Supply chain-oriented performance measurement for automotive spare parts

Sander de Leeuw*
Department of Economics and Business Sciences
Information and Logistics
Vrije Universiteit Amsterdam
De Boelelaan 1105/3A–33
1081 HV Amsterdam, The Netherlands
and
Windesheim Honours College
Praubstraat 17, 8011 PN Zwolle, The Netherlands
E-mail: sleeuw@feweb.vu.nl
*Corresponding author

Loek Beekman
AP-Logistics B.V.
’s-Gravenlandseweg 379
3125 BJ Schiedam, The Netherlands
E-mail: l.beekman@xs4all.nl

Abstract: Literature provides a number of conceptual frameworks and discussions on performance measurement in supply chains. However, most of these frameworks focus on a single link of a supply chain. Furthermore, there is a lack of empirical analysis and case studies on performance metrics and measurements in a supply chain context. This article provides the results of an empirical study into performance measurement in the automotive spare parts supply chain, with a focus on the dependent channel. We have applied a supply chain performance measurement model called the LogiQual model. We will discuss the types of measures used by companies in the automotive spare parts supply chain and will argue that in the automotive spare parts supply chain performance is, to a certain extent, measured with a supply chain perspective but not completely.

Keywords: automotive; supply chain management; performance management; performance measurement; spare parts; logistics.


Biographical notes: Sander de Leeuw is an Assistant Professor of Logistics at the Vrije Universiteit Amsterdam and is the Head of Studies for the study area of trade, transport and logistics at the Windesheim Honours College, Zwolle, the Netherlands. de Leeuw holds an MSc and a PhD degree in Operations Management from Eindhoven University of Technology, the Netherlands. He has extensive experience in distribution and supply chain management issues.

Copyright © 2008 Inderscience Enterprises Ltd.
both as an academic and as a consultant to international companies. His area of research interest is performance measurement in supply chains and logistics outsourcing, with a particular focus on the automotive industry.

Loek Beekman (1980) is a Logistics Process Analyst at AP-Logistics B.V., a logistics service provider specialising in automotive spare parts distribution and logistics. Prior to joining AP-Logistics B.V., Beekman graduated from the Vrije Universiteit Amsterdam. He holds an MSc degree in Business Administration with specialisation in distribution and logistics. His masteral thesis discussed the possible value-added of single entity performance measurement in the automotive spare parts industry.

1 Introduction

With the growing importance of logistics and supply chain management within organisations, the management of the performance of supply chains is also gaining interest (Gunasekaran et al., 2004; Lohman et al., 2004; Hausman, 2003). Statements such as ‘poor’ or ‘good’ are not sufficient to make an assessment of the effectiveness and efficiency of supply chains. A quantified approach is needed to evaluate the extent to which customer expectations are met or strategic objectives are adhered to. Formal performance measurement is therefore required (Beamon, 1999). Performance measurement is furthermore required to achieve control of processes in a supply chain – at least in part (Gunasekaran et al., 2004). The results of such measurements give insights into the effects of supply chain strategies and they reveal opportunities in the management of a supply chain (Chan, 2003). Literature suggests that performance measurement in a supply chain is not a matter of design per se, but above all a matter of coordination (Lohman et al., 2004). Selection of appropriate performance measures in a supply chain context is therefore crucial (Beamon, 1999). However, the current development state of supply chain management leaves a gap in evaluating the performance of a supply chain as a whole (Chan et al., 2006; Gunasekaran et al., 2001; Holmberg, 2000; Van Hoek, 1998).

There are a number of conceptual frameworks on supply chain performance measurement (Chan et al., 2006; De Toni and Tonchia, 2001). The balanced scorecard (Kaplan and Norton, 1992) is an often cited and popular example (Neely, 2005). However, these frameworks are mostly focused on single links in supply chains (Rafele, 2004). Since a supply chain is a mix of processes that ties chain partners together, performance of one activity within a company may influence the performance of a supply chain as a whole (Rafele, 2004). It is therefore becoming more and more important to focus on the performance of a supply chain as a whole (Gunasekaran et al., 2001; Lambert and Pohlen, 2001). However, there is a lack of empirical analysis and case studies on performance metrics and measurements in a supply chain environment (Gunasekaran et al., 2004).

