DIAGNOSIS OF 'EXTRA DISTANCE' IN THE SOUTH AFRICA FMCG RETAIL SECTOR

V. Sanchez-Rodrigues a, A. Potter a, M.M. Naim a, C. Schoeman b, S. Greeff c

a Cardiff Business School, Cardiff University, Aberconway Building, Colum Drive, Cardiff, UK

b CSIR: Logistics and Quantitative Methods, Meiring Naudé Road, Brummeria, Pretoria, South Africa

c Imperial Logistics, Goldfields Logistics Park, Germiston, South Africa

Abstract

Uncertainty can cause significant disruptions throughout supply chains. This paper focuses specifically on uncertainty within transport operations, an often neglected area within the literature. While the causes of uncertainty are documented, there is a need for research to understand the consequences of uncertainty on the transport operations. This paper introduces the concept of 'Extra distance' as a measure of uncertainty using a case study research approach. The measure is then applied to a distribution operation in South Africa to quantify the link between causes and consequences of uncertainty,. From the results, it is found that 6% of the transport distance actually run does not add value to the end customer, with both economic and environmental implications.

Keywords:
'Extra distance', grocery retail, primary distribution, secondary distribution

1 INTRODUCTION

Practitioners today need a broad view of the role of transport within an integrated supply chain (1). Due to the fact that transport is the link between companies to their customers, effective transport operations can enable the delivery of customer value. Uncertainty in the supply chain, in the form of disturbances and disruptions, is a barrier to the effective management and control of operations (2).

Transport has traditionally been considered as a marginal activity within supply chains (3) and it has not been explicitly taken into account in supply chain uncertainty frameworks. Recently, a focussed transport uncertainty model have been developed and refined to determine the main uncertainties affecting on the performance of transport operations (4). Further, uncertainty increases the risk within supply chains, as risk is a consequence of the external and internal uncertainties that affect a supply chain. By measuring risk logistics practitioners can take better and more informed decisions about which transport uncertainties should be more tightly monitored and controlled. Much previous work has focused upon the causes of uncertainty, while the aim of this paper is to evaluate the consequences of different supply chain uncertainty causes, using a novel measure of 'Extra distance', on the sustainable performance of transport operations. In doing so, a case application from the South African retail sector is used.

The paper proceeds by presenting a synthesis of the recent research works in manufacturing, transport and supply chain uncertainty. After that, the method deployed to undertake the research is explained. Subsequently, the findings are presented. Finally, we conclude the paper by highlighting the managerial implications and limitations of the research.

2 CAUSES OF TRANSPORT UNCERTAINTY

"Supply chain uncertainty refers to decision making situations in the supply chain in which the decision maker does not know definitely what to decide as he is indistinct about the objectives; lacks information about its environment or the supply chain; lacks information processing capacity; is unable to accurately predict the impact of possible control actions on supply chain behaviour; or, lacks effective control actions" (5). Suppliers, manufacturing and customers are the three main sources of supply chain uncertainty (6). Mason-Jones & Towill (1999) develop the uncertainty circle model adding an additional source of uncertainty, the control system (7). Most recently, exogenous events as a new dimension were added to the supply chain uncertainty literature (8).

In order to extent the supply chain uncertainty literature, logistics-focussed uncertainty model has been developed (9). The uncertainty types are defined as:

- Shipper: any uncertainty originating from the sender of products which directly impacts upon transport performance. These may relate to raw material sourcing, the production process or the activities involved in the despatch process.
- Customer: any uncertainty that is produced by the receiver of products. Examples include forecasting and ordering products or any delivery restrictions that the customer imposes.
- Carrier: any anomalies that can be originated from the carrier and directly affect the delivery process, such as vehicle failure or a lack of drivers.
- Control systems: any problems caused by inadequate and fragmented ICT systems within the logistics triad, or the lack of physical monitoring systems.
- External uncertainty: any disruption caused by exogenous factors that are not under the control of the logistics triad, including congestion, labour shortages and volatility of fuel prices.

The transport uncertainty model has empirically been tested through focus groups, evaluating the different causes of supply chain uncertainty impacting on transport operations in the UK (10). The main causes are delays within the supply chain, variable demand and/or inaccurate forecasts, lack of supply chain coordination and delivery

restrictions. More generally, increases in supply and demand uncertainties, globalisation, reduction in product and technology life cycles, and the use of outsourcing in manufacturing, distribution and logistics resulting in more complex supply networks, can lead to higher exposure to uncertainty in the supply chain (11). "A number of managerial trends including JIT delivery, supplier rationalisation programmes and widespread outsourcing of non-core activities have all served to increase the efficiency of supply networks" (12), but at the same time, "there are concerns that these measures appear to have increased supply chain vulnerability" (13, 14).

