International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 18 (2017) pp. 7524-7529

Measuring National Business Logistics Costs: A South African Application and International Comparison

Wessel J. Pienaar

Stellenbosch University, Department of Industrial Engineering,
Private Bag X1, Matieland 7602, South Africa.

Orcid ID: 0000-0002-3638-1111

Abstract

This article briefly illustrates the macroeconomic relevance of business logistics cost measurement on a national level. The results of the 2015 logistics cost model for South Africa are presented. The country's logistics costs are compared with those of several other countries. The major portion of logistics costs are attributable to road transport, of which the biggest cost driver is fuel, which, in turn, is determined by volatile oil prices and the exchange rate of the country's monetary unit. This poses a significant exogenous risk to logistics cost management in South Africa.

Keywords*:* business logistics, Logistics Barometer, logistics cost measurement, logistics cost model, State of Logistics

INTRODUCTION

This article briefly illustrates the macroeconomic relevance of freight logistics cost measurement on a national level, shares the results of the latest South African national logistics cost model, and compares the country's logistics costs with those of several other countries.

Sustained economic growth and development are dependent on productive regional specialisation, the continued improvement of production efficiencies and the profitable exchange, or trade, of goods, services and information. Profitable trade presupposes local surplus production of those goods that might be more efficiently produced in a region in exchange for goods produced more efficiently elsewhere. This prerequisite level of comparatively or relatively advantageous efficiency stems from the economies of scale achievable from labour specialisation (including division of labour and development of skills), technological specialisation, productive utilisation of regional natural advantages and large-scale production.

To maximise a region's net gain in wealth created through local economies of scale and comparative efficiency requires effectively integrated and coordinated transport and storage systems (known as business logistics systems). According to United Nations research, [1] effective cost reduction in the national logistics system can only be accomplished by measuring and tracking logistics cost components to inform appropriate government policy.

The impact of both sufficient and insufficient measurement of economic performance was illustrated in South Africa previously. Sound monetary and fiscal decisions, enabled by robust macroeconomic indicators, allowed the country to weather the global financial crisis of 2009 admirably. However, a lack of management information on the impact of high economic growth and equal access to South Africa's energy demand resulted in a severe backlog in electricity-generating infrastructure. A lack of information leads to similar challenges within the freight logistics sector, and in terms of efforts to holistically plan for national transport infrastructure renewal and extension. [2]

Business logistics can be examined on various levels of granularity. On the lowest level, one considers the logistics function of an individual company, including only the processes from the supplier's gate, through the focal company's network and up to the customer's gate. One level higher, one considers the logistics processes across a sequence of supply chain partners that move freight through stages of transformation on the route from raw material to final product. On the highest level, the macro-level, one considers not only the logistics activities associated with one supply chain but the collective of all logistics within the country and the aggregate impact these activities have on the economy.

BUSINESS LOGISTICS IN THE SOUTH AFRICAN ECONOMY

South Africa's spatial challenge is a result of long transport corridors between especially the port of Durban and Gauteng (the industrial heartland which is 600 km inland), and Cape Town and Gauteng (which is 1 400 km inland). The industrial heartland was formed due to the discovery of gold and diamonds 150 years ago and gives the country the curious character of a relatively small GDP, but long dense transport distances to the interior. In this sense the country differs both from mining peers such as Brazil and Australia where most activity is coastal, and Europe and North America where

transport distances are also long, but relative industrial output much higher.

South Africa is a transport-hungry economy, requiring relatively many kilometres of transport activity for each rand of value generated. This transport-hungry nature of South Africa, combined with the volatility in the oil price, the key driver of transport cost, indicate that logistics cost is a strategic resource requiring national attention. [3]

Three factors contribute to this tendency. Firstly, the structure of the South African economy is built firmly on the freight-intensive primary (mining and agriculture) and secondary (manufacturing) sectors that generate many tons of freight requiring transportation, as shown in Table 1. Secondly, the majority of industrial and mining activity and a great deal of agricultural activity occur inland, hundreds of kilometres from the ports used to import and export freight. On average, every ton of freight travels relatively large distances between its origin and destination. Thirdly, South Africa's business logistics depends heavily on road transport instead of rail, which is a more efficient mode of transportation as it allows greater scale economies.