This article will provide the results of an empirical study into performance measurement in a supply chain context in the automotive after-sales market. We predominantly focus on the manufacturer related dependent channel, though we have verified our findings with an independent spare parts distributor as well. It is our objective to explore what types of measures are applicable to the automotive spare parts
supply chain and to what extent those measurements provide a supply chain perspective on after-sales performance. The automotive industry has been selected because supply chain management is crucial in this industry to create a competitive positioning (Holweg and Pil, 2004). We have focused on the automotive spare parts supply chain owing to its complexity and size (Cohen et al., 2000), the importance of after-sales for the automotive sector (Chieux et al., 2005) and its importance for total automotive profitability (Bijl et al., 2000).

The next section reviews literature on performance measurement in supply chains and discusses the selection of a supply chain performance measurement model for our empirical analysis. We describe a high-level overview of key issues and opportunities in supply chain-oriented performance measurement. For a more detailed overview of measurement models and metrics we refer to Chan et al. (2006) and Gunasekaran et al. (2001). Subsequently, we discuss our research methodology. The key characteristics of automotive spare parts supply chains and the results of our empirical investigation are discussed thereafter and conclusions and implications are reviewed in the last section.

2 Performance measurement in supply chains

2.1 The need for supply chain-oriented performance measurement

A supply chain is generally perceived as a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer (Mentzer et al., 2001). In supply chains, performance measurement is an essential element of effective planning and control as well as decision making (Chan et al., 2003). Successful performance measurement requires a systematic approach in order to support supply chain managers in understanding and improving the performance of supply chain operations (Chan et al., 2006). Organisations need a method to support the creation of such measurement systems. The role of such a method, also referred to as performance measurement system (Beamon, 1999), is to monitor business progress, to monitor the effect of strategies and plans, to diagnose, to support decision making, to guide operations directly and to facilitate motivation and communications (Chan et al., 2006).

Literature often splits performance measurement systems into traditional (cost accounting-based) and non-traditional (broader) methods. Traditionally, performance measures have relied on management accounting systems (Ghalayini and Noble, 1996). Attention was mainly focused on the performance of the operations within the boundaries of one link of a supply chain (Rafele, 2004; Short and Venkatraman, 1992).

These days the challenge of performance management research more and more lies in an interorganisational context (Folan and Browne, 2005; Beamon, 1999; Van Hoek, 1998). In this context, performance measurement not only involves the internal processes but also requires an understanding of other member firms of the supply chain (Lai et al., 2002; Beamon, 1999). However, there is a lack of literature on performance measurement system design in a supply chain context (Chan et al., 2006; Beamon, 1999). Chan et al. (2006) provide a recent literature review of supply chain performance measurement systems. Gunasekaran et al. (2001) provide a comprehensive overview of performance measures in a supply chain context.
Most of the performance measurement systems that focus on a supply chain context actually fail to do so (Chan et al., 2006). They focus on the development of performances measures for an organisation. These systems do not capture the performance of the supply chain in total nor how each organisation affects overall performance (Lambert and Pohlen, 2001). There are several issues with performance measurement in a supply chain context: performance measurement systems lack a balanced approach as they often heavily rely on cost as a primary measure; they are not inclusive and are inconsistent with the strategic goals of the organisation; they lack a holistic or ‘systems thinking’ view and as a result lose the supply chain context encouraging local optimisation (Chan et al., 2006; Lohman et al., 2004; Chan and Qi, 2003; Lambert and Pohlen, 2001; Gunasekaran et al., 2001; Holmberg, 2000; Beamon, 1999).

Few authors take the perspective of a complete supply chain when defining performance measures (Hausman, 2003; Gunasekaran et al., 2001). A generally applicable systematic approach to performance measurement in a supply chain is not yet widely available, mainly because of the specific measurement characteristics required (Beamon, 1999).

