Journal of Service Theory and Practice

Service Enterprise Productivity in Action: Measuring Service Productivity

Journal:	*Journal of Service Theory and Practice*
Manuscript ID	JSTP-06-2017-0104.R3
Manuscript Type:	Research Paper
Keywords:	Customer participation, Customer interaface, Service productivity, Data Envelopment Analysis, Travel and tourism

SCHOLARONE™ Manuscripts

Journal of Service Theory and Practice

SERVICE ENTERPRISE PRODUCTIVITY IN ACTION:

MEASURING SERVICE PRODUCTIVITY

Abstract

Purpose – The purpose of this paper is to measure service productivity using the Service Enterprise Productivity in Action (SEPIA) model. The research operationalises only one of the five stakeholder groups, the customer interface which incorporates service complexity, customer interactions, customer channel, customer loyalty (new) as inputs, and customer loyalty (referred and repeat) and willingness to pay as output measures.

Design/methodology/approach – The research extends our understanding of existing service productivity models with the development of the SEPIA model. Data was collected from 14 organisations operating in the Australian travel and tourism industry, which was analysed using a data envelopment analysis (DEA) input oriented variable return to scale method as applied to the SEPIA model customer interface.

Findings – Four key findings from the research include: customer choice and their ability to pay is a determinant of service productivity; service productivity is a two stage process when measured; service complexity is not categorical; and quality business systems do impact service productivity.

Research limitations/implications – A limitation of this research is that only one (customer) of the five key stakeholders, customer, employee, manager, supplier and shareholder, was operationalised inthis research paper.

Practical implications – The operationalisation of the SEPIA customer interface using transactional data and measuring non-financial, intangible factors of productivity provide managers with insights on what services to offer, when to invest in or promote the use of technology and whether to spend marketing effort on customer acquisition or customer retention.

Originality/value – The SEPIA model positions service firms within a social and service value network and provides a range of customer measures that extend the current capital (K), labour (L), energy (E), materials (M) and service (S), KLEMS measure of productivity and can be used to show the impact customers have on service productivity.

Keywords: Customer participation, Customer interface, Service productivity, Data envelopment analysis, Travel, Tourism.

Journal of Service Theory and Practice

Journal of Service Theory and Practice

Introduction

The service industry is an important pillar of national economies (Lee et al. 2007). Globally, service exports account for 22.6% of the world's total exports and are a critical driver for growth, especially in developing countries (Australian Government Department of Foreign Affairs and Trade [DFAT] 2017). In the Australian economy, the service sector plays a significant role as it represents over 70% of Australia's gross domestic product, employs four out of five Australians and contributes approximately 20.9% to Australia's total exports. It is expected that the impact of services is higher considering the majority of services produced each year are intermediary services; that is, they are embodied in the goods or operations of other businesses rather than sold to end consumers (DFAT 2017). Clearly, services are an essential ingredient of Australian economic growth and one that has implications on Australia's overall economic productivity.

At a macro-economic level, and in economic and social sciences, productivity's link to a nations prosperity and living standards make it a topical measure (Joppe & Li 2016). Productivity is a relative, volume-based measure that indicates how efficiently a country, region or organisation is able to convert inputs (resources used) to outputs (value) (Coelli et al. 2005). At the micro-level, productivity measures the efficient allocation of resources. The study of productivity has its roots in the era of manufacturing and mass production (Sigala 2004; Sigala & Mylonakis 2005), where measures were easily captured and quantified (Joppe and Li, 2016; Walsh et al., 2016). However, as nations have transitioned from manufacturing to service- and knowledge-based economies, productivity growth rates have declined (Byrne, Fernald & Reinsdorf 2016). This has led to scholarly debate over whether the current capital (K), labour (L), energy (E), materials (M) and service (S) (KLEMS) measures of productivity (Timmer, O'Mahony & van Ark 2007) are relevant for service- and knowledge-based economies (Byrne, Fernald & Reinsdorf 2016; Ostrom et al. 2015).

Despite questions on how productivity measures are applied to service, and consequently their validity, the importance of service productivity as a measure remains. A recent study of business leaders ranks the measurement of service productivity highest across 12 sub-topics and third highest in terms of the importance-knowledge gap (Ostrom et al. 2010). Yalley and Sekhorn (2014) blame an over-reliance on the use of concepts that are grounded in traditional manufacturing and production processes for the lack of knowledge of productivity in services. Vargo and Lusch (2004a, b) and others have claimed that service should be viewed differently from goods production and requires a new logic, either a service dominant logic (Vargo & Lusch 2004a; Vargo & Lusch 2004b) or a service systems approach (Sampson 2000; Spohrer 2007; Spohrer & Maglio 2006; Vargo, Maglio & Akaka 2008) in order to understand service productivity.

Major differences exist between goods production and service delivery; in particular, studies indicate that the intangible nature of services and the role customers play in service delivery are two key differentiators (Lovelock & Young 1979; Sampson & Froehle 2006; Vargo & Lusch 2004a). The intangible nature of services makes them difficult to quantify (Johnson & Jones 2004; Walsh et al. 2016), which has resulted in reluctance amongst service firms to attempt to measure service productivity (Walsh et al. 2016). In addition, customers play a critical role in services as they provide input into the service delivery process, where customer input is viewed as a precondition to the service delivery process commencing (Sampson & Froehle 2006). The notion that '*customers supply one or more input components for that customer's unit of production*' (Sampson & Froehle 2006, p. 12) places the customer in a dual role of customer and supplier; that is, of co-producer and co-creator of value (Sampson 2000; Vargo & Lusch 2004a; Vargo, Maglio & Akaka 2008). Hence, customers are inextricably involved in the service delivery process and have an impact on the service firm's operation, use of resources and, ultimately, firm productivity (Ordanini & Pasini 2008). Ostrom et al. (2010, p. 18) acknowledge that service design affects key customer outcomes '*and the trade-offs between customer and organisational objectives e.g. customer productivity versus organisational productivity*' requires further study. The fact that customers, their input and their actions serve as a resource within the service delivery process is justification for their inclusion in productivity measures; however, they are yet to be incorporated into the current KLEMS productivity measure.

Walsh et al. (2016, p. 9) claim '*there is a general belief in western societies that business firms measure and need to measure their productivity*'. This is supported by Ambler (2000) who suggests there is universal agreement that measuring productivity enhances business success. There are three main challenges to measuring service productivity: the identification of appropriate inputs and outputs; the unit of measure; and the ways relationships between inputs and outputs are measured in a service production system (Andersson 1996; Sigala & Mylonakis 2005). The lack of proper measurements and evaluation systems at an enterprise level exacerbate the problem of measuring service productivity. Walsh et al. (2016) suggest that service firms deviate from measuring productivity because the greater integration of customers in the service delivery process and the intangibility of services make them difficult to quantify. In the broadest sense, our study contributes to theory and practice by responding to Ostrom et al.'s (2010; 2015) call for service research, and the need to understand interactions and value creation from a multi-actor and service systems perspective. Specifically, this research focuses on one of the 12 research priorities they identify, '*measuring and optimising service performance and impact*' (Ostrom et al. 2015, p. 129).

This paper is structured in eight sections: section one provides a comprehensive literature review on existing service productivity models. This section also defines and develops the SEPIA model, which incorporates five key stakeholders of customers, employees, managers, suppliers and shareholders. Customer participation and customer variability is then discussed, resulting in the description of the customer interface construct. Section two includes the research methodology, where the importance of models is explained, commonly used methods of measuring service productivity are presented, and justification for using DEA provided. Section three provides details on the research design, section four shows data analysis, and section five presents the results and interpretation of DEA outputs. In section six we provide a discussion and key findings, before summarising the contributions in section seven. Section eight is the conclusion, which provides an overview of the research including limitations and suggestions for future research.

Literature Review

Motivated by the debate, challenge and importance around service productivity and calls from academics on the need for service productivity models and measures (Ostrom et al. 2010; Ostrom et al. 2015), this research examines existing service productivity models and draws on literature from operations management and service operations management. The models examined are Schmenner's (1986, 2004) Service Process Matrix (SPMa), Agarwal and Selen's (2005) Service Cubicle (SCu), Gronroos and Ojasalo's (2005) Service Productivity Model (SPMo), and Rust and Huang's (2012) Service Productivity Optimisation (SPO) model.

Of the service productivity models examined, only the latest SPO model operationalised service productivity using labour and automation costs as input measures, and service quality and firm profits as output measures. Schmenner's (2004) SPMa involve the throughput and degree of customer interaction and are based on the notion of high and low measures. These measures lack specificity and, therefore, were not operationalised. Agarwal and Selen's (2005) SCu extends the SPMa and

Journal of Service Theory and Practice

introduces an additional measure (the degree of technovation); however, the high and low measures remain, with the SCu also not operationalised. While Gronroos and Ojasalo (2005) introduce the notion of internal, external and capacity efficiency, specific measures are not detailed or operationalised.

One of the limitations of the SPMa is that it assumes one operating environment and attempts to place each organisation's operation within a matrix qualifying their operation as service factory, mass service, service shop or professional services. Schmenner (2001) and Schmenner and Swink (1998) incorporate the Theory of Swift Even Flow, claiming that the more evenly and swiftly goods or information flow through a system, the greater the productivity. Agarwal and Selen (2005) use the same Theory of Swift Even Flow to explain that the causality of productivity gains is also attributed to the degree of technovation axes. In doing so, they acknowledge two operating environments: the front office relating to customers, and the back office connecting with suppliers (Agarwal & Selen 2005). Gronroos and Ojasalo's (2005) SPMo model infers two operating environments via the notion of there being internal and external efficiencies. Rust and Huang's (2012) SPO model includes automation (technology) and human (labour) as two key and distinct operation models. The inclusion of technology enables the SCu, SPMo and SPO to take multiple input points into account by the SCu and SPMo linking the firm to a front and back office, and the SPO enabling customer facing automation and human interactions. Whilst the notion of a front and back office and technology implies connections with service providers, and the SPMo discusses internal and external efficiency, none of the models explicitly position the firm within a broader service value network (SVN). The SPMo notionally expresses the impact of suppliers on service productivity, expressed as external efficiency, but no measures are explicitly presented. Table 1 provides a review of service productivity models along with their characteristics that have been addressed by each of the service productivity models as examined in this paper.

