherwise confuse" (Williamson, 1985, pp 47-48). The result of bounded rationality and opportunism is the risk that one or other of the parties to a transaction or series of related transactions will exploit his or her information advantage. Williamson has described this as "self interest seeking with guile" (Williamson, 1996, p.6). Akerlof's (1970) concept of the 'lemon' is an extension of this argument and he points out that buyers in one-off exchanges are especially at risk of buying something that will disappoint.

One approach to controlling the behaviour of agents is to set down agreed rules - usually in the form of written contracts. But writing complete and transparent contracts is very problematic, as already discussed. The transaction cost literature emphasises that transaction costs will be lower if detailed information is available to the contracting parties prior to the contract being signed. Therefore, it is rational for parties to seek out information that will improve their contracting ability. In this respect, reputation (based on past behaviour) and trust (based on expectations of future behaviour) are central to the economics of contracting (e.g. Kramer and Tyler, 1996; Lane and Bachmann, 1998). Williamson (1993b) has acknowledged that attitudes such as trust reduce transaction costs and therefore help determine the comparative costs of governance.

In addition, the CSIR research (www.csir.co.za) found that some of the challenges facing equity investors in the PPP market are high transaction costs. Respondents interviewed by the CSIR indicated that the protracted procurement process for PPP projects was the cause of significant transaction costs, and in some projects could amount to as much as R100 million. This can severely limit the competition in the market and distort the competitive bidding process. In addition, the bidding consortia will eventually price transaction costs into the deal.

Risk management of private participation in infrastructure projects (PPI's) has been found to have both technical and political dimensions (IFC/World Bank, 1996). The early history of PFI in the UK was clouded by private sector complaints of over-protracted and wasteful project bidding and aborted projects. The cost of taking part in a PFI bidding process was estimated at between £0.5m and £2.5m (NAO, 1997a). The former Treasury PFI Taskforce, now known as the Partnerships UK, is an institute that was put into place with the aim of reducing these transaction costs.

In the SA context, Leiman (2004) states that "Although competitive tender procedures remain in use, SANRA has allowed the option of privatization through unsolicited private bids since September 1997. Ideally these would fund the fiscus while retaining the efficiency of private operation. Moreover, they would do so without the wasteful effort replication of the conventional tender process". Typically a consortium of contractors, operators and banks approaches the SANRA with an offer to construct a new road or to take over the management and maintenance of an existing one, on a Build Operate and Transfer (BOT) contract. SANRA considers the proposal and may accept or reject it. If accepted, other consortia may present counter-bids within 60 days. However, since all counter-bidders are responsible for their own costs, the high cost of preparing such a bid generally precludes them. South Africa's domestic civil engineering market is small and dominated by a few large firms, and Leiman (2004, p6) states "the bidding to date has been notably free of corruption or inefficiency. However, any process that allows oligopoly firms to form consortia that take over national assets will face public concern about collusion and impropriety. The mere perception that a cartel of engineering firms handles the entire arterial road system may engender political and social costs. Probity and the minimization of political costs require, not only that the bid offer be truly competitive, but that it be seen as such by the affected public." The Department of Transport recognized this and in its policy document (17 September 1997) stated, "All unsolicited proposals considered by the client, in its sole discretion, as being desirable shall be subjected to competition and counterproposals from other parties." The Department added that, "The client shall advertise an invitation to competitors to submit counterproposals, after consultation with the sponsor of the project concerning the content of the advertisement. This advertisement shall not contain any reference to the financial offer of the sponsor, but shall contain a sufficient technical description to allow other parties to identify the technical concept of the proposal, and to prepare counterproposals."

When two parties enter into an agreement in the private sector it is often with a view to private gain. Relevant information is neither rarely full nor even symmetrically shared. In consequence, where a contract binds two parties in a principal-agent relationship, resources are often spent on monitoring the operator or agent in the contract. Contractual efficiency is achieved when monitoring costs and opportunities for rent seeking behaviour are minimized. An additional dimension appears when a contract is not intended to run in perpetuity. Leiman (2004) indicates that this is the case with the "build, operate, transfer" format (and its variants) popular in recent years, a key feature of which is a fixed end-date. A fixed period contract means that the property rights of the agent are incomplete and the incentives accordingly distorted. These have to be corrected for if toll consortia are to act as the SANRA wishes. Certain features are known to help obviate shirking and self-seeking behaviours in agents (Lawther, 2000, p 160):

- The expectation of repeated future contract opportunities (including re-bidding once the operating period is complete);
- Difficulty in collecting unobserved income flows or other benefits;
- Stable corporate hierarchies in both parties and low costs of keeping contact;
- Agents who monitor their own staff;
- Short hierarchies.

At the beginning of the operating period the interests of the two parties are likely to be congruent. As one would expect, the divergence between the interests of the SANRA and the consortium increases as the transfer (end) date approaches.

Leiman (2004) indicates that the incentive to spend money on road maintenance declines as the end of the contract approaches. It is in the consortium's interest to look after the road well at first, since it is the source of their future income stream. As the end of the contract approaches, however, the returns on maintenance expenditures decrease. Leiman (2004) continues that by the final period of the contract, unless the firm is hoping to renew the contract, and reasonably expects to do so, there is virtually no incentive to spend money on road maintenance.

An independent technical expert is thus typically appointed in order to ensure that the terms of the contract are fulfilled. On all PPP projects in South Africa an Independent Engineer (I.E.) has been appointed to fulfill this function. There are, however, two important caveats to bear in mind. The first is the key role of the I.E. who is specified as the de facto technical auditor of the process in contracts between private consortia and the SANRA, and on whose probity and ability the efficiency of the process hinges. The second is the behavioural incentives that emerge from the contract between the consortium and the SANRA.

2.4.7 Efficiency in raising capital

The argument often cited against the financing of PPP's toll routes is the high cost of a private company raising capital relative to the state doing so. Historically, road construction in South Africa was primarily funded by the state, either from tax revenues or through state borrowing. One can leave aside debates about optimal tax rates and crowding out and simply assert that since the state is effectively a zero risk borrower, it should be able to raise funds more cheaply than the private sector. More arguably, the collection and diversion of tax revenues should be less expensive than the collection of toll revenues. Despite these points, merchant banks and toll consortia increasingly handle the funding of road construction and maintenance.

A further factor is that, though the merchant banking industry is highly competitive in both raising and lending funds, the contract between the state and the toll concessionaire may restrict the fundraising approaches open to the banks. Indeed substantial proportions of earlier contracts have been devoted to regulation of funding. This principal-agent problem introduces the issue of contractual efficiency.

The difference in the costs of capital arises from the way in which the exposure to risk is incorporated into the costs of finance.

There are two main categories of risk associated with road investment:

- systematic risk
- project-specific risk.

The EPAC Task Force (EPAC, 1995) took the view that there is no essential difference between the exposure of government or of private investors to the risks associated with general fluctuations in the economy and the capital markets.

However, in relation to project-specific risk, the Task Force noted that a major part of the difference between public and private costs of capital was due to the implicit guarantee by tax-payers to cover project risk under public ownership.

In effect, tax-payers have to bail out those public projects which fail, so long as there is no provision for government to default on its borrowing. The New South Wales (NSW) Treasury (1996) adds a specific charge to the cost of borrowing on behalf of government agencies to cover this implicit guarantee.

However, the EPAC Task Force distinguished between the project-specific risk associated with the behaviour of the other parts of the road network and those specific to the link in question. The Task Force noted that government road authorities were better able to manage network risk and that this could be very significant in the case of urban road investments. As a consequence, the true cost of capital to a road authority responsible for a complete network would be lower than the cost of capital to the private provider of a single road link.

The NSW Treasury (www.audit.nsw.gov.au) also makes the practice of looking to the private sector predominantly to finance new and expensive capital projects which confines private operators to ventures with a higher level of risk and precludes them from the normal practice of pooling old and new investments. More could be achieved by setting the need for discrete additional assets in the wider context of private responsibility for financing and managing a whole sector of infrastructure activity.

This approach has been followed in the United Kingdom in the transfer of responsibility for parts of the rail network to private operators (although the responsibility for track improvements has not been transferred at the same time) and in France, in relation to major water and sewerage systems (where in many cases the responsibility extends to major system upgrades).

In the UK The Ministry of Defence (MoD) (1999) claims that PPP/PFI have resulted in savings, but the supporting evidence has been sparse and is consistent with the findings for other PPP/PPI initiatives in the UK. There is much evidence on the capital value of PFI projects and a general claim that "PPP contracts have resulted in cost savings of between 5% and 40% compared with the public sector comparators" (MoD, 1999, p7). However, no indication is given of the cost base and time-period over which these savings apply (e.g. is the 40% saving on a sum of R10 million or R100 million each over 30 years?). Also, the savings are estimates expected over a long contract period where events can change so that the estimated savings might not be realised. Moreover, the economic basis of any cost savings from PPP needs careful scrutiny, distinguishing genuine efficiency improvements from ideological arguments and the government's enthusiasm for the initiative. If PPP is to lead to genuine efficiency improvements, it has to result in lower costs over the project's life cycle. Since the government can borrow at lower interest rates than the private sector can, the economic advantages of PPP's have to be more efficient in management during construction of the project and/or in lower operating costs from private sector management. Here, there are concerns that unless contracts are tightly specified, private firms might economise on the quality of output. Moreover, PPP contracts are for long periods over which events can change and, however careful the state is to specify the contract, industry will always seek to protect itself from income losses (e.g. by seeking cancellation payments; or renegotiating the contract; or through litigation) given an absence of complete trust in the 'partnership' (MoD, 1997).

One of the difficulties however, is to evaluate the true cost of a PPP approach versus a state financed debt approach. It is necessary to be pedagogic in explaining the benefits of private sector involvement: better efficiencies, new technologies and fewer risks for the public body (because some risks are transferred to the private party) and compare this to what the running of the service would have cost otherwise. We should also highlight that the true cost of apparently cheap state debt, in a context of limited debt capacity, always has an opportunity cost. A state loan used to finance a project which could otherwise have been financed privately will not be available to augment other crucial investments in the public sector where the private sector cannot help.

While the ability to manage network risk provides some justification for public as opposed to privately-financed investment in roads, it remains true that the general cost of capital in the public sector may encourage over-investment, since it does not incorporate the risks directly attributable to road infrastructure investment. There are many examples in the world of major road projects undertaken by the public authorities that have not been completed or have delivered a lower level of service than was originally intended. A method of assessing the risk associated with each investment project more precisely, in the context of specific risk-weighted financing, might have circumvented some of this waste of public resources. Although the cost of capital may be higher where road investment is privately-financed, the benefit to government and tax-payers arises from the explicit transfer of risk to the private investors.

There is now a general awareness of the significance of risk management in the contractual arrangements between government authorities and private infrastructure providers. Typically, all private providers are expected to bear the full risk associated with the design, construction, maintenance and operation of the asset and with the eventual demand for its use.

Private investors in turn seek to minimize their exposure to risks which might affect the level of traffic. Contractual negotiations aim to satisfy both sides about the allocation and apportionment of the most significant categories of risk.

The main problems arise from the nature of the contract between private road investors and government. Typically the contracts require that the level of toll is fixed from the outset and permitted to rise according to a pre-determined formula. This may for example be related to movements in the CPI or other indicators. At the same time, provisions are incorporated for either side to be compensated for unexpected developments such as faster or slower growth of traffic or the impact of related transport infrastructure works. The need to specify these possibilities in detail at the outset tends to encourage complex and legalistic contractual arrangements.

The length of the concession period has a direct impact on the uncertainty of future risks. Very long concession periods may involve contingencies which have not been envisaged at the outset. This sets a great premium on the careful drafting of the contracts between private infrastructure providers and governments. The public interest is not obviously protected by arrangements which exceed the easily foreseeable future.

2.5 SUMMARY

This chapter undertook a literature review of the economic efficiency of toll roads. The text highlighted the current demands on the new government for social and economic upliftment and the balance of spending on social needs versus infrastructure development needs. Currently there is an estimated backlog of R60bn in road infrastructure in South Africa and the gap between the required funding and the funding available to maintain and construct the national road network continues to widen. Furthermore, it becomes clear that the government has adopted a contractionary fiscal policy resulting in limited state funding being made available to the SANRA to construct or build new roads. It is under these pressures that government is trying to pave the way for lenders and investors to finance long-term infrastructure development and the SANRA has embarked upon a tolling and PPP strategy in order to lessen the financial burden by freeing up more money to maintain those roads funded through the national fiscus.

The economic efficiency of toll roads was then investigated and attention was paid to the following main economic issues:

a) Marginal operating costs
b) Marginal external costs
c) Misallocation of resources
d) Costs of collecting tolls
e) Contractual efficiency
f) Efficiency in raising capital.

