The impact of implementing a transport management system on a fertiliser supply chain: A case study

Abstract

Supply Chain Management (SCM) and logistics activities are key success factors in organisations and create value throughout the entire supply chain. In the current economic environment, organisations utilise information systems to optimise operations by reducing costs and improving productivity.

The purpose of this article is to investigate the impact of the implementation of a Transport Management System (TMS) on the supply chain operations of a fertiliser organisation in South Africa. Primary data, obtained from questionnaires, as well as secondary data from the enterprise resource planning (ERP) system (before TMS implementation) and TMS database (after implementation) were analysed.

The successful development and implementation of a TMS demonstrated a positive impact on the supply chain operations, with specific impact on volumes and number of loads handled, average tons per truck, average vehicle time at plant, production accuracy, reduced total transport costs and improved inventory accuracy.

Key phrases

fertiliser supply chain; inventory management; load planning; Supply Chain Management (SCM); transport scheduling; Transport Management System (TMS)

1. INTRODUCTION

1.1 Background to the South African fertiliser industry

Agriculture is an important building block of developing economies and in South Africa it remains an important sector despite its relatively small contribution of two per cent to the gross domestic product (Statssa 2015:Internet). Not only does the agriculture sector play an important role in job creation, especially in rural areas, but it also contributes to national food security and earns foreign exchange (IFA 2016:Internet).

An important aspect of agriculture is fertilising. As stated by the International Fertiliser Industry Association (IFA 2016:Internet), the role of the fertiliser industry is to help and assist farmers to grow enough crops and have the required nutrients to meet the demand for the supply of food, feed, fire and energy. In South Africa, 40 per cent of fertiliser is consumed within Gauteng, Limpopo and North West combined, while the Free State, KwaZulu-Natal and Western Cape each accounts for 20 per cent of total fertiliser consumption (Van der Linde 2011:6).

One of the major concerns for the local fertiliser consumers is that South Africa is becoming increasingly reliant on imports from Saudi Arabia, Qatar, Chile and Asia to satisfy local demand (IFA 2016:Internet). In 1990, approximately 20 per cent of South Africa's fertiliser demand was imported. In 1999, it was approximately 40 per cent and in 2008 the fertiliser imports were more than 65 per cent. Fertiliser import costs are highly dependent on supply and demand in the global market, and the exchange rates are the major determinants of import cost. In addition, the South African fertiliser industry operates in a deregulated environment with no import tariffs or government support procedures (Van der Linde 2011:12).

According to the Fertiliser Association of South Africa (FERTASA 2016:Internet), the South African fertiliser industry supplied an estimated two million tons of fertiliser to the local market in 2015. The fertiliser supply chain in South Africa is characterised by the long lead times of raw materials. In addition, inaccurate pricing and ineffective service delivery of fertiliser can create a series of damaging events which could lead to higher food prices and lower crop yields resulting in financial pressure on the farmers (Grain SA 2011:39).

The South African fertiliser industry has developed a highly focused fertiliser supply chain (Louw 2011:3). The consumption of fertiliser in South Africa accounts for 0.5 per cent of the total global consumption and makes it important to take the international supply and demand balances into consideration as this has a direct impact on the local market (Department of Agriculture, Forestry & Fisheries 2015:3).

Fertiliser has three major nutrients: Nitrogen (N), Phosphorus (P) and Potassium (K) and these nutrients can be used separately or mixed together to get the best combination of nutrients. Potassium and Urea (mainly N nutrient) are seen as two of the most important raw materials in the fertiliser industry. The South African fertiliser industry is very dependent on the import of these nutrients due to a shortage of potassium sources, no urea production facilities and the lack of production capacity for downstream fertiliser products in South Africa (Mostert 2013:2). The South African fertiliser industry is exposed to international markets with a deregulated environment that has no support from government and no import tariffs (Grain SA 2011:42). Within this deregulated market the fertiliser price is determined by international prices, currency exchange rates (R/US$) and shipping costs (Department of Agriculture, Forestry & Fisheries 2015:3). Additional costs are added to the fertiliser price which include transport, storage and packaging costs; and forms part of the supply chain and logistics costs that needs to be managed efficiently and effectively. It is clear that in the South African fertiliser industry the supply chain, logistics and transport play a major role in achieving time and place utility goals and objectives.

1.2 Description of the fertiliser company supply chain

This research specifically focused on the impact of the implementation of a TMS on the supply chain operations of a fertiliser company[1]. The fertiliser company has been a leading fertiliser supplier to the South African market for over 100 years and has endured through extremely challenging circumstances. The company differentiates itself from its competitors by operating a pull-based supply chain system, which implies that products are manufactured based on actual customer demands. Its supply chain network includes five production plants, two of which are situated at the coast, and three inland and 42 strategically located depots throughout South Africa. The main purpose of the depots is to move smaller amounts of fertiliser closer to the customers and increase customers' satisfaction by means of shorter lead times.

The strategy of the fertiliser company is to supply customers directly from the plants to achieve higher levels of cost effectiveness and only use the depots as storage locations for improved brand awareness. There are also stock transfers which allow plants to send raw material or finished goods to one another. All of these inbound and outbound transportation activities are performed by third party transport carriers.

Transport management is an important aspect of the company's supply chain and the company outsources its transport and uses third party transport carriers for inbound (raw materials to plants) and outbound (final product to customers, plants and depots) transportation. It uses its transport management skills to negotiate prices, select the most suitable carriers and act as an intercessor between the transporter and the customer.

The company used to utilise manual processing for production orders, delivery notes, truck allocation and administration, which influenced operations. However, the company realised that by improving the efficiency and effectiveness of its operations, it may reduce costs leading to improved profits. The company envisaged that the implementation of a transport

[1]The fertiliser company requested to remain anonymous

management system (TMS) would lead to increased levels of operational efficiencies in terms of the flow of real-time information to customers, the company's employees and third party transporters. The company decided to implement a *purpose-built* TMS mainly due to the requirement for a combined solution to fit the company's needs. Another reason for customisation of the TMS was budget constraints as the up-front costs were lower than *off-the-shelf packages.*

1.3 Purpose of the research

As a result of the manual processing of orders, delivery notes and truck allocations, the fertiliser company experienced inefficiencies that negatively affected the associated costs and service levels. In order to address these operational inefficiencies the fertiliser company implemented a TMS.