Table 1 – Review of current service productivity models

Characteristic	SPMa Schmenner (2004)	SCu Agarwal and Selen (2005)	SPMo Gronroos and Ojasalo (2004)	SPO Rust & Huang (2012)
Objective measures (operationalised)	X	X	X	✓
Multiple operating environments	X	✓	✓	✓
Information and Communication Technologies (ICT)	X	✓	✓	✓
Multiple input and output points	X	✓	✓	✓
Network as the unit of analysis	X	X	X	X
Impact of suppliers	X	X	✓	X
Inclusion of multiple points to increase service productivity	X	X	X	✓
Measures specified and operationalised	X	X	X	✓

✓ = addressed by the model
X = not addressed by the model

Rust and Huang (2012) operationalised their SPO model with labour and automation costs as input measures, and service quality and firm profits as output measures. The measures were based on five assumptions: (1) wage rates, cost of automation and the level of technology are fixed in the market in the short run and are known to the firm; (2) firms choose the level of service productivity that will maximise profits; (3) better service quality leads to higher levels of demand; (4) at a given level of technology less labour intensity in service decreases service quality; and (5) automation is more cost-effective than labour in providing service. However, two of the five assumptions may not necessarily hold true. With the introduction of cloud computing, new technology options have emerged enabling new business models. As the cost and level of technology are no longer static, assumption one no longer holds true. Moreover, Bitner et al. (2000) show that thoughtfully managed and effectively implemented technology applications enable the delivery of customised service offerings prompt and effective service recovery, and demonstrate an ability to spontaneously deliver to the customer's needs. Such benefits challenge Rust and Huang's (2012) fourth assumption that more technology equates to a decrease in service quality.

Service systems and the social context

As mentioned earlier, the introduction of technology by Agarwal and Selen (2005) and Gronroos and Ojasalo (2005) position the service firm within a service system (Sampson 2000; Spohrer 2007; Spohrer & Maglio 2006; Vargo, Maglio & Akaka 2008). According to Stichweh (2011), one set of scholars examine the evolutionary developments and adaptations of nature (Bertalanffy 1969; Boulding 1956), whereas others take a multi-faceted approach to analysing social systems by suggesting all activities, including value co-creation, occurs within a social system (Luhmann 1995; Parsons 1977). Social context implies social norms and values exert pressure and influence the service exchange and value co-creation process, inferring value co-creation extends beyond the individual and subjective setting. Consequently, an actor's perceptions of value and behaviours in utilising resources are determined by the boundaries of the social system in which they operate, and the positions and roles they take within those boundaries.

According to Ouchi (1984), Rust and Huang (2012) and Williamson (1975), organisations set boundaries to maximise the efficiency of economic exchange. There is an emphasis on the purpose of the boundary and where customers fit in relation to this economic exchange. One view suggests the customer participating in the service delivery process is integral to the firm, as their actions are similar to those of employees (Bowen & Schneider 1988; Mills & Morris 1986). An alternate view proposes customers be excluded from participating directly in the service delivery process, placing them outside the boundary of the firm (Bowen & Jones 1986).

Irrespective of the customer being inside or outside the organisational boundary, the customer interface becomes central to their interaction and the customer-supplier duality relationship. This places the customer, their input and their actions as a resource within the service delivery process, which defaults to the existence of a service system or a SVN (terms used interchangeably). Such a system describes the crucial role customers and service providers – as well as other stakeholders – play in the context of service networks, although more from the angle of strategic and operational efficiencies and service innovations. Agarwal and Selen (2011, p. 1167) provide a definition for SVN as follows:

> A SVN is a network of value chains, which vibrates its essence from the combined core competencies of the stakeholders in the chain, mobilizes the creation and reinvention of value of its assets, requires strategic focus and revives roles and responsibilities amongst different stakeholders. Through the use of relationship, technology, knowledge and process realignment and management, a SVN connects to the customer via the channel of choice, heightens the transformation of the nature, content, context and scope of the service offerings,

Journal of Service Theory and Practice

opens up new market opportunities, keeps the social infrastructure intact and secures competitive advantage.

Defining and positioning the SEPIA model

Underpinned by the definition of a service system or SVN, and recognising the importance of systems theory and service systems, Scerri and Agarwal (2015) extend existing service productivity models using Boulding's (1956) nine level general systems hierarchy (see Appendix 1) to create the Service Enterprise Productivity in Action (SEPIA) model. In doing so, the SEPIA model identifies and includes customers, employees, managers, suppliers and shareholders as stakeholders (see Figure 1), and places productivity and its measures in a social context and within a service system.

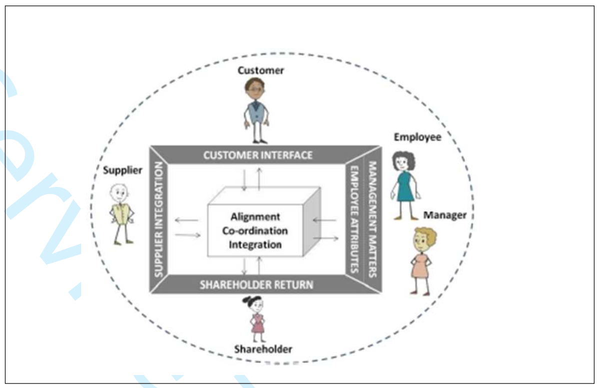

Figure 1 – Service Enterprise Productivity in Action (SEPIA) model

Specifically, the SEPIA model addresses many limitations identified in previous attempts to explain and measure service productivity, as summarised in Table 2. The inclusion of multiple stakeholders places the service firm within a social context, with service productivity '*being the result and the effect of the aggregate of decisions made by each stakeholders*' (Scerri & Agarwal 2015, p. 14). Along with the revisualisation of the service firm from a linear, single direction input–process–output form to a multi-stakeholder, bi-directional exchange as an integral component of a SVN, this premise suggests service firms should pursue strategies that optimise productivity across all stakeholders rather than attempt to maximise productivity from a single firm perspective.

Table 2 – Contributions of the SEPIA model

Characteristic	**SEPIA Scerri & Agarwal (2015)**	**SEPIA Contribution**
Objective measures (operationalised)	✓	Customer, employee and supplier stakeholder's measures were defined and operationalised. Manager and shareholder measures are operationalised in Management Matters (Bloom et al 2009) and capital measures exist in the current KLEMS model.
Multiple operating environments	✓	At an industry level, the SEPIA model is generalised and applied to multiple ANZSIC codes. At a firm level human, technical (fully automated) and hybrid operating models are catered for.
Information and Communication Technologies (ICT)	✓	Technology use (adoption) and technology integration is included in the customer and supplier interface constructs
Multiple input and output points	✓	Inputs and outputs are defined for each stakeholder group, hence using multiple input and output points
Network as the unit of analysis	✓	Link to customers and suppliers positions organisations to a wider network and the Networked Enterprise. Productivity in Action (NEPIA)* model.

Journal of Service Theory and Practice

		* The NEPIA model is not included in this paper.
Impact of suppliers	✓	Measures for supplier integration have been stabled (* excluded from this paper)
Inclusion of multiple points to increase service productivity	✓	Interface points for each of the stakeholders represents
Measures specified and operationalised	✓	Measures for customer interface, employee engagement and supplier integration have been determined. * The focus of this paper is on customer interface variables only

Noting the multi-dimensional and complex nature of services and various stakeholders involved, the aim of this paper is to operationalise one of the five stakeholders identified in Figure 1; that is, the SEPIA customer interface construct and associated variables in relation to the impact customer input may have on service productivity.

SEPIA customer interface decision variables

Crespi et al. (2006), Sampson and Froehle (2006), Teboul (2006), and Vargo and Lusch (2004a) each have their own interpretations of service. However, Agarwal and Selen (2011, p. 1169) put forth a co-produced dynamic capability and process-based view of service applicable to today's complex organisational environment. It sits within the realm of a SVN where different stakeholders interact, defined as:

> the application of competencies (knowledge, skills and experience) of the stakeholders, whereby the customer provides themselves, or provides significant inputs into the service production process and in the best case are transformed by the simultaneous consumption – the experience.

According to Vargo and Lusch (2004a), of the 10 properties defined, three key properties of services are established in the literature, namely: (1) service is the fundamental basis of exchange; (2) service is exchanged for service; and (3) the customer is always a co-creator of value. With this backdrop, we next describe each of the SEPIA customer interface decision variables.

Customer participation and customer introduced variability

The above definition of service and SVN clearly articulates the participatory role of customers as an implicit resource. Customers' involvement in the delivery process raises questions around how customers participate, along with the level and breadth of their participation, and how they contribute to an organisation as a resource. The heterogeneous nature of customer interactions, with their specific needs and requirements, introduces variability in service outcomes, defined as an *'unprogrammed event, which critically affects outcomes'* (Cherns 1976, p. 7). Service delivery becomes increasing complex with the introduction of customer variability and requires managers to make decisions on whether to reduce or accommodate customer-introduced variability (Frei 2006b; Schmenner 2004). Customer variability and the degree to which organisations reduce or accommodate variability affect firm performance (Frei 2006a, 2006b; Schmenner 2004; Walsh et al. 2016). Organisations attempt to control or deal with customer variability by grouping, categorising and segmenting customers into homogenous niches (Beltagui, Candi & Riedel 2016; Selhed & Anderson 2014). An example from the travel and tourism industry involves airlines categorising customers into different classes of travel and segmenting them based on their primary purpose of the travel. Corporate travellers and leisure travellers exhibit different behavioural characteristics and have different needs and wants. Moreover, the same traveller may exhibit different characteristics based on

Journal of Service Theory and Practice

the context of their travel (Edvardson, Tronvoll & Gruber 2011; Ng 2008). Therefore, firms make strategic operational decisions about the ways they deal with customer variability or, by defining the degree of service standardisation, service customisation, degree of customer participation, or level of integration they are prepared to offer their customer (Walsh et al. 2016).