This investigation highlighted that the tolls levied in South Africa are not based on actual axle loading, but on potential vehicle capacity (number of axles). Light passenger vehicles are clearly subsidizing heavy vehicle users and on some routes, users of one section of road tend to subsidise users of another. It was also argued that although un-tolled roads create externalities for which costs are not recovered, tolling a route results in larger market imperfections. Furthermore, roads and road reserves use up a substantial amount of land and in an efficient market, the opportunity cost of the land should be greater or equal to the price that the landowner has been paid out to that of the present value of the net revenues the land could have generated. It is, however, argued that road tolls have the effect of excluding some potential users from the tolled road link. These road users are either discouraged totally from traveling or continue to use the existing un-tolled section or un-tolled alternative routes - resulting in a misallocation of resources. In addition, an argument exists that the costs that users should bear should be limited to the short run costs of operation and maintenance and that the cost of collecting tolls should not form part of the operational costs. However, the cost of collecting tolls is typically transferred to the road user and thus constitutes a burden on road users, compared to the use of similar roads without tolls. It was also indicated that the protracted procurement process for PPP projects was the cause of significant transaction costs. The difference in the costs of capital also showed that the exposure to risk is incorporated in the costs of finance. There are two main categories of risk associated with road investment:

- systematic risk
- project-specific risk.

Since the government can borrow at lower interest rates than the private sector, the economic advantages of PPP's have to be more efficient in management during construction of the project and / or in lower operating costs from private sector management. The true cost of apparently cheap state debt was also highlighted, in a context of limited debt capacity, which always has an opportunity cost.

CHAPTER THREE : CASE STUDY STRUCTURE

3.1 INTRODUCTION

Cooper and Schindler (1995, p133) state that "Case studies place more emphasis on a full contextual analysis of fewer events or conditions and their interrelations." They continue that case studies can provide "a major challenge to a theory and provide a source of new hypotheses and constructs." In addition, Natal University Business Research Methodology Course Notes (2003) indicate that case studies are an excellent device for exploratory research and for evaluating valid problems. The basis of this paper is therefore to compare the hypothesis detailed in the literature review to the actual findings of a case study.

Scores of toll projects have been implemented around the world over the past decade. Unfortunately it is not always possible to get sufficient information on these projects to include in this paper. Trans African Concessions has therefore been selected as a Case study due to the quality and quantity of available information, as well as its contextual relevance to South Africa. An emphasis on the detail of the case study is in order to provide an evaluation of the efficiencies of tolling.

3.2 METHODOLOGY

The study will entail a description and a closer examination of the relevant economic issues debated in chapter 2 of this text. The case study will not be analysed in terms of the economic viability of the project. Instead the focus will be on economic efficiencies and the economic variances between a state versus PPP tolling consortia. The similarities which exist in both a state versus PPP toll road are also highlighted and the differences between an un-tolled, state tolled and PPP tolled road are discussed.

3.3 FORMAT

The case study will be analysed under the following broad headings:

- Project description;

- An investigation of the marginal operating costs;
- An assessment of the marginal external costs;
- Discussion on the misallocation of resources;
- An appraisal of the costs of collecting tolls;
- An assessment of the contractual efficiency;
- A description of the efficiency in raising capital;
- Summary.

The above listed criteria from the case study will be compared to the theoretical economic efficiency issues discussed in chapter 2 from which conclusions will be drawn and provided in chapter 6.

CHAPTER FOUR : CASE STUDY

4.1. BACKGROUND TO THE PROJECT

The N4 route was originally established as an alternative route for South Africa's Northern and Western provinces to provide an alternative access to a port. This route became an important transport axis supporting trade between South Africa and Mozambique for many years. In addition, there were significant numbers of South African tourists visiting Mozambique (approximately 300,000 annually at the peak of activity). However, since the 1970's, levels of activity of both trade and tourism declined, principally due to the civil war in Mozambique which led to the degeneration of transport infrastructure between the two countries and the development of other major ports within South Africa (Durban and Richards Bay). Within recent years, there has been renewed interest in using the concept of development corridors to stimulate economic growth between South Africa and Mozambique. The Maputo Development Corridor Initiative (MDCI) was conceived as a means of improving access, assisting the local economy and providing impetus for major industrial and commercial development within the Mpumalanga and Maputo regions. The MDCI is focused on the creation of an integrated infrastructure network. This network is expected to be based on existing road and rail links that, with improvement, will facilitate transport in both directions. Additional upgrading and development of ancillary transport infrastructure has also been encouraged at appropriate nodes within the Corridor.

It was envisaged that the MDCI would bring a range of benefits to both Mozambique and South Africa, including:

- the opening up of South African markets to Mozambique producers and access to global markets through the development of Maputo;
- employment creation through increased economic activity at Maputo and all along the Corridor, with the ability to shift to higher value-added industry sectors;

- increased access to international tourism;
- improved income generation through the encouragement of private investment inflow; and
- saving of public sector financial resources through the use of private sector investment in infrastructure development.

Resultant from the MDCI initiative, on 5th May 1997, TRAC signed the concession contract with the A.N.E. and the SANRA to design, construct, rehabilitate, operate and maintain the Maputo Corridor Toll Road over a thirty year period.

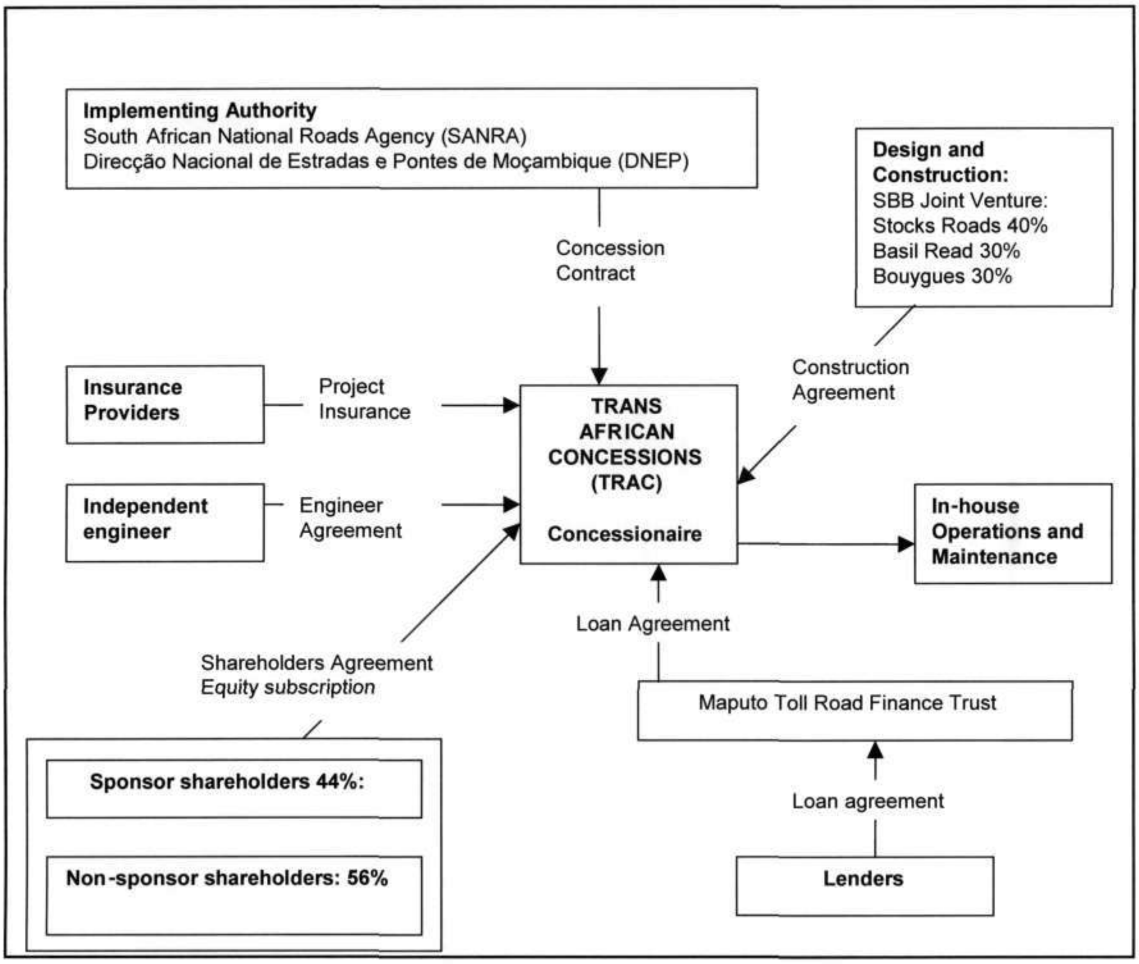
The Maputo Corridor Toll Road extends from the border of Gauteng and Mpumalanga to the Maputo Harbour – a distance of approximately 525 km, of which 432 km is in South Africa and 93 km in Mozambique. The Road is considered a key transport link between the two countries and the Project has been developed as a central element of the Maputo Corridor Development Initiative being promoted by the two governments to stimulate economic growth in the region. It was also the first major toll road to be implemented on a PPP Build-Operate-Transfer basis.

There are 5 toll plazas in total along the route, three of which are in South Africa and two in Mozambique. They are situated at Middleburg, Machadodorp, Kaapmuiden, Moamba and Maputo respectively.

The Middelburg toll Plaza was the first toll plaza to open in December 1998 whilst Maputo Toll Plaza was the last to open in January 2001.

The toll road project is structured in a way whereby TRAC is the toll concessionaire whilst the A.N.E. and the SANRA remain the authority of the road for the Mozambique and South African sides respectively. The functions and roles of each party are provided in the Concession Contract and the structure of the various parties is illustrated in Figure 4.1.

Figure 4.1: **TRAC concession contract structure**



(Source: Sproule 2003)

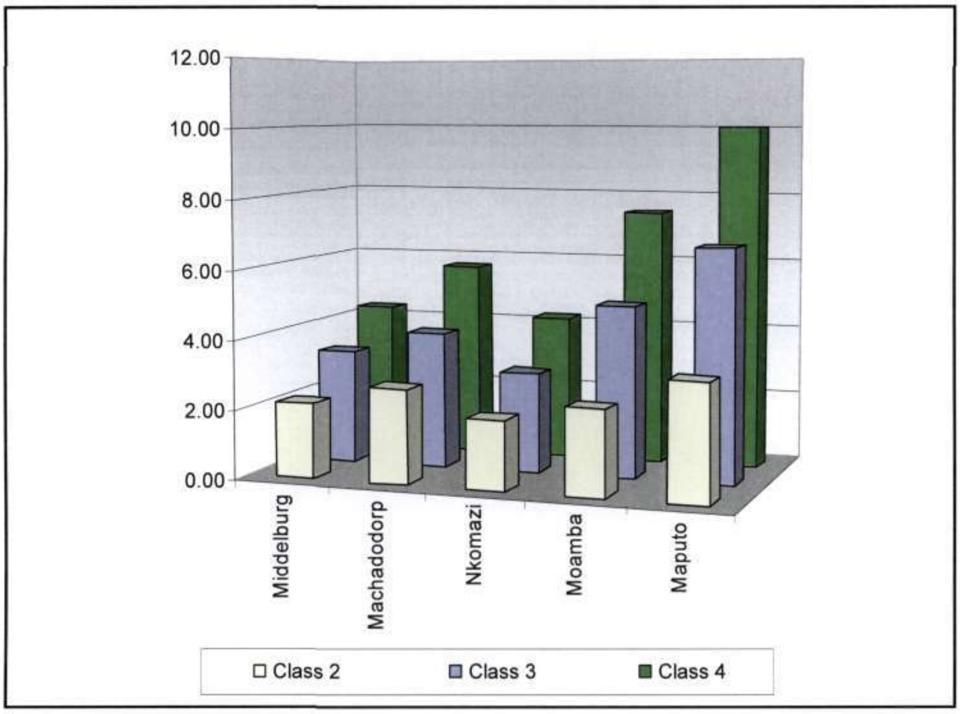
In essence, the operation of the Toll Plazas and maintenance of the road is undertaken solely by TRAC and the future rehabilitation and expansions of the toll road will be financed by TRAC and sub-contracted out to contractors by means of a competitive tender.

4.2 ECONOMIC IMPACT

4.2.1 Marginal Operating Costs

An analysis of the relative magnitude of toll fees for all toll plazas located on the TRAC N4 toll route is illustrated below.

Figure 4.2: **Relative magnitude of PPP mainline tolls by vehicle class (class 1 = 1)**



The statistical breakdown of these figures is provided in the Table 4.1.

Table 4.1: **Relative magnitude of PPP mainline tolls by vehicle class (class 1 =1)**

Statistic	Class 2	Class 3	Class 4
Maximum	**3.36**	**6.72**	**10.00**
Minimum	**2.00**	**2.90**	**4.19**
Mean	**2.55**	**4.37**	**6.33**
Median	**2.49**	**3.98**	**5.68**

The TRAC figures indicate that the relative magnitude is slightly higher than the average of all other toll plazas in South Africa, however, as illustrated in Chapter 2, economic marginal efficiency is unobtainable by using a tolling strategy. This is resultant from heavy vehicles being the primary cause of pavement damage and the inability to have a toll fee of relative magnitude to charge for such damage. Moreover it is apparent that the phenomena of overloading all heavy vehicles in South Africa is resulting in an acceleration of the destruction of the SA road infrastructure (CSIR estimated damage cost is R600 million per annum).