3 CONSECUENCES OF TRANSPORT UNCERTAINTY

There are two main consequences that are likely to emerge from uncertainty in transport operations – either extra distance run by the vehicles or a time delay to the delivery. In this paper, we particularly consider the former as the focus is on both economic and environmental performance. Strong parallels exist between this extra distance moved and the concept of non-value adding transport in the lean manufacturing literature. A number of causes of non-value adding transport, in both time and distance terms (15). However, they do not quantify the impact of these. By contrast, Overall Vehicle Effectiveness (OVE) has been suggested as a measure for evaluating transport effectiveness (16). The nature of this measure is such that the exact impact of uncertainty may be hidden once OVE is calculated.

In this paper, we use the concept of 'Extra distance' to quantify the impact of transport uncertainty. ''Extra distance' are the deviations between the number of miles lorries actually run, and the miles they would have needed to run if the transport planning is undertaken with accurate and timely information on the volumes to be moved, and/or there are not any operational failures that could disrupt the delivery process' (17). Figure 1 shows how this measure can be directly linked to non-value adding transport miles. The term 'Miles' reflects the development of the measure within a UK environment, but, being distance based, kilometres can be the unit of measurement.
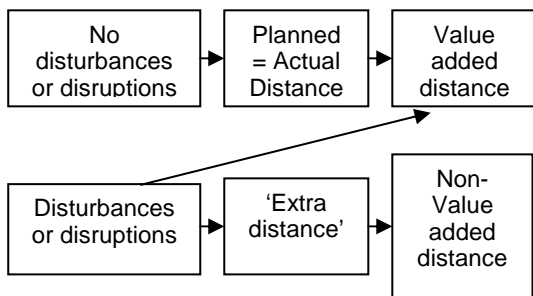

Figure 1 - *Value added and non-value added miles*

4 CASE STUDY CONTEXT

In this paper, the 'Extra distance' concept has been applied to the secondary distribution network of a South African FMCG retailer, shown schematically in Figure 2. The retailer has over 200 outlets throughout the country, serviced by a network of 3 distribution centres (DCs). The transport operations within this network are outsourced to a third party provider, and during data collection, the research team was based with this company. This logistics provider is the sole organisation involved in secondary distribution, as well as being responsible for a small proportion of primary distribution.

There are a number of reasons why this particular case was chosen:

- The 'Extra distance' tool was developed in the context of UK operations and so an international comparison aids generalisation.
- While similar logistics challenges exist between, for example, European countries, additional challenges unique to South Africa/developing countries may create different causes of uncertainty (18).
- By looking at the FMCG retail sector, comparisons with UK case study applications is possible in the future.
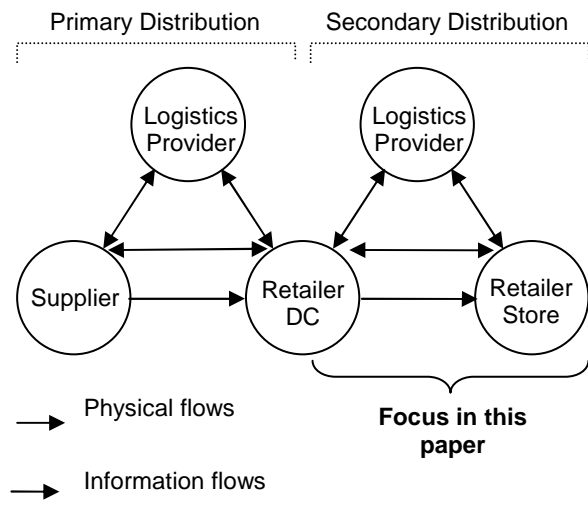

Figure 2 – *Logistics provider position within FMCG retailer supply chain*

5 METHOD

In order to undertake the 'Extra distance' assessment, the principles of the case study method have been applied, since the tool needed to be tested in a business setting. The unit of analysis for this assessment is a FMCG retail secondary distribution operation. This operation was selected because there was a particular interest on identifying the uncertainties from other supply chain partners.

In planning stage of the 'Extra distance' assessment, findings from a previous 'Extra distance' assessment (Sanchez-Rodrigues et al, 2009) were presented to the logistics provider's management staff in a teleconference meeting. As noted earlier, the retailer has three secondary distribution centres in South Africa. However, a decision was made to concentrate on the two bigger distribution centres, in Johannesburg and Cape Town. The data collection was undertaken by a team of two researchers, one from a UK university and the other from the South Africa CSIR, and a supply chain analyst from the case study company.

