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The relationship between operating efficiency and service quality: are they compatible?

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Transferring and applying manufacturing principles and practices to improve both service efficiency and service quality is an important area of research in service operations. This paper advances this stream of research by examining the compatibility of operating efficiency and service quality. Specifically, our research addresses the following questions: (1) Do operating efficiency and service quality have to be traded off, or can they exist in unison (are they compatible)? and (2) What aspects of service quality have a stronger association with operating efficiency? In disentangling these important issues, we utilise a combination of data envelopment analysis (DEA) and survey-based empirical research methods. Additionally, our focus lies on a novel type of service industry where such research has been sparse. We evaluate the relative operating efficiencies of service driving agencies based on actual transaction data and subsequently analyse differences in service quality dimensions based on efficiencies. Overall, our analyses suggest important strategic decision-making implications for service operations managers and provide novel insights for academic research.

Keywords: data envelopment analysis; survey-based empirical analysis; service operations; service driving industry; compatibility of operating efficiency and service quality

1. Introduction

Since Levitt's (1972) assertion for the need of transferring manufacturing principles and practices to improve the efficiency and quality of service operations, service research has attracted significant attention in the field of production and operations management (POM) (Gupta *et al*. 2006, Chase and Apte 2007). Nevertheless, the context investigated for operating efficiency and quality has been primarily manufacturing (Roth 2007, Foster *et al*. 2010), with the services side being replete of both empirical and conceptual works (Metters and Marucheck 2007). This is surprising, since service industries can achieve significant gains through the application of POM principles. While some studies have devoted themselves to filling this gap of linking POM principles with service research contexts (Mollenkopf *et al*. 2007, Brohman *et al*. 2009, Voss and Hsuan 2009), few scholarly works have examined the compatibility of operating efficiency and quality within the context of the service industry.

The potential of applying these two well-established POM concepts to the services side is substantial, and the importance for doing research in this area is clear. Current developments in the services domain, including the intense multidimensional competition on price, speed, quality, delivery and flexibility, the emergence of new types of services, innovative approaches to human resource management in service industries and new technologies facilitating service delivery, contribute to this significance (Frei 2006, Ross *et al*. 2007, Melnyk *et al*. 2009, Li and Lee 2010).

The pursuit of excellence in both operating efficiency and service quality is not without cost. Instead of leading to greater marketplace security, organisational servitisation can lead to a greater risk of failure in hypercompetitive environments (Frei 2006, Ross *et al*. 2007, Melnyk *et al*. 2009, Li and Lee 2010). Recent studies provide support to this contention. For example, Sampson and Froehle (2006) addressed the issue that service automation technologies can lead to lower customer satisfaction by overly standardising service processes. Campbell and Frei (2010) empirically supported this view by showing that the adoption of new service technology helps in attracting and retaining more profitable customers, rather than increasing the profitability of existing customers. Xia and Zhang (2010) also found that US retailers could not enjoy an early mover's advantage in the online-channel adoption. As illustrated by these studies, literature has generally been suggestive of operating efficiency and service quality being at diametrically opposite ends of a spectrum necessitating trade-offs between the two.

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However, a growing body of practitioner literature contests this conventional view, and forwards the idea that operating efficiency and service quality can be compatible. Of note in this vein are especially the efforts and accomplishments in the health care sector: top providers, such as the Cleveland Clinic and the Mayo Clinic, are able to provide quality while maintaining efficiency (Raghupathi and Tan 2008, Shortell and McCurdy 2009), indicating the compatibility of the two dimensions. For instance, Raghupathi and Tan (2008) suggested that the Cleveland Clinic could improve its operating efficiency by adopting health information technologies, such as imaging technology, web services and e-health systems. In this instance, technology was seen as a pivotal catalyst for providing decent service quality while maintaining efficiency. In addition, Shortell and McCurdy (2009) highlighted that many US healthcare providers, including the Cleveland Clinic and the Mayo Clinic, could improve their operating outcomes/value by coordinating three key factors: (1) incentives for change, (2) capabilities of providers to respond to the incentives and (3) the need for accountability and performance metrics. Thus, the simultaneous pursuit of operating efficiency and service quality seems possible.

Further support in this domain is provided by the list of Customer Service Champs 2010 (Bloomberg Businessweek 2010). In this service provider evaluation, 11 out of the top 25 companies received an A+ for both 'efficiency of service' and 'quality of staff.' Overall, 17 companies received the same grades in these two evaluation criteria, and only eight companies across the top 25 firms had different grades in the two dimensions. Specifically, five companies among those eight got a higher grade in 'efficiency of service' than in 'quality of staff', and vice versa for the other three companies.

The preceding discussion illustrates that there can be diverse and sometimes contradicting manifestations of operating efficiency and service quality in different settings. While sometimes the two dimensions had to be traded off, in other instances they were able to be pursued and excelled in at the same time. Further research into this contented domain is thus warranted to bring clarity to this area. It is the objective of the present study to do so. We believe that this seemingly contradicting result in the real world implicates several interesting points. First, traditional trade-off models on operating efficiency and service quality do not fully explain current dynamic changes in service industries. Second, the operating efficiency and service quality of most top service performers tend to move in the same direction. Third, operating efficiency and service quality can be in a compatible and/or synergic relationship, that is to say not in a trade-off relationship. This observation puts forward the notion of the ambidextrous service organisation, able to excel in both operating efficiency and service quality. Within this context, our research aims to provide insights into this domain by answering the following questions: Do operating efficiency and service quality have to be traded off, or can they exist in unison (are they compatible)? Furthermore, what aspects of service quality have a stronger association with operating efficiency?

1.1 *Research relevance, context and approach*

Our research is motivated by both theoretical and practical POM perspectives, illustrating their relevance to the domain. From a theoretical perspective, we advance a general theoretical topic in the manufacturing literature that is much contended: the debate surrounding whether capabilities in a firm have to be traded off against each other, or whether they can be pursued in unison. These two approaches have been referred to in the extant research as the trade-off model and the cumulative model. The former, pioneered by Skinner (1969), advocates that the achievement of one capability must come at the expense of another. The latter, first conceptualised by Ferdows and De Meyer (1990), forwards the idea that different capabilities can be pursued in unison, that is, in a cumulative fashion, obviating the need for trade-offs.

We investigate these issues within a novel and emerging setting, the South Korean service driving industry. In the service driving industry, *replacement drivers* are tasked to transport intoxicated individuals to their final destination in the customers' own vehicles. This new type of service is becoming increasingly popular, and has already made significant inroads into the European and US markets (Korea Service Driver Society 2010).

A further distinguishing feature of our study is the integration of both analytical and empirical methods to derive insight into the compatibility of operating efficiency and service quality. Since the majority of extant studies relied on anecdotal evidence, case studies, pure analytical or pure survey-based methods and/or conceptual frameworks anchored in traditional trade-off models based on Arrow's (1963) impossibility theorem, our research offers an important extension. As such, we provide a holistic understanding for the compatibility between operating efficiency and service quality; we do so in a comprehensive manner by combining multiple approaches to derive insights.