TRAC, however, recognized the financial implications and risk of overloaded vehicles at the inception of the project and consequently installed High Speed Weigh in Motion (HSWIM) detectors at all toll plazas along the N4. A HSWIM detector measures the weight of each axle that passes over it and thus the damage factor of overloaded heavy vehicles could be calculated. In terms of the concession contract, the I.A. are responsible for ensuring that the relevant Road Traffic Acts are upheld, which includes overloaded heavy vehicle control. From the inception of the project, however, it was clear that heavy vehicle overloading control was not undertaken by this party. A study undertaken by BKS consulting engineers (A strategy for truck load control in the N4 corridor, 1999, p11) indicated that "In November 1998, only 28% of the traffic officers posts in the province were filled, the budget was inadequate, most of the truck weighing facilities were in disrepair, and truck overloading was out of control to the extent that certain sections of the surfaced road in the province had been reduced to gravel roads. The problems with controlling overloading in Mpumalanga are further aggravated by the fact that certain aspects of the existing legislation, regulating requirements and the powers of law enforcement personnel, as well as appropriation of revenue from law enforcement activities, are illogical and counterproductive. Moreover, there are frequent incidents of unsuccessful prosecution of offenders caused by technicalities and the lenient attitudes of magistrates".

Resultant from the lack of enforcement of overloaded trucks, TRAC recognized the immense financial risk it was being exposed to and consequently in 1999 notified the IA of the possibility of a Material Adverse Governmental Action (MAGA) claim.

Consultants appointed by TRAC in the latter part of 1999 analysed the HSWIM data and estimated that TRAC had incurred road pavement damage in the region of R250 million over a 3 year period as a direct result of overloaded vehicles.

As a consequence of the MAGA notification and the financial claim of R250 million (claim is currently ongoing and being assessed by various parties) the IA initiated an overload control strategy in Mpumalanga. This control strategy was implemented in April 2002 at an initial capital cost of R18 million and an operating cost of R15 million per annum. The management of the overload strategy was sub-contracted to TRAC for an initial period of 5 years. In order to suppress the damage caused by overloaded vehicles, in conjunction with not losing revenue by heavy vehicle hauliers who may divert onto "un-policed" alternative routes, as well as ensure pavement damage was not transferred onto such routes, a dynamic overload strategy was implemented. This entailed the construction of permanent weighbridges on the N4 as well as on the most attractive alternative routes which are operated on a 24 hours, 365 day basis. Furthermore, weigh bridge lay-byes on less attractive alternative routes were also constructed.

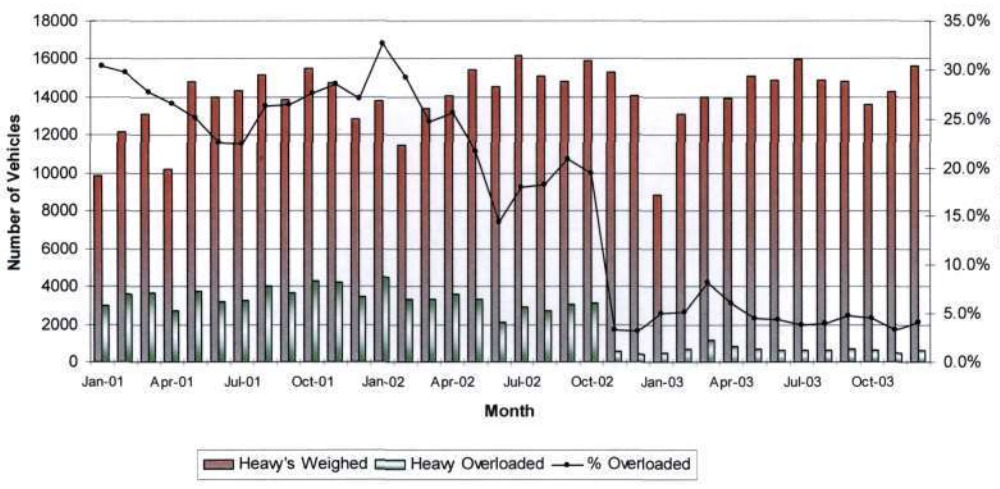
The lay-bye stations are not manned continuously, but there are 3 weighing "squads" who operate on a 24 hour, 365 day basis. The function of these squads is to randomly select alternative routes in the Mpumalanga province and thus attempt to eliminate overload vehicles on alternative routes. The rationale behind this strategy is that initially, heavy vehicles will search for alternative routes on un-policed sections; when these offenders find resistance to overloading on the alternative routes they will return to the N4. The report undertaken by BKS Consulting Engineers (A Strategy for truck load control in the N4 corridor, 1999) indicated that the practical capture rate of overloaded vehicles does not need to be 100%, but that hit rates of 70% to 80% eliminates continuous offenders over a period of time.

The abovementioned overload strategy is the only one implemented in SA to date and has proved to be very successful. Since the inception of the project to the end March 2004, the following summarized figures provide an indication as to the success of the project:

- A total of 79 288 heavy vehicles have been weighed on static scales;
- a total of 24 555 heavy vehicles were loaded over the legal limit;
- The total cumulative value of fines issued is R 35 686 838;
- R 8 253 475 (23.13% recovery rate) has been paid to date.

The graphical figure below indicates the overloading trend recorded by the HSWIM detectors located at Machadodorp, prior to and after the overloading strategy was implemented. The percentage of overloaded heavy vehicles weighed on the HSWIM has reduced from an average of 25% to 4% since the inception of the strategy (the HSWIM's are used as screening devices and do not indicate a precise vehicle mass).

Figure 4.3: **Overloading Trend**



From the preceding text it is suggested that without the intervention of a PPP company the excessive overloading and associated pavement damage would not have been addressed by the State.

Hence it can be argued that although there is a theoretical intrinsic economic inefficiency in the relative magnitude of toll charging, the implementation of a PPP has resulted in an economic gain by significantly lowering the pavement damage factor caused by heavy vehicles. This is due to the fact that PPP's attempt to eliminate the financial risk to which the shareholders are exposed to, whilst the State is seemingly less able to address such financial risk.

4.2.2 Marginal External Costs

The most common marginal external cost arguments relating to toll roads are that they result in:

i. Diversion of traffic to inferior road networks and through towns, thereby increasing environmental pollution (noise, air and visual) as well as accidents;
ii. Stopping the flow of vehicles at toll booths thereby increasing pollution and the propensity for accidents.

These 2 issues are investigated below:

The financial success of any PPP project is dependent on a number of factors. One of the primary factors is, however, to capture the maximum possible traffic on the road network. This is traditionally undertaken by 2 different tolling strategies, namely an "open tolling system" or a "closed tolling system". A system is typically described as "open" when there are no toll booths on entry or exit ramps to the road which is being tolled. The revenue collected under an "open" system is typically less due to vehicles using only a section of the toll route and then taking an off-ramp prior to passing through a toll plaza. This system is used typically in areas where the capital and operating costs of toll plazas at all access and excess points would outweigh the financial income. Conversely, in a "closed system" all exit and entry points are monitored and tolled, so that all travelers make payments and the tolls levied are directly related to the distance traveled on a tolled route. Typically, the diversion of motorists onto an alternative free route is significantly higher on an "open system" as opposed to a "closed system".

Due to the extensive number of entry and exit ramps onto the N4 a "closed system" was not considered to be economically viable and hence TRAC embarked upon an "open" toll system strategy.

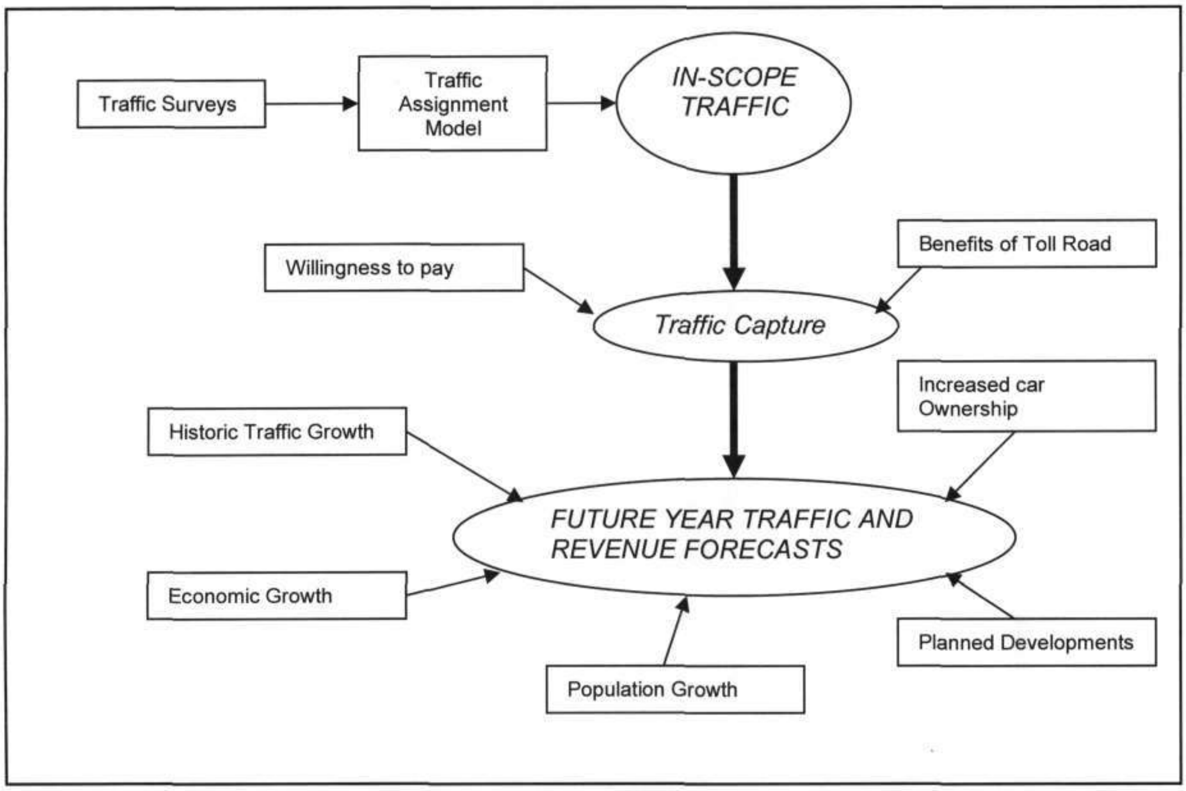
Forecasting toll road traffic is determined via a combination of complex factors. These include the overall level and pattern of vehicle trips in the area, the time and cost savings that the tolled road provides compared to alternative routes, the price of using the road, and the willingness and ability of people to pay that price. The key features of forecasting traffic as proposed by Steer Davies Gleave (SDG) (1997) are illustrated in Figure 4.4.

A method of estimating traffic capture, which is currently used by consultants worldwide (SDG, 1997) is the logit equation which is used to assess driver route choice under varying toll strategies, and it takes the form:

% Toll Route Capture = 1/ (1 + exp (-a (- cost of toll road + cost of alternative)))

Where *a* is a scaling parameter which tempers the shift of traffic from either road as the overall journey costs increase. The scaling parameter is calibrated from revealed preference surveys.

Figure 4.4: **Key outline of forecasting traffic**



Source SDG: Maputo Corridor Toll Road, Final Report, 1997, pg 4).

Table 4.2 indicates the SDG Banking Base Case of the N4 projected traffic capture rates at all the toll plazas.

Table 4.2: **Predicted traffic capture rates for TRAC**

Toll Plaza	Predicted Capture Rate of Traffic				
	Class 1	Class 2	Class 3	Class 4	Total
Middelburg	80%	52%	52%	52%	76%
Machado	92%	85%	85%	85%	91%
Nkomazi	95%	95%	95%	95%	95%
Moamba	75%	80%	80%	80%	80%
Maputo	75%	80%	80%	80%	80%

From the above it is clear that 100% capture of traffic was not predicted (and never is in almost every toll model). The reasoning for not capturing all the traffic is based on 2 factors:

a) Traffic will divert to an alternative un-tolled route;
b) Trip suppression – whereby motorists who would have previously made the trip no longer do due to cost.

Prior to opening the toll plazas TRAC collected traffic data on the viable alternative routes. An alternative route was considered unviable if the cost benefit of the toll road exceeded the alternative route by 75%. The increase on the viable alternative routes is indicated in the Figures 4.5 through to 4.7 below.

