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Supply chain best practices – identification and categorisation of measures and benefits

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Abstract

Purpose – This research aims to identify, categorise and compare supply chain measures and benefits listed in literature-based case studies that were named as "best practices".

Design/methodology/approach – The research applies iterative triangulation which is a method used to build theories from existing case studies. Selected case studies collected by project partners are used as a source of secondary data. The paper applies various approaches to classifying supply chains as well as identifying the difference between measures proposed in the literature and those used by case companies.

Findings – The analysis of the selected sample of cases indicated that the most common measures were related to economic aspects and to operational level activities. There is a lack of shared supply chain measures at the inter-organizational level, while social and environmental aspects are largely ignored.

Originality/value – The majority of the measures identified in the collected cases were economic (relating to cost, time, quality and customer). Metrics at an operational level dominate, while supply chain metrics are hardly used. Findings indicate that current performance measurement approaches do not generally include social and environmental issues, which are becoming increasingly important in business.

Keywords Supply chain management, Distribution management, Performance management, Benchmarking, Best practice

Paper type Research paper

Introduction

The paper presents logistics and supply chain (SC) measures derived from a review of the existing supply chain case studies. The authors analysed cases that they classified as supply chain best practices and identified common measures used to reflect performance improvements. Best practices were initiatives that influenced the whole supply chain, its part or key processes. These cases covered a wide variety of functions and processes that could be considered to have an impact on the supply chain, even though some of the cases focussed on internal changes within a single organisation. A practice was named as "best practice" by an independent body, the author of a case, or the journal publisher. The research presented in the paper is part of a larger research project which aims to create a framework for assessing supply chain best practices. The BestLog project (Best Practices in Logistics) was initiated by the European Commission and one of the project goals is the identification and promotion of logistics and supply chain best practices that support EU policies implementation. The authors lead work groups that aim to develop the methodology and criteria for assessing best practices in accordance with EC objectives. The research began with a literature

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review, searching for frameworks, models, measures and metrics already used to measure supply chain performance. The next step was to identify the benefits, measures and performance criteria used by companies in existing "best practices" and comparing these to those suggested in the literature.

Detailed research goals were:

- to classify the benefits and measures used in the cases according to the performance measurement frameworks identified in the literature;
- to find the most common benefits and measures used by organisations and to categorise them accordingly; and
- to identify similarities and differences between the measures listed in the literature and those used in the case studies.

The literature review confirmed that the majority of papers addressing performance measurement in SC are conceptual, not fieldwork based and that there is a lack of field research that identifies the measures used to reflect supply chain performance. Although detailed publications related to supply chain measures are available (for the latest review see: Shepherd and Gunter, 2006), they are mainly conceptual or literature based. Only five of 19 reviewed papers are supported by fieldwork (Angerhofer and Angelides, 2006; Gunasekaran *et al.*, 2004; Holmberg, 2000; Lai *et al.*, 2002; Lohman *et al.*, 2004). Thus, the authors decided to identify which SC measures are used by selected companies. In the research, secondary data and iterative triangulation, which supports theory development based on existing case studies, were used. Instead of primary data, existing case studies were collected. Using existing cases creates an opportunity to analyse secondary data that is available without time consuming and costly fieldwork. It was also necessary due to the tight project schedule. Altogether, 36 cases were collected, from which 17 were selected for this analysis. Rejected cases did not fulfil the quality criteria: the data available were not detailed enough, the case study was still in progress or the case was not based on primary data. Results of the analysis are presented in this paper.

This paper is comprised as follows: the results of the literature review and research methodology are briefly presented, followed by an overview of the collected cases. The main part of the paper is the categorisation of the measures used in the collected case studies according to classification approaches identified in the literature. The final part includes a discussion and recommendations for future research.

