THE STATE OF LOGISTICS IN SOUTH AFRICA – PERSPECTIVES FROM RESEARCH

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ABSTRACT

The purpose of this research was to measure the cost of Logistics in South Africa, determine the major cost drivers and assist both the country to manage those drivers and logisticians to manage logistics in this context. The measurement is on an industry and national level and can therefore relate logistics input with GDP as well as with industry-level turnover. A quantitative approach, based on a gravity-orientated freight flow model, road transport cost model, real transport costs for other modes, warehousing cost survey and inventory delay calculation for the economy, is followed.

The overarching outcome is logistics cost measurement in an extended and detailed model, backdated for five years to establish trends and cost drivers. This leads to specific items that can be considered by industry and managed by government. In the recent past the sensitivity of logistics costs to fuel and interest rates is disconcerting as both items are "administered" costs on an industry level and even on a national level for economies relying on imported fuel to move freight over long transport distances.

Logisticians manage inventory delay downward relentlessly, but the "Tragedy of the Commons"-effect is overlooked and trade-offs on a national and even industry level often not managed effectively. In contrast, collaboration does not only contribute to micro improvements, but could counter negative trends on a macro level. Eventually the tradeoffs between specialisation, growth and sustainability come into play. The relationship between energy optimisation and environmental consciousness is also illustrated and solutions suggested.

Introduction

As South Africa enters an era of uncertainty in times of unprecedented global upheaval, many questions will be asked regarding the country's economic stability and resilience. In terms of monetary policy, fiscal management and sound financial infrastructure it seems that the country is well-prepared to weather this storm. . The Reserve Bank raised interest rates since 2006 in line with inflation problems, thereby protecting the currency to some extent and providing leeway to now lower rates and stimulate growth. The fiscus managed public income to the extent that tax collection has become more efficient with wider compliance. Commercial banks recently received a clean bill of health in spite of a severely affected global banking system (Absa's market capitilisation were 5% of Barclays' market value on acquisition. Absa now forms 40% of Barclays' value).

All of these successes however have a single common theme, which is the backbone of all high performing management systems, i.e. management information. Without monthly and quarterly GDP and inflation figures, money supply measurements, key indicators such as housing prices, liquidations and business confidence indices, and many more, the ability to manage the financial system would be extremely challenging.

The availability and the correct use of management information therefore determine the state of readiness of a system to respond to change. Change has two possible manifestations, i.e. gradual change or cataclysmic change (in nature this is the difference between evolution over long periods of time and catastrophes such as meteor hits). In both cases information has a role, i.e. during evolutionary change it hones the performance of the system while during cataclysmic change it

enables survival. The absence of information will therefore either cause a system to run down gradually since it is not enabled to respond to a changing environment, or it could even be destroyed as its inability to protect itself from upheaval is exposed.

In the preceding physical science context, information is equated to the state of order in the system (the opposite of being run down), but it is not much different in business science where order also equals information and growth. A case in point is whether South Africa would have invested more in electricity generation infrastructure if the recent energy crisis' advent was anticipated and the impact understood.

In this, the 5th annual State of Logistics Survey, management information with regards to South Africa's logistics infrastructure and its performance is further enhanced. Some companies, such as Transnet and Imperial Logistics are investing in the development of this trusted body of knowledge and these actions must be commended. It is a pity, though, that government's contribution here is still lacking and, for instance, that out of 72 performance measures issued by the presidency in 2007, nothing, as yet, refers to logistics performance in the country. The results discussed below indicate that logistics cost in South Africa amount to 15.9% of GDP. It is therefore long overdue that the management information is not only maintained, but also acted upon.

Measuring the Overall Performance of the System – Model Improvements

In line with stated intentions since the first State of Logistics Survey published in 2003, major enhancements to the model were made in 2008. These enhancements were, in fact, definitive in that most remaining gaps in the modelling system were addressed, mainly attributable to additional investment from Imperial, as well as learnings enabled by the development of a Freight Demand Model for Transnet. These events made more attention to detail possible and the improvements are discussed below.

