ROAD FREIGHT AND THE ENVIRONMENT

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ABSTRACT

Freight transportation is one of the major contributors to economic development in a country. During a recent study, it was found that little information is available in terms of the cost of crashes to the environment. Environmental impacts of road freight transport are categorised as direct or secondary impacts. Externalities are an economic concept that refers to activities that have unintended consequences, positive or negative consequences. This review considers the different environmental links between heavy vehicle transport and the environment. Gauteng is used as an example to highlight the importance that freight plays in the province and highlights the need for adequate freight data to address environmental costs of freight crashes.

1. INTRODUCTION

The Department of Transport recently investigated the impact of freight crashes on South African roads. The study entailed investigations into the causes and consequences of freight crashes in South Africa as well as recommendations toward curbing these crashes. The research included a review of all available crash databases (toll concessionaires, national entities, provincial and local crash data bases) surveys with operators and a range of workshops with stakeholders in an attempt to understand the impact of road freight crashes in South Africa. Representation was obtained from operators with a national and cross border footprint as well as representation in all the provinces accepts the Northern Cape. Most of the operators were involved in the transportation of hazardous goods.

One of the key findings from the study revolves around the poor quality and availability of freight crash data and the fact that data sources do not seem to correspond with each other. The research was mainly concerned with freight crashes but also explored different types of crash costs including environmental costs. Environmental costs due to crashes was however difficult to quantify as little information is available. The need for reliable freight data has previously been recognised by the Department of Transport (DoT) and resulted in the publishing of the Freight and Logistics Strategies published in 2005 (Department of Transport, 2005) and 2011 (Department of Transport, 2011). Reliable information is needed to address issues such as excess freight, overloading, poor road conditions; ineffective law enforcement, slow regional integration and a poor road safety record, in order to find sustainable long-term solutions that will facilitate safe, efficient transport as set out in the 1999 White Paper.

2. PURPOSE OF THIS PAPER

This paper stems from the DoT research where a gap was identified in terms of South African information related to freight crashes and the costs thereof to the environment. This review considers the multidimensional links between transport and the environment. In order to contextualise the problem, Gauteng is used as an example to highlight the importance that freight play in the province.

3. IMPORTANCE OF FREIGHT IN SOUTH AFRICA

Freight transport is essential to the economy of any country, linking the demand from different industries with supply and generating a significant proportion of a country's Gross Domestic Product or GDP (Londoño-Kent 2009). South Africa is no exception with 90% of freight moved on road (Havenga, 2015). According to the 13th Annual State of Logistics for South Africa; the industry contributes to between 12.5% and 14% of the National GDP annually (Viljoen et al., 2014; Van Dyk et al., 2006). Van Dyk et al. (2006) and Havenga et al (2013) underlines the importance of quantifying logistic costs as these are integral to measuring economic growth, socio-economic development and regional integration.

Cronin (2011) highlights the fact that during the previous disposition, the deregulation of the road freight industry contributed to rail losing market share and it can be argued that this deregulation ultimately resulted in the skewed split seen between rail and road today (Cronin, 2011). The post-apartheid legacy of South Africa and the current socio-economic conditions might have led to planners capitalising on social and economic welfare irrespective of whether the environment is at risk or not.

According to the Road Traffic Management Corporation (RTMC) reports approximately 3% of the total vehicle population between 2004 and 2010 were heavy vehicles (trucks > 3500 kg or more). According to Roux and Salie (2010) the number of registered trucks increased by 3 486 (1.10 %) in December 2008 to a total of 321 604 in December 2009. The number of heavy loads trailers increased by 1 994 (1.38 %) to a total of 144 408. Grundelingh (2014) stated that between 2004 and 2008 truck sales increased dramatically although a slump in sales were observed during the 2008 recession it again escalated steadily on a year by year basis from 2009 to 2014. This is significant as this means that on a yearly basis more and more trucks are frequenting South African roads which essentially have implications for growing the economy. At the same time it raises concerns related to the increases in operational costs as well as increased costs to society as well as to the environment.

4. FREIGHT, URBAN AREAS AND THE ENVIRONMENT

4.1. Externalities and costs of freight to the environment

Research pertaining to freight and the environment focuses on both sides of the coin- the impact that freight has on the environment (Karani 2009; DoT, 2006) as well as the impact of the environment on freight and especially freight costs (Steyn et al., 2012; Mashoko et al., 2014).

