Mind the perception gap

An integrative performance management framework for service supply chains

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Received 30 September 2017
Revised 21 April 2018
22 July 2018
27 August 2018
Accepted 1 September 2018

Abstract

Purpose – A perception gap refers to the differences in perception among the stakeholders regarding any aspect of the supply chain relationship. The purpose of this paper is to investigate the perception gap among service supply chain partners relating to the relative importance of key performance indicators (KPIs) and the association of this gap with service performance.

Design/methodology/approach – This paper presents an integrative framework that combines statistical methods and data envelopment analysis for computing perception and performance gaps, and for identifying the association between the gaps. The study follows a middle-range theorizing research approach where general inferences are induced from instances, and a theory can be developed from the observation of empirical reality.

Findings – Analysis of data from a leading global insurance service supply chain suggests that perception gap exists and can be recognised as a factor associated with performance gaps. The results suggest that the perception gap not only affects performance but can also be tracked as a meta-KPI to improve performance throughout the service supply chain.

Practical implications – The key implication of the presented research is that service companies can identify and resolve the differences in perceptions regarding the importance of the KPIs, by methodologically computing the gaps and tracking them as meta-KPIs.

Originality/value – The study extends the theoretical boundary of supply chain performance management by introducing the perception and performance gaps as novel meta-KPIs. These meta-KPIs can be computed through the integrative framework developed in the study.

Keywords Data envelopment analysis (DEA), Service supply chain, Perception gap, Integrative performance management, Key performance indicators (KPI), Middle-range theorizing (MRT)

Paper type Research paper

Introduction

In the service industry success often favours those who deliver higher performances and value in the eyes of their buyers (i.e. partners and/or end-consumers). The performance of the delivered service, however, may not always meet the expectations of the buyer, or the service quality may be evaluated differently by the supply chain partners, leading to a performance shortfall in both cases. In addition, the importance attributed to a key

The authors sincerely thank the guest editors and the five anonymous reviewers for their careful reading, critical comments and valuable suggestions. The authors thank the case study partner for initiating the joint industry project and providing information, data and continuous support throughout the study. The authors also thank the respondents at the suppliers and at the buyer for participating in the survey and supporting the study.

International Journal of Physical Distribution & Logistics Management
Vol. 49 No. 1, 2019
pp. 33-51

0960-0035
DOI 10.1108/IJPDLM-09-2017-0302

performance indicator (KPI) by one supply chain partner may be significantly different than how the other partner(s) view the same KPI. In other words, the prioritisation of and weights given to KPIs may not be the same for all supply chain partners. This gap is referred to as the perception gap in the current presented study.

Perceptions involve the subjective response of people to a situation and therefore may be inconsistent with the reality or perceived reality of the supply chain partners. The relative importance given to different KPIs can be expressed in the form of KPI rankings or KPI weights. The focus of the presented study is the perception gap regarding service supply chain KPIs and the association of this gap with supply chain performance. Perception gap, in the context of this research, refers to the differences that the supply chain partners perceive regarding the importance of various KPIs. Performance gap, on the other hand, refers to a gap between supply chain partners regarding their evaluations of the delivered performance based on the used KPIs.

While there is extensive literature on the various KPIs that may be used (Asian *et al.*, 2009; Somarin *et al.*, 2016, 2017; Rezaei Somarin *et al.*, 2018), much less attention has been paid to what could be done if KPI prioritisation is not homogenous along the supply chain (He *et al.*, 2017; Ataseven and Nair, 2017). Earlier academic research (Morssinkhof *et al.*, 2011; Kant and Dalvi, 2017), as well as industry research (EyeForTransport, 2012), has shown that performance-related attributes can be weighed differently by different stakeholders, but those studies have not investigated the perception gap between the partners in a buyer–supplier relationship.

This research is motivated mainly by earlier empirical findings that KPI influenced perception gaps exist in three levels of a service supply chain. For any service supply chain echelon between two tiers composed of several suppliers (tier) and single buyer (tier), the perception gaps can be illustrated and framed by a three-level gaps model (Lu *et al.*, 2014), which is illustrated in Figure 1.

The Level-1 perception gap represents the perception difference between the supplier and the buyer regarding what will be delivered and at what level of standard. The Level-2 perception gap represents the perception differences between the various suppliers in the same tier of what they are supposed to deliver. Finally, the Level-3 perception gap represents the perception difference between the various employees within the same supplier or buyer.

Given the importance placed by the case study partner (a leading UK-based insurance service corp.) upon the supplier–buyer relation, the focus of this research is placed on the Level-1 perception and performance gaps, namely, the gaps between the buyer and its suppliers. While client prioritisation was the prime motivator, it is also notable that Level-1

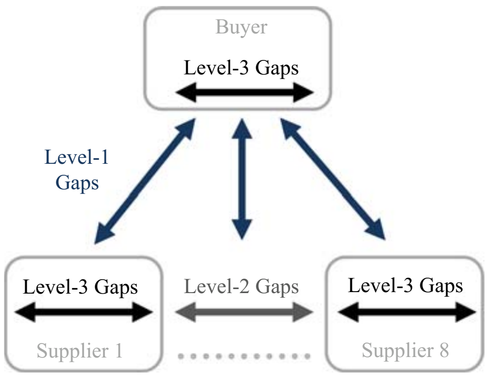

Figure 1.
Three-level perception gaps model

is the level that has received the most extensive research interest, as evidenced by the vast literature on the topic (Beske-Janssen *et al.*, 2015; Gunasekaran *et al.*, 2015; Wei *et al.*, 2018). The presented methodology, nevertheless, can be extended to cover gaps at other levels of the dyadic supply chain, namely, Levels 2 and 3, as well.

Existing literature confirms that both the perception and the performance gaps potentially exist at every stage of the service supply chain (Lu *et al.*, 2014). However, there exists no empirical research that investigated the methodological computation and extent of perception gaps. There also exists no research (with the exception of Lu and Ertek, 2015) on how such gaps may be associated with the performance of service supply chains and any resultant performance gaps.