### 2.2 Three supply chain performance measurement models

Recently, supply chain performance measurement models have been developed in an attempt to overcome the issues mentioned above. Bhagwat and Sharma (2007) have developed a balanced scorecard with a supply chain orientation. Balanced scorecards cover metrics from four perspectives: a financial perspective, a customer perspective, a business process perspective and an innovation and learning perspective. The work by Kaplan and Norton (1992) has been the most cited reference in the area of performance measurement for a long time and the balanced scorecard is commonly applied in industry (Neely, 2005). Bhagwat and Sharma (2007) have developed their balanced scorecard by following a customer order through the order fulfilment process. Based on this, they propose a number of metrics for each of the four perspectives of the balanced scorecard.

Also the Supply Chain Operations Reference (SCOR) model is a relatively new development that has received considerable attention (Lambert et al., 2005). This model is well applicable to performance measurement in a supply chain context (Holmberg, 2000). The SCOR model includes five business processes and describes each in four levels of detail. It provides support for business process reengineering, benchmarking and best practice analysis (Lambert et al., 2005). The SCOR approach advocates a set of supply chain performance measures composed of a combination of lead time metrics such as product lead time or order-to-cash lead time, cost metrics such as cost per shipment or per warehouse pick, service/quality metrics such as on-time delivery and asset metrics such as inventory levels (Lapide, 2000). A variant of the SCOR model is the model developed by Gunasekaran et al. (2004). That model does not only discriminate between processes but also discerns hierarchical decision levels.

A popular performance measurement model in industry and in literature (Neely, 2005) is the Servqual model developed by Parasuraman et al. (1985). This is one of the best known models for service evaluation (Rafele, 2004). The concept of service quality has been used to develop a supply chain equivalent of the Servqual model called the LogistiQual model (Grimaldi and Rafele, 2007; Rafele, 2004). This model can be used to determine a taxonomy of indicators representing the activities that make up supply chain
processes. In order to create such a hierarchy, basic service elements need to be defined and aggregated into homogeneous groups (‘classes’). Servqual has served as a starting point for defining the main service dimensions. These dimensions have been translated into three logistics service dimensions (Rafele, 2004):

1. **Tangible components** – these concern means and resources applied to the service realisation, such as assets, transport or inventory.

2. **Ways of fulfilment** – these include all manners and significant parameters of carrying out the service, such as flexibility and lead time.

3. **Informative actions** – this dimension adds the communication with the customers about service activities to the model, including marketing and order management.

Together, these three dimensions form a framework to determine the perceived service of a company and to develop detailed metrics. Rafele (2004) provides an overview of relevant indicators for each of these dimensions.

### 2.3 Method selection

When using a balanced scorecard it is important that every partner agrees on every measure in the system and on every change in these measures. Though the balanced scorecard is focused on multiple perspectives, it does not give a guideline with regard to how many indicators are required nor whether the right indicators are applied to check the process. A potential danger of such a method is that too many indicators are defined and that the link between the metric and the company drivers making the largest impact on the company’s performance is subjective (Ittner et al., 2003).

The SCOR and the LogistiQual models are both especially designed for application in a supply chain context and cover relatively similar aspects (Grimaldi and Rafele, 2007). A key difference between the two is that where the SCOR model builds on over 200 metrics, the LogistiQual model has defined a set of key measurement topics and focuses less on individual metrics. These key measurement topics provide a strict guidance, but the model leaves more flexibility in defining the exact metrics as long as they fit within the measurement topics identified. Owing to the more strict guidance in terms of the measurement topics and the fact that it is directly derived from a well-accepted model for measuring service quality, we have selected the LogistiQual model as our model for the empirical analysis in the automotive spare parts supply chain. We will discuss our empirical results based on the three dimensions of the LogistiQual model.

### 3 Research methodology

There is a lack of empirical research in the area of performance management in a supply chain environment (Gunasekaran et al., 2004). The remainder of this article is therefore focused on developing an empirical understanding of what needs to be measured if one were to measure the automotive spare parts supply chain as a whole. We will use the LogistiQual model as a framework for our empirical research. Our goal is not to provide empirical support for relationships but rather to understand the types of relationships that
may exist and to understand which relationships may be valid research objects. As such, an exploratory research approach seems appropriate (Yin, 1994; Eisenhardt, 1999; Johnston et al., 1999).