Past service productivity models had a trade-off between human and technology delivered services, assuming one operating mode took precedence over another (Schmenner 1986, 2004). However, more contemporary organisations have introduced multiple operating models offering clients full service (via human interactions) AND fully automated (technology enabled or assisted) service offerings. There are also blended or hybrid models of service offerings that incorporate human assisted and automated processing within the one service encounter. Service kiosks are one such example where customers using self-service kiosks also have access to human assistance if required. Thus, customers can choose their preferred way of interacting with the firm at any given point via the service delivery process (Baily & Solow 2001).

Lovelock and Young (1979) were among the first to argue that a customer interaction touchpoint is the point where an organisation interacts with their customer and is the intangible source for organisations to increase their service productivity. Basole and Rouse (2008) claim that in a SVN, the customer interface is the point at which cutomer interactions are initated and where value is realised and/or consumed. Furthermore, the customer interaction touchpoint '*is where customers trigger all the activities in the service value network*' (Basole & Rouse 2008, p. 56) and provides the opportunity to incorporate both the customer and firm perspectives (Ukko & Pekkola 2016). The measure of customer activity at the customer interface point is also consistent with contemporary analysis, such as customer journey mapping (Lemon & Verhoef 2016) and service blueprinting (Bitner, Ostrom & Felicia 2008). In addition, a focus on the role of customers as co-producers and co-creators of value (Ukko & Pekkola 2016; Vargo & Lusch 2004a) led Verhoef et al. (2016) to suggest that examining how customers interact provides the opportunity to understand customer inputs through the choices they make from the options firms provide.

Firms provide options but customers make the decision on what to buy, when to buy, where to buy, how to transact, from whom to buy the service and what they are willing to pay (Scerri & Agarwal 2015). Conversely, managers make decisions on who to service, when to service, how to transact, who do they actually service and their willingness to accept what the customer is willing to pay (Scerri & Agarwal 2015). This is supported by Lovelock's (2000) view that suggests any service delivery system should be concerned with where, when and how the service is delivered to the customer. These managerial decisions underpin the SEPIA customer interface measures (Scerri & Agarwal 2015). Table 3 shows these decisions alongside the rationale for including each variable as proxy for measuring the SEPIA customer interface construct.

Table 3 - SEPIA customer interaction decision variables

Decision	**Customer**	**Service firm**	**Decision variable at the** customer interface construct
1	What services do I want to buy? (Customer choice)	What services does the firm offer?	Service complexity (SC)
2	When do I want to buy the services? (Availability of service)	When to offer the service?	Access to services (AtS)
3	Where do I want to buy the services? (Technology adoption)	Where does the firm offer services?	Customer service interactions (CI)
4	How will these transactions occur? (Customer segment)	How do the transactions occur?	Customer channel (CC)

Journal of Service Theory and Practice

5	Whom shall I buy services from? (Service Quality)	Who buys our services?	Customer loyalty (CL)
6	What am I willing to pay for the services? (Value)	Will the firm accept what the customer is willing to pay?	Customer willingness to pay (WTP)

Service complexity (SC)

SC addresses the question of what services to offer. According to Basole and Rouse (2008, p. 57) for '*end consumers to experience, use and consume value they desire or expect a service (or bundle of services) with that value must be provided by one or more actors in the value network*'. Customers choose from a selection of service offering made available by the firm, some of which are provided by other service providers in the SVN. Therefore, firms introduce SC as a way of dealing with customer variability and customise service offerings in accordance with customer requirements. In some industries the service provider is merely an aggregator of multiple service providers, and it is '*the ability to tailor services and the transactional environment to individual customer requirements*' (Srinivasan, Andersen & Ponnavolu 2002, p. 42) that contributes to SC. According to Brueckner et al. (2015), organisations use bundling and unbundling services as a way of offering customised services to meet individual customer needs and create value. Subsequenty, SC can be categorised into four levels of complexity, as shown in Table 4. These are based on the number of service types and number of service providers in each service transaction. It should be noted, however, that only three of the four service complexity levels were relevant to the particpant data.

Table 4 – Service complexity matrix

		Number of service types	
		Single	**Multiple**
Number of servcie providers	**Single**	Low SC-1	Medium (Types) SC-2
	Multiple	Medium (Providers) SC-3	High SC-4

Access to services (AtS)

Access addresses the question of when to offer services to consumers or how readily services are available to customers. Consumers choose to avail themselves of services offered by the firm at different times. Conversely, firms decide which hours they will operate based on hours of the day, time of year, holiday season, availability of staff, and the combination of technical and human resource configurations. Baily and Solow (2001), Lowe (1995), Macken (1983) and Wolfl (2003) claim that the hours of business a firm operates and the ways in which they do business impacts on productivity and the performance of the firm, each presenting views that impede or increase productivity for service firms.

Customer service interactions (CI)

Journal of Service Theory and Practice

CI address the question of where to offer services. Organisations implement a range of CI possibilities as customers tend to use different service delivery systems in a complementary way, taking into account their assessment of the advantages and disadvantages of each one (Patricio, Fisk & Falcao e Cunha 2003). Scholars such as Jacobs (1969, 1984), Marshall (1980) and Porter (1985) claim geographic proximity is a key contributor to a firm's ability to add value for customers. They cite benefits and provide examples where firms adopt strategies to position themselves close to their customers to enable growth and market share. On the other hand, authors such as Friedman (2005) and Rogers (1995) suggest technology adoption is the key contributor to adding value, and the significance of geographic proximity is a thing of the past. Sigala (2002) also suggests location does not contribute to the productivity of hotels when measured from a firm's perspective. Roth and Menor (2003) classify CI broadly, as either face-to-face or face-to-screen, thereby defining the point of interaction rather than geographic proximity. This implies service delivery is either geographically bound (face-to-face) or technology enabled (face-to-screen). However, a more balanced approach is taken by Basole and Rouse (2008), Sigala (2008) and Sphorer (2006) who claim, and empirically show, that a combination of human and/or technology resources contribute to the value creation process.

The hybrid approach to service delivery and customer interactions is incorporated in Roth's (2001) P3 service proximity matrix, which includes face-to-face and transitions to fully automated examples of service delivery methods. According to Boyer et al. (2002), Roth's measures of technological mediation occur at the customer interface (touch points). Froehle and Roth (2004) refine this by determining how interactions occur at the customer interface. They recommend two customer archetypes that provide a series of face-to-face interactions, based on the customer's geographic proximity to the service provider and the level of technology mediated interactions between the customer and service provider. In the present study, we apply four of the customer contact methods incorporated in Frohle and Roth's (2004) study and relabel them as follows: (1) online transactions (CI-Self), which are technology assisted and occur across geographically disbursed locations; (2) self-service transactions, which are technology assisted and occur in the same geographic proximity (Frohele & Roth 2004); (3) call-chat centres, which are human assisted, synchronous and geographically disbursed; and (4) face-to-face transactions (CI-FF), which include human assisted transactions where the service provider and customer are co-located in the same geographic proximity.

Customer channel (CC)

The SEPIA customer interface construct includes a CC, referring to the context in which transactions between the service provider and the consumer occurs. Inclusion of the CC in the measure of service productivity recognises the multi-directional nature of customer interations and customers positioned in a complex web of direct and indirect ties between their contribution to the value creation process. Basole and Rouse (2008), Bovet and Martha (2000), and Normann and Ramirez (1993) recognise and argue that value in a SVN is created via a complex set of relationships in which they segment and describe customers as end consumers (CCB2C) or business consumers (CC-B2B). The implications of this construct are that business to consumer (B2C) and business to business (B2B) transactions often differ in prices, cost and/or volume. In addition, one customer may belong to one or more channels depending on the context of their interaction with the service firm (Ng 2008). From a productivity perspective, CC enables the segregation of consumers interacting as end consumers or as consumers of intermediate services, thereby showing the extent to which the organisation operates within a SVN.

Journal of Service Theory and Practice

Customer loyalty (CL)

CL addresses the question of to whom services are offered. The cost of acquiring new customers (CL-New) is higher than retaining existing customers; therefore, the ability to retain customers is a high priority and important measurement metric (Anderson & Fornell 1994). Furthermore, according to Lovelock (2000) reducing customer churn and being selective in the customer acquisition process is key to creating CL. CL manifests itself in a buyer's sense of attachment or commitment to a product, service or brand (Wang & Wu 2011). Behaviours that demonstrate CL include repurchasing or repeatcustomers (CL-Rep) patronising the service provider, or referrals made to other potenital customers (CL-Ref) (Lam et al. 2004; Ng 2008; Su, Shao & Ye 2011; Wang & Wu 2011; Zeithaml, Berry & Parasuraman 1996). Whether or not a customer remains loyal depends on their overall level of satisfaction with the supplier and the availability of alternatives (Anderson & Fornell 1994).

Customer satisfaction is a post consumption evaluation of the percieved quality received, relative to the level of quality expected (Oliver 1980, 1981). Moreover, service quality is a cumulative construct, which is an overall asssessment of the firm's delivery service across multiple service encounters and culminated into customer loyalty (Parasuraman, Zeithaml & Berry 1985). As CL is the result of service quality, it is used in this study as a proxy for service quality.

Customers' willingness to pay (WTP)

Customer value is defined as the maximum amount a buyer is willing to pay for a service (Ng, 2008). Customers must perceive the value they receive from the good or service to be equal to or greater than the amount they are willing to pay for it. The generally accepted view on service is that it is co-created with customers and the value it delivers is subjective, based on the individual's perception of value (Prahalad 2004; Thomke & Von Hippel 2002). As such, organisations design service transactions that enable high levels of customisation and enable individual needs to be met (Gilmore & Pine 2000).

From a firm's perspective, price addresses the question of why services are offered. Organisations exist for different reasons; some are profit driven while others are not-for-profit (Coelli et al. 2005). Profit organisations determine success by the customer's WTP for the service and the price is a reflection of the value (output) they are able to create. Therefore, WTP is used as a proxy for customer value.

SEPIA customer interface input and output measures

Each decision variable is determined to be an input or an output. According to Cook and Zhu (2013), the general rule of thumb is that where organisations want to decrease the measure, they should treat it as an input variable, and where organisations want to increase the measure, treat it as an output variable. As a result, all classifications of SC, CI, CC and new customers (CL-New), who are more expensive to acquire, are assigned to be input variables. Customers who have been referred (CL-Ref) or are repeat customers (CL-Rep) are indicators of customer satisfaction and service (Oliver 1981; Parasuraman 2002; Su, Shao & Ye 2011), and are assigned as output measures along with WTP. These definitions and assignment of variables as inputs and outputs (see Table 5) serve as a coding schema for the new service productivity model.

