Customer Orientation and Innovation: A Comparative Study of Manufacturing and Service Firms

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ABSTRACT

This study investigates the effect of customer orientation on innovation performance in manufacturing and service firms by comparing their innovation mechanisms. Based on a sample of 1,646 manufacturing firms and 686 service firms, our results indicate that customer orientation positively affects service innovativeness and product innovativeness in service firms and manufacturing firms, respectively, and that such effects are mediated by two important firm resources: supplier collaboration and technological capability. However, customer orientation has a stronger total effect on innovativeness and supplier collaboration has a stronger mediating effect on the relationship between customer orientation and innovativeness in service firms. Although many previous studies have indicated that technological capability is relatively unimportant in service firms, our analyses indicate that it is now an equally important factor in service innovation and manufacturing innovation. These findings contribute to our understanding of innovation in the service and manufacturing industries, and to the literature on customer orientation, the resource-based view of the firm, and service-dominant logic.

Keywords: Customer orientation; Manufacturing innovation; Service innovation; Resource-based view; Service-dominant logic

1. Introduction

Innovation is the use of new solutions to meet new or existing customer and market requirements, and its importance in both manufacturing and service industries is well recognized. Innovation has also been identified a key research issue in production research (Grubbstrom and Hinterhuber 2006; Wong and Huang, 2014). Ostrom et al. (2010, 2015) identified service innovation as a research priority in the science of service; Dominguez-Péry et al. (2013) and Spohrer and Maglio (2008) also pointed out that service innovations are needed to fuel economic growth. Despite the well-recognized importance of service innovation, and the service sector's growing share of the GDP in most developed and developing economies, innovation research is still focused on manufacturing innovation thus service innovation is not well understood (Chae, 2012; Ettlie and Rosenthal, 2011; Machuca et al., 2007). Ettlie and Rosenthal (2011) argued that compared with manufacturing innovation, service innovation is generally less formalized and may lack strategic planning due to the core belief of service industries: "Satisfy customers, and the rest will follow." However, a customer focus does not necessarily make innovation in the service industry less formalized. Drucker (1954) suggested that the purpose of every business (manufacturing or service) is to create a customer. Thus, strategically, a business enterprise has only two basic functions—marketing and innovation—and customer-oriented strategies are the core elements of innovation in both the manufacturing and service industries. In fact, many manufacturing firms are becoming more customer-oriented and are using solutions such as mass customization to satisfy customers' specific customized needs (MacCarthy et al., 2003; Pine, 1993; Wang et al., 2015).

There is a scarcity of research comparing service innovation with manufacturing innovation (Ettlie and Rosenthal, 2011; Song et al., 1999), and more empirical studies are needed to explore and substantiate their differences and similarities. If there are significant differences between manufacturing and service contexts, it may be foolish for service industries to fully emulate the processes that manufacturing uses to develop innovative products. However, it is likely that much of the extensive knowledge of innovation in manufacturing is relevant to service contexts. A more nuanced view of business strategies and the application of management knowledge across the two contexts is called for. This study investigates the factors that drive innovation performance using a large sample of both manufacturing and service firms. Specifically, we study a well-documented strategic driver of innovation performance—customer orientation—and two factors that mediate this relationship—supplier collaboration and technological capability—from the perspectives of service-dominant logic (SDL) (Vargo and Lusch 2004, 2008) and the resource-based view (RBV) of the firm (Barney, 1991). Previous research has indicated that customer orientation may influence innovation performance indirectly rather than directly (Keskin, 2006), whereas operational processes and capability-building activities (Peng et al., 2008; Wu et al., 2010) may facilitate the implementation of organizational strategy and thus mediate the relationship between customer orientation and innovation performance. To enable the comparison of service and manufacturing firms, innovation performance is captured by measuring the general innovativeness of each firm's offering-portfolio.

Theoretically, the concept of customer orientation is closely connected to SDL, as SDL contends that "a service-centered view is inherently customer oriented and relational"

(Vargo and Lusch, 2004, 2008). Michel et al. (2008) suggested that SDL is appropriate for studying service innovation because it moves away from perspectives drawn from the development of technological products. As SDL is still developing and evolving, scholars such as Arnould (2008) have pointed out the need to link it to resource theories, especially with the resource-based view (RBV) of the firm. The RBV suggests that firms can achieve strategic objectives and gain sustained competitive advantage by building up valuable, rare, imperfectly imitable, and non-substitutable resources (Barney, 1991). Arnould (2008) suggested that customer-centric models of firm resources need to be developed; to do this, it is necessary to study how a customer-oriented strategy influences a firm's capacity to build unique resources and sustained competitive advantage.