For more than a decade, the level of activity and cost of South African logistics has been traced and analysed by researchers at Stellenbosch University, first published in the State of Logistics Survey for South Africa [4] then more recently in the Logistics Barometer South Africa. [5]

National logistics cost model development commenced in 2005. Subsequent discussions with government and industry stakeholders pointed to the need for further refinement to the following areas of the model:

- Firstly, transport was identified as the largest component of South Africa's logistics cost in the first model, and extensive refinements were, therefore, made to this cost component in subsequent annual models.
- Secondly, the initial model applied a static warehousing cost estimate based on an estimation of the average inventory level for one year. This required expansion to include a more robust year-on-year inventory-cost comparison.
- Lastly, whereas all the other elements of the model estimated full costs, inventory carrying costs (or the opportunity cost of capital) was based on value-added costs, which underestimated inventory carrying costs and did not enable industry-level benchmarking. This was adapted to enable calculation of the opportunity costs of capital employed in each stage of the value chain.

The logistics cost model employs a bottom-up approach for the computation of logistics costs by aggregating detailed commodity-specific data – relating the tons produced and imported (in other words, total supply) of a specific commodity to the costs of performing logistical functions with respect to that commodity.

The model provides:

- the only available national view of the state of logistics in South Africa;
- a bottom-up approach that enables a detailed modal view as well as the refinement of the measurement on a detailed scale;
- an understanding of the national state of affairs which (i) focuses the activities of all participants on the impact of individual activities on the broader logistics environment, and (ii) enables more strategic and collaborative decision making at an industry and government level; and
- a holistic view of the state of logistics that enables government to engage meaningfully with stakeholders to address the country's logistics challenges.

Table 1: Physical components of South Africa's GDP, 2015

Sector	Tonnage (million)	
Mining	573,8	66%
Agriculture	84,3	10%
Subtotal – primary	658,1	76%
Manufacturing	206,4	24%
Total	864,6	100%

Source: [5]

The primary and secondary sectors together generated 864,6 million tons of freight in 2015. The transport activity required to move all this freight between respective origins and destinations amounted to 378 billion ton-km. (A ton-km is a unit that measures transport intensity. One ton-km implies that one ton of freight was moved one kilometre (I ton = 1 000 kg).) Overall, logistics activities in South Africa in 2015 cost R470 billion. (One euro is approximately equal to 14 South African rands (R).) The four cost components of logistics costs are transport, warehousing, inventory carrying cost, and management and administration. It is clear from Figure 1 that transport is by far the greatest cost component at 57% of the total.

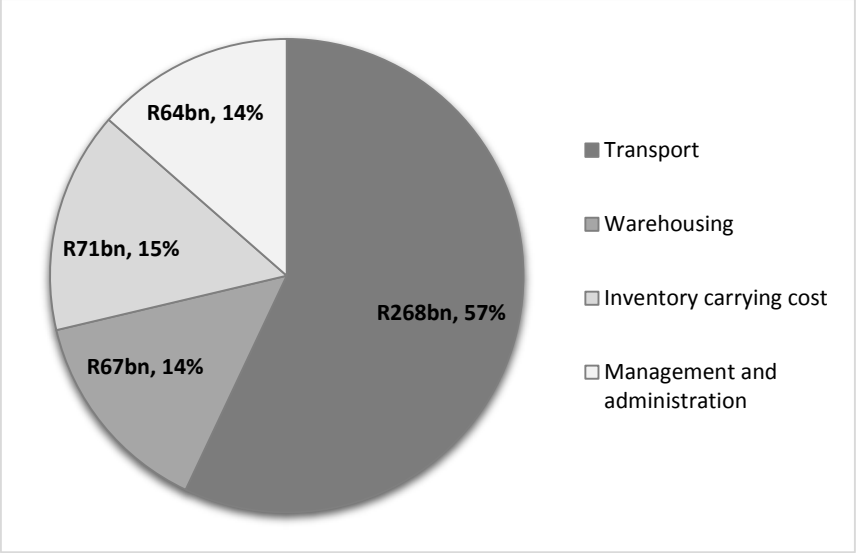

Figure 1: Components of South Africa's logistics costs, 2015

Source: [5]