Figure 4.5: **Traffic differential at Middelburg alternative route**

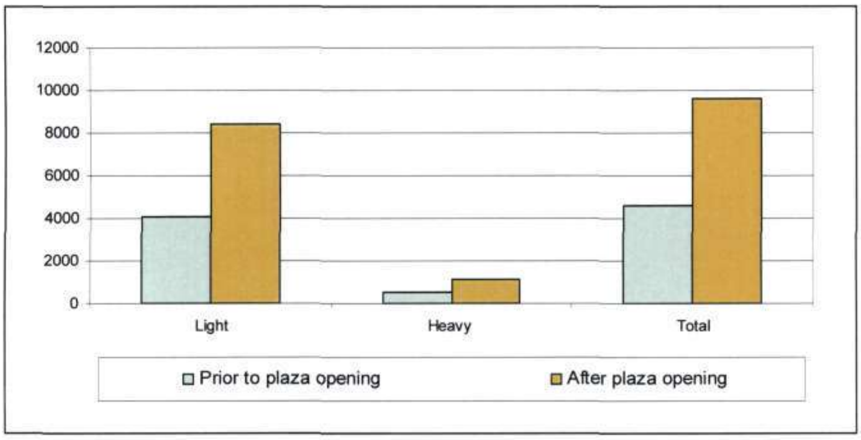


Figure 4.6: **Traffic differential at Machado alternative route**

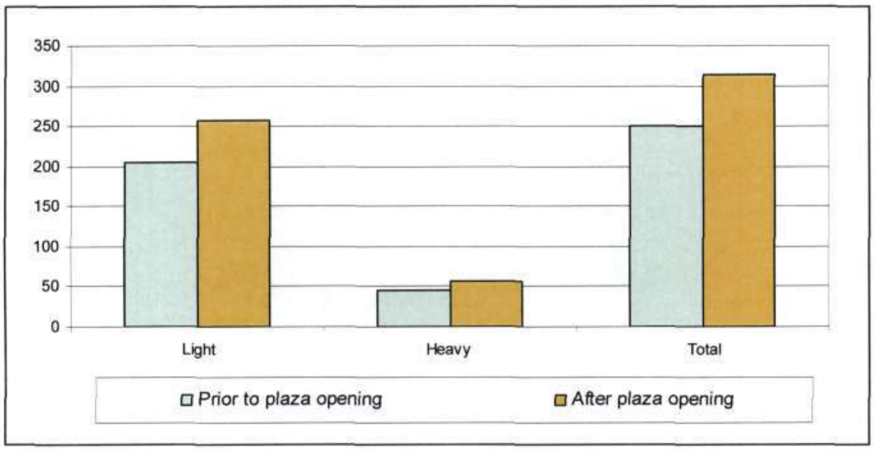
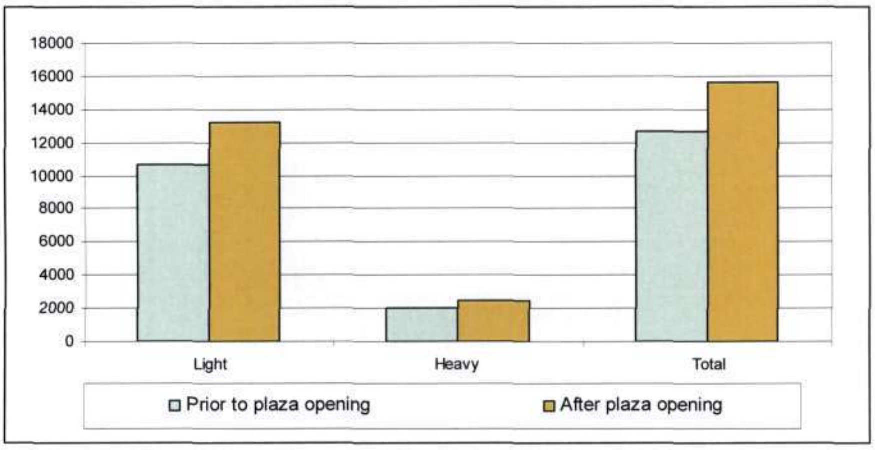


Figure 4.7: **Traffic differential at Maputo alternative route**



It is apparent that there was a considerable increase of traffic on the alternative route in the vicinity of the Middleburg Toll Plaza and to a lesser extent – the Machado and Maputo Toll Plazas. The traffic diverting to the alternative routes has had a negative impact on the local communities living in these areas due to the increased traffic congestion levels, deterioration in the pavement structure of the alternative routes as well as the degradation of environmental features due to noise, air and sight pollution. It is therefore clear that there has been an increase in the marginal external costs resultant from the toll plazas. Due to the lack of empirical values however, it is impossible to quantify this impact in monetary terms.

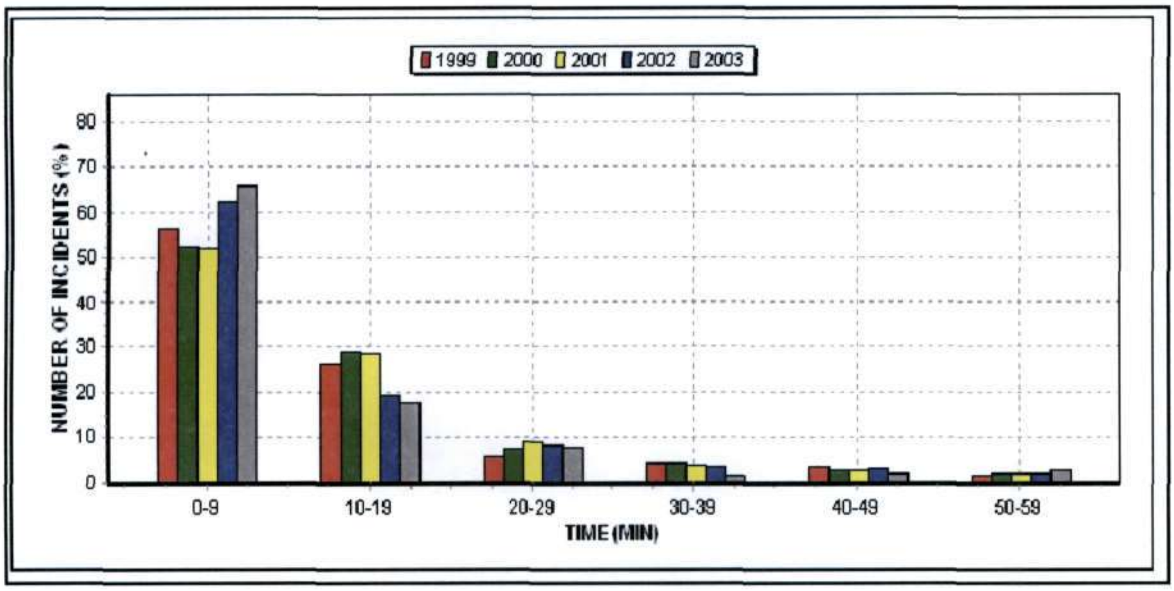
All TRAC toll plazas are operated manually. Thus, according to the theoretical economic theories this increases the marginal externalities related to air pollution due to vehicles stopping at the plaza and then accelerating back to their traveling speed. During 2003, a total of 19 494 468 vehicles were stopped across the 5 TRAC plazas (average of 53 410 vehicles per day). Although this is a relatively large number, it is estimated that it only becomes economically feasible to operate under ETC conditions once the traffic volumes surpass 35 000 vehicles per day at a plaza (i.e. across 5 plazas this would equate to 175 000 vehicles per day). Despite the latter judgment, the levels of pollution have undeniably increased, thereby indicating an increase in the marginal external costs.

Economic theory also indicates that stopping at toll booths increases the marginal costs due to a potential increase in accidents. TRAC's mission statement is "To be the safest route in Africa."

In terms of the Concession Contract between TRAC and the I.A., TRAC was responsible for setting up an Incident Management System (IMS). The primary purpose of the Incident Management System was to establish one set of protocols that are agreed to and are adhered to by all emergency and secondary services involved with management of incidents. Moreover TRAC has taken a leading role in managing the IMS and co-coordinating all emergency and secondary services. Forming part of the above IMS is the TRAC Incident Response Units. Currently there are 3 such units in South Africa which are located at Middelburg, Machadodorp and Nelspruit (one unit per location) and one unit located at Maputo in Mozambique. The primary function of the Incident Response Units is to secure the scene of all incidents, thereby ensuring that secondary accidents do not occur.

The IMS has proved to be highly successful and has resulted in increased reaction times of responders to an incident scene as well as impeded the classic problem of the incorrect and often duplicated emergency services from different regions responding to the scene of the same accident. The improvement in the emergency services mobilization times can be viewed below.

Figure 4.8: **Emergency services mobilization times**



In addition to the above, TRAC developed a Traffic and Incident Database System (TIDS) at a cost of R1.2 million. The system was developed specifically for TRAC, and allows all incident data which is recorded by the TRAC accident response teams at the scene of an incident, to be captured. TRAC is thereby enabled to proactively monitor the type, cause and location of every incident and accident which has occurred on the N4.

This system has permitted TRAC management to identify accident 'hot spots' and implement actions to ameliorate the causes of accidents. In order to determine what actions need to be undertaken to reduce the number of accidents, consideration is required as to why accidents occur. In broader terms, accidents are a result of 2 primary factors:

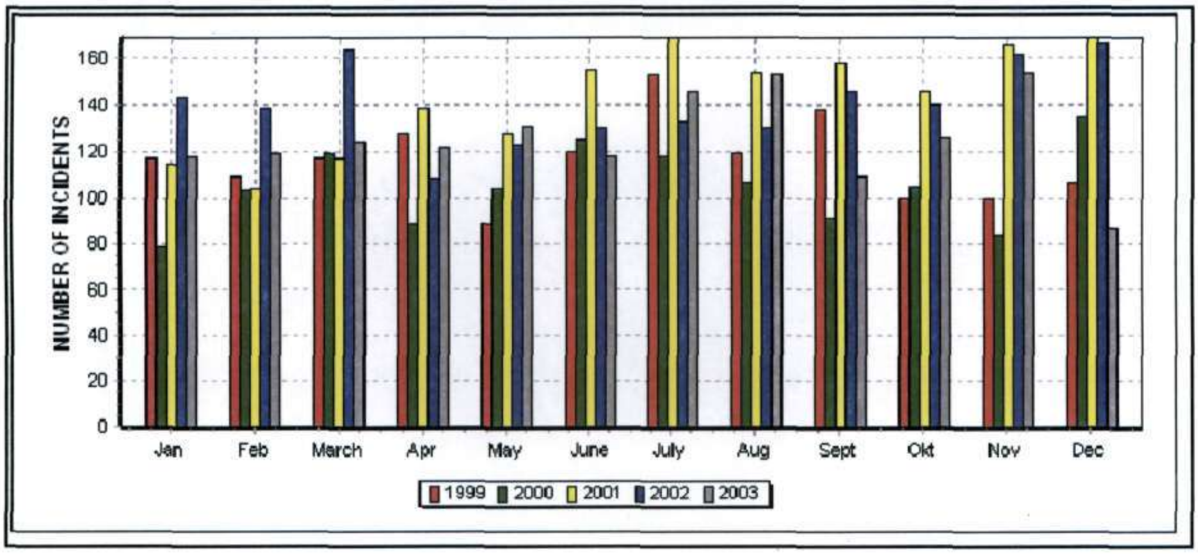
a) Driver behaviour (this generally includes speeding, reckless driving, driving under the influence of drugs and alcohol, and motorists driving un-roadworthy vehicles);

b) Engineering considerations (which typically includes poor geometric road design, poor signage, access locations, signal timings, shoulder recovery space etc.).

In order to address driver behaviour TRAC holds regular meeting with traffic officials at which accident reports from the TIDS are presented in order to assist with the allocation of traffic officials to areas where a high number of accidents are occurring due to driver behaviour. Further to the above, analysis of the accident reports has also provided guidance to TRAC management as to where and what type of engineering actions can be undertaken to reduce accidents.

This intervention by TRAC has led to a marked decrease in accidents from 1998 (when TRAC took over the N4) to the end of 2003 and is illustrated graphically below.

Figure 4.9: **Year on year number of incidents recorded per month**



It is, however, important to note that the number of accidents which occur are related to the number of vehicles traveling on the road. From 1999 to the end of 2003 TRAC has experienced a traffic growth of 3.1% per annum. In line with the above one should thus expect an associated increase in the number of accidents. Clearly this has not happened and it is suggested that the decline in accidents is directly linked to the pro-active stance undertaken by TRAC management. In order to determine the comparative number of accidents on the toll route to other national roads it is necessary to assess the relative number of accidents for road sections which may have different traffic volumes and geometric elements. The number of accidents is thus converted to an accident rate which is calculated by using the following formula:

Rate = Ca x 106 / 365 x AADT x km

Where:	Rate	=	Calculated accident rate (expressed as accident rate per million vehicle kilometers)
	Ca	=	Annual number of accidents which occurred in that specific road section
	AADT	=	Average annual traffic on that specific road section
	Km	=	Kilometer distance of that specific road section

The Department of Transport's (DOT) "Accident Rates Related to Rural Road Geometry Elements and Daily Traffic" report (1996) provides some guidance in terms of average accident rates in South Africa. This report was, however, prepared in 1996 and thus an attempt to try and gather more recent data from various sources was undertaken. During this process it became clear that little to no recent information pertaining to accident rates along the national road network in South Africa is available. The most recent information which was received from the Department of Transport indicated that the average accident rate in Gauteng in 1997 was 5,1 accidents per million vehicle kilometers. The "Accident Rates Related to Rural Road Geometry Elements and Daily Traffic" report concludes that for the levels of average daily traffic occurring in South Africa, the possible average accident rate for two lane roads is 2,3, for four lane freeways 1,5 and for six lane freeways 0,6 accidents per million vehicle kilometers.

