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SUSTAINABLE ROAD AND TRAFFIC MANAGEMENT: THE CASE OF A PROVINCIAL ROAD IN GAUTENG, SOUTH AFRICA

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Abstract:
This is a study of a major provincial road in South Africa's most densely settled and economic active province, Gauteng. The road plays a key role in Gauteng's transport network. The road is subjected to high traffic volumes, especially from trucks, as well as motorists using the road for a daily work commute. This study shows there is a misalignment between what the road was designed for and its present usage patterns, due to the road being poorly managed in terms of traffic volumes and load, as well as, weak maintenance regimes. The continuous traffic overloading has resulted in pavement distress and premature road surface failure, making road rehabilitation costly. As data records management and data collection procedures are weak, current road managers are unable to make appropriate rehabilitation decisions. Cumulatively, current usage and management patterns result in an unsustainable situation, whereby this major transport route is unable to function optimally, jeopardising those businesses and residents who rely on it and placing a significant maintenance burden on the public sector. This has resulted in a call to subject sections of it to a controversial and costly electronic tolling system. This study, rather, calls for better road management instead.

Key words:
Road maintenance, Road management, Traffic volumes, Overloading, South Africa, Sustainability

INTRODUCTION

In most cities, goods are transported by truck; as trucks are well suited to modern packaging and load size, enabling fast, flexible "door to door" deliveries. Thus, trucks are used in ever growing numbers in urban areas. But truck transportation consumes energy resources; destroys habitats; emits pollutants such as carbon dioxide and nitrogen oxide; generates noise pollution and can be economically inefficient [1]. Accordingly, transportation by truck is not in alignment with environmental sustainability principles [2]. Moreover, the benefits of road freight transport systems accrue to the private sector, whereas the costs, such as road maintenance, are borne by society as a whole. That is, the public sector, using tax revenues, pays for the roads and the costs associated maintenance, pollution and habitat loss [3]. This socially unsustainable and unjust situation is also true in South Africa [4].

The provincial road under study (known as the R59) is a road that suffers from extensive cracks, bleeding and potholes in both the north and south lanes of the Gauteng section of the road [5]. Due to this, the South African National Roads Agency Limited (SANRAL) has targeted the road for inclusion in its controversial electronic tolling system (the Gauteng Freeway Improvement Project or GFIP) with the notion that users should pay, via tolls, for repairs and rehabilitation[1]. This study, therefore, sought to determine what the cause of the premature road failure of the R59 is, in order to establish if tolling will help. In this regard, little is known about traffic volumes and traffic loads on this road of provincial significance. Furthermore, data for the study, collected from seven counting stations was compiled into a baseline dataset against which future increases/decreases in traffic volumes and overloading can be measured and road management decisions made.

1 TRUCKING, ROADS AND SUSTAINABILITY

A sustainable transportation system requires a good, well maintained road infrastructure. Pavements that are well-designed, durable and well maintained contribute to social, financial and environmental sustainability [6]. As the building and maintenance of roads accounts for up to 60% of the total cost of road infrastructure, managing the road surface is essential for financial sustainability. Environmentally, sustainable road infrastructure means the road surface uses as little natural resources and energy as possible and keeps greenhouse gas emissions and pollution to a minimum. In this regard, asphalt pavements are more environmentally friendly than concrete pavements [7]. This is due to, firstly, concrete pavements being energy intensive as they need reinforced concrete, and secondly, being more expensive than asphalt pavements. Thirdly, concrete pavements also generate more waste in the production process. However, in terms of life-cycle cost analysis and durability, concrete is superior as it lasts longer, is easier to maintain and requires less maintenance. An asphalt pavement requires regular rehabilitation and/or strengthening in the form of overlays [8].

That said, all pavements deteriorate over time with defects such as cracking, polishing, rutting and potholes manifesting. But, how, when and where the defects arise depends on factors such as design life, traffic loading, traffic volumes and environmental conditions (such as high temperatures or frost) [9]. For example, the combination of heavy vehicle wheel loads and high temperatures can be devastating for asphalt pavements [10]. In addition, poor construction can contribute to pavement failure. For example, inadequate pavement shoulders can lead to edge failure. Not taking drainage into account allows rainwater to penetrate the pavement from the sides and the top, causing the top layer to detach from the lower layers. Thus, deciding on what is the most sustainable road surface is a complex decision that involves taking multiple factors into consideration.