To fill this research gap, it is intended to explore the topic through a novel perspective and innovative propositions. While the presented research is based upon a general theory of supply chain management that general theory has not yet extended to the performance and perception gaps in service supply chains. The methodology that is adopted to overcome this challenge is middle-range theorizing (MRT), which is attracting a growing interest in the supply chain management literature (Craighead *et al.*, 2016; Pellathy *et al.*, 2018). Specifically, the present research demonstrates how MRT can be used to extend current knowledge on supply chain performance measurement and improvement. Following the methodology of Stank *et al.* (2017), an analytical framework that integrates data envelopment analysis (DEA) and statistical methods is developed. The framework can enable supply chain partners to overcome challenges by systematically identifying and managing the perception and performance gaps.

DEA is a highly effective and applicable methodology that can be implemented to benchmark a group of entities through efficiency scores (Cooper *et al.*, 2006). In this study, DEA is used as the primary analytical tool for reducing the dimensionality of supplier performance evaluations. The principal motivations for using DEA in the study were the capabilities of DEA in reflecting input–output relationships and in obtaining single-dimensional evaluations (efficiency scores) from multi-dimensional data.

The objectives of this paper are threefold: first, to investigate the existence of perception and performance gaps along the supplier–buyer interface; second, to examine the association between the perception gaps and the performance; and, third, to construct an integrative framework that factors-in the perception gap into service supply chains and measures them through meta-KPIs.

The rest of this paper is organised as follows. Next, a brief review of the relevant literature as the background for conceptual development, with an essential discussion leading to hypotheses propositions, is provided. The third section illustrates the introduced framework and discusses the sampling frame, the data collection and the selection of the analytical methods. The fourth section presents the analysis results as the framework is applied on the described case study and tests the proposed hypotheses. The fifth section addresses the managerial implications, draws conclusive remarks from the research and outlines areas for further research and exploration.

Literature review

The literature begins with the introduction and discussion of supply chain performance management and supply chain KPIs. Then the literature related to performance gaps, perception gaps and the joint discussion of the two gaps is reviewed. Finally, the key contributions of the presented research are highlighted and the research hypotheses are proposed.

Key performance indicators (KPIs)

Performance measurement is a critical concept and practice in SCM for assessing both the internal performance of a company, as well as that of its supply chain partners (Ntabe *et al.*, 2015; Beske-Janssen *et al.*, 2015).

For decades, significant research interest has focussed on designing KPIs for supply chain performance measurement and the integrated performance management systems (PMS) that incorporate KPIs (Holmberg, 2000; Gunasekaran *et al.*, 2004; Della Bruna *et al.*, 2014; Sanchez *et al.*, 2017). Hazen and Byrd (2012) suggest that integration of the PMS within the information systems of the supply chain partners can enhance performance in various dimensions.

Gunasekaran *et al.* (2015), in a seminal work on supply chain PMS, develop a taxonomy of KPIs in the supply chain at the three stages of outsourcing, namely, the pre-outsourcing, during-outsourcing and post-outsourcing. Giannakis (2011) argues that key processes in service operations are different than those in production operations and, thus, KPIs for service supply chains should be designed differently than those for product supply chains. A full list of carefully selected KPIs can be found in the service-oriented reference model of Giannakis (2011).

In the research project, the selection of the KPIs was one of the important milestones, as the progress and validity of the research would depend on the validity of the KPIs initially selected for the research. KPIs in the research were developed through the synthesis of the five performance objectives (quality, speed, dependability, flexibility and cost) identified by Slack *et al.* (2009), and the model of service excellence described by Johnston (2004). All the selected KPIs have their counterparts within the taxonomy of performance metrics demonstrated by Gunasekaran *et al.* (2015), and can be mapped to the service KPIs listed under Giannakis (2011) and other similar studies (Psomas and Jaca, 2016).

Performance gaps

Gap analysis is an approach for quantifying the expectation gap, which is the difference between the expected performance and the observed performance. Polyakova and Mirza (2015) present a comprehensive review of research on perceived service quality and on the subsequent gap analysis.

Apart from Lu *et al.* (2014) and Lu and Ertek (2015), performance falling short of expectations (i.e. expectation gap) has been the primary topic of the literature on performance gap analysis.

Following the terminology of Lu *et al.* (2014), in current research, performance gap – as an alternative to the expectation gap – refers to the gap between the evaluations of performance with regards to the used KPI. The expectation gap concept, which is the focus of gap analysis (Brady and Cronin, 2001), is very similar in nature to the concept of performance gaps examined in the current research. Although both expectation gap and performance gap refer to the discrepancy between what was delivered compared to what was expected, there is a meaningful difference which sets the central focus of this study. While an expectation gap is defined as the difference between what one party (e.g. the buyer) expects and receives, performance gap addresses the disparity between what two different supply chain partners believe was delivered.

Perception gaps

There exists limited research that directly explores the effects of sharing attribute weights with suppliers in purchasing (Morssinkhof *et al.*, 2011). The mentioned stream of research, however, does not investigate the gap between the weights of KPIs, which is referred to as the perception gap in this paper.

The existence of perception gaps regarding service KPIs has been, first, illustrated in Lu *et al.* (2014) and Lu and Ertek (2015). Mohamad *et al.* (2009) investigate the sourcing priorities of different types of companies in the UK, showing that gaps exist with respect to which KPIs are to be prioritised. Kant and Dalvi (2017) provide a detailed list of the supplier evaluation KPIs from 34 automotive industries, while also providing a popularity ranking of these KPIs according to collected survey data. Sanchez *et al.* (2017) analyse how supply chain partners perceive their counterpart's use of PMS and how this perception affects their own use of similar systems. Maestrini *et al.* (2018) present the lifecycle of a collaborative PMS and suggest incorporating the importance of KPIs into a PMS.

