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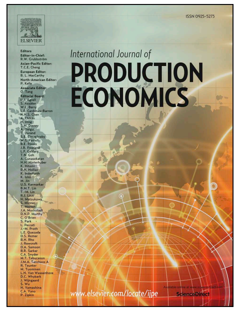

Service supply chain management process capabilities: Measurement development

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Service supply chain management process capabilities: Measurement development

Abstract

The role of supply chain management processes in achieving competitive advantages in the service industry has been widely discussed. However, due to the lack of valid measurement scales, the effects of service supply chain management (SSCM) process capability cannot be ascertained. This study aims to develop and validate measurement scales for SSCM process capability constructs. The measurement scales were initially developed by literature review, and refined by Q-sort method. The SSCM process capability is a seven-dimensional construct; each dimension consists of a collection of unidimensional multi-item scales. Confirmatory factor analyses of a large-scale survey confirmed the unidimensionality, reliability, and validity of the multidimensional construct of seven SSCM process capabilities. The validated measurement scales lay a crucial foundation for advancing knowledge of the service supply chain by enabling future empirical studies in the field, which previously relied on largely conceptual frameworks and descriptive accounts of SSCM processes.

Keywords: Service supply chain; process capability; scale development; empirical measurement methodology.

1. Introduction

Today, service sectors significantly contribute, with a range of 30.4% to 87.2%, to the gross domestic productivity (GDP) across countries of both post-industrialized and emerging economies (World Bank, 2015). It is therefore essential to understand how service firms compete (Schmenner, 1986). Service firms may compete on process capabilities (Roth and Jackson, 1995) because the intrinsic potential resources that enhance customer satisfaction and loyalty (Parasuraman et al., 1991; Prokesch, 1995) can be realized through service delivery processes (Ray et al., 2004). An enhanced understanding of service processes is thought to improve firm performance (Mattsson, 1994; Edvardsson 1997; Boyer et al., 2012).

So far, the management literature has examined firm-level process capabilities such as customer contact/service (Kellogg and Chase, 1995; Ray et al., 2004), technology-mediated process-based customer service experience (Froehle and Roth, 2004) and service development competence (Menor and Roth, 2007) for explaining service firms' competitiveness and profitability (Heskett et al., 1994). Beyond firm boundaries, recent evidence has revealed the value of various inter-organizational process capabilities in the service sectors (Gobbi and Hsuan, 2015; Giannakis, 2010; Sampson and Spring, 2012; Tang and Rai, 2012; Zhang et al., 2011). This development justifies new efforts to unpack service supply chain management (SSCM) processes. However, the current understanding of SSCM processes is limited by the availability of several conceptual definitions (e.g., Ellram et al., 2004; Baltacioglu et al., 2007; Breidbach et al., 2015) and anecdotal evidence (e.g., Giannakis, 2010; Sampson and Spring, 2012), short of appropriate construct measurement scales (Chen and Paulraj, 2004) with sound psychometric properties (Venkatraman, 1989; Cho et al., 2012; Chan et al., 2016). No effort has been made to formally develop a valid SSCM process capability measurement scale, leading to the inability of the field to further fully understand SSCM process capability, its antecedents and outcomes.

This paper addresses this crucial gap by theoretically develops and empirically validates new measurement scales for SSCM process capabilities. SSCM is defined as "the management of information, processes, resources and service performance from the earliest supplier to the ultimate customer" (Baltacioglu et al., 2007, p. 112). Drawing from the competence-based view (Prahalad and Hamel, 1990), competence is defined as "a bundle of aptitudes, skills, and technologies that the firm performs better than its competitors, that is difficult to imitate and provides an advantage in the marketplace" (Coates and McDermott, 2002: p. 436). The goal of the SSCM process is to transform heterogeneous resources into competitive service offerings. SSCM process capability is built up of several core competencies necessary for "coordinating diverse production skills and integrate multiple streams of technologies" (Prahalad and Hamel, 1990: p. 4). We thus view SSCM processes as a structured set of competencies that constitute proactive, relational, coordinative (Sarkar et al., 2009) people and technology dimensions desired to deliver specific service offerings.

The measurement scales for seven SSCM process capabilities were developed by a reconciliation of SSCM process literature (e.g., Baltacioglu et al., 2007; Ellram et al., 2004; Sengupta et al., 2006; Sampson and Spring, 2012). To identify processes relevant to service settings, structural and managerial differences between service and manufacturing supply chains (Sampson and Spring, 2012; Zhou et al., 2009) are seriously considered, in line with the Unified Service Theory (UST). UST provides a framework to conceptualize service operations management and unequivocally differentiate between service and manufacturing operations issues. UST also recognizes the bidirectional nature of service supply chains where customers may provide resources and labor or act as production managers (Sampson and Froehle, 2006; Sampson and Spring, 2012). We incorporated features unique to service sectors, including customer-supplier duality, service quality heterogeneity, intangibility capacity instead of inventory, and simultaneous production and consumption (Sengupta et al., 2006; Ellram et al., 2004; Boon-itt 2009). Interviews with managers from different service sectors were conducted to improve face validity. A two-step research design with Q-sort and mass survey was implemented to empirically validate the measurement scales. The empirically validated measurement scales for SSCM process capability enable future empirical investigations of SSCM performance and benchmarking of the SSCM process in practice.

2. Conceptual Background

2.1 Theoretical foundation

Generally, business process has been perceived as a structured set of activities for achieving specified business outcomes (Davenport and Beers, 1995). Its potent effects on service quality and market performance have been recognized (Roth and Jackson, 1995). SSCM processes that are path dependent, socially complex, and casually ambiguous may lead to competitive advantage, according to the competence-based view (Coates and McDermott, 2002; Prahalad and Hamel, 1990). Thus, we view SSCM from a process capability (Zacharia et al., 2011) and competency perspective (Coates and McDermott, 2002). It is a higher order of resources than the deployment of physical resources because service is less tangible (Gorman and Thomas, 1997), context-dependent, and hard to imitate (Ray et al., 2004; Karia and Wong, 2012).