The Annual State of Logistics Survey (SoL), published annually since 2003, tally the different cost aspects for freight in South Africa year-on year and compares different freight and logistic aspects for South Africa, African as well as international countries. The costs considered in this publication include direct logistic costs related to the GDP, national and provincial logistic costs as well as operational costs incurred on an operator level (inventory, administration management and so forth). External costs measured include crashes, carbon emissions, pollution and policing (Simpson et al., 2012).

According to Rodrigue (2013) externalities refer to activities that have unintended consequences, positive or negative and are not always addressed by the entities causing them. Mashoko et al. (2014) explain that externalities are situations where the causing entity does not pay for the negative action nor does the receiving entity receive any compensation due to the negative effect the action had on the economy, society or the environment.

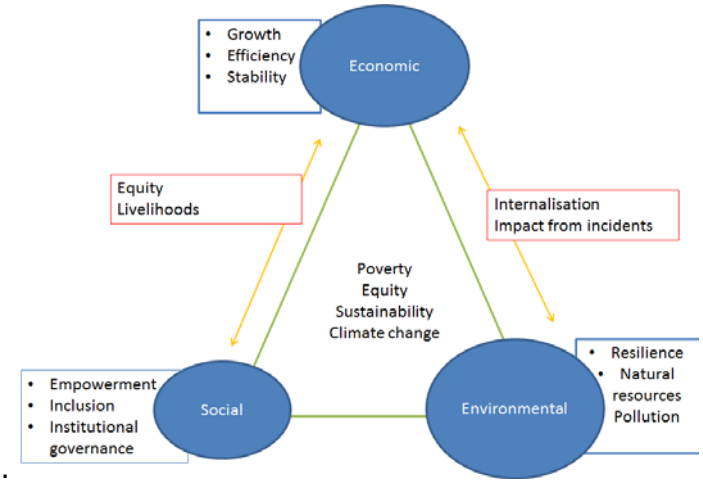

Figure 2: Conflict between the environment, economic and social factors (adapted from Munasinghe, 1993)

Rodrigue (2013) emphasises that when considering environmental externalities it should include physical cause and effect to the environment as well as costs to society. A triangle of conflict (figure 2) continues to exist between the environment, social and economic factors, especially if one or two of these factors are compromised in order to fulfil the other (Munashinge, 1993; Mensah and Castro, 2004).

4.2. Freight in Gauteng as an urban environments

Efficient transportation system is critical to ensure economic development and Wittlöv (2014) states that freight transport responds well to the requirements and development of urban economies. Gauteng Province is such an example as the Province is currently a gateway for doing business in the rest of Africa. Gauteng is the smallest of the provinces but (covering only 1.4% of the South Africa's land area), contributes 33% to the national economy 10% to the GDP of Africa (SouthAfrica.info, 2014). The 25 year Integrated Transport Master Plan for Gauteng states that there are more than 100 registered industrial areas in Gauteng which are considered major freight transport generators (Gauteng Department of Roads and Transport, 2013). As the economic hub, Gauteng therefore requires transport routes to the major ports South Africa. In 2003, Markman et al highlighted the fact that high levels of congestion on Gauteng's road network as a big problem as it leads to loss of productivity, longer travel times, increased fuel consumption, emissions and restricts regional accessibility. Marsay (2014) has predicted that corridor freight originating from Gauteng (to Beit Bridge, Maputo, Richards Bay, Durban, East London, Port Elizabeth, Cape Town and Walvis Bay) will grow with 182% between 2011 and 2024.

Figure 2 below shows the number of active heavy vehicles on South African roads and from the graph it is evident that Gauteng, as the economic hub, is the busiest in terms of freight movements.

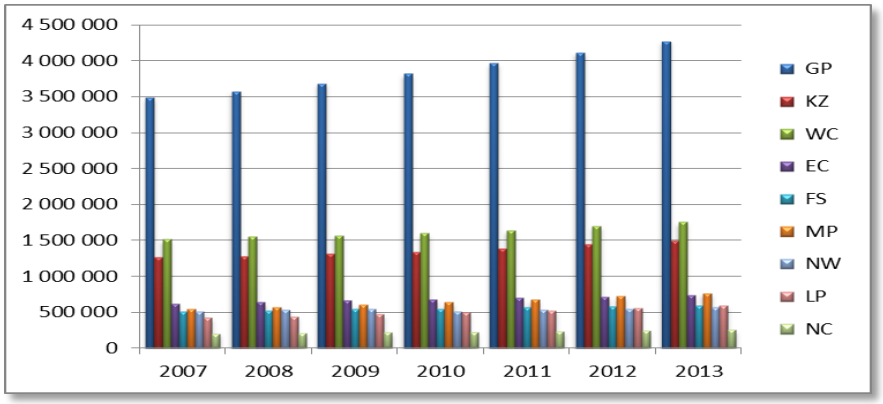

Figure 2: Total active vehicle population per province (TASIMA, 2015)