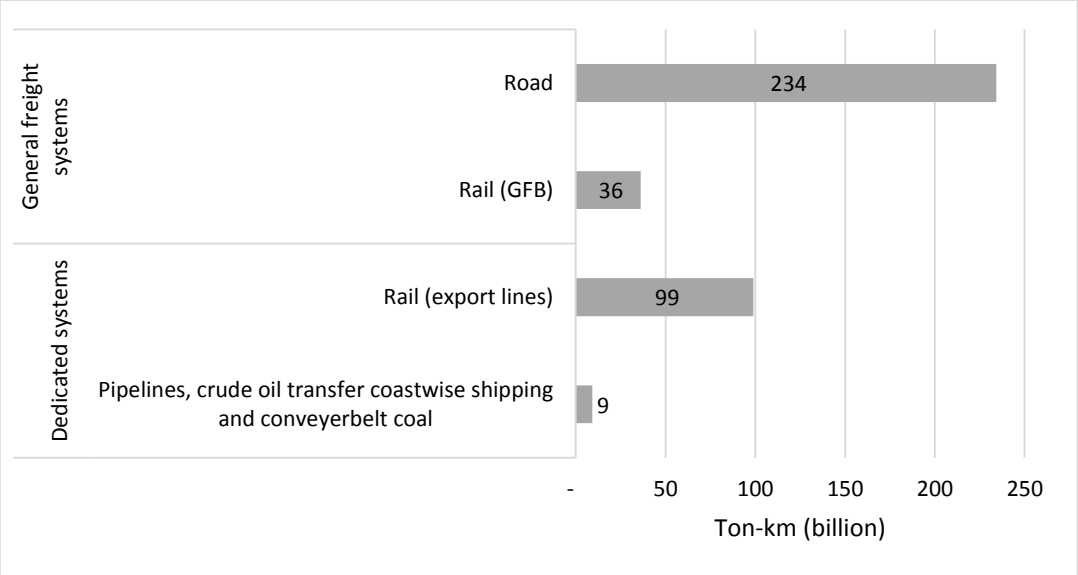

Figure 2: Ton-kilometres per mode

Source: [5]

To relate total logistics costs to the value produced in the economy, it is compared to the gross domestic product (GDP). Logistics costs amounted to 11,7% of total GDP in 2015. Logistics costs as a percentage of GDP is regarded as a benchmark measurement to gauge logistics efficiency. North America and Europe are comparatively more efficient with percentages of 8,6% and 9.2% in 2015 respectively. However, when compared to other developing regions like South America (11,9%) and Asia Pacific (13,5%) in 2015, South Africa's logistics efficiency is slightly better than par. [6]

According to the Logistics Barometer, [5] in 2015 the percentage was up 0,5% from 2014 when logistics costs were 11,2% of GDP. Increases and decreases in logistics activities and costs can occur while the economy can grow strongly in the tertiary sector and affect this ratio. To reduce this ambiguity one should consider logistics costs as a percentage of the *transportable* GDP – that is, the GDP emanating from only the primary and secondary sectors. In 2015, according to the Logistics Barometer, this percentage was a staggering 53,6%, which implies that a little over half of the landed cost of a product is attributable to logistics. [5]