Apart from the two researchers and the supply chain analyst, a number of managers from the secondary distribution operation studied were constantly validating the data collected and confirming that the researchers' interpretation reflected the reality of the operation.

The 'Extra distance' data used for the analysis was gathered in the last two weeks of January 2009. Due to the

fact that the company had distance-based archival data available, the week commencing on 5th January 2009 was selected. This week was considered by the company staff as a typical or average week that fairly represents what happen over a 12-month period. So, typical case sampling was applied as purposive sampling strategy (19). In the theory of activity sampling, the sampling strategy applied in this study is called attribute-based sampling, since the main objective was to find incidents with a common attribute. That attribute was that the incidents should originate 'Extra distance'.

All incidents that originated 'Extra distance' were identified from company historical reports and inputted into an Excel spreadsheet. In the study, there was a particular interest on determining the causes of 'Extra distance'.

The data collection approach is based around archival data reports. Although the same data was collected overall, different reports were used from each DC. In the Johannesburg DC, two reports were used to gather the 'Extra distance' data. One of them was the additional volume report, which summarise the extra trips run due to short-noticed volume increases. The other report used is the one that summarised the extra trips run due to operational failures at the distribution centre, stores and within the delivery process. In the Cape Town depot, the data was gathered from a single report, which summarises the service levels and delivery performance for the operation.

Detailed information about the trips that caused 'Extra distance' was recorded; this information includes: store location, miles run, 'Extra distance' source, visible cause and root cause. In this paper, 'Extra distance' is calculated in kilometres. From the spreadsheet, the number of 'Extra distance' originated by each supply chain uncertainty source was calculated. For each source of 'Extra distance', frequency and impact was also calculated. Furthermore, cost and carbon emissions of 'Extra distance' originated by all the uncertainty sources were estimated using the average running cost per mile and the average fuel consumption given by the logistics provider.

To understand more about the root causes of 'Extra distance' informal interviews and discussions with held with managers and transport planners within the secondary distribution operations, both from the logistics provider and retailer. These discussions also helped confirm the accuracy of the data collected.

After finishing the analysis of the data, a feedback presentation was delivered to the management board of the logistics provider. In that meeting, all the managers involved validate the findings. From their perspective, this presentation represents a starting point towards identifying the potential mitigation strategies to reduce 'Extra Miles'.

6 RESULTS AND ANALYSIS

In this section of the paper, the overall results of the data collection will be presented first. This includes the two secondary distribution centres involved in the study. After that, the impact of the causes of 'Extra distance' will be discussed, highlighting their potential sources and root causes. Subsequently, a risk assessment of all the causes of 'Extra distance' found will be shown.

As Table 1 shows, between the two DCs, a total of 207,000 Km were run in the week of data collection. The

Johannesburg facility represents just over 80% of the total Kilometres run between the two DCs. Also, 6.35% of the total miles run are 'Extra distance' and the rest are value-added miles. The total number of 'Extra distance' found in the data collection represents US$16,100 and 20,600 Kg of carbon.

	Johannesburg	Cape Town	Overall
Km run	172,000	35,000	207,000
'Extra distance' (km)	11,538	1,605	13,143
% of value-added miles	93.29	95.41	93.65
% of 'Extra distance'	6.71	4.59	6.35
Cost ($)	14,150	1,970	16,120
Kg of Carbon	18,100	2,500	20,600

Table 1- Overall impact of 'extra miles on the two secondary distribution centres

In the rest of this section, more in-depth insights from the analysis will be discussed.

Main causes of 'Extra distance'

As table 2 depicts, the four sources of 'Extra distance' are distribution centre failures, short-notice volume increases from retailer, retailer planned volumes more than actual and vehicle size less than planned. From these four sources of 'Extra distance', retailer distribution centre failure is the one that caused most of the 'Extra distance' gathered and short-noticed volume increases originate a very significant amount of 'Extra distance' as well. These two 'Extra distance' sources represent just over 90% of the 'Extra distance' found.

Distribution centre failures were the main source of 'Extra distance' found in the study. As shown in table 2, 37 incidents were found, originating 6,648km of 'Extra distance', which represents an additional US$ 8,200 and 10,400 Kg of CO2. According to the staff involved in the data collection, this 'Extra distance' source originates due to inefficiencies in the picking process at the distribution centre. The distribution centres are operated by the retailer rather than the logistics provider. The cause of this source of 'Extra distance' is picking delays originated by the fact that there is not enough staff for picking products.