In addition to the research studies reporting empirical support for the perception gaps, Gunasekaran *et al.* (2015) acknowledge the fact that the importance of performance measures may significantly vary, and incorporate this heterogeneity into PMS development. Resolving these gaps, or in other words, harmonising the perceptions regarding the importance of KPIs between the supply chain partners, can contribute to supply chain alignment and integration (Asian and Nie, 2014; Brekalo and Albers, 2016; Lu *et al.*, 2017; Paul *et al.*, 2017). Yet, one critical roadblock to resolving perception gaps lies in the question of how to quantify them. In this paper, a novel integrative framework is presented and measurement of the differences in supply chain partners' perception regarding the importance of KPIs is demonstrated.

The existence of perception gaps and performance gaps calls for the research question of whether these gaps are associated. Empirical evidence for the existence and level of association between the perception gap and the performance gap has been previously investigated by Lu and Ertek (2015). The authors conclude that such an association indeed exists and can also be systematically identified. They also suggest that the perception gaps can be potentially reduced to an insignificant level through collaborative efforts, such as information sharing (Sharifkhani *et al.*, 2016), leading to performance improvements along the supply chain.

Key contributions

A survey of the literature survey shows that, despite the extensive literature coverage on a whole range of factors that might affect the supply chain and logistics performance, one topic seems to have been largely excluded from the principal research scope – that is, the perception gap vs performance gap. A critical question, therefore, is how practitioners and researchers can systematically determine the degree of each of above-mentioned gaps, and their related degree of association. This quest becomes especially challenging when the gaps need to be computed based not on a single evaluator, but instead on the subjective evaluations of multiple stakeholders.

This research addresses above critical issues and can be distinguished from the existing literature in several aspects:

(1) Rather than focussing on and managing performance expectations, this study focusses on perceptions regarding the importance of KPIs, with an objective of reducing perception and performance gaps. The presented approach is similar to yet different than Mohamad *et al.* (2009), who investigate sourcing priorities. The study uses the perceptions of both the buyer and supplier, whereas Mohamad *et al.* (2009) focus only on the perceptions of the buyer. Similarly, Kant and Dalvi (2017) model only the buyers' perspective, whereas the presented research integrates the perspectives of both the buyer and its suppliers.

(2) In comparison to the literature on supply chain performance measurement, as well as that addressing expectation gap and gap analysis, the presented study focusses specifically on the importance (in the form of weights) given to KPIs and performance evaluations by adjacent supply chain partners for the same KPIs.

(3) As a unique contribution to this stream of research, the study offers a novel integrative framework that provides the specific steps on how to compute the perception gaps and performance gaps, along with the associations between them. While there is extensive literature on the application of DEA for supplier performance evaluation (Ertek *et al.*, 2012; Liu *et al.*, 2013; Marchet *et al.*, 2017), this research is the first to use DEA in the context of performance gaps analysis.

Motivated by the gaps discovered in the literature review, the following research hypotheses are proposed and validated:

H1. Perception and performance gaps exist between the buyer and the supplier.

H2. Perception gap values at the (supplier, KPI) granularity correlate with performance gap values based on individual KPIs. In short, performance gap correlates with perception gap.

H3. Performance gap still exists when multi-dimensional evaluations are reduced to the single dimension of efficiency score.

H4. Correlation between perception and performance gap can be higher for some KPIs.

Methodology

This section begins with a discussion of the business problem that motivated this research, including a description of the sample and the collected data. Then the key tools and methods that are used in the study, including DEA and statistical methods, are discussed. Finally, the proposed analytical framework, with specific taken steps, is explained.

Problem description and sample

In 2016, the total insurance premium volume in the UK, the largest insurance market in Europe and fourth largest in the world, was about £225bn. In total, 74 per cent of households in the UK purchased motor insurance in the same year, making it the most widely held type of general insurance product (ABI, 2017). In 2016, the gross written premiums for the private motor insurance market in the UK was £12.2bn, with an annual growth of 12.4 per cent (Business Insider, 2017).

A leading global insurance service corporation, based in UK, has launched a world-class assessment programme, with the aim of improving the company's business excellence and market competitiveness. The scope of the programme was the entire supply network, including the service supply chain. As a project within the programme, a section of the company's motor insurance business, which will henceforth be referred to as the "Motor-Insurer", was analysed. The term "Motor-Insurer" used in this research refers to the motor insurance branch of the corporation. The Motor-Insurer (the buyer) in the case study serves the "motor-insured" (end customers) and buys service from a variety of suppliers through contract. The processes of a Motor-Insurer are coherent with the service processes reference model of Giannakis (2011), and thus a Motor-Insurer is a representative sample of a buyer in a supply chain.

Working with the senior management team of the Motor-Insurer (the buyer), eight key suppliers of the Motor-Insurer and the Motor-Insurer were identified as the respondent-base. To respect confidentiality, the suppliers are coded in this paper as suppliers 1–8. The suppliers – which include motor dealers, body shops, collision repair shops and electrical testing services – offer a variety of services and products. They were selected based on the highest relevance and appropriateness for the research questions. Considering a Pareto pattern (Grosfeld-Nir *et al.*, 2007) and the suppliers' size and relationship to the Motor-Insurer (the buyer), these suppliers are the crucial first-tier service suppliers.

To set up the survey for the research, key contacts at the buyer and eight suppliers were asked to instruct their staff at all levels of the organisation to complete a simple online questionnaire. Altogether, 87 respondents from the buyer and 120 respondents from the eight suppliers responded to the questionnaire[1]. The number of respondents participating from each company is shown in Table I. The respondents were selected by the contacts based on direct involvement in service supply chain processes and have sufficient experience to be able to provide both quantitative evaluations and open-ended textual feedback.

The sample has the qualities listed in a study by Särndal *et al.* (2003), which describes the qualities of an ideal sampling frame. It is organised in a logical, systematic fashion and every element of the population (from both the buyer and the suppliers) is present in the frame. The respondents were coded before the data analysis as illustrated in Figure 2.

The next critical step was to decide on the most representative KPIs to be included in the study. Following a rigorous process, the following eight KPIs were selected to represent the key dimensions of performance in the Motor-Insurer's service supply chain:

(1) Service with a real "wow" factor being prepared to go the extra mile.