The main purpose of this research was to assess the impact of the implementation of a TMS on the supply chain operations of a fertiliser company. This was achieved by focusing on various operational measures before and after implementation of the TMS.

2. LITERATURE REVIEW

Logistics activities form a major part of supply chains. In South Africa logistics cost contributed a substantial 11.2 per cent of GDP in 2014 (Havenga, Simpson, King, De Bod & Braun 2016). Transport is fundamental to the logistical flow of freight in supply chains (De Villiers, Nieman & Nieman 2008:155) and is often one of the highest cost elements (De Villiers *et al.* 2008:151). The role of transport also needs to be considered in managing customer service levels as it creates time utility (created when the customer gets the product delivered at the right time) and place utility (created when the customer gets the product delivered to the desired location) in the supply chain (Wisner, Tan & Leong 2014:307). Since transport impacts the cost of products and service, transport management receives considerable attention in organisations (Swink, Melnyk, Cooper & Hartley 2013:365).

It is important for the transportation function to integrate with other departments such as accounting, engineering, inventory management, legal, manufacturing, purchasing, marketing/sales, receiving and warehousing (De Villiers *et al*. 2008:151). One way of ensuring integration with departments is making use of supply chain information systems, which can supply real-time information and assist with better and faster decision-making leading to reduced cost (Bèlanger & Van Slyke 2012:263). Supply chain information systems are required by management to make strategic, tactical and operational decisions (UCT 2015:16). Decisions need to be evaluated on a routine basis to determine whether the decisions have achieved the desired objectives.

According to the 2014 supplychainforesight survey (Barloworld Logistics 2014:15), individual companies ranked the cost of transport, ineffective processes and systems, and supply chain information and intelligence as some of the major supply chain / logistics constraints they are confronted with.

There are several reasons why information is crucial in the supply chain and logistics, which include (Ganapathi & Nandi 2015:536):

- Demand for real-time information by customers regarding availability and order shipment status has grown excessively.
- Through timeous information the inventory levels can be reduced due to accurate demand forecasting and better replacements.
- Information can provide greater flexibility to businesses by using resources for competitive advantage.
- Information sharing over the internet has improved supply chain relationships.

Information systems are considered one of the most important factors in management and operations of the organisation (Stair & Reynolds 2013:66) and a TMS is an example of an information system designed to assist with the transport management function (Myerson 2012:144). A TMS is an application that can be used to assist management in selecting the best mix of transportation services, obtain the best prices, ensure optimised product movement and supply real-time information about transportation activities (Wisner *et al.* 2014:333).

According to Grabara, Kolcun and Kot (2014:5) the benefits of an information system for the transport process include: increased transport efficiency, improved financial results, better coordination in the exchange of information, optimised and improved transport and transport quality, accessibility of remote monitoring conditions along the routes, lower percentage of incorrect deliveries, less drivers used which leads to optimal driver utilisation, better planning of timetable and planning of drivers and flexibility of trips to the customer’s requirements without incurring any additional costs.

The supply chain operations can be improved by using a TMS in relation to the following activities:

Production planning: In order to meet demand, one of the most important activities in an organisation is to effectively balance production with capacity (Wisner *et al*. 2014:174). Production planning has a direct impact on inventory as improved production planning may lead to improved inventory control (Wisner *et al.* 2014:179).

Due to the fact that the fertiliser industry follows a make-to-order strategy it is essential to plan loads before production starts. The planned loads on the TMS may be used to manage the production plan effectively. This will ensure product availability once the transporter/customer arrives for the product pickup.

Raw material availability: The raw materials requirements are driven by demand and are essential to the production process. Once the production planning is done accurately and effectively, the raw materials requirements can be estimated. This allows raw materials to be shipped in advance to eliminate production delays as raw materials usually have longer lead times to arrive at plants or depots and therefore need special attention (Swink *et al.* 2013:365).

The TMS allows operational personnel to see the movement of raw materials for a specific plant or depot which allows for the raw materials to be strategically positioned.

Facility utilisation: The TMS supplies information about the entire vehicle fleet ie trucks scheduled to arrive at the plant/depot and trucks currently at the plant/depot. In addition, the TMS supplies information related to specific fleet operations such as trucks being weighed in, loaded, loading complete, weighed out, or trip completed (Swink *et al.* 2013:377).

Productivity: The TMS integrates with the ERP system to ensure no manual transactions are necessary. This allows for faster transactions and increased levels of accuracy (Myerson 2012:137).

Transport: The TMS allows the transport activity to be optimised by using information to its advantage. The TMS information ensures that issues can be identified, reported and addressed to improve the transport activity (Swink *et al.* 2013:370).

Organisations use performance measurements to achieve leadership positions within their industry, but also to successfully manage major changes (Wisner *et al.* 2014:478). Performance is the process of quantifying action, where measurement means the process of quantification, and the performance of the operation is assumed to derive from actions taken by its management (Jacobs 2014:33). Performance is described as the degree to which an operation achieves the five characteristics of performance objectives at any point in time, in order to create customer satisfaction and include (Jacobs 2014:38):

- Quality and value
- Speed
- Reliability/dependability
- Flexibility, and
- Cost

By measuring supply chain operations before and after implementation of the TMS, the impact of the TMS can be monitored.

3. RESEARCH METHODOLOGY

This research is based on a case study approach and has been carried out in a South African environment from a fertiliser manufacturer's perspective. This approach was applied because the known theory of the case study was used to support untested conclusions (Saunders, Lewis & Thornhill 2012:144). The case study was conducted by focusing on collecting evidence of a specific organisation in a specific context and using this data to gain a better insight into the topic and of what was actually taking place (Farquhar 2012:6).

A multi-method approach was used to gather the data and analyse the results as it yielded advantages and created a better understanding of social phenomena (Farquhar 2012:22). The multi-method approach includes qualitative and quantitative research. Qualitative research emphasises a strategic level and at the same time remains flexible and contextual (Farquhar 2012:72). Quantitative research focuses on the relationship between variables and is measured in a numerical form (Saunders *et al*. 2012:162). The data collection for the research included both secondary and primary data.

The main purpose of this research was to assess the impact of the implementation of a TMS on the supply chain operations of a fertiliser company. The objective was to measure the periods *before* and *after* implementation of the customised TMS to determine the impact it had on supply chain operations within the fertiliser company. Measurement data from the period before implementation (2012) was extracted from the ERP system and data after implementation (2015) was extracted from the TMS system.