As the foundational core of the Unified Service Theory (UST), service supply chain management (SSCM) processes are different from those of a product supply chain in various aspects. For instance, the distinctive feature of the SSCM is based on customer-supplier duality. In UST, the customer provides some inputs to the transformation process in order to produce the service (Sengupta et al., 2006; Sampson and Froehle, 2006). In UST, intangibility is a distinguish characteristic of services. For this reason some logistics activities such as manufacturing flow management in manufacturing supply chain are not suitable for SSCM. Simultaneity, heterogeneity and perishable are features of service industry highlighted by UST. Simultaneity refers that customers must be present to provide the service. The heterogeneity characteristic of service reflects the fact that service standardization is not easy. For this reason, the service providers cannot easily predict the pattern of the demand for a particular period or specific item. Services are also perishable (Sullivan, 1982). If a service is not consumed when available, then there is no chance to stock it for future use (Ellram et al., 2004). Unused capacity is lost forever. All these reasons make the SSCM more dynamic and sophisticated in terms of the supply chain management process. It requires a different approach and framework to implement SCM in the service industry.

We define SSCM process capabilities as the competency of an organization in performing a bundle of activities required to manage its service supply chains. Such process capabilities are concerned with organizing and managing inputs, outputs, and combinations of processes (Coates and McDermott, 2002). According to the competence-based view theory, service operations require effective management of skills and knowledge or deployment of different people (capacity), resources (Amit and Schoemaker, 1993), activities, and organizational routines through complex interactions with suppliers and customers to create competitive advantage (Peng et al., 2008; Sampson and Spring, 2012). SSCM processes are intra- and inter-organizational in nature and therefore it is important to incorporate proactive, relational, and coordination attributes into the processes (Sarkar et al., 2004).

To enable a wider application of the SSCM process capability conceptualization, we ensure that the processes fit with most service settings. We first reviewed literature on manufacturing supply chains that has identified eight SCM processes (Croxton et al., 2001; Lambert, 2004; Lambert et al., 2005). They form part of the widely applied SCM framework of the Global Supply Chain Forum (GSCF). We scrutinized the GSCF process model based on a bottom-up approach to extract SSCM activities relevant to service sectors (Baltacioglu et al., 2007). For example, some service firms offer physical goods and therefore experience procurement processes and returns similar to manufacturers' (Zhou et al., 2009). Also, some procedures in delivery services can be quite tangible when physical flows are involved (MacCarthy and Wilson, 2001; Wong et al., 2013). Finally, we incorporated some of the common processes related to the management of demand, capacity, supplier and customer relationships, order fulfillment and customer service. However, due to heterogeneity in quality expectations (Ellram et al., 2004), not all service processes can be managed using quantitative control methods as in the manufacturing sectors (Kotz and Johnson, 2002; Puga-Leal and Pereira, 2007; Besseris, 2014). Thus, Unified Service Theory (UST) is used to incorporate customers' contributions as providers of labor and inputs (Maull et al., 2012; Sampson and Froehle, 2006; Sampson and Spring, 2012).

2.2 SSCM process capability dimensions and scales

Several attempts have been made by the existing literature to identify SSCM processes (e.g. Ellram et al., 2004; Baltacioglu et al., 2007; Breidbach et al., 2015; Wang et al., 2015; Aitken et al., 2016). Here we extend their efforts by suggesting that SSCM process capability can be measured in terms of seven major dimensions, namely (1) demand management (DM), (2) capacity and resource management (CAP), (3) customer relationship management (CRM), (4) supplier relationship management (SRM), (5) order process management (ORM), (6) service performance management (SPM), and (7) information and technology management (ITM).

In essence, several manufacturing-related SCM processes are eliminated. The manufacturing flow and returns management processes tailored for manufacturing sectors are incorporated into customer-facing processes (i.e., DM, ORM, SPM, CRM) which consider physical and returning flows of products in some service settings (Ellram et al., 2004; Rexhausen et al., 2012). Order fulfillment and customer service management from a manufacturing context are replaced by order process management (ORM) and service performance management (SPM), recognizing the importance of understanding each customer's unique needs, their diverse roles (Sampson and Spring, 2012) and the management of the service delivery performance (Ellram *et al.*, 2004; Baltacioglu et al., 2007). Product development and commercialization are more related to the design and commercialization of new parts and products, which are not the main concerns for service supply chains. Instead, information and technology management (ITM) is recognized as a key process because of the importance of information-enabled and technology-mediated service experiences (Froehle and Roth, 2004).

Demand management process capability (DM)

The management of service delivery is tricky because demand can be heterogeneous and volatile (Ellram et al., 2004; Klassen and Rohleder, 2001; Lun et al..2013), and services cannot be inventoried (Ellram et al., 2004). Demand management process (DM) capability is defined as the competence in managing and balancing customer demand by using up-to-date demand information (Klassen and Rohleder, 2001) for accurate demand forecasting and service delivery (Berry et al., 1979; Mabert, 1982). This includes the abilities to apply accurate service demand information to forecast, allocate, and plan resources reliably (Handfield and Nichols, 1999; Klassen and Rohleder, 2001; Liu et al., 2016), control demand by influencing the magnitude of its peaks and troughs against planned capacity (Crandall and Markland, 1996), proactively stimulate demand (Ellram et al., 2004; Cho et al., 2012) and adjust supply or match demand with capacity at an operations level (Klassen and Rohleder, 2001; LaGanga, 2011) given the fact that it is not able to store capacity in the form of inventory to respond to demand variation (Ellram et al., 2004).

Capacity and resource management process capability (CAP)

Service capacity is the highest quantity of output possible in a given time period with a predefined level of staffing and resources (Lovelock, 1992). Since service demand is heterogeneous and services are produced and consumed simultaneously (Sullivan, 1982), service firms need to constantly update capacity and resource information (Baltacioglu et al., 2007; Klassen and Rohleder, 2001). CAP capability encompasses service capacity planning, customer job scheduling, workforce scheduling, and facilities and equipment (e.g., vehicles) scheduling for some services (Mabert, 1982). It is a competence in managing resources and service capacity to meet demand with an optimum service capacity (Baltacioglu et al., 2007; Cho et al., 2012; Wen et al., 2016). This includes the ability to identify and manage tangible resources, such as facilities, labor, inventory and capital as well as intangible resources, such as skills, experience, and knowledge (Froehle and Roth, 2007; Kellogg and Nie, 1995; Moeller, 2010). While Ellram et al. (2004) use the term “capacity and skills,” we have added “resource” to consider both tangible and intangible resources to address the unique features in service sectors in terms of labor intensity, multiple customer roles, and skillfulness of workers (Froehle and Roth, 2004; Verma and Young, 2000; Yee et al., 2008; Sampson and Spring, 2012).