(2) Innovative products or services.

(3) Low price/charges.

(4) Fast response to your requests.

(5) Being on-time.

(6) Not making mistakes.

(7) Personal touch.

(8) Dealing well with problems and queries.

The mapping of the selected KPIs to the performance measures, categories and factor loadings in earlier research is provided in Table AI.

Supplier	Service	No. of responses (buyer)	No. of responses (supplier)
S1	Motor dealer	24	17
S2	Motor dealer	7	18
S3	Body shop	8	18
S4	Body shop	16	22
S5	Body shop	25	35
S6	Collision repair shop	27	3
S7	Collision repair shop	5	3
S8	Electrical testing	20	4

Table I. The suppliers and the services they provide, as well as the number of respondents from the buyer and each supplier that evaluate that supplier

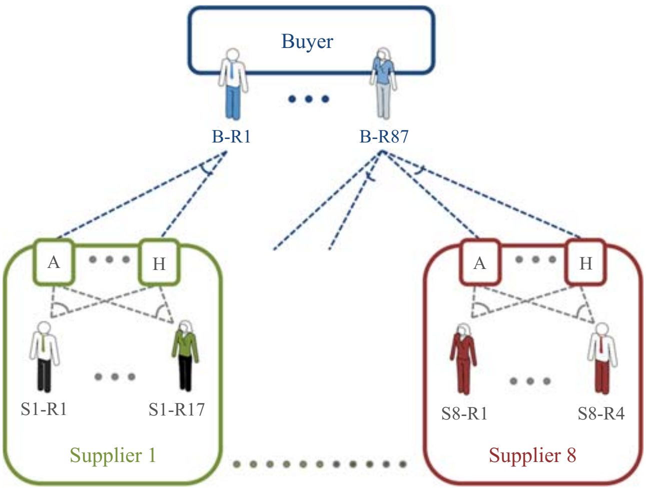

Figure 2. Perception of the respondents on the suppliers and the buyer about the KPIs

The first question (Q1) in the conducted survey asked the respondents (from both the buyer and the suppliers) to allocate a total of 100 points among the above eight KPIs (coded from "A" to "H") to denote the importance of each KPI to the Motor-Insurer[2]. This question therefore aims to acquire the perceived weights (priorities) and relative importance of the eight KPIs, revealing the differences in perception regarding the importance of the KPIs (perception gaps).

The second question (Q2) asked both buyer and supplier respondents to assess how well these eight KPIs have been delivered or achieved, on a scale from 1 to 10. This is the performance score as evaluated by the respondents. The question was designed to later reveal the differences in the performance assessments with respect to each KPI for each supplier (performance gaps). During the data collection process, not only were the buyer respondents asked to evaluate the service performance of suppliers, but also the supplier respondents were asked to evaluate the performance of their own company. Thus, the suppliers' performances were evaluated by both the buyer and the suppliers themselves.

Data cleaning is critically important in any type of data analysis, as the results of any analysis depend on the relevance, reliability and correctness of the utilised data. The survey data collected in the current study were deemed as mostly clean, yet still required careful restructuring for proper DEA and statistical analyses. To this end, the data for the research were cleaned, structured and prepared for analysis by using a well-established taxonomy of dirty data by Kim *et al.* (2003) as a checklist.

The main methodological contribution of the research – illustrated in Figure 3 – was developed as the end-result of the above described case study project.

Data envelopment analysis (DEA)

DEA has been extensively used for supplier performance evaluation and selection (Narasimhan *et al.*, 2001; Ertek *et al.*, 2012; Liu *et al.*, 2013). As a sub-topic within supplier performance evaluation, the use of DEA in the contract logistics industry (e.g. 3PL evaluation) is reviewed in Zhou *et al.* (2008), Ertek *et al.* (2012) and Marchet *et al.* (2017). The domain within the literature related to the presented application is "supplier evaluation and selection with DEA". However, none of the earlier studies apply DEA in the context of the perception and performance gaps in service supply chains.

One of the critical tasks in the research was to compute the statistical significance of the correlation between the perception and performance gaps related with the suppliers, over all the KPIs. Among available multi-criteria decision-making methods, DEA was selected as the most suitable method – due to its efficient dimensionality-reduction capabilities with minimal data requirements (Ishizaka and Nemery, 2013) – and used for summarizing the multi-dimensional performance evaluation values (for eight KPIs) in a single dimension, namely, the efficiency score[3].

Another important decision in the research was the selection of the most appropriate DEA model from among many alternatives. From among a large collection of DEA models reported in the literature, the BCC model family was preferred because of its robustness (Seiford and Zhu, 1998). In the data collected for this study, the values for all the outputs were non-negative, and the BCC allows for variable returns to scale. Since the input values (all equal to one) cannot be changed, the goal of a decision-making unit (DMU) is to increase the values of its outputs (the values given by respondents), hence the use of the output-oriented BCC model (BCC-O) is justified in the study[4]. For required calculations, an interactive DEA modelling software, Smart DEA Solver, was used (Akçay *et al.*, 2012).

In DEA, calculations of efficiency scores are based on the values of inputs and outputs for the entities, which are referred to as DMUs. Inputs are assumed to be "consumed" as resources by the DMUs, for generating the outputs. Efficiency score, which takes a value between zero and one, increases as more output can be generated with less input. For example, the efficiency score increases when a DMU can generate higher values in any