Transport costs in previous models were defined as either "line-haul" or local delivery and the underlying cost structures of only a few vehicle combinations on road were used. In this update, actual costs were established and used for all modes other than road. The inability to obtain actual road costs is due to the highly fragmented nature of the industry and no requirements for reporting. The extent of road freight transport in South Africa however necessitated the development of an extensive road cost model to improve the reliability of the overall model. The road cost model:

- Differentiates between 34 vehicle combinations.
- Differentiates between metropolitan, regional and corridor transport typology costs, rather than just line-haul and local delivery.
- Utilises all known drivers of road costs such as fuel, maintenance, toll fees, etc.
- Differentiates between variables in terms of cost drivers on different typologies (i.e. between typologies, but also within typologies, i.e. fuel costs in Gauteng Metro would be higher than in Durban and toll fees on certain routes would be higher than others).
- Uses the most refined measurement of volume demand available (drawing from experience in freight demand modelling enabled by Transnet investment).

These refinements resulted in a world-class model and one of a few, if not the only one, that contains this level of detail. True to our stated intention to ensure that figures are always comparable with those of previous years, all figures since the first survey published in 2003 were reworked according to the new approach.

The approach to inventory carrying costs was widened to include all data from various statistical releases from StatsSa. As these data were historically available it could also be backdated. These improvements caused a downward adjustment to transport costs and upward adjustment of inventory carrying costs which is reflected in Table 1 below.

Table 1: Adjustments to previous survey results due to model improvements

Year	2003	2004	2005	2006
Inventory carrying cost (2007 model)	R26bn	R27bn	R28bn	R30bn
Restated Inventory carrying cost (2008 model)	R26bn	R29bn	R33bn	R38bn
Transport cost (2007 model)	R117bn	R128bn	R141bn	R155bn
Restated transport cost (2008 model)	R101bn	R110bn	R121bn	R133bn

The overall effect of these changes on the cost of logistics is reflected in Table 2.

Table 2: Effect of adjustments on total logistics cost statement

	2003	2004	2005	2006
Logistics costs as percentage of GDP (2007 model)	16.6%	16.4%	16.2%	15.7%
Logistics costs as % of GDP (2008 model)	15.4%	15.3%	15.2%	14.9%

The improvements caused a slight downward adjustment of logistics costs as a% of GDP but is believed to be worth the refinements that was enabled. It resulted in a more robust model, further increasing the confidence in the outputs. Some users requested disaggregation of results on an industry level and also expression of results as a percentage of sales as well, which will enable the development of an industry benchmarking tool. This work is an important step in that direction. The country's actual logistics cost performance is introduced in the next section.

The Overall Performance of Logistics in South Africa

The cost of logistics in South Africa for 2007 was R317 billion or 15.9% of GDP. The contribution by the various stack elements is depicted in Figure 1.

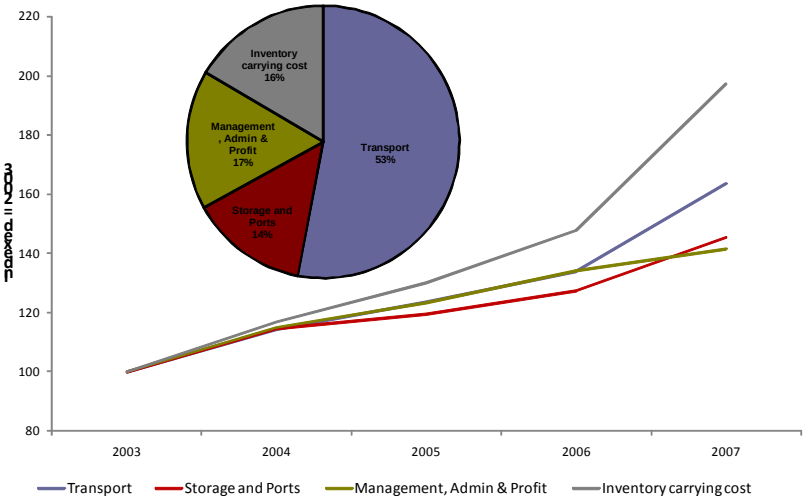

Figure 1: Logistics cost growth at current prices (nominal) and 2007 cost contribution

Even with the restated cost figures for transport, the percentage contribution of transport costs to total logistics costs (53%) is still higher than the world average of 39%. Transport and inventory carrying costs also show an alarming trend, even when the real (constant) increase is considered (Figure 2).