Despite being a contributor to economic development, at the same time, freight is also a major contributor to negative social and environmental impacts, particularly with regards to congestion, local air pollution, and noise. Wittlöv (2014) states that in Europe, urban areas constitute "the last mile" of freight transport, and generate approximately 28% of the transport costs. Traditionally, planners and policy makers has, therefore, viewed freight in urban areas as problematic and thereby has restricted freight access to city centres and urban areas in an attempt to to reduce externalities such as congestion, pollution, noise and crashes.

Havenga (2015) illustrates that South African transport costs also surged with externalities such as damage to roads and damage to vehicles, crashes and emissions adding to transport logistic costs in South Africa. The cost of freight has for example through the years risen significantly due to poor road environments and the condition of South Africa roads. Steyn et al. (2012) as well as Mashoko et al

(2014) show that deteriorating road conditions in South Africa not only contributed to truck maintenance and repair costs but contributed to monetary losses as a result of damaged goods as well as increases in freight crashes (Mashoko et al., 2014). On the other hand, in 2011, Nordengen stated that South Africa has seen a 32 % increase in freight vehicles on national and provincial roads between 2001 and 2011. Fifteen to 20 % of these vehicles were overloaded causing damage to the road infrastructure as well as making the road environment increasingly dangerous for other road users.

Viljoen (2014) states that emission costs is probably the best known externality. Across the world transport has been a major contributor to CO^2 emissions (VanDerSchuren et al., 2005). Havenga (2015) highlights that current estimates around the world are that transport contributes to 23% of emissions globally and that of this freight contributes approximately 10%. Various measures have been put into place to curb this externality ranging from the introduction of emission taxes to managing driver behaviour better (VanDerSchuren et al., 2005).

From a public perspective carbon emissions add to health costs, infrastructure damage and have a negative impact on food produce, ecosystems and biodiversity (Swarts et al., 2012, Viljoen et al., 2014). As with CO^2 emissions, noise is inherent to transport and affects specific locations through vibrations which is absorbed through the environment (Roderigue, 2013).

4.3. Freight crashes and the cost to the environment in Gauteng

Freight crashes are considered a major contributor to logistic cost (Swarts et al., 2012, Mashoko et al., 2014; Havenga, 2015). Viljoen et al. (2014) however emphasise that costs associated with freight crashes are one of the highest externality costs in South Africa. Swarts et al. (2012) estimated the cost of freight crashes in South Africa to be in the region of 11 billion rand for 2010.

According to the RTMC report (2010/2011) the rate of heavy vehicle crashes per 10 000 registered trucks has since 2004 increased across the country (Table 1 below).

Table 1: Fatal crashes per 10,000 registered heavy vehicles according to province (RTMC annual report 2008-2009)

Year	GP	RSA
2004	2.8	4.9
2005	1.4	4.3
2006	2.5	9.0
2007	2.3	8.2
2008	5.0	23.0

The City of Tshwane stated that freight transport contribute to increased traffic congestion leading to higher crash rates (Integrated Transport Plan 2006-2011). Both light vehicles and freight contend for diminishing road space in the province (Integrated Transport Plan 2006-2011). The Department of Transport (2006) indicated that an increase in the time travelled as well as an increase in kilometers travelled contributes to congestion, higher levels of noise and higher possibility of

crashes. In 2005, Golob and Regan indicated that heavy vehicle crashes are correlated with traffic flow conditions and road way characteristics on urban freeways in Southern California. The researchers investigated 19 000 crashes over a two year period and found that 10 % of these urban crashes involved trucks with at least six wheels on the road. Golob and Regan (2005) also found that the likelihood of a truck being involved in a crash is a decreasing function of the number of lanes as well as the annual daily traffic per lane. The research indicated that truck crashes due to incorrect lane changing behaviour, merging behaviour were the most prevalent form of crashes, followed by rear end crashes. Heavy vehicle crashes in urban areas are also a major source of delays (Golob et al, 2005). Congestion also leads to increases in air pollution that again increases the rate of climate change dynamics, and both the environmental and health effects of climate change are gradually being reported.