We investigated companies that play a role in the distribution of spare parts in the dependent channel: importers, distributors and dealers. We have decided to focus our efforts on the dependent channel. We expect that this channel is organised the most consistently and operates in a rather unified way as many aspects of the service channel are driven by the brand owners in the dependent channel (Chieux et al., 2005). We interviewed six dependent importers, one distributor and two dealers. All companies interviewed are part of different brands and are located in the Netherlands. We have researched a mix of European and Asian brands to cover a wide array of practices. Both specialty and volume brands have been included. Afterwards, our conclusions have been checked with an independent automotive parts distributor by means of an interview. Our research therefore provides a perspective on the independent channel as well. Results of this interview are presented in the discussion section.

Data collection comprised both field research and desk research. We have interviewed the employees responsible for after-sales and/or logistics. Telephone conversations have been held afterwards if additional discussion or data was required. We furthermore analysed documents from branch organisations and company reports.

Given the exploratory nature of the research, the interviews were semistructured to allow interviewees to discuss areas that opened up during discussion. Every interview has been based on the LogistiQual model (Rafele, 2004). For every dimension of the model – tangible components, ways of fulfilment and informative actions – the types of performance measures used were investigated. Every respondent was asked to indicate which types of performance indicators are used and why. For each of the three aspects, a potential list of measures was already proposed. Every interviewee also had the option to add measures to the list.

4 Performance measurement in the automotive spare parts supply chain

4.1 Automotive spare parts supply chain overview

The automotive spare parts supply chain contains billions of dollars in inventory, stocked at thousands of locations, with high transportation costs when shipments must be expedited (Cohen et al., 2000). It is estimated that after-sales activities make up about 50% of the profit in the automotive industry (Bijl et al., 2000).

In the automotive spare parts supply chain two different channels can be distinguished: an independent channel and a vehicle manufacturer channel (i.e., dependent channel). The supply chains of both channels are illustrated in Figure 1 (suppliers of raw materials and semifinished products are excluded from this analysis; we start from the assembly of the final product).

The dependent channel starts with the vehicle manufacturers. In the dependent channel, spare parts are directly distributed to main dealers. These dealers are related to a vehicle manufacturing brand. In most cases the main dealers are also the supplier of subdealers (i.e., dealers representing more brands), independent garages, body-shops and for the so-called service chains (Chieux et al., 2005). Both main dealers and subdealers
hold stock. Dealer stock replenishment takes place on average once a week. Every day dealers may place emergency orders for parts that are not on stock but are required urgently for vehicle repairs.

**Figure 1** Spare parts supply chain (see online version for colours)

The independent channel is more complicated. The independent channel starts with Original Equipment Suppliers (OES). OES can supply their parts directly to the vehicle manufacturers or to central buying/wholesale organisations. These central buying organisations can also import parts from other companies. The independent parts distributors can distribute parts to any kind of company (Chieux *et al.*, 2005). Normally, independent garages, service chains and body shops do not hold significant stock. These organisations may receive several parts deliveries every day (Chieux *et al.*, 2005).

4.2 Performance measurement in the automotive spare parts supply chain: background

Saturn, a subsidiary of General Motors in the USA, is often used as an example of a company that has achieved a high level of customer loyalty by focusing on improving service levels to customers (Cohen *et al.*, 2000). There are two main reasons for this success. First, the Saturn spare parts supply chain has been designed in such a way that it matches the urgency or criticality of its customers’ varying needs. Secondly, channel partners play a crucial role in executing the strategy. As a result, Saturn has experienced a significantly higher customer return rate for after-sales service activities than other vehicle brands in the USA (Cohen *et al.*, 2000).
The Saturn example shows that performance of the actual service activities and therefore the performance of spare part supply chains as a whole are directly related to the loyalty of customers (Cohen et al., 2000). Performance measurement has thus become a crucial issue in automotive spare parts supply chains (Chieux and Guillaneuf, 2005; Cohen et al., 2000). From a customer perspective, any performance measure of service should be related to the delay time between coming in for service and the actual repair and pick-up of their vehicle. Speed is crucial in these supply chains as customers require this delay time to be as short as possible (Barkawi and Partners GmbH, 2002). An important metric is therefore the ‘part fill rate’, which measures the fraction of demand for parts that are fulfilled from on-site stock. Other spare parts-related performance measures are ‘product availability’ or ‘availability rate’ (Cohen et al., 2005).