This means that inventory carrying costs has doubled over four years and transport costs has grown by more than 50%. The actual logistics cost figures are depicted in Figure 3 below.

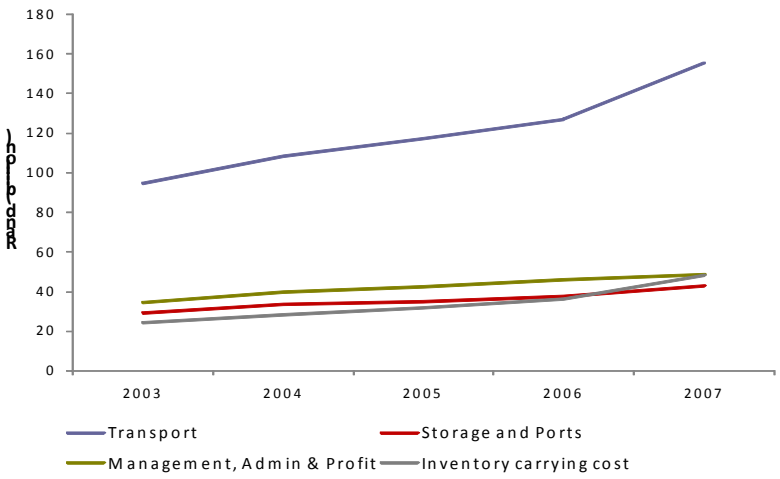

Figure 2: Logistics cost growth at 2000 constant prices (real)

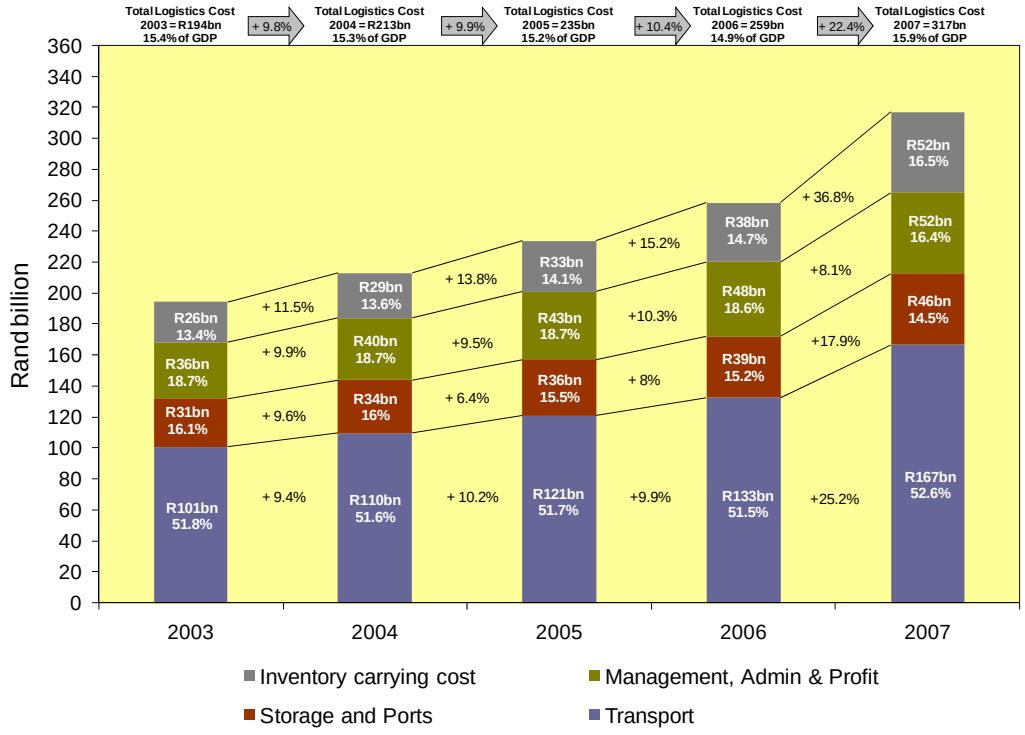

Figure 3: Actual logistics cost figures for South Africa

The significant growth in inventory carrying costs is further impacted by two key factors:

- The average interest rate for 2007 was 2% higher than for 2006 which contributed nearly R1 billion to the increase in inventory carrying costs.
- In addition, on average 18.4% more stock was tied up in inventory (R393 billion versus R332 billion in 2006) and this contributed a further R13 billion increase in inventory carrying costs.