[1] http://www.destinyman.com/2015/05/21/new-e-toll-rules-pave-the-way-for-more-tolling/ [Accessed 14 April 2017].

2 THE SOUTH AFRICAN ROAD NETWORK: AN OVERVIEW

South Africa has an extensive network of around 754 600 km of both primary and secondary roads, most of which are asphalt and built between 40 and 60 years ago [11]. They serve as an important driver of socioeconomic development. However, roughly 60% of South Africa's road infrastructure is in a poor state of repair, far below the international benchmark of 10 percent [12]. These deteriorating roads are characterised by potholes, cracks, bleeding and crumbling edges. Such conditions impact negatively on freight logistics operations and increase the cost of doing business [4]. For example, in 2012, the cost of logistics in South Africa was between 50 and 100 percent higher than countries such as the United States of America, Japan and Brazil [13]. In 2009, it was estimated that bad pavement conditions cost motorists (including truckers) R20-billion[2] due to increased fuel consumption; increased vehicle repair costs and increased tyre wear [14].

The poor state of repair of South Africa's roads is in part due to the high intensity rainstorms that characterise the country, coupled with a poor water drainage system. Another cause is poor road management, exacerbated by a lack of quality control over repair work and a failure to keep overhead administrative costs low [15, 16]. More recently, a shortage of asphalt, and a significant rise in the cost thereof, has hampered maintenance efforts [17,18]. Additional challenges can be attributed to money allocated for road repair being diverted to meet other State costs and a lack of skilled road engineers. For example, the number of professional road engineers employed in the public sector is ten percent of what it was 50 years ago, despite an increased workload. Lastly, for historical and financial reasons, South Africa has almost always opted for asphalt pavements, built for a maximum of 8200 kg axels (despite the legal limit for trucks being increased to 9000 kg in 1993) with a 20-year design life. Thus, South Africa's roads are old and under engineered vis-à-vis the significant current load/volume pressure. That is, high traffic volumes and many very heavy vehicles negatively impact on South Africa's asphalt roads [11].

Road transportation has recently come to dominate the South African land transportation sector, taking over from rail. Rail was once protected by legislation, such as the Motor Carrier Transportation Act (No 39 of 1930) which only allowed farmers, local authorities and government departments to transport agricultural commodities by road [19, 20]. However, relentless pressure from the private sector to allow for more trucks resulted in incremental deregulation of the freight industry. An important milestone was the promulgation of the Road Transport Act No. 74 of 1977, which significantly deregulated the sector. Another defining moment was the 1986 National Transport Policy Study which called for further deregulation and privatisation of road transport (especially freight transport) citing rising costs. As a result, the terms for the issuing of road transport commodity permits were further relaxed. Eventually all regulation ceased with the enactment of the Transport Deregulation Act No. 80 of 1988 and the Road Traffic Act No. 29 of 1989 [21, 20]. Over time, the legal permissible weight, length, height and width of vehicles has been significantly increased such that legally, trucks can weigh as much as 62 tonnes (gross). Consequently, a massive shift in freight haulage from rail to road has occurred. Between 1980 and 2005 there was a 100 percent increase in the number of Heavy Goods Vehicles, and by 2007, some 88% or 1.4 billion tonnes of freight went by road [11, 22].

Legislative emphasis then shifted from limiting what could be transported by road to the regulation of road safety using the Road Freight Quality System (RFQS). Unfortunately, the result was that the road freight industry is now mostly unmanaged [23, 17]. For example,

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[2] The USD to ZAR exchange rate was 1USD to 7.4066 ZAR on the 30th of Dec 2009, so this was around USD2.7 billion in 2009.

the RFQS was only partially implemented and never strictly enforced [24, 25, 26, 19, 27]. For example, South Africa has 2.5 million trucks but only has 72 weighing stations, many of which have inaccurate, obsolete equipment. This makes enforcement very difficult - if not impossible [13]. The challenges associated with enforcement coupled with a failure by both traffic and judicial authorities to make overloaded trucks their concern, means that the regulation of truck mass by the Road Traffic Act (Act No. 93 of 1996) and the associated National Road Traffic Regulations are routinely ignored by truckers. As a result, there has been excessive growth in the number, size and weight of heavy trucks on South Africa's roads. In 2001, it was estimated that some 15% to 20% of all trucks are overloaded (by five tonnes on average) causing some R650 million in road damage, increased road maintenance costs and road congestion each year [28, 13]. Overloading is rife with some operators habitually breaking the law. There are instances of trucks weighing in excess of 90 tonnes [29].