Owing to the perishability of service capacity (Sullivan, 1982) and heterogeneity of service demand (Ellram et al., 2004; Klassen and Rohleder, 2001), there is often inadequate information to define available capacity (Akkermans and Voss, 2013; Baltacioglu et al., 2007). Therefore, CAP is a unique competence in defining and constantly tracking the available capacity to meet varying demand (Browne, 1995; Ellram et al., 2004; Mabert, 1986; Klassen and Rohleder, 2001) by adjusting service capacity (Ng et al., 1999; Schmenner, 1986). This unique capability helps increase the utilization of capacity (Sampson and Froehle, 2006) while meeting uncertain demand better than competitors (Ng et al., 1999).

Customer relationship management process capability (CRM)

Customer contact and relationships in service supply chains help to understand the service needs of individual customers (Chase, 1978; Ross and Edvardsson, 2008; Cho et al., 2012). Since every customer is different, a good understanding of customer needs is required for the effective management of demand and capacity (Ellram et al., 2004) and maintenance of customer loyalty and retention. CRM process capability is a competence in maintaining and developing long-term customer relationships through such means as adopting customer information systems and understanding customer needs (Campbell, 2003; Wilson et al., 2002; Yang, 2012). CRM helps improve customer satisfaction via a focus in meeting customer needs (Bitner, 1995; Srivastava et al., 1999) at corporate and operational levels (Zeithaml and Bitner, 2003). To manage customer expectations, CRM helps communicate optimistic information to customers, enhance opportunities to use data and information to co-create value with customers, and improve customers' satisfactory on service quality (Baltacioglu et al., 2007; Berry et al., 1985; Oflac et al., 2012; Zolkiewski et al., 2007). CRM helps customers providing input, service specification, materials, and labor to the service delivery process (Sampson and Spring, 2012). By communicating with customers before and after service delivery they would have a good impression of the services and tendency to maintain long-term relationships (Kandampully, 1988).

Supplier relationship management process capability (SRM)

The relationship management literature suggests that firms establish inter-organizational process capabilities to accomplish strategic goals and remain competitive (Doran et al., 2005; Theoharakis et al., 2009; Chen et al., 2013; Vanpoucke et al., 2014). SRM process capability is a competence to develop, manage and maintain a close and long-term relationship with suppliers. SRM provides a platform for service firms to interact with suppliers (Chopra and Meindl, 2004) For some service firms, such as sourcing and logistics service providers, SRM is the core process as their main business is to source goods and services from suppliers (Baltacioglu et al., 2007). At the operational level, SRM is a key process that supports the planning and coordination of purchases, buffer stock, capacity and the resource and order management process (Mabert, 1982). It also supports the establishment of service-level agreements essential for the management of service performance (Ellram et al., 2004).

SRM process capability has been conceptualized from different perspectives in previous studies. For example, it is argued that SRM comprises five key components, namely coordination, cooperation, commitment, information sharing, and feedback (Carr and Pearson, 2002; Fynes et al., 2005). From a relational capability perspective (Theoharakis et al., 2009), SRM is about building long-term relationships with suppliers (Griffith et al., 2006). From a process capability perspective, it coordinates service development, sourcing, supply planning, and procurement across the value chain (Lang et al., 2002). SRM develops and maintains boundary-spanning activities with selected suppliers (Doran et al., 2005; Likert and Choi, 2004; Zhang et al., 2011) to build suppliers' trust (Zhang et al., 2011). To improve suppliers' service quality, service firms build good relationships with key suppliers (Zhang et al., 2011) via the development of partnership programs (Likert and Choi, 2004; Monczka and Morgan, 1997).

Order process management process capability (OPM)

Order processing includes getting service orders from customers, checking the status of service orders and communicating to customers about the status, and fulfilling them (Lambert et al., 1998). Service order processing may involve order preparation, order transmittal, order entry, order filling, and order status reporting (Croxton, 2003). However, getting service orders from customers is different from getting product orders in manufacturing settings. Although some services and manufacturing goods might be ordered based on standard menus or catalogs, manufacturing goods are often produced before a customer makes an order, but services are made after an order is made. Manufacturers often define their product specifications with no or limited customization options. However, in a service setting, customer clarifies their expectations and may request modification to 'standard' services when placing an order. The understanding of customers' service needs is a more delicate process because service needs cannot be fully described by standard menus or catalogs (Metters and Marucheck, 2007; Moeller, 2010). Service needs must be carefully communicated, clarified, and processed such that service providers fully understand the needs of each customer (Davis-Sramek et al., 2008; Fabien, 2005) and the customers understand exactly what they are getting (Virki and Wong, 2003). Service level agreements are not able to cover all implicit aspects (Ellram et al., 2004). Therefore, there is a need to continuously communicate customer needs and expectations of services.

We have specifically included OPM process capability as a key capability for SSCM. Adapted from Baltacioglu et al. (2007), OPM has a larger scope than the service delivery management process identified by Ellram et al. (2004), which focuses on making promises to customers and enabling service providers to meet these promises. The scope of OPM includes getting orders through to delivering the service to customers (Lambert et al., 1998; Lovelock and Wirtz, 2006). From a competence-based view perspective, OPM process capability includes the ability of firms to communicate customer orders step-by-step and correctly (Virki and Wong, 2003) and then effectively allocate customer orders to appointment or reservation systems (Mondschein and Weintraub, 2003). OPM process capability also requires a focus on customer expectations or psychological needs during order processing through interactions with customers (Chung-Herrera, 2007).

Service performance management process capability (SPM)

SPM process capability is the ability to manage and improve the performance of services processes (Baltacioglu et al., 2007). It is important because service quality is a comparison between expectation and performance (Heskett et al., 1985). While Ellram et al. (2004) consider service performance as a part of the service delivery management process, we distinguish OPM from SPM (Baltacioglu et al., 2007). Service delivery performance can be measured instantly while the service is being delivered. It is a multidimensional construct that should be measured independently. For this, we refer to another similar construct known as service quality management, which involves the use of coordinated marketing and operations service-related information to improve management decision-making and help gain competitive advantage (Collier, 1991). It also includes managing, measuring, modifying, and rewarding service performance to improve performance and meet customer expectations (Williams and Visser, 2002).