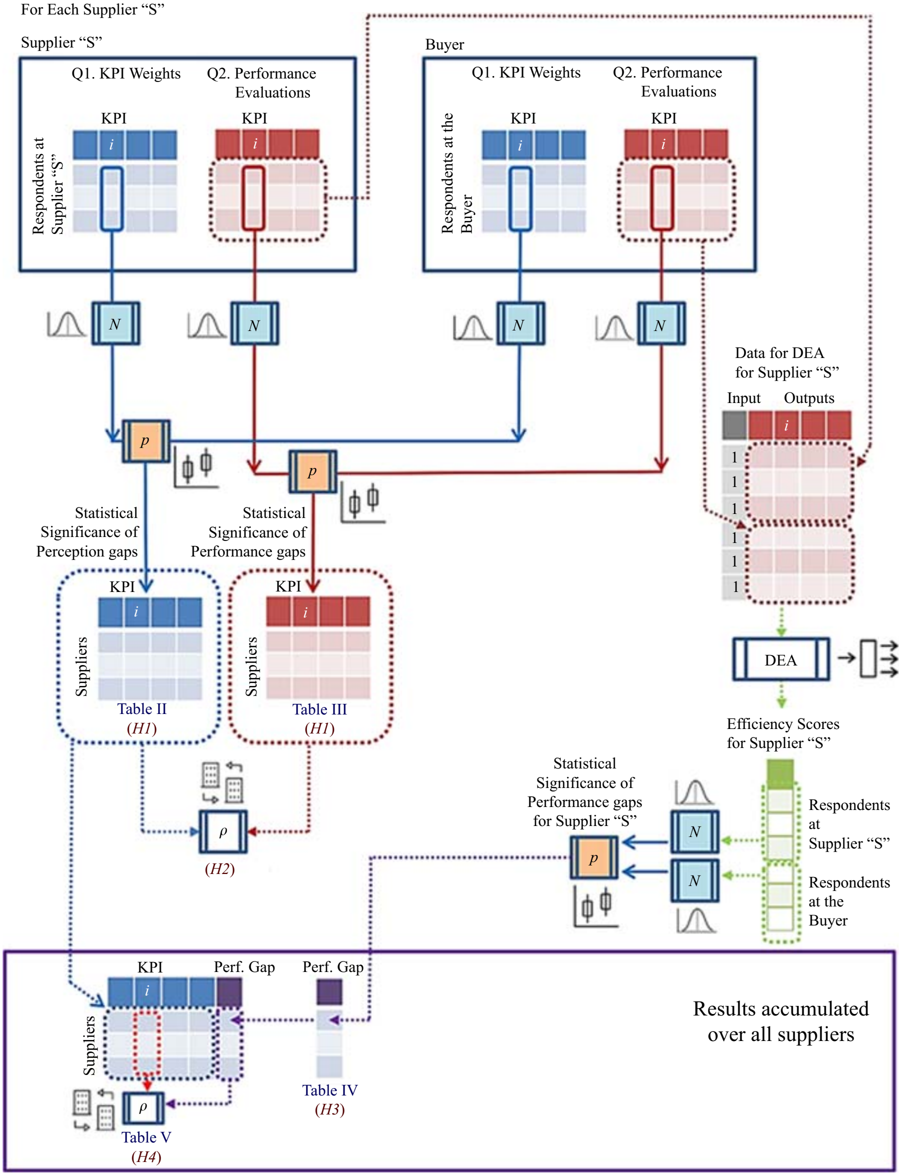

Figure 3. The developed integrative framework for calculating the meta-KPIs and the association between them

of the outputs with the same input values, or when a DMU can generate the same values in the outputs with lower values in any of the inputs. In this study, each respondent evaluation was considered a DMU[5]. Because there were no inherent inputs in the data set; a single auxiliary input, which takes the value of one for all the DMUs, was assumed. While the sole input of the DEA model is an auxiliary input, the outputs are considered as the evaluation scores for the eight KPIs.

When only the outputs are present, but an input is not apparent, DEA models can be constructed by creating an auxiliary input (also referred to as a dummy input), which takes the value of one for all DMUs. This is a popular and validated technique in DEA modelling, referred to as "DEA without explicit inputs" (Liu *et al.*, 2011), and has several applications (Yang and Kuo, 2003; Paradi *et al.*, 2011), justifying the selection of the input and outputs.

Statistical methods

To discover the significance of the association between perception and performance gaps between the suppliers and the buyer, and to test the proposed hypotheses, several statistical tests have been conducted.

The Shapiro-Wilk test was first applied to determine whether a sample follows normal distribution. The parametric *t*-test and the non-parametric Wilcoxon rank-sum test were used to test the statistical significance of the differences in the means of two samples (e.g. performance scores for a KPI regarding suppliers, coming from both buyer and supplier respondents). For computing the correlation between two paired samples, and to test against the null hypothesis of the correlation being zero, the Spearman rank correlation test was applied.

Integrative analytical framework

The developed integrative analytical framework is shown in Figure 3. The specific steps taken are explained below[6].

For each supplier "S":

- Step 1: data on KPI weights and performance evaluations are collected and prepared from the respondents at that supplier "S" and the buyer.
- Step 2: for each KPI, the column under that KPI is selected from the two data vectors (one column from supplier "S", and the other column from the buyer) for KPI weights.
- Step 3: the two vectors are independently passed through a normality test (Shapiro-Wilk normality test), as shown with the box labelled *N* (with the adjacent icon denoting the normal distribution). The results of the normality tests guide which statistical tests will subsequently be applied for two-sample comparisons (the boxes labelled with the letter *p*).
- Step 4: for each KPI, the weights from supplier "S" and the buyer are compared using the proper two-sample comparison test, and the *p*-value that denotes the statistical significance is obtained.
- Step 5: the resulting *p*-values obtained in Step 4, which denote the statistical significance of the perception gaps for that supplier "S" for each KPI, are stored in Table II.
- Step 6: returning to the top of Figure 3, the column under each KPI is selected from the two data vectors (one from supplier "S", and the other from the buyer) for performance evaluations.