Non-financial performance measures play an important role in the automotive spare parts supply chains. In a recent survey, 67% of the respondents mentioned effectiveness related measures as the most important measures (Saccani et al., 2006). Such measures are mostly related to the time dimension and could consist of, for example, service delivery lead time or delivery lateness.

According to research on spare parts supply chains performed by Barkawi and Partners GmbH (2002), the following seven supply chain-related types of key performance indicators are used by spare parts providers:

1. on-time delivery performance, to requested and committed dates
2. inventory turn rate, stock turnaround time, cycle time, stock turnover
3. average cost per event, movement
4. service level, stock availability, fill rate
5. accuracy of delivery, books, forecasts
6. total inventory, inventory level
7. complaint rate, failure rate, customer satisfaction.

This overview relates to performance measurement in a single link of the spare parts supply chain. However, for improvement of spare parts supply chain management, it is necessary to create a wide scope of control and to develop new approaches for cooperation between supply chain partners (Fortuin and Martin, 1999). Measuring the spare parts supply chain performance as a whole certainly contributes to the creation of such a wider scope. The next section discusses the empirical results of our study into supply chain-oriented performance measurement for automotive spare parts.

4.3 Performance measurement in the automotive spare parts supply chain: empirical results

We interviewed six importers, one distributor and two dealers. All companies interviewed are located in the Netherlands, are part of a dependent channel and represent different brands. One out of the six importer interviews has been omitted in the analysis because of the limited amount of questions that have been answered during the interview. After the interviews, all interview results have been assembled and analysed per aspect (tangible components, ways of fulfilment, informative actions), resulting in three overviews that will be discussed below.
4.3.1 Tangible components

The dimension ‘tangible components’ deals with means and resources applied to the service realisation. This dimension is divided into internal and external assets (such as physical instruments, operative means, handling, warehousing, transport, etc.), personnel aspects and inventory and availability aspects. Figure 2 indicates which types of measures were tracked in the tangible components category.

Out of the three categories in tangible components, the inventory/availability category was considered the most important by all interviewees. All respondents mentioned availability rate as the most important performance measure of tangible components. Availability rate has been defined as the percentage of orders that can actually be delivered from stock upon demand. The importance of the availability rate as a key measure is not surprising, this is in line with Cohen et al. (2005).

A second important measure appeared to be stockouts. Stockouts can be measured by tracking the number of orders delivered out of stock divided by the total number of orders ordered in that same period of time. Respondents indicated that stockout probability and availability rate are strongly related. Parts with high availability have a low stockout probability and vice versa. However, both measures are not fully correlated. If customers predominantly ask for parts that are not in stock, availability may be high overall but the stockout rate is also high.

For the other two categories of tangible components (assets and personnel) the picture was slightly more dispersed. Interviewees argued that these categories are not as important as the first one. However, the impact of incidents was mentioned as an important indicator as it can strongly backfire on the availability rate and on stockouts. The impact of incidents may be measured as the number of order delivery issues divided by the number of order delivery journeys in a certain period of time (Rafele, 2004). These issues may refer to any problem that may occur in a supply chain (e.g., wrong item delivered). It is therefore an indicator of potential problems in delivering the vehicle back to the customer on time. If incidents slow down the delivery process, the chance of the car not being ready within the requested time will increase.
Taking in mind the statements of the interviewees and the fact that the customers are demanding high speed and quality (Chieux and Guillaneuf, 2005), it is not surprising that most performance measures around tangible components are focusing on inventory and availability. Good performance on these metrics significantly contributes to short vehicle repair lead times. Respondents indicated that efficiency, utilisation and productivity are less important than the other types of measures. One of the possible explanations for this could be that in the automotive spare parts business, sales margins are rather high (Chieux et al., 2005). Given the objective to return serviced cars to customers as fast as possible, higher margins enable importers and distributors to execute a service supply chain that is more focused on responsiveness and less on efficiency (Fisher, 1997).