The double jeopardy of more stock in a high interest rate environment therefore contributed to an extremely poor performance in this stack element, with a concomitant impact on logistics costs in general.

One of the contributors to increased inventory is the long transport distances in South Africa, which not only lead to higher than normal transport costs, but also to added time that inventory is delayed (Figure 4).

The real interaction between inefficient transport and inventory delay is complex, as a direct relationship also exists between actual storage time and the delay in inventory as logisticians attempt to circumvent transport challenges.

Another part of logistics costs that experienced an increase, which is related to an additional delay in inventory, is storage. Table 3 unveils the increments of this increase.

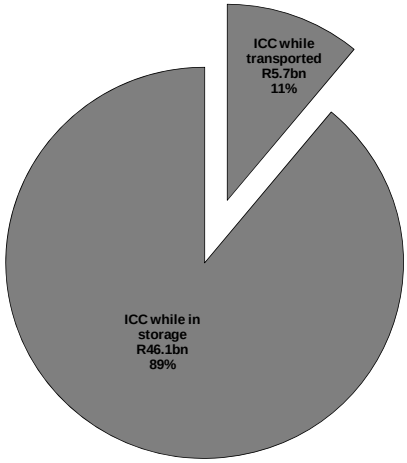

Figure 4: Transport's contribution to inventory delay financing Inventory carrying cost elements

In the case of storage the effect of inventory delay is additional time that goods requires storage. This factor is external to the unit price of storage, which can either increase (or decrease) in line with, above or below inflation.

Finally, additional volumes due to an increase in production will also have an effect on total storage costs. For South Africa, in 2007, increases in line with inflation would have caused a R2.8 billion increase in costs and a further R0.4 billion due to increased production. A further R1.7 billion was added, however, due to storage unit costs above inflation and finally R2.2 billion because of an additional delay in inventory.

Table 3: The causes of increase in storage cost in 2007

Change incurred due to:	R billion
1. Inflation	2.8
2. Increase in storage volume	0.4
3. Storage costs increases above inflation	1.7
4. Delay in inventory	2.2

Sensitivity to Exogenous Factors – the Role of Transport

Transport is an input into extraction, manufacturing and service processes just like any other input in the economy. The base commodity purchased can be described as tonkilometers and it is a fact that South Africa needs more of this commodity per unit extracted, produced or service provided than most countries in the world. Apart from that, unlike most other processes, transport is directly dependent on a risky and unpredictable core cost driver, i.e. the price of fuel. In "normal" strategic procurement terms this input would be managed carefully and with clear strategies in mind. Often, in South Africa, this is not the case on a company, industry, infrastructure or regulatory level. This is why transport costs, as a percentage of GDP, can be expected to be erratic and exposed to global risks, as illustrated in Figure 5.

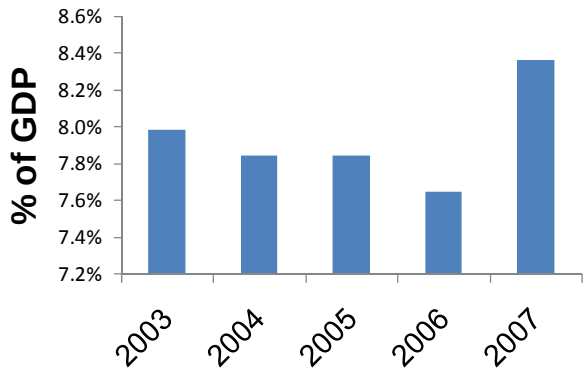

Figure 5: Transport costs as a percentage of GDP

During 2007 (from 1 January to 31 December) the average diesel price increased by 32%. Fuel contributes 32% of all road transport costs and road transport's cost market share further increased in 2007 to 90%, which makes South Africa more and more vulnerable to fuel price fluctuations.