One of the key recommendations in the Gauteng 25 year Integrated Master Plan was to reduce the number of heavy vehicles with access to city centers (CBDs) as this is expected to significantly reduce the costs associated with crashes and congestion (Markman and Van As, 2003; Gauteng Department of Roads and Transport, 2013). This is in line with previous European practices where previously policy makers and planners introduced measures such as vehicle time regulations, vehicle weight and size regulations, and route restrictions such as advisory or mandatory routes for goods vehicles. Wittlöv (2014), however, also states that internationally, a paradigm shift regarding urban freight is taking place. Planners and policy makers are rethinking restrictions to urban freight in order to accommodate urban freight in support of local social, environmental and economic development.

4.4. Qualitative findings from the DoT freight crash analysis study

Freight crashes was a prominent news feature in 2014 and in November the DoT proposed new regulations that will restrict freight operations to specific routes and hours (Supply Chain Update, 2015). There are, however, serious concerns from the freight industry as the feeling is that these restrictions will in fact increase operating and externality costs rather than reducing heavy vehicle crashes on the roads.

From the research conducted for the DoT in 2014, it became clear that very little specific information for crashes involving heavy vehicles on a micro level is currently available. With reference to Gauteng, an overview of databases revealed that none of the two metropolitan databases or the national databases had any provision for entries related to freight crashes that involved environmental factors, hazardous goods or human factors (associated with driver behaviour and so forth). Two of the toll concessionaires operating in the province have made provision for entries related to hazardous goods and chemicals and all three toll concessionaires captured additional information related to crashes in a “sub-cause” column. Operators are under no obligation to report company crash statistics to government. They are, however, obliged to report crashes to authorities, hazardous goods incidents to the DoT and in the event of environmental damage the company is responsible for the cleaning and rehabilitation of the environment.

Industry initiatives exists that can potentially assist operators with guidelines for the safe transportation of dangerous goods, accreditation for transporting hazardous goods and initiatives such as the Road Traffic Management System (RTMS) that promote self-regulation in industry. However there was a perception that only larger operators can afford to subscribe and belong to these initiatives. These initiatives do however promote a holistic perspective for managing freight operations in terms of the economy, society and the environment.

5. CONCLUSION

Freight operations are essential to the development of a country's economy. The costs of freight related to the environment is however high in especially urban areas such as as Gauteng. In the event that exponential logistic growth will take place in the province as is predicted, it is expected that the externalities will also increase. In order to curb and manage the costs of freight, a holistic approach that encompasses all three key elements (economy, environment and society) is needed. This though is not possible in the absence of reliable freight data.

Access to relevant data is of fundamental importance for long-term decision making, especially for authorities such as Gauteng where the expectations are that the demand for more space, more goods and increased logistic activities will escalate within the next ten years. Authorities, planners and policy makers need reliable and acurate data to build urban specific freight models which contribute to livable and sustainable cities. In order to make meaningful inputs into future policy and legislation changes such as driving restrictions in urban environments, reliable freight data is essential and there is clearly a need for improved reporting not only from government agencies but operators as well to ensure that reliable freight data is collected. Improved freight data could potentially contribute to a long-term better understanding; planning and design of interventions to address all costs associated freight operations.

REFERENCES

Cronin, J, 2011, 'The Future of Rail.', *Opening Address - Railways & Harbours Conference,* Johannesburg.

Department of Transport, 2006, *'Transport, Environment and Health in South Africa'.* Transport Policy Analysis and Environmental Co-ordination, Pretoria.

Federal Highway Administration, 2013, '*The Economic Costs of Freight Transportation*, accessed on the 19 May 2015 available online at http://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/costs.htm.

Gauteng Department of Roads and Transport, 2013, '*25 year Intergrated Transport Plan: Annexure I Freight Strategy*, Gauteng Province, Johannesburg.

Golob, T.F. and Regan, A, 2005, 'Traffic conditions and truck accidents on urban roads', *Annual Meeting of the Transportation Research Board ,*National Academies of Science, Washington D.C., pp. 1-38.

Grundlingh, G, 2014,*'RSA New Vehicle Sales 2004-2013 - NAAMSA Statistics' accessed online at* http://environment.fhwa.dot.gov/projdev/tdmimpacts.asp

Havenga, J.H, 2015, 'Macro-logistics and externality cost trends in South Africa-underscoring the sustainability imperative', *International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management*, 18(2)pp. 118-139.