4.3.2 Ways of fulfilment

Indicators to measure the performance of the actual execution of the order to delivery process can be categorised as ‘ways of fulfilment’. There are two categories: supply conditions (such as supply frequency) and service care (such as correctness and completeness), see Figure 3.

Figure 3 Measures for ways of fulfilment (letters a–h each represent a company; x = measured by the respective company) (see online version for colours)

It appears that companies measure much more of this part of the LogistiQual model than of the tangible components dimension. One of the importers even appeared to measure every aspect from this part of the model. It turned out that in this specific case all these indicators were requested by the car manufacturer (this was an overseas manufacturer). In actual practice, the role of this importer concerning after-sales is strictly a coordinating role as the distribution centre is located abroad. A second and third importer measuring nearly all aspects related to ways of fulfilment also experienced a strong manufacturer influence. Interestingly enough, there are also two importers that hardly measure anything in this category (companies B and D). One of these two, company D, is operating a privately owned warehousing and distribution centre within the Netherlands. The distribution process of company D is less influenced by the manufacturer. Compared
to Company C, the distribution centre of D is located close to the customer, which makes it easier to respond to last minute parts requests. Measuring supply conditions was therefore considered not that crucial.

Completeness, correctness and lead time are measured by most respondents and all indicated during the interviews that these measures are very important. Lead time can be seen as an indicator of speed. Correctness and completeness are indicators of quality. As mentioned before, importers, distributor and dealers all state that fast delivery and high delivery quality are the most important elements for ensuring fast vehicle repairs.

4.3.3 Informative actions

Informative actions have a special position in the LogistiQual model. This dimension adds the communication around service between supply chain partners before, during, and after an order to the LogistiQual model. Figure 4 presents the results.

Figure 4 Informative actions (letters a–h each represent a company; x = measured by the respective company) (see online version for colours)

During the interviews, it turned out that companies have difficulties defining performance measures for informative actions. Though interviewees mostly indicated that concrete measures are actually not available, actions that represent this category do take place and are a crucial part of the total service delivery. Informative actions regarding marketing and e-business were indicated as not very relevant. Informative actions with regard to marketing deal with, for example, range completeness and product information. E-business concerns online support and online ordering systems. All interviewees indicated that informative actions concerning after-sales and order management are the most relevant in this category. They argue that informative actions around order management and after-sales contribute to speed and quality of the distribution process. Order management systems enable supply chain partners to follow orders, place orders and check stocks at different locations. The after-sales informative actions mentioned by interviewees concentrate on warranty issues, back orders and customer support. Companies indicated that both after-sales and order management are in fact seen as minimum conditions for managing after-sales activities.
5 Discussion, conclusions and implications

The interviewees indicated they considered the measurement dimension ‘ways of fulfilment’ more important than ‘tangible components’ and ‘informative actions’. All respondents measured more aspects of this dimension than of the other two. This was confirmed in our interview with an independent spare parts distributor afterwards. The independent distributor argued that there is no room for mistakes in the spare parts supply chain given the short delivery lead times and high frequency of delivery to dealers (up to three times per day). Therefore ways of fulfilment measures are the most important.

In the ways of fulfilment category, both the measures related to service care and to supply conditions are equally important according to the interviewees. The most frequently mentioned key measures were completeness and punctuality. Measures related to inventory and availability were considered the most important in the tangible components category. In line with Cohen et al. (2005), it was found that availability rate is a key measure in spare parts supply chains.

This conclusion is not a surprise when considering the key characteristics of automotive spare parts supply chains. Short turnaround times of service activities are key in this business and therefore supply chain activities are oriented towards high off-the-shelf availability of parts (inventory/availability perspective). Furthermore, if parts are not available, short turnaround times for orders (i.e., supply conditions) and complete and correct deliveries (i.e., service care) are essential to have vehicles serviced in the shortest time possible.