The following measures were considered to be important for the research and were compared before (2012) and after (2015) the implementation of the TMS:

- The volume transported (tons)
- Number of loads

- Time of a truck in plant (inbound and outbound trucks)
- Production accuracy
- Inventory accuracy percentage (%)
- Production accuracy percentage (%) (planned vs actual)

To ascertain the perceptions regarding the challenges and accomplishments of implementing a TMS, a survey was conducted among the company's employees with direct association with operations and planning activities. A self-administered paper-based questionnaire was distributed through email to selected participants. Of the 36 participants who were requested to complete the questionnaire, 26 complete responses were obtained, giving a 72 per cent participation rate.

The questionnaire included both closed- and open-ended questions. The closed-ended questions focused on who and for what purpose the TMS was being used (planning, operational and reporting), which functionalities were being used, as well as ratings of the user-friendliness of the system and problems experienced with the system. The open-ended questions addressed potential issues with the TMS. Frequency distributions of the results of the closed-ended questions and a summary of the open-ended questions provided useful information about the challenges and accomplishments of implementing the TMS.

4. DISCUSSION OF THE RESULTS

In 2012, the operational process was controlled and managed by a Load Schedule Planner (LSP), which was an internet-based simplistic module, designed to control the confirmed orders in a loading plan that determined capacity requirements. Duplications and incorrect orders needed to be checked resulting in a labour intensive process.

Urgent orders were often placed and scheduled for same-day delivery, which caused delays in the deliveries of orders placed and planned in advance. Control of transporters inside the plants was a considerable task. An additional time planning system was also integrated to keep track of truck arrivals and departures, but no reporting could be generated and the information could easily be manipulated and changed.

Subsequent to the TMS implementation in 2015 up-to-date information was available that assisted with better planning of loads (eg linking products), ensuring information was available for production planning, monitoring of trucks on a real-time basis, managing transporters (eg rates per ton and profit/loss statement) and automating hand written delivery notes.

The following measures were considered important for the company's supply chain operations and were compared before (2012) and after (2015) the implementation of the TMS, namely: volume transported (tons) per month, number of loads (monthly and daily), time of a truck in plant (inbound and outbound trucks), production accuracy (monthly and daily) and inventory accuracy percentage (%).

Error! Reference source not found. 1 shows the monthly inbound volumes for 2012 and 2015. The results indicate the seasonality as volumes started to increase from July to December, while October recorded the peak for both periods ie 53 167 tons in 2012 and 54 814 tons in 2015. The total inbound tons for 2012 were 240 126 tons and 254 612 tons in 2015, which showed a six per cent increase.

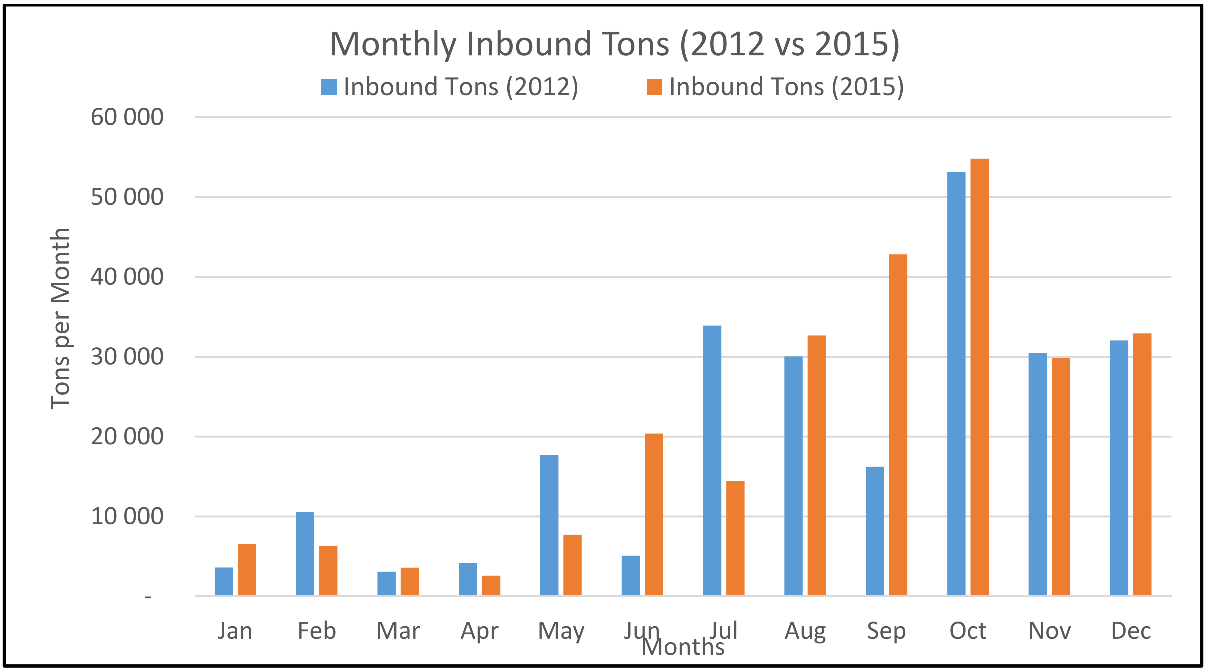

FIGURE 1: Monthly inbound tons (2012 vs 2015)

Source: Calculated from company data

The seasonality experienced during 2012 made transport planning extremely difficult. The 2015 data showed an upward trend over the July to September period. Figure 2 shows the outbound volumes for 2012 and 2015. The seasonality for outbound volumes in general was experienced from August to December.