Havenga, J.H., Pienaar, W.J. and Simpson, Z, 2011, 'A case for measuring logistics costs on a national level: a South African application', GeoCities, pp. 1-13.

Havenga, J.H., Simpson, Z.P. and De Bod, A, 2013, 'Macro-logistics trends: Indications for a more sustainable economy', *Journal of Transport and Supply Chain Management*, 7(1), pp. 1-7.

Karani, P, 2009 *'Environmental implications of the road network in South Africa',* Development Bank of South Africa, Pretoria.

Londoño-Kent, P, 2009. '*Freight transport for development toolkit: Road Freight*', Transport Research Support document, World Bank Washington D.C. :.

Markman, M. Steynberg, S. and Van As, C, 2003, 'Gauteng congestion strategy heavy vehicle', *South African Transport Conference,* Pretoria, Document Transformation Technologies, pp. 1-10.

Marsay, A, 2014, 'A comparison of road vs rail investment': options on the Gauteng-Durban Corridor',*Road Pavements Forum,* Gateway Centre, Mhlanga.

Mashoko, L., Bean, W.L and Steyn, W.JvdM, 2014, 'Investigating the Environmental Costs of Deteriorating Road Conditions in South Africa', *The 33rd Annual Southern African Transport Conference*,Pretoria, pp. 1-10.

Mensah, A.M. and Castro, L.C, 2004, '*Sustainable resource use and sustainable development: A contradication?!* ', University of Bonn Centre for Development Research, Bonn, pp. 1-22.

Munasinghe, M, 1992, 'Environmental Economics and Sustainable Development', *Paper presented at the UN Earth Summit, Rio de Janeiro, Environment Paper No.3*, World Bank, Washington DC, USA.

Nordengen, P, 2011, 'Road friendly vehicles and improved performance', *FOCUS on transport and logistics.*

Road Traffic Management Corporation, 2011, *'Road Traffic report 31 December 2010'* RTMC, Pretoria.

Road Traffic Management Corporation, 2010, *'Road Traffic Report 2009'.* RTMC, Pretoria.

Roderigue, J.P, 2013, 'The Environmental Impacts of Transportation', *The Geography of Transport Systems, accessed on the 19 May 2015 from* http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html.

Roux, M. and Salie, I, 2010, ' South African Long Term Overload Control Statistics (1995 to 2009)', Department of Transport, Pretoria.

Simpson, Z. and Havenga, J.H., 2012, 'Logistics costs –Lower relative risk, higher costs', *8th Annual State of Logistics - Gearing up for change*.

SouthAfrica.info, 2014, 'Investing in Gauteng *accessed on 11 January 2015 from from* http://www.southafrica.info/business/investing/opportunities/gauteng.htm#.VV7zZPmqpBc.

Steyn, W., Bean, W., Pretorius, C. and Vander Walt, G, 2012, 'The potential effects of bad roads on transported cargo', *8th State of South African Logistics Survey: Gearing up for change*.

Supply Chain Update, 2015, 'RFA: Restriction on Freight Vehicles will NOT reduce Road Carnage - Real Causes Ignored!',*Supply Chain Update*April 22, accessed 8 May 2015 from .http://www.supplychainupdate.co.za/Article.aspx?ID=568.

Swarts, S., King, D., Simpson, Z., Havenga, J. and Goedhals-Gerber, L, 2012, 'Calculation of freight externality costs for South Africa', *Journal of Transport and Supply Chain Management*, pp. 207-222.

TASIMA, 2014, *eNaTis*July 1, accessed online from http://www.enatis.com.

Van Dyk, E., Ittmann, H., Marais, M., Meyer, E. and Maspero, E, 2006, 'State of logistics: research priorities for sustained improvement', *28th Annual SAPICS Conference and Exhibition June 4-7,* Sun City, South Africa, *pp* 1-18.

VanDerSchuren, M.J.W.A. and Jobanputra, R, 2005, 'Fuel Effcienicy measures for South Africa',*Proceedings of the 24th Annual South African Transport Conference*, Pretoria: Document Transformation Technologies, pp. 728-738.

Viljoen, N (ed), 2014, '*10th Annual State of Logistics Survey for South Africa',* Industry Report, Pretoria: CSIR.

Wittlöv, A, 2014,'*URBAN FREIGHT: Transport challenges and Oppertunities in Urban Freight for Livable Cities'* Göteborg, The Volvo Research and Educational Foundations, VREF.