Table 2- Summarised findings of 'Extra distance' assessment

Short-notice volume increases from the retailer were the second most significant 'Extra distance' source found. It represents 42% of the total 'Extra distance' originated in

the week of data collection. Also, it was the most frequent source of 'Extra distance' found with 43% of a total of 90 incidents of 'Extra distance' gathered. According to the logistics provider staff involved, this issue primarily occurs since the demand forecast of volumes to be moved is not sufficiently accurate.

The other two sources of 'Extra distance' found are 'planned volumes more than actual' and 'vehicle size less than planned'. The first one represents 4% of the total 'Extra distance' and the second one is 3% of the 'extra distance' found. These two 'Extra distance' sources were found in the Cape Town operation only. In Cape Town, the transport planning process is undertaken by the retailer instead of the logistics provider like in the case at the Johannesburg distribution centre. The planned volumes are more than the actual volumes since the retailer over-plans the resources to have more flexibility during the delivery process. However, the fact that the retailer creates an artificial need for spare capacity has a knock-on effect on vehicle capacity utilisation. There are between 3 and 6 vehicles a day that have less than 30% capacity utilisation. Therefore, the transport network can be better optimised if volumes were more accurate.

The vehicle size is less than planned primarily due to breakdowns of vehicles returning from store deliveries. When there is a breakdown of a vehicle and only a smaller vehicle size is available, there is the need to use two vehicles instead of one. However, vehicle size less than planned represents only 3% of the total 'Extra distance' found.

7 MAGERIAL IMPLICATIONS

Although the case study presented in this paper is a logistics provider from South Africa, the research has identified a number of opportunities to other transport operations within and other countries. From this, it is possible to identify some generic managerial implications. The paper has highlighted the importance of measuring the impact that supply chain uncertainty has on transport performance. Previous other researchers have primarily proposed transport time-based performance measurement tools. However, from a transport operation perspective, it is equally important to measure transport performance in terms of distance.

The 'Extra distance' assessment applied in this research can be used as a diagnostic tool in other transport operations, especially within the FMCG and other fast moving consuming goods sectors. In that way, a more explicit link between supply chain uncertainty and deviations in transport execution could be made. Furthermore, the 'Extra distance' assessment has informed future decision making within the logistics provider studied.

In addition, distribution centre failures originate about half of the 'Extra distance' found. In the supply chain studied, the transport operation is run by the logistics provider and the warehousing operation is run by the retailer. This can be considered as a significant barrier between these two supply chain functions. Therefore, both companies need to review the warehousing process to improve the coordination between the distribution centres and the transport network. Also, due to the fact that about 40% of the 'Extra distance' found are originated by short-noticed volume increases, the retailer need to evaluate the process of demand management from the stores to the logistics provider.

One issue that needs addressing is that to reduce 'Extra distance', there is a need for the logistics provider to actively engage with the retailer (as the shipper and receiver of the products), and that while there are overall supply chain benefits, these may not be evenly distributed between the two parties. Previous research has highlighted the fact that transport is often seen as a commodity within the supply chain (20) and so the shipper of the product may want to take the cost benefit. However, others have argued that the shipper, carrier and customer should work together and share benefits, through a concept termed the logistics triad (21). This would enable all to benefit from a reduction in empty miles.

8 CONCLUDING REMARKS

This paper defined 'Extra distance' as any non value-added miles run within a distribution network. This paper presents 'Extra distance' as a tool to assess transport functions within distribution networks. The tool has been developed based on the principles of the Toyota production system. It can be applied to assess the efficiency of transport operations in terms of 'Extra distance', or more specifically in terms of unnecessary vehicle usages. Also, it can be used to determine the root causes of unnecessary mileage and estimate the risk that they represent.

According to the findings, in this South African case study, 6.35% of the total miles run are 'Extra distance' or non-value added miles. The two main 'Extra distance' sources found are distribution centre failures and short-noticed volume increases. Together, they represent just over 90% of the 'Extra distance' found. Also, the assessment of the four sources of 'Extra distance' has been done by calculating the risk that they represent. In order to reduce 'Extra distance' the logistics provider needs to find mechanism to encourage the retailer to improve their volume demand planning and product picking processes.

Before embarking in any 'Extra distance' reduction programme, the logistics provider should monitor 'Extra distance' for a longer period of time. The findings are based on data gathered over a fairly average week. Therefore, the outcome of this exercise should take as a guide for future decision making, but the exercise needs to be repeated in order to verify the reoccurrence of the findings.

'Extra distance' as a tool has been developed previously and tested in a secondary distribution network in the South Africa FMCG sector. The 'Extra distance' tool needs to be further tested in other transport operations in other industrial sectors. Also, information on the efficiency of transport operations varies from company to company. Therefore, before applying the 'Extra distance' tool in another company, it is necessary to review how that company records information on the efficiency of their transport function, so data can be gathered in the most effective way.