Specifically, we first seek to evaluate the comparative operating efficiency of service providers (service driving agencies) using the nonparametric methodology of data envelopment analysis (DEA). By analysing 649 actual transaction records from 14 service providers, we identify provider groups based on their overlap in the least significant difference test on efficiencies. A unique attribute of our sample is that it properly represents the South Korean service driving industry. As such, we utilise data comprising 40% of the South Korean service driving agencies, which cover the Seoul and Gyeonggi Province (population: 21,507,582 as of 2009) – this itself comprises 70% of the industry's market. Overall, this focused study and sampling design provides us with a comprehensive picture of the South Korean service driving industry.

Subsequently, based on a survey and in-depth interviews with all service agencies that provided transaction data for the DEA, we trace the influence of various service quality dimensions on operating efficiency. In doing so we rely on service quality dimensions fundamental to service quality theory (Rust and Oliver 1994), and address the fact that service quality is comprised of the service product, the service delivery and the service environment. Our research is anchored in the generally accepted notion that 'attributes associated with a service firm's personnel play a key role in the determination of customer satisfaction and customer perceptions of service quality' (Hays and Hill 2001, p.336). We therefore rely on the underlying structural and infrastructural dimensions ensuring service quality as assessed by the CEO of the service provider as the key informant (we note that we are not assessing service quality as perceived by the customer, which would be unreliable in the setting investigated, as further described below).

Based on this evidence derived by identically matching the service transaction data with the survey/interview data, this study rigorously assesses a generally applicable decision-making approach. This, in turn, allows for an explicit evaluation and optimisation of service excellence in an economically justified and quality-oriented manner. Consequently, this casts light on the missing link between POM practices and service research. Overall, we provide important and novel insights for both academic researchers and practicing managers in POM, which is further highlighted below.

The rest of the paper proceeds as follows. In the next section, we illustrate the service processes and characteristics of the service driving industry, and review relevant literature related to the operating efficiency and service quality of organisations. This is followed by our investigation of the relationship between operating efficiency and service quality. We first briefly introduce DEA, with the subsequent sections presenting the DEA results. These are then complemented and integrated with our empirical data collected via a matched survey. In a last section we highlight our contributions to theory development in the area of POM, discuss managerial implications, and conclude with future research opportunities.

2. Background

2.1 *Service driving industry*

The unique focus of our study is the South Korean service driving industry offering replacement driving services. This setting provides a formidable example for the dynamic changes in the hypercompetitive environment of service industries, and illustrates the significant potential of the application of POM principles. In the service driving industry, replacement drivers are tasked to transport intoxicated individuals to their final destination in their own vehicles. To provide an illustration of the magnitude of this industry, about 100,000 replacement drivers in South Korea provide transportation services for approximately 700,000 customers each day (Choe 2007). According to the Korea Service Driver Society, a not-for-profit association which offers a wide variety of services such as training, statistics and networking for the industry, the market size had reached a value of US$2.653 billion as of 2005. As a highly fragmented and still growing business in the maturity phase in South Korea, it is now also spreading to countries in East Asia, such as Japan and China, as well as US cities with large East Asian populations, such as New York, Los Angeles and Chicago (Korea Service Driver Society 2010).

The primary impetus for this new type of service originated from the intensified penalty for drunk driving and the introduction of modern intoxication measurement devices by the South Korean government and police bureau in 1997. At the same time, the economic downturn of the South Korean economy had made a low-wage workforce available for this industry. The fare generally ranges between US$15 and US$45 depending on the driving distance, and agencies usually deduct 15% to 20% as fees.

The overall service process is as follows. First, an intoxicated customer makes a phone call to the service driving agency, which then issues a call to all replacement drivers located within a five-mile radius of the desired pickup location. The drivers are equipped with global-positioning-system-based (GPS-based) personal digital assistants

(PDAs), which inform them of the approximate pickup location and destination of the customer. Drivers interested in serving this customer push an acceptance button on their PDAs, and the closest driver is allocated to the customer. The driver then receives the customer's phone number and his or her exact pickup location, and then travels to this location by foot.

Very interesting dynamics occur in this environment. For example, experienced drivers may bid on serving a customer even if they are not within close proximity. For instance, a driver interested in a specific destination can discount his/her share from the total fare in order to get the customer allocated, even though he/she might not have been the closest driver. This can occur at the end of a driver's workday or when he/she wants to move to another location with more customer calls. On the contrary, if there is no available driver within the specific area, a driver can bid a higher price by including fees for his/her own transportation, such as subway tickets or taxies. The assigned driver's destination becomes his/her next starting point.

Considering these unique service processes, the service driving industry is set within a turbulent environment characterised by the following complexities: (1) an extreme sensitivity of customers to time delay (based on our in-depth interviews with service agencies we found that customers switch to a different agency if no driver is assigned to them within 10–15 minutes), (2) a high turnover and variability in the skills of the workforce (anybody with a driver's license can be hired), (3) low entry/exit barriers (there has not been any detailed government regulation on this business until now), (4) intense price/non-price competition (according to our interviews, over 90% of new start-ups go out of business within 12 months), (5) continuous new technology adoption (replacement drivers with more up-to-date PDAs can convey their location more precisely and thus get offered more calls) and (6) real-time price bidding. Overall, this setting poses an intriguing and formidable environment in which to investigate the compatibility of operating efficiency and service quality, with the objective to provide operational support for service driving agencies.

2.2 *Operating efficiency*

Operating efficiency refers to a measure assessing the effectiveness with which inputs are transformed into outputs. As such, the pursuit of plant operating efficiency via planning, scheduling and control has been a long-standing concern in the POM field. Chase (1981), in his pioneering study on service operating efficiency measures, conceptually addressed a service system's operating efficiency as a function of the degree to which the customer is in direct contact with the service facility relative to the total service creation time for that customer. In another foundational study, Parkan (1987) analysed operating efficiencies of Canadian commercial banks by using various inputs (such as total authorised full-time-employees, annual rent, customer service quality, telephone/stationary expenses, number of on-line terminals and marketing activity) and outputs (such as number of transactions, commercial account openings, number of loan applications, customer service survey ratings and number of corrections).

The concept of operating efficiency in manufacturing fits very well to the service operations context in the present research in that it deals with the more efficient use of limited resources, such as human resources, capital, equipment and facilities (Field *et al*. 2006, Sampson and Froehle 2006). Operating efficiency has therefore significantly affected how POM techniques are applied to the production and delivery of services (Machuca *et al*. 2007, Metters and Marucheck 2007). Referring to previous POM-based service research, the service operating efficiency can be said to be influenced by miscellaneous factors, such as types of service functions, inventory visibility, delay cost structures and other transaction costs (Grigorian and Manole 2006, Laseter *et al*. 2007, Afanasyev and Mendelson 2010, Xia and Zhang 2010).

It has also been shown that operating efficiency is positively associated with a service firm's financial and/or nonfinancial performance (Keh *et al*. 2006, Agatz *et al*. 2008), though there are also contradicting findings (Roth and Jackson 1995). More recently, academic work on service operating efficiency has been extended to control operating uncertainty, further aggravating the expected inputs and outputs of supply chains, which can result in overall system inefficiencies (Cachon and Lariviere 2001).

Nevertheless, our extensive literature review on recent publications regarding service operating efficiency shows that these studies are still heavily concentrated on specific issues (scheduling, delivery, location and cross-training optimisations) of very few traditional industry domains, such as financial institutions (Bergendahl and Lindblom 2008, Kao and Hwang 2008), hospitals (Gowen *et al*. 2008, Denton *et al*. 2010), call centres (Chevalier and Schrieck 2008, Bokhorst and Gaalman 2009), postal services (Deprins *et al*. 2006) and libraries (Apte and Mason 2006).