In order to analyze accident rates the N4 Toll Route has been split into varying sections based on the following criteria:

- Geometric cross-section similarities;
- traffic volume consistency along sections (i.e. sections were split where a large number of vehicles turned onto or off the N4);
- urban and rural sections as indicated in Amended Annexure XVIII of the Concession Contract; and
- finally, the number of counting stations and subsequent traffic volume data, which is available.

Using the above criteria, the N4 toll Route has been split into 22 sections for which accident rates have been calculated.

The accident rate reports for 2002 and 2003 are attached herewith in Appendix 1. This data indicates that the accident rate on the N4 rural sections is significantly less than the average rate suggested in the "Accident Rates Related to Rural Road Geometry Elements and Daily Traffic" report as well as the accident rates provided by the Department of Transport.

Further to the above, an economic value related to the cost to the government associated with injuries (fatality, serious or slight injuries) is available from the CSIR. The most recent accident values are as follows:

Fatality	=	R554 538
Serious injury	=	R127 492
Slight Injury	=	R33 254

Table 4.3 indicates the total number of injuries recorded on the N4 from 1998 to the end of 2003.

Table 4.3: **Severity of injuries and number of accidents**

Severity of injury	1998	1999	2000	2001	2002	2003
Fatal	203	181	103	115	109	103
Serious	440	315	267	323	347	302
Slight	1073	785	743	713	598	615
Total Number of accidents	1244	953	836	767	730	708

In addition to the above, table 4.4 indicates the economic value associated to the accident injuries incurred on the N4.

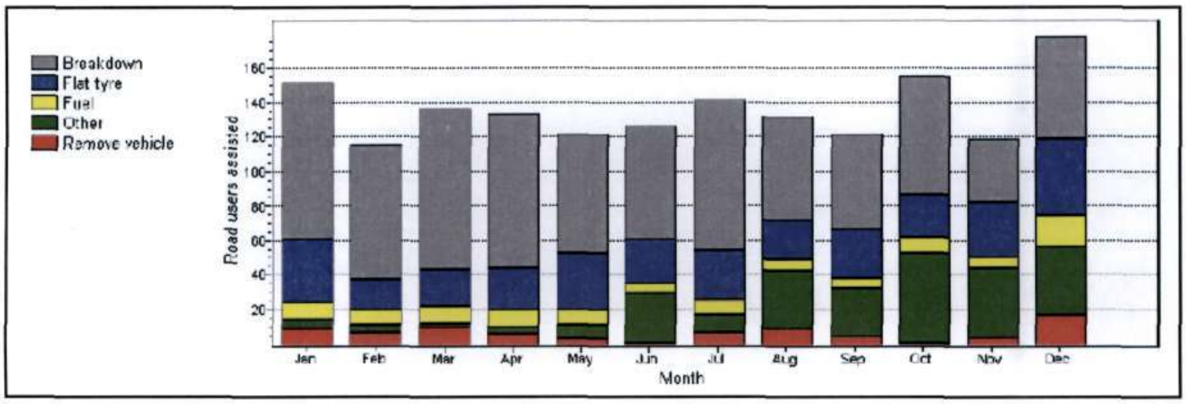
Table 4.4: **Economic cost of injuries in R' million**

Severity of injury	1998	1999	2000	2001	2002	2003
Fatal	R 112.6	R 100.4	R 57.1	R 63.8	R 60.4	R 57.1
Serious	R 56.1	R 40.2	R 34.0	R 41.2	R 44.2	R 38.5
Slight	R 35.7	R 26.1	R 24.7	R 23.7	R 19.9	R 20.5
Total	R 204	R 167	R 116	R 129	R 125	R 116

The data above illustrates the significant costs associated with accidents in South Africa and reveals a significant economic benefit consequential to enhanced management of the N4 toll route. It could be argued that these benefits have been attained primarily due to TRAC's interventions. This economic saving can be explored further by using 1998 as a base year and assuming that without the interventions of TRAC, the number of accidents would have remained the same. Although there is no empirical evidence to support this, this presumption is based on the fact that the number of accidents across South Africa seemingly continues to increase with little evidence of any serious remedial actions being undertaken to reduce the death rate on South African roads. Once again, there is no empirical data to corroborate this assumption due to the lack of a central accident database being available to determine the accident trend in the country. However, the economic costs tabulated above indicate that there has been a potential benefit of a staggering R370 million over a 5 year period. Although it is not possible to verify this saving as a result of TRAC interventions, it does however provide some indication as to the potential economic benefit which has been derived from the road being under the control of a concession company.

Further to the above it is interesting to note the number of road users who have been assisted by the N4 patrol officers. The N4 patrol officers patrol the N4 on a daily basis and one of their primary functions is to assist any stranded motorist on the route. During 2003 a total of 1 630 motorists were assisted by TRAC patrol officers and the breakdown of the assistance offered is indicated in Figure 4.10. It is, however, clearly difficult to quantify this economic benefit in rand terms.

Figure 4.10: **Number of road users assisted – 2003**



4.2.3 Misallocation of resources

A central economic concern regarding toll routes relates to efficiency in terms of the need to achieve the most cost effective and beneficial use of the road network as a whole, following investment in a new road link. The efficiencies of misallocation of resources are similar in both state and PPP toll projects and are discussed hereunder.

Roads and road reserves use up a substantial amount of land. In an efficient market, the opportunity cost of the land should be greater or equal to the price that the landowner has been paid out, to that of the present value of the net revenues the land could have generated. From the preceding Chapter 4.2.2 it becomes clear that motorists have diverted from the N4 since the inception of tolls. It could therefore be argued that the outcome of potential users not using the tolled section has resulted in an inefficient way of using the land, thereby resulting in a misallocation of resources.

4.2.4 Costs of collecting tolls

The economic efficiencies of the costs of collecting tolls relate to both state and PPP toll projects. An argument exists that the costs that users should bear should be limited to the short run costs of operation and maintenance and hence, that the cost of collecting tolls should not form part of the operational costs.

Currently all state owned toll roads are operated on behalf of the state by toll contracting companies, typically for a period of 8 years. These contracts are awarded on a competitive tender basis. Due to the competitive nature of the tendering process no reliable information relating to the cost of collecting tolls was made available to the author. However, all toll plazas (with the exception of some of those on the Platinum Toll route which are mixed, i.e. ETC and manual mode) in South Africa are operated on a manual basis resulting in a cost associated to collecting tolls. Due to the fact that state toll roads are operated by different competing companies, it is anticipated that the costs of collecting tolls do not differ substantially form PPP projects.

During 1997 their were 205 toll collectors working for TRAC and the operating costs of the TRAC plazas constituted 8% of the total company operating costs. This cost is transferred to the road user and thus constitutes a burden on road users, compared to the use of similar roads without tolls. These costs are expected to decline in the future as ETC is introduced into the remaining plazas on the national road.

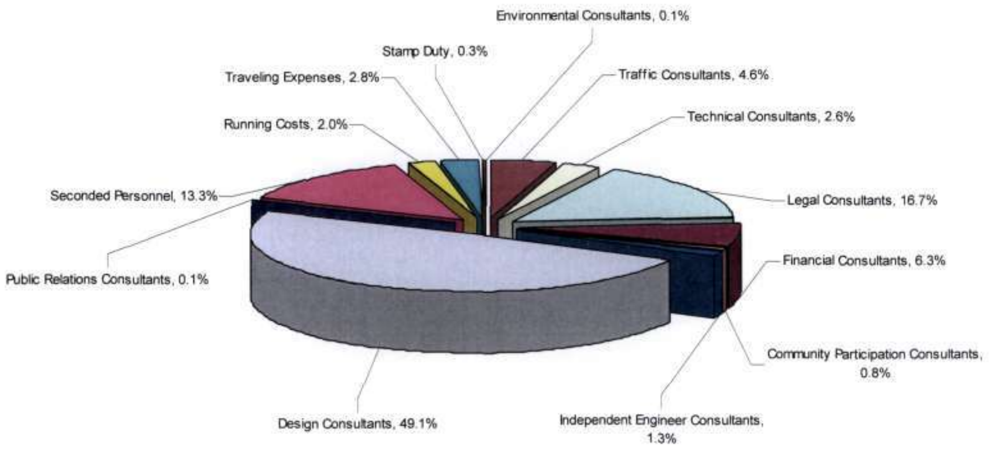
Economic theory therefore indicates that there is inefficiency in the costs of collecting tolls. However, in a South African context where unemployment levels are so high the economic benefits of employment require careful consideration. It can be argued that the inefficiency in collecting tolls on the N4 is off-set by the increase in economic demand resultant from employing toll collectors, which ultimately results in stimulating the economy of the country.

4.2.5 Contractual efficiency

It is argued that contractual efficiencies differ significantly between a state and a PPP toll project. This is primarily due to the significant costs of the tendering process, as well as the additional monitoring costs once the project is awarded. Since state owned toll roads are operated on behalf of the state by toll contracting companies, it follows that there are additional costs incurred as a result of the tendering processes. However, these costs remain substantially less than those incurred by a PPP project due to the additional complexities and financing inherent in a PPP project. Due to the competitive (and hence classified) nature of the tendering process to operate a state toll road, no reliable information relating to the tendering costs was obtainable. It was thus unfeasible to compare the contractual costs of state owned toll roads versus those arising from a PPP.

TRAC embarked upon the tender process for the N4 Toll Road in 1996 and there were initially 8 consortia who tendered for the project - of which 3 were shortlisted. From 1996 to the point of financial closure, 7 May 1997, a transaction cost of some R96 million was accrued by TRAC. Of the latter amount, 53% was incurred directly and 47% was based on the provision of the success of the project and hence paid once the tender was awarded. The breakdown of these costs is provided in Figure 4.11.

Figure 4.11: **Breakdown of transaction costs incurred by TRAC**



In addition, an I.E. was appointed prior to the commencement of the project to fulfill the function of the technical and contractual auditor of the concession project (which consisted of a joint venture between 5 civil engineering consulting firms). The cost associated with the functioning of the I.E. is distributed between the state and TRAC who pay 60% and 40% of the fees respectively. During the initial construction phase, which occurred during the periods 1998 and 2002, the I.E.'s fees were just under R1 million per annum. Currently the I.E.'s fees are in the region of R650 000 per annum.

Furthermore, various additional technical and financial consultants were appointed by the lenders of the project, the costs of which were borne by TRAC.

All the above-mentioned transaction and contractual costs have been transferred into either the capital or operating costs of TRAC and as such, have been ultimately been shifted to the road user in the form of toll fees.

4.2.6 Efficiency in raising capital

The major financing requirement spanned the initial three and a half year Construction Period. Operation, maintenance, rehabilitation and expansions during the period extending between the end of the construction period to the end of the concession period is funded from the cash flow generated by the toll revenues.

The debt : equity ratio of the project was set at 80:20. Senior debt consisted of a rand term loan, a DBSA facility, and a consumer price index (CPI) linked loan. A subordinated loan made up about 10% of the funding.

During the construction period, standby facilities were put in place. These consisted of an R175m loan facility, which held equivalent ranking to the senior rand term facility, and an R25m equity standby facility to cover shortfalls in revenue during this period.

Table 4.5: **Base Case Capital Structure**

Sources of funds	R'm	Application of funds	R'm
Debt			
Rand Term Loan	468	Development costs	1 512
CPI Linked Loan	455	Operating costs	156
DBSA Facility	200	Fees and interest	332
Subordinated debt	200	Debt Service Reserve	41
Equity			
Investor's equity	199		
Sponsor's equity	132		
Revenue during construction	387		
Total funds available	**2 041**	**Total funding required**	**2 041**

The total senior debt financing facilities amounted to about R1bn. Sproule (2003), lists the main terms as follows:

Table 4.6: **Rand Term Loan**

Amount	R468m including Capitalised interest and fees
Maturity	15 years from first drawdown
Margin*	2.125% over applicable interest rate
Repayments	4-year grace period on principal repayments. Amortising semi-annual repayment profile over 15 years to maturity

Table 4.7: **CPI linked facility**

Amount	R455m including Capitalised interest and fees
Maturity	20 years from first drawdown
Margin*	6% coupon subject to indexation
Repayments	4-year grace period on principal repayments. Equal real semi-annual repayment profile over 16 years to maturity
Indexation	Both principal and interest payments are indexed to inflation

Table 4.8: **DBSA facility**

Amount	R200m
Maturity	20 years from first drawdown
Margin*	2.125% over applicable interest rate
Repayments	10-year grace period on principal repayments. Amortising semi-annual repayment profile over 10 years to maturity.

Table 4.9: **Standby Facility**

Amount	Up to R175m including capitalised interest and fees
Maturity	15 years from first drawdown of any of the debt facilities
Margin*	2.35% over applicable interest rate
Repayments	4-year grace period on principal repayments. Amortising semi-annual repayment profile over 11 years to maturity.

Table 4.10: **Quasi Equity**

Subordinated Loan	
Amount	R200m including capitalised interest* and fees
Maturity	15 years from first drawdown
Margin*	3% over applicable interest rate
Repayments	5-year grace period on principal repayments. Amortising semi-annual repayment profile over 11 years to maturity.
Equity warrant	For 8% of the facility amount, exercisable at par

*During the initial construction period interest is capitalised. For a period of 1,5 years thereafter, interest is only capitalised if there is insufficient cash flow available.

