



8<sup>th</sup> ANNUAL  
STATE OF LOGISTICS™ SURVEY  
FOR SOUTH AFRICA 2011

# GEARING UP FOR CHANGE





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## **8<sup>th</sup> State of Logistics™ survey**

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# PREAMBLE



The global economic landscape is shifting with increased focus on emerging markets that have been more resilient than their counterparts in developed countries. Countries that never featured as consumer markets in the past are suddenly appearing on the scene, while medium-sized developing economies are seeing increases in their consumer demand.

The growth in these countries, despite the recession, demands the attention of big business worldwide. The BRICS countries (including South Africa) are also experiencing encouraging growth. Going forward, it will not be 'business as usual', as corporations and indeed, countries, are reconsidering their global trading partners.

Against the backdrop of these global changes, the South African government has increased its investment in infrastructure development. Particularly, R262 billion has been set aside for transport and logistics projects. The effective management, maintenance and expansion of our country's

infrastructure will enable South Africa to compete at a higher level globally.

The Council for Scientific and Industrial Research (CSIR), IMPERIAL Logistics and Stellenbosch University proudly present the 8<sup>th</sup> State of Logistics™ survey: **Gearing up for Change**. Since its inception, the annual survey has addressed critical research questions emanating from the South African logistics environment through in-depth quantitative analysis. This year is no exception.

The survey has become an authoritative study of logistics in South Africa and is acknowledged as such both nationally and internationally.

As the value of rigorous, quantitative analysis becomes more apparent to government decision makers and industry strategists, the potential for the impact of the research contained in the survey escalates. Taking this into account, the CSIR and its partners are committed to expanding the research programmes and strategic collaborations that make this survey possible.

The financial support from IMPERIAL Logistics is greatly appreciated and the company's continued commitment to the South African logistics sector is commended.

We also acknowledge the critical contribution by the Centre for Supply Chain Management at Stellenbosch University; we share their passion for extending and enhancing the research. We thus also thank all the authors who graciously gave of their time and expertise.

Let's gear up for change into the future, aligned with the CSIR's brand statement – our future through science!

**Dr Cornelius Ruiters**

*Executive Director: CSIR Built Environment*

April 2012

# PREFACE

Logistics is fast becoming relevant to all South Africans. In the consumer market, logistics management is recognised as a core competence of international giants investing in South Africa and as an underlying cause of domestic performance gaps. In the commodity markets, logistics constraints are compromising export efficiency and limiting development of Africa's potential.



Government is committed to substantial capital investment to improve logistics infrastructure and the controversial e-tolling on the Gauteng's national roads is expected to help shape logistics behaviour.

Unfortunately, logistics is still regarded by most as an impediment to the competitiveness of South Africa as a country and to the organisations that operate locally. The reality is that the logistics challenges facing South Africa continue, with increased fuel costs, insufficient investment in inter-modal capabilities and inadequate maintenance of over-strained roads thus exposing the soft underbelly of our geographically challenged economy.

For logistics to become a competitive weapon for South Africa, change is required. Change to the mindsets that shape our perceptions about logistics. Change in the way we think about the

opportunities that the logistics profession offers. Change to the credit we give ourselves when we succeed amongst complex logistics challenges.

Firstly, South Africans need to recognise that logistics is an important value-adding activity that forms part of all value chains. Not only does it ensure that products and services are made available when and where required, but it facilitates cost-effective trade-offs in the entire journey from source to destination. We need to change from the mindset that logistics is merely the consequence of other institutional or organisational activity, to that of recognising logistics as a creator of value.

Secondly, South Africans need to recognise that the logistics profession offers immense opportunities for talented people across multiple spectra of society. Logistics execution, like controlling transport or warehouse operations,

will remain a critically important function in manufacturing, distribution and retail organisations. Logistics planning, including forecasting, demand management, materials, production and replenishment planning and vehicle routing offers great career opportunities for people with analytical and decision-making capabilities. Logistics management, including tactical and strategic aspects is becoming increasingly important for company competitiveness and provides fantastic aspirational opportunities.

Thirdly, South Africans need to recognise that we are and can be counted among the best in logistics. We acknowledge that we will always have much to learn from others, but we need to recognise that we also have a lot to offer to others. We are leaders in complex, emerging and dynamic logistics environments and we have achieved success despite severe skills

shortages, lack of scale and geographical impediments. Having a higher, justifiable regard for our own achievements will facilitate even more progress.

We have the opportunity and obligation to drive these changes in attitude. We owe it to ourselves, the companies in which we practice and the country that we serve as proud citizens. Furthermore, specific required changes are addressed in this 8<sup>th</sup> State of Logistics™ survey, with which IMPERIAL Logistics is very proud to be associated.

We need to gear up for change.

**Cobus Rossouw**

*Chief Integration Officer: IMPERIAL Logistics,  
a division of the IMPERIAL Group (Pty) Ltd*

April 2012

# EXECUTIVE SUMMARY

Nadia Viljoen (CSIR), Scientific editor: 8<sup>th</sup> State of Logistics™ survey

The 8<sup>th</sup> State of Logistics™ survey is released amidst change and uncertainty in the global economic landscape. These changes and uncertainties inevitably impact global supply chains and have trickled down to the South African logistics sector – even down to daily logistics decisions.

South Africa should take a proactive stance in this regard, hence the theme **Gearing up for Change**. The research published here underlines the changes facing South Africa and makes directed calls to action. This edition also discusses the methodologies, models and metrics used to measure logistics performance, pointing out the changes that could lead to improved long-term strategic planning of South Africa's macro-level logistics systems. The various topics discussed in articles published in the survey are referred to in this summary.

## Introduction

Government has elevated infrastructure development on the national agenda through directed initiatives and increased funding. Integrated national planning is essential to the success of government's intention to boost growth through sustainable infrastructure development. Disproportionate freight growth on non-corridor infrastructure should be addressed and a drastic shift from road freight onto rail is required. However, given current tariff structures and modal trends, less than

13.3% of inland freight can be considered for a potentially viable shift from road to rail.

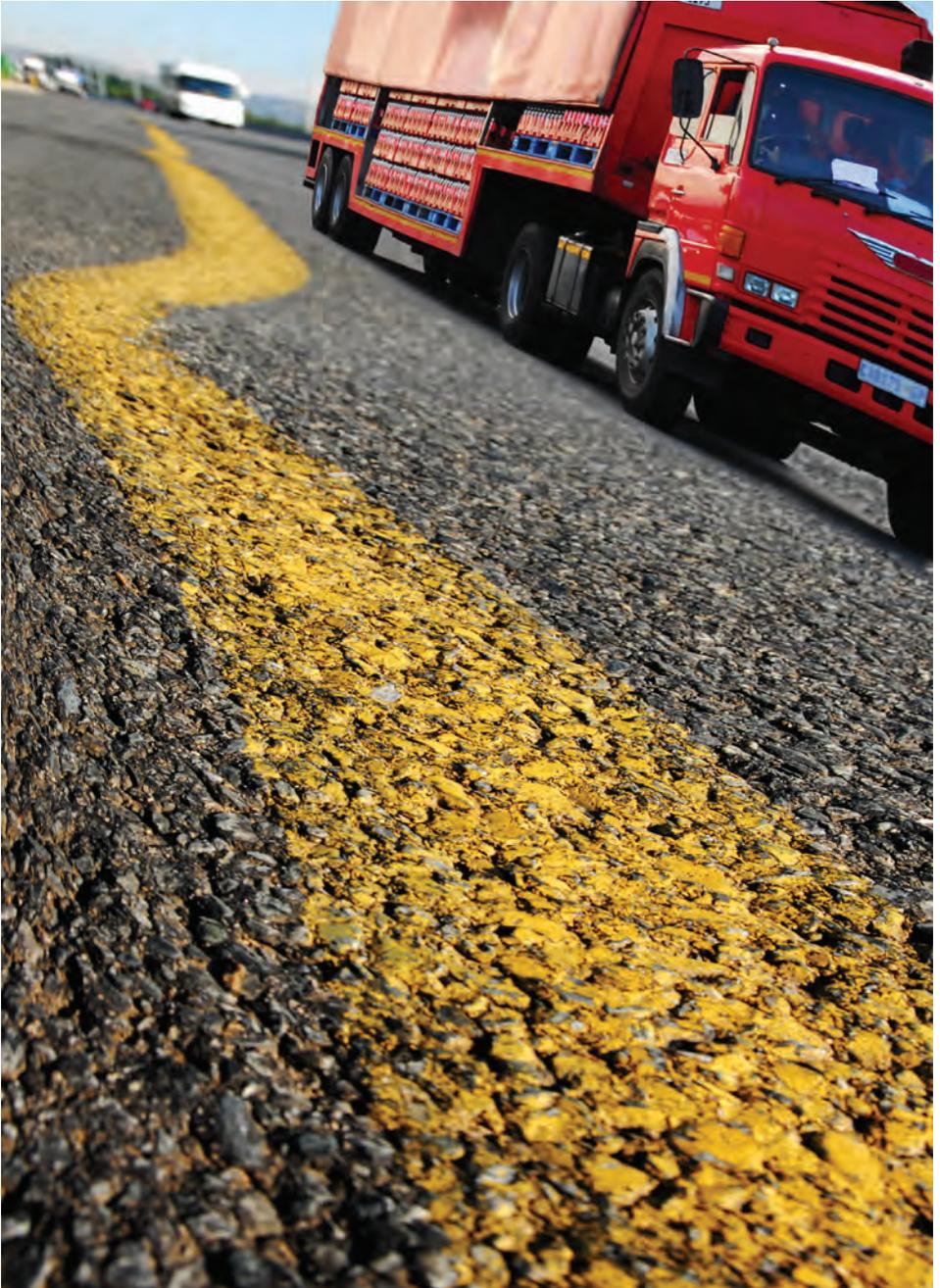
E-tolling will have a significant effect on national logistics costs. Not only will it increase direct costs, but it will also cause freight vehicles to be diverted to alternative roads, aggravating congestion and road damage on those routes.

Global supply chain trends are also evolving. Driving real customer value through flexible operations has become the overriding goal. Risk management has also moved firmly into the spotlight as a result of recent natural disasters and ever-present economic and political uncertainties.

## SECTION 1: A NATIONAL VIEW OF LOGISTICS

### *Logistics costs – lower relative costs, higher risk*

The logistics costs survey has served as a macroeconomic measurement tool for eight consecutive years. Logistics costs rose from R323 billion in 2009 to R339 billion in 2010. Transport costs rose by 16.2% attributable to steep fuel price increases, while inventory carrying



costs dropped by 19.9% due to record low interest rates. Traditional wisdom regarding trade-off decisions that favour minimal inventories to optimised transportation are revisited in light of fuel price uncertainty.

Logistics costs as a percentage of GDP have decreased from 13.5% in 2009 to 12.7% in 2010, but this should be interpreted with caution. The effect of the rapid growth in South Africa's tertiary sector on this metric is only now becoming apparent.

Provincial logistics cost metrics are presented for the first time in this survey and results are discussed regarding province-specific transport challenges. The provincial analysis echoes the impact of transport on logistics costs, reiterating the assertion that transport should be regarded as a strategic resource.

Road accidents constitute the largest proportion of externality costs associated with road transport. National costs for road accidents are estimated at R13.8 billion per annum, while CO<sub>2</sub> emissions would have added another R6.5 billion to the transport bill, if these emissions were taxed.

Three paradigmatic scenarios show that the South African logistics costs are extremely vulnerable to oil price volatility, exchange rate uncertainty and CO<sub>2</sub> emissions tax.

### **Comparing country-level logistics costs**

More countries aim to quantify their national logistics costs as the correlation between logistics costs and country competitiveness

becomes apparent. The three primary research approaches used are questionnaire-based surveys, modelling-based studies and ad hoc or case studies. In addition, the methodologies and data used in each of these approaches differ among countries, making direct comparisons challenging. Nonetheless, country-level comparisons yield meaningful insights if one takes cognisance of the differences.

South Africa and Brazil use similar modelling approaches to quantify their logistics costs; as the macro-level logistics challenges facing these countries are alike, a comparison between them raises interesting issues. Most notably, the proportional cost of rail per 1 000 tonne-km in Brazil is significantly cheaper than that of South Africa, casting a new perspective on the South African road-rail debate.

### **National land freight transport activity**

The modelling methodologies underlying the National Freight Flow Model and Freight Demand Model are described. The primary data sources for these models are SANRAL vehicle counts and Transnet data. Greater cooperation from the road haulage industry in terms of data sharing could enhance and extend the road freight analyses currently possible without jeopardising sensitive company information.

Freight volumes are growing faster than the GDP in South Africa, resonating with the global phenomenon caused by the specialisation of economies. Given South Africa's vulnerability to transport costs, this trend poses a threat to the sustainability of current transport philosophies.

Land freight tonnes increased by 5.5% while total land freight tonne-km increased by 3.7%. Corridor transport saw the largest growth in terms of tonnes, increasing by 7.4%. The greatest growth in terms of tonne-km was observed for metropolitan road freight, which increased by 6.1%. Shifting freight from road to rail and reducing transport demand are two recommendations made to reduce transport cost vulnerability.

## **SECTION 2: NEW PERSPECTIVES ON MODELLING AND PERFORMANCE MEASUREMENT**

### *Transport planning revisited*

State-of-practice models for transport planning, such as the four-step model, fail to adequately capture the behaviour of commercial vehicles. Consequently, infrastructure development plans and policy decisions based on these models do not directly cater for commercial vehicles.

The disaggregate agent-based modelling approach has proven to yield more accurate travel-time predictions and a richer result set for passenger transport when provided with the same input required by the four-step model. To use agent-based modelling for commercial vehicles, one must understand the behaviour of such vehicles. Great strides have been made in characterising commercial vehicle behaviour in South Africa through the analysis of the GPS records of over 40 000 commercial vehicles over a six-month period.

One of the valuable insights from the analysis is that, although Gauteng has a high level of through-traffic from a commodity point of view, commercial

vehicles generally do not travel through the province, but rather enter the province, offload cargo to be picked up by another vehicle travelling to the final destination, and then exit the province again. These and similar insights could enable more effective facility location and infrastructure planning.

The dataset currently does not include information about commodities carried or vehicle loading. It is stressed that industry needs to be more forthcoming in sharing data and knowledge to make this an even more powerful decision-support resource.

### *Maritime connectivity of South African ports*

Logistics connectivity improves the competitiveness of a macro-level logistics system. In the maritime industry a port that is well-connected within the global network of ports offers supply chains greater accessibility to global markets, flexibility and reliability.

The Liner Shipping Connectivity Index (LSCI) is one metric tracked by the United Nations Conference on Trade and Development that measures maritime connectivity on a country level. According to the LSCI, South Africa ranks 30th out of 162 coastal countries, in league with Brazil and India, and outperforms coastal SADC countries by a big margin.

The Port Connectivity Index developed by the Georgia Institute of Technology uses a more sophisticated, disaggregate approach to measure connectivity on a port level. Durban and Mauritius outshine other ports in the coastal



SADC region, while Durban is on par with ports such as Mumbai, Santos and Rio de Janeiro.

For South Africa, striving to build and maintain regional maritime connectivity should be a priority. This mind set reframes collaboration strategies on port and country levels.

### **SECTION 3: TOPICAL RESEARCH**

#### *The potential effects of bad roads on transported cargo*

Previous surveys quantified the negative effect deteriorating road quality can have on logistics activities in South Africa with an emphasis on vehicle operating costs. In this survey, the potential effect that bad road conditions can have on transported cargo is investigated in two case studies.

The first case study measures the range of vibrations fruit cargoes undergo while en route from various growers in Limpopo to Pretoria and Johannesburg. Results show that the higher up from the loadbed fruit is packed, the more susceptible it is to damaging frequencies. It also confirmed that gravel roads pose a far greater risk of damage to fruit cargoes than provincial and national roads that have a lower surface roughness. The relative impact of the loss of revenue due to fruit cargo damage is smaller for larger farming concerns that can afford insurance or have service level agreements in place. Smaller businesses, on the other hand, are more vulnerable.

The second case study quantifies the incremental loss of revenue incurred due

to wheat-loss when wheat is transported on bad as opposed to good roads. Shipping data analysed over a nine-month period showed that the vibrations on bad roads resulted, on average, in an additional wheat-loss of 0.62 kg/tonne per trip. This amounts to an incremental revenue loss of R1.34 per tonne per trip, or R2.5 million annually for South Africa, when wheat is transported on bad roads.

The growing body of research pertaining to the effect of bad roads on logistics activities underscores the need for appropriate road maintenance and compels stakeholders to take mitigating action.

#### *Low-carbon development opportunities for logistics*

South Africa is the 13<sup>th</sup> largest CO<sub>2</sub> emitter in the world. The transport sector currently contributes 10.5% to the national carbon footprint and has been identified as a sector with rapidly growing emissions. Agreements emanating from the recent UNFCCC 17<sup>th</sup> Congress of Parties (COP17) in Durban are encouraging, but South Africa cannot wait for treaties and legislation to be finalised if it is to reach its low-carbon economy goals.

The logistics industry has a large role to play in reducing the national carbon footprint. Fuel consumption and electricity usage at industrial and commercial sites are the two main contributors to CO<sub>2</sub> emissions in the sector. A number of operational measures and energy-saving technologies can be employed to reduce emissions from these two sources.

The Eskom Integrated Demand Management programme and the Industrial Energy-Efficiency project are two government initiatives to enable this change.

The Green Logistics Hub project in Paarl, Western Cape, is an example of a sustainable logistics hub developed by IMPERIAL Cargo. A photovoltaic system will power the site for the next 20 years and three solar geysers will supply all hot water. The design of the office building allows for maximum sunlight and lux-level meters automatically switch off lights when there is sufficient lighting. The payback period for the power system installation is 6.5 years and an annual energy-usage saving of 44% is reported.

### ***An integrated approach to skills development***

South Africa's challenges regarding education and training, job creation targets, unemployment, regional integration and socio-economics are shared by its BRICS counterparts.

Poor succession planning and a lack of mentorship are worsening the loss of skills from the logistics and supply chain management sector. There is a great need for on-the-job training and human resource functions need to work more closely with supply chain staff to define internal training programmes.

Graduates need to bridge the gap between their broad knowledge base and the management

skills required of logistics and supply chain managers. Role models and graduate training programmes play a vital role in helping young graduates focus their career development.

The management skills required by logistics and supply chain managers are rapidly diversifying and employees need to pursue broader areas of learning to remain competitive. Cultivating the human capital that already exists in organisations is crucial to address the skills shortage on the high-skills end of the spectrum.

## **CONCLUSION**

The 8<sup>th</sup> State of Logistics™ survey covers a broad range of research topics that addresses the performance of South Africa's logistics industry. For South Africa to become more competitive amidst global changes and uncertainties it is necessary that land freight transport be elevated as a strategic priority and that infrastructure planning takes into account the operational characteristics and needs of logistics systems. Enhancing the quantitative research that provides decision support for planning and industry strategy requires more comprehensive datasets, made possible only through industry cooperation and input. Finally, it is critical, from a sustainability point of view, that the imperatives of a low-carbon economy and skills development remain top priorities.



# CONTENTS

Executive summary .....	6
Introduction – <i>Hans Ittmann</i> .....	16
<b>SECTION 1: A NATIONAL VIEW OF LOGISTICS</b> .....	<b>26</b>
Logistics costs – lower relative costs, higher risk – <i>Zane Simpson and Jan Havenga</i> .....	27
Comparing country-level logistics costs – <i>Hans Ittmann</i> .....	42
National land freight transport activity – <i>Zane Simpson and Jan Havenga</i> .....	51
<b>SECTION 2: NEW PERSPECTIVES ON MODELLING AND PERFORMANCE MEASUREMENT</b> .....	<b>58</b>
Transport planning revisited – <i>Johan Joubert</i> .....	59
Maritime connectivity of South African ports – <i>Nadia Viljoen and John Bartholdi III</i> .....	68
<b>SECTION 3: TOPICAL RESEARCH</b> .....	<b>78</b>
The potential effects of bad roads on transported cargo – <i>Wynand Steyn, Wilna Bean, Cornelia Pretorius and Gert-Louis van der Walt</i> .....	79
Low-carbon development opportunities for logistics – <i>Reetsang Mothibi</i> .....	87
An integrated approach to skills development – <i>Jessica Fraser and Nadia Viljoen</i> .....	94
<b>PROFILES</b> .....	<b>104</b>

## List of Figures

<i>Figure 1: Primary, secondary and tertiary sector growth rates</i> .....	29
<i>Figure 2: South Africa's logistics costs as a percentage of GDP</i> .....	30
<i>Figure 3: A comparison of the logistics costs as a percentage of GDP for South Africa and the USA</i> .....	31
<i>Figure 4: Long-term inventory carrying and transport cost trends in the USA</i> .....	32
<i>Figure 5: Components of South Africa's logistics costs</i> .....	34
<i>Figure 6: Changes in the cost drivers of transport and inventory carrying costs for South Africa</i> .....	35
<i>Figure 7: Road transport cost components</i> .....	36
<i>Figure 8: GDP dollars per tonne-kilometre – global comparison</i> .....	36
<i>Figure 9: Logistics costs per province by cost component</i> .....	37
<i>Figure 10: Provincial logistics costs as a percentage of provincial GDP</i> .....	38
<i>Figure 11: Primary, secondary and tertiary sector composition of provincial GDP</i> .....	39
<i>Figure 12: Externality costs by category in South Africa for 2010</i> .....	40
<i>Figure 13: Scenarios: Impact of externality costs on logistics costs</i> .....	41
<i>Figure 14: Total logistics costs as a percentage of GDP for selected countries</i> .....	43
<i>Figure 15: Modal contribution to land freight as a percentage of total tonne-kilometre</i> .....	47
<i>Figure 16: Potential over-counting due to the use of vehicle counts in the NFFM</i> .....	53



Figure 17: Comparison of road freight tonne-kilometre growth and GDP growth.....56

Figure 18: Modal distribution of road and rail freight in South Africa .....57

Figure 19: Commercial vehicle activity densities across South Africa .....62

Figure 20: Characteristics of commercial vehicle activity chains and individual activities .....63

Figure 21: Typically observed daily gateway activities in Gauteng.....65

Figure 22: Comparison of the distribution of the normalised annual LSCI scores.....72

Figure 23: Movement among the top 10-ranked countries, according to the normalised LSCI scores.....72

Figure 24: Import and export score comparison for BRICS countries.....75

Figure 25: Import and export score comparison for BRICS countries; China excluded.....75

Figure 26: Location of accelerometers on trucks.....81

Figure 27: Comparison between dominant frequencies and fruit cargo damage due to vibration .....82

Figure 28: Vertical accelerations experienced within pallets at the front of the truck .....83

Figure 29: Vertical accelerations experienced in the truck for different road conditions .....84

Figure 30: South Africa's CO<sub>2</sub> emissions by sector .....88

Figure 31: Electricity market share per sector .....90

Figure 32: Bridging the gap between graduates' knowledge base and job requirements..... 100

## List of Tables

Table 1: Scenarios based on oil price volatility, exchange rate volatility and emissions cost levels .....40

Table 2: Comparison of country statistics between Brazil and South Africa .....46

Table 3: Modal split comparison between Brazil and South Africa .....48

Table 4: Comparison of the four logistics cost components between Brazil and South Africa.....48

Table 5: Comparison of road freight results from the FDM and NFFM .....54

Table 6: Updated year-on-year road freight volumes from the NFFM.....55

Table 7: Fraction of in-out gateway activities observed .....66

Table 8: Fraction of out-in gateway activities observed .....66

Table 9: LSCI ranking for coastal BRICS and SADC countries .....73

Table 10: Top 10-ranked ports in terms of the PCI import and export scores.....74

Table 11: Comparing transshipment and non-transshipment traffic for South African ports...76

Table 12: Comparison of average wheat-loss on good and bad roads.....86

Table 13: Shared challenges in BRICS countries .....97

Table 14: Targeted calls to action for South Africa..... 102

# INTRODUCTION

Ittmann, Hans W (HWI Consulting)

The worldwide economic situation has not improved over the past year and in some respects things look worse than a year ago. This is confirmed by the International Monetary Fund (IMF) report, 'The World Economic Outlook for 2012'<sup>1</sup>(p xv), where it is stated: "The global economy is in a dangerous new phase. Global activity has weakened and become more uneven, confidence has fallen sharply recently, and downside risks are growing."

Many economies of developed countries, especially in Europe, are facing huge financial and debt problems. The list of countries that are in trouble is growing and both the Netherlands and Spain are now, for all practical purposes, in a recession. Given the strict measures put in place to help these troubled countries recover, the longer-term future remains bleak. The situation in developing countries was also affected but not as badly. In this regard the same IMF report states: "Sub-Saharan Africa (SSA) continued to expand at a robust pace." (p 1)

There is no doubt that the global economic landscape is changing as are the global supply chains that support it. Focus is shifting to emerging markets that have been more resilient than their counterparts in developed countries. Countries such as Brazil, India and China – to name but a few – that never featured as consumer markets in the past are

now recognised as future growth areas, while medium-sized developing economies are also seeing increases in their consumer demand.

Africa is perhaps not in the same position as the countries named here but an increasing spending power is developing with enormous growth potential for the long term. This growth, despite the recession, demands the attention of big business worldwide which impacts directly on supply chain management and logistics. The BRICS countries are amongst those that are experiencing encouraging growth – both in supply and demand.

It is thus essential that during such challenging periods countries and organisations relook and reconsider their infrastructure, supply chains and systems that support competitiveness in the global market. In this regard it is very appropriate that the theme of this survey is **Gearing up for Change**.

<sup>1</sup> International Monetary Fund. 2011. *The World Economic Outlook - Slowing Growth, Rising Risks*. September 2011. IMF eLibrary. USA. ISBN 9781616351199.

## Infrastructure

Infrastructure development is a critical enabler to economic growth. The logistics infrastructure of a country – which includes roads, railways, ports, pipelines and airports – forms the backbone for this growth. The emphasis on developing and enhancing the South African infrastructure as recently outlined in the President's State of the Nation address<sup>2</sup> is not only very encouraging, but indicates that government realises the importance of sufficient and modern infrastructure to support growth. It echoes the theme of **Gearing up for Change!** Even more encouraging is the funding that will be earmarked for this purpose<sup>3</sup>. It is now essential and critical that all of these intentions are realised and implemented as this can stimulate significant economic growth.

As the infrastructure is established, supply chains need to be optimised to capitalise on this newly created infrastructure. Equally important, and a matter of great urgency, are the maintenance and repair of existing infrastructure.

## Growth

The growth rate of the South African economy was 3.1% in 2011<sup>4</sup> which is excellent given the financial crises in the world. For 2012 the growth rate forecast remains positive but is expected to be lower than the previous year. Nevertheless, with the economy growing and the long-term prospects seemingly very positive, the country's infrastructure needs to be kept abreast with this growth.

2 President of the Republic of South Africa, Jacob G Zuma. State of the Nation Address. 9 February 2012. Parliament, Cape Town, South Africa. Transcript available from : <http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=24980&tid=55960>. [Accessed on 12 April 2012.]

3 Minister of Finance Pravin Gordhan. 2012 Budget Speech. 22 February 2012. Parliament, Cape Town, South Africa. Transcript available from: <http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=25270&tid=57402>. [Accessed on 12 April 2012.]