In the development of a measure for operating efficiency in the service driving industry we relied on in-depth interviews with CEOs of service driving agencies and our overall insight into the industry. Literature in this area has been extremely sparse, and primarily consists of newspaper reports introducing interested readers to the phenomenon and emerging challenges for the new industry sector (for example, Chunzhe 2011), necessitating our inductive development. Specifically, applying a DEA approach, we utilised as inputs the assignment time in seconds, which is the difference between the time a driver is assigned and the incoming call time, and travel time in seconds. These measures provided a parsimonious assessment of the resources expended, as assessed by the CEOs of the agencies. As the output or reward received from these inputs, the total fare was considered.

2.3 *Service quality*

Service quality, which can be defined as 'a measure of how well the service delivered matches customers' expectations' (Lewis and Booms 1983, p.100), has received considerable attention in POM, marketing and hospitality management. Pioneering studies on service quality have focused on its measurement, which has its theoretical roots in Parasuraman *et al*. (1985), who identified 10 determinants of service quality. Going a step further, the same authors devised the most popular measure for service quality, SERVQUAL, by reclassifying their previous 10 determinants into five categories: tangibles, reliability, responsiveness, assurance and empathy (Parasuraman *et al*. 1988). Further studies have investigated other types of quality measures for various service organisations, such as transportation and distribution centres (Caro and Garc 2007, Carr 2007, Correia *et al*. 2008). Service quality research has also applied six sigma practices to service settings (Hensley and Dobie 2005, Antony *et al*. 2007, Chakrabarty and Tan 2007).

As a proxy for employee performance, service quality has been regarded as having a significant and direct impact on customer satisfaction and overall firm performance (Juran 1989, Roth and Jackson 1995); therefore, service quality research has continuously been exploring the antecedents and consequences of service quality. Basing their research on Heskett *et al*.'s (1994) conceptual framework of the impact of internal service quality on a firm's revenue growth and profitability, several analytical and empirical studies have investigated the antecedents and consequences of service quality.

For example, in terms of the antecedents of service quality, Hays and Hill (2001) highlighted the positive effect of a strong service guarantee on customer perceptions of service quality, customer satisfaction and loyalty. In addition, based on a survey of finance service professionals, Field *et al*. (2006) found that process improvement and service quality are positively correlated. Furthermore, Froehle (2006) showed that customer satisfaction is driven by the three characteristics of thoroughness, knowledgeableness and preparedness of a customer service representative, rather than by the traditional attributes of courtesy, professionalism and attentiveness. On the issue of service quality consequences, Gowen *et al*. (2006) found initiatives aimed at employee commitment and control affecting the perceived results of quality management programs of US hospitals more than other quality practices. Despite this wealth of studies, contrary to Bowersox *et al*.'s (2002, p.81) recommendation (that is to say, that 'service quality is an evaluation over *multiple* transactions') on the measurement of service quality, most research in the service quality domain has been based on cross-sectional survey data or pure analytical models. It is this limitation that has hindered the possibilities of service quality research, specifically as it relates to the inclusion of operating efficiency. With the present study we aim to alleviate this shortcoming in the extant research.

To measure service quality in our specific context of the service driving industry, we relied on five service quality proxies. These were dimensions that were derived from service quality theory (Rust and Oliver 1994) and that were, at the time, being considered by the service driving agencies, as determined in our interviews with their CEOs. Specifically, we utilised the aspects of demand control capability (DCC), employee characteristics (EMP), employee satisfaction (ES), service standardisation (SS) and technological advances (TA). Further details associated with each of these will be introduced in a later section.

2.4 *The trade-off versus the cumulative perspective in manufacturing research*

The overall theoretical positioning of our research is in the trade-off versus cumulative capability perspective as briefly discussed earlier. The trade-off model was pioneered by Skinner (1969), who contended that the achievement of one capability must come at the expense of another. Support for this trade off perspective is provided by the scarcity of resources (compare with the product-process matrix by Hayes and Wheelwright (1984)) and the apparent

conflict between low cost and high quality (Lapré and Scudder 2004). Under this notion, firms need to prioritise their strategic objectives (Boyer and Lewis 2002); the concept of the focused factory also derives from this view (Skinner 1974). This model can provide support for the apparent trade-off between operating efficiency and service quality.

In contrast, the cumulative perspective, also oftentimes referred to as the sand cone model, proposes that capabilities can be pursued in unison/jointly, that is that they do not have to be traded-off against each other. Ferdows and De Meyer (1990) are commonly associated with having forwarded this notion, which has received great attention. A comprehensive meta-analysis, offering support for the cumulative view, is provided by Rosenzweig and Easton (2010). This cumulative perspective can offer an explanation of why several, also seemingly contradictory, capabilities can be pursued jointly. According to this view, operating efficiency and service quality do not have to be seen as mutually exclusive.

A third stream of research in this domain aimed to reconcile the above two views. Proponents suggested that firms can improve several capabilities at the same time (which is consistent with the cumulative/sand cone model), but that their relative performance cannot be improved at the same rate (which is consistent with the trade-off model) (Hayes and Pisano 1996). Reconciling the two views very nicely is the work by Schmenner and Swink (1998, p. 107), who noted that the trade-off model becomes more applicable as a firm progresses closer toward its asset frontier; in this instance, synergies derived from cumulative capabilities diminish. In contrast, the farther away a firm is from this frontier, the more the available choices are, providing support for the cumulative capabilities view of the sand cone model.

Against this background, and combining the literature on operating efficiency and service quality, our study contributes to POM research and practice by disentangling the conundrum of whether operating efficiency and service quality have to be traded off, or whether they can exist in unison. We also delve into the identification of service quality aspects that have a stronger association with operating efficiency.

3. Modelling the relationship between operating efficiency and service quality

3.1 *Research methodology process*

An intriguing differentiation and contribution of the present study is its utilisation of both quantitative and qualitative data, and their ensuing analytical and empirical treatment in deriving insights. As such, we utilised actual transaction records from service driving agencies for the DEA, and complemented these results with survey-based data obtained from key informants in those agencies. This subsection outlines the overall approach employed, with the ensuing subsections providing further detail. The overall process pursued, consisting of seven steps, is illustrated in the flow chart in Figure 1.

In a first step we obtained a commitment from the Korea Service Driver Society, a not-for-profit association which offers a wide variety of services such as training, statistics and networking for the industry. The cooperation and support of the association was essential in carrying out this study, and provides further substantiation for the practical relevance and importance of the topic and the analyses carried out.

With the help of the society, we were able to obtain a commitment and participation from the majority of the service driving agencies in South Korea, which constituted the second step of the process. The data obtained are representative of 40% of the industry in that region, consisting of a total of 14 agencies. Six of them were rather small (less than 50 service drivers each), and hence we grouped them together into a homogeneous set (denoted as 'agency 9 (others)' in the ensuing discussion). This yielded a total of nine agencies to be considered in the DEA evaluations. The final dataset consisted of 649 transactions from these nine groups.

In the third step, we selected relevant input and output measures for the DEA. We determined inputs and outputs from available transaction data based on in-depth interviews with the CEOs of the participating service driving agencies. These variables represented a crucial and parsimonious set of dimensions as assessed by the key informants (the CEOs) in the service driving agencies.