We argue that SPM process capability could be manifested in several aspects. First, service firms with such capabilities would have a good track record of service performance to remain competitive and profitable (Heskett et al., 1994). Next, they would have the ability to maintain consistency in service quality and reliability of the service process (Ellram et al., 2004; Parasuraman et al., 1991). It also includes the ability to provide services to the right customer, in the right place, and at the right time (Caruana and Pitt, 1997), improve service quality and fulfill customer requirements (Mattsson, 1994; Boyer et al., 2012).

Information and technology management process capability (ITM)

The management of information flow is an important SSCM process because it helps identify demand, share information, establish expectations, define the scope of service and the skills required of service providers, and provide feedback on performance (Ellram et al., 2004; Ruggles, 2005). From the information-processing theory, information reduces the uncertainty faced by decision-makers (Galbraith, 1974). Uncertainty about service demand is a critical issue facing the service industry. To reduce uncertainty, service staff need to gather, manipulate, store, retrieve, and classify recorded information but their information processing and memory capacity is somewhat limited. The uncertainty facing service firms (Sullivan, 1982) can be masked by adequate information-processing capabilities (Castrogiovanni and Macy, 1990) provide by information technology. In service settings, information technology adoption helps process customer and service performance information (Froehle and Roth, 2004; Boon-itt and Wong, 2011) and share quality information with service staff. Quality information can be created by effective management of IT, and therefore ITM is a crucial SSCM competency. ITM supports coordination and collaboration within the supply chain to improve service operations (Sander and Premus, 2002). In the service environment, ITM may enhance operational efficiency and effectiveness on a real-time basis (Hayes and Thies, 1991).

We define ITM process capability as the competence in adopting information technology and systems that support SSCM processes. We view ITM process capability as a technology-enabled process capability that provides an effective flow of information for DM, capacity and resource management, CRM, SRM, and OPM (Baltacioglu et al., 2007). From a competence-based perspective, ITM process capability is the process in which information technology is utilized to generate and share information in assisting decision making (Ray et al., 2005). ITM process capability is, therefore, a crucial enabler of key functions in using up-to-date information to make decisions. ITM extends the information flow from a service firm to its suppliers and customers to facilitate inter-organizational information sharing (Baltacioglu et al., 2007).

3. Development and validation of measurement scales and scales

Following prior operations management studies (e.g., Li et al., 2005; O'Leary-Kelly and Vokurka, 1998; Swafford et al., 2006; Lu et al., 2012), we performed a two-stage approach for developing and validating the SSCM multi-item measurement scales as follows.

3.1 Stage 1: Item generation and pre-testing

Measurement scales were generated and pre-tested in three steps (Schwab, 1980). First, measurement scales were initially generated through an extensive literature review to conceptualize the constructs based on sound theories comprehensively (Churchill, 1979; MacKenzie et al., 2011). The literature was searched from academic databases including Science Direct, Emerald, Springer-Link Journals, IEEE Xplore, Academic Search Premier, and World Scientific Net using keywords "supply chain", "logistics", "service," "operations," and "management". As shown in Appendix A (the supplementary document), constructs were defined and their respective dimensions were identified based on the construct definitions. The measurement scales were derived from the extant empirical studies of SSCM processes (e.g., Baltacioglu et al., 2007; Ellram et al., 2004) grounded in the Competence-based view to reflect the focus on process capability and Unified Service Theory (UST) to reflect the bidirectional nature of service supply chains (Sampson and Spring, 2012).

Second, to ensure the practical relevance of the measurement scales, we refined the domain of SSCM process capabilities by using a series of interviews. We interviewed 15 practitioners from low and high contact service sectors, such as banking, insurance, logistics and transportation, and healthcare to identify each SSCM process capability. We discussed the initial SSCM process capability dimensions and scales established from the literature review. Based on the responses from these practitioners, all the dimensions and scales established based on the literature review, including those proposed by Baltacioglu et al. (2007) and Ellram et al. (2004), and additional scales based on UST, are deemed appropriate to reflect SSCM process capability. New scales were added wherever deemed necessary. In addition, redundant and ambiguous scales were either modified or eliminated. This step enabled us to generate an initial set of scales for each SSCM process capability, which were further reviewed by four academicians specialized in service operations management and SCM. Finally, 46 initial scales were identified (Appendix A).

Third, we sorted scales using four rounds of Q-sort procedures with two independent judges; each round was used to assess initial construct validity and the reliability of the measurement scales. This method requires experts to act as judges and sort the scales into several groups, with each group corresponding to a factor or dimension (Moore and Benbasat, 1991). Three evaluation indices are used: (1) inter-judge agreement, (2) Cohen's Kappa, and (3) Moore and Benbasat's average placement ratio (Moore and Benbasat, 1991). Agreement between the judges represents face validity and placement of scales to theoretical constructs represents content validity (Moore and Benbasat, 1991). According to Li et al. (2005), Cohen's Kappa measures the 'proportion of joint judgment in which there is an agreement after chance agreement is excluded'. A Cohen's Kappa score greater than 0.70 (Jarvenpaa, 1989; Li et al., 2005) and a placement ratio more than 0.76 are considered acceptable.

--Insert Table 1: Q-sort results--

Practitioners working in areas related to service operations management from low and high contact service sectors were invited to participate in the four rounds of Q-sort. Table 1 shows how the inter-judge agreement scores improved over the Q-sort rounds. Though the inter-judge agreement level (71%) and Cohen's Kappa coefficient (0.76) are acceptable (Li et al., 2005) in the first round, the average overall placement ratio was in the border-line at 0.78. Thus, we analyzed the off-diagonal scales in the placement matrix (i.e., scales placed into a category different from that intended) to identify ambiguous scales (i.e., scales placed in more than one category) and indeterminate scales (i.e., scales placed in the "not applicable" category) were reworded or eliminated based on the feedback from the judges. As a result, eight scales were removed after the first round of Q-sort (scales labeled '[a]' in Appendix A).