With so much tonnage on the road, some on overloaded heavy vehicles, the impact on the road network is immense. These heavy vehicles damage the roads, hold up traffic and present a danger to other road users [30, 31, 32]. Accordingly, the road freight logistics system is now viewed as a key constraint to South Africa's growth aspirations because there is no holistic management of who is hauling freight, to where and what the nature of the freight is [21, 20]. Recently there have been some moves to deal with this problem, such as the amendments to the National Road Traffic Regulations [33]. However, while these amendments seek to better manage all road freight over 50 tonnes, by making insurance (Goods-In-Transit, Carrier's Liability and motor vehicle) compulsory and making operators more accountable if they overload, it is widely believed that the new regulations are onerous, vague, poorly drafted, hard to comply with and almost impossible to enforce [34].

Deregulation alone, however, was not the sole cause of the rise of trucking. Under investment in rail, poor maintenance thereof and the failure to develop an integrated alternative to road transport meant that although shipping goods by rail was cheaper, it was slow and unreliable. This served to discourage the use of rail. Currently, rail can only compete if the distance the freight must be transported is more than 600km [22]. Little will change, however, unless the regulatory environment is adapted to enable rail to compete with road in terms of price and service delivery [35]. Thus, the unmanaged deregulation of road transport combined with a failure to stop the decline of the railways means that impacts on road infrastructure and the environment continue to be ignored [36].

3 THE ROAD UNDER STUDY: THE R59 PROVINCIAL ROAD

The R59 provincial road is a regional road running between the Alberton, part of the Ekurhuleni metro of Gauteng, and Hertzogville, a small village in the Free State, a rural and depopulating province of South Africa (see Figure 1). The Gauteng section of the R59 freeway was constructed about 30 years ago to supplement a secondary road, namely the K89 (otherwise known as the Alberton/Vereeniging Road). This study focuses only on the Gauteng section of the route, both the north and south corridors (from South Rand road, Johannesburg, through Alberton, past the smaller settlement of Meyerton, as well as the secondary cities of Vereeniging and Vanderbijlpark, which are part of the Emfuleni Local Municipality, in south Gauteng). This section is the most heavily used part of the road.

The length of the road under study is 60.3km and has three sub-sections: (1) the P156/1, which runs from Alberton to Klipriver; (2) the P156/2 from Klipriver to Vereeniging and (3) the P202/1 between Vereeniging and the Free State border. The route is a strategic one, carrying significant numbers of vehicles and goods. Currently the route is part of a local 'development corridor' or designated economic node, thus traffic volumes are expected to increase over time.

It is also an important non-tolled alternative a national road, the N1. However, it appears that there are long term plans to incorporate the R59 into the highly controversial GFIP e-toll project.