Specifically, we considered assignment time (AT) in seconds, which is the difference between the time a driver is assigned and the incoming call time, and travel time (TT) in seconds, as inputs for the DEA model. These two factors are considered as inputs since smaller values indicate better performance, in other words, the efficacy with which the customer is handled. Total fare (TF) is utilised as the output measure in the DEA since it represents the benefit derived from each transaction, that is, larger values indicate better performance. The categorisation of small

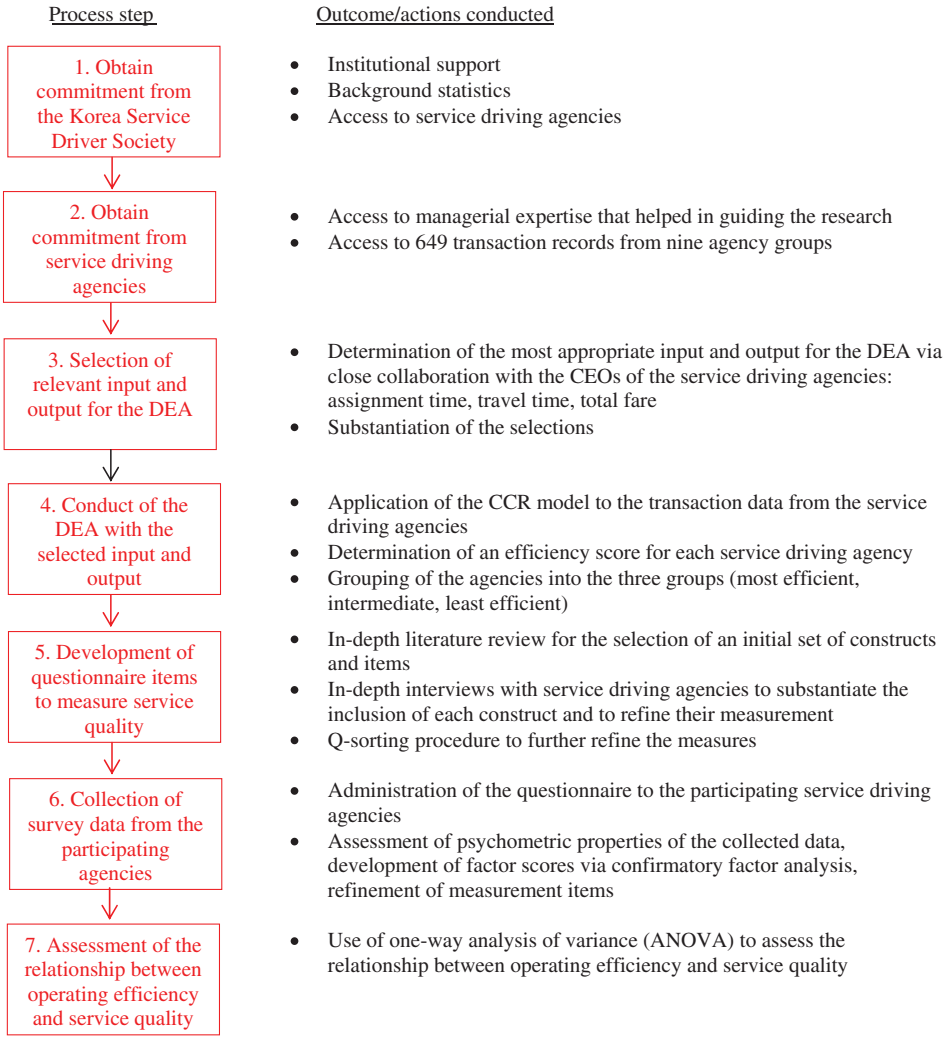


Figure 1. Flowchart of the research methodology employed.

is better as inputs and large is better as outputs, is consistent with some of the prior work in DEA (Khouja 1995, Baker and Talluri 1997).

Our selection of inputs and outputs is somewhat different from a traditional DEA standpoint where inputs are resources and outputs are performance-based dimensions. For example, prior research employing DEA in the service industry utilised manpower, operating cost and management level (rank) as the inputs, and revenue and facility success as the outputs (Zhu 2004). In their model on performance monitoring of suppliers, Talluri and Sarkis (2002) used total cost and number of shipments as the inputs, and the number of bills received without error, the number of shipments to arrive on time and ratings for experience and credence as output measures. Lu and Hung (2010) included the inputs of employees, assets and equity, and the outputs of revenue, profits and earnings per share as the outputs. However, as discussed above, we have utilised an appropriate method for selecting relevant inputs and outputs, which was driven by practical realities experienced by the service driving agencies.

Also, the rationale behind the input/output selection is that agencies take a fixed portion (15% to 20%) from each TF, as well as the existence of a minimum fare (US$15). In other words, service driving agencies realise higher profits by minimising AT and TT because each service driver serves more customers. Overall, these input and output measures offer a granular view at the operational level, and were deemed most appropriate by the CEOs consulted.

3.2 *Data envelopment analysis to determine operating efficiency*

With these measures in place, we proceeded with the conduct of the DEA, representing the fourth step in our research approach. DEA is anchored in Farrell's (1957) seminal frontier analysis and Charnes *et al*.'s (1978) mathematical formulation (referred to as the Charnes, Copper, and Rhodes (CCR) model). As a nonparametric approach of multi-criteria decision analysis, DEA transforms multiple inputs and multiple outputs into a single performance measure (an efficiency score).

It is especially useful to assess the operating efficiency for the following reasons. First, efficiency scores of various decision-making units (DMUs) can be derived solely from their quantitative inputs and outputs. Second, compared to other traditional parametric methods, the data utilised do not have to rely on prior assumptions of normality and equal variance. Third, it enables to set targets for inefficient DMUs by recognising the most efficient DMUs (a benchmark set) on the basis of the efficiency score. In this vein, DEA has been one of the most dominant analysis techniques for evaluating the relative operating efficiencies in many POM-based service research studies (Talluri *et al*. 2003, Bergendahl and Lindblom 2008, Feng and Antony 2009).

According to Doyle and Green's (1994) conception, the efficiency measure employed in DEA is best delineated by:

$$E_{ks} = \frac{\sum_y O_{sy} v_{ky}}{\sum_x I_{sx} u_{kx}} \tag{1}$$

where E_{ks} is the efficiency measure of agency s, using the weights of test agency k; O_{sy} is the value of output y for agency s; v_{ky} is the weight assigned to agency k for output y; I_{sx} is the value for input x of agency s; and u_{kx} is the weight assigned to agency k for input x. In the context of the service driving industry, the efficiency evaluation can be represented by a nonlinear programming problem as shown in Equation (2) below:

$$\begin{aligned} &\max\ E_{kk} = \frac{\sum_y O_{ky} v_{ky}}{\sum_x I_{kx} u_{kx}} \\ &\text{s.t.} E_{ks} \le 1\ \forall \text{ Agencies } s \\ &u_{kx}, v_{ky} \ge 0 \end{aligned} \tag{2}$$

By constraining $\sum_x I_{kx} u_{kx}$, the denominator of the efficiency measure of a test agency k to 1, Equation (2) shown above can be converted to a linear programming problem, shown as Equation (3) below:

$$\begin{aligned} &\max\ E_{kk} = \sum_y O_{ky} v_{ky} \\ &\text{s.t.} E_{ks} \le 1\ \forall \text{ Agencies } s \\ &\sum_x I_{kx} u_{kx} = 1 \\ &u_{kx}, v_{ky} \ge 0 \end{aligned} \tag{3}$$

The result of Equation (3) above is an optimal efficiency score (E^*_{kk}) of a DMU which is equal to or less than 1; $E^*_{kk} = 1$ indicates that agency k is an efficient DMU. If $E^*_{kk} \prec 1$, agency k is an inefficient DMU, and at least one other agency, or a linear combination of other agencies from the sample, can generate the same vector of outputs by using a lesser vector of inputs. Equation (3) is executed s times in determining the efficiencies for all agencies. The DEA evaluations associated with the CCR model including the range of CCR efficiency scores and standard deviations of each agency are shown in Table 1.