4 Statistics South Africa. 2012. P0441 - Gross Domestic Product (GDP), 4<sup>th</sup> Quarter 2011, 28 February 2012, Statistics South Africa. Pretoria, South Africa. Available at: <http://www.statssa.gov.za/publications/statsdownload.asp?PPN=P0441&SCH=5171>. [Accessed on 28 February 2012.]

Simultaneously, industry needs to operate world-class supply chains. The emphasis is on exports and rightly so – South Africa needs to benefit from its rich natural resources. However, other needs and requirements in the country should not be neglected. In this regard, it is interesting that the tonnage of freight transported – both on rail and road – on corridors grew by 39.5% over the period 2003 to 2008. In contrast the growth on rural roads and rail was 85%. In tonne-kilometre this growth was 18.5% and 72.7%, respectively<sup>5,6</sup>. This raises the question whether sufficient attention is given to non-corridor infrastructure.

Today the rail branch lines are basically unutilised while existing secondary road infrastructure capacity is fast becoming insufficient, a problem exacerbated by poor road maintenance. These issues require immediate attention and methodical action plans.

The announcement by the Minister of Transport that the South African National Roads Agency Limited (SANRAL) has been pulled in to improve delivery on the R22 billion S'hamba Sonke (Moving Together) provincial and municipal roads maintenance programme, which is due to run until 2014, is a move in the right direction<sup>7</sup>. SANRAL has an excellent track record in road maintenance, as evidenced by the good condition of the national roads.

*(Freight and cost values quoted in the following two sections are from the articles National land freight transport activity, p 51 and Logistics costs – lower relative costs, higher risk, p 27.)*

## Freight

Freight is transported along five modes in South Africa: road, rail, pipelines, air and coastal shipping. South Africa has no internal waterways for inland freight transportation. The freight transported in pipelines, along the coast and by air accounted for merely 24 million tonnes (Mt) in 2010, which is only 1.5% of the total freight transported in the country. Land freight – the freight transported by road and rail – showed an increase on the 2009 volumes of 5.45%, from 1 544 Mt to 1 628 Mt. Although there was a marginal increase in rail freight (9 Mt), road freight accounted for 76 Mt of the increase. The resulting modal split between road and rail is thus 88.8% and 11.2%, respectively. The freight transported on South African roads remains disproportionately high.

It is agreed that there needs to be a drastic shift of freight from road to rail in an effort to drive down logistics costs, decelerate road wear and free-up road capacity. However, taking a more detailed look at the land freight modal split reveals that the volume of freight that could, realistically, be shifted is not that significant.

5 1<sup>st</sup> Annual State of Logistics survey. 2004. CSIR, South Africa. p 14, Figure 7.

6 Havenga, JH, Van Eeden, J and Simpson, Z. 2009. The state of logistics in South Africa – sustainable improvements or continued exposure to risk. 6<sup>th</sup> Annual State of Logistics™ survey. CSIR. Pretoria, South Africa. pp 14 - 23.

7 Creamer, T. 2012. SANRAL to lend support to R22 bn roads maintenance programme. Engineering News Online, 28 February 2012. Available at: <http://www.engineeringnews.co.za/article/sanral-to-lend-support-to-r22bn-roads-maintenance-programme-2012-02-28>. [Accessed on 29 February 2012.]

**Figure 18** (*National land freight transport activity*, p 57) shows a more detailed breakdown of road and rail freight, distinguishing between freight transported along the Natcor and CapeCor corridors, other major corridors, metropolitan networks and freight transported to rural areas.

Bulk mining is also classified for rail freight. Considering the total land freight tonnage transported in 2010, 76% was transported on road within metros or destined for rural areas. Freight transported within metros cannot conceivably be shifted to rail as the network is not nearly pervasive enough. Additionally, freight transported to rural areas covers, on average, 175 km which, with current rate structures, does not constitute an economically viable rail shift. This implies that only the 13.3% of land freight currently transported on road along the corridors could potentially move to rail. However, not all of this freight is rail addressable and if, for example, only half of the 13.3% of land freight shifts to rail, the impact on logistics costs at a national level will not be significant.

It is clear from the facts mentioned that with current tariff structures and trends in both modes, there is not much scope for a road to rail freight shift. But this cannot be the final conclusion. Freight transport costs are by far the largest component of logistics costs at 53.2%, and with looming fuel price increases, e-tolling and potential taxes on carbon emissions and congestion, transport costs will continue to grow. In addition, road capacity is a critical constraint and the current trend will see roads becoming the bottleneck of supply chains much sooner than expected – especially on the country's corridors.

The capacity issue would be exacerbated by continuous maintenance, necessitated by the increase in heavy freight traffic. It is therefore imperative that freight from the various corridors should move to rail, where at all possible. This increase in rail freight should cause a decrease in rail tariffs and could potentially accrue savings in terms of road maintenance and development. But if this is not enough, drastic reconsideration of current infrastructure development trends is required.

### Logistics costs

In 2010, the 'in-country' logistics costs as a percentage of GDP were 12.7%, a decrease from 13.5% in 2009, and the lowest this has ever been since the metric has been tracked.

**Figure 2** (*Logistics costs – lower relative costs, higher risk*, p 30) shows logistics costs as a percentage of GDP since 2003. This continued decreasing trend since 2007 is very positive for the country but it comes as somewhat of a surprise and exposing the reasons for the decrease is no simple task.

The GDP grew by 2.9% from 2009 to 2010, while logistics costs decreased. This is counter-intuitive as increased economic activity is synonymous with increased demand for logistics services. **Figure 5** (*Logistics costs – lower relative costs, higher risk*, p 34) shows the components of logistics costs and it is clear that the decrease in inventory holding costs and the simultaneous increase in transport costs were both significant, a reduced interest rate and an 11% fuel price hike being the respective causes of the movements.

The other two components of logistics costs remained almost constant. In the State of Logistics™ survey the calculation of logistics costs takes into account the primary and secondary sectors, but not the tertiary sector that primarily represents the service sector. Previously this was justified because logistics costs in the tertiary sector are a) relatively small and b) more difficult to quantify.

On the other hand, the GDP takes into account the market value of all three sectors. Rossouw<sup>8</sup> discussed the implications and pointed out caveats to using the statistic for industry-level benchmarking. The effect of the incongruity in the calculation of the numerator (logistics costs) and denominator (GDP) is only now showing up more clearly in the analysis. This is mainly due to the rapid growth in the tertiary sector, detailed in the article *Logistics costs – lower relative costs, higher risk*, p 27, which is extenuating the understated logistics costs. For many years, the tertiary sector's contribution to the economy was insignificant and using the GDP did not create a problem – a notion that now requires revision.

In comparison, the decreasing trend in logistics costs as a percentage of GDP is in line with Brazil, one of the other

BRICS countries, where logistics costs as a percentage of GDP have decreased from 12.1% in 2007 to 10.6% in 2010<sup>9</sup>. In the USA, on the other hand, the logistics costs as a percentage of GDP increased to 8.3% in 2010<sup>10</sup> from a very low 7.7% the previous year, in keeping, intuitively, with the recovery from their financial crisis. One should, however, be cautious of blindly comparing logistics costs figures between countries for benchmarking purposes as elaborated on in the article *Comparing country-level logistics costs*, p 42.

Tolling in the Gauteng region will add significant additional costs to logistics operations. Other potential side effects could also make the situation worse. Freight vehicles may divert to alternative routes to avoid toll roads, causing even more congestion on these alternative routes and possibly aggravating the damage to the roads. The cheaper toll rates could also reduce the shift of commuters to the Gautrain, utilising the buffer capacity incorporated in the toll roads much sooner than anticipated.

In the 4<sup>th</sup> State of Logistics survey<sup>11</sup> the 'spatial challenge' faced by the country was highlighted. A great proportion of the economic activity in the country happens within Gauteng, which is in the northeast interior of the country.

8 Rossouw, C. 2006. *Lies, statistics, benchmarking – tripping over the denominator*. *Logistics News*, October, 2006, pp 13 - 15.

9 Instituto de Logística e Supply Chain. 2011. *Logistics Costs in Brazil – Executive Summary*. English PowerPoint Presentation received from Maria Fernanda Hijjar, Diretora de Inteligência de Mercado ILOS on 17 February 2012.

10 Council of Supply Chain Management Professionals. 2011. *22<sup>nd</sup> Annual State of Logistics Report®: Navigating Through the Recovery*. Washington, USA.

11 4<sup>th</sup> Annual State of Logistics survey of South Africa. 2007. CSIR. Pretoria, South Africa.



This increases internal logistics costs as produce and raw materials need to be transported to the ports over very long distances – the same with automobile and consumer goods imports. One way of countering this is for industries to be located closer to the coastal areas and specifically the various ports. This will reduce logistics costs and increase logistics competitiveness. However, the fact that the country's natural resources are concentrated in the northern interior of the country makes this more difficult.

### Rural area growth points

A recently-released report by IHS Global Insight<sup>12</sup> identified a number of strong growth points in different areas of the country (the study excluded the Tshwane, Johannesburg, Cape Town and eThekweni metros). These areas showed significant economic growth, typically above 3% or more, during 2010. The areas include Polokwane (Limpopo), Rustenburg (North West), Vereeniging (Gauteng), Letsemeng local municipality (including towns such as Petrusburg, Luckhoff, Koffiefontein, Jacobsdal and Oppermansgronde, all in the western Free State) as well as the Nelson Mandela metro (Eastern Cape). All these areas, except for the Nelson Mandela metro, are forecasted as long-term growth areas.

The five major geographically-focused infrastructure programmes announced in the President's SoNA dovetail very well with these growth areas. This clearly illustrates the seriousness of government's intention to develop infrastructure in the high economic growth areas which will assist in stimulating further growth. This can only be commended. The exception is possibly the Letsemeng area, which is not clearly included.

From a state of logistics and supply chain management point of view all the recent announcements by government bid well for the future. Notwithstanding, there is a requirement for a clear long-term strategy around the nation's logistics infrastructure. This will ensure a well integrated national plan that everyone can work towards.

### Trends in supply chain management

The supply chain management environment is continuously evolving. Not that long ago the emphasis was on 'strategies for reducing cost and improving service'<sup>13</sup> as well as on collaborating and cooperating. In the beginning of the 21<sup>st</sup> century, the 'Triple-A Supply Chain' was strongly promoted where: "The best supply chains aren't just fast and cost-effective. They are also *agile* and *adaptable*, and they ensure that all their companies' interest stay *aligned*" (p 102)<sup>14</sup>. The devastating effects of Hurricane

<sup>12</sup> HS Global Insight. 2011. *Regional Explorer, Quarter 4*, p 3. Report can be bought from IHS Global Insight at: <http://www.ihs.com/>. [Accessed on 19 February 2012.]

<sup>13</sup> Christopher, M. 1998. *Logistics and Supply Chain Management*. 2<sup>nd</sup> ed. Prentice Hall, London.

<sup>14</sup> Lee, HL. 2004. *The Triple-A Supply Chain*, *Harvard Business Review*. Vol82(10), pp 102 - 111.

Katrina led to the realisation that supply chains are very vulnerable. Sheffi<sup>15</sup> introduced the concept of the 'resilient enterprise', which will overcome this vulnerability for competitive advantage. Supply chains had to become 'living supply chains'<sup>16</sup> being much more 'dynamic' – the so-called quick-change supply chains that mobilise the enterprise to deliver what the customer really wants.

All of the aforementioned remain important but these are not sufficient anymore. Progressively, the thinking in supply chain management has shifted towards 'delivering customer value through flexible operations'<sup>17</sup> and 'driving real value'<sup>18</sup>. The emphasis is clearly on providing value addition in the process of delivering a comprehensive service to customers.

The major earthquake in Japan in March 2010 was a drastic wake-up call for the supply chain and logistics fraternity. Risk management has now become a huge topic of discussion among supply chain professionals<sup>19</sup>. Various natural disasters are hastening the move to better risk management practices. Risks are dynamic in nature, with new risks emerging all the time. Therefore, companies need to assess and study the landscape continuously to determine which

risks are worth addressing at that moment and how this should be done. Risk management will remain a top priority in future. During the coming year, fluctuating currency exchange rates and oil price volatility have been identified as high risks.

The impact of what happened in Japan is remarkable. In response to the disaster and its effects on the Toyota global supply chains, the company has implemented a three-step programme to help combat supply chain risks in future, a plan that is expected to be completed in about five years' time<sup>20</sup>:

- (i) The first step in the programme is to work to standardise auto parts across Japanese automakers, so that companies can share common components that could be manufactured in several locations;
- (ii) The second step involves suppliers further down the chain, who will be asked to hold as much as a few months' worth of inventory of specialised components to safeguard against manufacturing problems; and
- (iii) The final step in Toyota's supply chain risk protocol is to make each region independent in its parts procurement so that another earthquake would not impact production abroad.

15 Sheffi, Y. 2005. *Resilient Enterprise*. MIT Press. Cambridge, USA.

16 Gattorna, J. 2006. *Living Supply Chains*. Pearson Education Ltd. UK.

17 Simchi-Levi, D. 2010. *Operations Rules: Delivering customer value through flexible operations*. MIT Press. Cambridge, USA. pp 1 - 239.

18 Slone, RE, Dittmann, JP and Mentzer, JT. 2010. *The New Supply Chain Agenda*. Harvard Business Press, Boston, USA.

19 Gonzales, A. 2011. *Supply Chain and Logistics Predictions for 2012*. *Logistics Viewpoints*. Published on 14 December 2011. Available at: <http://logisticsviewpoints.com/2011/12/14/supply-chain-and-logistics-predictions-for-2012/>. [Accessed on 15 February 2012.]

20 Scarpati, K. 2011. *Supply Chain Digital, Best of 2011: Toyota Supply Chain*. 29 December 2011. Available at: <http://www.supplychaindigital.com/procurement/best-of-2011-toyota-supply-chain#>. [Accessed on 15 February 2012.]

Gonzales<sup>21</sup> also identifies a number of noteworthy trends:

- Companies will continue to adopt social media tools in supply chain and logistics processes. This is still in its infancy but interest is growing;
- Traditional enterprise and supply chain software vendors will accelerate their investments in cloud computing and software-as-a-service;
- Transportation will remain under a veil of uncertainty due to fuel costs while in places like the USA there are all kinds of legislation that kindle this uncertainty;
- More companies will start to ‘walk the talk’ of collaboration; and
- Customer engagement management will become a higher priority for 3PLs.

Another respected expert in the field of logistics and supply chain management, Professor Simchi-Levi, published his predictions of the most impactful supply chain trends in the *Supply Chain Digest*<sup>22</sup>:

- Supply chain risk management (see above);
- Suppliers’ performance monitoring;
- Manufacturing moving closer to demand. This is interesting, especially in the case of the USA where serious consideration is given

to re-establishing manufacturing within the country or among closer neighbours in Central and South America;

- Implementation of supply chain segmentation and flexibility strategies;
- Investment in sustainability, which includes proactively planning for environmental issues such as the implementation of carbon emission taxes; and
- Technology will continue to advance on many fronts. A very interesting comment, which appears more frequently in the literature, is the increased use of business analytics (the new buzzword for the use of quantitative methods).

Considering these trends in the context of South Africa, it is clear that risk management needs to become a priority for companies. South Africa is very vulnerable to the effects of oil price volatility as well as fuel availability. In addition, government’s position on the issues of carbon emissions mitigation and emission taxes will become clear in the near future, but regardless of the final decision, it will impact logistics costs negatively. Another noteworthy trend is that of business analytics becoming an important tool in supply chain management and other areas. South Africa needs to develop the technological capabilities and human capital to stay on the forefront of this trend.

<sup>21</sup> Gonzales, A. 2011. *Supply Chain and Logistics Predictions for 2012. Logistics Viewpoints*. Published on 14 December 2011. Available at: <http://logisticsviewpoints.com/2011/12/14/supply-chain-and-logistics-predictions-for-2012/>. [Accessed on 15 February 2012.]

<sup>22</sup> Supply Chain Digest Editorial Staff. 2012. *Supply Chain Gurus Predictions for 2012. Supply Chain Digest*. Published on 15 February 2012. Available at: [http://www.scdigest.com/ASSETS/ON\\_TARGET/12-02-15-1\\_Supply\\_Chain\\_Predictions.php?cid=5493](http://www.scdigest.com/ASSETS/ON_TARGET/12-02-15-1_Supply_Chain_Predictions.php?cid=5493). [Accessed on 20 February 2012.]

## Survey content

It is clear from the evaluation of the current state of logistics in South Africa (presented in Section 1) that the time has come for all stakeholders to stop and critically evaluate where current trends are leading in terms of infrastructure development, infrastructure maintenance and logistics and supply chain management.

For South Africa to remain competitive in the changing global marketplace, a drastic change is needed in the way we measure, evaluate and plan our macro-level logistics systems. This is the sentiment echoed throughout the 8<sup>th</sup> State of Logistics™ survey.

The first section presents an evaluation of national logistics costs and land freight flow patterns in keeping with the methodologies used in previous surveys. At the same time, these articles shed light on the methodologies and models used, eliciting discussion and critique that will lead to future refinements.

A discussion on the comparison of country-level logistics metrics places the research approaches and methodologies of this survey into perspective and an in-depth comparison of South Africa's logistics costs with a key BRICS counterpart, Brazil, challenges institutional beliefs about various transportation modes.

Section 2 proposes state-of-the-art research that could redefine the way in which the planning of transport infrastructure is currently done. The section also introduces the notion of including network connectivity as a performance metric for logistics systems and illustrates the concept by evaluating the connectivity of South Africa's ports.

The third and final section presents focused research on three pertinent issues in the South African logistics sector. The effect of deteriorating roads on national logistics systems has been an ongoing stream of research in this survey and this year the effect on transported cargo is quantified through case studies in the agricultural sector – reiterating the dire urgency for appropriate road maintenance and repair on secondary roads. 'Going green', though inevitable, seems to be a daunting task for supply chains.

In this section the role that the logistics sector should play in the context of recent and upcoming policy development is illustrated through practical guidelines and a case study.

Finally the section addresses the pressing need for all stakeholders to take up the baton of human capital development, as resonated by current research in the industry and skills development experts.

# SECTION I: A NATIONAL VIEW OF LOGISTICS



# LOGISTICS COSTS – Lower relative costs, higher risk

Simpson, Zane and Havenga, Jan H (Stellenbosch University)

The source data used for this analysis originate from the Transnet Freight Demand Model, and the Growth and Intelligence Network (GAIN)'s National Freight Flow Model and Logistics Cost Model.

The logistics costs survey is in its eighth year of publication and the continuity of the research allows an assessment of both the core research tenets and the application of the outputs. Since its inception, the logistics costs survey served as a macroeconomic measurement tool to inform national strategic objectives and assist in policy making. The research has been expanded and refined over the years, but the alignment with the initial research tenets has been an imperative.

Developing a logistics costs measurement tool for South Africa deepened the understanding of our nation's freight logistics challenges and identified opportunities to address these challenges. Significant advances were also made in the field of logistics costs measurement. At the outset of this year's study two key concepts are considered, namely the impact of the GDP on the national logistics costs statistic and the importance of a longer planning horizon to inform logistics costs trade-offs.

Early on in the research, Rossouw<sup>23</sup> highlighted the important fact that the logistics costs survey neither measures logistics **contribution** to the GDP nor a relationship between logistics and turnover that can be

used for industry-level benchmarking.

The equation merely **relates** national logistics costs to GDP, a more suitable approach for macro-level evaluation. On a national level, we consider the equation  $\frac{\text{logistics costs}}{\text{GDP}}$  and that it can be improved by either a decline in logistics costs or a rise in GDP.

Consider that every time freight is transported from A to B, logistics costs are incurred and market value is created. It may happen that the logistics costs or market value associated with this action changes independently. For example, better routing drives down transport costs without affecting revenues, or the market value of the product increases without any change to the logistics costs. The same analogy holds true at a macro level when logistics costs are related to the GDP.

<sup>23</sup> Rossouw, C. 2006. Lies, statistics, benchmarking – tripping over the denominator. *Logistics News*, October, 2006. pp 13 - 15.

However, the ratio of logistics costs to GDP also changes when new transportation links with different logistics costs/market value ratios are added.

But the theory of constraints teaches that a system will only be as efficient, in this case its logistics costs will only be as low, as its most constraining component allows<sup>24</sup>. Therefore, often the ratios of these new links are dictated by the constraints in the current system. The question is whether the absolute constraint in the South African logistics sector is capacity. If demand is critical, but a lack of capacity drives up costs, freight will flow regardless as long as the net value-add to the GDP is positive. An example is South Africa's coal and iron ore export lines that are currently the only available method of exporting these commodities. If the net value-add to the GDP is positive, these flows should be allowed even though the logistics costs to GDP ratio worsens. Similarly, if a new mineral deposit that can be mined and exported profitably is discovered, high logistics costs can be tolerated as long as new value is added to the economy.

This explanation does not consider the beneficiation/raw material export issue. Spending higher than 'normal' logistics costs on mineral exports might be less desirable than

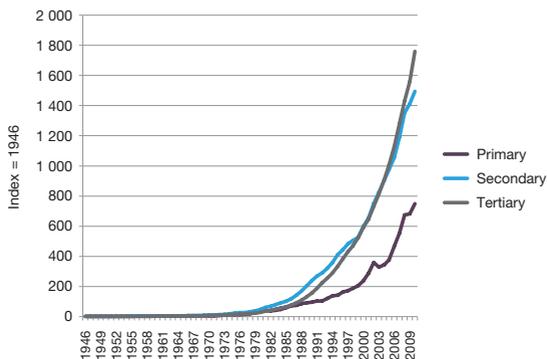
mining and beneficiating, but this is an issue for trade and industry policy. The crux of the matter is that, in each sector, certain constraints create a concrete ceiling above which logistics efficiency cannot rise. Ultimately these constraints limit the improvement potential of the logistics costs to GDP ratio.

The GDP measures the market value of the primary, secondary and tertiary sectors. The primary sector involves all initial physical separation activities such as farming and mining. The output of the primary sector is unbeneficiated commodities such as coal and wheat. The secondary sector, with unbeneficiated commodity inputs, adds value to these commodities and transforms them into final products. The tertiary sector provides the services required to enable this transformation, namely services such as construction, electricity, commerce, finance and government services.

Economic growth in developing economies is usually skewed towards growth in the tertiary sector that is not as logistically intensive as the other two sectors. This trend is clearly evident in the South African economy as shown in

**Figure 1**, where the growth in the primary and secondary ('transportable') sectors is compared to that of the tertiary ('services') sector over the past 65 years.

<sup>24</sup> Jacobs, FR, Chase, RB and Aquilano, NJ. 2009. *Operations and Supply Management*, 12th ed. McGraw-Hill/Irwin. Boston, USA.

**Figure 1: Primary, secondary and tertiary sector growth rates: 1946 – 2010 (Lehohla<sup>25</sup>, StatsSA<sup>26</sup>)**

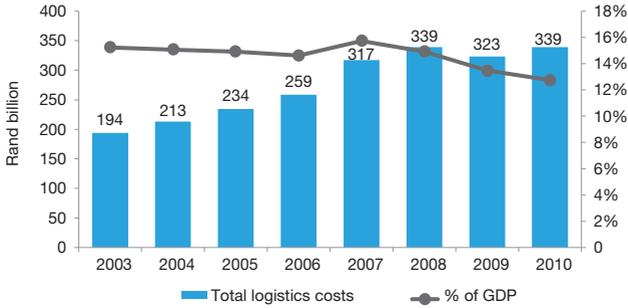
The trade-offs made by logisticians to lower the total cost of ownership should also be considered in more detail. An important consideration must be the length of the planning horizon when life-cycle costs are considered and, consequently, what the planning horizon should be for the nation. On a business level, the cost of various logistics activities is traded off against one another, for example the lowering of transport costs through consolidation could lead to higher inventory and associated costs, but lower ordering costs. Conversely, lower inventory costs could lead to smaller consignments that can increase transport and ordering costs.

These trade-offs are usually made with relatively short planning horizons, often linked to normal contracting cycles. On a national level the trade-offs should be linked to the infrastructure investment that is required to provide these logistics services. Logistics infrastructure on a national level has exceedingly long life spans, in most cases many decades.

The underlying cost drivers linked to these choices should also be forecasted way into the future. Forecasting the impact of long-term trends could change the trade-offs and investment decisions made in the short term.

<sup>25</sup> Lehohla, P. 2004. *South Africa Statistics 2003*. Statistics South Africa. Pretoria, South Africa.

<sup>26</sup> Statistics South Africa. 2011. *Gross Domestic Product: Statistical release P0441*. Statistics South Africa. Pretoria, South Africa.

**Figure 2: South Africa's logistics costs as a percentage of GDP**

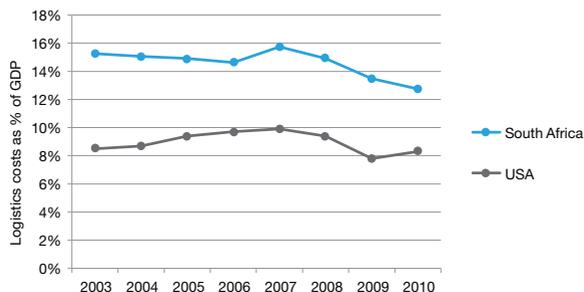
### Logistics costs as a percentage of GDP

South Africa's freight logistics bill for 2010 was R339 billion. While this is a 4.9% increase from R323 billion in 2009, logistics costs as a percentage of GDP have improved from 13.5% to 12.7% as depicted in **Figure 2**. In absolute terms, national logistics costs for 2010 are on par with the logistics costs for 2008, with the negative impact of the 2009 economic recession on logistics costs discussed in the 7<sup>th</sup> State of Logistics™ survey<sup>27</sup>. The continuing downward trend in South Africa's logistics costs as a percentage of GDP to its lowest point since measurement is in contrast to recent movements in the USA<sup>28</sup>, where this percentage increased from its lowest ratio of 7.7% to 8.3% in 2010.

**Figure 3** compares the trends for this percentage in South Africa and the USA since 2003. There are at least two apparent reasons for this dissimilarity. The first is that the composition and dynamics of the two economies differ, one being the biggest *developed* economy in the world and the other being a fast *developing* economy. The growth of South Africa's tertiary sector (**Figure 1**) is driving down the percentage, while the growth of the tertiary sector in the USA is fairly stable. Secondly, the logistics challenges surfacing in the USA's mature economy are causing the upward creep and should serve as warning signals for South Africa on its growth path.

27 Havenga JH, Simpson ZP, Van Eeden J, Fourie PF, Hobbs, I and Braun, M. 2010. Logistics costs – volatility, agility and future shock. 7<sup>th</sup> Annual State of Logistics™ Survey for South Africa. CSIR. Pretoria, South Africa.

28 Wilson, R. 2010. 22<sup>nd</sup> Annual State of Logistics Report®: The Great Freight Recession. Council of Supply Chain Management Professionals. Washington, USA.

**Figure 3:** A comparison of the logistics costs as a percentage of GDP for South Africa and the USA

### The trade-off between inventory control and transportation

In mature economies such as the USA, logisticians, enabled by deregulation and technology, have made great efforts to decrease logistics costs<sup>29</sup>. Simultaneously, consumer power and globalisation challenged logisticians to be more agile and lower the costs caused by increasing specialisation. Consumer power gave rise to the shift from a push to a pull phenomenon and globalisation led to high transport costs.