	Key performance indicators (KPIs)							
Supplier	A	B	C	D	E	F	G	H
S1	0.8526	0.0225**	0.1101	0.1815	0.9041	0.2740	0.7573	0.8944
S2	0.5153	0.0043**	0.0125**	0.2359	0.7010	0.3442	0.2303	0.5051
S3	1.0000	0.0319**	0.0825	0.3375	0.2275	0.9555	0.7764	0.5955
S4	0.0353**	0.0562*	1.0000	0.4110	0.2808	0.0824*	0.0357**	0.0025**
S5	0.0232**	0.0000**	0.1234	0.3514	0.1520	0.0575*	0.1749	0.0023**
S6	1.0000	0.1502	0.1152	0.9720	0.0373**	0.2366	0.7801	1.0000
S7	0.0148**	0.0101**	0.0734*	1.0000	0.9480	0.1685	0.0314**	0.0336**
S8	0.8526	0.6142	0.1313	0.4994	0.5550	0.2636	0.0800*	0.0343**

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$

Table II.
Statistical significance (p-values) of the Level-1 perception gaps for each (supplier, KPI) pair

- Step 7: the two vectors are passed through the Shapiro-Wilk normality test independently, as shown with the box labelled *N*.
- Step 8: like Step 4, the performance evaluation values – for each KPI – from supplier "S" and the buyer are compared using the proper two-sample comparison test, and the *p*-value that denotes the statistical significance is obtained.
- Step 9: the resulting *p*-values obtained in Step 8, which denote the statistical significance of the performance gaps for that supplier "S" for each KPI, are stored in Table III. Tables II and III are mainly constructed to test *H1*.
- Step 10: the correlation between the values in Tables II and III is then computed, as shown in the box labelled with ρ. This correlation value is computed to test *H2*.
- Step 11: again, returning to the top of Figure 3, focussing on Q2, the complete performance evaluation tables from the suppliers and the buyer are merged (as shown with the arrows). A new column is added as the first column to denote the auxiliary input, with all the cells under this column having the value of 1.
- Step 12: a DEA model is built, as shown with the box labelled "DEA" (with the icon next to it denoting DEA with single input and multiple outputs).
- Step 13: the DEA model is run using Smart DEA Solver to obtain the efficiency score results.
- Step 14: the efficiency scores (single-dimensional performance evaluations) for the respondents from the suppliers and the buyer are considered as two samples.
- Step 15: each efficiency score sample is passed through a normality test to guide which statistical test will subsequently be used for the two-sample comparison.
- Step 16: the two-sample comparison is conducted using the proper statistical test, as shown with the *p* box, and the resulting *p*-values are obtained and stored in Table IV. Similar to the *p*-values obtained in Step 8 and then stored in Table III at Step 9, these new *p*-values also denote the statistical significance of performance gaps, this time for supplier "S". However, these *p*-values are not based on the original data values (performance evaluations), but instead on efficiency scores.

After Steps 1–16 are completed for every supplier "S":

- Step 17: Table II (statistical significance of perception gaps) and Table IV (statistical significance of performance gaps for supplier "S") are merged for subsequent correlation analysis (Table V).

	Key performance indicators (KPIs)							
Supplier	A	B	C	D	E	F	G	H
S1	0.0149**	0.0693*	0.0007**	0.0431**	0.0395**	0.2419	0.0578*	0.0904*
S2	0.0834*	0.0828*	0.1167	0.1189	0.0419**	0.1054	0.0226**	0.0264**
S3	0.1149	0.0514*	0.0636*	0.4140	0.2068	0.4082	0.5147	0.0531*
S4	0.0001**	0.0074**	0.0800*	0.0002**	0.0008**	0.0015**	0.0003**	0.0016**
S5	0.0000**	0.0000**	0.0001**	0.0008**	0.0004**	0.0000**	0.0000**	0.0000**
S6	0.7518	0.3580	0.8610	0.8074	0.4644	0.5759	0.5782	0.7805
S7	0.4272	0.4214	0.7336	0.5757	0.2612	0.2238	0.1254	0.1350
S8	0.0323**	0.3489	0.0001**	0.0001**	0.0530*	0.0070**	0.0310**	0.0039**

Notes: *$p < 0.10$; **$p < 0.05$

Table III. Statistical significance of the Level-1 performance gaps for each (supplier, KPI) pair

- Step 18: the respective column for each KPI is selected from Table V, and the correlation is computed between that vector and the performance gaps vector in the last column of Table V. The correlation values, which denote the correlation between perception and performance gaps, as well as their statistical significance, are recorded in the last two rows of Table V.

Analysis and hypothesis testing

In this section, the analysis results are presented and the research hypotheses are tested.

Existence of gaps (H1)

Table II (produced at Step 5) represents the statistical significance (p-values) of the Level-1 perception gaps for each (supplier, KPI) pair. Table II shows that the perception gaps regarding KPI "B" (innovative products or services) are significant in relation to most of the suppliers. For instance, there is a strongly significant perception gap ($p \leqslant 0.05$) between supplier 1 and the buyer regarding the importance of KPI "B". The p-value for the statistical significance of this gap is $p = 0.0225$, meaning that there is only a 2.25 per cent chance that the conclusion (about the existence of this perception gap) is false.

Table III (produced at Step 9) presents the statistical significance (p-values) of the Level-1 performance gaps for each (supplier, KPI) pair. For example (as read from the first line of Table III) there is a weakly significant gap ($p \leqslant 0.10$) in the performance evaluations of supplier 1 and the buyer regarding KPI "B". The p-value for the statistical significance of this gap is $p = 0.0693$, meaning that there is only a 6.93 per cent chance that the conclusion (about the existence of this performance gap) is false.

Table IV. Comparison of average efficiency scores, as evaluated by the buyer and the suppliers, based on DEA

Supplier	Avg. eff. buyer	Avg. eff. supplier	Perf. gap	Shapiro p-values (buyer)	Shapiro p-values (supplier)	Wilcox p-values	t-test p-values
S1	0.6500	0.8588	0.2088	0.0014	0.0001	0.0189**	–
S2	0.6571	0.8889	0.2317	0.8525	0.0004	0.0279**	–
S3	0.7500	0.9333	0.1833	0.3297	0.0003	0.0057**	–
S4	0.6750	0.9045	0.2295	0.0111	0.0000	0.0001**	–
S5	0.5320	0.8486	0.3166	0.0507	0.0000	0.0000**	–
S6	0.5852	0.6000	0.0148	0.2151	0.2196	–	0.9589
S7	0.7200	1.0000	0.2800	0.1180	–	–	0.1660
S8	0.5300	0.9250	0.3950	0.0885	0.2725	–	0.0001**
Average	0.6374	0.8699	0.2325	–	–	–	–