Equity was provided to the project in the form of ordinary shares, drawn down on a pro-rata basis with debt to ensure an 80 : 20 debt : equity ratio. Sponsor shareholders committed 40% of the total equity funding, with non-sponsor shareholders providing the other 60%. Sponsor shareholders also had to provide the R25m standby equity facility, and on drawdown of the standby equity, sponsors were obliged to offer 60% of this facility to non-sponsor shareholders. During the development period three banks underwrote the non-sponsor equity commitment (Sproule 2003).

The following funding agreements were put in place with certain of the non-sponsor equity holders to cover costs during the development period:

- South African Infrastructure Fund (SAIF)
- The SAIF were to fund pro-rata and at their own risk a proportion of the first R50m of Development Period costs in the ratio 15 : 35 SAIF : TRAC. SAIF had a call option to purchase R100m of the sponsor Shareholders equity in TRAC within 90 days after completion of the construction.
- Commonwealth Development Corporation (CDC)
- COMAFIN, a private equity fund supported by CDC, committed R15m of risk capital towards the costs of TRAC during the development period. These funds were utilised in the ratio 15 : 35 COMAFIN :

TRAC. COMAFIN were repaid once the concession contract came into effect, whereupon the CDC could exercise an option to invest a further R15m in the equity of TRAC (Sproule 2003).

As at 1 December 2003 the equity structure of the Project looked as follows:

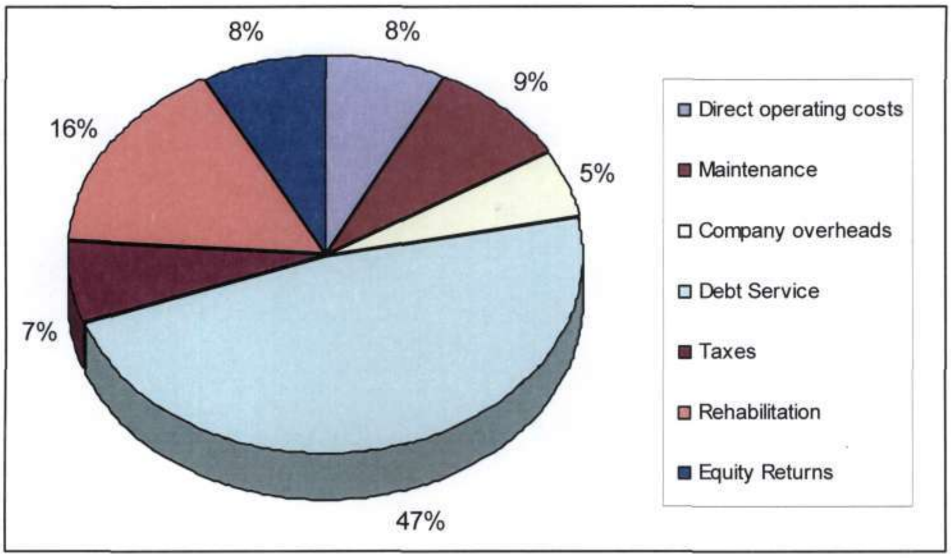
Table 4.11: **Equity Structure**

Equity Structure	Relative split	Shareholding
Project sponsors		
Bouyges SA	30%	13.31%
Basil Read Ltd	30%	13.31%
Stocks Holdings Ltd	40%	17.74%
	100%	**44.36%**
Non-sponsors		
Commonwealth Development Corporation	27.78%	15.46%
Futurebank Corporation	0.93%	0.52%
Investec Bank	2.80%	1.56%
Metropolitan Life	2.52%	1.40%
RMB Asset Management	1.26%	0.70%
Sociedade de Desenvol De	16.72%	9.30%
SA Infrastructure Fund	37.88%	21.07%
SA Mutual Life	2.52%	1.40%
SA National Life	7.58%	4.21%
	100%	**55.64%**
Summary		
Sponsors	44.36%	R157,750,016
Non-sponsors	55.64%	R197,850,000

(Source: Sproule 2003)

The apportionment of the TRAC toll fees at year 7 (2004) of the project is indicated in Figure 4.12. It is apparent that the majority of the toll fees (some 47%) are currently going towards the debt repayment of the project. This underlines the high cost in raising capital to undertake PPP financed infra-structure projects, for which the road user pays.

Figure 4.12: **TRAC toll fee apportionment: Year 7**



The fee apportionment of the toll fees does nevertheless change during the lifecycle of the project as debt is reduced. The manner in which this profile changes is largely dependent on the financial success of the project in terms of the revenue derived from traffic, as well as managing pavement damage risk.

Economic theory indicates that if the government can borrow at lower interest rates than can the private sector, PPP's have to be more efficient in management during construction of the project and/or maintain lower operating costs in order to obtain an economic advantage. However, as state toll roads are operated on behalf of the SANRA by toll operating companies, it is not anticipated that the operational costs are significantly less than those of TRAC due to the competitive tendering nature of the industry.

4.3 SUMMARY

This chapter reviewed TRAC as a case study and compared the economic efficiencies debated in chapter 2 as opposed to those realized in the case study.

An analysis of the relative magnitude of toll fees of all toll plazas located on the TRAC N4 toll route indicated that marginal efficiency is unobtainable by using a tolling strategy. This is resultant from heavy vehicles being the primary cause of pavement damage and an inability to have a toll fee of relative magnitude to compensate for such damage. However, TRAC recognized the financial implications and risk of overloaded vehicles at the inception of the project, which resulted in the government initiating an overload control strategy thereby limiting the damage of overloaded vehicles on the route. Hence, it can be argued that although there is a theoretical intrinsic economic inefficiency in the relative magnitude in toll charging, the implementation of a PPP has resulted in an economic gain by significantly lowering the pavement damage factor caused by heavy vehicles. This is due to the fact that PPP's attempt to eliminate the financial risk to which the shareholders are exposed to, whilst the State are seemingly less able to address such financial risk factors.

Analysis of the traffic figures on the alternative routes indicated that there was a considerable increase of traffic on the alternative routes resulting in an increase in the marginal external costs. Furthermore, as all TRAC toll plazas are operated manually, it becomes apparent that the levels of pollution have increased, thereby further increasing in the marginal external costs. Economic theory further suggests that stopping at toll booths increases the marginal costs due to a potential increase in accidents. In reality however, accident statistics from the N4 toll route indicated that there has been a potential economic benefit due to a reduction in the number of accidents along the route.

A central economic concern regarding toll routes relates to efficiency in terms of the need to achieve the most cost effective and beneficial use of the road network as a whole, following investment in a new road link. It is argued that the consequence of potential users not using the tolled section equates to inefficient land use, thereby resulting in a misallocation of resources.

An argument exists that the costs that users should bear should be limited to the short run costs of operation and maintenance and that the cost of collecting tolls should not form part of the operational costs. However, the costs of collecting tolls have been transferred onto the motorist thereby signifying a further economic inefficiency.

It was further acknowledged that contractual efficiencies differ significantly when comparing a state to a PPP toll project. This is linked primarily to the significant costs of the tendering process as well as the additional monitoring costs once the project is awarded. All the transaction, contractual and cost of capital costs have been transferred into either the capital or operating costs of TRAC and as such, have been transferred onto the road user in the form of toll fees - thereby implying further economic inefficiencies.

CHAPTER FIVE : ALTERNATIVES MECHANISMS OF ROAD TOLLING

5.1 INTRODUCTION

Fisher and Babbar (2003) indicate that in order to maximize the benefits of toll road concessions there should be minimum financial support forthcoming from the government. This is primarily due to the fact that governments embark upon concession projects due to political realities precluding continued funding of all road maintenance and construction from the fiscus. What needs to be investigated however is whether tolling is the most efficient of the alternative funding systems that conform to the "user-pays" condition.

To answer the above question alternative strategies are investigated below. The alternative mechanisms discussed are based on raising finances through other means as well as government financial support linked to revenue enhancements. Different methods of equity guarantees provided to a concessionaire, although important, do not impact significantly on the economic efficiency of tolling and are therefore not investigated hereunder.

5.2 DEDICATED FUEL LEVIES TO FINANCE ROADS

Pienaar and Stander (Engineering News, 17. 2001) estimated that in 1998 R6 billion was spent on building and maintaining national and provincial roads, including State contributions to the cost of metropolitan and municipal roads. In the same period the total amount paid into the national fiscus by road users was roughly R26 billion per year. As discussed previously, fuel levies have existed in South Africa for many years, however the county's current fiscal system treats all tax revenue as fungible and precludes revenue targeting. Revenues raised through a particular tax cannot thus be reserved for a single pre-specified use; instead they go into a central fund and are then allocated across all competing uses via the budgetary process. Leiman (2004) argues that even if the fiscal process changed to allow revenue targeting, fuel levies could not be efficient. This is based on the fact that an individual engine's fuel consumption is not directly linked to road usage or to road damage. For example, a tax on diesel fuel would affect drivers of small delivery vehicles, of tractors and users of generators as well as hauliers using large vehicles on the roads. Scale economies enhance the appeal of large vehicles. Certainly fuel use rises with vehicle mass, but it does so at less than an arithmetic rate, while the road damage done rises exponentially. From a theoretical efficiency point of view a simple fuel levy is thus not the answer; Leiman (2004) states that it could not act as an *optimal Pigouvian tax* to internalize the externalities of heavy vehicles. This does not mean however that fuel levies have no place. Indeed, they might help internalize externalities related to speed, since both the severity of damage to third parties and fuel consumption rise with vehicle speed.

Furthermore, whilst increasing pressure remains on government to increase the delivery of houses, social welfare benefits and security etc. it is unlikely that the government will dedicate fuel taxes to one segment of the economy. It is thus probable that the budget allocated to the SANRA will remain relatively consistent and no dedicated fuel tax will be allocated to the SANRA.

5.3 ANNUAL VEHICLE LEVIES

Annual vehicle levies are widely used internationally and are currently in place in South Africa. However, they typically appear as lump-sum annual license fees. A lump-sum tax is effectively a change in fixed costs that leaves variable (and hence marginal costs) unaffected. It can affect the decision to enter or leave an industry, but should not affect the operating behaviour of those who do not stay. Efficiency requires the internalization of external costs; a fixed charge per vehicle is neither likely to achieve this nor to be consistent with the requirements of 'Moving South Africa'. Theory prescribes a tax on variable costs, ideally one that varies with actual road use (deterioration caused). Leiman (2004) indicates that implementing such a tax would be difficult without AVI technology and sealed odometers in all heavy vehicles. Optimality would require that vehicles be weighed at random intervals and locations, and annual mileages monitored. A levy based on the observed mean and peak gross vehicle masses, and the annual mileage covered would then be levied and targeted for road maintenance. Immediately a number of problems emerge: revenue targeting would be required, monitoring and revenue collection would be expensive, the potential for evasion and corruption would be substantial, and finally, the actual use of the funds would have to be monitored. To avoid double taxation rebates would be necessary for heavy vehicles using privately constructed toll roads. Only in the absence of transactions and monitoring costs could such a system be regarded as ideal.

5.4 TRIP PERMIT SALES

Leiman (2004) argues that 'trip permit sales' is a technique which is suited to the internalization of external costs and the achievement of system-wide economic efficiency. A look at international practices in this regard shows that currently, certain USA states issue permits for each trip undertaken by a heavy vehicle - the prices of which vary to capture the road damage costs generated by the vehicles used. For example, Minnesota imposes a permit charge based on the axle configuration, weight carried, number of axles and distance covered (Federal Highway Administration, March 1995, Volume 2, Ch 2, 22/23). With adequate monitoring, appropriate penalties and a sound bureaucracy, such permit sales could circumvent certain efficiency problems of toll roads. The permit can be used in conjunction with a weighting factor designed to improve the level of compliance with vehicle regulations. Examples of this are the recommendations made in New Zealand and in the USA for a register of vehicle operators in which compliance with such factors as speed limits and load limits would be recorded. Operators with a record of overloading would be penalized by the implementation of a higher weighting. The comment made by advocates of this approach is that many vehicle externalities are consequences of operator behaviour rather than the legal operation of heavy road rigs. The combination of trip permit fees and compliance weights can help capture both problem areas. Although this seems to be a viable option, technological development costs, as well as the monitoring and operational costs are deemed to be prohibitive. In addition, it is argued that the increased tariff imposed upon heavy vehicles would be transferred to the consumer.

5.5 SHADOW TOLLS

Shadow tolls are an alternative structure, whereby the government contributes a specific annual payment per vehicle recorded on the road. Fisher and Babbar (2003) indicate an advantage of shadow tolls as being that they are paid over time and therefore may be less of a burden to the government than an up-front grant. Furthermore, they enhance the concessionaire's incentive to attract users to the facility due to the subsidised toll tariff.

The drawback of shadow tolls is that they may not use government funds efficiently enough to protect investors from revenue risk. Government contributions under a shadow toll arrangement are higher when traffic is high and lower when traffic is low. Thus government support may inadequately protect investors when traffic falls below expectations. Conversely, government support may be unnecessarily high when traffic exceeds expectations.