Performance measurement and measures in supply chain – literature review

The authors reviewed operations management, operational research, logistics and performance measurement-related academic journals, searching for frameworks, models and lists of proposed, or used, criteria to measure SC performance. The importance of the research topic is justified, as measuring SC performance can improve the understanding and collaboration between SC partners (Brewer and Speh, 2001; Chan *et al.*, 2003) and increase SC integration (Gunasekaran *et al.*, 2001). SC measures can be applied in the decision-making process, helping to define, test and implement new strategies (Chan *et al.*, 2003; Gunasekaran *et al.*, 2001) and other improvement opportunities, such as targetting the most profitable market segments, service differentiation and cost reduction (Lambert and Pohlen, 2001). Apart from providing a

view of the performance of an individual SC member, measurement also offers the possibility of considering the performance of the whole SC and the impact of a single organisation on the whole SC (Lambert and Pohlen, 2001). For the BestLog project, the identification of commonly used measures was required to create a set of criteria to assess best practices. In the literature, various frameworks and models to classify SC performance measures have been proposed:

- plan/source/make/deliver (Gunasekaran *et al.*, 2004; Gunasekaran *et al.*, 2001);
- plan/source/make/deliver/return (Shepherd and Gunter, 2006);
- scorecard approach (Brewer and Speh, 2000, 2001; Bullinger *et al.*, 2002); and
- qualitative and quantitative (Chan *et al.*, 2003; Shepherd and Gunter, 2006).

These frameworks were used to classify the measures identified in the collected cases.

Methodology and case reviews

Iterative triangulation (Lewis, 1998) is used as a structured framework to build theories from existing case studies. Instead of data collected directly from organisations, selected case studies were analysed to develop theories. Although results of the work presented in this paper are not a theory, the application of iterative triangulation creates an opportunity to use a standardised and documented research process for data collection and analysis. This research is based on the positivistic paradigm, as the final aim of the BestLog project is to develop a generic methodology for best practice assessment. The review presented in this section was an important step in the research process. The analysis involved searching for common patterns across disparate studies that were prepared using different data collection methods in different organisational contexts and created for various purposes, but each representing a best practice. Iterative triangulation is recommended in situations where the research topic is novel and underdeveloped, but at the same time a body of relevant literature exists (Lewis, 1998). The authors used the method as a guide for case collection and data analysis. Criteria for case collection were defined and distributed. Project partners completed on-line pre-defined forms where data about cases was collected and then analysed. The research partners searched for existing case studies of supply chain practices that could be defined as "good" or "best" practice. The "good" and "best" practices were listed as such in logistics publications, were awarded such a title at the EU or country level, or were used by the market/industry leaders. The requirements for the case collection encouraged a wide perspective on "supply chain best practice", with the only major caveat being that they had to be a maximum of six years old, in order to avoid the inclusion of outdated initiatives. Therefore, case studies could be published or unpublished and created for academic or teaching purposes. The resulting collection of case studies provided views from different industries and sectors, as well as different points of the supply chain. More than 50 per cent of the collected cases were presented as supply chain improvements, while the remaining practices influenced key supply chain processes, mainly transport and distribution. Over half of the cases were declared as "best practice" by the authors of the published cases or project partners based on their knowledge of the national logistics market. Two cases (ABB, 2005; Frameworx, 2005) were well documented and identified as best practices by the European Logistics Association.

In each of the collected cases, benefits and the measures used to reflect improvements achieved as a result of best practice implementation were extracted. However, in a few situations improvements were listed without any benefit quantification. The authors decided to consider both measures and benefits, as in many situations benefits were possible to quantify, even though their measurement was not always clearly presented in the cases. Identified benefits and measures then were examined and assigned to the categories included in the frameworks derived from the literature. In the literature terms "metrics" and "measures" are used in different ways; exchangeable and without clear differentiation (Gunasekaran *et al.*, 2001; Holmberg, 2000; Lambert and Pohlen, 2001; Shepherd and Gunter, 2006), measures can also be defined as metrics categories (Brewer and Speh, 2000) or solely by the term "metrics" (Kleijnen and Smits, 2003). In this paper term "measures" is used and includes both quantitative and qualitative performance indicators. In the following section the measures assigned to the categories are presented. However, in some cases, the measures were difficult to assign immediately to a particular category. In such situations the project members were consulted and the most suitable category was selected. The authors did not intrude into the measurement process.