The majority of supply chains in such economies are already highly efficient, making it difficult for companies to compete on a cost level. Inventory control is often seen as one of the last areas of competitive advantage<sup>30</sup> as it is often the largest single

investment in assets for most manufacturers, wholesalers and retailers<sup>31</sup>. Inventory carrying costs are also not that apparent as a system cost in the enterprise's profit and loss statement<sup>32</sup>, creating an opportunity for logisticians to demonstrate value. Furthermore, inventory control is influenced and improved on a firm level, reaping direct rewards for companies that could accelerate their inventory turnover. This is why a culture of optimising inventory control emerged to drive down cost.

The trade-off of tighter inventory control, however, is increased demands placed on the transport function – causing an increase in transport costs. **Figure 4** shows the indisputable trend in transport and inventory carrying costs in the USA over the past three

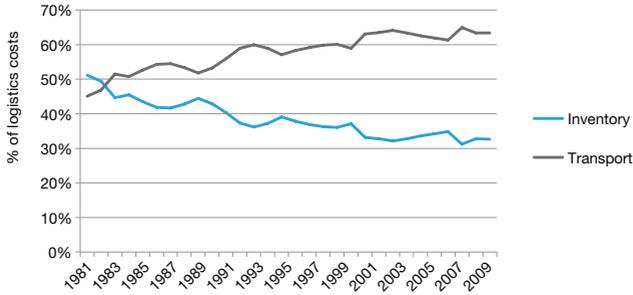
29 Murphy, PR, Jr and Wood, DF. 2011. *Contemporary Logistics*, 10<sup>th</sup> ed. Pearson. Boston, USA. pp 24 - 27.

30 Grant, DB, Lambert, DM, Stock, JR and Ellram, LM. 2006. *Fundamentals of Logistics Management: European Edition*. McGraw-Hill. Maidenhead. p 8.

31 Stock, JR and Lambert, DM. 2001. *Strategic Logistics Management*, 4<sup>th</sup> ed. McGraw-Hill. Boston, USA. p 188.

32 Bowersox, DJ and Closs, DJ. 1996. *Logistics Management: The integrated supply chain process*. McGraw-Hill. New York. p 256.

**Figure 4: Long-term inventory carrying and transport costs trends in the USA**  
(Wilson and Delaney<sup>33</sup>, Wilson<sup>34</sup>)



decades. This implies that the core tenets of logistics thinking are still geared towards driving down inventory levels rather than optimising transport on a national level.

Is it not possible that the logistics costs challenges facing the USA are driven by a trade-off analysis between transport and carrying inventory that is based on the underlying belief that the current price relationship between the primary cost drivers – fuel and interest rates – will not change? Recent global economic developments now challenge this belief. Transport costs are expected to rise much more sharply than anticipated. Not only do many forecasters continue to have an increasingly negative outlook on the fuel price given peak oil concerns, but all indications point

to the inclusion of externality costs on the transport bill in the near future.

The change in transport costs is so momentous that long-standing global economic trends are being revised to cope with the impact. For example, relatively low transport costs allowed nations to import raw materials and export products on such a scale that global trade grew exponentially over the past century (from 1% of global GDP in the 1820s, to 10% in the 1970s, to a third by the turn of the century and soon to approach a half of global GDP)<sup>35</sup>. This allowed countries to specialise in certain industries while importing the final products for consumption from other industries – a trend called mass specialisation. It is expected that this trend will be reversed to cut down on the cost of transport.

33 Wilson, R and Delaney R. 2003. *14<sup>th</sup> Annual State of Logistics Report®: The Case for Reconfiguration*. Cass Information Systems Inc. Washington, USA.

34 Wilson, R. 2010. *21<sup>st</sup> Annual State of Logistics Report®: The Great Freight Recession*. Council of Supply Chain Management Professionals. Washington, USA.

35 Havenga, JH. 2011. *Trade Facilitation through Logistics Performance: The Enabling Role of National Government*, *Journal of Transport and Supply Chain Management*, Vol5(1), pp 123-124.



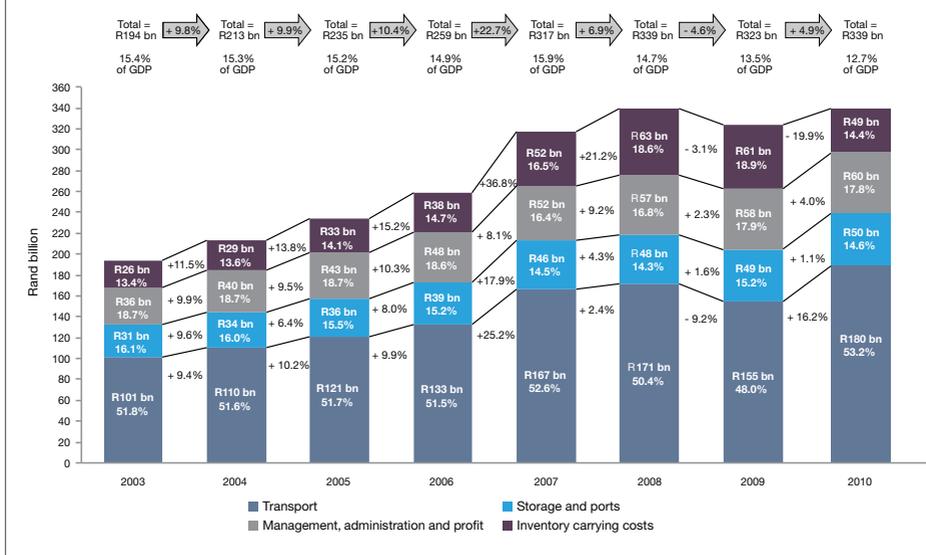
### Components of South African logistics costs

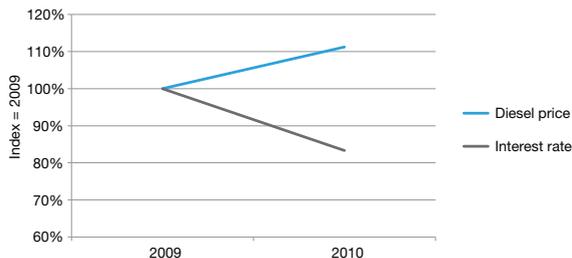
Figure 5 shows a detailed trend analysis of the four major logistics cost components since 2003. It is notable that, in absolute terms, the total logistics costs for 2010 are on par with those of 2008. Nonetheless, there has been a remarkable decrease in inventory carrying costs and an equally significant increase in transport costs. These drastic changes are understandable, given the sharp short-term changes in the diesel price and interest rates (Figure 6), the respective underlying cost drivers of transport and inventory carrying costs.

But the diesel price is derived from the global oil price, which would also have impacted on the USA's transport cost component. In contrast to South Africa, the proportional contribution of transport and inventory carrying costs to overall logistics costs in the USA remained the same.

The relative impact of these short-term shocks on national logistics costs implies vulnerability within the national logistics system. The key question is what the long-term expectation of the value of these two cost drivers is, given the severe short-term changes in 2010.

Figure 5: Components of South Africa's logistics costs



**Figure 6:** Changes in the cost drivers of transport and inventory carrying costs for South Africa

### **Inventory carrying costs**

The decrease in inventory carrying costs (Figure 5) is partly due to lower overall inventory volumes but mostly due to the lower interest rate in 2010 (Figure 6). At the start of 2010, the prime lending rate was 10.5%. Three decreases during the year saw it ending that year at 9%. This had a significant impact on the cost of carrying inventory. Had the interest rate for 2010 been that of 2009 (which saw a high of 15% at the start of 2009), inventory carrying costs would have been R9.8 billion more, which would have put the total logistics costs as a percentage of GDP at 13.1% instead of 12.7%.

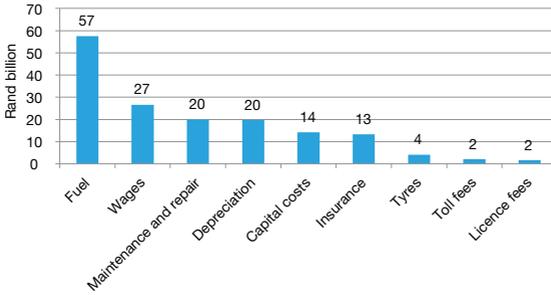
### **Transport costs**

The marked impact of the 11% fuel price increase between 2009 and 2010 is no surprise considering the fuel price is the primary transport cost driver. Had the fuel price remained as it was in 2009, total transport costs in 2010 would have been R5.8 billion

less, consequently putting logistics costs as a percentage of GDP at an even more favourable 12.5%. Transport costs as a percentage of total logistics costs would then have been 52%, instead of 53%. Globally, transport costs as a percentage of logistics costs are less than 40%, which makes South Africa's percentage relatively high. It is the prospect of an upward trend, however, that is more alarming. (It is noted that transport costs as a percentage of logistics costs are much higher for the USA than for South Africa, but this is believed to be due to a difference in methodology – some management and administration costs that are depicted separately in South Africa's survey seem to be included under transport costs in the USA.)

A breakdown of the road transport costs is given in Figure 7, clearly showing the impact of fuel costs, being 36% of road transport costs (more than double the cost of wages).

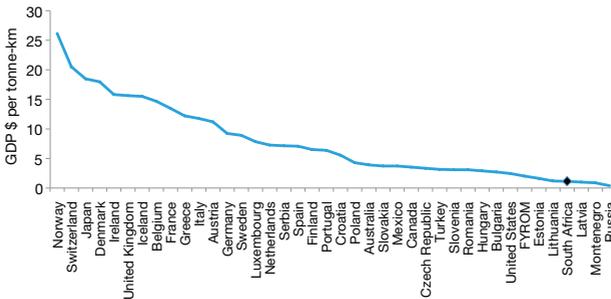
**Figure 7: Road transport cost components**



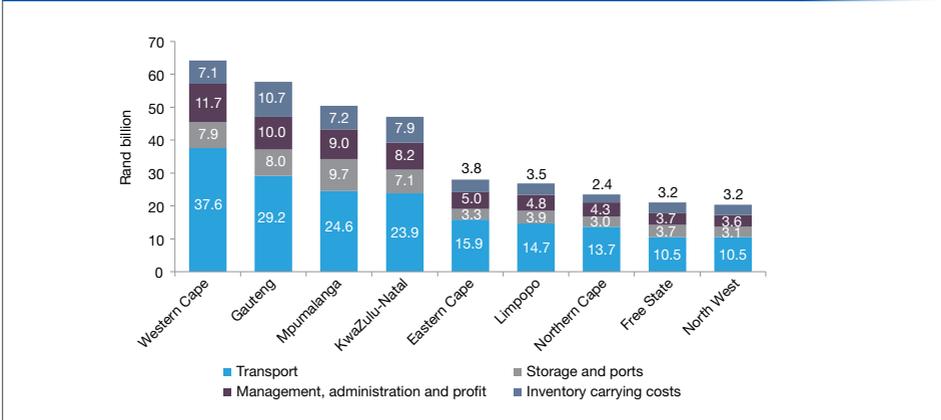
South Africa is particularly vulnerable to increases in transport costs. Expressing South Africa's tonne-kilometre (tonne-km) requirements in terms of GDP indicates how much is contributed to the GDP by moving a tonne of freight for one kilometre. A higher value means that more is earned by each tonne-km, or alternatively fewer tonne-km are required to achieve the same level of GDP. **Figure 8**

confirms the fact that South Africa is a highly transport-'hungry' country compared to the rest of the world, especially Western Europe. The transport-'hungry' nature of the country, combined with the fact that the key driver of transport costs is a commodity with a volatile pricing structure attests that transport is, in fact, a *strategic resource* requiring national attention.

**Figure 8: GDP dollars per tonne-kilometre – global comparison (OECD, Trading Economics, Bambulyak and Frantzen, US DOT<sup>36</sup>)**



<sup>36</sup> Organisation for Economic Cooperation and Development (OECD). 2010. *Key transport statistics. International Transport Forum. Paris.*

**Figure 9: Logistics costs per province broken down into the cost components**

For the first time since the inception of the logistics costs survey for South Africa, an attempt has been made to allocate the national logistics costs to the nine provinces.

**Figure 9** shows the logistics costs for each province broken down into the four logistics cost components. Logistics costs were assigned to each province based on the freight movements to and from that province using the following simplified assumptions:

- Freight movements that originate and end in the same province are assigned wholly to that province.
- Where freight movement originates in one province, with the destination in another province, the logistics costs of this are split equally between the two provinces. (This assumption is believed to be fair for both provinces on a macro level whereby either the sender or receiver pays the costs.)

- For imports, the destination province receiving the freight incurs the costs, and not the province where the port of entry is located. It is similar, in the case of exports, where the province of origin exporting the freight incurs the costs.

A number of interesting observations can be made about the characteristics of provincial logistics. Western Cape has the highest logistics costs, largely attributable to the high volumes of freight trading over long distances between Western Cape and Gauteng and Western Cape and KwaZulu-Natal, incurring high transport costs. Mpumalanga has the third highest transport costs after Western Cape and Gauteng, a peculiar result for a province with relatively low road-network coverage, no significant metros and a relatively small consumer market. One reason for this is that smaller commercial vehicles are used along the routes in Mpumalanga – partly because

these routes do not have the capacity of major corridors and partly because the dispersed pockets of consumer demand do not allow for significant consolidation. Fewer deliveries are made per trip to recover running costs. In addition, vehicles often travel at lower speeds due to the road network, taking longer to earn revenue from deliveries. Gauteng incurs the highest inventory carrying costs due to the size and value of the automotive industry in the country's most populous province.

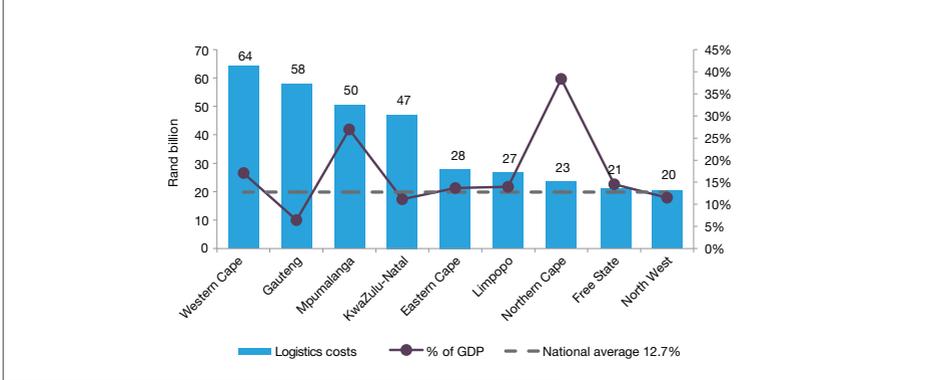
A deeper analysis of the logistics costs per province considers the logistics costs as a percentage of provincial GDP, which is given in **Figure 10**.

Northern Cape is clearly an outlier, with the highest logistics costs relative to GDP. This is partially due to the iron ore exports from Northern Cape, which increase transport costs by relatively higher margins than what

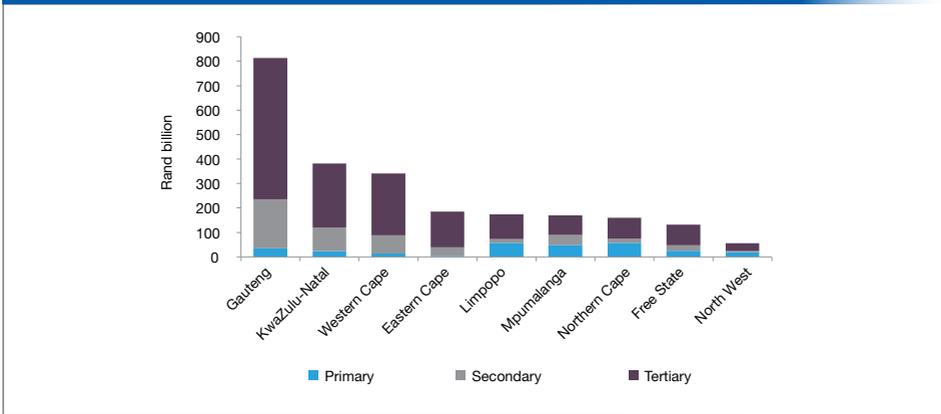
the iron ore exports increase the GDP. Other factors impacting logistics costs are the long distances freight has to travel combined with slower travelling speeds allowing fewer deliveries per trip to recover running costs, and thus higher transport costs for routes to Northern Cape. Mpumalanga is in a similar situation with its coal exports and also incurs relatively high transport costs to move freight to and from this region. Most interestingly, Gauteng's low logistics costs relative to its GDP are driven by lower relative transport costs and a more mature tertiary sector, as shown in **Figure 11**. Once again this underlines the impact of the tertiary sector on the metric that expresses logistics costs as a percentage of GDP.

The provincial analysis echoes the increasing role of transport in logistics costs and the importance of finding solutions for a sprawling transport-'hungry' economy.

**Figure 10: Provincial logistics costs as a percentage of provincial GDP (StatsSA<sup>37</sup>)**



<sup>37</sup> Statistics South Africa. 2011. *Gross Domestic Product: Statistical release P0441*. Statistics South Africa. Pretoria, South Africa.

**Figure 11: Primary, secondary and tertiary sector composition of provincial GDP**

## Externality costs

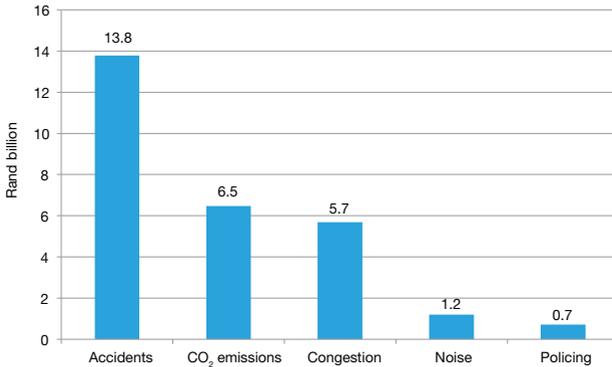
Externality costs are those induced by logistics (specifically transport) that are not reflected in the financial statements of the users of the logistics system. The five types of externality costs considered in this study during 2010 are graphed in **Figure 12**. To calculate CO<sub>2</sub> emissions, a cost of R225 per ton of CO<sub>2</sub> is assumed, in line with National Treasury's proposals<sup>38</sup>. The other externality cost elements were calculated using the same assumptions as in the previous survey<sup>39</sup>. Total externality costs

for 2010 are estimated at R27.8 billion. This is significant as it is a yet unaccounted-for cost in the South African logistics system.

From a macroeconomic point of view these costs should be included in an analysis of logistics costs and should inform trade-off decisions. From a strategic supply chain point of view it is clear that some of these costs will be internalised through taxation and other similar mechanisms in the near future and should, therefore, not be ignored.

38 National Treasury. 2010. *Reducing Greenhouse Gas Emissions: The Carbon Tax Option*. Pretoria, South Africa.

39 Havenga JH, Simpson ZP, Van Eeden J, Fourie PF, Hobbs, I and Braun, M. 2010. *Logistics costs – volatility, agility and future shock*. 7<sup>th</sup> Annual State of Logistics™ survey for South Africa. CSIR. Pretoria, South Africa.

**Figure 12: Externality costs by category in South Africa for 2010**

The methodology used to calculate the emissions externality costs has been iteratively refined over the past two years, but methodologies to calculate the other externality costs are still in a draft stage. A much more refined system, yielding more accurate cost results, is being developed.

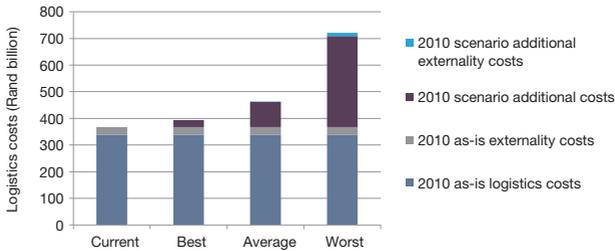
## Scenarios

As stated in the previous surveys, the underlying drivers of the fuel price costs to the consumer is the international crude oil price and exchange rate. These are two of the biggest and potentially most volatile drivers of transport costs in South Africa. Whereas the oil price is highly unstable,

and a future risk, there has been no agreement on the offset cost of carbon emissions, which means it poses an even greater risk in terms of future predictability. The effect of three variables – oil price volatility, exchange rate volatility and emission tax uncertainty – on the total cost of logistics is investigated. Emission tax uncertainty is added as the increasing global pressure to internalise emission costs makes taxation in the near future highly likely, despite the uncertainty about the actual levels of these taxes. **Table 1** outlines three paradigmatic scenarios based on the three variables mentioned.

**Table 1: Three paradigmatic scenarios based on oil price volatility, exchange rate volatility and uncertain emissions cost levels**

	Best	Average	Worst
ZAR to USD exchange rate	R7.50	R10.00	R15.00
USD per barrel crude oil	\$150	\$250	\$500
CO <sub>2</sub> emission costs per tonne	R225	R300	R500

**Figure 13:** Potential impact of externality costs on logistics costs

Should the worst-case scenario have existed in 2010, South Africa's logistics costs would have increased by R354 billion as depicted in **Figure 13** (more than the country's current total logistics costs!). The probability of such a scenario materialising should be high on the country's research agenda.

## Conclusion

At a glance, South Africa's logistics costs as a percentage of GDP are improving. Discussion and analysis in this article show, however, that this should not be interpreted blindly as an actual improvement in the country's logistics capacity and capability. The dynamism of the transport-inventory trade-off should also not be underestimated. Currently, the trend still favours lower inventory carrying costs at the expense of lower transport costs.

A major structural change in underlying cost drivers might be looming as a possible consistent rise in fuel prices could overshadow the rise in the interest rate. Should this happen, the current 'total cost' oriented inventory-transport balance would become invalid, leaving the country locked into dismal cost inefficiencies through long-term infrastructure decisions (such as warehouse locations) that did not cater for such a game-changing development.

Transport should be addressed strategically through collaborative, industry-wide and even nation-wide initiatives. Transport improvements have much more potential to lower national logistics costs than company or supply chain-level inventory management strategies. However, decisions regarding transport have a long-term impact on the country and careful (but urgent!) consideration is required.

# COMPARING COUNTRY-LEVEL LOGISTICS COSTS

Ittmann, Hans W (HWI Consulting)

'Logistics costs' is a widely-used term, yet there is no concise, widely-accepted definition of the concept. Farahani et al.<sup>40</sup> note that despite the importance of understanding and evaluating national logistics costs, literature on the topic is scant.

The World Bank recently endeavoured to quantify logistics performance by means of the Logistics Performance Index (LPI)<sup>41</sup>.

It has been observed that there is a strong correlation between the LPI score and the logistics costs of a country – a low LPI score implying high logistics costs and vice versa. The LPI is an informative metric as it encompasses the performance of a number of critical logistics functions, but it is not a substitute for quantifying logistics costs.

As the importance of quantifying and understanding the national logistics costs of a country becomes more apparent, many countries have made great efforts to measure their own. In the USA, logistics costs as a percentage of GDP has been calculated annually since 1990 while in South Africa this research started in 2004. Another country where these costs are now being calculated on a bi-annual

basis is Brazil. A study in the Baltic Sea Region, which includes Finland and seven other countries, also quantifies logistics costs, but uses a different approach<sup>42</sup>. This study was conducted in 2007 and is being updated currently. In addition to these regular studies, a whole range of other countries has conducted ad hoc studies in the recent past. Bowersox et al.<sup>43</sup> even endeavoured to quantify the total global logistics costs. With this growing interest in computing logistics costs at a national level, it is inevitable that comparisons will be made among countries. For example, **Figure 14** gives a comparison of total logistics costs as a percentage of GDP, the customary way of expressing these costs, for selected countries.

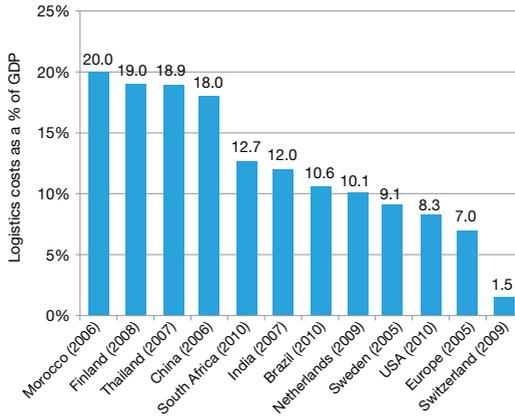
This article discusses the value and challenges of country-level comparisons in a more general sense, followed by a focused comparison of logistics costs in South Africa and Brazil.

40 Farahani, RZ, Asgari, N and Davarzani, H. 2009 *Supply Chain and Logistics in National, International and Governmental Environment – Concepts and Models*. Physiga-Verlag, Berlin, Germany.

41 World Bank. 2007. *Connecting to Compete*. World Bank Report.

42 Ojala, L, Solakivi, T, Hällinen, HM, Lorentz, H and Hoffmann, TM. 2007. *State of Logistics in the Baltic Sea Region 2007*. LogOn Baltic Master reports 3:2007. Tampere, Finland.

43 Bowersox, D, Calantone, R and Rodrigues, A. 2003. *Estimation of Global Logistics Expenditure Using Neural Networks*. *Journal of Business Logistics*. Vol24(2). pp 21 - 36.

**Figure 14:** Total logistics costs as a percentage of GDP for selected countries

### Challenges in country-level comparisons

The greatest challenge in comparing country-level logistics costs is ensuring that appropriate comparisons are made – ‘apples are compared with apples’. Many differentiating factors exist in the process of computing these costs. The outcome of the process is a measure of logistics costs generally expressed by means of one of three metrics, namely logistics costs as a

% of GDP, logistics costs as a % of sales or turnover, and absolute logistics costs. A fundamental differentiating factor is the research approach used. There are three primary categories<sup>44</sup>:

1. Questionnaire-based surveys (Finland, for example);
2. Modelling-based studies (including South Africa, Brazil and the USA); and
3. Case studies or ad hoc studies.

<sup>44</sup> Rantasila, K. 2010. *Measuring national logistics costs*. Master's thesis. Turku School of Economics. Finland.



Even if the same approach is used, other factors hamper comparison between countries including:

- The complex nature and various dimensions of logistics processes;
- Methodologies that are not comparable between countries;
- Evolving methodologies that hinder year-on-year comparisons and trend analysis;
- Diverse data sets used between countries;
- Varying national definitions of what logistics entails as well as different opinions on the boundaries of various logistics elements;
- Different ways of calculating costs in different countries;
- Dissimilar results for the same country, based on different ad hoc studies and case studies;
- The uniqueness of each country in terms of geography, demography, economy, industry, politics, etc.; and
- Understatement of logistics costs when divided by the GDP (discussed in-depth in previous articles: *Introduction*, p 16 and *Logistics costs – lower relative costs, higher risk*, p 27).

The Logistics Performance Index Observatory (LPIO), a recent initiative driven by the World Bank, aims to standardise tools for the

computation of logistics costs. An initial step towards such standardisation is the Generic Logistics Cost Structure (GLOCS)<sup>45</sup> that endeavours to transform logistics data into standardised data structures.