Table 5 – Data coding schema

Decision Variable	Categories	Definition	Code	Input	Output
Service complexity	Low	One service type provided by one	SC1	Y	

		service provider			
	Medium	Multiple service types provided by one service provider	SC2	Y	
	Medium	One service type provided by multiple service providers	SC3	Y	
	High	Multiple service types provided by multiple service providers	SC4	Y	
Access to services*		Removed			
Customer interface	Self-service	Online transactions (different geographic proximity)	CI-Self	Y	
	Face-to-face	Face-to-face transaction (same geographic proximity)	CI-FF	Y	
Customer channel	Business-to-consumer	End consumers	CCB2C	Y	
	Business-to-business	Corporate customers	CCB2B	Y	
Customer loyalty	New	New customers	CL-New	Y	
	Referral	New customers that were referred by existing or past customers	CL-Ref		Y
	Repeat	Customer who had purchased services more than once in the last 12 months	CL-Rep		Y
Customer willingness to pay	Proxy for customer value	Sum of the net transaction value	WTP		Y

Note: *AtS was removed after expert opinion, which is discussed in a later section.

Furthermore, we interpret the traditional productivity equation of outputs divided by inputs to propose a mathematical definition of service productivity as:

$$Service\ productivity\ (customer\ interface) = \frac{SQ\ ,CV}{SC,AtS,CI,CC,CL-new} \qquad \text{Equation 1}$$

where, outputs of service quality are SQ = service quality and CV = customer value divided by inputs of service quality and SC = service complexity, AtS = access to services, CC = customer channels, CI = customer service interactions and CL = customer loyalty (new customers) as inputs. Further, we suggest service quality is a function of CL as defined by the number of repeat customers (CL-Rep) and new customers (CL-New). Hence, SQ is defined as:

$$Service\ quality\ = f\ (CL\_Rep, CL\_New)\ \text{ WTP} \qquad \text{Equation 2}$$

Research Methodology

Models are important to the development of theory (Simon 1957) and are recognised as a key component and research priority required to enhance our understanding of service and service productivity (Ostrom et al. 2010; Ostrom et al. 2015). Models also provide an abstraction or framework for the simplification of real-world phenomena (Busha & Harter 1980; Powell & Connaway 2004). These models assist investigators to describe, predict, test or understand complex systems more fully (Shafique & Mahmood 2010). They provide opportunities for groups to think collectively and combine their knowledge in logical and consistent ways (Manzoni 2007; Simon 1957). The present study examined service productivity models and identified the strengths and limitations of each; therefore, the continuation and appropriateness to further develop service productivity models led to the creation of the SEPIA model.

Common methods applied to measure productivity include ratio analysis, stochastic frontier analysis and data envelopment analysis (DEA). Ratio analysis is the simplest and easiest to apply; however, a major limitation of this method is its inability to handle multiple inputs and outputs simultaneously (Coelli et al. 2005; Cook, Tone & Zhu 2013; Sigala et al. 2005; Zhu 2000). Stochastic

Journal of Service Theory and Practice

frontier analysis accommodates multiple inputs and outputs simultaneously and employs advanced econometric techniques (Assaf & Josiassen 2016; Coelli et al. 2005). However, it is a parametric technique, which assumes a functional form for the relationships between inputs and output and subsequently may suffer from specification errors (Coelli et al. 2005; Sigala 2004). For this reason, Sigala et al. (2005) claims that stochastic frontier analysis might be inappropriate and suggested DEA instead, a non-parametric approach where no assumptions are made about the functional form when measuring service productivity, that is the relationships between the inputs and outputs.

DEA is a non-parametric linear programming method used to measure and compare service productivity across decision making units (DMU). DEA identifies the most efficient DMU classified as 'best practice' DMU amongst other DMUs included in the study (Charnes, Cooper & Rhodes 1978; Coelli et al. 2005; Cook & Zhu 2013). DEA constructs a linear production frontier by comparing each DMU in the observed dataset. This is achieved by comparing the mix and volume of resources used by each unit in relation to those of all other units included (Assaf & Josiassen 2016). Different DEA models exist and the one most often used for exploration is an input or output orientation with a constant or variable to scale (Coelli et al. 2005; Cook & Zhu 2013).

Charnes et al. (1994, p. 8) presents 12 strengths of using DEA, which were summarised by Sigala (2004, p. 43) into eight strengths. DEA provides a comprehensive productivity evaluation because: (1) it generates a single aggregate score by comparing simultaneously multiple inputs and outputs of comparable units and using a benchmark of 100% efficiency; (2) is independent of the units of measurement allowing flexibility in specifying inputs/outputs to be studied; (3) objectively assesses the 'importance' of the various performance attributes; (4) evaluates each entity in the best possible light, with all alternative priorities reducing performance; (5) calculates efficiency based on observed best practice, not against an 'average' or 'ideal' model; (6) best practices are identified; (7) no functional relationship between inputs and outputs needs to be specified; and (8) inefficient DMUs are identified as well as the sources and amounts of their inefficiency.

Research Design

The research design considered participants, sample size and the homogeneity of business operations. Expert opinion was sought to validate the appropriateness of the decision variables and categories of data. Data collection and data coding were required to prepare the data for analysis with DEA Frontier software, along with a test plan that was developed to ensure the definitions could be interpreted and data assigned unambiguously. Each of these factors are discussed next.

Participants

Participants for the present study were recruited from the travel and tourism industry, a service industry important to the Australian economy and recognised the high levels of customer contact, customer participation, automation and reliance on participants of service value networks (Scerri & Agarwal 2014). A series of five industry presentations were conducted to recruit participant organisations. Academic literature shows differences of opinion in relation to the optimum sample size of participants for this type of study. Boussofine et al. (1991) suggest the DMU number should be a multiple of the number of decision variables, while Golany and Roll (1989) caution against using a large number of organisations (each one representing a DMU). Cook and Zhu (2013) posit that the number of DMUs is immaterial as DEA is based on optimisation rather than a statistical regression

Journal of Service Theory and Practice

based model and the average behaviour of each DMU has no relevance to the result. Adopting Cook and Zhu's (2013) most recent thinking, we included 14 DMUs in this study.

Another point of consideration in recruiting participants is the homogeneity of the participant operation. Coelli et al. (2005) and Haas and Murphy (2003) claim DMUs must be engaged in the same process and operate under the same conditions, whilst Ray (2004) and Zhu (2000) contradict this claim. Zhu's (2000) study sets a precedence where Fortune 500 companies operating across a range of industries were used in the same study. He proclaims the standardisation of variables and the unit of measure as the determinant of whether firms could be included in the same study or not. The 14 DMUs included in this study included three retail travel agents (Australian and New Zealand Standard Industrial Classification [ANZSIC] Division N group 722) and 11 accommodation providers (ANZSIC Division H group 44).

Data collection

Secondary data was collected from the Australian travel and tourism industry, which have high levels of automation that enable the storage, standardisation and availability of information to be more accessible. By definition, secondary data is data collected for a purpose other than analysis (Gray 2009) and, according to Watmough, Polovina and Andrews (2013), transactional data is the record of internal and external events that take place as a result of an organisation doing business. As such, to measure service productivity, transactional data, bookings and payments made during the period 01 January through to 31 March 2012 were obtained. The data included itinerary information for each booking, including flights, accommodation, car hire, package tours, and insurance and payment information. This level of data was required to determine the measures for the SC category. Systems logs in electronic format, using extracts from global distribution systems, accounting systems and property management systems, identified whether the interactions occurred via an online channel or not. CC data was determined either by a record in the booking or where the invoice or form of payment was recorded against a corporate account. CL-Ref data was identified from the booking source and CL-Rep was determined by cross checking client booking data for the previous 12 months where an exact match of client name, initial, telephone and/or address matched. WTP data was determined by commission earned for each booking paid within the three-month period or, for accommodation, the amount paid was used as a proxy (excluding goods and service tax). In total, there were 476,944 records across all 14 DMUs.

Expert opinion

Prior to coding the data, we followed Manzoni's (2007) approach and consulted with industry experts on the appropriateness and application of each of the SEPIA variables and classifications, via a series of semi-structured questions (see Appendix 2). During these discussions, it was agreed that access and hours of operation had more to do with an employee measure (number of hours worked) than the availability to customers. Consequently, the removal of the AtS decision variable from the present study ensued, resulting in four input variables only.

Data Schema and Coding

A data schema was used to assist with the coding of each transaction to the appropriate variable and classification (see Table 4). It was important for the data schema to be unambiguously applied. To test this, the data schema and data was provided to two additional researchers who had no prior knowledge of the research. Each rater was provided with a random sample of transaction data relating to 20 clients across all 14 organisations. They were then required to code each set of client

Journal of Service Theory and Practice

data and assign transactions to each of the variable categories. This enabled determination of inter-rater reliability. Each of the three raters, the primary researcher and two additional researchers rated each of the set of 20 client transactions to every variable and corresponding category equally. Where everyone agreed, the inter-rater reliability was 100% and the goal of no ambiguity in the interpretation of the data schema was satisfied.

Furthermore, each of the 14 DMU organisations were anonymised and coded, with three travel agents coded from AA1 to AA3 and 11 accommodation providers coded from PA1 to PA11.

Appendix 2 shows the formatted data in accordance with the specifications of the DEAFrontier software. It should be noted that SC3 (i.e. one service type provided by multiple service providers) was omitted from the data as SC3 transactions did not exist for any of the 14 organisations in the study.

Data Analysis

The data was analysed using DEAFrontier software to determine an efficiency index for each DMU. As this was the first attempt to operationalise the SEPIA customer interface construct, an input oriented variable returns to scale method was applied 10 times. Table 6 shows the test plan created. DEA input oriented variable return to scale was run 10 times. First, all variables were included, after which one variable was reduced at a time, until finally a single input variable was used to understand the dynamics of each variable and their impact on the efficiency score of each DMU.