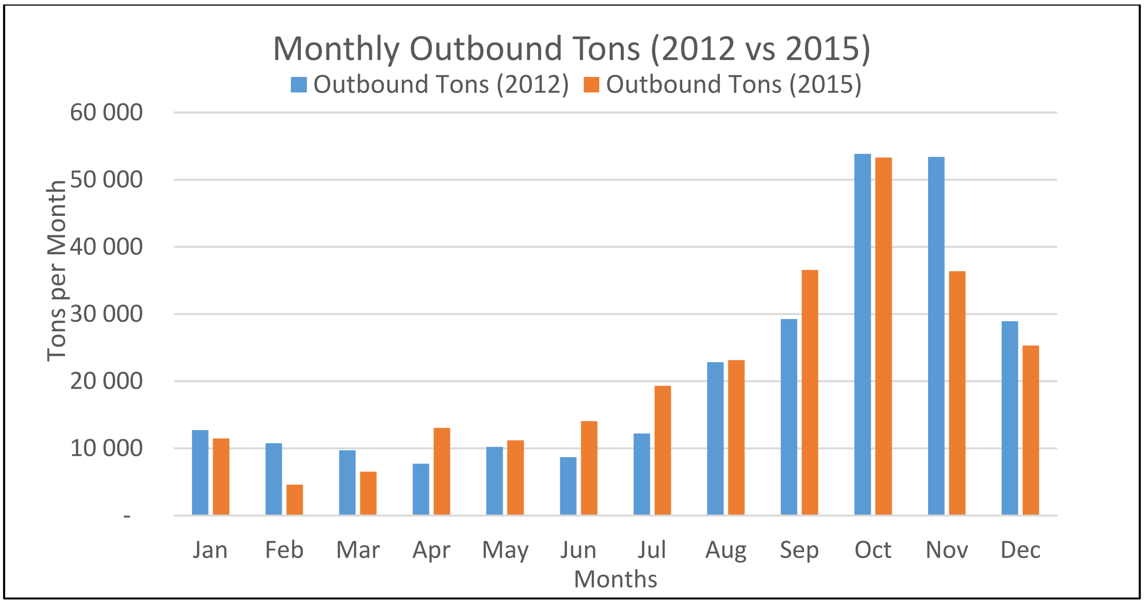

FIGURE 2: Monthly outbound tons (2012 vs 2015)

Source: Calculated from company data

It is seen in **Error! Reference source not found.** that a large proportion of the outbound tons was moved from September to December 2012 showing peaks in October and November 2012. In 2012 the total outbound tons were 260 224 tons and 254 849 tons in 2015, showing a two per cent decrease. This decrease was mostly due to weaker demand in 2015 as a result of lower rainfall. The total volume transported (inbound plus outbound) amounted to 500 350 tons in 2012 and 509 461 tons in 2015, which showed a 1.8 per cent increase.

The number of inbound and outbound trucks loaded refers to the actual number of trucks entering or leaving the plants with product. Not all trucks had the same capacity, as an inbound truck's average capacity was approximately 34 tons, while the outbound trucks had an average capacity of 30 tons per truck. This was mainly due to customers wanting smaller loads to be delivered.

Error! Reference source not found.3 contains the number of inbound trucks offloaded in 2012 and 2015. The maximum number of inbound trucks offloaded for 2012 and 2015 were both in October, 1 647 and 1629 trucks respectively. The total number of inbound trucks offloaded in 2012 was 7 521 and 7 696 in 2015 indicating an increase of 2.33 per cent.

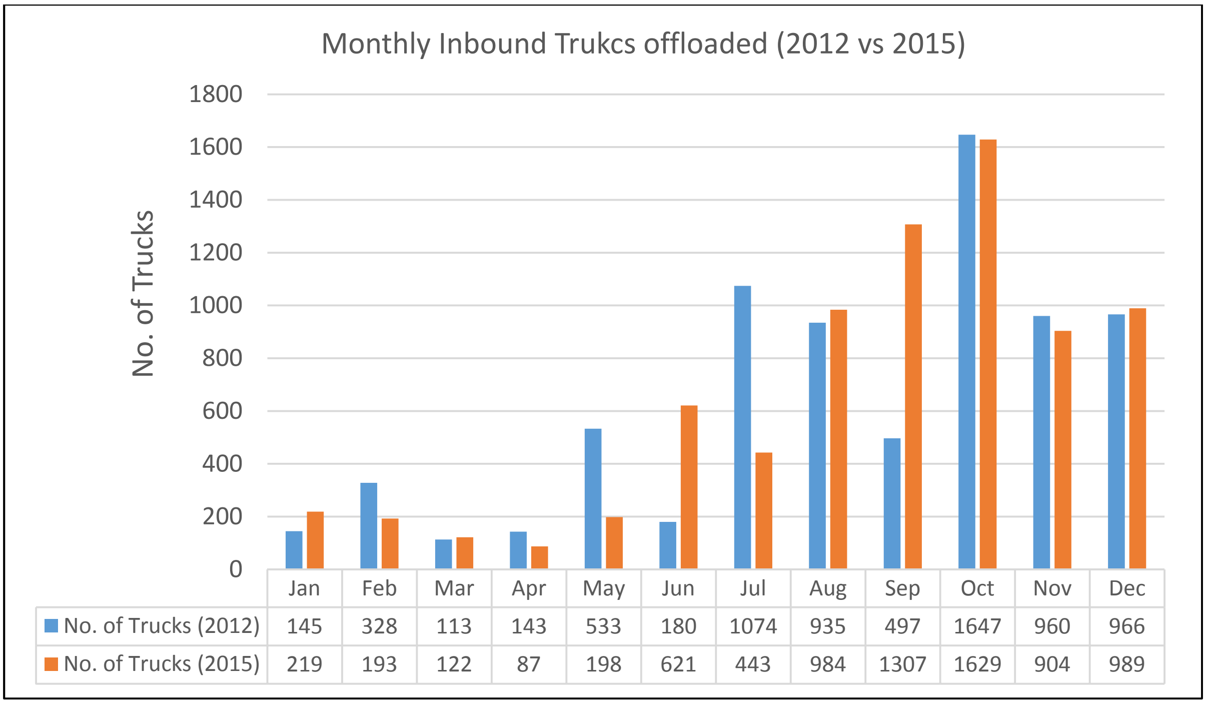

FIGURE 3: Monthly inbound trucks offloaded (2012 vs 2015)

Source: Calculated from company data

Figure 4 illustrates the number of outbound trucks loaded for the period under review. The maximum number of outbound trucks loaded for 2012 and 2015 were both in the month of October, 2 064 and 2 125 trucks respectively. The total number of outbound trucks loaded in 2012 was 10 228 and 10 436 in 2015, which indicated an increase of two per cent of outbound trucks loaded for the year. The number of trucks loaded in November 2012 was higher than in November 2015, which could be ascribed to the fact that deliveries went out later in 2012, compared to 2015 ie the September and October 2015 totals were higher than the totals for the comparative period in 2012.