Keeping these challenges in mind, is it still sensible to compare logistics costs between countries? Clearly there are many pitfalls to these comparisons, but they serve as a basis for a more in-depth analysis.

Great value can be realised through these comparisons if they are viewed as a mechanism of enquiry into the differences and similarities between countries. The value of country-level comparisons does not lie in placing two percentages side-by-side, but questioning and understanding the differences in the dynamics that drive those percentages.

### Comparing Brazil and South Africa

A detailed comparison between South Africa and Brazil is possible since both countries use basically the same modelling-based approach, both have completed an analysis for the 2010 reporting year and both have a number of historical trend points.

In addition, the two countries share many other similarities despite the fact that Brazil is much larger than South Africa.

<sup>45</sup> Ojala, L., Solakivi, T., Hälinen, HM, Lorentz, H and Hoffmann, TM. 2007. *State of Logistics in the Baltic Sea Region 2007*. LogOn Baltic Master reports 3:2007. Tampere, Finland.

**Table 2:** Comparison of country statistics between Brazil and South Africa<sup>46, 47</sup>

	Brazil	South Africa
Population	194.9 million	50 million
Area	8.5 million km <sup>2</sup>	1.2 million km <sup>2</sup>
GDP (USD)	USD 2.088 trillion (2010)	USD 363.704 billion (2010)
Total road network	1 751 868 km	746 978 km
Proportion of paved roads	220 000 km	153 719 km
Total rail network	28 538 km	20 192 km
Pipelines	22 341 km	3 279 km
Inland waterways	50 000 km	None

It is apparent from **Table 2** that the Brazilian economy is six times that of South Africa. Brazil is the world's third largest exporter of agricultural products and the world's second largest exporter of ores. Most of the Brazilian agricultural products originate in the mid-western region of the country far from the Brazilian coast. This obviously has a negative effect on logistics costs. Conversely, Brazilian industries are concentrated in the southern and south-eastern regions, close to the coastline.

The Brazilian transport infrastructure is not very sophisticated and the result is that freight is transported mainly on road, even more so than in South Africa. Half of the railroads are concentrated in the southern and south-eastern

regions while most of the agricultural produce from the mid-western region is transported by road. Clearly Brazil and South Africa face similar challenges in terms of the geographic dispersion of their industries and transportation infrastructure. Road transport in Brazil is relatively inexpensive compared to other countries, partly because truck owners do not usually take depreciation costs into account when setting transport tariffs. On the other hand, inventory carrying costs are high due to high interest rates.

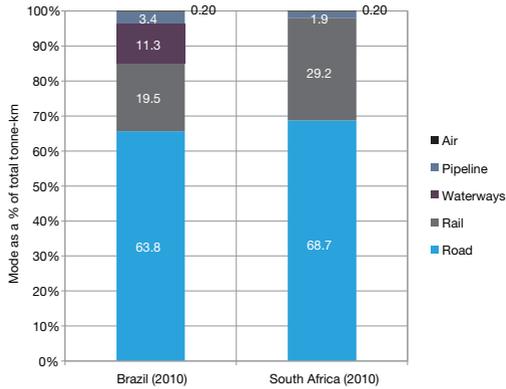
(All the data and information pertaining to Brazil in this section were provided by the Instituto de Logística e Supply Chain (ILOS), Brazil<sup>48</sup> and the Council for Supply Chain Management Professionals<sup>49</sup>.)

46 Central Intelligence Agency. *World Fact Book*, 2010. Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/sf.html>. [Accessed on 4 April 2012.]

47 Kannemeyer, L. 2009. *18<sup>th</sup> Meeting of the Road Pavement Forum*. November 2009. South Africa.

48 Instituto de Logística e Supply Chain. 2011. *Logistics Costs in Brazil – Executive Summary*. English PowerPoint Presentation received from Maria Fernanda Hijar, Diretora de Inteligência de Mercado ILOS - on 17 February 2012.

49 Council of Supply Chain Management Professionals. 2007. *Global Perspective – Brazil*. CSCMP, 2007.

**Figure 15:** Modal contribution to land freight as a percentage of total tonne-kilometre

The logistics environments in Brazil and South Africa are very similar, with the different modes comprising similar proportions of the total national tonne-kilometre measurement, as illustrated in **Figure 15**. The only exception is that Brazil has inland waterways that

absorb some of the market-share that would otherwise be transported via rail or road. This would influence Brazilian logistics costs as transportation along inland waterways in Brazil is much cheaper than road transport, yet only slightly more expensive than rail transport.



**Table 3** compares the modal split between the two countries in more detail while **Table 4** compares the four logistics cost components. Together these tables give a comprehensive view of the logistics costs of the two countries. The costs in these tables are listed in the currencies of the respective countries. Given the differences in currency and magnitude

of the economies, it is sensible to compare proportional costs and the % of GDP each category represents instead of absolute costs. Both countries use a modelling-based approach to calculate logistics costs but it is not possible to compare the methodologies since a detailed description of the methodology used for Brazil is not available.

**Table 3: Modal split comparison between Brazil and South Africa**

Brazil				
	R\$ (billion)	% GDP	1 000 tonne-km	R\$/1 000 tonne-km
Rail	10.63	0.30	277 900 000	38.25
Road	202.62	5.50	935 979 215	216.48
Waterway	13.88	0.40	162 448 540	49.32
Pipeline	3.13	0.10	48 835 128	37.85
Air	1.75	0.05	705 491	1 603.20
<b>Total</b>	<b>232.01</b>	<b>6.30</b>	<b>1 425 868 374</b>	
South Africa				
	R (billion)	% GDP	1 000 tonne-km	R/1 000 tonne-km
Rail	19.60	0.735	112 629	174.02
Road	159.00	5.972	265 307	599.30
Coastal fuel	0.10	0.005	944	105.93
Pipeline	1.60	0.061	7 351	217.65
Air	0.04	0.001	9	4 444.00
<b>Total</b>	<b>180.40</b>	<b>6.800</b>	<b>386 240</b>	

**Table 4: Comparison of the four logistics cost components between Brazil and South Africa**

	Brazil		South Africa	
	R\$ (billion)	% GDP	R (billion)	% GDP
Transport	232.0	6.3	180.4	6.8
Inventory carrying costs	118.4	3.2	48.9	1.8
Storage and ports	25.7	0.7	49.7	1.9
Management and administration	14.6	0.4	60.3	2.3
<b>Total logistics costs</b>	<b>390.7</b>	<b>10.6</b>	<b>339.2</b>	<b>12.7</b>

In both countries transport costs are the biggest contributor to logistics costs. Heavy dependence on road transport is mutual between these countries, as is the challenge presented by the spatial location of major industries far from the countries' ports. However, Brazil's transport costs are somewhat lower, potentially due to the access to inland waterways that certainly impacts logistics costs in a positive way. In **Table 3**, 'coastal fuel' is shown in the case of South Africa instead of waterways. This enables more accurate results and comparisons.

Apart from transport costs, the three other logistics cost elements are proportionally fairly different. In the case of inventory carrying costs, a country's interest rate is the definitive cost driver. It has already been mentioned that Brazil has a very high interest rate – the prime lending rate of commercial banks was 39.99% at the end of Dec 2010 est.<sup>50</sup>, while South Africa's interest rate by the end of 2010 was 9% – an all-time low since 1974. The difference in these two costs can also be ascribed to differing inventory management philosophies. In the case of the other two cost components much of the difference can be credited to the varied ways of defining and calculating these costs. In some countries, for instance, management and administration costs are assumed to be a fixed 4% of overall logistics costs, while in other countries these costs are calculated from the bottom up. It is not clear how the costs of the

categories of storage and ports, and of management and administration are calculated in the case of Brazil.

What is very notable is the proportional cost per 1 000 tonne-km for the different modes of transport. It is neither possible nor relevant to compare the absolute values, but the proportional costs reveal much about the various modes in each country. In Brazil, rail is a factor of almost six times cheaper than road, whereas in South Africa rail is only three times cheaper. This defies expectation in the South African case. More than half of rail freight in South Africa is bulk mining freight. Transporting bulk mining freight on rail should be cheaper than road by a much larger factor than three. This implies that, for other freight transported on rail, the factor difference is even less than three.

This possibly explains why the majority of freight growth in South Africa is on road and not rail. The cost differential is simply too small to justify switching to a transport mode that is known to be slower, less predictable and less reliable than road. This insight raises some pertinent questions regarding the pricing structures of rail transport in South Africa.

Similar to rail, moving products via pipeline in Brazil is proportionally much cheaper than in South Africa. There may be country-specific factors that adequately justify this difference, but this requires further investigation.

<sup>50</sup> Central Intelligence Agency. *World Fact Book*, 2010. Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/sf.html>. [Accessed on 4 April 2012.]

## Conclusion

Even though it is difficult to compare logistics costs between countries, thoughtful comparison can yield meaningful insights as illustrated by the comparison between Brazil and South Africa.

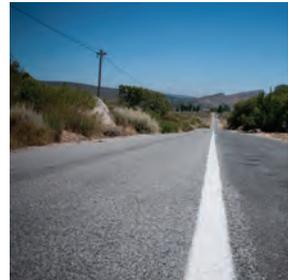
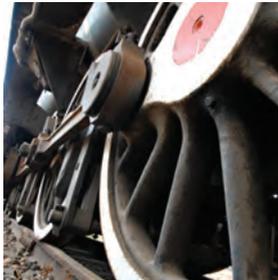
Most importantly, such comparisons raise questions that spark further investigation. The value of the logistics cost surveys in these two countries cannot be overstated. Both follow a modelling-based approach for determining the logistics costs as a percentage of GDP. So, although the methodologies are not exactly the same, the fact that the methodologies employed in the two countries are the same every year, make country trends comparable. This is already very useful.

This article is the starting point of a process whereby more consistent and reliable

comparisons between countries can be made in terms of logistics capabilities. The LPI index produced by the World Bank is a similar, though further advanced, effort. However, the LPI does not quantify national logistics costs. Standardising the various approaches and tools used to quantify logistics costs would greatly advance comparison. The overarching goal remains that of continuous improvement.

## Acknowledgement

*The author gratefully acknowledges the assistance from ILOS, Brazil – especially Dr Maria Fernanda Hijjar, Diretora de Inteligencia de Mercado, and her colleague – who translated and collated the logistics cost results and other information for use in this article. Their willingness to share this information made this article possible.*



# NATIONAL LAND FREIGHT TRANSPORT ACTIVITY

Simpson, Zane and Havenga, Jan H (Stellenbosch University)

The source data used for this analysis originate from the Transnet Freight Demand Model, and the Growth and Intelligence Network (GAIN)'s National Freight Flow Model and Logistics Cost Model.

The article *Logistics costs – lower relative costs, higher risk*, p 27 emphasised the critical need to treat the improvement of the country's freight transportation system as a strategic imperative, based on the vulnerability of the country's logistics performance and competitiveness to transport costs. But before one can embark on any such endeavour it is necessary to first understand the status quo of freight transport activity. One component of freight transport activity is the magnitude and nature of freight flows throughout the country.

The majority of inland freight in South Africa is transported via the road and rail networks, with less than 1.5% of freight transported through pipelines, along the coast or via air. This article describes the modelling methodology used to calculate road freight flows and presents a detailed analysis of the modal split between road and rail for the 2010 reporting year.

## Using the NFFM and FDM to calculate road freight volumes

An accurate reflection of freight flow requires, at the very least, a nationally representative sample of two types of data – the volume of freight transported during a trip and the origin-destination pair associated with the trip. The hesitance of

industry to share this information currently makes it impossible to obtain such a sample. Over the years, various kinds of data have been used as a proxy for the data mentioned here and intricate models have been built to extract valuable insights and inferences from the proxy data.

Freight volumes presented in this article are generated by the National Freight Flow Model (NFFM)<sup>51</sup>. The NFFM can be described as a supply-side model, since it is based on SANRAL vehicle counts to represent road freight. However, the NFFM includes the complete set of actual rail freight data, supplied by Transnet Freight Rail for this survey. Because the rail freight component is based on a complete data set, the results are much more accurate and useful.

51 Havenga, JH and Pienaar WJ, 2012, *The Creation and Application of a National Freight Flow Model for South Africa*. Journal of South African Institution of Civil Engineering. Vol54(1). pp 2 - 13, paper 734.

The road haulage industry is urged to be more cooperative in sharing data in order to improve the accuracy of the road freight results. Understandably, companies are wary of sharing data for reasons pertaining to competition and security. However, by combining road industry data according to the methodologies in this survey, the specific performance data of individual companies will not be visible, while aggregate data will provide an informed holistic view of national freight volumes. The objective of the NFFM is to measure land freight flows across South Africa. Even though pipeline, coastal and airfreight are included in logistics cost measurements, it is excluded from this article as it represents such a relatively small portion of inland freight.

Vehicle counts capture the volume of freight passing a certain point on the road network, but the origin-destination pair of the freight has to be modelled based on certain assumptions. These assumptions are outlined by Havenga and Pienaar<sup>52</sup>. A primary objective of vehicle counts is to measure congestion and traffic along a certain route, but for the NFFM these are used to quantify the usage of various portions of our nation's road

infrastructure, for instance the usage of the Gauteng-Beitbridge corridor or the Gauteng-Cape Town corridor.

There are three typologies of road infrastructure: corridor, metropolitan and rural. Corridors are the long-distance transport links between cities, for example the Durban-Johannesburg corridor along the N3. Metropolitan networks are mostly the transportation networks within cities. The rural typology feeds freight from rural areas into the metropolitan and corridor typologies.

An estimated 28% of road freight is transported across more than one typology. **Figure 16** depicts such a scenario where 10 tonnes of freight are transported over the maximum combination of road typologies. The truck with 10 tonnes of cargo travels from Zimbabwe to Cape Town through Gauteng. This truck would be observed at vehicle count sites along the Gauteng-Beitbridge corridor, in the Gauteng metropolitan area, along the Gauteng-Cape Town corridor and, finally, in the Cape Town metropolitan area. The vehicle is observed four times (indicated by the blue blocks), registering



<sup>52</sup> Havenga, JH and Pienaar WJ, 2012, *The Creation and Application of a National Freight Flow Model for South Africa*. *Journal of South African Institution of Civil Engineering*, Vol54(1), pp 2 - 13, paper 734.

40 tonnes of freight travelling from Zimbabwe to Cape Town, when in actual fact only 10 tonnes (indicated by the grey block) moved from Zimbabwe to Cape Town. Thus, by using vehicle counts as input to the NFFM, there is a certain level of over-counting for the estimated 28% of freight that travels across multiple typologies. However, the tonne-km measurement, being tonnes transported over a distance, cannot, by definition, be observed more than once and would therefore reflect actual consignments.

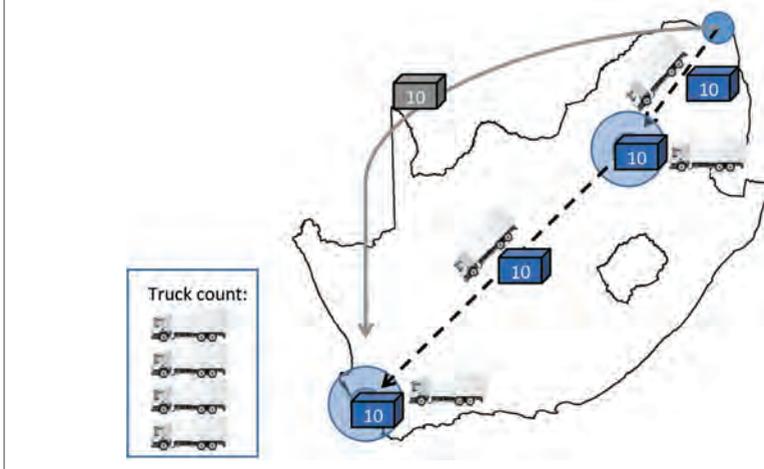
The fact that 28% of land freight is measured more than once using the current data and methodology is outweighed by the fact that tonne-km measurements are accurate and the significant advantages of using the current methodology namely:

- Trend analysis is possible as the methodology remains consistent over time;

- Distinct usage patterns for each typology can be measured;
- Typology usage can be compared between road and rail; and
- The NFFM is able to generate results from currently available datasets.

The other model used to monitor the flow of road freight in South Africa is the Freight Demand Model (FDM), sponsored by Transnet. The FDM measures total freight demand and is therefore 'mode blind'. Because Transnet Freight Rail, the National Ports Authority, Transnet Piped Liquids, Sasol, Eskom and major shipping lines provide actual data, the road data can be derived by subtracting these data from the total freight demand. Given a freight demand in a certain location, the FDM predicts how freight *should* flow and does not, in its base form, account for distribution or redistribution.

**Figure 16:** Potential over-counting of freight volumes due to the use of vehicle counts in the NFFM



In the scenario in **Figure 16**, this demand-side model will make the simple observation that 10 tonnes of a specific commodity was imported via Beitbridge, with 10 tonnes being consumed in Cape Town. As this freight was not transported by rail, pipeline, coastal shipping or air, it therefore had to be road freight.

The FDM and NFFM models augment each other, providing a more detailed and comprehensive land freight result set upon which to base analyses. The FDM measures lower volumes for metropolitan and rural freight as it does not account for distribution or redistribution. It is, however, highly detailed on a commodity level, which enables cost calculations. Conversely, the NFFM accounts for distribution and redistribution but is completely ‘commodity blind’ as vehicle counts do not report on the type of cargo transported. This limits the usability of its outputs.

The fact that roadside vehicle counts exaggerate freight volumes compared to other methods is a global phenomenon and has been researched and described by, among others, McKinon<sup>53</sup>, who reports that in the UK, 29% of freight travels over multiple typologies. Compare this to the 28% observed for South Africa when using the same methodology. McKinon also states that “as the unit of survey is the journey, it is impossible to track the movement of individual consignments across a supply chain comprising several linked journeys” (p 29).

**Table 5** compares the results generated for national road freight by the FDM, the FDM with a modification to account for distribution and the NFFM. The correlation between the demand-side and supply-side models is deemed acceptable, however it is apparent that the FDM undercounts rural freight to some extent.

**Table 5: Comparison of road freight results from the FDM and NFFM**

Tonne (millions) of road freight			
	FDM	FDM with distribution	NFFM
Metropolitan	111	760	798
Rural	222	222	431
Corridor	167	202	217
Total	500	1 183	1 446
Tonne-km (billions) on road			
	FDM	FDM with distribution	NFFM
Metropolitan	4	58	62
Rural	42	51	75
Corridor	91	118	128
Total	138	227	265

<sup>53</sup> McKinon, A and Leonardi, J. 2007. *The collection of long distance road freight data in Europe, in Transport survey methods: Keeping up with a changing world.* Bonnel, P, Lee-Gosselin, M, Zmud, J and Madre, JL (eds). Emerald. Bingley.

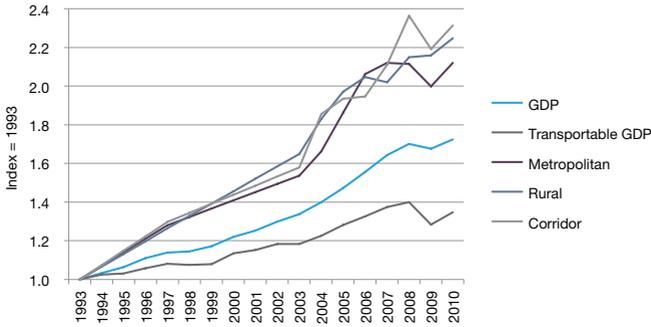
Every year a more reliable historical analysis is possible as SANRAL changes the location of counting stations relative to preceding years, augmenting the dataset. Each year's road volumes are thus based on more complete information than that of the previous years. To accommodate the growing dataset, slight year-on-year changes are made to the modelling process. The results from previous years are updated using the augmented dataset to enable year-on-year comparison

of road freight volumes. **Table 6** shows the updated road freight volumes over the past 11 years.

The tonne-km growth in road freight depicted in **Table 6** is compared to the growth in total GDP (accounting for the primary, secondary and tertiary sectors) and the transportable GDP (accounting only for the primary and secondary sectors) at constant prices in **Figure 17**.

**Table 6:** Updated year-on-year road freight volumes from the NFFM

Tonne (millions) of road freight											
	1990	1993	1997	2003	2004	2005	2006	2007	2008	2009	2010
<b>Metropolitan</b>	326	376	482	579	626	696	772	799	791	757	798
<b>Rural</b>	196	196	242	309	345	374	387	387	413	412	431
<b>Corridor</b>	96	94	122	141	165	174	180	196	215	202	217
<b>Total</b>	618	666	846	1 030	1 137	1 244	1 339	1 383	1 419	1 370	1 446
Tonne-km (billions) on road											
	1990	1993	1997	2003	2004	2005	2006	2007	2008	2009	2010
<b>Metropolitan</b>	25	29	37	45	48	54	60	62	62	58	62
<b>Rural</b>	34	33	42	55	61	66	68	68	72	72	75
<b>Corridor</b>	53	55	72	88	103	107	108	117	131	122	128
<b>Total</b>	112	118	152	188	213	228	236	246	265	252	265

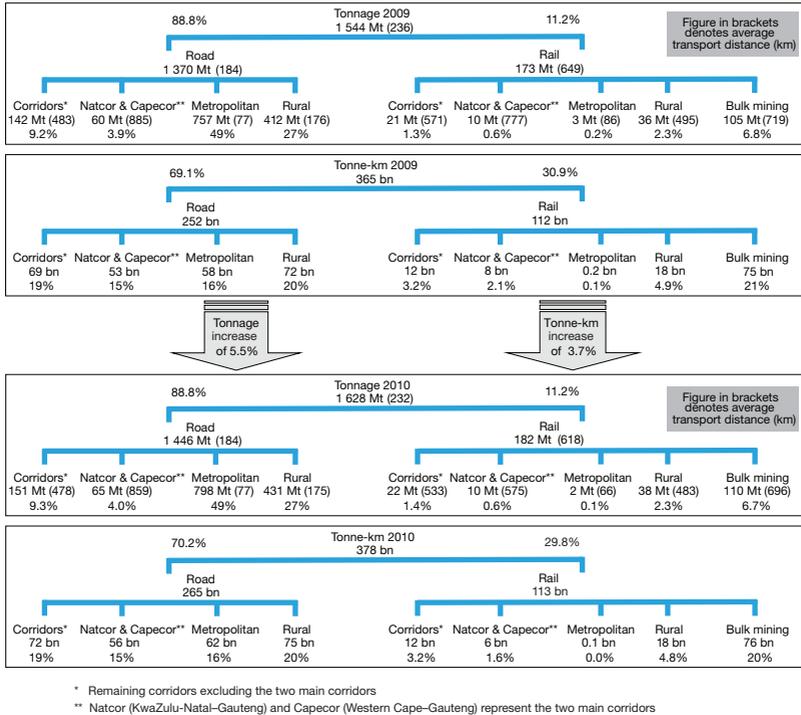
**Figure 17:** Comparison of road freight tonne-kilometre growth and GDP growth

It is clear from **Figure 17** that freight volumes over all typologies grew more rapidly than the GDP. This is a global phenomenon caused by the specialisation of economies. Specialised economies are more transport intensive as outputs from the specific industries in which they specialise must be 'exported' to satisfy demand in other economies while outputs from the industries not represented in that economy

must be 'imported' from other economies. The decoupling of transport growth from GDP is an important sustainability objective for most developed economies to enable the elimination of unnecessary transport<sup>54</sup>. Faced by its vulnerability to rising transport costs and the results in **Figure 17**, this should also be a sustainability objective for South Africa.



<sup>54</sup> European Commission, 2011. *Impact Assessment, an Accompanying Document to the White Paper: Roadmap to a Single European Transport Area – Towards a Competitive and Resource Efficient Transport System*. Brussels.

**Figure 18: Modal distribution of road and rail freight in South Africa**

Latest results from the NFFM show that the total number of land freight tonnes increased by 5.5%, while the total land freight tonne-km increased by 3.7%. **Figure 18** shows the modal split between different road and rail typologies for both the 2009 and 2010 reporting years. The largest growth in tonnes transported was for corridor freight, which saw an increase of 7.4% across all corridors. The greatest growth in tonne-km was observed for metropolitan freight on road which increased by 6.1%. The average distances travelled on road remained the same, while these decreased for rail.

## Conclusion

An important risk identified in South Africa's logistics cost calculation is transport costs, driven by uncertainty and risks relating to the fuel price. South Africa has a relatively high transport demand as illustrated in *Logistics costs – lower relative costs, higher risk*, p 27, which is also growing much faster than GDP. A solution to mitigating the risk associated with transport costs is a significant modal shift from road to rail, but consideration should also be given to reducing transport demand.

# SECTION 2: NEW PERSPECTIVES ON MODELLING AND PERFORMANCE MEASUREMENT



# TRANSPORT PLANNING REVISITED

Joubert, Johan W (University of Pretoria)

As the pressure increases for companies to become more competitive and lower their logistics costs many creative solutions are employed. These include agile supply chains; green logistics; seeking opportunities for 'co-opetition' and supply chain visibility in the ever-globalising market. In doing so, supply chains become ever more complex.

**D**espite this reality, logistics is still very much played as a 'bottom-up' game. That means that while companies are honing their skills to become increasingly better at playing their daily game of logistics, they assume that the 'game board' on which they play allows for a productive game. It doesn't. This article introduces a different perspective of freight transport planning based on a disaggregated modelling approach.

## Planning for transport infrastructure

Consider that the game board is the transport infrastructure on which business is conducted, including the road and rail networks, ports, and intermodal facilities. Government, the custodian of this transport infrastructure, is assumed to provide a game board conducive to playing an efficient logistics game. Yet, the process followed for planning and providing transport infrastructure is inherently a top-down approach, and does not reflect the bottom-up nature of logistics companies and their supply chains. It definitely does not represent the co-evolutionary complexities in decision-making that shippers, carriers and service providers face daily.

## *The state-of-practice of transport planning*

Transport planning, as a discipline, is usually associated with civil engineering and involves the design, siting, evaluation and assessment of transport infrastructure. When planning for new or extending existing infrastructure, models are built that allow for what-if analyses to be done to evaluate the impact of the proposed infrastructure.

The state-of-practice in South Africa involves aggregate transport planning, using an equilibrium approach known as the four-step model. These models are referred to as aggregate since the study area is divided into zones such that the area inside a zone is considered homogeneous. Such models are sensitive to the level of aggregation.

The first of the four steps is to consider each zone and determine, for different trip purposes like work, education and leisure, the number of trips generated from and attracted to each zone based on the underlying land use and zonal demographics.

A residential area would typically generate more work trips during the morning peak as people leave home for work, while an office park will attract more work trips during the same period.

The second step matches all trip productions to trip attractions, often using the gravity model, resulting in an origin-destination matrix of trips. The third step involves modal choice and assigns a proportion of trips for each origin-destination pair to a specific (available) mode. Lastly, route assignment allocates trips to particular routes and often follows an equilibrium assignment approach. The mechanics of these models can be, and often are, quite sophisticated.

A major problem with the four-step approach, especially from a freight point of view, is that it does not reflect reality very accurately, and is not very intuitive. It assumes freight vehicles behave very similarly to passenger vehicles and, most counter-intuitively, that a vehicle is everywhere simultaneously on its journey.