The remaining 38 reworded scales were used for the second round. Table 1 shows all the inter-judge agreement measures are acceptable. Though the results provide preliminary evidence of measurement validity and reliability, the off-diagonal scales in the placement matrix were removed as aligned with the feedback from the judges. As a result, 10 scales were further removed (scales labelled '[b]' in Appendix A). We present the second round of item-placement ratio in Table 2 as an example of the placement matrix. Each of the capability reflecting SSCM process capabilities is placed in the rows of the table.

--Insert Table 2: Item-placement ratios (Q-sort second round)--

In the third round of Q-sort, comprising 28 scales for sorting, the inter-judge agreement (90%), average overall placement ratio (0.90) and Cohen's Kappa score 0.92 were improved from the previous round after further elimination of ambiguous scales in a second round of Q-sort. The fourth round exhibited an inter-judge agreement score very similar to that in the third round. The Q-sort results suggest an excellent level of inter-judge agreement, indicating a high level of reliability and construct validity for the initial SSCM process capability measurement scales. Finally, each of the construct dimensions consists of the least four measurement scales, which is desirable for structural equation modeling (Hinkin, 1995). The final 28 scales capturing the seven dimensions of SSCM process capabilities were used in the next stage.

3.2 Stage 2: Large-scale survey

To empirically verify measurement reliability and validity, we conducted a large-scale survey questionnaire. Based on the results from Q-sort, we designed a survey questionnaire and asked practitioners to review. Some statements were refined in accordance with their suggestions. In addition, a pilot study was conducted to pretest the questionnaire with 25 managers. Consequently, the final version of the questionnaire, consisting of 28 scales, was developed. In the survey, managers were asked to indicate their level of agreement on each measurement item by using a five-point Likert scale anchored by "1" as "strongly disagree" to "5" as "strongly agree". We also included demographic variables, such as industry, professional title, experience, and firm size in the questionnaire.

3.2.1 Data collection

Mass mail survey was conducted in the Thai service industries. The English version of the questionnaire was then translated into Thai by a bilingual native of Thailand. Another bilingual native of Thailand proofread the English version and noted ambiguities that could confuse respondents. The questionnaire was then revised accordingly. The revised questionnaire in Thai was reviewed by several Thai practitioners and academicians familiar with service operations management and SSCM. Their comments primarily focused on the clarification of the instructions and refinement of item wording. The questionnaire was further amended based on their feedback.

A mailing list was obtained from two sources: (1) Thailand Business Directory and (2) Ministry of Commerce. Respondents were operations managers as well as CEOs, presidents, vice presidents, directors, or managers of service firms who are presumed to have adequate knowledge concerning the service operations and SSCM of their organizations. The sample respondents cover services across different sectors using different customer contact models

(Mersha, 1990) including high and low contact services, to embrace the diversity of the service sectors (Chase and Tansik, 1983; Skaggs and Galli-Debicella, 2012; Soteriou and Chase, 1998). Low-contact services include financial/banking, retailing, and transportation/logistics and high-contact services include hotels, education, and healthcare. These sectors have a broad presence in the Thai economy. The final mailing list contained 660 organizations. Since the questionnaires were sent by bulk mail, the mailing addresses were verified. To maximize response rate, the researchers called respondents to explain the research purpose and asked them to participate before sending the questionnaires with a cover letter indicating the contribution of this study. The questionnaire was send out in two phases. In the first phase, 76 responses were received. The reminder was then sent to targeted respondents who did not respond, and consequently, we received 28 additional responses in the second phase. There were 104 usable responses, with a response rate of 16%, which is comparable to prior studies using a key informant approach (Frohlich, 2002; Wong et al., 2011). Table 3 presents the demographic data. Non-response bias was first tested by using the extrapolation method suggested by Armstrong and Overton (1977). A comparison between early and late response showed no statistical differences across all demographic data including professional title, industry, experience and firm size between non-responding and responding firms at $p < 0.05$, which suggests no non-response bias. . Furthermore, we tested for multivariate normality and kurtosis, and no violations were found.

--Insert Table 3: Demographic data--

Common method variance is addressed as follows. First, we collected data through in-depth interviews, Q-sort, and a large-scale survey to reduce bias from the use of a single source of data. The collection of data from these three approaches enables data triangulation, reducing the problem of common method variance. Second, we used the years of tenure of respondents as a theoretically unrelated marker variable (Lindell and Whitney, 2001) to test if common method variance is an issue. As shown in Table 4, the marker variable was not significantly related to any of the variables. Third, we conducted Harman's one-factor test to examine if the chi-square of a single latent factor accounts for the hypothesized seven-construct model. The results indicated significant differences between the chi-square values of the two models. The fit in the one-dimensional model was significantly worse than the seven-construct model. These results suggest that common method variance is not an issue.

--Insert Table 4: Descriptive statistics and correlations --

3.2.2 Construct validity and reliability

To assess construct validity and reliability, confirmatory factor analysis (CFA) was conducted on each SSCM process capability construct. To test the unidimensionality, we examined if a single latent variable (construct) underlies a set of measurement scales (Anderson and Gerbing, 1988). Table 5 indicates that all models exhibit fit indices (GFI, NNFI and CFI) greater than 0.9, implying a satisfactory fit and all scales are valid in reflecting their corresponding constructs (unidimensionality). All the composite reliability values exceeded the 0.70 threshold, suggesting adequate scale reliability and that the scales sufficiently represent their respective constructs (Bagozzi and Yi, 1998).

--Insert Table 5: Unidimensionality and reliability analyses--

Convergent validity is assessed by examining the AVE values and standardized path loading. The AVE values exceeded 0.5 as shown in Table 5, indicating that a large amount of the variance is captured by the measurement scales (Hair et al., 2010). In addition, the CFA results lend support to the first-order model of SSCM process capability with $\chi 2 = 486.12$, $df = 329$, $p < 0.001$, CFI = 0.90, TLI = 0.90, and SRMR = 0.07. The magnitude and sign of the standardized path loading of the measurement scales shown in Table 6 indicate that all the scales are highly significant related to their corresponding construct with loadings ranging from 0.518 to 0.925, providing evidence of the convergent validity of the scales.