This means that 29% of transport and 15% of South Africa's logistics costs are exposed to direct external factors (given the current configuration) and cannot be controlled by logisticians as such. Many other "hidden" aspects are also outside of the sphere of control, such as the additional cost burden on operations that are caused by ailing infrastructure. Furthermore, externalities that are not accounted for (such as congestion, accidents, pollution) add aspects that cannot be controlled directly on a firm level.

Primary and Secondary Sectors

Logistics cost elements can also be distinguished between the primary and secondary sector. (Figure 6).

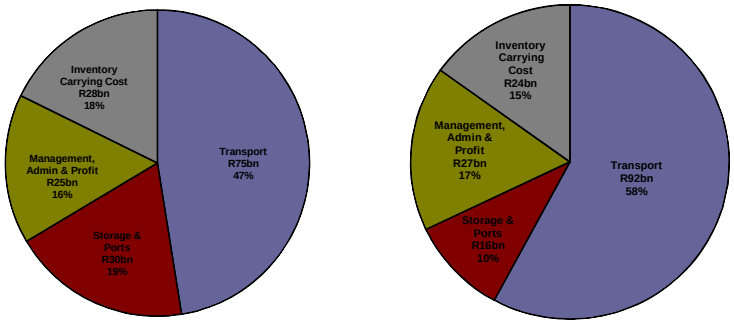

Figure 6: Primary and secondary sector logistics cost elements

The transport costs for the secondary sector is extremely high and if it is calculated as a percentage of value add it means that for every rand *value added* by this sector, 55% in transport costs is incurred. This is a massive burden on the global competitiveness of South Africa's manufacturing sector.

Configuration

South Africa's current logistics configuration leads to unacceptable risk exposure to global upheaval. Where-as logisticians continually attempt better practices, the current modal configuration, infrastructure condition and lack of management information poses a total system risk. The core drivers of logistics costs are currently the price of imported fuel and the interest rate. Strategic procurement practices suggest, at minimum, that more transport output should be generated with local input. This could only be achieved by higher local fuel production or a switch of transport supply to a locally generated power source such as rail. This switch can only be enabled by intermodal services being provided by road and rail operators in South Africa.

Transport remains the biggest contributor to the cost of logistics (and the biggest challenge in South Africa) and as such is analysed in more detail further in this article.

Land Freight Transport Volumes and Costs

South Africa's R167 billion transport costs described in the previous article is a product of volume and cost per unit of transport in the country. The drivers of this cost differ greatly per mode. In order to meaningfully impact on South Africa's transport costs, an understanding of South Africa's modal configuration (i.e. the key transport modes) as well as the cost drivers for these key modes is therefore imperative.

Methodology for Flow Measurement

The National Freight Flow Model ("NFFM") utilises the South African National Roads Agency's (SANRAL) Comprehensive Traffic Observation (CTO) Yearbooks as a basis for the development of a current and historical view of freight traffic flows in South Africa. The model accounts for the differences between corridor, rural and metropolitan freight and the various carrying capacities of the types of trucks that are used. This is then collated and compared to actual rail data to develop views on market shares, corridor densities and overall investment strategies for South Africa.

Transnet invested in a comprehensive freight demand model ("FDM") in recent times that allows for the disaggregation of freight into a much finer level of granularity, i.e. commodity, commodity characteristic and magisterial district origin and destination level. The two models (NFFM which is used in the State of Logistics Report, and the FDM utilises completely different methodologies, i.e. demand side based on gravity and truck observations. However on a typology level the results correlates $r^2 =$ 99.9. This correlation increases the confidence in the results which is reported below.

Modal Configuration

As depicted in the article on logistics costs, road and rail are the predominant means of freight transport in South Africa (contributing 99% of all logistics costs), and therefore require close attention. The remaining 1% of costs is associated with other modes (0.08% with air, 0.29% with coastal shipping and 0.69% with pipelines).

South Africa's sea routes are not well developed for domestic shipping due to relatively high terminal costs, limited vessel and terminal capacity and inclement weather conditions. Plans are afoot to address these limitations, but no concrete advancements have been made. Air transport has a higher predominance in more advanced economies with high levels of beneficiation, which is not yet the case in South Africa. Pipeline transport is increasing with the first private project coming on line and planned capacity expansion at Petronet, but contribution to overall costs are still low. All of these costs are accounted for in the cost model, but not discussed further in terms of modal configuration.