Results

DEAFrontier software generates three worksheets, each addressing the questions proposed by Sigala and Mylonaki (2005). The '*efficiency*' worksheet shown in Table 6 addresses '*how well is a DMU doing, in comparison to its peer*s' (Sigala & Mylonakis 2005, p. 178). The '*slack*' worksheet (summary provided in Table 7) addresses the question '*which dimensions and how much could the DMU improve*' (Sigala & Mylonakis 2005, p. 178). The '*target*' worksheet (Appendix 2) quantifies the optional target value for each variable.

Efficiency worksheet

The results are shown as an aggregated efficiency score and comparative peers among the reference set. Three outcomes are possible: organisations may be technically efficient, weakly efficient or technically inefficient. Technically efficient firms have a score of 1 with no comparative peers, as is the case for DMUs AA1, AA2, PA1, PA4, PA5, PA6, PA7, PA9, PA10 and PA11 (see Table 6). Weakly efficient firms have a score of 1 and have comparative peers identified. This indicates that weakly efficient firms are efficient in the use of one or more inputs, but may also show potential to further reduce one or more input, or increase one or more output. There were no weakly efficient DMU firms identified in the present study. Technically inefficient firms have a relative efficiency rating score of less than 1 and one or more comparative peers identified. Technically inefficient firms can reduce the number of inputs or increase the number of outputs for each of the variables. The highlighted DMUs in Table 6 shows DMUs AA3, PA2, PA3 and PA8 as being technically inefficient.

Table 6 – DEA efficiency worksheet results

DMU name	Input-oriented VRS Efficiency	Benchmark and comparative peers

Journal of Service Theory and Practice

AA1	1.00000				
AA2	1.00000				
AA3	**0.30894**	**1.000 AA1**			
PA1	1.00000				
PA2	**0.95715**	**0.868 PA5**	**0.066 PA10**	**0.066 PA11**	
PA3	**0.83266**	**0.261 PA1**	**0.309 PA4**	**0.310 PA10**	**0.120 PA11**
PA4	1.00000				
PA5	1.00000				
PA6	1.00000				
PA7	1.00000				
PA8	**0.92890**	**0.744 PA4**	**0.152 PA10**	**0.104 PA11**	
PA9	1.00000				
PA10	1.00000				
PA11	1.00000				

Sigala (2002) suggests the value of DEA analysis lies in the ability to identify which DMU is technically inefficient, and ability to locate comparative peers – all of which provide managers with the ability to transfer techniques and management practices for measuring productivity. Moreover, DEA helps locate specific areas of inefficiency. For example, DMU AA3 shown in bold in Table 6 as it is found to be inefficient (efficiency rating is 0.30894, which is less than 1) and when compared to DMU efficiency reference set AA1 (also shown in bold) is deemed inefficient. Hence, managers are able to identify that DMU AA3 is inefficient and its inefficiency can be studied more directly by comparing DMU AA3's business operation to the efficiency reference set AA1. In this way, DEA focuses the search for sources and remedies of inefficiency, enabling managers to take decisive actions.

Slack worksheet

Beyond identification of inefficient DMUs, DEAFrontier also provides a slack worksheet showing results for the technically inefficient DMUs (see Table 7). The slack worksheet indicates the number of input reductions for each input variable and the number of output increases for each variable required for the DMUs to become technically efficient. This provides managers with the ability to identify the area and extent of improvement required for each of the variables. As noted earlier, SC3 did not apply to any of the 14 organisations and is not included in the analysis.

Table 7 – Summary of DEA slack worksheet for technically inefficient firms

	Input slack								**Output slack**		
	Service complexity			Customer interactions		Customer Loyalty (New)	Customer channel		Willingness to Pay (Proxy for Value)	Customer loyalty (Proxy for service quality)	
DMU	SC1	SC2	SC4	CI-Self	CI-FF	CL-New	CCB2C	CCB2B	WTP	CL-Ref	CL-Rep
AA3	40.0	32.94	115.65	0.00	186.59	0.00	186.59	0.00	62273.00	0.00	17.0
PA2	831.14	0.00	72.65	7059.08	0.00	3123.62	0.00	831.14	0.00	2128.63	33.84
PA3	0.00	0.00	140.63	3407.18	7833.60	5453.10	0.00	0.00	0.00	4143.35	0.00
PA8	0.00	0.00	39.86	6730.64	3000.35	2900.88	0.00	0.00	0.00	2578.15	15.45

We illustrate one example of how DEA results obtained in Tables 6 and 7 are interpreted in practice and what they mean. From Table 6, DMU AA3 has an efficiency rating of 0.30894 and AA1 can be used as their comparative peer. Using the information extracted from the slack worksheet for AA3 (Table 7) we interpret the results for AA3 accordingly. AA3 should be able to reduce the level of SC across all SC categories by a reduction of 40.0 customers receiving SC 1, 32.94 customers

Journal of Service Theory and Practice

receiving SC 2 and 115.65 customers receiving SC 3, as well as reducing the number of face-to-face transactions by 186.59 customers and the number of leisure travellers (B2C) by 186.59 consumers. Keeping the same inputs, they should look to increase their customers' WTP by 62,273 units ($) and increase the number of repeat clients (CL-Rep) by 17.0. The data indicates that AA3 are over servicing their customers, may have quality issues, and their customers are extracting more value than those of their peers. DEA provides managers with specific areas to investigate and the most appropriate comparative peer business practices in which to conduct the investigation.

Target worksheet

The target worksheet, shown in Appendix 4, presents the target values for each of the input and output variables. These target values show the values required for each organisation (technically efficient, weakly efficient and technically inefficient) to be technically efficient.

Validated findings with expert opinion

These findings were presented to eight staff and four managers of the organisations, and two key industry experts. There was agreement and consensus that all variables except the SC variable provided an accurate account of their business operations and client interface. Their comments and feedback indicated that whilst the SC variable was indicative of the cause of complexity in their business, it failed to capture the extent of complexity experienced at a micro level. One consultant expressed it this way: '*... group travel is more complex than one person travelling on their own, you have to collect more information, and everyone invariably wants to do different things and you have to make sure everyone gets what they want*' (AA2).

Discussion and Findings

DEA showed four of the 14 DMUs technically inefficient in relation to their comparative peers, and identified which variables could be improved. However, it is the job of the manager to investigate the cause and potential remedy of the inefficiency (Manzoni 2007). Five key findings stand out from this research, namely: (1) the customer's choice and their ability to pay are determinants of service productivity; (2) service productivity is a two-stage process; (3) SC is not categorical; and (4) quality business systems impact service productivity.

Customer's choice and their ability to pay are determinants of service productivity

As discussed earlier, the results showed AA3 was technically inefficient with AA1 as a comparative peer. One of the key areas for improvement centred on the customer's WTP (refer to WTP column in Table 7). Investigation comparing the customer's WTP for AA1 and AA3 led to two key findings. The first relates to the geographical location of each business, where AA1 was located in a suburb with a high socio-economic rating according to the Australian Bureau of Statistics, while AA3 is located in a high ethnic-centric suburb with a low socio-economic rating. AA1 customers were holidaymakers predominantly booking international travel, which is complex and requires detailed itinerary planning and co-ordination. In contrast, AA3 customers book high levels of domestic travel and point-to-point international travel to visit friends and relatives. AA3 customers were able to leverage their position in a social network to extract greater value and negotiate discounts because of their real or perceived ability to pay. Therefore, customer's choice and their ability to pay are determinants of service productivity.

Journal of Service Theory and Practice

Service productivity is a two-stage process

Further investigation into AA3 customers' WTP showed customers' commitment to utilise the service occurred when the travel booking was made, and the service delivery concluded when the customer made final payment (for accommodation providers, customers' commitment to utilise the service occured when the booking was made and concluded when the customer checked out). The time period between the booking date and payment date or booking date and checkout date means inputs and outputs can occur over different periods. This was the case for a number of AA3 clients due to the context of their travel, which was visiting friends and relatives. In contrast, AA1 clients' holiday travel was paid for prior to 31 March due to airfare increases and payment deadlines. This implies that service productivity is a two-stage process and a different DEA model – multi-period input (Ozpeynici & Koksalan 2007) or two-stage DEA model (Zhu, 2000) – may be more appropriate for measuring service productivity.

Service complexity is not categorical.

SC was defined and categorised in the present study based on the number of service types and number of service providers included in a service transaction (booking). SC was also indicated a firm's position within a service network and the extent bundling unbundling was used to co-create value. However, when presenting findings to staff, managers and industry experts, they indicated that the SC definition, as it stood, did not adequately capture the level of complexity. Expert opinions indicated the number of customers and service segments included in a service transaction added further complexity. As a result, we propose SC is not categorical, rather it can be mathematically derived and expressed as shown in Equation 3, where SC is the sum of the number of customers (C), the number of service providers (Pi), the number of service types (Ti) and the number of service segments (Si).

$$Service\ complxity\ = \sum_{i=1}^{n} CiPiTiSi \qquad \text{Equation 3}$$

Quality business systems impact service productivity

The number of service transactions that resulted from CL-Ref and CL-Rep were used as a proxy for service quality (Gummesson 1998). Therefore, where organisations were shown to be technically inefficient due to the ability firms to increase their levels of repeat and/or referred customers, DEA results suggested that quality issues existed within the organisations that warrant further investigation by management. During the post study industry presentations seeking to validate the findings with expert opinion, the causality of the results became apparent. Technically efficient accommodation providers had structured referral programs in place, asking customers to post their experiences on Facebook and to 'refer a friend'. In contrast, none of the technically inefficient firms had an established customer referral program. Technically efficient accommodation providers also collected feedback from customers and recorded information on repeat customers in their customer relationship management systems. This is consistent with findings from Sigala's (2000) study into hotel productivity, where more sophisticated business systems and management practices led to higher levels of productivity. The implementation of customer referral and customer feedback systems and alterations to business practices to record and track the source of customer bookings (which also includes specific marketing programs), provide practical ways for managers to improve their business operations and offer value to customers; and thereby enhance overall DMU service productivity.