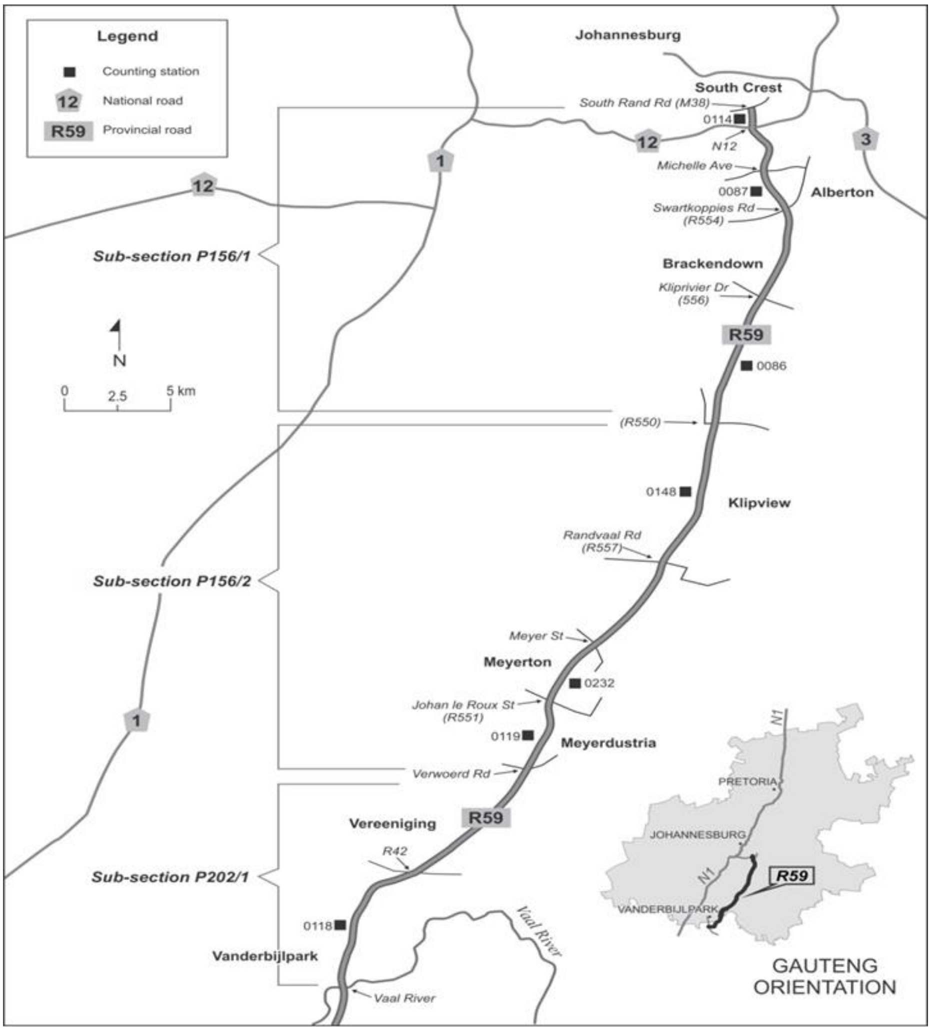

Fig.1 *The Gauteng section of the R59 from South Rand road, through Alberton, past Meyerton, and Vereeniging, ending with the 0118 counting station north of Vanderbijlpark (Source: Authors).*

4 METHODOLOGY

Traffic data for the study was supplied by Gautrans, a provincial authority tasked with managing the road. Gautrans released its yearbooks (which are not in the public domain) to the authors. The Gautrans Yearbooks for 2007; 2009; 2010; 2011; 2012 and 2013 capture data collected from the seven counting stations situated along the R59 [37,38,39,40,41,42]. The following data were extracted from the yearbooks: The average daily traffic (ADT); the average daily heavy traffic (ADHT); the night traffic (NT); the percentage truck split (light, medium, heavy trucks); the E80/HV data (weight); the average number of axles per heavy vehicle; the average mass per heavy vehicle; the peak flow patterns and, lastly, the speed profile on the road. The study sought to analyse this data to determine: (1) Traffic volumes and types found on the R59; (2) Traffic loading; (3) Heavy vehicle usage (split); (4) The classification of the road [according to the heavy vehicle composition]; and (5) The extent of heavy vehicle overloading.

Internationally, roads are classified according to the composition of heavy vehicles using them. This classification is known as ‘percentage truck split’. The percentage truck split is a ratio of short heavy vehicles (2-axles or 4.6 - 11m long): medium heavy vehicles (3 to 4 axles or 11 - 16.8m long): long heavy vehicles (5 or more axles or >16 m long). In this study classification methods set out by (1) the pre 1994 provincial government [43] which relied on the Bosman (1988) method and (2) the Bosman 2006 method were used.