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$

Table V. Correlations between perception gaps and performance gaps, after multi-dimensional performance evaluations were reduced to single dimension through DEA

	Perception gap p-values based on key performance indicators (KPIs)								
Supplier	A	B	C	D	E	F	G	H	Perf. gap p-values
S1	0.8526	0.0225	0.1101	0.1815	0.9041	0.2740	0.7573	0.8944	0.0189**
S2	0.5153	0.0043	0.0125	0.2359	0.7010	0.3442	0.2303	0.5051	0.0279**
S3	1.0000	0.0319	0.0825	0.3375	0.2275	0.9555	0.7764	0.5955	0.0057**
S4	0.0353	0.0562	1.0000	0.4110	0.2808	0.0824	0.0357	0.0025	0.0001**
S5	0.0232	0.0000	0.1234	0.3514	0.1520	0.0575	0.1749	0.0023	0.0000**
S6	1.0000	0.1502	0.1152	0.9720	0.0373	0.2366	0.7801	1.0000	0.9589
S8	0.8526	0.6142	0.1313	0.4994	0.5550	0.2636	0.0800	0.0343	0.0001**
Correlation	0.6728	0.1786	−0.6429	−0.0714	0.1071	0.5357	0.7500	0.8929	
p-values	0.0977*	0.7131	0.1389	0.9063	0.8397	0.2357	0.0663*	0.0123**	

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$

Tables II and III confirm that *H1* (existence of perception gaps and performance gaps) is supported by data. Because the perception gaps and performance gaps both exist, the next question is whether they are associated (*H2*).

Association between the gaps (H2)

H2 proposes the association between the perception and performance gaps for (supplier, KPI) pairs, and the significance of the association can be tested using the Spearman correlation test. From Table I, it is observed that the number of evaluations for supplier 7 is only eight (five from the buyer, three from supplier 7 itself). Thus, supplier 7 is omitted from the test (see Table V).

Using the data in Tables II and III, the Spearman correlation value obtained is 0.5167. The p-value corresponding to this test is $p = 0.00004562$, suggesting that there is a significant correlation between the p-values of the perception and performance gaps. This suggests that *H2* is also supported by data; in other words, that there is an association between perception and performance gaps for (supplier, KPI) pairs.

Gaps for each supplier (H3)

H3 proposes the possible association between the perception and performance gaps at the supplier level only, rather than the (supplier, KPI) granularity. This would lead to a more general understanding of any underlying causal connections between the perception and performance gaps. DEA was used to compute the correlation between these gaps, by reducing the eight-dimensional performance evaluation values (for all the eight KPIs) to a single dimension, namely, the efficiency score. This enabled the computation of the performance gaps between the respondents at the suppliers and the buyer by comparing the efficiency scores, respectively.

Table IV (produced at Step 16) shows the results obtained when testing *H3*. In Table IV, the following information is provided for each supplier:

- Number of responses at the buyer and the supplier "S", as obtained from Table I.
- Average efficiency scores (denoted as "Eff.") from the respondents at the buyer and the respondents at the supplier "S".
- Performance gap for a supplier (denoted as "Perf. Gap") computed as the difference of the average efficiency scores from the buyer and the supplier "S". All values under this column are positive, suggesting that the respondents at the suppliers always evaluated themselves better than the respondents at the buyer evaluated them.
- Shapiro-Wilk p-values, which test whether the efficiency scores from the buyer or the supplier "S" follow normal distribution. These p-values are needed to select the appropriate statistical comparison test.
- p-values obtained for the Wilcoxon t-tests, where $p \leqslant 0.10$ suggests the existence of a weakly significant difference and $p \leqslant 0.05$ suggests strongly significant difference between the efficiency scores from the buyer and the supplier "S" (performance gap for supplier "S").

The last two columns of Table IV, which present the statistical significance of the multi-dimensional performance gap with the p-values, suggest that performance gap exists at $p = 0.05$ for all suppliers, except suppliers 6 and 7. This result suggests that *H3* is supported by the data. In other words, performance gap may still exist when dimensionality is reduced to a single dimension, as an efficiency score.

Varying levels of association for different KPIs (H4)

H4 hypothesises that the perception gap may vary across the KPIs. In other words, *H4* states that specific KPIs may have higher correlation with the performance gap, while others may have lower (even statistically insignificant) correlation.

Table V (produced at Step 18) shows the results obtained for testing *H4*. The values in the first eight columns ("A" through "H") come from Table II, and the values in the last column (performance gap p-values) come from Table IV. The bottom two rows of Table V show the Spearman correlation values and the respective p-values obtained from Spearman correlation tests. For example, the correlation between the perception gaps of KPI "A" (under column A) and the performance gap (under the last column) is 0.6728 and is weakly significant ($p = 0.0977 < 0.10$). Table V reveals that correlation is statistically significant for KPI "A" (service with a "wow" factor), KPI "G" (personal touch), and especially for KPI "H" (dealing well with problems and queries). Thus, the results suggest that *H4* is supported by data and thus the level of association may vary across the different KPIs.

An important corollary of *H4* is that the overall positive correlation between the perception and performance gaps (shown in *H2*) can be due to one or some particular KPIs, rather than all the KPIs. The practical implication is that reducing the perception gap for those most crucial KPIs should have precedence in supplier collaboration and integration efforts. For the service supply chain investigated in this case study, correlation between the perception and performance gaps is highest for KPI "H", namely, "dealing well with problems and queries". Therefore, for this service supply chain, the managers at both the buyer and the suppliers should prioritise coming to terms with the relative importance (weight) of this KPI and seek its alignment before working on other KPIs.

Conclusions and future research

Should service supply chain partners mind the perception gaps? The presented research confirmed that perception gaps do exist and can have significant association with the performance gaps along the service supply chain. The development of the presented analytical framework for quantifying the gaps offers a new window to researchers and practitioners. Using the proposed framework, supply chain partners can observe, understand and considerably improve the performance of the service supply chains they are working with, by acknowledging the perception gaps.