Journal of Service Theory and Practice

Contributions of the Research

This research makes three contributions theory and one contribution to practice. The first theoretical contribution made extends the seminal works by Schmennner (1984; 2004), Agarwal and Selen (2005) and Gronroos and Ojalo (2005) and other existing models. Only through exploring the strengths and limitations of existing models was the development of the SEPIA model made possible. The SEPIA model positions service productivity in a social context by incorporating five key stakeholders groups, namely customers, employees, managers, suppliers and shareholders. The inclusion of multiple stakeholders and decisions made by them impact on the productivity of service firms. This leads to a paradigm shift, where service firms seek to optimise efficiencies across all stakeholders, rather than maximize productivity for one.

The second theoretical contribution is made by defining and operationalising key non-financial measures occurring at the customer interface point. By doing so, we extend the work of Zhu (2000) who used standard financial variables to measure productivity across heterogeneous business operations; that is, Fortune 500 companies listed on the US stock exchange. In this research non-financial measures were applied to 14 organisations operating in the travel and tourism industry operating across two ANZSIC codes. This leads to the third theoretical contribution where customer inputs were defined as service complexity, customer interactions, customer channel and customer loyalty (CI-new), and outputs as willingness to pay and customer loyalty (CI-Ref and CI-Rep). This provided an opportunity to extend the KLEMS framework, currently used to measure productivity, to include a customer measure resulting in a KLEMS-CI framework, which would enable recognition and capture of customer resources in the service productivity equation.

The practical contribution made in this research is where in service organisations being able to measure and benchmark their organisations across a range of intangible factors, such as customer choice. This is based on the levels of SC, technology adoption based on the levels of self-service and face to face interactions, and customer loyalty (the mix between the numbers of customers who are newly acquired, referred or repeat). Developing a better understanding the impacts of each of the intangible factors may provide insights into which services (bundled or unbundled) to offer, when to invest in these services, implement various technologies, and where to spend marketing efforts related to customer acquisition or customer retention.

In particular, the SEPIA customer interface construct was operationalised where input and output measures of SC, CI, CC, CL and WTP were defined, measured and operationalised. This extends the current measure of productivity to include customers as a factor of production, which is missing from the KLEMS productivity model. Moreover, as a result of this research, we determined that SC can be mathematically derived from the number of customers, service providers, service types and service segments within a single service transaction.

The results of the DEA analysis showed differentiation across technically efficient and technically inefficient firms using customer inputs. In addition, the variables in which technically inefficient firms could improve their operations was also identified and interpreted. This capability provides managers with a practical and actionable way to undercover strategies that could facilitate improvement of their organisation's service productivity. Using DEAFrontier software through an Excel interface makes measuring service productivity more accessible to business managers, thereby facilitating the use of productivity measures in the workplace.

Journal of Service Theory and Practice

Limitations and Recommendations for Future Research

Firstly, the SEPIA model includes five stakeholders: customers, employees, managers, service providers and shareholders. However, the key limitation of this research is that only the customer interface construct was operationalised in the study, with inputs and outputs incorporated into the customer interface variable. Future research could include more than one or all other stakeholders. Secondly, an input oriented variable return to scale DEA model was used to operationalise the customer interface. As a range of DEA models exist, other DEA models such as a two-stage DEA may be more suitable.

Conclusion

The importance of services to a nation's economy cannot be underestimated, prompting academics to call for new models and new measures of service productivity. The contemporary view of service definition recognises customers as co-producers and co-creators of value. In the present study, the SEPIA customer interface was defined, standardised, operationalised and measured via the collection of data from 14 organisations. These included three retail travel agents and 11 accommodation providers operating in the Australian travel and tourism industry, belonging to two ANZSIC codes. An input oriented variable return to scale DEA model was applied using DEAFrontier software. Key findings from this research include that customers determine value based on their willingness and ability to pay. As such, service productivity is a two-stage process, service complexity is not categorical and may be determined mathematically, and quality management systems impact service productivity. Operationalisation of the SEPIA customer interface construct shows how customers participate in the service delivery process and how customer variability affects decisions made by service firm managers. This new measure of productivity is based on customer inputs and outputs, and demonstrates the use of DEAFrontier software to provide managers with practical and valuable insights into improving their operations and overall service productivity.

Journal of Service Theory and Practice

Journal of Service Theory and Practice

Appendix 1 – Boulding's (1956) nine level systems hierarchy aligned with the development of the Service Enterprise Productivity in Action (SEPIA) and Networked Enterprise Productivity in Action (NEPIA) models (Scerri & Agarwal 2014)

Level	Boulding's Nine Level Systems Hierarchy	Model and scholar	Contribution	Limitation
1	Framework – static models are where theories begin	Service Process Matrix (Schmenner, 1986)	Identification of four service operating models	Static in nature with broad measures
2	Clockwork – systematic analysis introduces dynamics and motion, which affect the steady state	Service Process Matrix (Schmenner, 2004)	Introduction of the productivity diagonal based on the theory of swift even flow	Difficult to plot an organisation in the matrix with accuracy
3	Thermostat – feedback begins to occur	Service Cubicle (Agarwal & Selen, 2005)	Introduces front office and back office functions	Exchange of information within an organisation
4	Interactions with external environment is introduced	Service Cubicle (Agarwal & Selen, 2005)	Introduction of the 'z' axis and the degree of technovation	Difficulty to plot an organisations operation accurately with the cubicle
5	Genetic-social – different geo-types and division of labour occur	Transition and development stage	Reconceptualising service productivity	Model in development
6	Animal level – specialist information receptors and information are able to be sent and received, reorganised and knowledge created	Value Creation Cube (Scerri & Agarwal 2013)	Inclusion of key stakeholders. Illustration of service productivity to be convergent rather than linear	No measures
7	Human level – human characteristics and perspectives are added	Opening the value creation cube (Scerri & Agarwal, 2013)	Stakeholders as the unit of analysis for service productivity	Multiple input and output points identified but not operationalised
8	Symbolic of behaviour – unit of the system defined by the role in the social organisation rather than the individual. The inter-relation, content and meaning of messages are important	SEPIA model (Scerri &Agarwal, 2013)	Analysis of input and output decisions and common set of variables identified	Conceptual model, empirical results pending
9	Transcendental level – includes the ultimate and the absolute, which sometimes remain unknown	NEPIA model (Scerri & Agarwal, 2013)	Positions the firm in various network configurations	Identified for future research

Appendix 2 – DEAFrontier formatted file

DMU	SC1	SC2	SC4	CI-Self	CI-FF	CL-New	CCB2C	CCB2B		WTP	CL-Ref	CL-Rep
AA1	74	10	45	0	131	114	131	0		83000	0	17
AA2	55	11	111	0	177	127	127	0		54421	0	50
AA3	369	139	520	0	1028	369	1028	0		20727	0	0
PA1	33740	0	203	14690	19050	31951	28546	5194		1026880	1166	623
PA2	26622	0	270	15620	9002	21588	18329	6293		774515	3034	0
PA3	64266	0	504	27470	36796	56439	49158	15108		1811384	7526	301
PA4	11647	0	338	5359	6288	11193	9648	1999		470725	446	8
PA5	8891	0	180	5190	3701	6780	6073	2818		320009	2109	2
PA6	10167	0	258	4880	5287	5862	7603	2564		213933	4273	32
PA7	25132	0	271	13894	11238	19710	22382	2750		638423	5355	67
PA8	38474	0	382	19418	19056	34097	30679	7795		1256749	4316	61
PA9	94516	0	125	44892	49624	85056	58877	35639		2011709	9192	268
PA10	73091	0	356	41047	32044	45479	43604	29487		2616952	27204	408
PA11	153866	0	93	10413	49683	130513	141670	12196		4892109	23273	80

Table 3 – SEPIA customer interface test plan

		Inputs				Outputs		
Model	Orientation	SC	CI	CC	CL-New	WTP	CL-Ref	CL-Rep
1	IO-VRS	Y	Y	Y	Y	Y	Y	Y
2	IO-VRS	Y	Y	Y	N	Y	N	N
3	IO-VRS	Y	Y	N	Y	Y	Y	Y
4	IO-VRS	Y	N	Y	Y	Y	Y	Y
5	IO-VRS	N	Y	Y	N	Y	N	N
6	IO-VRS	Y	Y	Y	Y	N	Y	Y
Test one input variable at a time								
7	IO-VRS	Y	N	N	N	Y	Y	Y
8	IO-VRS	N	Y	N	N	Y	Y	Y
9	IO-VRS	N	N	Y	N	Y	Y	Y
10	IO-VRS	N	N	N	Y	Y	Y	Y

Appendix 4 - DEAFrontier target worksheet (due to space limitations the figures are shown to the two decimal place only – not rounded).

DMU	SC1	SC2	SC4	CI-Self	CI-FF	CL-New	CCB2C	CCB2B	WTP	CL-Ref	CL-Rep
AA1	74.00	10.00	45.00	0.00	131.00	114.00	131.00	0.00	83000.00	0.00	17.00
AA2	55.00	11.00	111.00	0.00	177.00	127.00	127.00	0.00	54421.00	0.00	50.00
AA3	74.00	10.00	45.00	0.00	131.00	114.00	131.00	0.00	83000.00	0.00	17.00
PA1	33740.00	0.00	203.00	14690.00	19050.00	31951.00	28546.00	5194.00	1026880.00	1166.00	623.00
PA2	22735.83	0.00	185.00	7891.62	8616.27	17539.35	17543.62	5192.21	774515.00	5162.63	33.84
PA3	53511.87	0.00	279.00	19466.05	22805.03	41541.52	40932.01	12579.86	1811384.00	11669.35	301.00
PA4	11647.00	0.00	338.00	5359.00	6288.00	11193.00	9648.00	1999.00	470715.00	446.00	8.00
PA5	8891.00	0.00	180.00	5190.00	3701.00	6780.00	6073.00	2818.00	320009.00	2109.00	2.00
PA6	10167.00	0.00	258.00	4880.00	5287.00	5862.00	7603.00	2564.00	213933.00	4273.00	32.00
PA7	25132.00	0.00	271.00	13894.00	11238.00	19710.00	22382.00	2750.00	638423.00	5355.00	67.00
PA8	35772.99	0.00	315.31	11324.14	14717.84	28802.38	28525.22	7247.76	1256749.00	6894.15	76.45
PA9	94516.00	0.00	125.00	44892.00	49624.00	85056.00	58877.00	35639.00	2011709.00	9192.00	268.00
PA10	73091.00	0.00	356.00	41047.00	32044.00	45479.00	43604.00	29487.00	2616952.00	27204.00	408.00
PA11	153866.00	0.00	93.00	10413.00	49683.00	130513.00	141670.00	12196.00	4892109.00	23273.00	80.00

Journal of Service Theory and Practice

Appendix 5 – Semi-structured interview questions for model validation

Questions used for semi-structured interviews in the model validation process. Questions were approved by Human Resource Ethics committee.