These guidelines are: (1) If two axle heavy vehicles constitute more than 70 per cent of the truck split, then the road is a L1 road; (2) If two axle heavy vehicles constitute between 55 per cent and 70 per cent of the truck split, then the road is a L2 road; (3) If two axle heavy vehicles constitute between 35 per cent and 55 per cent of the truck split, then the road is a S1 road; and (4) If two axle heavy vehicles constitute less than 35 per cent of the truck split, then the road is a S2 road. Bosman (1988) proposed two main classes, namely roads carrying Light-Heavy Vehicle traffic (sub divided into 2, 3 and 4 axles) and roads carrying Heavy-Heavy Vehicle traffic (sub divided into 5, 6, 7 and 8 axles) [44].

The Bosman 2006 represents an update of the Bosman 1988 method and was brought about because much heavier trucks (5- to 8-axle heavy vehicles) now ply the roads, and lighter heavy vehicles also now carry greater loads [32]. Thus, the Bosman 2006 method classifies South African roads into three classes, namely: (1) If short heavy vehicles constitute more than 55 per cent of the truck split, then the road is a Low Heavy Vehicle Road or L Road; (2) If short heavy vehicles constitute between 35 and 55 per cent of the truck split, then the road is a Medium Heavy Vehicle Road or M Road; and (3) If short heavy vehicles constitute less than 35 per cent of the truck split, then the road is a High Heavy Vehicle Road or H Road. These guidelines informed the data analysis of this study with respect to road classification.

The trends in the average daily traffic, average daily heavy traffic and night traffic were analysed by using the averages for the counting stations for each year to obtain an overview of the entire road. Unfortunately, the data was inconsistently collected by Gautrans. For example, secondary counting station data was not always collected for the same periods of time and annual traffic counts were not always conducted. Thus, there are significant gaps in the data (see Table 1).

***Tab. 1** Data collection periods of the 7 Counting Stations on the R59 for 2004 – 2013 (Note: Station 0087 is a permanent station).*

Station	0086	0087	0114	0118	0119	0148	0232
2004	29/09 – 11/10	Not surveyed	11/03 – 22/03	03/09 – 09/09	02/09 – 09/09	16/06 – 26/06	Not surveyed
2005	Not surveyed	07/10/ - 31/12	Not surveyed	Not surveyed	Not surveyed	Not surveyed	Not surveyed
2006	Not surveyed	01/01/ - 31/12	Not surveyed	Not surveyed	Not surveyed	Not surveyed	Not surveyed
2007	17/10 – 25/10	01/01 – 31/12	Not surveyed	26/09 – 08/10	25/10 – 02/11	01/01 – 31/12	25/10 - 02/11
2009	Not surveyed	13/08 – 31/12	Not surveyed	Not surveyed	30/10 – 09/11	18/09 - 16/09	08/09 – 16/09
2010	23/03 – 01/04	01.01 – 31/12	11/11 – 29/11	28/09 – 07/10/	Not surveyed	11/05 – 19/05	20/10 – 28/10
2011	21/11 – 29/11	01/01 31/12	01/01 – 31/12	24/11 – 01/12	06/10 - 14/10	04/10 – 13/10	06/10 – 11/10
2012	Not surveyed	01/01 – 14/02	01/01 – 31/03	Not surveyed	Not surveyed	Not surveyed	Not surveyed
2013	Not surveyed	Not surveyed	30/06 – 31/07	Not surveyed	23/08 - 30/08	23/08 – 30/08	Not surveyed

Source: Gautrans Year Books 2007-2013

Overloading was determined by comparing the average number of axles per heavy vehicle to the mass of the heavy vehicle. This was then compared to the legal mass as per the National Road Transport Act No 93 of 1996. A number of problems were encountered. Firstly, it was difficult to determine if the road was under engineered as the original design data for the road has been lost. Thus, it had to be inferred from other Gautrans documents. Secondly, design criteria for the 1996 and 2006 rehabilitation of the road were also not available.