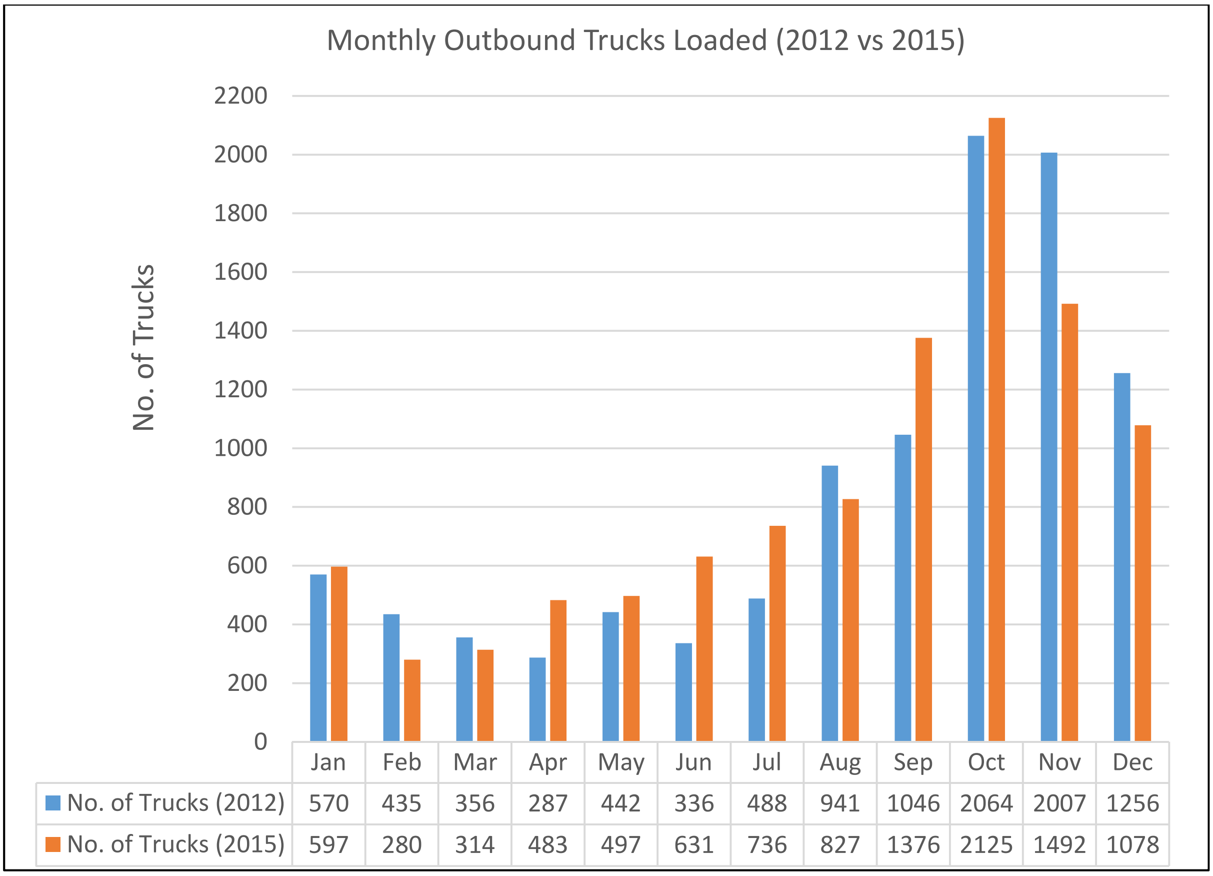

FIGURE 4: Monthly outbound trucks loaded (2012 vs 2015)

Source: Calculated from company data

The total time a truck spent in a plant included the time associated with the following five processes, namely: vehicle security sign in, vehicle weigh in, start loading, end loading and vehicle weigh out

In Figure 5 the monthly average inbound time of a truck spent in a plant is illustrated on a monthly basis. In 2012 the longest time was 167 minutes in October, while the longest time for 2015 was 163 minutes in September.

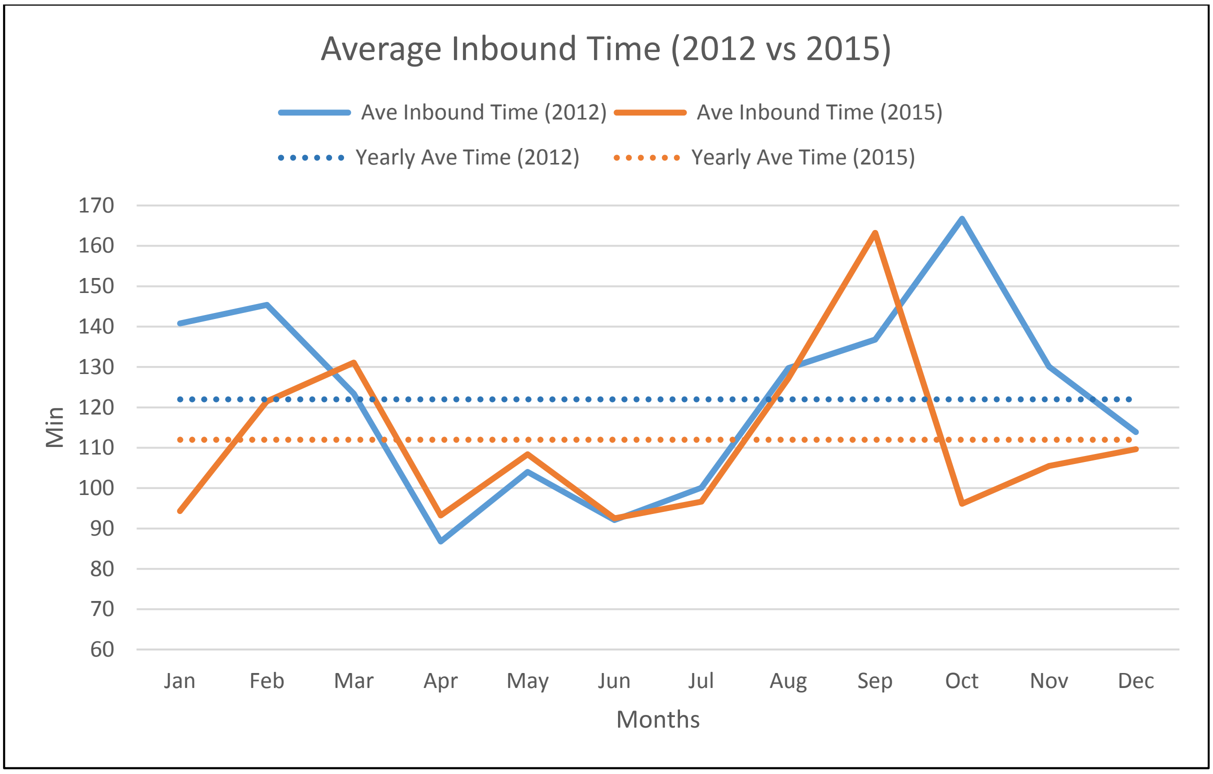

FIGURE 5: Monthly average inbound time of a truck in plants (2012 vs 2015)