Interestingly enough, assets do not play a significant role according to the interviewees. Particularly, utilisation rate, productivity and efficiency were rated less important than inventory and availability-related measures. This can be explained by the focus on responsiveness on the one hand, and the availability of considerable margins on the other hand. Both aspects do not require a strong focus on operational efficiency, at least in the short term. The spare parts supply chain can thus be characterised as a responsive supply chain in terms of the typology of Fisher (1997) and therefore requires responsiveness-related metrics. This seems in line with Saccani et al. (2006) who found that mainly effectiveness oriented measures are used for automotive spare parts rather than efficiency oriented measures. The focus on responsiveness was also confirmed in the interview with the independent spare parts distributor. However, it was argued that assets are becoming more and more important for the independent channel and therefore a change may be expected in the future. A stronger focus on reducing personnel costs was mentioned in particular. This may be related to the fact that the possibility for dealers to order up to three times per day is very expensive. Such high order frequencies may not be necessary for achieving high service levels given the relatively small size of the Netherlands.

All interviewees argued that informative actions with regard to order management and after-sales are essential in spare parts supply chains but these actions are hardly measured. Also the independent distributor we interviewed afterwards agreed that tracking informative actions is relevant. This is the only way to obtain consumer-related information in a structural way. As a result, there is an opportunity to develop measures that focus on these informative actions in spare parts supply chains. Examples of such types of measures could be invoice completeness or backorder quantity.
During the interviews, most companies indicated that their performance information was sufficient except for two aspects: the importers and distributors indicated that there was a need for information about the actual consumer who has a car serviced. This could consist of, for example, information on service history. The dealers, and also the distributor on the other hand, indicated that information about parts availability in other parts of the supply chain could be advantageous. This would imply that a dealer can, for example, see parts availability at central warehouses and maybe also at other dealerships in the vicinity.

One of the questions was to what extent the automotive spare parts supply chain is measured as a whole. In line with the findings of Cohen et al. (2005) there seems to be an agreement about the use of inventory and availability-related measures as key indicators. This was confirmed in our interview with the independent spare parts distributor. Spare parts companies currently seem to measure the supply chain as a whole with regard to this aspect. However, there are also considerable differences between the entities in the supply chain for the other tangible components and in fact all the metrics related to the ways of fulfilment. For these aspects, companies do not seem to measure the supply chain as a whole though most interviewees mentioned that order completeness and correctness combined with lead times are key measures.

The managerial implications are threefold. First of all, both literature and our empirical study suggest that measurements focused on the ways of fulfilment such as order completeness and correctness are universally accepted and important measures in spare parts supply chains. Also, inventory and availability-oriented measures are key measures for all parties involved. On these aspects, companies are well underway to measure their spare parts supply chain as a whole. However, there is a desire in the supply chain upstream towards the manufacturers to know more about consumers. Downstream towards the consumers, there is a desire to know more about parts availability in other sections of the supply chain (at other dealers or in distribution centres). These areas need to be developed as they are currently lacking. Secondly, when designing performance measures on tangible aspects in supply chains, it is important to realise that asset-related measures such as utilisation, efficiency and productivity are not as important as inventory and availability-related performance measures. This is related to the fact that entities in this supply chain focus on responsiveness more than on process efficiency. However, there may be a pressure towards more focus on such efficiency related measures in the future. Thirdly, informative actions and in particular information with regard to after-sales and order management were found to be relevant for all supply chain participants. However, hardly any measures are available in this area. As a result, there is an opportunity to develop new measures for this dimension.

It is clear that a step has been set in the direction of supply chain-oriented performance measurement of automotive spare parts. However, particularly in the area of transparency of links in the supply chain for all supply chain participants as well as the measurement of ways of fulfilment and informative actions there is a need to further develop supply chain-oriented performance measurement.
Supplementary performance measurement for automotive spare parts

Acknowledgements

The authors would like to thank Thomas Chieux of the International Car Distribution Programme and Professor Carlo Rafele and his research group at the Politecnico di Torino for their support during the preparation of the empirical part of their research. Furthermore, the authors would like to thank the anonymous reviewers for their valuable suggestions for the improvement of this article.

References