2. Theoretical Background and Literature Review

2.1. Service versus manufacturing innovation

The division between service innovation and manufacturing innovation is rooted in the traditional classification of services versus goods. Unlike manufactured goods, service is characterized by simultaneous production and consumption, perishability, intangibility, and heterogeneity (Fitzsimmons and Fitzsimmons, 2004), and often emphasizes the value of actions, experience, or assurances, rather than the value of physical things (Spohrer and Kwan, 2009). In addition, a manufacturing firm can sustain its advantage by patenting its innovative new products (Lieberman and Montgomery, 1998), whereas a service firm may not be able to protect its new services, due to their intangible nature.

There has been considerable research on the differences between manufacturing and service in areas such as quality management (Gowen and Tallon, 1999; Pekovic, 2010; Prajogo, 2005), supply chain management (Sengupta et al., 2006), and strategic management (Awasthy and Gupta, 2011; Forsman, 2011; Song et al., 1999). There is a smaller, but growing field of study associated with new service development (NSD) and innovation. Previous research has focused on the differences in the development processes of services and products. Various new product development (NPD) process models (e.g., Booz et al., 1982) and NSD process models (e.g., Bitran and Pedrosa, 1998; Johnson et al., 2000; Voss, 1992) have been proposed. Alam and Perry (2002) argued that a major point of difference between product development and service development is the involvement of customers in services. Martin and Horne (1993) and Griffin (1997) found that NSD processes tend to be less sophisticated or formal than NPD processes. Zomerdijk and Voss (2011) found that some successful service organizations used formal NSD processes, but some used unstructured processes.

Although previous studies have found significant differences in some areas of service and manufacturing innovation, such as the product/service development process, there is also evidence that these differences do not exist in all areas. Most previous studies of service innovation have adopted one of three approaches: assimilation, demarcation, and synthesis (Coombs and Miles, 2000; de Vries, 2006; Drejer, 2004; Gallouj, 1998). The assimilation approach sees service innovation as similar to manufacturing innovation and views service from a manufacturing perspective; the demarcation approach argues that service innovation is distinctively different from manufacturing innovation and thus requires new theories and instruments; and the synthesis approach suggests that service innovation focuses on the neglected elements of innovation that are often of relevance to both the manufacturing and service industries. Further, as many previous studies have been exploratory or have limited sample sizes and inadequate analyses, a more rigorous empirical analysis is needed to improve the interpretation and generalizability of the findings on service innovation.

2.2. Customer orientation and innovation performance

Customer orientation refers to "the sufficient understanding of one's target buyers to be able to create superior value for them continuously" (Narver and Slater, 1990). Customer orientation is an important strategic orientation for an organization (Gatignon and Xuereb, 1997; Wang et al., 2015; Zhou et al., 2005) and represents an organization's strategic posture towards its customers (Kohli and Jaworski 1990, Narver and Slater 1990). In practice, customer orientation involves all of the activities related to information generation and dissemination and appropriate responses to current and future customer needs and preferences (Kohli and Jaworski, 1990). It is based on a marketing concept that puts the interests of customers first (Han et al., 1998). Narver and Slater (1990) conceptualized customer orientation as a part of market orientation, a construct that consists of three behavioral components: customer orientation, competitor competition, and inter-functional coordination. Of these three components, customer orientation is the most fundamental (Deshpandé et al., 1993; Lawton and Parasuraman, 1980). Some scholars regard customer orientation and market orientation as synonymous and use them interchangeably (Berthon et al., 2004; Deshpandé et al., 1993; Hartline et al., 2000).

It has been recognized that a customer-oriented strategy (Hartline et al., 2000) is important in both NPD and NSD. Being close to the customer can increase a firm's innovativeness and competitive advantage (Adams et al., 1998). Although customer orientation is seen as critical for both manufacturing and service innovation, some scholars have argued that customer orientation plays a more important role in service firms than in tangible product firms (Alam and Perry, 2002; Hartline et al., 2000). Innovation has been called the “missing link” between customer orientation and firm performance (Agarwal et al., 2003; Han et al., 1998; Kirca et al., 2005; Matear et al., 2002). Previous studies have suggested that customer orientation may influence innovation performance indirectly rather than directly, but theoretically sound mediators have not been proposed and tested empirically. Customer orientation may lead to strategic actions that improve capabilities or resources for new services or product development, which in turn lead to innovation.