The inefficiencies of shadow tolls can however be countered in a number of ways, including a declining schedule of shadow toll payments as traffic levels increase or a maximum traffic ceiling above which shadow toll payments are not paid. In spite of these alternatives, the financial burden is not completely removed from the state (notwithstanding the negation of initial capital costs) and the economic marginal efficiencies of tolling remain valid.

5.6 SUMMARY

This chapter has reviewed the alternative mechanisms to tolling a road and whether one system is more economically efficient than another. From a theoretical efficiency point of view a simple fuel levy and annual vehicle levies are not viable solutions as they fail to internalize the externalities of heavy vehicles. Trip permit sales are a technique which is suited to the internalization of external costs and the achievement of system wide economic efficiency. Although this seems to be a theoretically feasible option, technological development costs, as well as the monitoring and operational costs are deemed to be prohibitive. Shadow tolls were also discussed as an alternative but they do little to nullify the economic inefficiencies of tolling.

CHAPTER SIX : CONCLUSIONS

6.1 INTRODUCTION

South African road infrastructure has traditionally been funded through general government budgets and dedicated taxes and fees rather than tolls. However, the South African Government has adopted a strategy of tolling portions of the national road infra-structure either through PPP's or toll routes owned by the SANRA.

This paper set out to investigate whether the approach of tolling the road infrastructure together with the financing, construction and maintenance of roads by means of PPP's is the most efficient economic manner to finance such an endeavour.

The objective of the work is to analyse the economic impacts of un-tolled roads, versus government financed toll roads, versus privatized toll roads.

Chapter 2 reviewed literature which focused on the current backlog in infrastructure maintenance as well as the current economic policies of the government. The economic efficiencies of tolling were then investigated

The case study analysis of a toll road project detailed in Chapter 3 demonstrated whether such economic efficiencies or inefficiencies were attained and alternatives to a PPP toll road arrangement were also investigated. The findings of this paper are presented in the following section.

6.2 FINDINGS

This section focuses on specific criteria that were shown, in chapters 2 and 4 discussing the findings pertaining to infrastructure financing and the economic efficiencies of tolling. These findings are then appraised as those in support of toll roads, and those which inhibit toll road efficiency.

6.2.1 Financing infrastructure

It was shown in chapter two that there is currently an estimated backlog of R60bn in road infrastructure in South Africa and the gap between the required funding and the funding available to maintain and construct the national road network continues to widen. Furthermore, there are huge demands on the new government for social and economic upliftment and this tips the balance of spending in favour of social needs as opposed to infrastructure development needs. In addition, it becomes clear that the government has adopted a contractionary fiscal policy resulting in limited state funding being made available to the SANRA to facilitate the construction of new roads. Burdened by these pressures, the government has adopted a strategy of tolling national roads and more recently, embarked upon a private-public-partnership (PPP) strategy in order to finance the construction and maintenance of the road infrastructure. This "off balance sheet" financing mechanism translates to concessioning sections of the national road network in order to lessen the financial burden by freeing up more money to maintain those roads funded through the national fiscus.

6.2.2 Marginal operating costs

It can be concluded that tolls levied in South Africa are not based on actual axle loading, but on potential vehicle capacity (number of axles). Light passenger vehicles are thus clearly subsidizing heavy vehicle users and similarly, along some routes, users of one section of road tend to subsidise users of another. More significantly, an increase in the number of axles reduces the damage done by a given load, yet paradoxically, the South African tolling system increases the charge in direct proportion to number of axles. It is thus important to note that the actual loading of a vehicle does not affect the toll paid and a true user-pay toll to determine the marginal operating costs should thus be based on a combination of: loading per axle / number of axles / distance covered. The costs to implement such a system remain decidedly restrictive.

TRAC however recognized the financial implications of and risk associated to overloaded vehicles at the inception of the toll concession project. Their diligence resulted in the government initiating an overload control strategy, thereby limiting the damage of overloaded vehicles on the route. Hence it can be argued that although there is a theoretical intrinsic economic inefficiency in the relative magnitude in toll charging, the implementation of a PPP has resulted in an economic gain by considerably lowering the pavement damage factor caused by heavy vehicles. This is due to the fact that PPP's attempt to eliminate the financial risk to which the shareholders are exposed to, whilst the State are seemingly less able to address such financial risk.

6.2.3 Marginal external costs

Although it is recognized that un-tolled roads create externalities for which costs are not recovered, it can be concluded that tolling a route results in larger market imperfections. The latter is due to the fact that tolling results in a diversion of vehicles to minor roads, resulting in increased in externalities such as noise and air pollution. In addition, the efficiency of the transport system is comprised as tollbooths obstruct traffic flow. Thus elevated pollution and accident rates raise the external costs imposed and create general inefficiency.

These factors were highlighted whilst reviewing the case study wherein analysis of the traffic figures on the alternatives to the N4 evidenced a considerable increase of traffic on these routes, resulting in increased marginal external costs. Furthermore, as all TRAC toll plazas are operated manually, it becomes apparent that levels of pollution have increased, thus impacting on the marginal external costs.

Economic theory also indicates that stopping at toll booths increases the marginal costs due to a potential increase in accidents. Contrary to the latter, accident statistics recorded on the N4 point to a potential economic benefit due to a reduction in the number of accidents along the route.

6.2.4 Misallocation of resources

Roads and road reserves utilize a substantial amount of land. In an efficient market, the opportunity cost of the land should be greater or equal to the price that the landowner has been paid out, to that of the present value of the net revenues the land could have generated. However, tolls have the effect of excluding some potential users from the tolled road link. These road users are either totally discouraged from traveling or continue to use the existing un-tolled section or un-tolled alternative routes, hence compromising optimal land usage and resulting in a misallocation of resources. This last was evidenced in the case study and validated by comparing 'before' and 'after' traffic count data.

6.2.5 Costs of collecting tolls

The literature review hypothesized that the costs users should bear should be limited to the short run costs of operation and maintenance, whereas the cost of collecting tolls should not form part of the operational costs. As the case study highlighted however, this ideal is not achieved in actuality. The costs of collecting tolls have indeed been transferred onto the motorist thereby signifying a further economic inefficiency.

A counter argument is however, that the inefficiency related to toll collection may be compensated by the increase in economic demand resultant from employing toll collectors which ultimately stimulates economic activity in the country.

6.2.6 Contractual efficiency

Contractual efficiencies differ significantly when comparing a state to a PPP toll project. This is related primarily to the significant costs arising from the tendering process as well as the additional monitoring costs once the project is awarded. From 1996 to the point of financial closure (7 May 1997) a transaction cost of some R96 million was accrued by TRAC and in addition, an I.E. was appointed prior to the commencement of the project to fulfill the function of the technical and contractual auditor at a cost of R1 million per annum. Furthermore, the I.E.'s appointment is ongoing until project completion (currently the I.E.'s fees are in the region of R650k per annum). All the above-mentioned transaction and contractual costs have been transferred into either the capital or operating costs of TRAC and as such are ultimately transferred onto the road user in the form of toll fees.

Clearly, intrinsic challenges facing equity investors in the PPP market include high transaction costs and a protracted procurement process for PPP projects. These severely limit the competition in the market and distort the competitive bidding process. In addition, the winning consortia eventually prices transaction costs into the deal. These transaction costs are not evidenced in a state run toll road and hence the economic inefficiencies are diminished.

6.2.7 Efficiency in raising capital

The government can borrow at lower interest rates than can the private sector. This means that in order to for a PPP to have an economic advantage, the PPP has to be more efficient in management during construction of the project and/or in realising lower operating costs from private sector management. In South Africa, all state run toll plazas are sub-contracted to companies for a period of eight years and hence the operating cost differential between a state owned and a PPP's operated plaza is considered negligible. Due to the increased margin of a PPP raising finance and the similarities in the operating of a PPP versus state owned toll road, the economic efficiencies of a PPP road become debatable.

However this needs to be considered against the true cost of apparently cheap state debt in a context of limited debt capacity, which always carries an opportunity cost.

6.2.8 Inhibiting factors of toll roads

From the above it is apparent that tolling of roads is theoretically economically inefficient. Despite this, it is seemingly not the economic inefficiencies which inhibit the decision to toll a road, but rather public resistance to tolling. One of the greatest impediments to toll roads is the public's resistance to paying tolls, especially on existing roads that the public typically consider 'already paid for' through tax revenues. Public resistance to tolling has impeded or halted private toll road programs in numerous environments. However, the concept of road pricing is still not widely accepted. Of particular concern to some opponents of tolling is the alleged inequity of charging the public, especially low-income passengers, to use a vital public facility.

A further inhibiting factor facing PPP's is the complexity of the concession process as well as the time and cost required to establish the complex legal and policy framework required for a concession, implement the program, and close financing. As discussed in the section on financing structures and sources, private toll road concessions involve highly complex legal and financial arrangements and are often difficult and time-consuming to finance. In many cases these costs may outweigh the benefits of private tolling, although increased experience and sophistication among public and private partners may reduce these costs in the future.

In addition, the competition for financing can be viewed as an inhibiting factor. Alternative investment opportunities, including water supply, prisons and other infrastructure projects, will compete with toll roads for capital. Private toll roads will be able to attract capital only to the extent that they are able to generate competitive risk-adjusted returns relative to the alternatives.

Finally, private tolling is unlikely to become a substantial portion of total highway funding simply because there are a limited number of roads, particularly new roads, with strong enough project economics to attract private financing without substantial government contributions.

6.2.9 Supporting factors

Continued growth in toll and particularly private toll road financings is supported by a number of factors. First and foremost are the funding needs of Government. The South African government will continue to experience severe funding shortfalls for road maintenance, rehabilitation, and construction. However, highway needs are expanding in spite of the fact that public funding sources are constrained by limited resources and spending priorities in other areas. The government is currently unwilling and unable to raise taxes to meet highway needs. Private tolling will thus be an increasingly attractive option for closing a portion of the highway funding gap.

Secondly, one has to take cognizance of the success of toll roads in raising capital as demonstrated by the existing 3 PPP toll concession companies in South Africa. The demonstrated success of public and private toll roads in raising capital will be an important contributor to future toll road development. In addition, as the Government gains more experience with toll roads and other types of infrastructure concessions, the legal and policy frameworks for implementing toll road concessions should become more sophisticated and supportive. Furthermore, both private industry and public entities are gaining experience and expertise in designing and implementing workable concession structures. Likewise, as experience with successful infrastructure finance transactions grows, the ability of private toll roads to access a variety of financial sources and instruments should improve. For example, institutional investors may become more important sources of capital in the future, although certain regulatory hurdles and risk issues will have to be addressed for this to happen.

The third consideration concerns the privatisation trend not only in South Africa but also internationally. The global inclination towards commercializing and privatizing state-owned enterprises and reducing government's role in the economy has increased support for private toll roads.

Finally, the development and advances in electronic tolling technologies (such as *automatic vehicle identification*) allows motorists to pay tolls without stopping thereby making toll collection more convenient, lowering toll collection costs and ultimately reducing the economic marginal external cost.

6.3 SUMMARY

In theory, the economic efficiencies of tolling suggest it would be more economically efficient not to have toll roads. However, policy-makers consider numerous non-economic issues when evaluating the viability of toll road programs. These include funding needs of Government, public acceptance of tolling, the equity of charging tolls for road use, and the impact on the government's flexibility in future road development. In particular, public acceptance is one of the overriding issues in toll road development and may be the greatest impediment to tolling. Non-economic issues tend to be greater impediments to private than to public toll road development. After taking these important non-economic issues into consideration, policy-makers may make different decisions to those recommended by a purely economic assessment.

The primary economic benefits of tolling, public or private, are the user-based funds generated to support road development and the ability to influence road use and traffic patterns through road pricing. The primary economic disadvantages of tolling are the time and cost required to implement toll systems and the potential delays and excessive traffic diversions associated with toll collection. On purely economic grounds, therefore, tolls should be used when the benefits of toll revenues and traffic management exceed the costs of implementation and any delays and excessive diversions caused by the system.

The biggest difference between public and private tolling is in the financing arrangement, since all the other links in the value chain can be contracted to private parties under either a public or a private tolling scheme.

The primary economic advantage private tolling has over public tolling is the strong incentive for financial success created by the use of private debt and equity to fund the project. In addition, the South African Government is finding it difficult to attract capital finance to a project that a private consortium is able to fund, due to conflicting areas of priority.

The economic disadvantage of private over public tolling is the potentially higher cost of developing, implementing, and administering a private concession program relative to a public tolling scheme. On purely economic grounds, therefore, private tolling should be used whenever the value of the private sector's financial incentive exceeds the additional costs associated with the private concession process.

On balance, private toll road development is likely to experience a modest increase over the next decade, with several new toll facilities financed during this period. However, the inhibiting factors are unlikely to allow for a dramatic transformation in highway funding toward private toll roads.