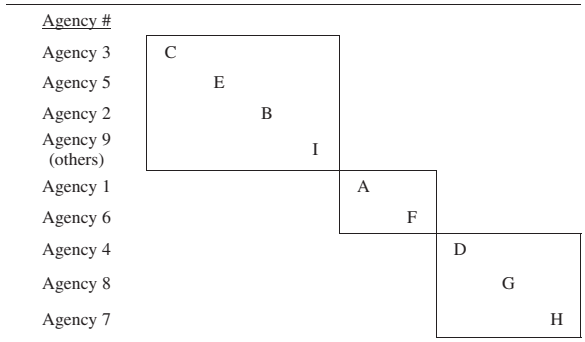
In order to test the differences in efficiency scores among various agencies and identify homogenous groups, we considered the variability in efficiency scores for each of the agencies based on transaction data. Since the efficiency scores do not lend themselves to normality assumption, we utilised the Kruskal–Wallis (KW) test (Kruskal and Wallis 1952), a nonparametric counterpart of the ANOVA F-test.

The KW test is an extension of the Mann–Whitney (MW) test. While the MW test compares two unrelated samples, the KW test can be used to analyse two or more unrelated samples. The use of such a nonparametric test has been proposed and utilised by previous studies to categorise multiple DMUs into homogeneous groups based on

Table 1. Agency data with mean CCR efficiency score ranges.

Agency #	# of transactions	CCR efficiency range		Standard deviation
		Minimum	Maximum	
Agency 1	103	0.14875	1.00000	0.17920
Agency 2	72	0.17734	0.89334	0.15593
Agency 3	38	0.20559	1.00000	0.19770
Agency 4	153	0.10686	1.00000	0.15306
Agency 5	69	0.05899	1.00000	0.19206
Agency 6	128	0.06850	0.95661	0.17166
Agency 7	24	0.11820	0.67590	0.14275
Agency 8	35	0.22432	0.63114	0.11648
Agency 9 (others)	22	0.12696	0.95556	0.19645

Table 2. Agency groups based on Kruskal–Wallis test.



efficiencies (Talluri *et al*. 2000, Talluri and Narasimhan 2004). Based on this procedure, using the KW test, we tested the following hypotheses:

H_0 *All agencies have identical efficiency scores.*
H_1 *At least one of the agencies tends to yield larger efficiency scores than at least one other agency.*

Our test resulted in a p-value of 0.0334 thereby rejecting the null hypothesis at a $\alpha = 0.05$ level. Hence, there exists sufficient evidence to conclude that there is a difference among the nine agencies based on their efficiency scores, and at least one agency tends to yield larger efficiency scores than at least one other agency.

As a subsequent step we conducted all pairwise comparisons to identify heterogeneous agencies by adopting the least significant difference test (Conover 1998). Three homogeneous groups of agencies were identified based on the overlaps in the least significant difference tests. According to the results of our analysis, shown in Table 2, agencies are classified into the following three groups based on their service operating efficiencies: (1) agencies 3, 5, 2 and 9 excel against others (that is to say, these are the most efficient service providers), (2) agencies 1 and 6 demonstrate an intermediate efficiency and (3) agencies 4, 8 and 7 have the lowest levels of service operating efficiency.

3.3 *Assessment of service quality*

To understand whether tradeoffs exist between operational efficiency and service quality, we employed a survey-based methodology to assess the current service quality of agencies. As such, we proceeded in our research

methodology with step five (Figure 1) and the development of the questionnaire items for service quality. In assessing service quality, we were provided with the challenge that it would not be suitable or reliable to assess this dimension from the customers' perspective due to their intoxicated state and mental inebriation. Therefore we had to rely on measures that commonly are attributed to constituting or leading to service quality, as assessed by our key informants in the study, namely the CEOs of the service driving agencies. As such, measures were sought that would be able to provide the foundation for excellent service quality to ensue. To ensure the reliability and validity of the measures, we proceeded with a very methodical and structured approach, as described below.

Aiming to develop measures constituting the foundation for service quality, we drew items from the extant literature and modified them accordingly to reflect the context of the service driving industry. This enabled us to capture the unique characteristics of this new business model, a recommendation issued by Kettinger *et al*. (1995). The constructs were further corroborated through in-depth interviews with the participating agencies, confirming their relevance, applicability and value as being able to assess service quality.

Also part of this fifth step in our approach was the refinement of these construct measurement items via a q-sorting procedure (compare with Cao *et al*. 2010, Jayaram *et al*. 2012). This was performed to ensure that measurement items indeed provide an assessment of the underlying construct. In the approach, a panel of five POM faculty and doctoral students at a major Midwestern university were provided with all measurement items used in the study, in random order. They were then asked to assign each of these items to one of the underlying service quality dimensions, based on their subjective judgment. Ideally, items developed for a particular dimension should then be matched to this dimension, and not to any other dimension. If the item is matched to a different dimension, it indicates that the measure does not truly reflect the desired dimension, and thus should be modified to better do so. This approach ensures that there is maximum differentiation between the items measuring different dimensions, but that items measuring the same dimension are coherent. The q-sort approach was thus used to ensure the validity of the measurement items and to ensure that they assess their respective underlying construct (the service quality dimensions). As such, the q-sort approach improved the rigor of the measure development process leading to the final measures assessing service quality. Since we were provided with a challenge in the assessment of service quality (as noted above, in that we were not able to measure service quality directly by asking the customer receiving the service, due to their intoxicated state), we included this additional step in the process. After a refinement of the items based on the feedback of the initial q-sort, the modified items were subjected to another q-sort with a different group of faculty and doctoral students at the same institution. This yielded an acceptable convergence on the constructs, and offered confidence in a valid and reliable assessment of service quality.

The result of this fifth step of our research methodology was a set of five service quality proxies that are fundamental to service quality theory (Rust and Oliver 1994), and that are also currently being adopted by service driving agencies. These dimensions include demand control capability, employee characteristics, employee satisfaction, service standardisation and technological advances. Our approach of assessing service quality with these dimensions is anchored in the generally accepted notion that 'attributes associated with a service firm's personnel play a key role in the determination of customer satisfaction and customer perceptions of service quality' (Hays and Hill 2001, p.336), and as such relies on the underlying structural and infrastructural dimensions ensuring service quality as assessed by the CEO of the service provider as the key informant. The dimensions also address the fact that service quality is comprised of the service product, service delivery and service environment. The five constructs are briefly described below with Table 3 summarising the final measurement items utilised and corresponding literature.