Historically, there is a strong tendency to focus more on people movement in four-step models, with freight often loaded merely as background noise. As this article points out in the later analysis, commercial vehicles' activity chains are much more complex than what is reflected in state-of-practice transport models. Consequently, when decisions are made based on these models, those decisions will most likely

not have the intended positive effect on freight stakeholders.

### **An agent-based alternative**

An alternative view to transport planning exists. Fourie<sup>55</sup> already showed that, if the exact same inputs required for an aggregate four-step model are used in an agent-based approach, travel-time predictions are more accurate and a much richer result set is generated from which to draw analyses.

In an agent-based model individual agents (in this case vehicles) have unique attributes and can behave autonomously. Because each agent is described and modelled individually, the resulting model is considered disaggregated. Not only are such models more intuitive, but they reflect reality more accurately. In the case of passenger transport, the individual decides when to leave from home, what route to take, and whether (s)he is going to walk, cycle or drive. Her/His actions are not the result of an equilibrium assignment. Similarly, commercial vehicle movements in an agent-based model are the result of companies' operational decisions.

The catch is that with agent-based modelling, one is required to understand intricately how the agents would behave and make decisions in real life. In the case of freight vehicles, or commercial vehicles in general, this requires not only obtaining data regarding the movement

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<sup>55</sup> Fourie, P.J. 2010. Agent-based transport simulation versus equilibrium assignment for private vehicle traffic in Gauteng. The 29<sup>th</sup> Annual Southern African Transport Conference. pp 12 - 23.

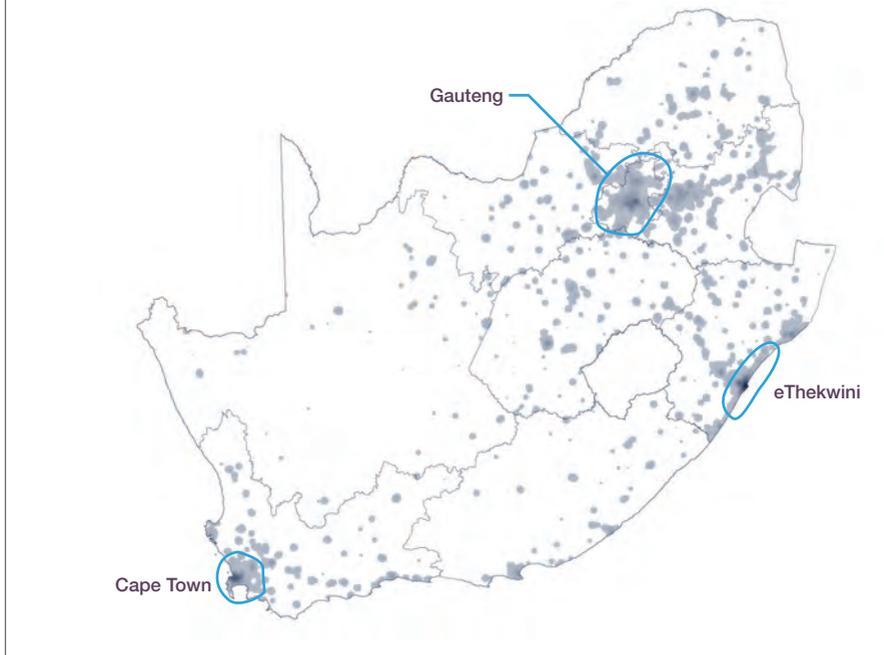
of the vehicles, but also details regarding what is being moved. This is no small challenge. Companies spend millions to just map and understand their own complex supply chains. Indeed, one may understand one's own company, but government is tasked to provide infrastructure that benefits all companies and people participating in the economy.

The remainder of this article shares some of the recent and insightful results achieved in understanding commercial vehicle movement in South Africa. As part of an ongoing research project between the University of Pretoria and Digicore, the GPS records of more than 40 000 commercial vehicles were analysed over a six-month period<sup>56</sup>.

The objective of this analysis is to understand the typical activity-chain structures of commercial vehicles. An activity chain is a sequence of tasks performed by the commercial vehicle. In this research, the activities are those loading and unloading tasks performed at warehouses, distribution centres, retail stores and the like. The act of driving from one facility to another is considered merely a means to an end, and not an 'activity' as such. From these activity-chain structures, one can infer the behaviour of commercial vehicles and duplicate it in an agent-based model. As a result, it is now empirically shown that commercial vehicle behaviour is indeed very different to that of passenger vehicles, and should be addressed separately.

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<sup>56</sup> Joubert, JW and Axhausen, KW. 2011. *Inferring commercial vehicle activities in Gauteng, South Africa. Journal of Transport Geography. Vol19(1), pp 115 - 124.*

**Figure 19:** Commercial vehicle activity densities across South Africa

### Understanding commercial vehicle movement

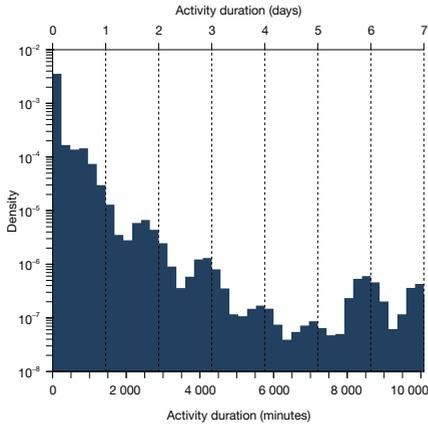
The process used to extract vehicle activities and the associated activity chains are described comprehensively by Joubert and Axhausen<sup>57</sup>. For each activity chain, both the spatial (where) and temporal (when and how long) characteristics are known. The overall activity density in South Africa is illustrated in **Figure 19**. Although the three focus areas – Gauteng, eThekweni and Cape Town – are intuitive, the sparsity of activities

across the rest of the country emphasises South Africa's 'proximity gap'<sup>58</sup>.

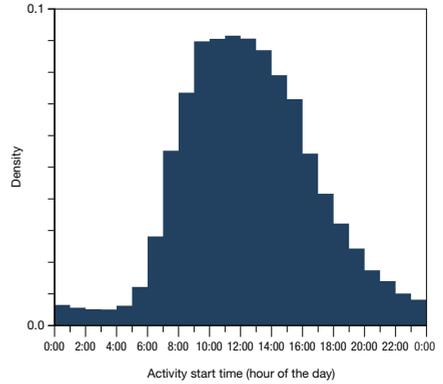
Once the activity chains are known they can be analysed in terms of a myriad of temporal and spatial attributes. Consider, for example, the duration of individual activities (**Figure 20 a**); the start time of individual activities within activity chains (**Figure 20 b**); the number of activities per chain (**Figure 20 c**); and the ending times of activity chains (**Figure 20 d**).

<sup>57</sup> Joubert, JW and Axhausen, KW. 2011. *Inferring commercial vehicle activities in Gauteng, South Africa*. *Journal of Transport Geography*. Vol19(1), pp 115 - 124.

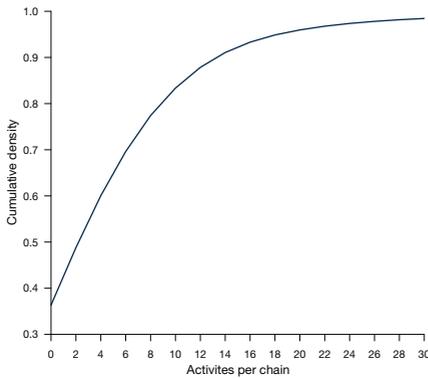
<sup>58</sup> Naudé, W. 2009. *Geography, transport and Africa's proximity gap*. *Journal of Transport Geography*. Vol17(1), pp 1 - 9.

**Figure 20:** Characteristics of activity chains and individual activities

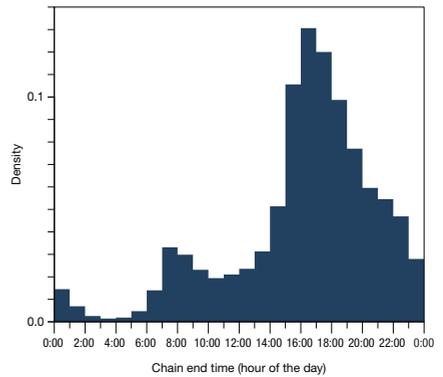
a) Distribution of the duration of individual activities within activity chains



b) Distribution of the start time of individual activities within activity chains



c) Cumulative distribution of the number of activities that occur in one activity chain



d) Distribution of the ending times of the last activity in an activity chain

One of the benefits of working with disaggregate models is that one can aggregate to a variety of levels without changing the model specification. And that is quite intuitive: If you know where the actual vehicles are travelling, you can aggregate to any geographical level. Consider the case of Gauteng, often hailed as ‘the gateway into Africa’ – insinuating a significant amount of through-traffic on road. Actual analysis of vehicle movement tells a different story.

**Figure 21** shows the number of observed vehicle entries and exits at eight of the main gateways in Gauteng. What is noticeable is the high level of activities at gateway 1, the N3 connecting Gauteng with KwaZulu-Natal (Durban), and at gateway 8, the N1 connecting Gauteng with Free State and the Cape provinces. More specifically, one notices the morning peak in entries, and a similar afternoon peak of exits. This suggests that a large volume of vehicles enters and exits at the same gateway – as analysis is done on a disaggregate level, one can refer back to individual vehicle movements to confirm this.

Consider the vehicles that spend less than 60% of their time in Gauteng. Their activity chains are split into two groups. Firstly, one gets those vehicles with in-out chains that originate outside Gauteng, enter through one of the gateways, perform a number of activities, and leave through one of the gateways, possibly the same one through which they had entered. Secondly, look at those vehicles with out-in chains that originate inside Gauteng, leave through one of the

gateways, perform activities outside before entering again through one of the gateways, possibly the same as the one through which they had left. **Table 7** shows the combinations of gateways through which vehicles entered and exited the province for in-out chains, and **Table 8** does the same for out-in chains. The shade graphically represents the percentage of the total – the darker, the more frequently that combination occurs.

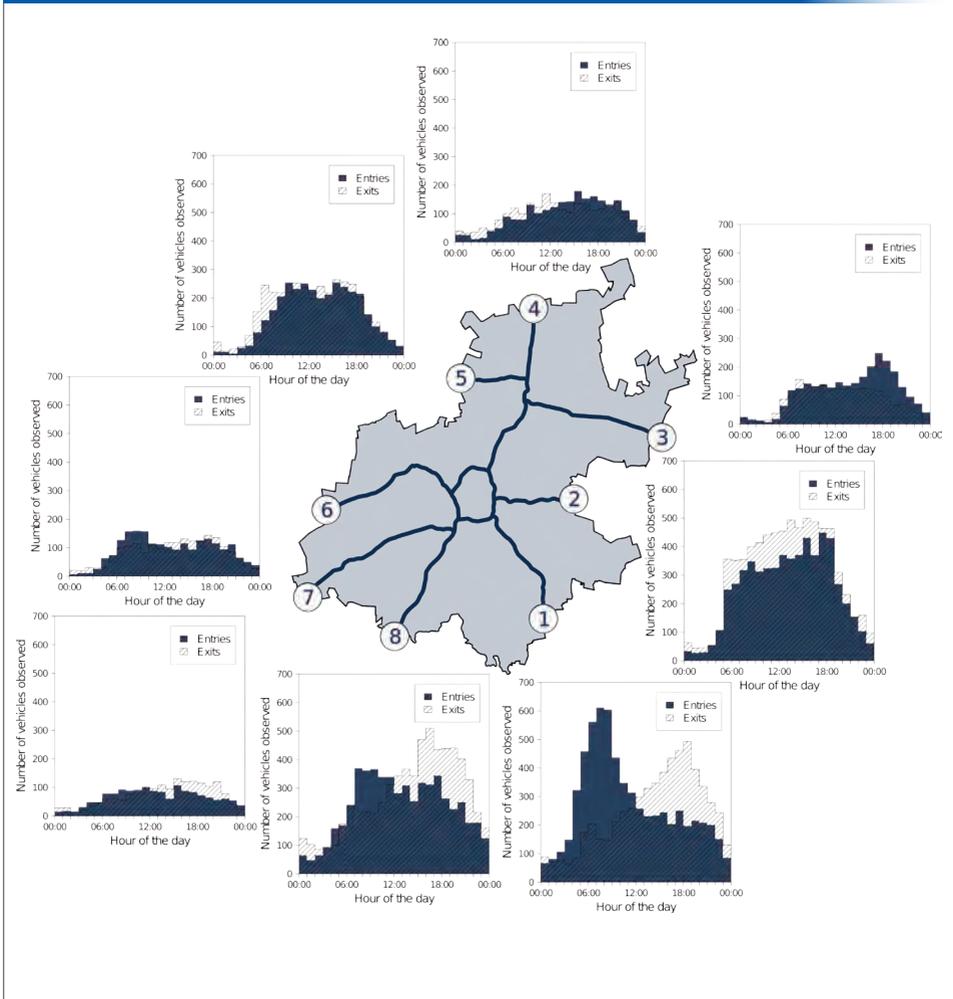
From a freight traffic point-of-view, as opposed to a commodity point-of-view, this highlights that very little through traffic actually exists in Gauteng. It may be that goods flow through Gauteng en route to their final destination, but it is clear that traffic does not necessarily – at least not at the proportions expected. This suggests that if South Africa is serious about lowering logistics costs, the options available to relocate the facilities and businesses that deal with large quantities of imports and exports closer to the ports of entry should be seriously considered. Arguably this would have up and downstream ramifications that must be carefully considered to ensure the goal of overall lower logistics costs is achieved.

Many more analyses can be done to extract insightful information from commercial activity chains. For example, unproductive ‘hotspots’ can be identified at facilities where commercial vehicles wait in queues to perform a meaningful activity, such as loading or unloading. This is typically identified in the GPS logs when a vehicle ignition is switched on, only to move a few metres further before switching off again.

Another extension to this research is analysing the network that exists between commercial facilities in an area based on the commercial vehicle movement between them. Most importantly, understanding the behaviour

of commercial vehicles in this way is a fundamental step in developing accurate, representative, agent-based models that can provide the necessary decision-support transport planning requires.

**Figure 21:** Typically observed daily gateway activities in Gauteng



**Table 7:** Fraction of in-out gateway activities observed for specific incoming and outgoing gateway combinations

		Outgoing gateway									
		1	2	3	4	5	6	7	8		
Incoming gateway	1	0.57	0.12		0.05			0.14		23%	Percentage of total incoming activity
	2	0.07	0.66					0.12		19%	
	3		0.37	0.43		0.08				7%	
	4	0.20	0.09		0.36	0.10		0.17		5%	
	5	0.09	0.07	0.08	0.05	0.62				9%	
	6	0.06	0.12				0.47	0.19	0.06	7%	
	7	0.09	0.12					0.63		22%	
	8	0.12	0.08			0.15	0.10	0.10	0.40	7%	
		20%	23%	6%	6%	10%	6%	23%	6%	Percentage of total outgoing activity	

**Table 8:** Fraction of out-in gateway activities observed for specific outgoing and incoming gateway combinations

		Incoming gateway									
		1	2	3	4	5	6	7	8		
Outgoing gateway	1	0.89	0.05							14%	Percentage of total outgoing activity
	2	0.05	0.75	0.18						25%	
	3		0.23	0.67	0.06					9%	
	4			0.06	0.87					7%	
	5					0.80			0.13	14%	
	6						0.82	0.07	0.09	7%	
	7	0.07						0.88		18%	
	8					0.25	0.07		0.62	7%	
		15%	22%	11%	8%	13%	7%	17%	7%	Percentage of total incoming activity	

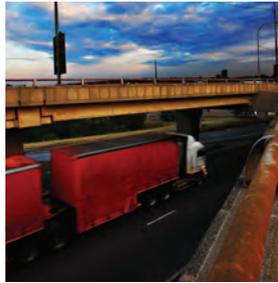
## Conclusion

There is, indeed, a gap for government to fill in terms of how decision makers go about transport planning. They need to understand the players – and their game – much better, and reflect that in appropriate decision support models. But to improve their understanding, the logistics industry needs to be more forthcoming with how it conducts its business.

Sharing knowledge and data is, contrary to popular belief, not a case of revealing trade secrets. A mind shift is needed away from the

myopic paradigm that “If I want some more pie, I have to take some of yours”. Rather, it is a case of creating a much bigger pie. The de facto attitude of not worrying about who creates the game board or how it is created needs to be revised.

From a research point of view, Joubert et al.<sup>59</sup> showed that commercial vehicles can be modelled alongside other road users very accurately. Good progress has been made, but much work remains to better capture the realistic behaviour of logistics players in transport planning models.



59 Joubert, JW, Fourie, PJ and Axhausen, KW. 2010. Large-scale agent-based combined traffic simulation of private cars and commercial vehicles. *Transportation Research Record*. No. 2 168, pp 24 – 32.

# MARITIME CONNECTIVITY OF SOUTH AFRICAN PORTS

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The global economic landscape is shifting. New markets are emerging while more mature markets are reinventing or repositioning themselves amidst ongoing economic and political tumult. Now that the boat has been rocked, many companies – and indeed countries – are re-evaluating their strategic options in terms of trading partners. Inevitably, switching trading partners implies drastic changes in a company's supply chain.

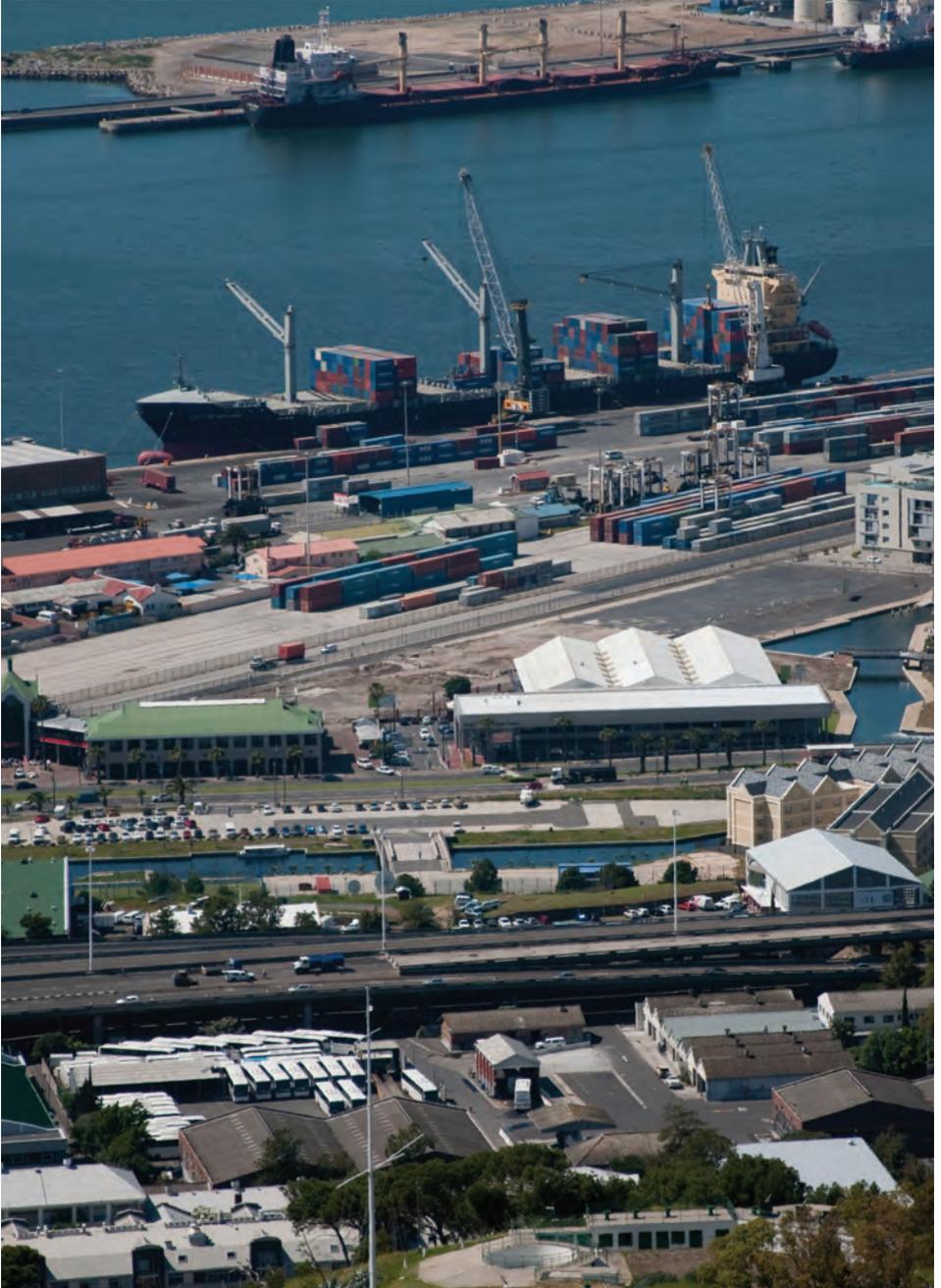
Keeping in mind that the strength of a supply chain depends greatly on the infrastructure, institutional frameworks and service industries that support it, companies should perform comprehensive evaluations of their logistics options before switching.

Measuring the performance of the logistics industry – especially on a macro level – has always been a contentious issue. Not only does the lack of consistent methodologies hamper the global comparison of specific metrics (refer to *Comparing country-level logistics costs*, p 42), but it is nearly impossible to find one metric that convincingly encompasses all aspects of logistics performance in a fully-representative manner. For this very reason one often considers a basket of metrics when evaluating a logistics system. The purpose of this article is, firstly, to introduce the concept of connectivity within the maritime industry and motivate why this is an important metric to add to the basket and, secondly, to discuss the connectivity of South Africa's sea ports according to two global connectivity indices.

## Logistics connectivity

Any logistics system can be characterised as a geographic system of nodes and links. Nodes are connected to one another directly by a single link or indirectly by a sequence of links. In the maritime industry ports are fixed, thus they are well-defined nodes. One could argue that a direct link could exist between any given port pair, but it is generally accepted that a link only exists between a port pair when there is regular and significant traffic between them. In terms of freight this would imply the regular movement of tonnes of bulk or hundreds of TEUs between a port pair. (A Twenty-foot Equivalent Unit (TEU) is a standard unit for expressing a vessel's cargo-carrying capacity. One TEU implies a rectangular shape with dimensions 20 x 8 x 8 feet).

A well-connected port offers greater accessibility, flexibility and reliability. A well-connected port provides access to the important maritime trade routes which, in turn, offers access to all the significant global markets. Furthermore, a well-connected port



offers more than one way of getting from Port A to Port B, lending flexibility to the supply chain design process. In addition, having multiple different routes between Port A and Port B also creates redundancy in the system, so that if one link fails – say due to trade embargoes – the vessel is still able to reach Port B through other links. This redundancy increases reliability in a supply chain. Connectivity is therefore an important aspect of a port's competitiveness.

The United Nations Conference on Trade and Development (UNCTAD) cites empirical studies<sup>60</sup> that have shown a strong correlation between a country's maritime connectivity and its trade costs, particularly its cost of external transportation. (Note that transport costs referred to elsewhere in this survey consider only those costs incurred once freight has already entered the country.) Understanding maritime connectivity could inform strategic collaboration and redefine competitor strategies.

Many types of services exist in the maritime industry. Container shipping is by far the most regular, consistent and predictable of maritime services. In container shipping the term 'service' is defined as a fixed sequence of port calls, with a port call being the action of a vessel anchoring at a port to load or unload cargo. Each port in the sequence expects vessels operating on that service to anchor at its berths at fixed time intervals (e.g. weekly or biweekly) – this is termed

the service frequency. To maintain a service frequency, multiple vessels are assigned to that service. Most often it does not make business sense for one container shipping company to devote many vessels to maintain a single service, thus alliances are formed between companies. Consequently, one service may have vessels from a number of different container shipping companies, acting in an alliance, calling at the ports in its sequence.

The Liner Shipping Connectivity Index (LSCI) measures the maritime connectivity of a country based solely on data from the global container shipping industry. The LSCI is computed and published annually for 162 coastal countries by UNCTAD. The LSCI aggregates incoming and outgoing container traffic from all ports in a country to give a single country-level index. It comprises five components:

1. The number of container vessels that call at the country's ports;
2. The container carrying capacity (in TEUs) of the container vessels;
3. The number of companies that operate services that call at the country's ports;
4. The number of services that call at the country's ports; and
5. The size of the largest vessel (in terms of TEUs) that calls at the country's ports<sup>61</sup>.

60 United Nations Conference on Trade and Development (UNCTAD). 2011. *Review of Maritime Transportation 2011*. United Nations, Switzerland. ISBN 978-92-1-112841-3. p 90.

61 United Nations Conference on Trade and Development (UNCTAD). 2011. *Review of Maritime Transportation 2011*. United Nations, Switzerland. ISBN 978-92-1-112841-3. p 90.

UNCTAD has been tracking trends in port connectivity by means of the LSCI since 2004, based on data from Containerisation International Online.

### Results from the LSCI

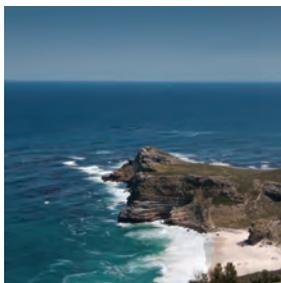
The LSCI scores from 2004 to 2011 are available from UnctadStat<sup>62</sup> and the method used to calculate the annual LSCI scores is explained in detail in the notes to the spreadsheet available from the website. To facilitate comparison here, the annual scores have been normalised to a score out of 100. Because China achieved the maximum LSCI score every year since 2004, China's normalised score is 100 each year.

**Figure 22** plots the distributions of the normalised LSCI scores for each of the years from 2004 to 2011. Firstly, it is clear that the distributions have not changed much over the recent years.

The long, flat tail of the distribution shows that a very small proportion of countries, led by China, outperforms the rest by a great margin.

**Figure 23** shows the top 10-ranked countries according to their normalised LSCI scores.

Two notable facts are that Hong Kong and Singapore, small countries with only one sea port each, are outstanding, and that the USA shows a decreasing connectivity. Because the scores are normalised relevant to the maximum (China), the downward trend of the remaining top 10 countries since 2009 suggests that China's connectivity is increasing at a more rapid pace than the rest of the world. The trough in scores around 2008 is indicative of the effect of the global recession, which greatly reduced container traffic. Lastly, it is worthwhile observing that there has been minimal shuffling among the top 10 countries, with the same countries being among the top 10 since 2007.

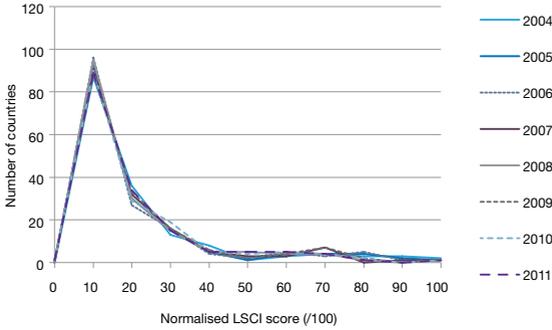


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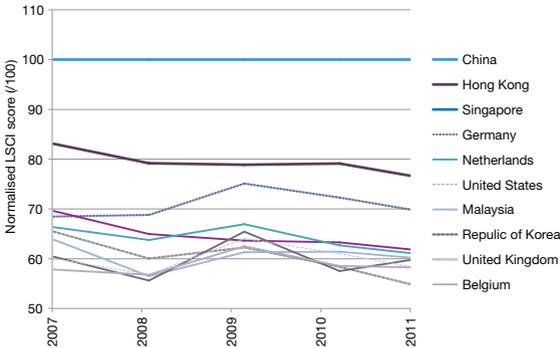


62 UnctadStat. 2011. *Liner shipping connectivity index, annual, 2004-2011*. United Nations Conference on Trade and Development. Available at: <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx>. [Accessed on 28 February 2012.]