--Insert Table 6: First-order CFA results --

To assess the discriminant validity, CFA was conducted on each pair of constructs (21 pairs in total) by comparing the chi-square difference between the unconstructed model (i.e., the latent factors were freely correlated) and the constrained model (i.e., the correlation between the latent factors was constrained to one). The chi-square differences of each pair of latent factors are statistically significant at $p < 0.05$, suggesting that the measurement scales capture their respective constructs (Appendix B in the supplementary documents). Thus, the discriminant validity of each multi-item measurement scale was established.

3.2.3 First- and second-order model comparison

Based on our theorization and competence-based theory, seven process capabilities are a priori factors of the SSCM process capabilities of firms. We, therefore, tested if these capabilities reflect the SSCM process capabilities and form a high-order factor in three steps. First, we developed a first-order model, where the seven process capabilities are correlated but do not reflect a common latent factor. The loadings of the measurement scales on their respective latent factors are summarized in Table 6.

Second, we developed a second-order model, where the seven process capabilities reflect SSCM process capability as a higher-order latent factor. The second-order model has significant χ^2 statistics ($\chi^2 = 506.41$, df = 343, $p < 0.001$), and the fit indices meet their respective thresholds (CFI = 0.90, TLI = 0.90, SRMR = 0.07). Figure 1 shows the standardized second-order loadings onto SSCM process capabilities. The proportions of variance in the first-order factors explained by the second-order factors are: 0.38 (DM), 0.38 (CAP), 0.76 (CRM), 0.35 (SRM), 0.60 (OPM), 0.49 (ITM), and 0.69 (SPM). These results provide preliminary support that the higher-order model gives a good account of the covariance among the first-order factors. Third, to further verify the efficacy of the two models, we compared the χ^2 statistics of the first- and second-order models. We computed the target coefficient (i.e., first-order model χ^2/second-order model χ^2) and obtained T = 0.96, which is very close to the theoretical upper limit of 1.0. This means the relationship among the second-order factors accounts for 96% of the first-order factors. Thus, SSCM process capability can be conceptualized as a second-order multidimensional construct with the seven first-order variables.

3.2.4 Nomological validity

The nomological validity of the SSCM process capabilities measure was tested to ensure the construct structure was consistent with the literature and in line with the theory on service performance. Specifically, we tested if the second-order construct (i.e., SSCM process capabilities) sufficiently predicted the outcome variables in terms of service quality and customer satisfaction. Following Liu et al. (2012), we tested the predictive efficiency of SSCM process capabilities by computing the ratio of the R^2 of the first-order factors–performance outcomes model and the R^2 of the second-order factors–performance outcomes model of the two regressions. The R^2 of the first-order factors–performance outcomes model was 0.653 for service quality and 0.462 for customer satisfaction. The R^2 of the second-order factors–performance outcomes model was 0.643 for service quality and 0.444 for customer satisfaction. The predictive efficiency of the second-order construct was 0.643/0.653 = 98% for service quality and 0.444/0.462 = 96% for customer satisfaction. This means the SSCM process capabilities construct accounts for 98% and 96% of the variances in service quality and customer service explained by the seven first-order variables, respectively. These high, predictive efficiency scores indicate that the second-order variables can replace the role of the first-order variables in predicting the performance outcomes, providing evidence that nomological validity is established.

4. Discussion and conclusions

This study advances theory and our understanding of SSCM through the conceptual development and empirical validation of a set of multi-item scales of SSCM process capabilities. From anecdotal accounts of the various SSCM processes, this paper advances the field by laying down the theoretical foundation and rigorously testing their measurement scales. With such empirically validated construct measurement scales with sound psychometric properties further meaningful empirical investigations are made possible (Venkatraman, 1989). This is achieved by scrutinizing existing conceptualizations of SSCM processes based on the competence-based theoretical lens, and then placing the newly developed SSCM process capability measurement scale under rigorous empirical tests based on the Q-sort method and a survey of a wide range of service sectors. Such reliable and validated measurement scales make it possible to examine how service firms develop their SSCM process capabilities to achieve service quality and performance.

Consistent with the Unified Service Theory and competence-based views, this study ascertains that SSCM process capability as a second-order construct comprises seven key SSCM process capabilities, each represented by a unidimensional multi-item scale. SSCM process capability is found to be a bundling of seven facets of processes, which cover the ability to (i) manage and balance customer demand, (ii) manage capacity and resources of services, (iii) maintain and develop long-term customer relationships, (iv) develop and maintain a close and long-term relationship with suppliers as partners, (v) organize responses for order processes, (vi) manage services systems performance, and (vii) adopt technologies to support and collaborate with supply chain partners to improve service supply chain operations. These measurement scales are specially developed for the service sector with unique characteristics (Ellram et al., 2004; Sampson and Spring, 2012) while incorporating processes similar to manufacturing settings (Zhou et al., 2009).

Our findings provide some crucial theoretical and practical implications into SSCM processes. The development of SSCM process capability scales represents a crucial step toward further theoretical advancement. While earlier studies suggest that inter-organizational or SSCM process capabilities are valuable for service firms (Maull et al., 2012; Sampson and Spring, 2012; Tang and Rai, 2012; Zhang et al., 2011), this study theoretically develops and empirically proves the value of SSCM process capabilities. With our empirically validated measurement scales, it is now possible to further examine, for example, the effects of various antecedent, consequent, and contingency factors to better understand how service firms may achieve and utilize their capabilities to improve performance in future studies. The measurement provides a foundation of research for future SSCM studies.

The measurement provides a comprehensive list of organizational activities for managers to communicate with various functions to develop SSCM process capabilities for the development and improvement of the services supply chain. The measurement also facilitates managers to plan resources, develop infrastructure (e.g., information systems and technologies) and to establish SSCM process capabilities. The analysis of our survey data provides initial evidence that SSCM process capabilities significantly explain service quality and customer satisfaction for Thai service firms. Having the SSCM process capabilities would be beneficial to service firms in achieving competitive advantage.

Furthermore, the measurement scales for SSCM process capabilities developed by this research are widely applicable to many service sectors. Based on the validated measurement of this study, service managers may now expand their benchmarking or diagnostic scope from the typical internal service capabilities developed decades ago to SSCM process capabilities. Such capabilities may bring about new competitive advantage owing to the increased use of outsourcing in many service sectors. Further research may explore how service managers from different sectors view the importance of each SSCM process and how they manage to develop such capabilities in reality.