Benefits and measures in collected cases

The following sections categorise the benefits and associated measures according to the various measurement frameworks identified in the literature. The identified measures are assigned to the frameworks found in the literature, such as:

- plan/source/make/deliver;
- the Balanced Scorecard; and
- qualitative and quantitative measures categories.

Plan/source/make/deliver

Gunasekaran *et al.* (2004) and Gunasekaran *et al.* (2001) propose three levels of SC measures:

(1) operational;
(2) tactical; and
(3) strategic.

Additionally, measures are grouped into four categories based on the SCOR model. Shepherd and Gunter(2006) use further sub-classifications related to: cost, time, quality, flexibility and innovativeness, using the extended ECOR model with return as one of the top processes. Table I indicates that most of the measures and benefits achieved in the collected cases were concentrated in three areas:

(1) plan;
(2) source; and
(3) deliver.

Only a limited number of cases included links to manufacturing. The cases prepared by Dutta (2002) and Sigurd (2005) were related to manufacturing – but the latter concentrated on a product design process that included planning for transport capacity

Table I. Measures separated into SCOR model groups

Plan	*Strategic cost* Costs – personnel, financial, infrastructure, transport, inventory level, administration and management (Szelerski, 2007; Kuchnia and Domagala, 2007) Payback period (DfT, 2006b) *Time* Order cycle (Jouenne, 2000) *Quality* Customer service level (Jouenne, 2000) Service level (Bukk and Sigurd, 2005)	*Tactical cost* Lost sales (Jouenne, 2000) Transport capacity (Sigurd, 2005) *Time* Stock rotation (Jouenne, 2000) No of stock turnovers (Jouenne, 2000) *Quality* Forecasts reliability (Jouenne, 2000) Incorrect deliveries (Bukk and Sigurd, 2005) Improved planning process (Bukk and Sigurd, 2005)	*Operational cost* Distribution costs reduction (Bukk and Sigurd, 2005)
Source	*Cost* Inventory in transit (DfT, 2004) *Quality* Earlier warnings of anticipated supply problems (GCI, 2001)	*Cost* Return On Investment (ROI) (Frameworx, 2005) Beneficial depot splits (GCI, 2001) Stockholding (%) (DfT, 2004) *Quality* Communication (GCI, 2001) Picking error detection (Mumby, 2006) Clean data (Mumby, 2006) Picking accuracy (Mumby, 2006) Forecast accuracy (GCI, 2001)	*Cost* Cost savings (DfT, 2004) Total costs (DfT, 2004) *Time* Waiting times (% and in £) (DfT, 2004) No of deliveries (%)(DfT, 2004) Transport times (DfT, 2004) *Quality* On-time and scheduled shipments (DfT, 2004) Damage free shipments (DfT, 2004) Collections accuracy (DfT, 2004) Suppliers on-time delivery (ABB, 2005) *Innovativeness* Track&trace visibility (DfT, 2004) Product traceability (Sigurd, 2007) Wastage information by depot (GCI, 2001)

(*continued*)

Table I.

Make/assemble	*Cost* Margin (ABB, 2005) Cash flow (ABB, 2005) *Time* Lead time (Dutta, 2002; ABB, 2005) Total process length design to delivery) (Dutta, 2002) *Flexibility* Response to changes in fashion (Dutta, 2002)	*Cost* Raw materials inventory level (ABB, 2005) *Time* Manufacturing lead time (ABB, 2005)	*Cost* People costs (Dutta, 2002) Manufacturing costs (Dutta, 2002) *Other* Order volume (ABB, 2005) Export volume (ABB, 2005)
Deliver	*Quality* Delivery quality, risk, impact on strategy (Kuchnia and Domagala, 2007) *Innovativeness* Potential access to wider customer base (DfT, 2006c)	*Cost* Operating costs (DfT, 2006c; Frameworx, 2005) *Time* Time-keeping (DfT, 2006a; Jouenne, 2000) On-time delivery (ABB, 2005) Damaged goods (DfT, 2006a) *Flexibility* Flexibility (customers can order only the quantities what they need) (DfT, 2006c)	*Cost* Fuel costs (DfT, 2006c; DfT, 2006b) Cost per roll cage equivalent (RCE) (DfT, 2005) Efficiency (Frameworx, 2005) Productivity (Frameworx, 2005) *Time* Working time (DfT, 2005) *Quality* Pallet control (DfT, 2006a) Proof of delivery control (DfT, 2006a) Inspection failure rate (Frameworx, 2005) *Innovativeness* Information availability (Frameworx, 2005) *Flexibility* Operational flexibility (DfT, 2005; Frameworx, 2005)
Return	*Quality* Returns/refusals by customers (DfT, 2006a)		