6.4 AREAS FOR FURTHER RESEARCH

Areas for further research are:

- Determination of South African Total Societal Costs by calculating real values for the administrative, compliance and pollution costs. This can then be utilised to determine more accurately the economic efficiencies of tolling related to the marginal external costs;
- Calculating the real values associated with the State raising capital versus the private sector doing so;
- Collecting accident statistics of a non-tolled versus a tolled route and determining the economic benefit of such. In order to be truly reflective, the entire un-tolled national network should be compared to the tolled sections;
- Using empirical values to determine whether a state managed toll road is more or less efficient than a PPP. This would ideally include case studies of all such routes.

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APPENDIX 1

TRAC
TRANS AFRICAN CONCESSIONS

Accident Rate Report for 12 Months

[1 Jan 2002 to 31 Dec 2002]

Road Section	Accidents per Million Veh-Km																							
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum
Balmoral to Eadie Street Interchange	1.59	1.59	0.00	0.79	0.00	0.73	0.00	0.69	0.00	0.64	0.00	0.61	0.00	0.57	0.00	0.54	0.00	0.51	0.00	0.48	0.00	0.46	0.00	0.44
Eadie Street Interchange to Vandyksdrif Interchange	1.42	1.42	0.00	0.83	0.00	0.77	0.00	0.72	0.00	0.67	0.00	0.63	0.00	0.60	0.00	0.56	0.00	0.53	0.00	0.51	0.00	0.48	0.00	0.46
Vandyksdrif Interchange to Wonderfontein	0.65	0.65	0.00	0.69	0.00	0.64	0.00	0.60	0.00	0.56	0.00	0.53	0.00	0.50	0.00	0.47	0.00	0.44	0.00	0.42	0.00	0.40	0.00	0.38
Wonderfontein to Belfast	0.98	0.98	0.52	0.76	0.22	0.56	0.22	0.47	0.91	0.56	0.90	0.62	0.00	0.53	0.00	0.45	0.00	0.46	0.00	0.46	0.00	0.41	0.82	0.44
Belfast to Machadodorp	0.43	0.43	0.70	0.56	0.76	0.63	0.80	0.67	0.60	0.66	0.20	0.58	0.57	0.58	0.73	0.60	0.00	0.53	0.00	0.57	0.00	0.55	1.05	0.59
Machadodorp to Cross Roads	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.58	0.00	0.48	0.00	0.41	0.00	0.36	0.00	0.42	0.00	0.46	0.00	0.50	0.00	0.47	0.00	0.43
Cross Roads to Sappi	1.00	1.00	0.00	1.15	0.00	1.07	0.00	0.99	0.00	0.93	0.00	0.88	0.00	0.83	0.00	0.78	0.00	0.74	0.00	0.70	0.00	0.67	0.00	0.64
Sappi to Montrose	0.54	0.54	0.00	0.28	0.00	0.38	0.00	0.42	0.00	0.51	0.00	0.45	0.00	0.54	0.00	0.51	0.00	0.47	0.00	0.49	0.00	0.49	1.09	0.52
Schoemanskloof	0.40	0.40	0.21	0.31	0.70	0.45	0.18	0.38	0.19	0.34	0.36	0.35	0.00	0.29	0.00	0.24	0.00	0.21	0.00	0.21	0.00	0.21	0.49	0.23
Montrose to Nelspruit West Boundary	0.15	0.15	0.00	0.46	0.00	0.43	0.00	0.40	0.00	0.38	0.00	0.35	0.00	0.33	0.00	0.31	0.00	0.30	0.00	0.28	0.00	0.27	0.00	0.26
Nelspruit Town	0.83	0.83	0.00	0.70	0.00	0.65	0.00	0.60	0.00	0.57	0.00	0.53	0.00	0.50	0.00	0.47	0.00	0.45	0.00	0.43	0.00	0.41	0.00	0.39
Nelspruit West Boundary to Kanyamazane	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.34	0.00	0.35	0.00	0.32	0.00	0.33	0.00	0.34	0.00	0.32	0.00	0.30	0.00	0.29	0.00	0.28
Kanyamazane to Barberton Turn off	0.71	0.71	0.00	0.67	0.00	0.62	0.00	0.58	0.00	0.55	0.00	0.51	0.00	0.48	0.00	0.46	0.00	0.43	0.00	0.41	0.00	0.39	0.00	0.37
Barberton Turn off to Malelane Western Boundary	1.02	1.02	0.00	0.65	0.00	0.61	0.00	0.57	0.00	0.53	0.00	0.50	0.00	0.47	0.00	0.44	0.00	0.42	0.00	0.40	0.00	0.38	0.00	0.36
Malelane Western Boundary to TSB Interchange	2.55	2.55	0.00	1.35	0.00	0.96	0.00	0.84	0.00	0.78	0.00	0.74	0.00	0.71	0.00	0.65	0.00	0.65	0.00	0.64	0.00	0.60	1.06	0.63
TSB to Hectorspruit	0.51	0.51	0.00	0.27	0.00	0.25	0.00	0.34	0.00	0.31	0.00	0.27	0.00	0.31	0.00	0.28	0.00	0.28	0.00	0.27	0.00	0.25	1.27	0.32
Hectorspruit to Lebombo Border	0.65	0.65	1.46	1.04	0.00	0.67	0.00	0.49	0.00	0.39	0.00	0.32	0.00	0.31	0.00	0.37	0.00	0.36	0.00	0.33	0.00	0.31	1.36	0.39
Ressano Garcia Border to Moamba Interchange	1.30	1.30	0.00	0.69	0.00	0.44	0.00	0.36	0.00	0.37	0.00	0.42	0.00	0.45	0.00	0.44	0.00	0.46	0.00	0.43	0.00	0.41	0.93	0.44
Moamba Interchange to Mozal Intersection	1.41	1.41	0.00	1.33	0.00	1.24	0.00	1.15	0.00	1.08	0.00	1.02	0.00	0.96	0.00	0.91	0.00	0.86	0.00	0.82	0.00	0.78	0.00	0.74
Mozal Intersection to Matola Intersection	0.52	0.52	3.42	1.91	1.47	1.75	0.49	1.42	0.47	1.22	1.48	1.26	0.00	1.07	0.00	0.92	0.00	0.88	0.00	0.84	0.00	0.77	0.42	0.75
Matola Intersection to Machava Interchange	3.12	3.12	0.00	2.01	0.00	1.87	0.00	1.75	0.00	1.64	0.00	1.55	0.00	1.46	0.00	1.38	0.00	1.31	0.00	1.24	0.00	1.18	0.00	1.12
Machava Interchange to Xai Xai Interchange	4.63	4.63	0.00	3.06	0.00	2.85	0.00	2.66	0.00	2.49	0.00	2.35	0.00	2.21	0.00	2.09	0.00	1.98	0.00	1.88	0.00	1.78	0.00	1.70
Total	1.05	1.05	0.56	0.58	0.53	0.51	0.37	0.47	0.43	0.48	0.46	0.46	0.42	0.44	0.45	0.41	0.43	0.41	0.44	0.43	0.49	0.43	0.62	0.48

Accident Rate Report for 12 Months

[1 Jan 2003 to 31 Dec 2003]

TRANS AFRICAN CONCESSIONS

Road Section	Accidents per Million Veh-Km																							
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum	Month	Cum
Balmoral to Eadie Street Interchange	0.75	0.75	0.00	0.83	0.00	0.77	0.00	0.72	0.00	0.68	0.00	0.64	0.00	0.60	0.00	0.57	0.00	0.54	0.00	0.51	0.00	0.49	0.00	0.46
Eadie Street Interchange to Vandyksdrif Interchange	0.80	0.80	0.00	0.69	0.00	0.64	0.00	0.59	0.00	0.56	0.00	0.52	0.00	0.49	0.00	0.47	0.00	0.44	0.00	0.42	0.00	0.40	0.00	0.38
Vandyksdrif Interchange to Wonderfontein	0.76	0.76	0.00	0.59	0.00	0.55	0.00	0.51	0.00	0.48	0.00	0.45	0.00	0.43	0.00	0.40	0.00	0.38	0.00	0.36	0.00	0.35	0.00	0.33
Wonderfontein to Belfast	0.92	0.92	0.49	0.71	1.08	0.84	0.21	0.67	0.00	0.54	0.00	0.48	0.00	0.46	0.00	0.43	0.00	0.40	0.00	0.43	0.00	0.41	0.20	0.39
Belfast to Machadodorp	0.62	0.62	1.79	1.18	0.20	0.83	0.38	0.71	0.40	0.65	0.00	0.54	0.00	0.42	0.00	0.35	0.00	0.31	0.00	0.30	0.00	0.29	0.85	0.33
Machadodorp to Cross Roads	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.48	0.00	0.41	0.00	0.47	0.00	0.42	0.00	0.38	0.00	0.54	1.21	0.59
Cross Roads to Sappi	1.54	1.54	0.00	1.01	0.00	0.94	0.00	0.87	0.00	0.82	0.00	0.77	0.00	0.73	0.00	0.69	0.00	0.65	0.00	0.62	0.00	0.59	0.00	0.56
Sappi to Montrose	0.00	0.00	0.00	0.77	0.00	0.71	0.00	0.66	0.00	0.62	0.00	0.58	0.00	0.54	0.00	0.51	0.00	0.48	0.00	0.46	0.00	0.44	0.00	0.42
Schoemanskloof	0.19	0.19	0.42	0.30	0.54	0.39	0.00	0.28	0.00	0.31	0.00	0.28	0.00	0.24	0.00	0.23	0.00	0.21	0.00	0.19	0.00	0.23	0.16	0.22
Montrose to Nelspruit West Boundary	0.29	0.29	0.00	0.53	0.00	0.49	0.00	0.46	0.00	0.43	0.00	0.41	0.00	0.38	0.00	0.36	0.00	0.34	0.00	0.33	0.00	0.31	0.00	0.30
Nelspruit Town	0.32	0.32	0.00	0.71	0.00	0.66	0.00	0.62	0.00	0.58	0.00	0.54	0.00	0.51	0.00	0.48	0.00	0.46	0.00	0.44	0.00	0.42	0.00	0.40
Nelspruit West Boundary to Kanyamazane	0.00	0.00	1.31	1.31	1.19	1.25	0.00	0.81	0.00	0.64	0.00	0.53	0.00	0.49	0.00	0.55	0.00	0.55	0.00	0.50	0.00	0.47	0.35	0.46
Kanyamazane to Barberton Turn off	0.22	0.22	0.00	0.86	0.00	0.79	0.00	0.74	0.00	0.69	0.00	0.65	0.00	0.62	0.00	0.58	0.00	0.55	0.00	0.53	0.00	0.50	0.00	0.48
Barberton Turn off to Malelane Western Boundary	0.48	0.48	0.00	0.62	0.00	0.58	0.00	0.54	0.00	0.50	0.00	0.47	0.00	0.45	0.00	0.42	0.00	0.40	0.00	0.38	0.00	0.36	0.00	0.35
Malelane Western Boundary to TSB Interchange	2.41	2.41	0.00	1.26	0.00	0.92	0.00	0.80	0.00	0.75	0.00	0.66	0.00	0.65	0.00	0.63	0.00	0.63	0.00	0.59	0.00	0.59	1.04	0.62
TSB to Hectorspruit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.16	0.00	0.24	0.00	0.28	0.00	0.26	0.00	0.25	0.00	0.25	0.00	0.28	0.00	0.26
Hectorspruit to Lebombo Border	0.62	0.62	1.01	0.81	0.91	0.84	0.64	0.79	0.30	0.69	0.00	0.57	0.00	0.46	0.00	0.39	0.00	0.35	0.00	0.32	0.00	0.34	0.27	0.34
Ressano Garcia Border to Moamba Interchange	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.11	0.00	0.09	0.00	0.07	0.00	0.21	0.00	0.19	0.00	0.20	0.00	0.18	0.00	0.19	0.70	0.23
Moamba Interchange to Mozal Intersection	0.87	0.87	2.03	1.40	0.00	0.93	0.00	0.82	0.00	0.86	0.00	0.83	0.00	0.76	0.00	0.76	0.00	0.76	0.00	0.75	0.00	0.73	1.53	0.78
Mozal Intersection to Matola Intersection	1.34	1.34	0.48	0.93	0.00	0.60	0.00	0.44	0.00	0.37	0.00	0.38	0.00	0.47	0.00	0.50	0.00	0.48	0.00	0.45	0.00	0.42	0.77	0.44
Matola Intersection to Machava Interchange	2.22	2.22	0.00	1.78	0.00	1.65	0.00	1.55	0.00	1.45	0.00	1.36	0.00	1.28	0.00	1.21	0.00	1.15	0.00	1.09	0.00	1.04	0.00	0.99
Machava Interchange to Xai Xai Interchange	2.16	2.16	0.00	2.94	0.00	2.73	0.00	2.55	0.00	2.39	0.00	2.25	0.00	2.12	0.00	2.00	0.00	1.90	0.00	1.80	0.00	1.72	0.00	1.64
Total	0.81	0.81	0.52	0.47	0.42	0.44	0.43	0.41	0.42	0.43	0.40	0.40	0.40	0.37	0.47	0.39	0.43	0.39	0.41	0.41	0.55	0.41	0.48	0.44