Demand control capability refers to the ability in managing demand to avoid/promote peaks/off-peaks. As service goods cannot be stored nor transported, balancing demand and supply is one of the key concerns for service managers (Zeithaml *et al*. 1985, Schmenner 1986). In particular, there exist huge demand variations between peaks (nighttime hours Thursday to Saturday) and off-peaks (daytime hours on the other days of the week) in the service driving industry. Further, in our in-depth interviews, CEOs of service driving agencies were concerned that even a single unassigned customer can severely harm their overall service quality. Under the ever-present and intense price/non-price competition, customers can easily switch to other agencies if no driver is assigned within 10–15 minutes, and never make a call again to that agency. Hence, agencies are undertaking considerable efforts, such as effective workforce scheduling and regular promotions for customers, to manage rapid changes in demand.

The variable employee characteristics are defined as an employee's characteristics that enable him or her to serve customers better, which has been regarded as one of the most critical factors affecting service quality in the service literature (Parasuraman *et al*. 1985, Loveman 1998). Specifically, in the service driving industry, a single driver's service quality can influence the overall reputation of the agency, and a high variability in the skills of the

Table 3. Service quality measurement items and related literature.

Service quality component	Construct	Item	Question	Illustrative literature
Service environment	Demand control capability (DCC)	DCC1	Regular promotions for customers	– Schmenner (1986) – Santos (2003)
		DCC2	Discounts for off-peak customers	– Yang and Jun (2008)
		DCC3	Regularly implementing customer promotion activities	
		DCC4	Effective workforce scheduling	
Service delivery	Employee characteristics (EMP)	EMP1	Employees' average tenure in the agency	– Jaworski and Kohli (1993) – Loveman (1998)
		EMP2	Employees' years of driving experience	– Verma (2000) – Wieseke *et al*. (2007)
		EMP3	Established hiring practices	
Service delivery	Employee satisfaction (ES)	ES1	Offering health insurance for employees	– Dubinsky *et al*. (1986) – Heskett *et al*. (1994)
		ES2	Existence of employee reward systems	– Maddern *et al*. (2007) – Brown and Lam (2008) – Yee *et al*. (2008)
Service product	Service standardisation (SS)	SS1	Existence of corporate norms for driver's attitudes towards customers	– Black *et al*. (1999) – Hensley and Dobie (2005) – Raisinghani *et al*. (2005) – Antony *et al*. (2007)
		SS2	Regular internal service training programs	
		SS3	Providing checklist on how to serve customers in the right manner	
		SS4	Regular updates on service checklists	
		SS5	Existence of service–quality-related corporate mission	
		SS6	Regular service training programs by external entities	
Service delivery	Technological advances (TA)	TA1	Availability of new personal digital assistants (PDAs)	– Bharadwaj *et al*. (1993) – Kellogg and Nie (1995) – Verma (2000)
		TA2	Subsidies for employees purchasing new PDAs	– Roth and Menor (2003)
		TA3	Free (or discounted) program upgrades for PDAs	

workforce can easily lead to inconsistent service quality. To reflect the context of the service driving industry, based on in-depth interviews, we adapted existing measurement items of the EMP construct (Verma 2000, Wieseke *et al*. 2007) to assess each driver's average tenure in the agency, years of driving experience and the agency's hiring practices.

Employee satisfaction, which measures the level of the employees' satisfaction in their jobs, has also been seen as a factor influencing service quality and customer satisfaction (Dubinsky *et al*. 1986, Yee *et al*. 2008). The service driving industry has been suffering from a high workforce turnover because most of the replacement drivers are comprised of unemployed males, who regard the employment as their second or temporary job. This low job

Table 4. Summary of service quality measurement items.

Construct	Item	Mean	Standard deviation	Cronbach's alpha (≥ .70)	Factor loading (≥ .60)
Demand control capability (DCC)	DCC1	4.143	1.167	0.876	0.896
	DCC2	1.643	0.497		0.170††
	DCC3	4.214	0.699		0.899
	DCC4	3.571	1.089		0.812
Employee characteristics (EMP)	EMP1	2.889	1.453	0.944	1.068
	EMP2	3.204	1.471		0.878
	EMP3	2.630	1.184		0.837
Employee satisfaction (ES)	ES1	2.214	0.579	0.553†	–
	ES2	3.286	0.726		
Service standardisation (SS)	SS1	3.857	1.292	0.939	0.907
	SS2	4.071	1.072		0.728
	SS3	4.000	1.038		0.913
	SS4	3.643	1.216		0.872
	SS5	4.571	0.646		0.850
	SS6	3.071	1.207		0.920
Technological advances (TA)	TA1	4.429	0.756	0.934	0.932
	TA2	3.357	1.216		0.975
	TA3	3.571	1.453		0.945

†: Construct(s) dropped after reliability test; ††: Item(s) dropped after CFA

commitment, combined with the availability of a large low-wage workforce generated by the Korean economic downturn, has led to service quality problems (Korea Service Driver Society 2010). In our in-depth interviews, one CEO of a service driving agency also stated:

> We would like to improve our service quality to win this huge and constantly growing market – but it is not that easy . . . Service driving is not being regarded as a profession in South Korea, but more like a *second* job. We have seen that most of our service drivers leave the agency anytime when they get full-time jobs elsewhere. Fortunately, new employees keep coming in due to this bad economy, and there still exist a lot of unemployed workers in the labor market . . . I admit that many of our customers are not satisfied with the quality of our service, but we are not the only ones worrying about service quality problems.

This quote illustrates the importance of personnel, which is emphasised even more as the competition for good drivers increases, due to new agencies entering the market that scout for experienced drivers. Overall, our interviews revealed that agencies are becoming more concerned with employee satisfaction as a tool for exceeding or at least maintaining their current service quality level, warranting the inclusion of this variable in our research.

Service standardisation represents the ability to provide consistent customer service. Service firms establish formal service specifications to standardise their service for maintaining consistent service quality (Parasuraman *et al.*1985). In particular, the service circumstances of the service driving industry are extremely diverse as most of the customers are intoxicated. Hence, the standardisation of service through corporate norms, a service manual/checklists and specialised training programs are essential for having consistent service quality.

Technological advances, which refer to state-of-the-art technologies for employees, have been stressed as a source of competitive advantage in the service literature (Bharadwaj *et al.* 1993, Kellogg and Nie 1995). In the service driving industry, a state-of-the-art PDA is an essential device for drivers to convey their locations to agencies more precisely and get a higher number of calls. As customers of the service driving industry are extremely sensitive to time delay, better technological support provided by the service driving agencies, such as subsidies and discounts on new PDAs, can positively affect the customer's perception of the service quality of agencies.

Having developed these sound dimensions of service quality and their associated measurements, we proceeded with step six of our research approach: the collection of survey data from the participating agencies. In order to do so, the 14 service driving agencies, from which we had transaction data records, were contacted, and the CEOs were asked to answer the questionnaire assessing the five dimensions. We deem this data to be more accurate and reliable since it is very doubtful that the average customer would be able to provide such an assessment of service quality, given their intoxicated state. All service driving agencies participated in the survey, resulting in a response rate of 100%.

Table 5. Analysis of variance of agency groups[a].