Source: Calculated from company data

The shortest monthly average time of an inbound truck in 2012 was 87 minutes in April, compared to 93 minutes in April and June for 2015. The annual average inbound time of a truck in 2012 was 122 minutes and 112 minutes in 2015. This indicates a decrease of 10 minutes, an improvement of nearly nine per cent. A decrease in the average time a truck spent in a plant could be viewed as an improvement and needed to be monitored on a monthly basis to ensure continuous improvement.

Figure 6 shows the monthly average time an outbound truck spent in a plant for 2012 and 2015, while also illustrating the annual average time for 2012 and 2015. In 2012 the longest monthly average time was 275 minutes in October, while the longest monthly average time for 2015 was 256 minutes in September.

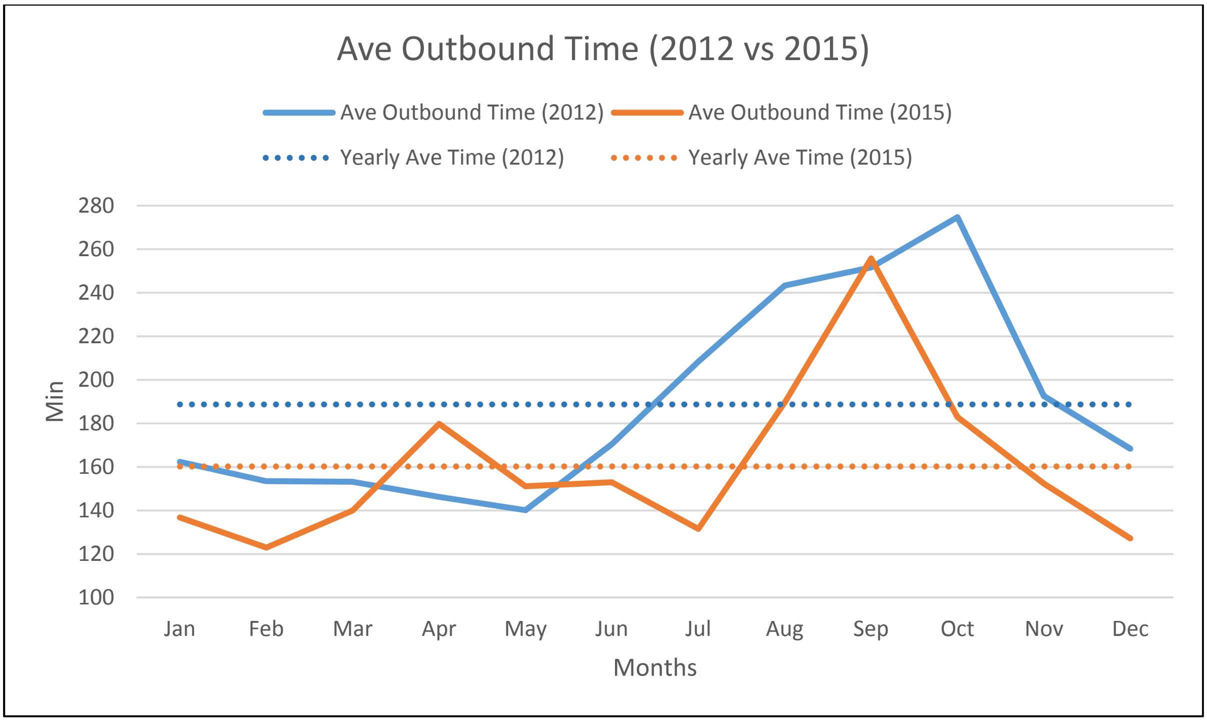

FIGURE 6: Monthly average outbound time of a truck in plants (2012 vs 2015)

Source: Calculated from company data

The shortest monthly average time of an outbound truck in 2012 was 140 minutes in May, compared to 123 minutes in February for 2015. In 2012 the annual average time in the plant of an outbound truck was 189 minutes and 160 minutes in 2015. This indicated a decrease of 29 minutes in the annual average time that an outbound truck spent in a plant, an improvement of 15.3 per cent. This improvement allowed transporters to be more profitable as trucks recorded less idletime. The implementation of the TMS allowed the number of trucks loading for the day to be monitored, which assisted in planning to expedite the trucks scheduled for inbound or outbound transport.

Production is an important part of the fertiliser company's supply chain operations as transporters may withdraw a truck in the event of loading delays. This leads to the customer not receiving their order and potentially cancelling the order. Production was driven from the information supplied by the TMS, as this was viewed to be current demand. The TMS was used for production planning using information relating to volumes outstanding (still needed to be loaded) and volumes dispatched. If the planned vs actual production strayed too far from each other it indicated bad planning that led to capital and resources being tied up, eg extra storage space required. Taking this into consideration the planned vs actual production

(production accuracy) was measured on a monthly basis for 2012 and 2015 and illustrated in Figure 7**Error! Reference source not found.**.