5 RESULTS

The data from all of the counting stations between Alberton and the Free State border was collated per counting station (see Table 2). Average daily traffic, average daily heavy traffic and night traffic all increased between 2004 and 2013. The typical average traffic volume for the study period was 378 vehicles per lane per hour in both directions. As Table 2 shows, there is a 50 % increase in the average daily traffic between counting stations 0114 and 0087. The volume of traffic stays constant thereafter until counting station 0119 when it drops by 53 % at counting station 0118. The sharp increase at counting station 0087 is most likely due to it being permanent station, collecting data all year round. Thus, it is likely that the data for this station is more accurate and that the other stations reflect an undercount. The sharp decrease in traffic at station 0118 [which is located on the border between Gauteng and the Free State] may indicate that little traffic originates in the Free State or travels to the Free State on this road. The Average Night Traffic shows a similar pattern, with a sharp increase (of 52%) at the permanent counting station. It seems that most night traffic originates in the towns of Alberton and Meyerton. In terms of the Average Daily Heavy Traffic, there is a steady increase from north to south, with the bulk of the heavy traffic found in the industrial areas of Klipview, Meyerton and Meyerdustria.

Tab. 2 *Average values for each counting station for the period 2004 – 2013 (Stations are listed from North to South or station 0114 to station 0118. Station 0087 is permanent.*

Counting Station	0114	0087	0086	0148	0232	0119	0118
Location	South Crest	Alberton	Brakendowns	Klipview	Meyerton	Meyerdustria	Vaalriver
Average daily traffic	28 435	56 665	37 704	37 860	33 938	33 960	16 055
Average daily heavy traffic	2 510	4 234	4 926	5 573	5 880	5 781	3 072
Night traffic	4492	6453	6092	5 763	6253	3630	2497

Source: Gautrans Year Books 2007-2013

Average daily traffic increased by 22% between 2004 and 2013 or an average of 2.4% per year. The average daily heavy traffic increased 19% over this period, or 2.1% per year; whereas the night traffic increased by 16% increase or 1.8% per year. So, traffic volumes on the road have increased over time, with a combined increase of light vehicles, trucks and night traffic of 2.1% per year. However, there was a decrease of nine percent in the average daily traffic between the years 2009 and 2011, and 5% for night traffic, most likely due to the economic recession [45]. Interestingly, average daily heavy traffic dips (by 14%) prior to the decline in other traffic, and also increases ahead an increase in the other traffic. As heavy vehicles are used to transport freight, economic upturns or downturns seem to affect heavy vehicles volumes first. Thus, the pattern of heavy vehicle use of the R59 may be a proxy economic indicator. That is, a decline in trucking volumes may predict a future economic downturn and an uptick in heavy vehicle traffic may predict a future increase in economic activity.

Between 2012 and 2013 there was a 17% reduction in the average daily traffic and a 42% reduction in night traffic. The average daily heavy traffic on the other hand showed an increase of 24%. This anomaly is probably due to a change in the data collection system and methods due to challenges relating to the awarding of a new counting tender (pers comm Pierre van Heerden, Gautrans, 07/08/2014). That is, the 2012 data is only for the first quarter. In addition, there were periods when only two counting stations (one of which was the permanent one) were operational. Also, in 2013, no data from the permanent station was collected. Thus, the 2012 and 2013 data is different to the other years under study due to methodological differences and different companies being involved in the process [in 2012, TES Trust collected the data, whereas in 2013, Mikros Traffic Monitoring did]. Thus, data for these two years may be less reliable than data for the other years under study.

The study found that the R59 experiences peak traffic flows. The traffic flow shows a classic morning and evening peak representing a daily commute from the Vanderbijlpark/Vereeniging to Alberton and, most likely onwards to Johannesburg and even Pretoria (although some commuters may be travelling even further than this). Thus, people are living in Vanderbijlpark/Vereeniging and working in the north. The Monday morning peak appears to be the highest for the week, with a decline towards Friday mornings, thus fewer commute on a Friday. In terms of the afternoon peaks, Thursday afternoons show the highest afternoon peak. The Friday afternoon peak is also lower than for the rest of the week. Peak traffic travelling to the south also starts earlier on Fridays. This may be due to the work day ending earlier on Fridays for some. On a Sunday afternoon, there is a peak in traffic heading north. Thus, it could be that some people are living in Johannesburg or its surrounds for four days of the week, travelling north on Sunday afternoon or Monday morning and then travelling home on Thursday afternoon/evening (to reduce their overall commute time and length). Also, there is a weekend migration of the "weekend warriors", people who have a second home on the Vaal River to participate in recreational activities.