The validated measurement also enables service firms to track and monitor their SSCM process capabilities, enabling them to maintain records of their service supply chain development. The multi-facet characteristics of SSCM process capabilities provide a direction for departments to work jointly together to achieve and improve SSCM process capabilities. The measurement is also useful for communicating for the implementation of SSCM processes between managers and staff.

As with all research, there are some limitations that should be noted. First, the data for this study is cross-sectional that limits the ability to determine the causal phenomenon. Future research should include other types of data such as longitudinal data for the analysis. In addition, this study used of a single respondent from each firm. Future study should attempt to collect additional data sources for the scale validation to minimize the possibility of bias in the response to the survey questions. Finally, future research should extend the study to other service industries from both different developing and developed countries.

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Table 1: Q-sort results

Agreement Measure	Round 1	Round 2	Round 3	Round 4
Inter-judge agreement (%)	71	87	90	90
Cohen's Kappa coefficient	.76	.84	.92	.92
Average overall placement ratio	.78	.86	.90	.91

Table 2: Item-placement ratios (Q-sort second round)

Intended placement scales	Actual placement									
	1	2	3	4	5	6	7	N/A	Total	Item-placement ratio (%)
1. SRM (5)	9							1	10	90
2. SPM (6)		10						2	12	83
3. ITM (6)			10					2	12	83
4. ORM (4)				8					8	100
5. CRM (6)				1	10			1	12	83
6. DM (5)			1			9			10	90
7. CAP (6)						1	10	1	12	83

*Note: Inter-judge agreement = (66/76) *100 = 87%; Overall placement ratio = (612/700)*100 = 0.86*

Table 3: Demographic data

Measure	Category	Freq. (n=104)	Percentage
Professional title	President/CEO	20	19%
	Assistant Vice president	26	25%
	Marketing Manager	25	24%
	Operations and Procurement Manager	26	25%
	General Manager	7	7%
Industry	Retail	19	18%
	Hotel	8	8%
	Insurance	11	11%
	Education	8	8%
	Transportation/Logistics	13	12%
	Healthcare	13	12%
	Finance/Banking	26	25%
	Other	6	6%

Experience	Less than 2 years	21	20%
	2–5 years	21	20%
	6–10 years	21	20%
	More than 10 years	41	40%
Firm size	100–250 employees	38	37%
	251–500 employees	6	6%
	501–1000 employees	15	14%
	More than 1000 employees	45	43%

Table 4: Descriptive statistics and correlations

Variables	Mean	S.D.	DM	CAP	CRM	SRM	ORM	SPM	ITM
DM	3.38	.60							
CAP	3.65	.59	.51**						
CRM	3.94	.66	.41**	.43**					
SRM	3.58	.67	.22**	.29**	.54**				
ORM	3.64	.60	.32**	.40**	.59**	.44**			
SPM	3.85	.58	.44**	.45**	.64**	.43**	.56**		
ITM	3.43	.80	.43**	.25**	.49**	.43**	.50**	.49**	
Marker variable	2.68	1.19	.00	.02	.05	.06	.14	.05	.10

*Note: ** Correlation is significant at 0.01 level (two-tailed)*

Table 5: Unidimensionality and reliability analyses

Construct	**Items**	**χ^2 (*P*-value)**	**GFI**[a]	**NNFI**[a]	**CFI**[a]	**Composite reliability** [b]	**AVE**[c]
SRM	4	1.27 (p=0.26)	0.99	1.00	0.99	0.91	0.72
SPM	4	1.40 (p=0.49)	0.93	0.94	1.00	0.87	0.62
ITM	4	1.19 (p=0.28)	0.94	0.95	0.99	0.87	0.63
ORM	4	0.26 (p=0.61)	0.99	0.99	1.00	0.84	0.67
CRM	4	4.08 (p=0.13)	0.98	0.98	0.99	0.85	0.62
DM	4	1.94 (p=0.38)	0.99	0.98	1.00	0.81	0.64
CAP	4	0.79 (p=0.37)	0.97	0.99	1.00	0.74	0.61

Note: [a] Goodness-of-fit index (GFI), non-normed fit index (NNFI), and comparative fit index (CFI); [b] Composite reliability value exceeds 0.70 indicate strong convergent validity; [c]Average variance explained (AVE) exceeds 0.50 indicate strong convergent validity.

Table 6: First-order CFA results

SSCM capability and measurement items	Standardized path loading	Critical Ratio[a]	Mean	Standard deviation
Supplier relationship management process capability (SRM)				
SRM1: The ability to develop long-term relationships with suppliers in service supply chain	.922	14.28	3.64	.75
SRM2: The ability to maintain close relationships with a limited pool of suppliers in service supply chain[b]	.925	-	3.63	.74
SRM3: The ability to focus on key suppliers to improve service chain quality in service supply chain	.805	10.58	3.70	.76
SRM4: The ability to develop a partnership program with suppliers for the benefit of the whole service supply chain via information sharing (e.g., service development, sourcing, supply planning, and procurement)	.760	10.21	3.52	.85
Service performance management process capability (SPM)				
SPM1: The ability to carry out an accurate and reliable service process	.832	8.94	3.90	.63
SPM2: The ability to provide services to the right customer, in the right place, and at the right time	.788	8.35	3.88	.72
SPM3: The ability to offer a standardized service	.776	-	3.84	.67
SPM4: The ability to improve service quality and fulfill customer requirements	.747	7.97	3.90	.74
Information and technology management process capability (ITM)				
ITM1: The service provider has an information technology system to share information with customers in service supply chain	.725	8.87	3.40	.94
ITM2: The service provider has an information technology system to share information with	.725	9.33	3.34	.91