Sources: Gunasekaran *et al.* (2004), Gunasekaran *et al.* (2001) and Shepherd and Gunter (2006)

utilisation, so the measures were included in the Plan category. The majority of measures could be classified as operational or tactical (Table I). Only a limited number of benefits were assigned to the strategic category. Where strategic benefits did exist, they were mainly in the Plan category. In the Source and Deliver categories, it could be observed that disproportionately large numbers of measures were at the Operational and Tactical levels (48 measures) in comparison to 21 measures at the Strategic level. Benefits and measures in Table I also are separated into categories used by Shepherd and Gunter(2006):

- cost
- time;
- quality;
- flexibility; and
- innovativeness.

However, it should be noted that on some levels it was impossible to assign measures neatly into just one of these categories. The most common issues that were missing were flexibility and innovativeness. All categories and levels had at least one missing aspect. However, according to Shepherd and Gunter (2006), only the joint usage of all the measurement categories provided a possibility of properly monitoring SC performance.

Scorecard approach

This section presents the benefits reported by the case companies by applying the balanced scorecard (BSC) (Kaplan and Norton, 1992) dimensions: customer, financial, business processes, growth and learning (or innovation). Brewer and Speh (2000, 2001) propose the BSC to measure SC performance. The scorecard approach was also used by Bullinger *et al.* (2002), who separated the measures into the BSC dimensions using three further perspectives within each dimension, from, at the lowest level, the operational perspective, through the process perspective and at the highest level the inter-organisational level SC perspective. Table II lists the measures that were identified from the cases. These findings were in accordance with those of Lambert and Pohlen (2001) who suggested that SC measures were usually a collection of internally oriented logistics measures that do not reflect SC performance. The large majority of the measures were at the operational level, some were at the process level, but there was a lack of SC measures used at the multi-organisational level measuring supply chain performance rather then only organisational performance.

In the cases, only three measures could be classified as SC focussed. i.e. not only at the organisational level, and these were identified in only two cases (Dutta, 2002; GCI, 2001):

(1) faster response to changes in fashion (Dutta, 2002);

(2) total process length (design to delivery) (Dutta, 2002); and

(3) earlier warnings of anticipated supply problems (GCI, 2001).

At the operational level, a long list of measures was identified (Table II). Such a wide variety of measures, which in many cases were related to the same function, could create difficulties in comparing performance between organisations or in sharing the