These commuters are travelling at least 120.6km a day to get to work and back. Over a month, this is at least total of 2592.9km, but most likely to be higher as this figure only acknowledges the length of the road under study, whereas it is probable that most commuters travel further as they must onramp and offramp the R59 to get to their places of work and back again. A commute of such length will be exceedingly costly for these people. This commute from Vanderbijlpark/Vereeniging may be due to people electing to live in Vanderbijlpark/Vereeniging because housing is cheaper; crime is lower and access schools is easier but here are fewer jobs (both cities are deindustrialising and multiple factories are closing due to poor economic conditions) so people must travel north to Johannesburg, Ekurhuleni and Pretoria/Tshwane for work.

In terms of heavy trucking, the volume of heavy vehicles on the road peaks during mid-day and is at its lowest at night. Very few heavy vehicles ply the road on a weekend. It can thus be stated that South Africa still follows the traditional workweek model of working Mondays to Fridays, with little evidence of flexihours to attempt to manage peak traffic. Long heavy vehicles on the R59 increased in percentage terms between the years 2004 – 2009 and then decreased between the years 2009 – 2013. The decline in long heavy vehicles coincided with increase in short heavy vehicles on the road. Between 2007 and 2013 the number of short heavy vehicles has increased (see Figure 2). These shifts may in part be attributable to (a) an increase in the price of diesel and (b) the 2008 economic downturn. In Gauteng, diesel increased by 350% between 2004 and 2013 and represents a strong incentive to economise. It may be that during an economic downturn, companies use short heavy vehicles or consolidate loads into one long heavy vehicle to save on diesel and driver costs. As the economy started to slowly recover, the truck split pattern returns somewhat that to which prevailed in 2004.

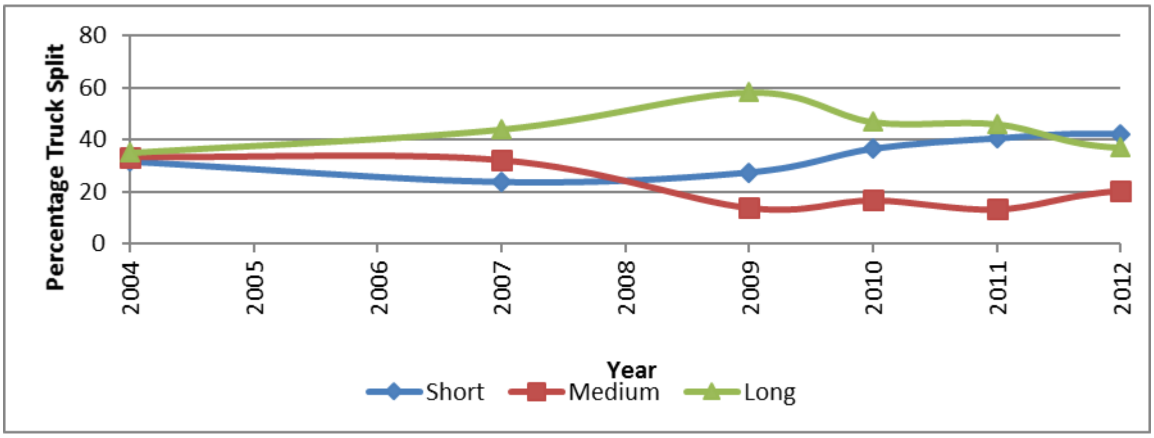

Fig.2 *Percentage Truck Split, 2004 to 2013*
(Source: Gautrans Year Books 2007-2013).

Using both the 1988 and 2006 Bosman systems and the R59 truck data, the R59 was classified and the results are presented in Table 3. On this basis, it can be said that the R59 is an S (or H) road. This suggests that if the R59 road surface is ever replaced, concrete should be used due to the load it carries. This road classification can be also used to inform any subsequent rehabilitation of the road, as it eliminates the need for costly axle mass surveys.