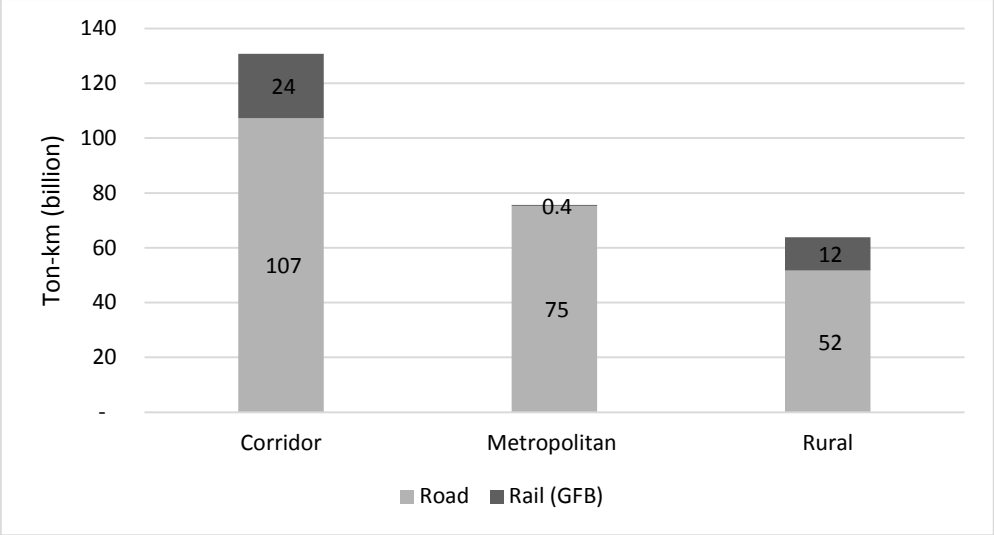

Figure 3: General freight system ton-kilometres by typology

Source: [5]

With transport costs such a significant contributor to logistics costs, and thus landed costs, this warrants further discussion. South Africa's surface logistics is an interconnected network of railways, roads, pipelines and conveyors. Pipelines (primarily for liquid fuel products), conveyors (used in the mining industry) and the coal and iron ore rail export lines are considered dedicated systems. According to the Logistics Barometer, [5] from the 378 billion ton-km transportable freight in South Africa (2015), road transport and rail general freight business (GFB) accounted for 270 billion of these ton-kilometres, as shown in Figure 2. This means that the road network handled 62% of the transport activity while rail transport hauled 36%.

Apart from these systems, general freight business uses one of three transport typologies: corridors, metropolitan or rural. Corridors refer to long-haul transport links between industrial centres. The country's most significant corridors are the Western Cape–Gauteng corridor and the eThekwini–Gauteng corridor. Corridor transport is ideally suited to a rail-only or intermodal (rail-and-road) solution. It is on this typology that a drastic shift in modal balance from road back to rail could reap significant efficiency rewards for South African logistics. The metropolitan typology includes short-distance distribution networks in and around industrial and population centres. This short-distance transport is better suited to road transport. Here cost savings are gained mostly by more effective logistics network design, management of the inventory/transport trade-off, and the use of more fuel-efficient transport. Lastly, rural transport is the most difficult to manage and optimise as it entails transport across a widely dispersed road network that serves all locations outside of the industrial centres. While rural transport may also sometimes be 'long haul' like corridors, this typology does not have the same scale economies that warrant rail solutions. Instead, more systemic solutions are required, such as those that move production closer to points of consumption and/or supply, or solutions that consolidate freight to rural areas, reducing the demand for logistics. Figure 3 shows the proportions of the 270 billion ton-km generated by the general freight business attributed to each of the typologies, as well as the modal split of this transport activity between road and rail.

Efficient and effective logistics systems offer significant competitive advantages to an economy, but inefficient logistics systems drive up the cost of doing business. In this transport-hungry economy, superior logistics management is paramount, from the lowest level of detail right up to national policies and infrastructure planning.

COMPARISON BETWEEN SOUTH AFRICA AND OTHER COUNTRIES

Logistics costs measurements have internationally grown in popularity over the last decade, and comparisons could reveal some interesting factors that drive the management of logistics on a macro level. The question is: how does South Africa compare to other countries?

As South Africa is part of the BRICS (Brazil, Russia, India, China and South Africa) bloc, these countries were chosen for comparison, as well as the USA, Western Europe and the Nordic countries (focusing on Finland), and Australia, a country with a strong mining focus just as South Africa.