Group classification		DCC	EMP	SS	TA
Most efficient (M)	Group mean	4.611667 (I, L)	4.125000 (I, L)	4.625000 (I, L)	4.569167 (I, L)
	Standard error	0.451076	0.599265	0.489578	0.495369
	N	12	12	24	12
Intermediate (I)	Group mean	3.666667 (M, L)	2.666667 (M, L)	3.583333 (M, L)	3.500000 (M, L)
	Standard error	0.516398	0.516398	0.900337	0.836660
	N	6	6	12	6
Least efficient (L)	Group mean	2.555556 (M, I)	1.444444 (M, I)	2.277778 (M, I)	2.111111 (M, I)
	Standard error	0.881917	0.726483	0.894792	1.166667
	N	9	9	18	9
F-value		26.663089***	47.213589***	51.545092***	21.821740***

***$p < 0.01$; **: $p < 0.05$; *: $p < 0.1$

[a]Group names in parentheses indicate the group from which this group is significantly different at 0.05 level of significance based on the Scheffe or Dunnett's T3 pairwise comparisons.

Using the collected data, we tested construct reliability by using Cronbach's alpha reliability test. As shown in Table 4, all constructs except ES exhibited values greater than the suggested 0.7 level, providing evidence for the reliability of our construct measures. Due to the poor psychometric properties of the ES construct, it was omitted from further analysis. Confirmatory factor analysis (CFA) using unweighted least squares (ULS) was also performed to evaluate the factorial invariance of our measurement model.

The ULS approach was chosen since maximum likelihood (ML) would not be robust due to its dependence on multivariate normality, which is very rare in datasets of social and behavioural sciences (Micceri 1989). Compared to ML, ULS does not need a large sample size and is not driven by assumptions on the distribution of the observed variables; we therefore applied the ULS method for our CFA (Jöreskog and Sörbom 1984, Jöreskog 2003). The results suggested the removal of one item (DCC2).

The overall fit of this modified model was good, as indicated by various goodness-of-fit indices, such as the normalised fit index (NFI = 0.953), the relative fit index (RFI = 0.942), the goodness of fit index (GFI = 0.964) and the adjusted goodness of fit index (AGFI = 0.949). As can be seen, every index exceeds or is near the minimum recommended value of 0.950, suggesting that our model is adequate for measuring the service quality of individual agencies.

3.4 *Assessing the relationship between operating efficiency and service quality*

In the seventh and final step of our research approach, one-way analysis of variance (ANOVA) was implemented to determine whether the means of the three agency groups (that is, most efficient, intermediate and least efficient) statistically differ with respect to each service quality measure. The use of ANOVA to complement groups created via DEA is an approach that has successfully been applied in prior research (for example, Talluri *et al*. 2003, Saen *et al*. 2005, Cullinane and Wang 2006). The results for the group means, standard errors, F-tests and Scheffe's comparisons in Table 5 suggest that there exist significant differences across the three agency groups with respect to their service qualities.

For further investigation, we matched the results of the DEA on the 649 transaction data records for assessing the relative operating efficiencies with the responses to the survey. These matched results are shown in Table 6. Service quality measurement items were averaged by agency.

The results explicitly show that there exist clear differences among most efficient, intermediate and least efficient groups with respect to the four service quality measures. As can be seen from the table, the most efficient group excels against the other two less efficient groups in all four service quality measures with averages of 4.611 (in DCC), 3.963 (in EMP), 4.625 (in SS) and 4.570 (in TA). All service quality measures of the intermediate group, 3.667 (in DCC), 2.667 (in EMP), 3.584 (in SS) and 3.500 (in TA), were also above the ones of the least efficient group. The criticality of the service quality measures is further shown in order of DCC, SS, TA and EMP in all three groups.

Table 6. Matching of operating efficiency and service quality measurement items.

		DCC		EMP		SS		TA	
Group classification	Agency #	Avg.	Indiv.	Avg.	Indiv.	Avg.	Indiv.	Avg.	Indiv.
Most efficient	3	4.611	5.000	3.963	4.667	4.625	4.833	4.570	4.667
	5		4.667		4.000		4.833		5.000
	2		4.333		4.000		4.500		4.333
	9 (others)		4.444		3.833		4.333		4.278
Intermediate	1	3.667	3.667	2.667	3.000	3.584	3.667	3.500	3.667
	6		3.667		2.333		3.500		3.333
Least efficient	4	2.555	3.333	1.444	2.000	2.278	2.000	2.111	3.000
	8		2.333		1.000		2.333		1.667
	7		2.000		1.333		2.500		1.667

It is also interesting to note that EMP, which has the lowest scores in all three groups compared to other service quality measures, shows the greatest difference (2.519) between the most and least efficient agencies when compared to others. We suspect that this observation is due to the intrinsic variability of human resources. Through our in-depth interviews, we could partially confirm this reasoning by noting that many service driving agencies still prefer to lay off employees or hire inexperienced and low-waged drivers in accordance with their business conditions. Another interesting observation is that the greatest difference (1.389) between the intermediate and least efficient agencies is seen in TA and not in EMP. This illustrates that the inferior service quality of the least efficient group is mainly caused by its lower level of technological advances. Considering that the service driving business heavily relies on GPS-based PDAs and the sensitivity of customers to delayed arrivals, this observation points to the fact that the initial service quality perception of customers using the least efficient agencies is lower than that of customers using their more efficient counterparts.

4. Discussion and conclusion

4.1 *Implications for theory and POM practice*

Existing research studying operating efficiency and service quality postulated these two dimensions being in a trade-off relationship. Our study tests this relationship in the context of the service driving industry. To this end, this study contributes to service management theory and managerial insight in this unique context, which is characterised by an extreme sensitivity of customers to time delay, high turnover and variability in the skills of the workforce, low entry/exit barriers, intense price/non-price competition, continuous new technology adoption and real-time price bidding.

From an academic point of view, our research provides first insights into this novel and rapidly growing industry. Our results support the notion that service agencies with excellent operating efficiency also experience superior service quality, and vice versa. With these results we therefore highlight the compatibility of operating efficiency and service quality. This is in contrast to the conventional trade-off perspective, and speaks in favour of organisations being able to achieve these seemingly contradictory objectives. As such, our research parallels the achievements in the healthcare sector, specifically by such top-level hospitals as the Mayo and the Cleveland Clinics as discussed earlier.

On a broader level, we also illustrate the applicability of POM principles to the services domain, and highlight the importance of the realisation of synergies between these two fields, contributing to service operations management. Specifically, we build on, extend, and bring further insight into the debate surrounding whether capabilities in a firm have to be traded off against each other, or whether they can be pursued in unison. As such, we follow recent calls for the further advancement of this theory issued by Schroeder *et al*. (2011) and Schoenherr *et al*. (2012). Calls which we especially follow include the ones issued by Sarmiento *et al*. (2010) and Sarmiento and Shuka (2011), who encouraged the employment of multiple methodological and statistical approaches to test the trade-off perspective. We do so in the present study by the incorporation of both DEA based on secondary data and matched primary data collected via an empirical survey.

Our results provide evidence that operating efficiency and service quality can be pursued at the same time. This observation may also be indicative of the relative newness of the service driving industry overall, in that it has not reached its performance frontier yet. Alluding to the work of Schmenner and Swink (1998), it may be that the simultaneous pursuit of operating efficiency and service quality is still possible at the present time, but that as the industry matures and approaches its performance frontier, trade-offs need to be made. This contention offers an intriguing motivation for further study, and a potential replication of our approach in the future, once the service driving industry has matured.