Tab. 3 *Classification of the R59, 2004 to 2013 (Note: For 2012 and 2013 the road is at the very upper limits of the M classification).*

Year	**Percentage Truck split**			**Classification of road**	
	Short	**Medium**	**Long**	**TRH16 (1991) Bosman (1988)**	**Bosman (2006)**
2004	32	33	35	S2	H
2007	24	32	44	S2	H
2009	28	14	58	S2	H
2010	37	17	47	S1	M
2011	40	13	46	S1	M
2012	42	21	37	S1	M
2013	36	24	39	S1	M

Source: Gautrans Year Books 2007-2013

Overloading is determined using the average number of axles as well as, the average mass per heavy vehicle. A comparison of the masses obtained from the 0087 permanent counting stations is shown in Table 4. The data demonstrates that trucks exceeded their legally permitted mass for all the years understudy except for 2011 and 2012. In general, medium and long heavy vehicles with four or more axles are more overloaded. Secondly, overloading can also be determined by using the direct measurement of weight from the permanent counting station. This data showed that there is a definite pattern of overloading on the R59 during the period 2005 to 2013 for both northbound and south bound traffic, but the northbound traffic is more overloaded than southbound traffic.

Tab. 4 *Average number of axles/mass per heavy vehicle, 2004 to 2013*

Year	**Average Nº of Axles per heavy vehicle**	**Average mass per heavy vehicle (in Tonnes)**	**Legal Mass (Tonnes)**	**Status**
2004	4.8	24.2	24	Overloaded
2005	5	29	24	Overloaded
2006	5	29	24	Overloaded
2007	5.2	29.4	24	Overloaded
2009	5.2	27.6	24	Overloaded
2010	4.8	27.7	24	Overloaded
2011	5	24	24	Not overloaded
2012	5	24	24	Not overloaded
2013	4.3	26.5	24	Overloaded

Source: Gautrans Year Books 2007-2013

6 DISCUSSION

The current usage patterns of this road are unsustainable because the heavy truck traffic is, for the most part, unmanaged and truck load size regulations are unenforced. So, if road surface distress is to be reduced then better load control of long heavy vehicles is urgently required. This would entail strict enforcement of legal mass per axel number by provincial authorities. To achieve this, it is recommended that an additional permanent traffic counting and weighing station is erected either between Vereeniging and Sasolburg or between Vereeniging and Meyerton, on both the north and south sides of the R59. Additionally, as these overloaded vehicles are on-ramping and exiting the R59 to and from secondary roads, it is recommended that local authorities join forces with provincial authorities to manage this situation as the damage such vehicles can cause to secondary roads is immense.

The study has demonstrated that the road is a S2/H road and this should be taken into account when maintenance decisions are made, such taking the strength requirements associated with this heavy vehicle usage into account. It is also highly recommended that traffic data collection is improved. For example, the collection of data by secondary stations should occur at specific times of the year for all the stations so that data can be easily compared year-on-year. Secondly, all temporary stations should be used for data collection to eliminate huge gaps in the data so as to provide a clearer picture of annual variations. Furthermore, it is important to ensure that the data tender process commences timeously so as to prevent gaps in occurring in the data due to time gaps between the ending of one tender and the start of another. For the R59, the root cause of the road failure problem lies with poor management of heavy trucking and a failure to make appropriate road maintenance decisions. Tolling this road will not solve these problems, but will have, instead, a significant negative financial impact on the commuters using it for get to work and is, therefore, not recommended.

7 CONCLUSION

The peak traffic flows recorded on this road confirm that it is a vital commuting route for many Gauteng residents. If the proposed tolling of this road proceeds, the already very high cost of commuting will only worsen. Although the increased traffic volumes are a cause of the road damage, environmental pollution, road safety problems and congestion, the main culprit is trucks, especially overloaded ones. Tolling will not solve this problem. Thus, the road freight industry needs to be better managed to stop the routing of excessive numbers of large, overloaded heavy vehicles onto this road. Laws regarding overloading must be enforced. Better management by controlling the weight, size and number of the heavy vehicles on the road is recommended over tolling. The manifestation of cracks, bleeding and potholes on the road mean that although the road has been rehabilitated twice, more repairs are required. In this regard, rehabilitation must take usage patterns into account as currently usage exceeds design specifications. If not, then poor road conditions and maintenance issues will continue. As it is likely that there is also a knock-on effect associated with overloading onto secondary roads that form part of the R59 road network, which warrants further study.

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