Table II.
Measures separated into scorecard dimensions

	Financial perspective	Customer perspective	Organisational perspective	Growth and learning perspective
Supply chain perspective		Response to changes in fashion (Dutta, 2002)	Process length (design to delivery) (Dutta, 2002)	Earlier warnings of anticipated supply problems (GCI, 2001)
Process perspective	Payback period (DfT, 2006b) ROI (Frameworx, 2005) Margin (ABB, 2005) Cash flow (ABB, 2005)	Customer service level (Jouenne, 2000) Flexibility (customers can order only the quantities what they need) (DfT, 2006c) Service level (Bukk and Sigurd, 2005) On-time delivery(ABB, 2005)	The order cycle (Jouenne, 2000) Lead time (Dutta, 2002; ABB, 2005) Manufacturing lead time (ABB, 2005) Suppliers on-time delivery (ABB, 2005)	Forecasts reliability (Jouenne, 2000) Potential access to wider customer base (DfT, 2006c) Order volume (ABB, 2005) Export volume (ABB, 2005)
Function perspective	Costs – personnel, financial, infrastructure, trasnsport, inventory level, administration and management (Szelerski, 2007) Lost sales (Jouenne, 2000; DfT, 2006c; DfT, 2006b) Cost per RCE (DfT, 2005) Operating costs (Dutta, 2002) Cost savings (DfT, 2004)M People costs (Dutta, 2002) Manufacturing costs (Dutta, 2002) Distribution costs (Bukk and Sigurd, 2005) Efficiency (Frameworx, 2005) Productivity (Frameworx, 2005) Raw materials inventory level (ABB, 2005) Inventory in transit (DfT, 2004)	Returns/refusals by customers (DfT, 2006a; Jouenne, 2000; DfT, 2006a) No of promotions (Jouenne, 2000) Collections Accuracy (DfT, 2004) Proof of delivery control (DfT, 2006a) Incorrect deliveries (Bukk and Sigurd, 2005) On-time and scheduled shipments (DfT, 2004) Damage free shipments (DfT, 2004) No of deliveries (%) (DfT, 2004)	Empty running (DfT, 2006a) Fleet size (Bukk and Sigurd, 2005; DfT, 2005) Total distance travelled (DfT, 2004; DfT, 2005; DfT, 2006c) Fuel consumption (Blinge and Swensson, 2006; DfT, 2004) Total fuel used (litres) (DfT, 2006) No of stock turnovers (Jouenne, 2000) Number of out-of-stock (Jouenne, 2000) Stock rotation (Jouenne, 2000) Truck fill rate (DfT, 2004, 2006a; Jouenne, 2000; Sigurd, 2005) Capacity utilisation (Bukk and Sigurd, 2005) Vehicle avg. utilisation per mile (%) (DfT, 2005, 2006c)	No of drivers educated in eco-driving, traffic safety working environment and health issues (Blinge and Swensson, 2006) RFID reading rate (Mumby, 2006) Clean data (Mumby, 2006) Communication (GCI, 2001) Forecast accuracy (GCI, 2001) Wastage information by depot (GCI, 2001) Product traceability (Sigurd, 2007) Track&trace visibility (DfT, 2004) Information availability (Frameworx, 2005)

(*continued*)

Financial perspective	Customer perspective	Organisational perspective	Growth and learning perspective
		Pallet fill (Jouenne, 2000) Transport capacity (Sigurd, 2005) Vehicle time utilisation (DfT, 2004) Total vehicle and driver hours (DfT, 2006c) No of urgent orders (Jouenne, 2000) Avg load size (DfT, 2006a) Drops per load (DfT, 2006a) Avg drop size (DfT, 2006a) Damaged goods (DfT, 2006a) Pallet control (DfT, 2006a) Back-loads level (DfT, 2006a) Avg weight-based factor (DfT, 2006a) Avg of total journey run empty (%) (DfT, 2006c) Productivity (% in regard of oil per km) Reduction of staff (Bukk and Sigurd, 2005; DfT, 2006c) Less stressful work for planners (Bukk and Sigurd, 2005) Operational flexibility (DfT, 2005; Frameworx, 2005) Working time (DfT, 2005) Transport times (DfT, 2004) Stockholiding (%) (DfT, 2004) Waiting times (% and in 3) (DfT, 2004) Inspection failure rate (Frameworx, 2005)	

Source: Bullinger *et al.* (2002)

Table II.

measures with business partners. The variety of measures identified in the cases suggests a lack of performance measurement standardisation among SC members, which was also indicated by Brewer and Speh (2001). However, there were some cases where the companies used the same measures, such as those prepared by the Department for Transport (DfT, 2005, 2006c). There was a lack of measures that concentrated on inter-organisational supply chain performance. When looking at the BSC perspectives (Table II) it was possible to see that the measures mainly related to an organisational perspective. The majority of cases covered internal organisational issues and internal, not inter-organisational, processes. Inter-organisational measures, such as supply cycle efficiency (Brewer and Speh, 2001) or total SC inventories, revenue or costs (Bullinger *et al.*, 2002) were not used in the cases.