We further find service operating efficiency and service quality to be compatible by showing that more efficient service agencies have better service quality with respect to a variety of dimensions. More specifically, we find that high and low levels of customer contact service processes (for example, employee or service standardisation versus demand control capabilities or technological advances) do not necessarily have to be decoupled for service quality improvement within the context of this new service business area, namely, the service driving industry. Our results thus provide support for the notion of the ambidextrous service organisation, being proficient in achieving both operating efficiency and service quality.

Our illustrative analyses also suggest numerous strategic decision-making implications for POM practice and service operations managers. For instance, as can be seen from the relative differences of the service quality measures, the differences in service standardisation and technological advances are consistently greater than those in demand control capabilities among the operating efficiency groups. This illustrates that service standardisation and technological advances are more closely associated with service quality. Specifically, the gap between the intermediate and the least efficient group was more pronounced than the one between the most efficient and the intermediate group, except in our factor related to employee characteristics. This therefore provides supportive evidence for the argument that inefficient service providers should spend more resources on technological advances than others in order to experience the same amount of improvement in service operating efficiency. In other words, the results show that service quality measures are associated with service efficiency in the order of technological advances, service standardisation and demand control capabilities.

An explanation for this finding provides the ability to derive not only product benefits from technological advances, but also process benefits. As such, while the product itself (the PDA) offers the potential for significant efficiencies in terms of communicating between the agency and the service drivers (also involving, for example, real-time dynamic bidding), the process of implementing this technology may also yield benefits. Parallels can be seen in the literature on enterprise resource planning (ERP) systems, where it was found that not only the ERP system as a product enabled greater performance of the firm, but also the process of implementing it (Bendoly and Schoenherr 2005). In doing so, processes have to be mapped out, enabling the identification of potential wastes, and the subsequent improvement and streamlining of the process. Similar arguments can be made for service standardisation, which involves the development of an established guide for the provision of the service, ensuring consistency. The development of such a catalogue of norms and service standards is also likely to yield the identification and subsequent communication of best practices, contributing again to greater service quality. Based on the rationales provided, such benefits are also likely to be expected for product quality in the manufacturing sector.

Going a step forward, our results also demonstrate that the intermediate and the least efficient service driving agencies in terms of operating efficiency are more focused on demand control capabilities, in contrast to the most efficient agencies focusing on service standardisation. Moreover, the gap between demand control capabilities and the other three service quality measures gradually decreases as service providers become more efficient. These results imply that service providers should give priority to demand control capabilities after achieving improvements in service standardisation, employees and technological advances. We believe that this is one of most useful implications of our study, especially considering that the service driving industry is operating in a highly diversified market comprised of innumerable small-sized service providers (agencies).

As a further contribution of this study, we combine our quantitative analysis employing DEA with an empirical survey and interview data representing all service agencies that provided transaction data for the DEA. The former assesses operating efficiency, while the latter is used to measure service quality. This stands in contrast to extant research that employed either pure analytical or pure empirical methodologies. This multi-method approach thus offers further corroboration for our findings and conclusions. Specifically, our identically matched dataset allows us to control for heterogeneity in operating efficiency and service quality at the individual service provider level. While we admit that this cannot fully rule out selection bias, it significantly increases our confidence about the positive

association between operating efficiency and service quality. We therefore offer evidence suggesting that our results are not a mere consequence of differences in unobserved conditions among different service providers.

We would like to conclude our discussion with a caveat, noting that we study the compatibility of operating efficiency and service quality in a specific context, namely the South Korean service driving industry. We chronicle the uniqueness of this sector, and explicate our findings above with the current state in the industry (for example, the ability to pursue the two dimensions in union at the present time, based on the theory of production frontiers). While we contend that our findings are generalisable across other industries with similar current characteristics, they may not be applicable across the board for all service providers. This points attention to the importance of considering contingencies and interpreting findings within their respective contexts. The criticality to take into account, the context, was for example recently illustrated by Schroeder *et al*. (2011) for the applicability of the sand cone model, and by Sousa and Voss (2008) for the POM domain in general. We echo their recommendations, stress that our findings have to be viewed within the context of the South Korean service driving industry and encourage future research to explicitly consider the specific context when studying POM phenomena.

4.2 *Limitations and future research*

While providing important insights to both POM theory and practice, our study is not devoid of limitations. As such, all survey data were gathered from a single respondent (namely, the CEO) at each participating service driving agency, providing an indirect assessment of service quality. We substantiated this approach from both a theoretical and practical perspective. Specifically, from a theoretical angle, the dimensions with which we assessed service quality rely on extant service quality theory (Rust and Oliver 1994) and are consistent with prior service quality research (Hays and Hill 2001, Stanley and Wisner 2001, Hays and Hill 2006). From a practical angle, we felt that customers would not be able to reliably provide answers due to the specific context we were provided with, that is to say the intoxicated state of the customers. As such, although the CEO is likely the most knowledgeable individual about the service quality of each service agency, serving as a key informant, this issue may still be a potential concern, since he or she may not be completely aware of how their service quality norms are implemented by individual service drivers. We aimed to mitigate this bias and our inability to assess service quality directly, as perceived by the customer, via in-depth interviews with service driving agencies. We, for example, assured that all CEOs had prior experience with drivers, and that they understood what type of service quality efforts can possibly be executed in the field. Future research employing multiple informants and/or dyadic surveys on service drivers and customers might strengthen our results on service quality measures and their associations with service operating efficiency.

As a further limitation, we were not able to achieve favourable psychometric properties for our employee satisfaction construct considered, despite its methodical and structured development. We were therefore unable to assess the relationship of ES to operating efficiency. Future research is encouraged to overcome this shortcoming by the development of a more robust measure. In addition, we were hampered by a relatively small sample size and, as such our statistical analysis, especially the ANOVA, had to be rather exploratory in nature. While we contend that we cover a significant proportion of the service driving industry population in the region considered (40%), the small sample size must be noted as a limitation, preventing us from more rigorous statistical testing. To overcome this shortcoming, which will be a challenge in future research, we suggest the sampling of all service driving agencies in multiple countries, since a survey conducted in a single country is likely to still yield an insufficient sample. Only when multiple countries are included can the sample size be increased enough to enable more confirmatory model testing.

We also should note that our study has been conducted in a specific national context (South Korea). Even though service driving is still uncommon in other countries, except in East Asia and US cities with large East Asian populations such as New York, Los Angeles and Chicago, it is important to note that caution is warranted when applying the results to other countries in accordance with Harvey's (1998, p.596) point: 'Not all service industries are created equal.' Nevertheless, we expect this industry to grow quickly, and as such, our results can provide invaluable insight for POM managers as service driving becomes more common in other parts of the world. We also recommend that future POM-based service research expand our idea on the compatibility of operating efficiency and service quality to the service recovery paradox that refers to situations in which a customer's post-failure satisfaction exceeds pre-failure satisfaction (Bolton *et al*. 2006, Lapré 2011); in other words, how does excellent service recovery affect a firm's corresponding operating efficiency, service

quality and customer satisfaction? Furthermore, a longitudinal investigation on the same industry, or applications to other types of services, will be useful as it may provide further insight on whether our findings from this study can be applied to different industry contexts.

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