The **Australian** Logistics Council [7] has determined that logistics represents 8,6% of Australia's GDP (much lower than the 11,7% for South Africa). Australia also has long transport distances, but mostly between coastal locations and with the ability to deliver more of the domestic freight task by water. At 600 billion ton-km, the freight task is two-thirds larger than that

of South Africa, but only about one-third of Australia's freight task is delivered by road, compared to South Africa's nearly two-thirds. Significantly, Australia's GDP ($1 454 billion at 2014 current prices) is around four times larger than South Africa's ($350 at 2014 current prices), bringing South Africa's freight task problem (which is around 50% of Australia's volume) into sharp focus. This means that transport distances in South Africa are relatively longer, but at the same time more freight in South Africa is on road. Australia projects that the 600 billion ton-km will grow by 80% from 2010 to 2030, compared with South Africa's projection of 68% growth over the same period.

The nation in the world with the highest absolute logistics cost is the **United States of America**, which was $1 408 trillion in 2015, but only equal to 7,9% of GDP, according to the Council of Supply Chain Management Professionals. [8] The USA also has the longest history (three decades) of measuring logistics costs as a percentage of GDP, starting in 1984 when it was equal to 13,4% of GDP. Most of the cost reduction relative to GDP achievements were made in the two decades following 1984, as, especially in the USA, cost reduction efforts were facilitated by deregulation (such as with the Staggers Act) and technology advancements. Deregulation provided logisticians with more modal choices and the ability to lower total cost of ownership. Deregulation of other industries (such as agriculture) removed the natural accumulation of commodities, and challenged logisticians to become leaner and more agile. Technology enabled the concepts of richness and reach, meaning that the advantages of centralisation (efficiency) and decentralisation (being responsive and closer to the customer) were both enabled. By 2004, logistics costs were equal to 8,6% of GDP, which shows that in the two decades between 1984 and 2004 they improved by 4,8%. but in the last decade up to 2014 by only 0,3%. Efficiency gains are more difficult now, and new and innovative ways are sought to lower logistics demand and improve supply.

As shown in Table 2, **Finland**'s logistics costs (as measured at the Turku University) as a percentage of GDP at 11,4% is the highest of all the Nordic and West European countries [10] (which are seen as typical representatives of developed countries), and slightly higher than for South Africa.

Table 2: Country comparison of logistics cost as a percentage of GDP

Country	Logistics costs as % of GDP
Finland	11,4
Sweden	7,3
Norway	7,7
Denmark	6,1
Germany	8,6
Western Europe	6,7

Source: [9]

It is estimated that more than 60% of Finland's logistics activities are not outsourced. The economies of scale that are achieved by outsourcing (allowing for more effective routing and scheduling, full return loads and warehouse space maximisation) is challenged by a low-outsourced environment. Finland's manufacturing industry has seen the cash-to-cash cycle deteriorate from just over 40 days in 2005 to over 60 days in 2013. (The cash-to-cash cycle calculates the time that operating capital (cash) is out of reach of the business – the faster this cycle, the fewer days this capital is unavailable in the operation of the business.) This led to an inventory carrying cost of €6,4 billion, which is 28% of the logistics costs for Finland, compared to South Africa's 14%. Where South Africa's problem is clearly a transport challenge (due to long transport distances, delivered mostly on road), Finland's problem is the slow-down of the cash-to-cash cycle. [9]

Although **Germany** [10] is also a relatively large country in European terms, it has a massive economy, and gains from an exceptional central position in an open-border European environment. This position, combined with a highly proficient logistics industry (Germany often scores the highest in the World Bank's Logistics Performance Index) enables a relatively low logistics cost bill compared to GDP.

Logistics costs as a percentage of GDP is generally higher than the South African figure for the other partners in the **BRICS** alliance, shown by these approximate numbers in Table 3.

Table 3: BRICS comparison of logistics cost as a percentage of GDP

Country	Logistics costs as a % of GDP
South Africa	11,7%
Brazil	12%
Russia	20%
China	18%
India	13%

Sources: [11,12,13]

Each of these countries is dealing with different challenges illustrating issues relevant to developing countries in these circumstances. India is a densely populated country with high levels of congestion and inadequate infrastructure to deal with this challenge. Even though India's surface area is 2,7 times larger than South Africa, it has a population more than 20 times larger, which explains the massive levels of congestion in the country. It does, however, also have a relatively large economy (more than five times than that of South Africa). A highly concentrated economy (more output for less space) usually means that logistics costs can be lower. Poor infrastructure in the face of high levels of congestion makes this difficult, and McKinsey [14] estimates that infrastructure challenges in India translate into unnecessary logistics costs relative to 4,5% of