Questions:

1. In your opinion, is the (factor) related to, or does it contribute to service productivity?
2. In your opinion, does (factor) convey pertinent information that is not included in the current measures of service productivity?
3. In your opinion, does the (factor) contain elements that interfere with the notion of technical efficiency?
4. In your opinion, is data on (factor) readily available and generally reliable?

Additional questions:

5. Are there any other factors or changes in the business environment that you consider to have a negative effect on productivity for service and network-based firms?
6. Are there any other factors or changes in the business environment that you consider to have a positive effect on productivity for service and network-based firms?

Journal of Service Theory and Practice

References

Agarwal, R. & Selen, W. 2005, 'The Service Cubicle: A new service taxonomy', paper presented to the *Annual EurOAM Conference*, Budapest, Hungary.

Agarwal, R. & Selen, W. 2011, 'Multi-dimensional nature of service innovation: operationalisation of the elevated service offerings construct in collaborative service organisations', *International Journal of Operations & Production Management*, vol. 31, no. 11, pp. 1164-92.

Ambler, T. 2000, *Marketing and the bottom line. The new metrics of corporate wealth*, Financial Times, Prentice Hall, London, UK.

Anderson, E. & Fornell, C. 1994, 'A Customer Service Research Perspective', in R. Rust & R. Oliver (eds), *Service Quality*, SAGE Publishing Inc, Thousand Oaks, CA.

Andersson, T. (ed.) 1996, *Traditional key ratio analysis versus data envelopment analysis: A comparision of various measures of productivity and efficiency in restaurants*, Cassell, London.

Assaf, A. & Josiassen, A. 2016, 'Frontier Analysis: A state of the art review and meta analysis', *Journal of Tourism Research*, vol. 55, no. 6, pp. 612-27.

Baily, M. & Solow, R. 2001, 'International productivity comparisions built from the firm level', *Journal of Economic Perspectives*, vol. 15, no. 3, pp. 151-72.

Basole, R. & Rouse, W. 2008, 'Complexity of service value networks: Conceptualisation and empirical investigation', *IBM Systems Journal*, vol. 47, no. 1, pp. 53-70.

Beltagui, A., Candi, M. & Riedel, J. 2016, 'Setting the stage for service experience: Design strategies for functional services', *Journal of Service Management*, vol. 27, no. 5, pp. 751-72.

Bertalanffy, L. 1969, *General System Theory*, Brazillier, New York.

Bitner, M., Brown, S. & Meuter, M. 2000, 'Technology Infusion in Service Encounters', *Journal of the Academy of Marketing Science*, vol. 28, no. 1, pp. 138-49.

Bitner, M., Ostrom, A. & Felicia, M. 2008, 'Service blueprinting: A practical technique for service innovation', *California Management Review*, vol. 50, no. 3, pp. 66-94.

Boulding, K. 1956, 'General systems theory - the skeleton of science', *Management Science*, vol. 2, no. 3, pp. 197-208.

Boussofiane, A., Dyson, R. & Thanassoulis, E. 1991, 'Applied data envelopment analysis', *European Journal of Operational Research*, vol. 52, no. 1, pp. 1-15.

Bovet, D. & Martha, J. 2000, 'Breaking the Supply Chain to Unlock Hidden Profits'John Wiley and Sons, New York.

Bowen, D. & Jones, G. 1986, 'Transaction costs analysis of Service Organisation-Customer Exchange', *Academy of Management Review*, vol. 11, no. 2, pp. 428-41.

Bowen, D. & Schneider, B. 1988, 'Services marketing and management: Implications for organisational behaviour', *Research in Organisational Behaviour*, vol. 10, pp. 43-80.

Boyer, K., Hallowell, R. & Roth, A. 2002, 'E-Services: operating strategy - a case study and a method for analyzing operational benefits', *Journal of Operations Manamegment*, vol. 20, pp. 175-88.

Brueckner, J., Lee, D., Picard, P. & Singer, E. 2015, 'Product unbundling in the Travel Industry: The Economics of Airline Bag Fees', *Journal of Economics and Management Strategy*, vol. 24, no. 3, pp. 457-84.

Busha, C. & Harter, S. 1980, *Research methods in librarianship: techniques and interpretations*, Academic Press, New York, USA.

Byrne, D., Fernald, J. & Reinsdorf, M. 2016, 'Does the United States have a Productivity Slowdown or a Measurement Problem', paper presented to the *BPEA Conference* Washington DC.

Charnes, A., Cooper, W., Lewin, A. & Seiford, L. 1994, *Data Envelopment Analysis" Theory, Methodology and Application*, Kluwer Academic Publishers, Norwell

Charnes, A., Cooper, W. & Rhodes, E. 1978, 'Measuring the efficiency of decision making units', *European Journal of Operational Research*, vol. 2, pp. 429-44.

Cherns, A. 1976, 'Principles of socio-technical design', *Human Relations*, vol. 28, pp. 9-22.

Coelli, T., Prasada, D., O'Donnell, C. & Battese, G. 2005, *An Introduction to Efficiency and Productivity Analysis*, 2nd edn, Springer Science and Business Media, New York, USA.

Cook, W., Tone, K. & Zhu, J. 2013, 'Data Envelopment Analysis: Prior to Choosing a model', *Omega*, vol. 9, no. 4, pp. 1-14.

Cook, W. & Zhu, J. 2013, *Data Envelopment Analysis: Balanced Benchmarking*, Wade Cook and Joe Zhu, Worchester, MA USA.
Crispi, G., Criscuolo, C., J, H. & Hawkes, D. 2006, 'Measuring and Understanding Productivity in UK Market Services', *Oxford Review of Economic Policy*, vol. 22, no. 4, pp. 560 - 72.
Edvardson, B., Tronvoll, B. & Gruber, T. 2011, 'Expanding understanding of service exchange and value co-creation: a social construction approach', *Journal of Academy of Marketing Science*, vol. 39, pp. 327-39.
Frei, F. 2006a, 'Breaking the trade-off between efficiency and service', *Harvard Business Review*, pp. 1-13.
Frei, F. 2006b, 'Customer Introduced Variabillity in Service Operations', *Harvard Business Review*, pp. 1-19.
Freidman, T. 2005, *The world is flat: A brief history of the 21st Century*, Picador, New York.
Frohele, C. & Roth, A. 2004, 'New measurement scales for evaluating perceptions of the technology mediated cutomers service experience', *Journal of Operations Manamegment*, vol. 22, pp. 1-12.
Gilmore, J.H. & Pine, B.J. 2000, *Markets of one: Creating customer-unique value through mass customization*, Harvard Business Press.
Golany, B. & Roll, T. 1989, 'An application procedure for DEA', *Omega*, vol. 17, pp. 237-50.
Gray, D. 2009, *Doing research in the real world*, SAGE Publications, London, UK.
Gronroos, C. & Ojasalo, K. 2005, 'Service Productivity, Towards a conceptualisation of the transformation of inputs into economic results in services', *Journal of Business Research*, vol. 57, no. 4, pp. 414-23.
Gummesson, E. 1998, 'Productivity, quality and relationship marketing in service operations', *International Journal of Contemporary Hospitatlity Management*, vol. 10, no. 1, pp. 4-15.
Haas, D. & Murphy, F. 2003, 'Compensating for non-homogeneity in decision making units in data envelopment analysis', *European Journal of Operational Research*, vol. 13, pp. 429-39.
Jacobs, J. 1969, *The Economy of Cities*, Random House, New York
Jacobs, J. 1984, *Cities and the Wealth of Nations*, Radom House, New York.
Johnson, R. & Jones, O. 2004, 'Service productivity: Towards understanding the relationship toward operational and customer productivity', *International Journal of Productivity and Performance Evaluation*, vol. 53, no. 3, pp. 201-13.
Joppe, M. & Li, X. 2016, 'Productivity Measurement in Tourism: The need for better tools', *Journal of Travel Research*, vol. 55, no. 2, pp. 139-49.
Lam, S., Shankar, V., Erramilli, M. & Murthy, B. 2004, 'Customer value, satisfaction, loyalty and switching cost: an illustration from business to business service context', *Journal of Academy of Marketing Science*, vol. 32, p. 2930311.
Lee, S., Ribeiro, D., Olson, D. & Roig, S. 2007, 'The importance of the activities of service business in the economy: welcome to the service business', *Service Business*, vol. 1, no. 1, pp. 1-5.
Lemon, K. & Verhoef, P. 2016, 'Understanding customer experience through the customer journey', *Journal of Marketing*, vol. 80, pp. 69-96.
Lovelock, C. 2000, *Services Maketing: People, Technology and Strategy*, Prentice-Hall, Englewood Cliffs, NJ.
Lovelock, C. & Young, R. 1979, 'Look to customers to increase productivity', *Harvard Business Review*, pp. 1-10.
Lowe, P. 1995, 'Labour Productivity Growth and Relative Wages 1978 - 1994', paper presented to the *Productivity and Growth Reserve Bank of Australia*.
Luhmann, N. 1995, *Social Systems*, Stanford University Press, Stanford, CA.
Macken, J. 1983, *Report to the Minister for Industrial Relations. In the matter of the opening and closing hours of shops*, Report No. 1074 of 1982, Sydney.
Manzoni, A. 2007, 'A new approach to performance measurement using Data Envelopment Analysis', University of Melbourne, Melbourne ,VIC Australia.
Marshall, A. 1890, *Principles of Economics*, Macmillan, London.
Mills, P. & Morris, J. 1986, 'Clients as partial employees of service organisations: Role development in client participation', *Academy of Management Review*, vol. 11, pp. 726-35.
Ng, I. 2008, *The Pricing and Revenue Management of Services*, Routledge, London, United Kingdom.