Close to 1.6 billion tons of freight were observed on the four different typologies in South Africa in 2007 (see Figure 7).

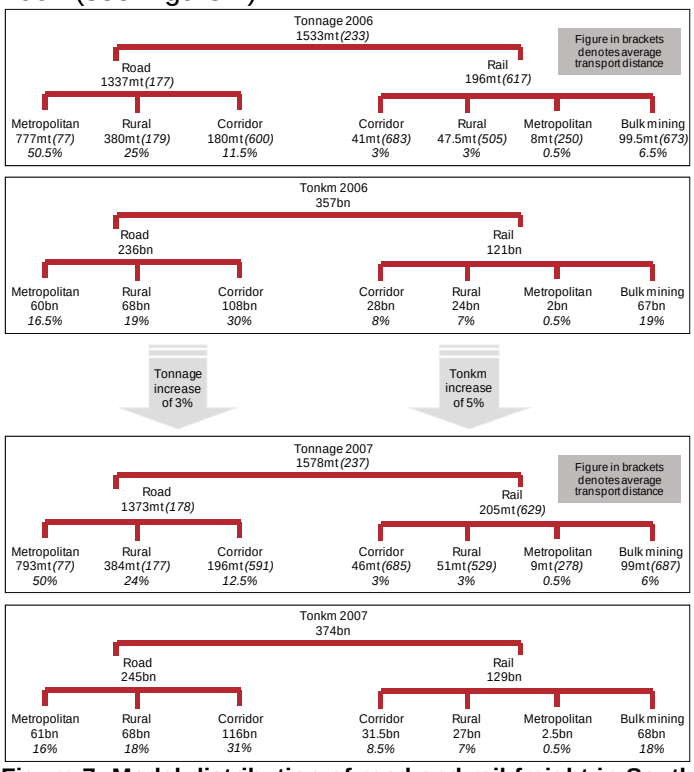

Figure 7: Modal distribution of road and rail freight in South Africa

Almost 1.4 billion tons were observed on the road mode at an average transport distance (ATD) of 178 kilometres, delivering 245 billion tonkilometres. Rail only contributed 205 million tons at an average transport distance of 629 kilometres, delivering 129 billion tonkilometres. The model is an observation based model (as opposed to a survey or gravity model). This means that freight is "observed" or counted at 363 counting stations in the country and then allocated to a typology (corridor, rural, metropolitan or bulk mining). It is then further allocated to a specific sub-class, i.e. the Cape Town-Gauteng corridor or the Durban-Gauteng corridor. A vehicle travelling from Cape Town to Beitbridge, for instance, will be counted twice (once on the Cape Town-Gauteng corridor and once on the Gauteng-Beitbridge corridor). In order to enable road and rail comparisons, the actual rail data is classified in the same way. Since gravity modelling results are now also

available and because actual rail data is available, the double-counting percentage can be estimated and is around 10%.

Bulk Mining

All bulk mining in South Africa is transported by rail, mostly on world-class "export machines" i.e. the coal line between Mpumalanga and Richards Bay in the east and the iron ore line between Sishen and Saldanha in the west. Together 99 million tons (6% of all tons observed) over an ATD of 687 kilometers produces 68 billion tonkilometers (18% of all tonkilometers produced by all modes). This form of transport is by far the highest contributor to rail market share and also the most lucrative rail transport in the country. It has no road alternative and is "captured" rail traffic.