GDP. This means that India's figure could have been less than 10 per cent as it is for most of the developed world. Infrastructure is in fact the most important challenge for logistics in all the BRICS countries. For Russia [12] one could add the obvious huge transport distances, the non-rational location of many manufacturing facilities, and the archaic organisation of cargo delivery from manufacturer to consumers. In Brazil's case, port infrastructure and operations specifically are important. The Chinese government regards high logistics costs as one of the major growth inhibitors of the economy, [14] and is seeking to address this with improved infrastructure and preferential tax policies for logistics service providers.

CONCLUSIONS

South African businesses need to improve their long-term logistics forecasting and demand management abilities, and collaborate more in order to better contain costs. Improved long-term forecasting and planning ability is a prerequisite to enhance lean, efficient logistic supply, and to remain logistically agile and service-effective during economic upheavals. At the same time, government policy should take into account the effect of unpredictability on the logistics system and consider steps to make the system less vulnerable to external risks, such as the international fuel price, the exchange rate and climate change.

Sound logistic resilience is an imperative for a nation's economic competitiveness. However, resilient supply chains will typically incorporate strategic buffers in the form of inventory and capacity. Managing the paradox encapsulated in striving towards logistics resilience, namely being both lean and agile, necessitates the performance of the logistics industry being continually monitored in order to facilitate the measurement of the industry's cost and productivity.

With respect to infrastructure, South Africa faces challenges, but so do other countries. The country's position is, however, deemed to be more vulnerable to external shocks and cost impacts, due to its size and distance from markets. As far as cost reductions in general are concerned, on the demand-side South Africa need to beneficiate more. This is a central planning fundamental for job creation and growth, but also for logistics costs, as beneficiation reduces logistics costs relative to GDP.

REFERENCES

[1] United Nations, 2002, Commercial development of regional ports as logistics centres, United Nations Publications, New York.

[2] Havenga, J.H., 2010, "Logistics costs in South Africa – The case for macroeconomic measurement," *South African Journal of Economics,* 78(4) pp. 460–478.

[3] Havenga, J.H., and Simpson, Z., 2014, "Reducing national freight logistics costs risk in a high-oil-price environment: A South African case study," *The International Journal of Logistics Management,* 25(1) pp. 35–53.

[4] CSIR, State of logistics surveys, Series of publications available from: http://www.csir.co.za/sol

[5] Stellenbosch University, Logistics barometer South Africa 2016, ISBN: 978-0-620-73253-6 (e-book) Available: http://www.sun.ac.za/logisticsbarometer

[6] Armstrong and Associates Inc., Global 3PL market estimates, Available:http://www.3plogistics.com/3pl-market-info-resources/3pl-market information/global-3pl-market-size-estimates/ (accessed 1 June 2017).

[7] Australian Logistics Council, 2016, The economic significance of the Australian logistics Industry, Sydney.

[8] CSCMP (Council of Supply Chain Management Professionals), 2016, CSCMP's Annual State of Logistics Report. Available: http://www.cscmp.org (accessed 1 May 2017).

[9] Rantasila, K., and Ojala, L., 2012, International Transport Forum. Measurement of national-level logistics costs and performance, Turku School of Economics, Turku, Finland.

[10] CBRE, German industrial logistics annual report, Spring 2012, Hamburg.

[11] The World Bank (The International Bank of Reconstruction and Development), 2012, How to decrease freight logistics costs in Brazil, Washington, DC.

[12] RosBusinessConsulting, 2011, Russian transport and logistics service market in 2010–2011 and forecast to 2014, 6th edition, Moscow.

[13] McKinsey and Company, Building India: transforming the nation's logistics, Available: http://www.mckinsey.com/search?q=Building%20%20India%20Transforming%20the%20nations%20logistics&ignoreSpellingSuggestion=true (accessed on 10 February 2017).

[14] Fung Business Intelligence Centre, 2013, Logistics industry in China, Hong Kong.