Normann, R. & Ramirez, R. 1993, 'From Value Chain to Value Constelation: Designing Interactive Strategy', *Harvard Business Review*, vol. 71, no. 4, pp. 65-77.

Oliver, R. 1980, 'A cognitive model of the antecedents and consequences of satisfaction decisions', *Journal of Marketing Research*, vol. 57, pp. 25-49.

Oliver, R. 1981, 'Measurement and evaluation of satisfaction processes in retail settings', *Journal of Retailing*, vol. 57, no. 25-48.

Ordanini, A. & Pasini, P. 2008, 'Service co-production and value creation: The case for a service oriented architecture (SOA)', *European Management Journal* vol. 26, no. 2, pp. 160-72.

Ostrom, A., Bitner, M., Brown, S., Burkhard, K., Goul, M., Smith-Daniels, V., Demirkan, H. & Rabinovich, E. 2010, 'Moving forward and making a difference: Research priorities for the science of service ', *Journal of Service Research*, vol. 13, no. 1, pp. 4-36.

Ostrom, A., Parasuraman, A., Bowden, D., Patricio, L. & Voss, C. 2015, 'Service research priorities in a rapidly changing context', *Journal of Service Research*, vol. 18, no. 2, pp. 127-59.

Ozpeynici, O. & Koksalan, M. 2007, 'Performance evaluation using data envelopment analysis in the presence of time lages', *Journal of Productivity Analysis*, vol. 27, no. 3, pp. 221-9.

Parasuraman, A. 2002, 'Service quality and productivity: A synergistic perspective', *Managing Service Quality: An International Journal* vol. 12, no. 1, pp. 6-9.

Parasuraman, A., Zeithaml, V. & Berry, L. 1985, 'A conceptual model for service implications and its implications for future research', *The Journal of Marketing*, vol. 49, no. 4, pp. 51-0.

Parsons, T. 1977, *Social Systems and the Evolutionof Action Theory*, Free Press, New York, NY.

Patricio, L., Fisk, R. & Falcao e Cunha, J. 2003, 'Improving satisfaction with bank service offerings: measuring the contribution of each delivery channel', *Managing Service Quality* vol. 13, no. 6, pp. 471-82.

Porter, M. 1985, *Competitive Strategy* Free Press, New York, USA.

Powell, R. & Connaway, L. 2004, *Basic Research Methods for Librarians*, Greenwood Publishing Group, Westport, CT.

Prahalad, C.K. 2004, 'The cocreation of value', *Journal of Marketing*, vol. 68, no. 1, p. 23.

Ray, S. 2004, *Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research*, Cambridge University Press, Cambridge UK.

Rogers, E. 1995, *Diffusion of Innovations*, Simon and Schuster, New York, NY.

Roth, A. 2001, 'Seven myths of electronic services', *Harvard Business Review*, vol. 100, pp. 88-96.

Roth, A. & Menor, L. 2003, 'Insights into service operations management: A research agenda', *Production and Operations Management*, vol. 12, no. 2, pp. 145-65.

Rust, R. & Huang, M. 2012, 'Optimizing Service Productivity ', *American Marketing Association*, vol. 76, pp. 47-66.

Sampson, S. 2000, 'Customer supplier duality and bi-directional supply chains in service organsiations', *International Journal of Service Industry Management*, vol. 11, no. 4, pp. 348-64.

Sampson, S. & Froehle, C. 2006, 'Foundations and implications of a proposed Unified Service Offering', *Production and Operations Management Society*, vol. 12, no. 2, pp. 329-43.

Scerri, M. & Agarwal, R. 2013, 'The Evolution of the Production Function: Transition to the "Value Creation Cube"', in I.I.o.S. Department of Management Studies, Bangalore (ed.), *Driving the Economy through Innovation and Entrepreneurship: Emerging agenda for technology management*, Springer, Bangalore, pp. 561-72.

Scerri, M. & Agarwal, R. 2014, 'Service Enterprise Productivity in Action', in E. A & C. E (eds), *Managing Service Productivity: Using frontier efficiency methodologies and multi-criteria decision making for improving service performance*, Springer, Berlin, Heidelberg, pp. 93-114.

Scerri, M. & Agarwal, R. 2015, 'Service Enterprise Productivity in Action (SEPIA)', in E. Ali & E. Cabanda (eds), *Manging Service Productivity*, Springer, Birmhingham, United Kingdom, pp. 93-114.

Schmenner, R. 1986, 'How can service firms survive and prosper', *Sloan Management Review*, vol. 27, no. 3, pp. 12-32.

Schmenner, R. 2001, 'Looking ahead by looking back: Swift, even flow in the history of manufacturing', *Production and Operations Management*, vol. 10, no. 1, pp. 87-96.

Journal of Service Theory and Practice

Schmenner, R. 2004, 'Service and business productivity', *Decision Sciences*, vol. 35, no. 3, pp. 333-47.
Schmenner, R. & Swink, M. 1998, 'On Theory in Operations Management', *Journal of Operations Manamegment*, vol. 17, no. 1, pp. 97-113.
Selhed, O. & Anderson, L. 2014, 'The gap between theory and practice ', Masters thesis, Umea University Umea, Sweden.
Shafique, F. & Mahmood, K. 2010, 'Model Development as a Research Tool: An example of PAK-NISEA', *Library Philosophy and Practice 2010*, pp. 1-12.
Sigala, M. 2002, 'Using Data Envelopment Analysis for Measuring and Benchmarking Productivity in the Hotel Sector', *Journal of Travel and Tourism Marketing*, vol. 16, no. 2, pp. 39-60.
Sigala, M. 2004, 'Using Data Envelopment Analysis for measuring and benchmarking productivity in the hotel sector', *Journal of Travel and Tourism Marketing*, vol. 16, no. 2/3, pp. 36-60.
Sigala, M. 2008, 'Integrating and exploiting information communication technology (ICT) in restaurant operations', *Journal of Foodservice Business Research*, vol. 6, no. 3, pp. 55-76.
Sigala, M., Jones, P., Lockwood, A. & Airey, D. 2005, 'Productivity in hotels: a stepwise data envelopment analysis of hotels rooms division processes ', *The Service Industries Journal*, vol. 25, no. 1, pp. 61-81.
Sigala, M. & Mylonakis, J. 2005, 'Developing a data envelopment analysis model for measurig and isolating the impact of contextual factors on hotel productivity', *International Journal of Performance Management*, vol. 7, no. 2, pp. 174-90.
Simon, H. 1957, *Models of a man*, Wiley, New York, USA.
Spohrer, J. 2007, 'Service Science: The next frontier in Service Innovation', *IBM Systems Journal*.
Spohrer, J. & Maglio, P. 2006, 'The emergence of Service Science: Toward systematic service innovation to accelerate co-creation of value', *IBM Almaden Research Centre*, pp. 1-40.
Srinivasan, S., Andersen, R. & Ponnavolu, K. 2002, 'Customer loyalty in e-commerce', *Journal of Retailing*, vol. 78, no. 51-60.
Stichweh, R. 2011, 'Systems theory', *International Encyclopedia of Political Science*, pp. 1-8.
Su, Q., Shao, P. & Ye, Q. 2011, 'An integrated analysis framework for customer value, customer satisfaction switching barriers, repurchase intention and attitudinal loyalty: Evidences from China Mobile Data Services', *Management Science and Engineering*, vol. 5, no. 3, pp. 135-42.
Teboul, J. 2006, *Service is front stage: Positioning services for value advantage*, Palgrave Macmillan, London, UK.
Thomke, S. & Von Hippel, E. 2002, 'Customers as innovators: a new way to create value', *Harvard business review*, vol. 80, no. 4, pp. 74-81.
Timmer, M., O'Mahony, M. & van Ark, B. 2007, 'EU KELMS Grwoth and Productivity Accounts: An Overview', *International Productivity Monitor*, pp. 64-78.
Ukko, J. & Pekkola 2016, 'Customer centred measurement of service operations: A B2B case study', *Operations Management Research*, vol. 9, pp. 11-21.
Vargo, S. & Lusch, R. 2004a, 'Evolving to a new dominant logic for marketing ', *Journal of Marketing*, vol. 68, pp. 1-17.
Vargo, S., Maglio, P. & Akaka, M. 2008, 'On value and value co-creation: A service systems and service logic perspective', *European Management Journal*, vol. 26, pp. 145-52.
Vargo, S.L. & Lusch, R.F. 2004b, 'Evolving to a new dominant logic for marketing', *Journal of Marketing*, pp. 1-17.
Verhoef, P., Kooge, E. & Walk, N. 2016, *Making smarter decisions*, Routledge, New York.
Walsh, G., Walgenbach, P., Evanschitzky, H. & Schaarschmidt, M. 2016, 'Service Productivity; What stops service firms from measuring it?', *Journal of Organisational Transformation and Social Change*, vol. 13, no. 1, pp. 5-25
Wang, C. & Wu, L. 2011, 'Customer loyalty and the role of relationship length', *Managing Service Quality*, vol. 22, no. 1, pp. 58-74.
Watmough, M., Polovina, S. & Andrews, S. 2013, 'Designing learning to researech the formal concept analysis of transactional data', in H. Pheiffer, D. Ignatov, J. Poelmans & N. Gadiraju (eds), *Conceptual Structures for STEM Research and Educational Lecture Notes in Computer Science*, Springer, London, UK.

Journal of Service Theory and Practice

Wolfl, A. 2003, *Productivity growth in service industries: An assessmen of recent patterns and the role of measurements*, OECD, Paris, France, pp. 1-66.

Yalley, A. & Sekhon, H. 2014, 'Service production process: Implications for service productivity', *International Journal of Productivity and Performance Management*, vol. 63, no. 8, pp. 1012 - 30.

Zeithaml, V., Berry, L. & Parasuraman, A. 1996, 'The behavioral consequences of service quality', *Journal of Marketing*, vol. 60, no. 31-46.

Zhu, J. 2000, 'Multi-factor performance measure model with an application to Fortune 500 companies', *European Journal of Operational Research*, vol. 123, no. 1, pp. 105-24.

Journal of Service Theory and Practice