There was a low level of customer related measures and benefits. Even when they did not exist, they tended to be focused on the operational perspective, with only a single measure – faster response to changes in fashion, listed in the case (Dutta, 2002) at the SC level, and with a limited number of measures at the process level in only three cases ((Bukk and Sigurd, 2005; DfT, 2006a; Jouenne, 2000):

(1) level of customer service (Jouenne, 2000);

(2) service level (Bukk and Sigurd, 2005); and

(3) flexibility (customers can order only the quantities what they need) (DfT, 2006a).

In the financial dimension, the majority of benefits and associated measures considered cost issues, and reported reductions in different cost categories, as opposed to increases in sales. In most cases, the actual information relating to the level of financial investment required to achieve reported savings was missing. This was linked to the lack of other documented financial measures, such as ROI and payback period. The exceptions were DfT (2006c), which gave an example of the payback period calculation, and Frameworx (2005) that presented the financial results for a warehousing system implementation. In all cases any shared financial SC measures, such as total cash flow, were absent.

Similarly, there were few measures relating to growth, learning and innovativeness. Despite the growing importance of IT usage, reflected by growth and learning perspective, the cases collected by the project partners did not generally reflect such a trend, with one exception, (Frameworx, 2005), which limited access to potential measures used to reflect growth, learning and innovativeness. Apart from one case (Blinge and Swensson, 2006.), measures relating to education and skills improvement were also absent. The main concentration on innovation was at the operational perspective, with only two measures at the process level being identified in cases (DfT, 2006a; Jouenne, 2000):

(1) forecast reliability (Jouenne, 2000); and

(2) access to wider customer base (DfT, 2006a).

Qualitative and quantitative approach

Chan *et al.* (2003) separated measures into two major categories, those that can be directly presented as numbers (quantitative), and those that cannot (qualitative), but that could be to some extent quantified. Table III reflects such an approach. In this

Qualitative	Quantitative
Customer service level (Jouenne, 2000)	*Based on costs:*
Flexibility (customers can order only the quantities what they need) (DfT, 2006c)	ROI (Frameworx, 2005)
Service level (Bukk and Sugurd, 2005)	Payback period (DfT, 2006b)
Operational flexibility (DfT, 2005; Frameworx, 2005)	Margin (ABB, 2005)
Forecasts reliability (Jouenne, 2000)	Cash flow (ABB, 2005)
Potential access to wider customer base (DfT, 2006c)	Costs – personnel, financial, infrastructure, transport, inventory level, administration and management (Szelerski, 2007)
Communication (GCI, 2001)	Fuel costs (DfT, 2006c, b)
More consistent approach to business planning (GCI, 2001)	Cost per RCE (DfT, 2005)
Clean data (Mumby, 2006)	Operating costs (DfT, 2006c; Frameworx, 2005)
Earlier warnings of anticipated supply problems (GCI, 2001)	Cost savings (DfT, 2004)
Better forecast accuracy (GCI, 2001)	People costs (Dutta, 2002)
Product traceability (Sigurd, 2007)	Manufacturing costs (Dutta, 2002)
Track&trace visibility (DfT, 2004)	Distribution costs (Bukk and Sigurd, 2005)
Less stressful work for planners (Bukk and Sigurd, 2005)	Raw materials inventory level (ABB, 2005)
Wastage information by depot (GCI, 2001)	Lost sales (Jouenne, 2000)
Information availability (Frameworx, 2005)	*Based on customer:*
Inspection failure rate (Frameworx, 2005)	Order volume (ABB, 2005)
	Export volume (ABB, 2005)
	Returns/refusals by customers (DfT, 2006a)
	Response to changes in fashion (Dutta, 2002)
	No of promotions (Jouenne, 2000)
	Incorrect deliveries (Bukk and Sigurd, 2005)
	Lead time (Dutta, 2002; ABB, 2005)
	Order cycle (Jouenne, 2000)
	Provide on-time an scheduled shipments (DfT, 2004)
	Collections accuracy (DfT, 2004)
	Proof of delivery control (DfT, 2006a)
	Improved time-keeping (DfT, 2006a; Jouenne, 2000)
	No of out-of-stock (Jouenne, 2000)
	Total process length (design to delivery) (Dutta, 2002)
	Damage free shipments (DfT, 2004)
	Inventory in transit (DfT, 2004)
	Based on productivity:
	Empty running (DfT, 2006a)
	Vehicle time utilisation (DfT, 2004)
	Vehicle avg. utilisation per mile (%) (DfT, 2005)
	Total distance travelled (DfT, 2004, 2005, 2006c)
	Truck fill rate (DfT, 2006a; Jouenne, 2000; Sigurd, 2005)
	Pallet fill (Jouenne, 2000)
	Avg. of total journey run empty (%) (DfT, 2006c)
	Avg. vehicle utilisation per mile (%) (DfT, 2006c)
	Capacity utilisation (Bukk and Sigurd, 2005)
	Productivity (% in regard of oil per km) (Bukk and Sigurd, 2005)
	Efficiency (Frameworx, 2005)
	Productivity (Frameworx, 2005)
	No of stock turnovers (Jouenne, 2000)
	Drops per load (DfT, 2006a)
	Minimum fill target (80%) (DfT, 2004)
	Efficient transport capacity (Sigurd, 2005)
	Stockholding (%) (DfT, 2004)
	Stock rotation (Jouenne, 2000)
	No of deliveries (%) (DfT, 2004)
	Manufacturing lead time (ABB, 2005)