**Figure 22:** A comparison of the distribution of the normalised annual LSCI scores between 2004 and 2011 (adapted from source data by UnctadStat<sup>63</sup>)



**Figure 23:** Movement among the top 10-ranked countries, according to the normalised LSCI scores, between 2007 and 2011 (adapted from source data by UnctadStat<sup>63</sup>)



When investigating normalised LSCI scores since 2007, it is apparent that the scores of very few countries have increased or decreased considerably. It is apparent that maritime connectivity is not that sensitive to short-term global shocks (i.e. there is not a big change between the year-on-year scores),

but that significant change is observed for specific countries that maintain a trend over a number of years. It would be worthwhile to study the changes in economy, politics, infrastructure development and logistics strategy in countries that show significant changes either way.

<sup>63</sup> UnctadStat. 2011. *Liner shipping connectivity index, annual, 2004-2011*. United Nations Conference on Trade and Development. Available at: <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx>. [Accessed on 28 February 2012.]

**Table 9:** LSCI ranking for coastal BRICS and SADC countries (adapted from source data by UnctadStat<sup>64</sup>)

BRICS countries					
	LSCI rankings				
	2007	2008	2009	2010	2011
China	1	1	1	1	1
India	20	20	22	23	22
South Africa	32	35	29	33	30
Brazil	24	27	33	34	32
Russian Federation	65	64	48	53	59
Coastal SADC countries					
	LSCI rankings				
	2007	2008	2009	2010	2011
South Africa	32	35	29	33	30
Mauritius	52	55	64	63	70
Namibia	88	74	69	69	75
Angola	77	80	75	78	81
United Republic of Tanzania	75	77	82	79	78
Mozambique	98	88	84	95	84
Madagascar	89	94	90	102	98
Seychelles	115	122	117	120	103
Democratic Republic of Congo	149	143	136	118	140

When investigating normalised LSCI scores since 2007, it is apparent that the scores of very few countries have increased or decreased considerably. It is apparent that maritime connectivity is not that sensitive to short-term global shocks (i.e. there is not a big change between the year-on-year scores), but that significant change is observed for specific countries that maintain a trend over a number of years. It would be worthwhile to study the changes in economy, politics, infrastructure development and logistics strategy in countries that show significant changes either way.

### Port connectivity index

Although an aggregated country-level maritime connectivity metric is valuable, understanding maritime connectivity on the port level is much more relevant and tangible to strategic and operational planning. The Port Connectivity Index (PCI), developed by the Supply Chain and Logistics Institute at the Georgia Institute of Technology, calculates maritime connectivity at port level.

The PCI defines the network's links based primarily on inter-regional container services.

64 UnctadStat. 2011. *Liner shipping connectivity index, annual, 2004-2011*. United Nations Conference on Trade and Development. Available at: <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx>. [Accessed on 28 February 2012.]

Each link is weighted according to the five factors considered (on a country level) for the LSCI. Whereas the LSCI derives its scores by aggregating the inflows and outflows of a country's ports, the PCI calculates its score by first weighting the direct links between ports and then calculating the connectivity of each port based not only on the weights of its direct links with its 'neighbours', but on the weights of the links its neighbours have with their neighbours, and so on along all the direct links of the network. The score thus

indicates how well each port communicates with the entire network. In addition, the PCI distinguishes between incoming and outgoing links and thus presents an import and export score for each port. An interactive tool that displays the PCI and other container service-related metrics will soon be available from the Supply Chain and Logistics Institute.

**Table 10** shows that, according to the PCI, the Asian region dominates the rankings in terms of both import and export connectivity.

**Table 10:** Top 10-ranked ports in terms of the PCI import and export scores (adapted from source data, Georgia Institute of Technology<sup>65</sup>)

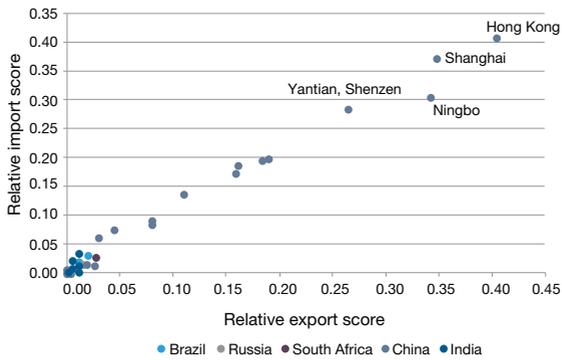
IMPORT			EXPORT		
Rank	Port	Country	Rank	Port	Country
1	Hong Kong	China	1	Hong Kong	China
2	Shanghai	China	2	Shanghai	China
3	Ningbo	China	3	Singapore	Singapore
4	Yantian, Shenzhen	China	4	Ningbo	China
5	Busan	South Korea	5	Yantian, Shenzhen	China
6	Singapore	Singapore	6	Busan	South Korea
7	Kaohsiung	Taiwan	7	Kaohsiung	Taiwan
8	Chiwan, Shenzhen	China	8	Port Klang	Malaysia
9	Xiamen	China	9	Chiwan, Shenzhen	China
10	Shekou, Shenzhen	China	10	Xiamen	China

<sup>65</sup> Bartholdi, JJ III. 2012. Source data. Georgia Institute of Technology. [Accessed on 27 February 2012.]

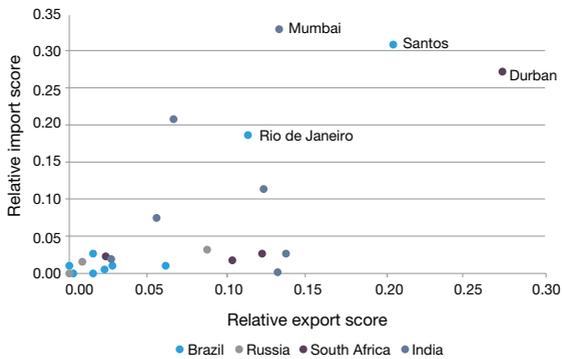
Figure 24 shows a comparison of the relative import and export scores for the ports in the BRICS countries. The connectivity of China's ports overshadows that of the other ports by such a great margin that Brazil, Russia, India

and South Africa have to be graphed separately to obtain a clearer picture (Figure 25). A similar analysis of the coastal SADC countries showed that Durban and Mauritius are the distinctive leaders of the pack.

**Figure 24:** Import and export score comparison for BRICS countries (adapted from source data, Georgia Institute of Technology<sup>66</sup>)



**Figure 25:** Import and export score comparison for BRICS countries; China excluded (adapted from source data, Georgia Institute of Technology<sup>66</sup>)



66 Bartholdi, JJ III. 2012. Source data. Georgia Institute of Technology. [Accessed on 27 February 2012.]

### The importance of connectivity for South African ports

A closer look at maritime traffic in South Africa shows that the ports are specialised in terms of the type of cargo handled. All sea freight can be classified as either containerised or non-containerised cargo and South African ports are generally geared either more towards one or the other.

Furthermore, it is worthwhile distinguishing between transshipment traffic and non-transshipment traffic (import, export and coastal traffic). Connectivity is important for non-transshipment traffic as it connects the industries served by the port to the global markets. Additionally, connectivity is a vital characteristic for any port that handles transshipment traffic. Transshipment traffic boosts port revenues and during periods when the hinterland markets are not yet

engaging significantly in global trade, it could be a mechanism for establishing and preserving connectivity.

Transshipment traffic could, however, also worsen congestion at ports that act as critical gateways to inland supply chains.

**Table 11** shows the percentage of total transshipped and non-transshipped traffic handled at each port for both containerised and non-containerised cargo. From the data one can see that Durban, Ngqura, Port Elizabeth and Cape Town are the big players in terms of containerised traffic and that Ngqura and Port Elizabeth function mainly as transshipment hubs. Similarly, Durban, Richard's Bay, Cape Town and Saldanha play the biggest role in terms of non-containerised traffic, with Cape Town and Durban functioning mainly as transshipment hubs.

**Table 11:** Comparing transshipment and non-transshipment traffic for South African ports (adapted from source data, South African Maritime Safety Association<sup>67</sup>)

	Container traffic		Non-containerised traffic	
	Transshipment	Non-transshipment	Transshipment	Non-transshipment
Richard's Bay	–	0.64%	0.20%	<b>42.26%</b>
Durban	<b>46.68%</b>	<b>66.95%</b>	<b>78.09%</b>	<b>21.30%</b>
East London	0.07%	1.69%	0.00%	0.91%
Ngqura	<b>29.58%</b>	<b>5.84%</b>	5.61%	0.00%
Port Elizabeth	<b>14.40%</b>	<b>5.03%</b>	4.56%	3.63%
Mossel Bay	–	–	0.00%	0.94%
Cape Town	<b>9.48%</b>	<b>19.85%</b>	<b>10.62%</b>	1.76%
Saldanha	–	–	0.91%	<b>29.20%</b>

<sup>67</sup> South African Maritime Safety Association. 2011. Source data. Obtained from SAMSA in February 2012. Pretoria, South Africa.

This analysis of South African maritime traffic raises an important question in terms of the measurement of connectivity. While container traffic is an obvious starting point, it would be worthwhile to extend the metric to include non-containerised traffic to properly reflect the connectivity of South Africa's ports. Non-containerised traffic is not as regular or predictable as containerised traffic, thus the greatest challenge in expanding the metric would be defining and weighting the links between ports in terms of non-containerised traffic.

## Conclusion

The LSCI and PCI scores seem congruent, but the latter captures the network structure and presents results on a disaggregated port level. There is vast potential to expand these indices (to include, for instance, non-containerised traffic) or complement them with indices that harness alternative perspectives of network centrality<sup>68</sup>. The hurdle to such development is the availability of the global data required.

To illustrate the strategic potential of understanding maritime connectivity, one could consider the following key insights from this analysis: When the goal is creating and preserving regional connectivity, the question

of South African ports competing for volume is reframed. In addition, the importance of maritime connectivity suggests that South African ports should take more deliberate action to become maritime transshipment hubs so that the connectivity is maintained while hinterland logistics systems increase capacity.

Oil price increases and port developments on the African east and west coasts could result in a loss of South Africa's connectivity to global markets and this loss needs to be mitigated by a more competitive service offering.

Maritime connectivity is a metric that forces one to consider the importance of a certain port in terms of its relationship to the entire maritime network – it enables planners to take a more holistic and long-term view in the construction of the logistics networks that support supply chains. In this era of shifting supply chains and global partners, connectivity should thus be added to the basket of logistics performance metrics.

*Special acknowledgement to Pisit Jarumaneeraj from the Georgia Institute of Technology and Pablo Achurra from the Georgia Tech Panama Logistics Innovation and Research Center for their contributing research.*

68 Wikipedia. 2012. Centrality. Available at: [http://en.wikipedia.org/wiki/Centrality#cite\\_note-1](http://en.wikipedia.org/wiki/Centrality#cite_note-1). [Accessed on 19 March 2012.]



SECTION 3: TOPICAL RESEARCH

# THE POTENTIAL EFFECTS OF BAD ROADS ON TRANSPORTED CARGO

Steyn, Wynand JvdM (University of Pretoria), Bean, Wilna L (CSIR), Pretorius, Cornelia J (University of Pretoria) and Van der Walt, Gert-Louis (University of Pretoria)

Various studies published in the past few years indicate that there are many potential negative effects deteriorating road conditions could have on a country's logistics activities and costs<sup>69,70</sup>. Three studies focusing on the potential effects of deteriorating road conditions in South Africa show that these effects can be quite significant<sup>71,72,73</sup>.

Some of these negative effects can potentially impair the country's ability to compete globally. It is therefore critical for private and public sector stakeholders to take South African road conditions and their potential negative effects on logistics activities and costs into account during planning. Determining appropriate ways to address or mitigate these effects could ultimately enhance South Africa's logistics cost competitiveness, thereby positioning the country more favourably in terms of the changes in the global economy.

In 2008, the initial concepts around the potential effects of deteriorating road conditions on logistics activities and costs in South Africa

were introduced and explained<sup>71</sup>. This was followed by a case study conducted by two South African logistics service providers that clearly quantified the potential increases in truck maintenance and repair costs and, consequently, company logistics costs<sup>72</sup> resulting from deteriorating road conditions. The results showed that these increases could be significant. In 2010, a cost-benefit analysis compared the cost of maintaining roads in a good condition to the potential increases in vehicle operating costs attributable to additional vehicle damage caused by bad roads<sup>73</sup>. The results showed that maintaining roads in a good condition holds major long-term financial benefits.

69 Jarimopas, B, Singh, SP and Saengnil, W. 2005. Measurement and analysis of truck transport vibration levels and damage to packaged tangerines during transit. *Packaging technology and science*. Vol18(4), pp 179 - 188.

70 Steyn, WJvdM, Bean, WL, King, D and Komba, J. 2011. Evaluation of selected effects of pavement riding quality on logistics cost in South Africa, *Transportation Research Record. Journal of the Transportation Research Board*. No. 2 227(3), pp 138 - 145.

71 Steyn, WJvdM, Bean, WL and Monismith, CL. 2008. *The potential cost of bad roads in South Africa*. 5<sup>th</sup> Annual State of Logistics™ survey for South Africa. CSIR. Pretoria. South Africa.

72 Steyn, WJvdM and Bean, WL. 2009. *Cost of bad roads to the economy*. 6<sup>th</sup> Annual State of Logistics™ survey for South Africa. CSIR. Pretoria. South Africa.

73 Steyn, WJvdM and Bean, WL. 2010. *The potential cost of deteriorating road quality and maintenance in South Africa: Exploring benefit-cost analysis*. 7<sup>th</sup> Annual State of Logistics™ survey for South Africa. CSIR. Pretoria. South Africa.

Apart from the additional vehicle damage caused by bad roads, increased vibrations experienced by trucks travelling on bad roads could potentially have negative effects on transported cargo. Not much has been done to date in South Africa to investigate and quantify these effects. This article addresses this issue by building on the previous studies and presenting two case studies that investigate the potential effects of deteriorating road quality on cargo damage and losses.

### **Cargo damage and loss in the agriculture sector: Two case studies**

The distribution of fresh produce in the agriculture sector requires extensive handling and transportation after harvesting – actions that could result in damages to and loss of products. This has significant economic impact on the agriculture sector as damaged produce have reduced economic value<sup>74</sup> and losses decrease revenues.

The case studies investigate and quantify the additional damage to and losses of transported cargo incurred when fresh produce is transported on bad as opposed to good roads. Truck transportation is the preferred method of transportation for the South African agriculture sector because the road network

is far more pervasive, reaching a larger number of inland destinations than any other mode of transport<sup>75</sup>.

In this sector, trucks travel on a variety of road types before reaching their destination. In most cases the first stage of travel is on a gravel road from the farms where fresh produce are harvested. Gravel roads are generally in a worse condition, having a higher roughness than paved national and provincial roads. The majority of fresh produce damage and loss during transportation therefore occurs while travelling on gravel roads.

#### ***Fruit-damage case study***

The purpose of the fruit-damage case study is to quantify the vibrations a truck and the fresh fruit it carries have to endure due to different road conditions when travelling from growers in Limpopo to market distributors in Pretoria and Johannesburg. The vibrations generated during transport were then compared with vibration ranges known for causing damage to transported produce<sup>76</sup>.

The case study considered six similar trucks and four types of fruit. The trucks used in the case study travelled on national and

<sup>74</sup> Chonhenchob, V, Sittipod, S, Swasdee, D, Rachtanapun, P, Singh, SP and Sing, J. 2009. Effect of truck vibrations during transport on damage to fresh produce shipment in Thailand. *Journal of Applied Packaging Research*. Vol3(1), pp 27 - 38.

<sup>75</sup> Jarimopas, B, Singh, SP and Saengnil, W. 2005. Measurement and analysis of truck transport vibration levels and damage to packaged tangerines during transit. *Packaging Technology and Science*. Vol18(4), pp 179 - 188.

<sup>76</sup> Pretorius, C.J. 2011. *The influence of road roughness on the transportation of fresh produce*. BEng dissertation, University of Pretoria, Pretoria.

provincial roads considered to be in a good condition, with International Roughness Index (IRI) values of between 0.8 and 2.5 mm/m. The trucks also travelled on gravel roads that had not been re-gravelled in the past eight years and had an IRI value of around 8 mm/m.

The vertical acceleration experienced when travelling over rough road surfaces causes damage to vehicles, increased wear and tear and, potentially, damages to and loss of transported cargo. In this case study, vertical acceleration data were collected by installing

accelerometers at different locations on the trucks and inside the packaging of transported fruit.

**Figure 26** shows the location of accelerometers on the truck body. Measurements from the truck body were compared to measurements from inside the packaging to investigate the damping and amplifying effect of packaging. As expected, measurements did not differ significantly among the six truck bodies, but differences were observed among different types of fruit cargo.

**Figure 26:** Location of accelerometers on trucks



O'Brien et al.<sup>77</sup> indicated that various types of fruit can be damaged when vibrated at frequencies ranging from 9 to 54 Hz, with specific bands of frequencies for different types of fruit. Most of these frequencies fall in the range of the axle-hop frequencies of the truck (high frequency vibrations mainly experienced by the axles and tyres of the truck), which are between 5 and 20 Hz. The axle-hop frequencies are often transposed to the fruit cargo inside the packaging, especially in the case of bad truck suspension.

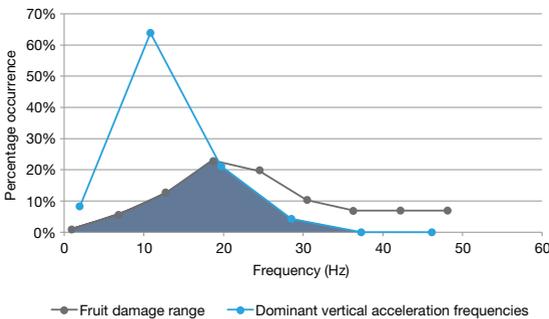
The dominant vertical acceleration frequencies experienced by the four types of fruit cargo were identified and compared with frequency ranges at which the different types of fruit are susceptible to damage. **Figure 27** provides

a visual comparison between the dominant frequencies experienced by the fruit cargo and the damage frequency range of the different fruits.

The shaded area in **Figure 27** represents the overlap of dominant frequencies with the frequency range where different types of fruit are likely to be damaged. This overlap is an indication that some of the vibrations experienced during transportation may result in damage to transported produce.

Different packing locations in a truck experience different magnitudes of vertical acceleration during transit. The range of vertical acceleration depends on factors such as tyre pressure, truck suspension type, vehicle loading and the size

**Figure 27:** Comparison between dominant frequencies experienced by fruit cargo and the vibration range that results in fruit-cargo damage



<sup>77</sup> O'Brien, M, Centry, PJ and Gibson, RC. 1965. *Vibrating Characteristics of fruit as related to in-transit injury. Transactions of the ASAE. Vol8, pp 241 - 243.*

of the vehicle. Accelerometers were placed at different locations inside the truck within the pallets to compare the vertical acceleration experienced by cargo at different packing locations in the truck. In addition, the vertical acceleration experienced by the truck body was also measured.

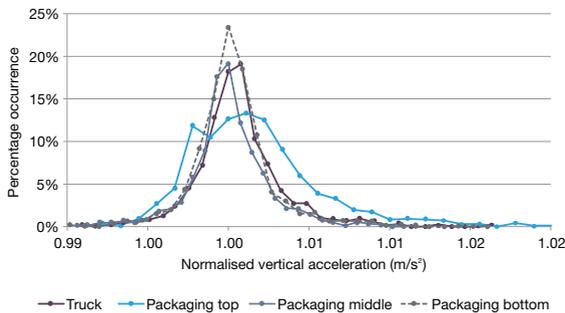
In general, pallets at the back of the truck and pallets on top of the pallet stacks in the front and middle of the truck experienced higher acceleration.

**Figure 28** displays the normalised distributions of the vertical accelerations experienced at various packing levels in the front of the truck as well as on the truck body. The distributions for the accelerations experienced by the bottom

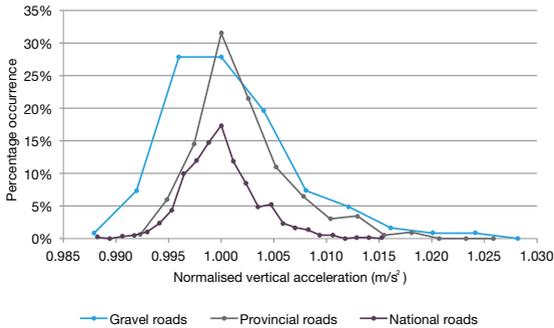
and middle levels are very similar to that of the truck body. It is evident from the slightly lower mean value and variation of accelerations experienced in the bottom pallets than the truck body that the packaging does, in fact, dampen the vertical acceleration.

The difference in distributions between the top level and the other levels is notable. Not only is it likely that these pallets experience very high vertical accelerations throughout the trip, but the broad shape of the distribution indicates that the vertical acceleration experienced is far more variable. Fruit packaged on fibreboard pallets on the bottom level in the front of the truck are thus most protected against vibration damage incurred during transport.

**Figure 28:** Normalised distributions of the vertical accelerations experienced within pallets at various packing levels at the front of the truck



**Figure 29:** Normalised distributions of vertical accelerations experienced in the middle of the truck body for different road conditions



The vertical acceleration experienced by the loadbed in the middle of the truck body while travelling on national, provincial and gravel roads is compared to see whether road condition has a significant impact on the potential of fruit cargo-damage during a trip.

**Figure 29** graphs the normalised distributions of the vertical acceleration experienced on each of these roads. The widest distribution of accelerations for the middle of the truck is experienced when travelling on a gravel road. This means that a higher proportion of increased vertical accelerations will be applied to the freight transported on gravel roads, causing potentially higher levels of damage to the fruit. As expected, national roads present the lowest probability of experiencing vertical acceleration that is potentially harmful to fruit cargo.

It can be concluded that fruit transported from Limpopo to Gauteng is highly likely to be subjected to vertical acceleration levels that could potentially damage cargo and lower its economic value. The probability of such

damage is far greater along stretches of road that can be classified as 'bad' according to their IRI. Furthermore, the packing location inside the truck has a decided effect on the level of vibration experienced and fresh produce packaged on fibreboard pallets are somewhat insulated against vibrations.

The economic impact of damaged agricultural cargo is absorbed differently by large and small-scale farming companies. Large companies either use in-house fleets or outsource to transportation companies. In the first instance, trucks can be customised for certain cargo or operational techniques can be enforced that mitigate damage due to vibration. In the latter case service level agreements and insurance safeguard the farmers' interests to a great extent. Small-scale farmers are typically more vulnerable. Generally they provide their own transport and are thus not safeguarded by service level agreements or insurance. Furthermore, unlike large fleets, their vehicles, packaging and operational procedures are not customised to moderate cargo damage.

### Grain-loss case study

Wheat has a fine granularity, making it a cargo susceptible to losses during transportation, especially on bad roads characterised by higher surface roughness. The grain-loss case study investigates the potential wheat losses of a grain shipping company during transportation as a result of increased truck vibrations caused by bad roads in South Africa.

Farm loads and silo-to-mill loads are two types of transportation contracts in the grain shipping industry. Shipping data from these two types of contracts between November 2010 and July 2011 were used for the case study. 'Farm loads' refer to the transportation of wheat between farms and silos, which happens mainly via gravel roads. Farm loads are thus generally transported along roads that are in a bad condition. Silo-to-mill contracts transport loads mainly along paved roads in South Africa; these roads are mostly in a good condition. A similar mix of truck fleet is used to transport wheat for both types of transport contracts.

The shipping data analysed in this case study provide the weight of individual wheat loads when loaded and unloaded. The difference between these two weights is the basis for calculating wheat-loss during transit. After accounting for extreme causes of variation (such as vehicle accidents) it is assumed

that the remaining variation was due to a variation in scale calibration, causing over or underweighting, or a variation in the vibration experienced as a result of varying road quality conditions. It was assumed that the variation due to over and underweighting cancelled out across the data sample and was thus ignored.

Data were grouped according to the type of contract, farm loads or silo-to-mill loads, assuming that farm loads travel on bad roads while silo-to-mill loads travel on good roads. The average load size, average loss per load and average loss per tonne were calculated for the two road conditions over a nine month period. These values are tabulated in **Table 12 (a)** along with the difference in wheat-loss per tonne between roads that are in a good and a bad condition. Given that the truck fleet mix is the same for both contracts, it can be concluded that wheat-loss is 0.62 kg/tonne higher, on average, when travelling on bad roads. The economic implications of these losses are quantified in **Table 12 (b)** according to the average wheat price between November 2010 and July 2011<sup>78</sup>. The additional loss of 0.62 kg/tonne translates to a loss in potential revenue of R1.34 per tonne loaded. Given that 1.849 million tonnes are harvested annually in South Africa<sup>79</sup>, this amounts to a potential revenue loss of R2.5 million.

78 Johannesburg Stock Exchange (JSE). 2012. *Wheat price statistics for 2008 – 2012*. Available at: <http://www.jse.co.za/Markets/Commodity-Derivatives-Market/Commodity-Derivatives-Price-History.aspx?wheat>. [Accessed on 9 February 2012.]

79 Department of Agriculture, Forestry & Fisheries (DAFF). 2010. *Wheat production guideline*. Available at: <http://www.daff.gov.za/docs/Brochures/prodGuideWheat.pdf>. [Accessed on 9 February 2012.]

**Table 12:** Comparison of average wheat-loss on good and bad roads

(a) Wheat-loss by weight (average values)				
Road condition rating	Load weight (tonne)	Loss per load (kg)	Loss/tonne loaded (kg/tonne)	Difference (kg/tonne)
Good	34.71	36.09	1.04	-
Bad	22.86	37.85	1.66	<b>0.62</b>
(b) Wheat-loss in Rand (average values)				
Road condition rating	Wheat price (R/tonne)	Loss/tonne loaded (kg)	Value lost/tonne loaded (R)	Difference (R)
Good	R2 167.82	1.04	R2.25	-
Bad	R2 167.82	1.66	R3.59	<b>R1.34</b>

## Conclusion

The potential effects of deteriorating road quality on logistics activities and costs have been overlooked by planners and logisticians in the past. However, various studies focusing on this topic have been published in the past few years and all of these indicate that the potential negative effects of deteriorating road quality can be quite significant. These effects extend beyond an increase in truck maintenance and repair costs, but also enlarge the potential damage to transported cargo and cargo losses due to greater vibrations.

The two case studies have quantified the potential impacts that deteriorating road quality

could have on transported cargo; it is clear that the increased roughness on deteriorating roads greatly increase the risk of damage to fresh produce and loss of wheat during transit. Much can and should be done in terms of packaging, cargo handling, route planning and driving techniques to reduce the effect of deteriorating road quality on transported cargo.