This research was motivated by field observations within the scope of the general perception theory, where the general theory did not extend to the perception and performance gaps and the association in between them. Through systematic application of MRT, which is an emerging research methodology in SCM, the boundary of the general perception theory was extended. Although the data tested and analysed in this research were sourced from the insurance service industry, the nature of the findings are general and can contribute to a more extensive body of knowledge from which new theories specific to supply chain management may be induced. Below are some extended implications for service supply chains.

The key implication of the presented research is that service supply chain partners can focus on the differences in perceptions regarding the importance of various supply chain KPIs, methodologically compute the perception and performance gaps, and track them as meta-KPIs. The presented step-by-step methodology can be used as the computational engine behind the supply chain initiatives that aim at the identification and elimination of perception gaps. This ultimately can enable them to reduce the perceived gaps to an insignificant level through collaborative efforts, such as sharing key relevant information and synchronizing their perceptions.

To achieve the above goal, as a continuous enterprise process, the performance and perception gaps can be monitored in various dimensions at regular intervals. To automate the application of such a process, the presented analytical methodology can be embedded within the information systems of the supply chain partners. Following the identification of the perception gaps, the partners can collectively work on supply chain re-alignment and improvement, focussing specifically on the identified gaps to alleviate and, where possible, eliminate them.

Another implication of this research is a perspective expansion. Service supply chain performance management can begin with the acquisition of KPI weights from the supply chain partners, and the identification of any perception gaps, whether at the supply chain stage level, supplier level, KPI level or Supplier-KPI level. Sharing of information regarding the perceptual importance of the KPIs can be a new form of information sharing – alongside shared information on demand, inventory and POS data – for supply chain coordination.

Another possible implication is the analysis of data from diverse real-world cases and the observation of patterns across them. While big data is ubiquitously available and data science tools are becoming mainstream, the potential for similar research is practically unlimited. For example, unexplored primary data readily available in companies' ERP systems, as well as additional secondary data, can be analysed through exploratory, descriptive, predictive and prescriptive data science techniques to observe phenomena, propose hypotheses and develop a plethora of general theory that is highly relevant, actionable and applicable. This research can serve as an example, especially in the supply chain performance management literature, of how such a combined study can be conducted.

While the presented research explores the possibility of sharing of information about perception gaps, there are other moderating factors, besides information sharing, which can potentially enhance supply chain integration and improve the overall performance. As an example, synchronizing the perceptions of the supply chain partners on the relative importance of each KPI can motivate supply chain alignment and encourage corrective actions. This could, in turn, reduce performance gaps, ensure that the expected performance is delivered, strengthen the relation between the supply chain partners, and result in a more effective supply chain.

The current study can be extended in various ways to strengthen the quality of the findings. Viable research questions towards other extensions include the following:

RQ1. Are there certain supplier, buyer, product/service, industry characteristics that contribute to the magnitude of the association between the perception and performance gaps?

RQ2. How can one explain that the perception gap in specific measures have a relatively higher association and possible influence on the performance gap?

RQ3. How does perception gap correlate with performance gap, when the effects of other factors that contribute to the service supply chain performance are also considered? Can researchers and analysts use alternative analytical techniques in investigating this problem?

Notes

1. The full data also include feedback and comments from the respondents on what they would like the supply chain partner to "stop doing", "continue doing" and "start doing". The current research, however, is based only on the quantitative footnote text evaluations.
2. Due to the heterogeneity of the services received from the eight suppliers, separate data for KPI weights were obtained from the buyer regarding the relation with each supplier.
3. The efficiency score for an evaluation represents the opinion of the respondent regarding that supplier's overall success for the eight KPIs. If the efficiency score is close to one, this indicates that the respondent believes that a high performance is achieved by that supplier.

4. The mathematical derivation and formulation of the DEA models can be found in Akçay *et al.* (2012).
5. For example, the evaluation of supplier 1 by respondent 3 at the buyer was identified as DMU "3_for_1".
6. While Steps 1–10 directly use the survey data values, Steps 11–18 of the methodology are constructed around DEA, which transforms multi-dimensional performance evaluation data into one-dimensional efficiency scores.

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Appendix

KPIs used in this study		Slack *et al.* (2009)	Johnston (2004)	Gunasekaran *et al.* (2015)	Giannakis (2011)	Psomas and Jaca (2016)
KPI	Description					
A	Service with a real "wow" factor being prepared to go the extra mile	Quality	Going the extra mile	Service performance, customer satisfaction, skills and knowledge, quality improvements, communication quality	Quality assurance	Service quality performance, customer satisfaction
B	Innovative products or services	Flexibility	Going the extra mile	Service performance, customer satisfaction, skills and knowledge	Quality assurance	Customer satisfaction
C	Low price/charges	Cost	na	Cost efficiency, profitability, productivity, ROI	Cost analysis, financial analysis	Financial performance
D	Fast response to your requests	Speed	na	Service performance, customer satisfaction, Skills and knowledge, responsiveness, quality improvements, communication quality	Time analysis	Service quality performance
E	Being on-time	Speed	Delivering the promise	Service performance, customer satisfaction, skills and knowledge, quality improvements, responsiveness	Time analysis	Operational performance
F	Not making mistakes	Quality	Delivering the promise	Service performance, customer satisfaction, quality improvements, skills and knowledge	Quality assurance	Service quality performance
G	Personal touch	Quality	Providing a personal touch	Service performance, customer satisfaction, skills and knowledge, information sharing, communication quality, trust, reputation, value of the outsourcing relationship	Quality assurance	Service quality performance, customer satisfaction
H	Dealing well with problems and queries	Quality	Dealing well with problems and queries	Service performance, customer satisfaction, skills and knowledge, information sharing, quality improvements, communication quality, trust, reputation, value of the outsourcing relationship	Quality assurance	Service quality performance, customer satisfaction

Table AI. Mapping of the selected KPIs to performance measures in earlier research