Table III.
Qualitative and quantitative measures

table, the quantitative measures were also split into three factors: cost, customer responsiveness, and productivity. Categorisation of the measures according to a qualitative and quantitative split was also used by Shepherd and Gunter (2006). Quantitative measures dominated the collected cases (Table III). However, unlike in the literature (Beamon, 1999; Bullinger *et al.*, 2002; Holmberg, 2000), financial measures were not the major category. The most common measures were productivity measures, such as utilisation, productivity or distance. This could be related to the fact that the benefits focused on the operational level. The qualitative measures that were identified were related to the customer service level, flexibility, information access and quality. All these aspects are largely intangible; data are difficult to capture; and there is a lack of standard approaches to measuring qualitative benefits.

Other benefits and measures

Within the cases, benefits and measures were also identified that were not included in the reviewed literature. The authors separated them into environmental and social dimensions.

Environmental

Some benefits and associated measures that could be classified as environmental were identified in four case studies (Blinge and Swensson, 2006; DfT, 2004, 2006a, 2006c):

(1) Fuel consumption (Blinge and Swensson, 2006; DfT, 2006c).

(2) Road congestions (DfT, 2006a).

(3) CO_2 produced per litre delivered (grams) (DfT, 2006a).

(4) CO_2 emission (per cent or in tons) (Blinge and Swensson, 2006; DfT, 2004, 2006a).

The environmental group of measures focused on lowering the negative impact of transport on the natural environment. It is possible to see that CO_2 emission was listed in three cases (Blinge and Swensson, 2006; DfT, 2004, 2006a) and is the most common measure.

Social

The least common group of issues were those that could be classified as social, and these were identified in cases Bukk and Sigurd (2005) and Dutta (2002):

- number of drivers educated in eco-driving, traffic safety working environment and health issues (Blinge and Swensson, 2006);
- less stressful work for planners (Bukk and Sigurd, 2005);
- no of employees who work in EU (Dutta, 2002); and
- per cent of production in EU (Dutta, 2002).

Conclusions

The majority of the measures used in the collected cases were economic (relating to cost, time, quality and customer). However, the review of the cases also resulted in a list of measures and benefits that could be classified as social or environmental. In fact, in some case studies the category of environmental benefits as suggested by Blinge and

Swensson (2006) and DfT (2006a) was used. Findings indicate that current performance measurement approaches do not generally include social and environmental aspects and are concentrated on economic aspects, not on sustainable development. The benefits and measures listed in the cases can be classified into strategic, tactical and operational. A minority of the benefits and measures were assigned to the strategic group relating to long-term performance and competitive advantage. Most cases concentrated on improvements in operations and individual processes rather than on a supply chain. The focus on a single organisation was clearly visible when the scorecard perspectives were considered. Classifying measures according to BSC and SC/process/function perspectives (Table II), it is possible to see the dominance of measures from a function perspective (over 70 measures identified), while measures at a SC level are lacking (three measures only). Quantifiable productivity benefits or softer customer service benefits at the organisational level dominated the cases. As might be expected, commercially sensitive financial measures were not made public.