All stakeholders in the South African logistics sector should take into account the potential effects of deteriorating road quality on transported cargo. By doing so, the monetary losses of transporting cargo on bad roads can be reduced, which would drive down the cost of logistics, especially in the agriculture sector.



# LOW-CARBON DEVELOPMENT OPPORTUNITIES FOR LOGISTICS

Mothibi, Reetsang E (IMPERIAL Logistics)

The impact of climate change is one of the greatest threats facing the planet and as such poses a challenge for business. Most scientists and governments agree that the ongoing increase in greenhouse gas (GHG) emissions is likely to cause changes to the climate that will have detrimental effects to the economy, biophysical environment and human health. Developing countries will be hardest hit, due to their heavy reliance on the natural environment and inherent vulnerability to disasters.

The Intergovernmental Panel on Climate Change (IPCC) refers to climate change as any change in climate over time, whether due to natural variability or as a result of human activity. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is – in addition to natural climate variability – observed over comparable time period<sup>80</sup>. Irrespective of the definition adopted, surface temperatures are increasing and there is consensus among scientists that global GHG emissions have grown significantly since pre-industrial times.

The Goddard Institute for Space Studies (GISS) survey of the earth's surface temperatures shows that average temperatures have increased at a rate of 0.2°C per decade over the past three decades. At the current rate, the surface temperature is projected to increase between 2°C – 5°C from the pre-industrial average until 2100. Based on the potentially devastating effects of climate change, the IPCC<sup>81</sup> indicates that this temperature increase should be stabilised below the 2°C of the pre-industrial average. The report further states that an increase of 3°C would still be acceptable, but exceeding the 4°C mark would likely result in an unstable state leading to further increases regardless of the mitigation measures implemented. This highlights the need for a firm commitment to reduce GHG emissions

80 IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Pachauri, RK and Reisinger, A. (eds.). IPCC, Geneva, Switzerland. p 30.

81 IPCC. 2007. *Summary for Policymakers*. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Solomon, S, Qin, D, Manning, M, Chen, Z, Marquis, M, Averyt, KB, Tignor, M and Miller, HL. (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

and a move towards a low-carbon economy by all stakeholders including policy makers, the scientific community and the business sector.

Based on 2008 emissions, South Africa is ranked the 13<sup>th</sup> largest emitter of CO<sub>2</sub> in the world, with 435 million tonnes of CO<sub>2</sub>, approximately 1.45% of global emissions, emitted annually<sup>82</sup>.

The country's high reliance on fossil fuels for energy positions electricity usage as the highest contributor of CO<sub>2</sub> at 47.60%, followed by the metals sector at 22.20% and the transport sector at 10.50% (Figure 30).

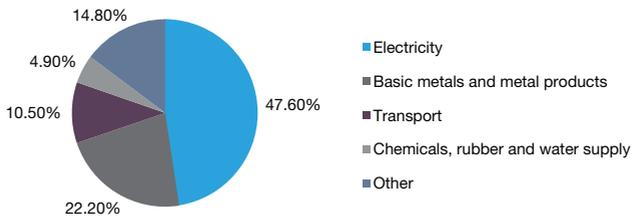
Even though the transport industry is currently only the third largest contributor to the national GHG emission inventory, the sector has been

identified as one with rapidly increasing emissions. The heavy reliance on road to move freight over long distances between the country's ports and Gauteng, its major centre of consumption, coupled with the expected future growth in freight volumes does not bode well for the sector's carbon footprint.

### Global policy developments

At the UNFCCC 15<sup>th</sup> Congress of Parties (COP15) meeting in Copenhagen, Denmark, the South African government made a voluntary commitment to reduce the country's emissions by 34% by 2020 and 42% by 2025. South Africa made it clear that this commitment would be subject to financial and technical support from the international community.

**Figure 30:** South Africa's CO<sub>2</sub> emissions by sector (SA National Treasury<sup>83</sup>)



<sup>82</sup> Wikipedia. List of countries by carbon dioxide emissions. Available at: [http://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_carbon\\_dioxide\\_emissions](http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions). [Accessed on 27 February 2012.]

<sup>83</sup> Republic of South Africa, 2010. Department of National Treasury. Discussion Paper for Public Comment. Reducing Greenhouse Gas Emissions: The Carbon Tax Option, December 2010. p 17.

Following the announcement, the government developed a number of policy and economic instruments to encourage the business sector to actively develop and implement initiatives to reduce CO<sub>2</sub> emissions and move towards a low-carbon economy. Policy and economic instruments developed since then include:

- Discussion paper on Reducing Greenhouse Gas Emissions: Carbon Tax Option (2010);
- Integrated Resource Plan for Electricity 2010 – 2030 (2010);
- National Climate Change Response White Paper (2011); and
- Green Economy Accord (2011).

In 2011, South Africa hosted the UNFCCC COP17 meeting in Durban, which produced the Durban Platform, the climate change deal where the international community reached a compromise in the way it would respond to the challenge of climate change. Some of the key agreements were:

- A second commitment period of the Kyoto Protocol by five to eight years, with the final term to be decided at COP18, which will be held in Doha, Qatar in 2012;
- A commitment to negotiate a new climate treaty by 2015, which will come into effect by 2020; and
- Implementation of the Cancun Agreement that seeks to establish the Green Climate Fund to help raise \$100 billion per year from developed countries to help developing countries implement mitigation measures.

The Durban Platform has been hailed as a success as it shifts from the voluntary climate commitments introduced in Copenhagen in 2009 towards a legally binding treaty. The new treaty, which is still to be developed, will require all countries – including the two largest emitters, China and the USA – to meet emission targets to be set by the treaty.

Despite the myriad achievements of the Durban Platform, it can be argued that real action to mitigate the impact of climate change could potentially be delayed by another decade, as the new treaty could only come into effect in 2020 with the legally binding agreement. Globally, potential risk of the delayed action is the possibility of increasing the surface temperatures by a catastrophic 3°C – 5°C by 2100. Locally, the impact of delayed action is that South Africa may not reach its ambitious targets of reducing carbon emissions by 34% in 2020 and 42% in 2025.

### **Role of logistics**

It is clear that South Africa cannot wait on international treaties to move into action. Although the financial and technical support that underwrote South Africa's initial commitments is still required to deliver on all the promises, much can already be done by individual stakeholders in the logistics industry. And now, faced with upcoming electricity cost increases and looming oil price volatility, it is no longer only a question of environmental stewardship and corporate conscience – it is a strategic direction that drastically cuts costs and buffers supply chains against the risks associated with dependence on non-renewable energy.

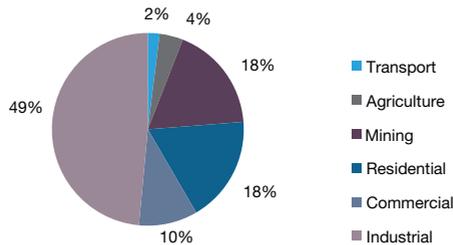
This is evidenced by the consideration given by an increasing number of companies to environmental sustainability in business planning and strategy processes.

However, it is not just limited energy sources that impose risks on supply chains; increasingly, industry players will be impacted by the effects of climate change. South Africa recently experienced severe weather conditions, including the floods in January 2011 and uncharacteristic snow along the N3 in July 2011, both of which disrupted supply chain networks in the country. Extreme and uncharacteristic weather conditions are increasing and scientists are predicting that storms will become more frequent and intense in the future. This is just one reality that results directly from global climate shifts that industry players will need to contend with.

Logistics and supply chain management can play a key role in mitigating climate change risks and

reducing costs throughout the supply chain. The greatest source of CO<sub>2</sub> emissions in the transportation industry is fuel consumption, estimated at 75% of the industry's 10.5% slice, which is approximately 8% of the total national CO<sub>2</sub> emissions as reported by National Treasury. The second largest source of CO<sub>2</sub> emissions in the logistics industry is electricity consumption at warehouses and office spaces. **Figure 31** shows that industrial sites (which would include manufacturing and warehousing) together with commercial sites (including retail space and office buildings) account for nearly 60% of the country's electricity usage. Targeting these sites could result in massive savings in CO<sub>2</sub> emissions. There are many simple energy-saving initiatives suggested and supported by Eskom's Integrated Demand Management programme<sup>84</sup> that could reap great rewards in warehouses and office buildings.

**Figure 31: Electricity market share per sector (Eskom IDM<sup>85</sup>)**



<sup>84</sup> Eskom Integrated Demand Management. Website: [www.eskomidm.co.za](http://www.eskomidm.co.za). [Accessed on 3 April 2012.]

<sup>85</sup> Eskom Integrated Demand Management. Demand Side Management Implementation in South Africa. In Library; Presentations. Available at: <http://www.eskomidm.co.za/library>. [Accessed on 29 March 2012.]

Regarding the state-of-practice in the logistics industry pertaining to fuel consumption and electricity usage in warehouses and office buildings, there is a large margin for improvement. Measures that can be implemented to proactively reduce resource consumption and emissions include:

- Developing and implementing energy-efficient technologies for buildings and vehicles;
- Redesigning distribution networks to shorten distances and consolidate cargo – decreasing fuel consumption per payload;
- Training drivers to employ driving techniques that conserve fuel;
- Adding additives to diesel to reduce consumption and emissions;
- Driving sustainability through the value chain by forming partnerships with service providers and customers to find innovative ways of curbing consumption and emissions; and
- Including sustainability requirements in procurement policies.

These measures are by no means novel, but the implementation of ‘green logistics’ only recently started to gain momentum when environmentally responsible companies started rolling out environmental requirements to their supply chains through procurement policies. In 2011, 90% of respondents in the Carbon Disclosure Project (CDP) Supply Chain Report<sup>86</sup> indicated that they include procurement in their formal climate change strategies.

This represents an increase from 74% in 2009 to 79% in 2010. Apart from harnessing business influence to enforce environmentally sustainable practices along the supply chain, government incentives also play a role in encouraging the business sector to implement new technologies and participate in the drive to reduce national emissions.

### **Government initiatives**

Government incentives are designed to boost the financial benefits of ‘going green’ by offering rebates or co-funding energy-efficiency initiatives. Participating in government incentive schemes enables companies that would otherwise not be able to procure new technologies to do so and encourages others to hasten the implementation of such technologies.

Two such government incentive programme that businesses can participate in include:

#### ***Eskom Integrated Demand Management programme***

The National Energy Efficiency Strategy for South Africa – last reviewed in 2008 – sets the national target for energy-efficiency improvement at 12% by 2015, to sustainably meet the country’s energy needs. The strategy is supported by Eskom’s Integrated Demand Management (IDM) programme, which aims to promote and implement energy-efficient technologies and behavioural change.

86 Supply Chain Report. 2012. *A New Era: Management in the Low-Carbon Economy*. Carbon Disclosure Project. p 1.

Eskom awards a rebate to participating companies for implementing energy-efficiency initiatives geared towards reducing electricity consumption. Technologies funded include:

- Energy-efficient lighting systems;
- Building management systems;
- Electric hot water systems; and
- Process optimisation.

### **Industrial Energy-Efficiency project**

The Industrial Energy-Efficiency project is hosted by the National Cleaner Production Centre. It is a collaboration between the South African government and international donors. Objectives of the project are to assist companies to reduce GHG emissions and enhance competitiveness through improved energy efficiency. The focus areas are energy management systems standard (ISO 50 001); energy systems optimisation and capacity building.

### **Green logistics hub: A case in point**

IMPERIAL Logistics is committed to proactively researching, developing and implementing innovative solutions to respond to the threat of climate change and move towards a low-carbon economy.

In 2009, the company, through one of its operating companies – IMPERIAL Cargo – tackled the challenge of using renewable energy as a viable, cost-effective and long-term alternative. The Green Logistics Hub project in Paarl, Western Cape was IMPERIAL Cargo's response to rolling electricity blackouts, water shortages and the complete lack of a sewerage system. The goal was to develop a self-sufficient, sustainable logistics hub. Managing

Director, Christo Theron, notes that IMPERIAL Cargo overcame all these challenges by taking lessons from the surrounding environment and harnessing natural resources without wastage. The project has enabled clean, renewable energy generated from a photovoltaic (PV) system to power the site for the next 20 years. The PV system emits only 31 tonnes of CO<sub>2</sub> annually.

The IMPERIAL Cargo hub includes an office building for 120 employees, 2 000 m<sup>2</sup> of warehousing, wash bays and a workshop. The office building runs on electricity generated from the PV system mounted on the roof of the warehouse. The system has a capacity to serve as an uninterruptible power supply for three days, even if there has been no sunlight for five days. Three solar geysers are sufficient to meet all hot-water requirements on the site.

Natural environmental elements have been integrated into the design of the office building. Orienting the building to receive maximum sunlight during the day means that lights can be switched off on a normal sunny day. The lights are fitted with lux-level meters to automatically switch off when there is sufficient lighting to meet the requirements of the Occupational Health and Safety Act (Act 85 of 1993).

The company has taken real costs out of its internal systems. Taking the average electricity tariff increase of 25% per annum into consideration; the payback period for the installation of the power generation system is 6.5 years. A comparison between 2010 and 2011 energy consumption figures shows an average energy usage saving of 44% per month.

## Conclusion

South Africa already has comparatively high logistics costs, calculated at 12.7% of GDP in 2010. The cost of logistics is likely to increase in the near future because of turbulent oil prices, pending Gauteng e-tolling and the proposed carbon tax.

In addition, the industry is vulnerable to the potential impact of climate change and severe weather conditions.

Given the state-of-practice, much can be done to reduce resource consumption and GHG emissions by targeting transport and electricity usage in commercial buildings in the logistics industry. Not only does this have the potential to greatly reduce South Africa's carbon footprint, but it will buffer supply chains against the risks

and cut down on operational costs for businesses.

Policy makers have shown a commitment to climate change and mitigation to reduce the potential impacts. The government has developed a number of policies over the years and introduced incentive schemes to encourage businesses to take advantage of new opportunities. Furthermore, with the agreements concluded at COP17 in Durban, there will be additional financial and technical resources flowing into the country to assist companies in addressing the challenge of climate change. This political and financial impetus bodes well for industry, especially in the medium and long term, but companies do not have to wait to implement practices that can drastically cut costs and emissions in the short term.



# AN INTEGRATED APPROACH TO SKILLS DEVELOPMENT

Fraser, Jessica FE (University of Pretoria), Viljoen, Nadia M (CSIR)

There is no debating the gravity of the skills shortage in the logistics and supply chain management sectors<sup>87,88,89</sup>. Undoubtedly, the paucity of human capital in these areas would eventually cripple competitiveness, if left unaddressed. The education and training sector thus has a critical role to play in positioning South African supply chains as formidable competitors amongst their BRICS peers.

But the time has come for other role players in the logistics sector to be more proactive. Ongoing research at the University of Pretoria (UP) is exploring the gaps in training needs from both managerial and grassroots levels.

This article arranges key insights from this ongoing research according to three 'I's: Inspiration, Innovation and Implementation. Firstly, it serves as 'inspiration' by outlining the similarities in the challenges faced by South Africa and other BRICS countries. Secondly, it identifies the 'innovation' in human capital development that industry, education and training service providers and government should focus on. Lastly, 'implementation' suggestions are made for industry, education and training service

providers and government based on literature, industry studies and the UP's ongoing primary research regarding training needs and skills development.

## **Inspiration: We are not the only country facing challenges**

South Africa is not alone in the everyday challenges we face. Historically many East European and Indian people landed on South African shores to look for work opportunities. South Africans may be surprised to hear from Brazilian engineers working in this country, that Brazil also has issues with crime. Small businesses owned by Chinese struggle in the radically-competitive business environment in China – hence the migratory trend to almost every town in South Africa for setting up a Chinese clothing store or restaurant.

87 Kilbourn, PJ and Wessels, C. 2010. *A refocus on the skills issue. 7<sup>th</sup> Annual State of Logistics™ survey for South Africa*. CSIR, Pretoria, South Africa.

88 Barloworld Logistics. 2011. *The Skills Crisis Revisited*. *supplychainforesight*. pp 16 - 18. Available at [www.supplychainforesight.co.za](http://www.supplychainforesight.co.za). [Accessed on 20 March 2012.]

89 Transport and Education Training Authority. 2011. *Sector Skills Plan*. Randburg, South Africa.



Simultaneously, many South Africans currently work in Brazil, Russia, India and Hong Kong and South African tertiary-level educators are even found in mainland China. **Table 13** lists some common issues experienced by the BRICS countries that should fill South Africans with hope that others are facing and have overcome similar challenges.

However, the challenges in **Table 13** as well as more uniquely South African issues such as the effect of HIV/Aids on the labour force, will not be solved if the country continues ignoring these. There is a great need for innovative approaches to skills development and the honesty and political that will be required to implement these.



**Table 13: Shared challenges in BRICS countries**

		Millions of people unemployed
<b>UNEMPLOYMENT<sup>90</sup></b>	<i>Brazil</i> : 5.5% of 190 million	10.45
	<i>China</i> : aiming for <5% of 1.3 billion	65
	<i>The Russian Federation</i> : 6.6% of 142 million	9.3
	<i>India</i> : 9.4% of 1.2 billion	112.8
	<i>South Africa</i> : 23% of 50 million	11.5
		<b>New jobs per annum</b>
<b>JOB CREATION TARGETS</b>	<i>China</i> needs 45 million new jobs in three years	15 million
	<i>South Africa</i> needs 5 million jobs before 2020	0.625 million
<b>REGIONAL INTEGRATION</b>	<p><i>Brazil</i> must reach out to the rest of Latin America instead of only engaging in bilateral arrangements with country-specific car manufacturers such as China's JAC Motors, BMW from Germany and India's Tata Motors.<sup>91</sup></p> <p><i>The Russian Federation</i> wants visa-free zones for Russians to visit European properties owned by Russians.</p> <p><i>South Africa</i> has to reach out to the African Union and other African regional trade blocks.</p>	
<b>EDUCATION AND TRAINING</b>	<p><i>The Russian Federation</i>: Children are sent abroad to study and hardly ever return, since not enough is invested in Russian schools. In recent years, Russian science and engineering graduates studying abroad were tempted to live the American dream after completing their studies. Incentives were important to attract them to return to their country of origin.</p> <p><i>Brazil and India</i>: Canada is targeting Brazil and India for science and engineering student exchange programmes, even with Brazil thinking it has a poorly-educated workforce. Brazil wants to implement new policies to promote innovation and higher education and training.</p> <p><i>China</i>: 20 million graduates flock to cities in search of jobs per annum and hundreds of thousands go to great lengths for the opportunity to study in Western countries.</p>	
<b>SOCIO-ECONOMICS</b>	<p>Consumer debt, inflation driving up food and fuel prices and inequality gaps<sup>92</sup> exist everywhere in the BRICS countries.</p> <p>The Russian Federation faces a particularly tumultuous time as the discontent of the public is reaching breaking point. Roots of discontent include low-quality medical services, corruption among public servants, crime, a deplorable education system, restriction on media freedom<sup>93</sup> and the outcome of the recent elections.</p>	

90 *Trading Economics. Unemployment rates, list by country. Available at <http://www.tradingeconomics.com/unemployment-rates-list-by-country?c=bric>. [Accessed on 17 February 2012.]*

91 *The Economist. 2012. Brazil's trade policy – seeking protection. Sao Paulo. Published on 14 January 2012 in the Economist Print Edition. Available at <http://www.economist.com/node/21542780>. [Accessed on 17 February 2012.]*

92 *De la Torre, I. 2011. Dynamic Markets: The next crisis will arise in the BRICS countries. Forbes Leadership Forum, Posted on 18 July 2011. Available at [http://www.gibs.co.za/igibs\\_1/igibs/links/dynamic-markets-the-next-crisis-will-arise-in-the-bric-countries.aspx](http://www.gibs.co.za/igibs_1/igibs/links/dynamic-markets-the-next-crisis-will-arise-in-the-bric-countries.aspx). [Accessed on 17 February 2012.]*

93 *The Economist. 2011. The mood of Russia: time to shove off. Moscow. Published on 10 September 2011 in The Economist Print Edition. Available at <http://economist.com/node/21528596/print>. [Accessed on 17 February 2012.]*

### **Innovation: Addressing the root causes with interventions that matter**

The skills deficiency is apparent throughout the ranks of the logistics and supply chain management sectors. In terms of the unskilled and lower-skilled labour force (order pickers, administrative clerks, drivers) the critical mass required to fuel the workhorse has become more of a mirage than an achievable goal.

On the other end of the spectrum, there is a shortage of relevantly qualified and appropriately experienced managers. There is no blanket approach or miracle innovation that addresses both ends of the spectrum. As Ted Black<sup>94</sup> rightly points out, the solution is not a big fix, but rather lightweight, simple innovations that address the roots of the problem and that the individual can sink their teeth into.

One of these root problems is a loss of skills due to an aging workforce and poor succession planning. This is true of both ends of the skills spectrum. Decreased life expectancy, health and quality of life plague the unskilled and lower-skilled labour force<sup>95</sup>, while the dynamism and mobility of the high-skilled labour force means that huge chunks of experience and institutional knowledge walk out a company's (and even industry's) doors on an annual basis. The true value of age, wisdom and workplace experience lies in the willingness to leave a legacy in the minds of potential successors.

It is not enough to chant “each one, hire one” but rather each one should teach one. Skills transfer should be expedited and mentorship, coaching and on-the-job training should not be underestimated as a powerful tool. Granted, the concept itself is not innovative, but finding ways of implementing it to provide organisations the return-on-investment they desire – that is the innovation.

Where the first root problem relates to mitigating the outflow of skills from the sector, other root problems relate to creating the inflow of skills into the sector. Contrary to popular belief, it is not primarily the lack of educated youth that constricts the inflow, but rather that their education does not equip them with the practical skills and experience which make them employable. Statistics indicate that only 9% of matriculants with adequate scholastic performance and no work experience find a job (any job) within the first 12 months<sup>96</sup>.

On the high-skills end of the spectrum, the new generation of recruits should capitalise on the basics they graduate with and chase after new learning opportunities. The I-Factor challenge in **Figure 32** shows the varied knowledge base of newly-graduated students and the T-set of management skills required by logistics and supply chain managers. The T-set has been adapted from Christopher<sup>97</sup>

<sup>94</sup> Black, T. 2010. *The task is not to make the poor wealthy... but productive*. ADCORP Holdings Quarterly September 2010. ADCORP Holdings. pp 4 - 8.

<sup>95</sup> Transport and Education Training Authority. 2011. *Sector Skills Plan*. Randburg, South Africa.

<sup>96</sup> Sharp, L. 2010. *Skills development: A contrary perspective*. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 9 - 12.

to show, in the blue blocks, the specific areas of skills uncertainty identified in the South African logistics sector by ongoing research.

The T-set illustrates that logistics and supply chain managers are experts in certain functional areas, but require a broader set of skills and experience to succeed. The importance of these so-called job skills in the logistics and supply chain sector is corroborated in literature<sup>98,99</sup>.

Logistics and supply chain education is no longer confined to engineering faculties.

A plethora of tailored certificate, diploma and degree courses are offered by business management faculties and professional short courses and in-house training opportunities abound. Tertiary education produces qualifications from a National Qualifications Framework (NQF) 5 upwards, while Further Education and Training (FET) institutions recently teamed up with professional associations in the logistics and supply chain sector to offer courses below NQF 5. There is thus a broad range of customised education providers in the sector, yet proactive initiatives are required to bridge the gap between the base and the T-set in **Figure 32**.

Young graduates have been exposed to many disciplines and need role models and mentors to guide them in career development.

Organisations that recruit students into graduate training programmes and expose them to their organisations' entire operations before guiding them into areas of expertise should be commended. Similarly, organisations that expose students and educators to industry opportunities through on-campus marketing get students thinking of their future long before it is upon them. Besides the influence of industry actors, the impact of parents and other role models should not be overlooked when guiding youth in career decisions.

But guiding graduates to identify their interests and career paths is not enough – mechanisms such as internships or graduate training programmes should be utilised to cultivate talent more efficiently in the first year or two after graduation. Finding that 'critical first job' has been identified as a primary obstacle for inexperienced youth .

The I-Factor challenge in **Figure 32** also highlights the need for employers and employees to continuously pursue broader areas of learning (shown in the grey rectangles), beyond normal business-oriented courses. For South African employees to navigate trade within BRICS, language and cultural barriers need to be overcome, not only for communication but also for product information purposes. Keeping abreast of international business

97 Christopher, M. 2011. *Logistics and Supply Chain Management*. 4<sup>th</sup> ed. Edinburgh Gate, Harlow, Great Britain. Pearson Education Ltd. p 221.

98 Myers, MB et al. 2004. *Maximizing the human capital equation in logistics: Education, experience, and skills*. *Journal of Business Logistics*. Vol25(1), pp 211 - 232.

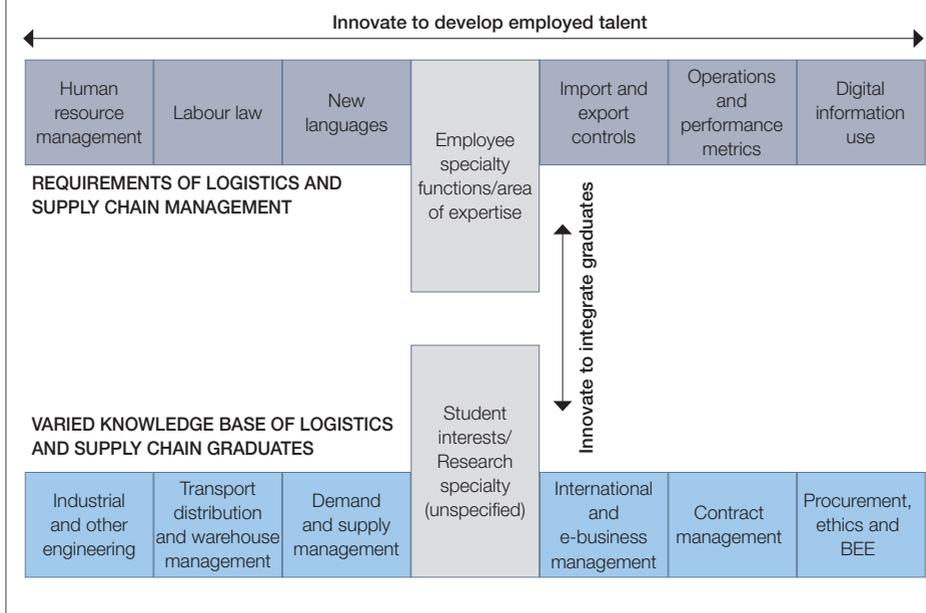
99 Gammelgaard, B and Larson, PD. 2001. *Logistics skills and competencies for Supply Chain Management*. *Journal of Business Logistics*. Vol22(2), pp 27 - 50.

requirements, trade agreements and technological developments are also non-negotiable.

Even if all graduates successfully bridged the gap into their critical first jobs and all employees were continually broadening their skills in line with market needs, some experts feel the demand for high-skilled labour would still outstrip supply. Loane Sharp, in his reflection on the skills

shortage crisis, comments that the immense legal barrier to the importation of highly-skilled foreigners into South Africa is a major contributor to the shortage of high-skills inflow into the logistics and supply chain labour markets<sup>100</sup>. What the enforcement of immigration policy lacks on the unskilled and lower-skilled side of the equation, it more than compensates for on the high-skills end.