9 ACKNOWLEDGMENTS

10 REFERENCES

[1] Stank, T.P. and Goldsby, T.J. (2000), "A framework for transportation decision making in an integrated supply chain", *Supply Chain Management: An International Journal*, Vol. 5, No. 2, pp. 71-77.

[2] Mason-Jones, R. and Towill, D.R. (1998), "Shrinking the supply chain Uncertainty Circle". *Control*, September, pp. 17-22.

[3] Stank, T.P. and Goldsby, T.J. (2000), "A framework for transportation decision making in an integrated supply chain", *Supply Chain Management: An International Journal*, Vol. 5, No. 2, pp. 71-77.

[4] Sanchez-Rodrigues, V., Stantchev, D., Potter, A., Naim, M. M., and Whiteing, A. (2008), "Establishing a transport operation focussed uncertainty model for the supply chain", *International Journal of Physical Distribution & Logistics Management, Vol. 38 (5), pp. 388 -411.*

[5] Van der Vorst, J and Beulens, A. (2002), "Identifying sources of uncertainty to generate supply chain redesign strategies", *International Journal of Physical Distribution & Logistics Management*, Vol. 32, No. 6, pp. 409-430.

[6] Davis, T. (1993), *Effective Supply Chain Management, Sloan Management Review*, Summer, 35-46.

[7] Mason-Jones, R. and Towill, D.R. (1998), "Shrinking the supply chain Uncertainty Circle". *Control*, September, pp. 17-22.

[8] Sanchez-Rodrigues, V., Stantchev, D., Potter, A., Naim, M. M., and Whiteing, A. (2008), "Establishing a transport operation focussed uncertainty model for the supply chain", *International Journal of Physical Distribution & Logistics Management, Vol. 38 (5), pp. 388 -411.*

[9] Peck, H., Abley, J., Christopher, M., Haywood, M., Saw, R., Rutherford, C. and Strathen, M. (2003), *Creating Resilient Supply Chains: A Practical Guide*. Cranfield University, Cranfield, Bedford).

[10] Sanchez-Rodrigues, V., Potter, A., Naim, M. M. (2007), *Determine the uncertainties hindering sustainability in the UK transport sector*. Proceedings of the 12th Logistics Research Network Conference, Newcastle, 5th-7th September, pp. 359-364.

[11] Christopher, M. and Lee H. (2004), "Mitigating supply chain risk through improved confidence", *International Journal of Physical Distribution & Logistics Management,* Vol. 34, No. 5, pp. 388-396.

[12] Haywood, M. and Peck, H. (2004), "Supply Chain Vulnerability within UK Aerospace Manufacturing: Development of a Vulnerability Management Toolkit"*, Supply Chain Practice*, Vol. 6, No. 1, February, pp. 72-83.

[13] McGillivray, G. (2000), "Commercial risk under JIT". *Canadian Underwriter*, Jan, Vol. 67, No.1, pp. 26-30.

[14] Svensson, G. (2000), "A conceptual framework for the analysis of vulnerability in supply chains". *International Journal of Physical Distribution & Logistics Management*, Vol. 30, No. 9, pp. 731-49.

[15] Sutherland, J.L. & Bennett, B. (2007), "The seven deadly wastes of logistics: applying Toyota production system to create logistics value", White paper No 701, Centre for Value Chain Research.

[16] Simmons, D., Mason, R., and Gardner, B. (2004), "Overall Vehicle Effectiveness", International Journal of Logistics: Research and Applications, Vol. 7, No 2, pp. 119-135.

[17] Sanchez-Rodrigues, V., Potter, A., Naim, M. M., Whiteing, A. (2009), Defining 'Extra Distance' as a Tool to Evaluate Road Transport Performance, Proceedings of the 14th Symposium of Logistics, Istanbul, 4th-8th July.

[18] King, D. (2008) The Fourth Annual State of Logistics Survey for South Africa, CSIR, Pretoria.

[19] Saunders M., Lewis P., Thornhill A (2007), Research Methods for Business Students, Fourth Edition, London: Prentice Hall.

[20] Stank, T.P. and Goldsby, T.J. (2000), "A framework for transportation decision making in an integrated supply chain", *Supply Chain Management: An International Journal*, Vol. 5, No. 2, pp. 71-77.

[21] Beier, F. (1989), "Transportation contracts and the experience effect: a framework for future research", *Journal of Business Logistics*, Vol. 10 No. 2, pp. 73-89.