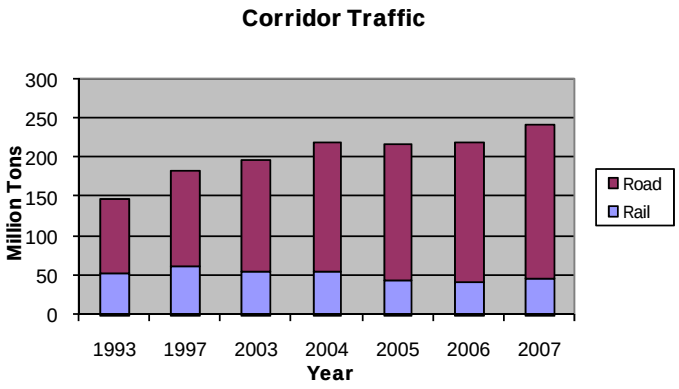

Figure 8: Corridor transport in South Africa since 1993

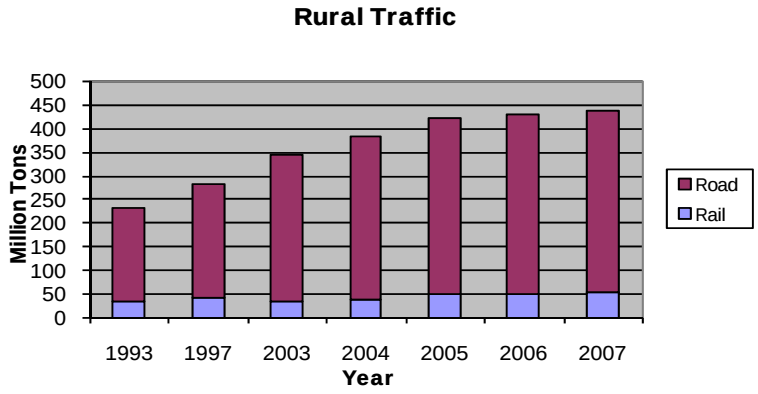

Figure 9: Rural transport in South Africa since 1993

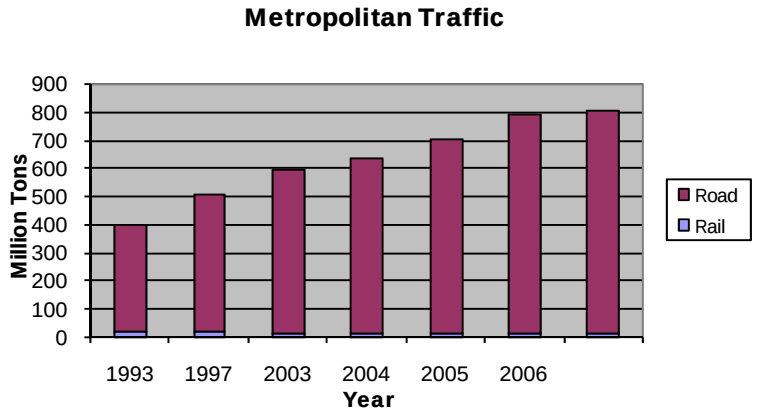

Figure 10: Metropolitan transport in South Africa since 1993

Corridors

South Africa's unique spatial challenges require more corridor transport relative to the size of our economy than most countries in the world (in fact it is hypothesized that only Russia's situation might be worse, though it is not known). Of the 242 million tons required over an ATD of 608km (147 billion ton kilometers), rail has a ton market share of 19% and a tonkilometer market share of 21%. The development of corridor transport since 1993 is depicted in Figure 8.

While rail has managed to halt the loss of corridor tons transported over the past few years, the significant growth in corridor freight movements has been captured by road. Corridor freight's compound annual growth rate (CAGR) since 1993 has been 3.6% with a market share decline for rail from 36% in 1993 to 19% in 2007 (a CAGR decline of 4.6% over the period).

Rural areas

Of the 435 million tons required over an ATD of 218km (95 billion ton kilometers), rail has a ton market share of 12% and a tonkilometer market share of 28%. The development of rural transport since 1993 is depicted in Figure 9.

Rural freight's compound annual growth rate (CAGR) since 1993 has been 4.7% with a market share decline for rail from 14.4% in 1993 to 11.7% in 2007 (a CAGR decline of 1.5% over the period).

Metropoles

Of the 802 million tons required over an ATD of 79km (63 billion ton kilometers), rail has a ton market share of 1% and a tonkilometer market share of 4%. The development of metropolitan transport since 1993 is depicted in figure 10.

Metropolitan freight's compound annual growth rate (CAGR) since 1993 has been 5.2% with a market share decline for rail from 5.1% in 1993 to 1% in 2007 (a CAGR decline of 10.9% over the period).