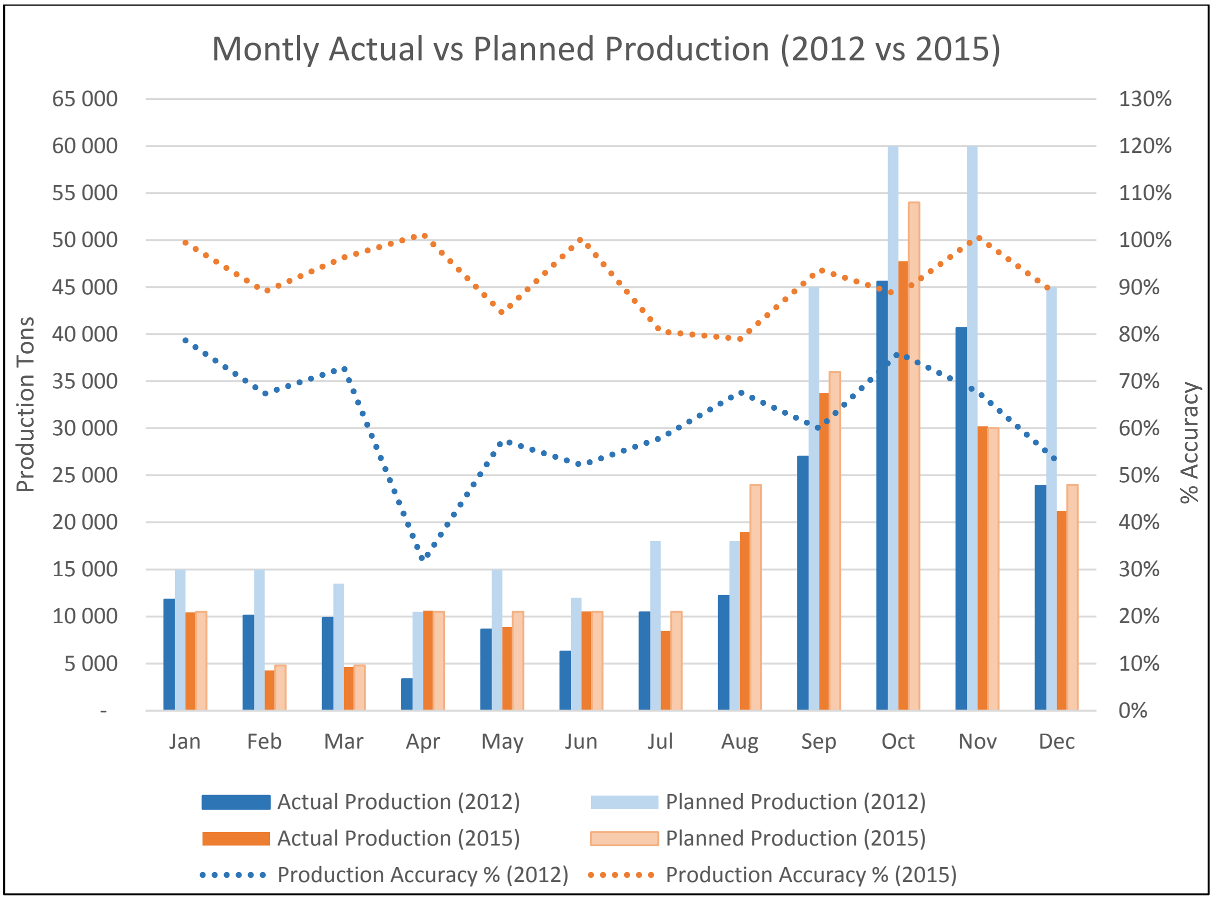

FIGURE 7: Monthly actual vs planned production (2012 vs 2015)

Source: Calculated from company data

In **Error! Reference source not found.**7 it is shown that actual production was at its highest in October for both 2012 and 2015, 45 589 and 47 751 tons produced respectively. The production accuracy in October for this peak was 78 per cent in 2012 and 88 per cent in 2015, indicating an improvement in planning and resource utilisation. The worst production accuracy was recorded in April 2012, 32 per cent compared to 79 per cent in August 2015.

In November and December 2012 the difference between planned and actual production (over planning) was 19 337 tons and 21 098 tons, which indicated 53 per cent and 64 per cent production accuracy respectively. In 2015 the biggest difference between planned and actual production was 6 248 tons in October, ie a production accuracy of 88 per cent. This increase in production accuracy coincided with a reduction in the time spent in the plant resulting in a decrease in bottlenecks at plants.

In 2012, the annual actual production was 209 720 tons and 327 000 tons was planned, which indicated a 64 per cent production accuracy for the year, compared to 2015 when the actual production was 209 737 tons and 230 100 tons was planned. The production accuracy increased to 92 per cent in 2015, showing a significant improvement.

Inventory accuracy was an important metric for the fertiliser company to determine stock availability in a plant for the customer collections. Prior to the implementation of the TMS, inventory accuracy was recorded in the ERP system and defined as the difference between the actual inventory in the plant and the inventory in the ERP system. Since the plant employees only processed the transactions of loads (booking inventory in or out of the ERP system) when they had the time to do it, inventory accuracy was rarely adequately measured. During a busy period, the loads were only processed one or two weeks later, causing the inventory levels in the ERP system to be inaccurate. When the stock was counted there were variances because processing had not yet been completed.

Table 1 illustrates the inventory in the ERP system compared to the actual inventory counted at the end of 2012 and 2015.

TABLE 1: Inventory accuracy (ERP stock vs actual stock - tons)

Year	Inventory in ERP system	Actual inventory counted	Inventory accuracy
2012	98 261	71 198	72.5%
2015	94 974	84 764	89.2%

Source: Calculated from company data

Table 1 shows a difference (inventory levels in the ERP system – actual inventory counted) of 27 063 tons in 2012, resulting in an inventory accuracy level of 72.5 per cent. This was mainly due to unprocessed transactions and inaccurate processing of transactions. In 2015 the closing inventory in the ERP system was 94 974 tons and 84 764 tons were actually counted, an inventory accuracy level of 89.2 per cent. The reason for the inventory accuracy level below

100 per cent in 2015 was the fact that there were outstanding transactions in the TMS. However these outstanding transactions were visible and could be resolved and managed.

A major reason for this improvement was the integration between the ERP system and the TMS, whereby information was sent from the TMS to the ERP to process the transaction, automatically booking inventory in or out. With more accurate inventory information in the ERP system, the purchasing department could also make more informed decisions as lead times were long in the fertiliser industry.

The employee survey results indicate that the majority of the respondents (73 per cent) used the TMS on a daily basis and a small percentage indicated that they sometimes used the TMS (15 per cent). A relatively large proportion of the respondents indicated that they used the TMS for planning, operational and reporting activities (38 per cent). An additional 31 per cent of the respondents indicated that they used the TMS mostly for operational activities. Fewer respondents used the TMS for planning (eight per cent) and reporting purposes (12 per cent). A large proportion of the respondents indicated that they experienced the TMS as user-friendly (46 per cent), but 50 per cent of the respondents indicated that they only "sometimes" experienced the TMS as user-friendly. However, a large proportion of the respondents (70 per cent) indicated that they often experienced problems with the TMS. This was mainly a result of early implementation issues related to hardware and processes which were subsequently addressed.   The respondents indicated that the availability of real-time information, automation of tasks and reporting capabilities were some of the benefits of the TMS.