**Figure 32: The I-Factor challenge.** Bridging the gap between the knowledge base of logistics and supply chain graduates and the ever-broadening job requirements of logistics and supply chain managers



100 Sharp, L. 2010. Skills development: A contrary perspective. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 9 - 12.

On the unskilled and lower-skill end of the spectrum, the key insight regarding the inflow of skills is that inexperienced job entrants learn by doing. Loane Sharp advocates that, in essence, the 'skills shortage' at this end of the spectrum is nothing more than a jobs shortage<sup>101</sup>.

Learnerships and apprenticeships are concepts specifically designed to enable on-the-job training in a more sensible, cost-efficient way.

Unfortunately, historic maladministration in the majority of the Sector Education and Training Authorities (SETAs) and the poor performance of many learnership programmes demand that these mechanisms and processes be relooked.

John Botha<sup>102</sup> cites research conducted in 2007 that showed that unspent SETA funds accrued an opportunity cost of 32 538 untrained learners. Furthermore, the average certification rate on learnerships was 34% – resulting in a cumulative 'waste' of R2.61 billion at the time.

In addition, providers had been charging nearly double of what was deemed necessary to facilitate learnerships. Botha discusses a number of possibilities to redress the skills development challenge, one of which is the role to be played

by the Recognition of Prior Learning (RPL). Leo Tome's research findings regarding the improved learning access through RPL highlights its ability to redress historic discrimination in education, training and employment opportunities, provide equitable access to education and training and instil the principle of lifelong learning<sup>103</sup>.

Furthermore, ongoing research by the UP has highlighted the need for the human resource function to work more closely with logistics and supply chain staff and shop stewards when defining internal training and education programmes.

### **Implementation: Each one, teach one**

Experience has shown that the more practical the skills development initiatives, the more significant and sustainable the results<sup>104</sup>.

**Table 14** lists some practical ideas for implementing the suggested innovations and creating synergy between industry, education and training service providers and government. This list is not exhaustive and any logistics manager can add a few ideas based on personal experience, but these smaller-scale can-do items are aimed to inspire individuals to take action.

101 Sharp, L. 2010. *Skills development: A contrary perspective*. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 9 - 12.

102 Botha, J. 2010. *Diagnosing the skills development challenge*. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 20 - 22.

103 Tome, L. 2010. *Learning access via Recognition of Prior Learning (RPL) and Bridging – research findings*. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 23 - 27.

104 Black, T. 2010. *The task is not to make the poor wealthy... but productive*. ADCORP Holdings Quarterly September 2010. ADCORP Holdings. pp 4 - 8.

**Table 14: Targeted calls to action for South Africa**

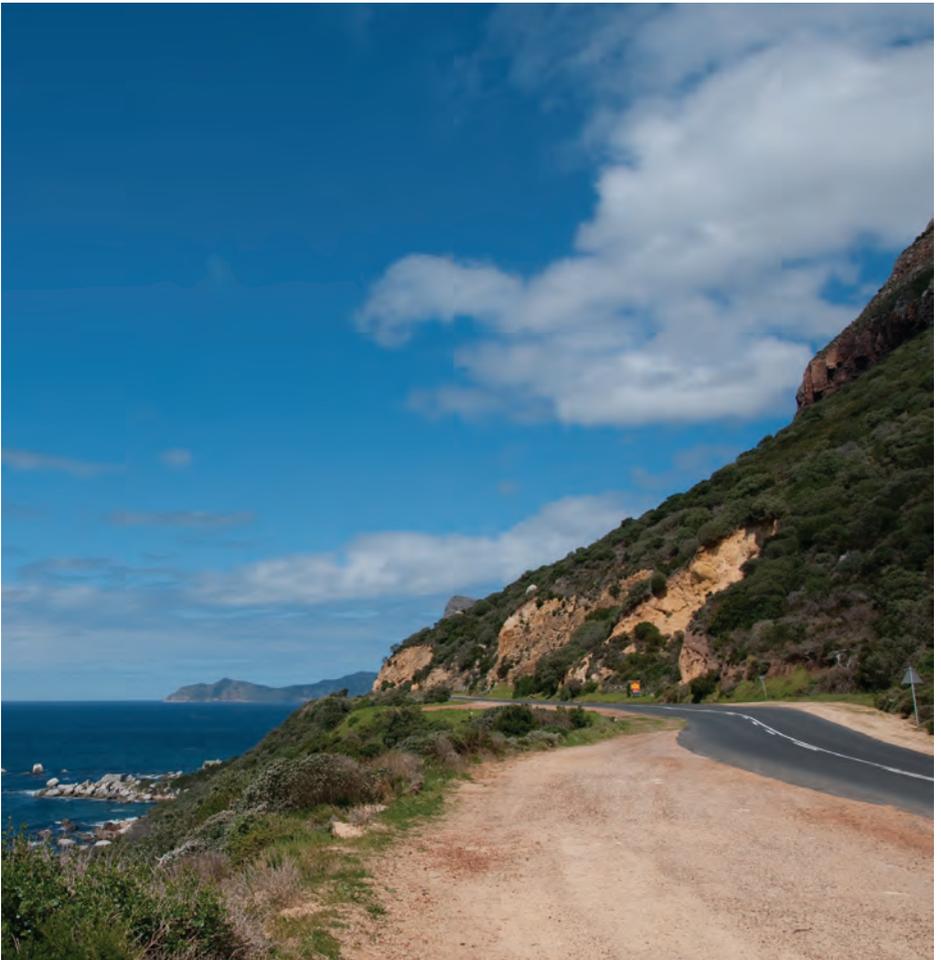
Target group	Call to action
<b>1. Industry</b>	<ul style="list-style-type: none"> <li>1.1. Organisations should be more proactive in 'growing their own wood'. In the long term the value added outweighs the cost of human capital development.</li> <li>1.2. Identify and support current staff members who are already studying part-time in order to retain them.</li> <li>1.3. Performance management should be a motivating tool with which to plan and track realistic and inspirational career goals for individuals. It should not be seen as a corrective activity. Change this perception from the top down.</li> <li>1.4. In the same way that supply chain metrics can be measured, staff performance should be measured and rewarded when it adds value.</li> <li>1.5. Target and cultivate logistics and supply chain students early on in their studies through bursary programmes, holiday internships or simply industry-related semester projects.</li> <li>1.6. Invest in sponsoring postgraduate students who can work during the day and study at night. (Time allowances for tests and exams should, however, be realistic to ensure their success.)</li> <li>1.7. Seek ways to expose employees to the global markets through exchange programmes, job rotation, international projects, etc.</li> <li>1.8. Link up with the international offices at universities. Send sponsored students to BRICS countries on exchange programmes to broaden the organisation's market and business knowledge and develop the individuals.</li> </ul>
<b>2. Education and training service providers</b>	<ul style="list-style-type: none"> <li>2.1. Educators need to step out of their comfort zones and interact more with both government and industry. This would allow for alignment of research, student projects and curricula with market needs.</li> <li>2.2. Listen actively to feedback from all stakeholders on the content requirements of teaching programmes and respond within the shortest lead times possible.</li> <li>2.3. Channel the academic requirements for research publications to produce pragmatic and useful research that addresses burning research questions in industry.</li> <li>2.4. Succession planning to replace professors and lecturers should be even more of a priority in education than replacing managers in industry as 'growing your own wood' in education and research requires more time.</li> <li>2.5. Do not lower standards of high-quality education – rather challenge learners to perform better.</li> <li>2.6. Create and promote international exchange programmes.</li> </ul>
<b>3. Government</b>	<ul style="list-style-type: none"> <li>3.1. Hold Sector Education and Training Authorities (SETAs) accountable not only for collecting skills-development plans on time, but on actual skills-development.</li> <li>3.2. Insist on follow-up research to be conducted to assess the value added to the sector through SETA initiatives.</li> <li>3.3. SETA short-term and once-off interventions leave participants without a defined direction for their careers. Plan long term and progressively about the roll-out of programme content to allow professional growth of human resources over time.</li> <li>3.4. Move to implement the policies and spend the funds that have been dedicated to lifting the skills shortage burden.</li> <li>3.5. Do not quench successful skills transfer and job creation initiatives due to challenges in administration or politics.</li> <li>3.6. Review laws and regulations that unduly restrict the importation of high-skilled foreigners<sup>105</sup>.</li> <li>3.7. Promote recognition of prior learning-based learnerships.</li> </ul>

<sup>105</sup> Sharp, L. 2010. *Skills development: A contrary perspective*. ADCORP Holdings Employment Quarterly September 2010. ADCORP Holdings. pp 9 - 12.

## Conclusion

South Africa is an untapped gold mine when it comes to human capital. Bright, young, inspired youth are eager to learn and are courageous in terms of international and cultural boundaries. Ancestral roots to BRICS and western European trading partners (India, Russia, China, Portugal,

Germany, and the Netherlands) and a diverse cultural base already positions South Africans to tackle language and cultural barriers. What matters now is harnessing, cultivating and retaining this human capital. The logistics and supply chain sector can no longer waste time pointing fingers, it is time for 'each one to teach one'.



# PROFILE OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR)

With a track record spanning more than 65 years, the Council for Scientific and Industrial Research (CSIR) contributes to research development through integrated, multidisciplinary research across diverse areas of science. The Scientific Research Council Act, 1988 (Act No. 46 of 1988) commits the CSIR to the pursuit of directed research, technological innovation and industrial and scientific development that contribute to the quality of life of the people of South Africa and the region.

Specific areas of focus for the CSIR are the built environment, health, energy, the natural environment, defence and security, as well as the needs of industry. These areas are underpinned by key enabling technologies such as information and communications technology, photonics, robotics, materials sciences, optronics and biotechnology, as well as leading scientific infrastructure.

The CSIR works closely – either as a partner or a client – with government departments, tertiary education institutions, other science councils, research institutions and a range of private sector organisations locally and abroad.

The CSIR's main campus is in Pretoria while the organisation has regional offices in proximity to applicable industries in other provinces of South Africa. The CSIR generates knowledge and research outputs to be applied or transferred as proven technologies through skilled people and projects that add commercial and social benefit.

The CSIR has a staff complement of about 2 300, of which close to two-thirds make up the science, engineering and technology (SET) expertise base. Almost half of the SET base is qualified at Master's level and higher. The CSIR invests in human capital development through bursaries, internships and a range of training interventions to foster young talent and further develop expertise.

## Infrastructure

A direct relationship exists between investment into infrastructure and socio-economic growth and development. Sound, well-performing infrastructure is also at the core of service delivery such as housing, access roads, health facilities, sanitation and water provision. This has been emphasised by government in the past decade, with significant investment being made in infrastructure and additional amounts planned for the future.

The challenges experienced with infrastructure in South Africa are not unique to this country. A number of factors lead to such challenges,

including insufficient funding to manage, plan and maintain infrastructure; a shortage of skilled resources; and a lack of appropriate technological solutions for the problems experienced with infrastructure planning, materials, design, construction, maintenance and operation.

What is unique to South Africa is our specific situation in terms of the character of the built environment on account of, for instance, the apartheid legacy, our specific conditions in terms of climate, geographical location, and geology availability and nature of materials, and our African heritage. This implies that foreign technologies and solutions for infrastructure cannot be applied directly to solve our problems. In most cases these have to be modified and often new technologies have to be developed to suit our specific conditions and needs.

In this regard, our infrastructure and the built environment are very different from technologies and products relating to consumer products that are readily transferable and/or purchasable from abroad. We therefore need to foster unique South African solutions to our problems and needs.

### **CSIR Built Environment**

Aligned with the South African government's increased focus on the built environment – specifically infrastructure – the CSIR uses its multidisciplinary capabilities to develop innovations and solutions that will improve the built environment in a sustainable manner. The vast majority of CSIR research, development and innovation activities relating to the built environment are combined within the CSIR Built Environment Unit.

To address the challenges the country faces in this regard, CSIR Built Environment has clustered its expertise into competence areas, for example transport systems and operations (including freight logistics); road pavement and infrastructure engineering; coastal engineering and port infrastructure; building science and technology; and planning support systems (including decision support).

The built environment is a complex system with numerous elements and a number of external factors influencing it. CSIR Built Environment adds value to South Africa through:

- a unique skills and expertise base in built environment disciplines that has national and international standing, particularly in transport planning and design; logistics and supply-chain management; advanced data analysis

and decision support development; urban dynamics modelling; architectural engineering; building materials and methods; pavement engineering; port engineering; and innovative infrastructure materials development;

- a core competence in the integration of multidisciplinary capabilities to develop key solutions and products aimed at solving problems in the public and private sectors;
- unique science, engineering and technology (SET) infrastructure including advanced materials testing laboratories, the coastal modelling hall, the heavy vehicle simulator technology platform, the urban dynamics laboratory, the building performance laboratory, and several technology and software platforms that allow for advanced research;

- a proud track record of successful development and implementation of SET-based solutions and products for the built environment sector, locally and internationally; and
- the capability to develop solutions and products that impact significantly on the national priorities of South Africa, including socio-economic growth and development and municipal service delivery, thus leading to social impact and public good.



**For further information,  
please visit [www.csir.co.za/built\\_environment](http://www.csir.co.za/built_environment)**

# PROFILE OF IMPERIAL LOGISTICS

IMPERIAL Logistics, a division of the IMPERIAL Group (IPL), is a global logistics and supply chain leader that moves business and industry through innovation, inspiration and foresight. An employer of more than 27 000 people internationally, it delivers excellence in end-to-end logistics and supply chain management – enabling our blue chip customers in almost every industry to grow in an efficient, proactive and cost-effective manner.

Established in 1975, today the brand is at the forefront of the logistics industry with extensive operations in Europe and Africa.

IMPERIAL Logistics stands apart with its network of services in Africa's most important economic regions, including countries such as South Africa, Botswana, the DRC, Namibia, Mozambique, Tanzania and Zambia – Africa's most important economic intersections, where flows of goods converge, creating an effective link between all modes of transportation and enabling a wide range of value-added services.

Across South Africa and Europe alone, the Group handles and transports over 110 million tonnes annually with total storage capacity of more than 2 240 000 m<sup>2</sup> and under-cover warehouse capacity of approximately 1 500 000 m<sup>2</sup>. Internationally, it manages in excess of 9 000 vehicles, two-thirds of which are owned and one-third is sub-contracted.

In southern Africa, these capabilities are found in more than 80 specialised operating companies

grouped according to market focus and supported with central IT solutions, bulk fuel procurement, in-house insurance and anti-hijacking services. In Europe our companies are market leaders within their areas of logistics specialisation. IMPERIAL Logistics International comprises Panopa Logistik, Lehnkering, neska, IMPERIAL Reederei and Brouwer Shipping.

IMPERIAL Logistics's differentiators lie in a combination of pre-eminent supply chain management skills and an extensive resource base of transportation, warehousing and storage, as well as best-of-breed technology solutions. As a multi-branded business, it is in a position to optimise the benefits, scale and synergies that are derived from large businesses, while retaining agility, customer focus and an entrepreneurial flair that often characterises smaller businesses.

IMPERIAL Logistics is, undoubtedly, fast moving and forward thinking.

**About IMPERIAL Logistics Consumer Products (ILCP)**

Consumer Products provides integrated supply chain solutions to a wide range of consumer product manufacturers, importers and retailers. Services include warehousing and distribution into top-end retail, mid-market trade and smaller retail environments, as well as logistics management, express food distribution, selling and merchandising services. As a comprehensive provider of outsourced logistical and integrated supply chain services, enabled by our strategic partnership approach, ILCP adds significant value to our clients' businesses through our leading-edge, innovative and customised solutions.

**About IMPERIAL Logistics Specialised Freight (ILSF)**

Boasting the largest and most modern tanker fleet in South Africa, the Division provides dedicated, specialised transport services to tanker industries throughout Africa. It is the brand leader in the petro-chemical industry, with unrivalled expertise in managing HSEQ requirements. In addition, Specialised Freight provides transport solutions in the fast moving consumer goods (FMCG) industry for the delivery of milk and other raw materials shipped in tankers.

**About IMPERIAL Logistics Transport and Warehousing (ILTW)**

This Division delivers full-spectrum logistics and supply chain services throughout South Africa and in neighbouring countries. Services include line-haul, local distribution, consolidation, warehousing and logistics, 4PL solutions, cross-

border transport, and end-to-end logistics and supply chain management solutions. These include road, rail and world-class multi-modal solutions.

**About IMPERIAL Logistics Integration Services (ILIS)**

Integration Services focuses on business process outsourcing (BPO) in the operations management environment, including logistics integration, operations planning, procurement, international logistics and asset maintenance services. These service offerings are enhanced with advanced IT offerings, including supply chain visibility, tailored software solutions and IT infrastructure. The Division also offers pragmatic consulting and advisory services focused on the design and implementation for strategic, tactical and operational improvements across end-to-end value chains.

**About IMPERIAL Logistics Africa (ILA)**

With a track record of more than 40 years of moving business and industry in Africa, the Division has extensive, established operations that span 14 countries across the continent. A leading logistics service provider across most industries in Africa, ILA manages total cargo flow and end-to-end logistics using the appropriate mode of transport, whether air, sea, rail or road. ILA's integrated logistics services include transportation, warehousing and distribution, sub-routing, cross-docking, hinterland inter-modal services, infrastructure developments such as inland and dry ports, as well as rail logistics. Expansion plans include establishment of operations in East and West Africa, as well as the Great Lake region.

### **About IMPERIAL Logistics Bulk Commodity Services (ILBC)**

IMPERIAL Logistics Bulk Commodity Services forms part of a broader network in the mining industry providing comprehensive supply chain solutions to major players in the bulk commodity sector in southern Africa. ILBC provides dedicated transport services and specialises in the run-of-mine operations including loading operations by means of front-end loaders, short-haul transport to rail siding, rail siding management and loading of rail wagons.

### **About CIS Holdings (CIC)**

CIC Holdings is the parent company of a group of businesses that operate in southern Africa. It operates within the FMCG industry through

agency agreements with blue chip manufacturers, both locally and abroad. Its service offering includes selling, merchandising, warehousing, distribution, debtors administration, and staffing and security solutions. The Group currently operates in 10 African countries, including a footprint of 18 sites across the continent with more than 10 000 staff. CIC Holdings has been wholly owned by IMPERIAL Logistics from November 2010.



**For further information,  
please visit [www.imperiallogistics.co.za](http://www.imperiallogistics.co.za)**

# PROFILE OF STELLENBOSCH UNIVERSITY: CENTRE FOR SUPPLY CHAIN MANAGEMENT

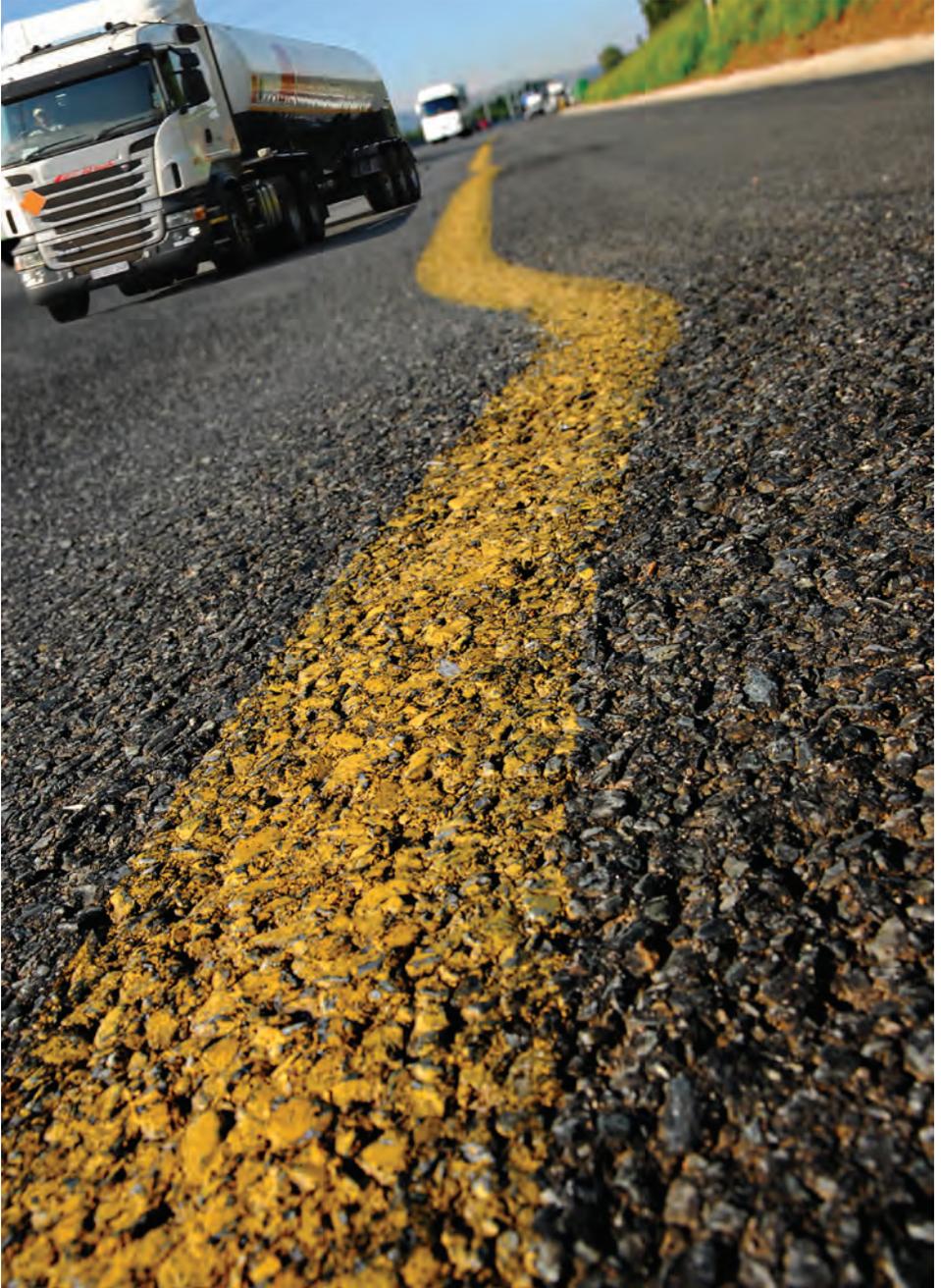
The Centre for Supply Chain Management (CSCM) is an academic, consultative research centre within the Department of Logistics at Stellenbosch University. It creates value for global and local organisations and businesses.

The Centre facilitates a symbiotic relationship between the academic development of supply chain management theory and the practical application of the theory. It provides clients and the community with cost-effective research solutions in the field, but at the same time produces results that are publishable and contribute to the discipline. The CSCM team (core staff and a complement of associates) has provided successful consulting interventions to a number of leading South African and multinational companies and provides continuous strategic guidance to various small and medium-sized clients.

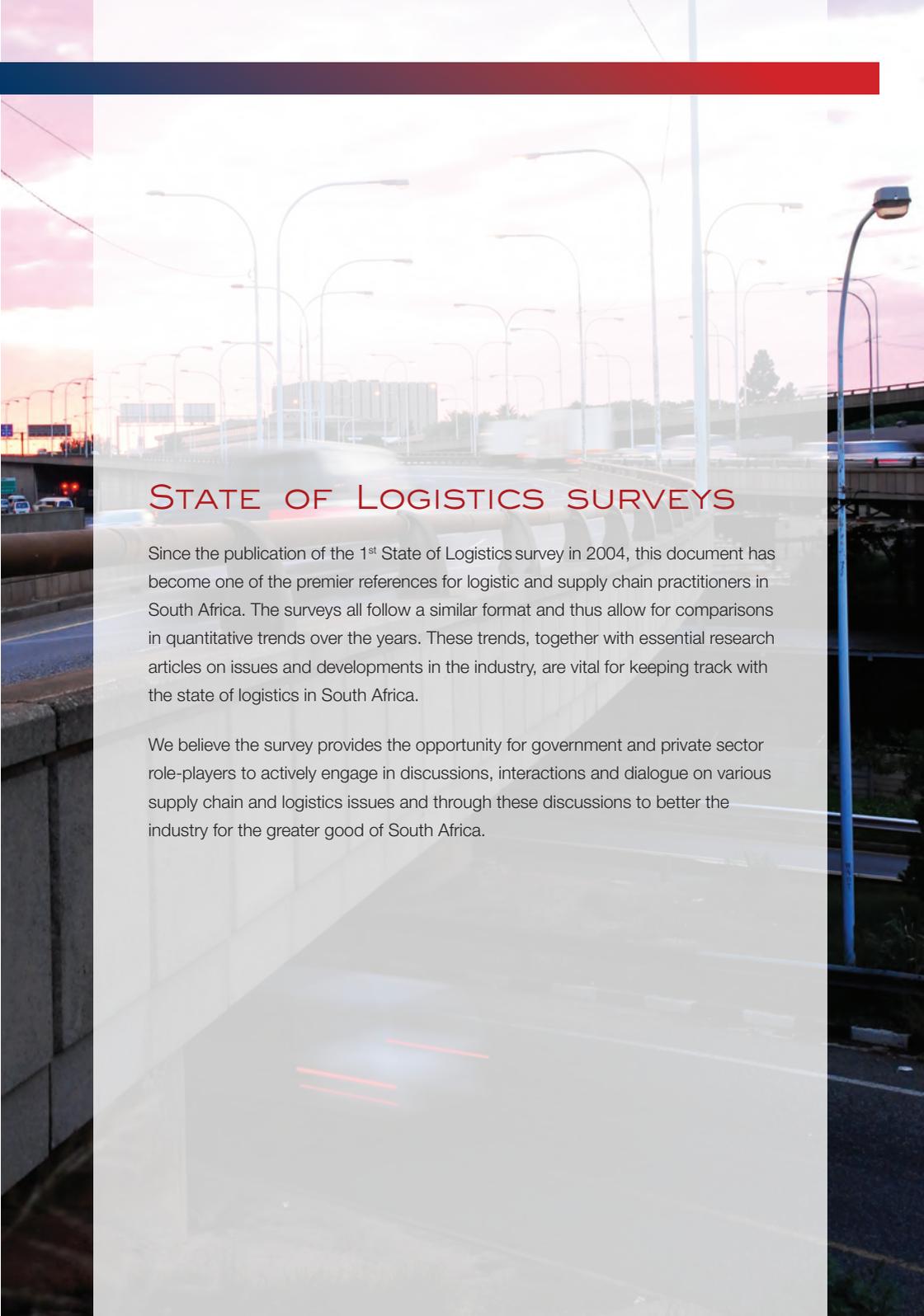
The core competencies provided are in the field of supply chain strategy, business strategy and positioning, market and economic research, freight flow modelling and transportation planning.



**For further information,  
please visit [www.sun.ac.za/cscm](http://www.sun.ac.za/cscm)**







## STATE OF LOGISTICS SURVEYS

Since the publication of the 1<sup>st</sup> State of Logistics survey in 2004, this document has become one of the premier references for logistic and supply chain practitioners in South Africa. The surveys all follow a similar format and thus allow for comparisons in quantitative trends over the years. These trends, together with essential research articles on issues and developments in the industry, are vital for keeping track with the state of logistics in South Africa.

We believe the survey provides the opportunity for government and private sector role-players to actively engage in discussions, interactions and dialogue on various supply chain and logistics issues and through these discussions to better the industry for the greater good of South Africa.