Overall Market Share

The question of rail market share is often asked by transport planners and marketers in the country. It drives the question of modal shift on a macro scale and informs the possibility of improving competitiveness through modal reconfiguration, or not. As evidenced in the previous paragraphs, it can be expressed as overall ton market share, overall tonkilometers and overall cost or income (see Table 4) Road transport it is often (in fact mostly) an "in-house" or "private" transport cost and not for reward. Transnet Freight Rail's business model does not include taking ownership of freight, which means that almost all rail freight is for reward. It is therefore more prudent to refer to cost (meaning the cost of transport) and (income) meaning tariffs. An attempt is however made here to split the total road transport as per Figure 1 into outsourced and in-house, based on unverified work in progress by StatsSa. It is acknowledged that the figures are unofficial and subject to future correction, but at least begins to provide a rough indication.

Table 4: Market share for land freight

		Tons in millions	Ton-kilometres in billions	Cost or income in billion Rands
Mode	Rail	205	129	14
	Road for Reward (outsourced)	279	58	27
	Road as ancillary traffic (in-house)	1094	187	124
% Market share	Rail	13%	34%	8%
	Road for Reward (outsourced)	18%	16%	16%
	Road as ancillary traffic (in-house)	69%	50%	75%

This means that although rail provides 34% of transport output (tonkilometers), only 13% of tons shipped are shipped by rail and rail only receives 8% of the proceeds available for transport in South Africa. It also means that road for reward only accounts for 16% of all road transport costs and that rail's market share of outsourced traffic is around 36%.

Another approach to market share (and probably the most important would be around "contestable" traffic. It is, after all, not really feasible to shift traffic on road or rail that could not travel on the other mode, effectively. This would mean that:

- "Captured rail" traffic (i.e. bulk mining) is excluded
- "Captured road" traffic (i.e. metropolitan and to some extent rural) is excluded
- It is assumed that even ancillary road transport on corridors should be a target for modal shift for a railroad

This means that for contestable traffic, only corridor market share should be considered (including road ancillary traffic) and this is reflected in Table 5:

Table 5: Corridor market share analysis

		Tons in millions	Ton-kilometres in billions	Cost or income in billion Rands
Volume	*Rail*	46	32	7
	Road	196	116	53
% Market share	*Rail*	19%	22%	11%
	Road	81%	78%	89%

Intermodal transport as a "mode" is not depicted, because no domestic intermodal solutions for South Africa exist.

Road Cost Drivers

The cost drivers for rail transport are not yet made public, but can, for the biggest portion of land freight (i.e. road costs equalling 91% of all costs) be determined from the logistics cost model discussed in the beginning of the article (figure 11).

Fuel is, by far, the most difficult cost driver to control. South Africa should consider better transport options for especially corridor transport, where intermodal solutions could alleviate congestion, save costs and reduce global risk.

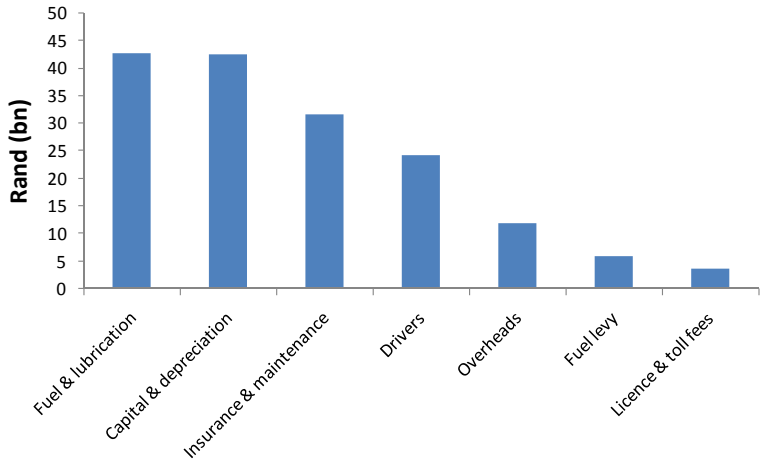

Figure 11: The drivers of road costs

Conclusion

The combined picture provided by the logistics cost model and the land freight transport model clearly point to an unsustainable situation. The core question remains – when will South Africa see changes that will reduce risks and costs and provide the blatantly evident domestic intermodal solution that the country requires.