5. LIMITATIONS OF THE STUDY

This research was based on a specific fertiliser company in South Africa and the TMS was developed in line with the company's strategic objectives. Another fertiliser company may have different focus areas related to their strategic objectives.

The results were based on data from 2012 and 2015 and continuous monitoring of the KPIs is necessary to establish whether improvements in supply chain operations as a result of the implementation of the TMS are sustainable.

The utilisation of alternative measurement tools such as the Supply Chain Operations Reference model (SCOR) may be considered to establish the impact of the TMS on the fertiliser company's supply chain (Alina & Fernando 2014:58; Georgise, Thoben & Seifert 2012:1).

6. RECOMMENDATIONS

In the event that a company decides to develop a TMS, sufficient time needs to be spent on the development phase. This approach allows high levels of system customisation. It is also crucial to ensure that the system integrates with the company's existing management systems such as an ERP system. It is recommended that the scope of the system requirements be agreed on by all parties involved at the start of the development process.

The implementation of a new system is difficult and support from top management is required throughout the process to ensure a successful implementation. In addition, proper training of the users of the system is viewed as a critical success factor to a successful implementation.

7. CONCLUSION

The supply chains of fertiliser companies in South Africa are subject to long lead times (importing nutrients from abroad) and the associated price variability due to exchange rate changes and the international fertiliser industry movements. In addition, fertiliser demand is dependent on weather conditions and relatively short order cycle times expected by the customers (farmers). In order to remain competitive fertiliser companies are continuously looking to create value for their customers. Transport is one area of the fertiliser supply chain that may be utilised to add value by ensuring on-time deliveries.

This research focused on the impact of the implementation of a TMS by a fertiliser company in South Africa. The results indicated better load planning (inbound and outbound), improved production planning (synchronised with orders), more accurate inventory levels, less truck idle time in plant, reduced transport costs and the availability of real-time information to optimise work load. In addition, users of the TMS indicated that it was used mainly for operational activities, but also for planning and reporting.

By implementing a TMS, the impact of the supply chain operations was perceived to be positive, together with adding additional information that had not been measured before the implementation of the TMS.

REFERENCE LIST

ALINA D C & FERNANDO M D. 2014. SCOR model and the balanced scorecard, a powerful combination for business management assets. *Revista Cientifica*. 18(1):58-75.

BARLOWORLD LOGISTICS. 2014. Supply chain foresight: the rise and fall of customers and companies. [Internet: www.barloworld-logistics.com/wp-content/uploads/2014/03/ Supplychainforesight-Report-2014.pdf; downloaded on 2016-07-14.]

BÈLANGER F & VAN SLYKE C. 2012. Information systems for business: an experiential approach. Chichester, UK: Wiley.

DE VILLIERS G, NIEMAN G & NIEMAN W. 2008. Strategic logistics management: a supply chain management approach. Pretoria: Van Schaiks.

DEPARTMENT OF AGRICULTURE, FORESTRY & FISHERIES. 2015. South African Fertilizer market analysis report. Arcadia: Department of Agriculture, Forestry & Fisheries.FARQUHAR J D. 2012. Case Study Research for Business. 1st ed. New Delhi: SAGE.FERTASA see FERTILISER ASSOCIATION OF SOUTHERN AFRICA

FERTILISER ASSOCIATION OF SOUTHERN AFRICA. 2016. Interactive statistics. [Internet: http://www.fertasastats.co.za/pages/index.php; downloaded on 2016-02-20.]

GANAPATHI SL & NANDI SK. 2015. Logistics management. New Delhi, IND: Oxford University Press.

GEORGISE FB, THOBEN KD & SEIFERT M. 2012. Adapting the SCOR Model to Suit the Different Scenarios: A Literature Review & Research Agenda. *International Journal of Business and Management,* 7(6), pp. 1-17.

GRABARA J, KOLCUN M & KOT S. 2014. The role of information systems in transport logistics. *International Journal of Education and Research* 2(1):1-8.

GRAIN SA. 2011. Grain SA fertiliser report. Durban: Grain SA.

HAVENGA JH, SIMPSON ZP, KING D, DE BOD A& BRAUN M. 2016. Logistics barometer South Africa 2016. Cape Town: Stellenbosch University.

IFA see INTERNATIONAL FERTILIZER ASSOCIATION

INTERNATIONAL FERTILIZER ASSOCIATION. 2016. About ferlizer. [Internet: http://www.fertilizer.org/AboutFertilizers; downloaded on 2016-02-20.]

JACOBS A. 2014. Supply Chain Process Management and Performance Measurement. Johannesburg: AJMJ Consultants.

LOUW C. 2011. Structure of the South African fertilizer industry: market concentration, trade and price. Cape Town: Grain SA.

MOSTERT A. 2013. South African fertilizer imports and exports. Pretoria: FSSA .

MYERSON P. 2012. Lean supply chain and logistics management. New York, NY: McGraw-Hill.

SAUNDERS M, LEWIS P & THORNHILL A. 2012. Research Methods for Business Students. 6th ed. Rome: Pearson Education.

STAIR RM & REYNOLDS GW. 2013. Principles of information systems. 11th ed. Boston: Course Technology, Cengage Learning.

STATSSA. 2015. Gross domestic product, 1st quarter 2015. [Internet: http://www.statssa. gov.za/publications/P0441/GDP_First_Quarter_2015_Presentation.pdf; downloaded on 2016-03-27.]

SWINK M, MELNYK SA, COOPER BM & HARTLEY JL. 2013. Managing operations across the supply chain. 2nd ed. New York, NY: McGraw-Hill Irwin.

UCT see UNIVERSITY OF CAPE TOWN

UNIVERSITY OF CAPE TOWN. 2015. Business systems and data: Module 3. Cape Town: Getsmarter.

VAN DER LINDE GJ. 2011. Fertiliser supply and demand in the short and medium term. Durban: Fertiliser Society of South Africa.

WISNER JD, TAN KC & LEONG GK. 2014. Principles of supply chain management: a balanced approach. 4th ed. Boston: South-Western Cengage Learning.