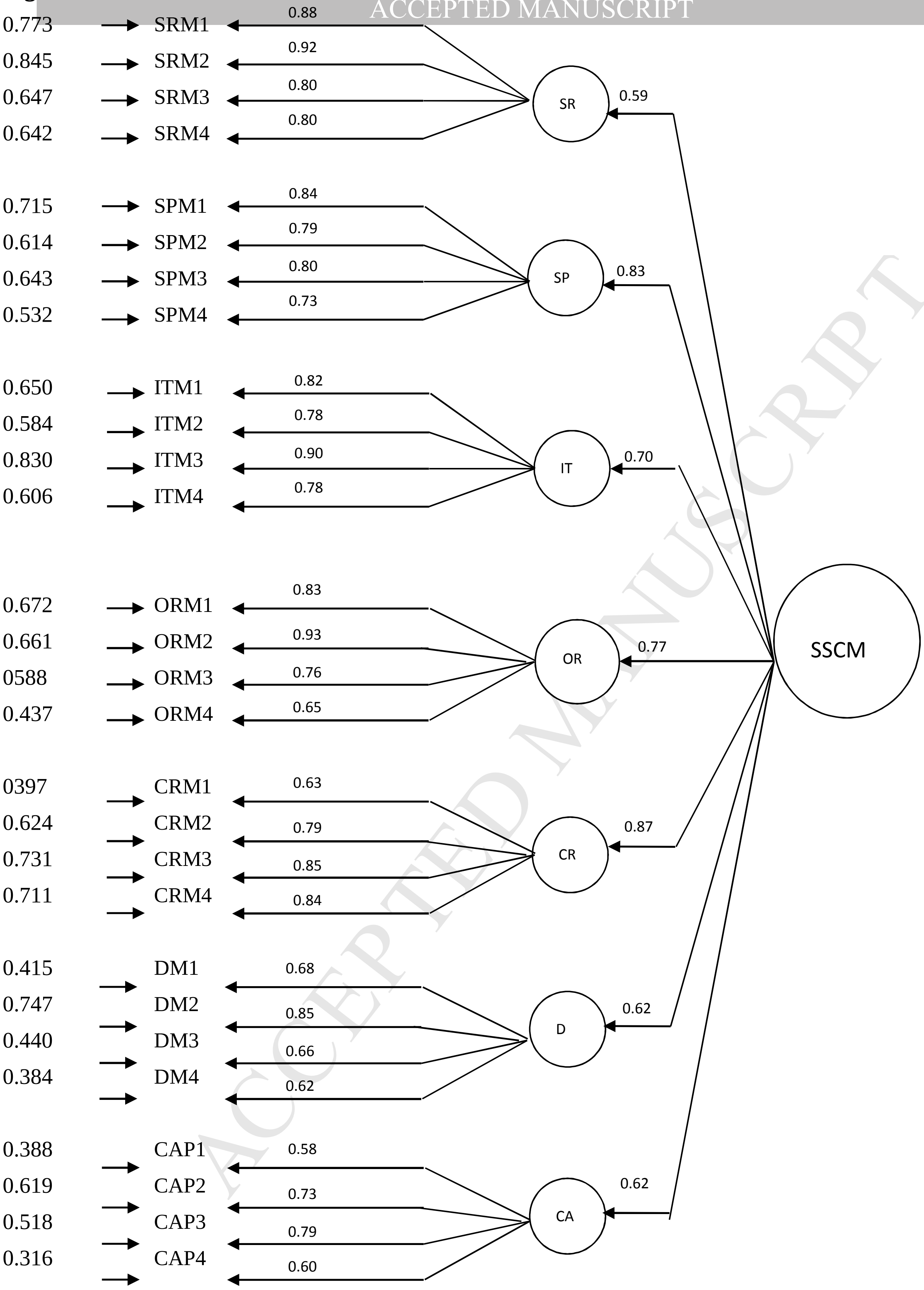
suppliers in service supply chain				
ITM3: The service provider can improve information-processing capacity via up-to-date information to make a decision service supply chain[b]	.922	-	3.48	.94
ITM4: Using new technology for increasing the service channel through which customers and suppliers can contact the organization	.792	10.79	3.58	.92
Order process management process capability (ORM)				
ORM1: The ability to process service order fulfillment correctly step-by–step (e.g., order preparation, order transmittal, order entry, order filling, and order status reporting)	.713	8.35	3.74	.68
ORM2: The ability to simplify the service order process by using the information technology system[b]	.706	-	3.46	.78
ORM3: The service order processing from getting order to delivering service to customer is fast and accurate [c]	.795	6.37	3.70	.65
ORM4: Have the ability to provide service delivery as promised to the right customer, in the right place, and at the right time	.656	5.53	3.52	.67
Customer relationship management process capability (CRM)				
CRM1: Focus on customer satisfaction as the center of corporate activities in service supply chain	.577	5.07	4.09	.80
CRM2: The ability to communicate optimistic information to customers in service supply chain[b]	.597	-	3.92	.77
CRM3: The ability to manage relationships with customers in service supply chain to create the impression before and after service	.754	7.83	3.87	.76
CRM4: The ability to establish effective relationships with customers to benefit brand loyalty in service supply chain	.865	6.36	3.90	.73
Demand management process capability (DM)				
DM1: The ability to focus on forecasting, allocating planning, and target-setting functions	.695	7.07	3.49	.67
DM2: The ability to simulate different service demand needs[b]	.825	-	3.37	.71
DM3: The ability to predict service demand accurately in risky and uncertain situations via up-to-date demand information	.722	7.37	3.26	.75
DM4: The ability to adjust and match customer service demand with capacity	.540	5.38	3.41	.88
Capacity and resource management process				

capability (CAP)				
CAP1: The ability to define service capacity in the service provider	.611	5.34	3.84	.76
CAP2: The ability to match service capacity with uncertain demand	.681	5.75	3.67	.80
CAP3: The ability to manage tangible resources (e.g., facilities, labor, and capital) to operate at optimum service capacity[b]	.720	-	3.72	.69
CAP4: The ability to manage intangible resources (e.g., skills, experiences, and knowledge) to operate at optimum service capacity	.518	5.66	3.60	.72

Note: [a] Critical ratio (CR) 3.10 or above means p-value <0.001. [b] The Critical ratio is not available because the regression weight of this variable is fixed at 1.

Model fit statistics: $\chi 2 = 486.12$, df = 329, $p < 0.001$, CFI = 0.90, TLI = 0.90, and SRMR = 0.07.

Figure 1: CFA results of second-order model



Model fit statistics = 506.41, *df* = 343, p < 0.001; CFI = 0.90; TLI = 0.90; SRMR = 0.07