According to Holmberg (2000) measures were designed to monitor organisational strategy implementation that result in a focus on the internal, not on the SC perspective The problem of performance measurement not being related to strategy has been well documented (Beamon, 1999; Bullinger *et al.*, 2002) and it seems that the case companies are no exception. Strategic measures relating to financial aspects, such as cash flow and ROI were missing in most cases, as well as measures linked to SC relationships and buyer-supplier partnerships. At the tactical level, measures mainly reflected performance in dyadic relationships, without taking into consideration more than two supply chain partners.

The majority of cases presented benefits achieved, or planned, however not all the cases measured and quantified the benefits. It was often not clear how and when benefits were measured, and what measures were used to quantify them.

In summary, the major issues that arose from the analysis of the collected best practices were:

- A supply chain dimension was lacking. The cases concentrated mainly on internal issues at a company level, not on the whole supply chain. (In the cases only three measures were identified that reflected supply chain performance).
- Operational benefits dominated, while the strategic impact was often ignored. (In six cases of 17, strategic benefits were not listed.)
- Economic benefits dominated, while social and environmental aspects were often ignored.
- There was a lack of consensus regarding the measures used, so there was a lack of common measures.

Measure categorisations suggest that the supply chain measures used by the case companies are largely operational and inwardly focused. Even within similar cases, a variety of measures were used that could create problems in benchmarking organisational and SC performance, when benchmarking a set of commonly used and accepted performance indicators was required, at least among SC partners. This suggests the need for metrics standardisation and for the identification of key measures that could be shared between SC members. With regard to the project goal, of

identifying measures for best practice assessment, there is a need to extend beyond economic measures, to include social and environmental criteria. Such criteria are increasingly important to develop sustainable business practice, and are incorporated within EU and national policies. With regard to the frameworks used to classify the measures, it was relatively easy to group measures into BSC dimensions, as well as into qualitative and quantitative categories. There was difficulty in assigning measures into the SCOR model, as the model is designed for commercial organisations to be applied from a focussed company perspective, SCOR was not developed to reflect the whole supply chain. A single company could easily identify planning, sourcing, making or delivery and related measures. However, from an external view point, such an approach would be difficult. For example, should measures related to sourcing and planning in a manufacturing company be classified, as sourcing, planning or making? Similar problems occur with planning in a distribution company. This suggests that applying the SCOR model to performance measurement also requires additional indicators that place the company in the SC, for example defining the company's core activity (manufacturer, retailer, etc.). Without understanding where the organisation is located within the supply chain, it could be problematic to define common measures used at various supply chain areas, as there may be differences between companies.

The issues highlighted above require additional research. The researchers acknowledge some limitations in the selected approach. Secondary data were used, so other additional measures could be applied within the organisations, but not be listed in the collected cases. Additionally, the authors assigned measures into different groups and categories, while it is not known how measures may have originally been grouped by the organisations themselves. As the analysis was based exclusively on secondary data, existing supply chain performance measurement systems could be examined, to find out what measures are used in practice. The authors did not consider how the data required for measurement should be captured.

The literature is rich in theoretical approaches to supply chain performance measurement, but at the same time there is a lack of empirical research, both qualitative and quantitative. Fieldwork data availability will provide the opportunity to verify theoretical concepts from the literature and to create frameworks that can be proposed as practical tools to measure performance across the supply chain. Future research could cover an in-depth study of a single supply chain, as well as a comparative analysis of measures in use between various chains as there might be differences across industries and supply chain models.

Researchers and practitioners investigating supply chain measures should remember to consider not only the economic, but also the social and environmental aspects.

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