2.3. The RBV and SDL

Service operations management scholars have often used the RBV to study innovation in manufacturing firms; more recently, it has been expanded to service contexts (e.g., Froehle and Roth, 2007; Menor and Roth, 2008). As services are not easily patented, and service innovations are thus seen as difficult to sustain (Tufano, 1989), previous research used the RBV to study how service innovations could be sustained by building resources that are valuable, rare, imperfectly imitable, and non-substitutable. SDL, an emerging theoretical lens proposed by Vargo and Lusch (2004, 2008), regards service as the central mechanism of any economic exchange and proposes a list of foundational premises. Ordanini and Parasuraman (2011) advocated the use of SDL to study service innovation and argued that it is an overarching perspective that can leverage (instead of compete with) other research approaches to service innovation. Arnould (2008) pointed out the need to link SDL with resource theories and suggested that customer-centric models of firm resources need to be developed. This study fills this research gap by examining how customer orientation influences innovation performance, specifically how it builds unique firm resources.

Barney (1991) classified firm resources into three categories: physical capital resources (i.e., technology, plant and equipment, location, etc.), organizational capital resources (i.e., formal/informal structure and relationships), and human capital resources (i.e., individual managers and workers). Adopting the perspective of RBV, we use two key firm resources—the internal technological capability of a firm and its external collaboration with suppliers—to investigate the underlying mechanism through which customer orientation influences innovation performance. Technological capability is considered to be one of the most important sources of sustainable competitive advantage (Barney, 1991; Grant, 1991; Xin et al., 2010). Menor et al. (2002) called for research on the role that technology plays in the development of new services. Technological capability is also considered a dynamic capability (Teece et al., 1997). Supplier collaboration can be considered an organizational capital resource that relates to the relational aspects of inter-firm value-creating processes. Collaboration with suppliers has been found to be important in the development of new products (Burt and Soukup, 1985; Shin et al., 2000; Swink, 1999). Arnould (2008) suggested an SDL perspective should be used to examine how inter-firm value-creating processes are embedded in organizational routines.

3. Research Framework and Hypotheses

Customer orientation is a well-documented driver of innovation, but it may play different roles in service firms and tangible product firms. Therefore, exploring the mechanism of its influence on innovation performance will enable us to determine some of the similarities and differences between service innovation and manufacturing innovation. Two key firm resources, supplier collaboration and technological capability, are proposed as mediating variables in the relationship between customer orientation and innovation. Firms' relationships with suppliers have attracted much attention from research disciplines such as supply chain management (e.g., Zhao et al., 2011), marketing (Liu et al., 2009; Wuyts and Geyskens, 2005), and operations research (Cheung and Hausman, 2000; Zhang et al., 2010). The extent of supplier involvement in innovation may range from simple consultation on design ideas to responsibility for the complete development and design of a specific component or even a whole system (Wynstra and ten Pierick, 2000). Technological capability, a critical asset embedded in a firm's product, includes not only technological knowledge, which is typically tacit and developed over time, but also the technological development capability, which is often based on learning-by-doing and scientific breakthroughs. Franco et al. (2009) argued that the ability of a firm to integrate, build, and reconfigure its technological competencies to address rapidly changing environments determines its competitive advantage and relative position in a market.

Based on the above argument, we develop a conceptual model in which the relationship between customer orientation and service/product innovativeness is mediated by supplier collaboration and technological capability to examine the mechanisms of innovation in service and manufacturing industries. This model is shown in Figure 1.

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3.1. The relationship between customer orientation and innovation performance

Customer orientation represents an organizational strategy (or "culture") of changing and improving in response to customers' changing needs and requirements (Narver and Slater, 1990; Kohli and Jaworski, 1990) and thus enhances innovation (Atuahene-Gima, 1995, 1996; Grinstein, 2008; Hult et al., 2004). Customer orientation emphasizes the use of information, learning, and uncovering latent customer needs and thus affects new product development activities and performance (Atuahene-Gima, 1995). As customer-oriented firms are more knowledgeable about current and future customer needs and preferences (Kohli and Jaworski, 1990), they have a better understanding of what new products or services will satisfy unmet customer needs. Atuahene-Gima (1996) found that in both product innovation and service innovation samples, a customer orientation significantly improved the performance of innovation projects. Therefore, we put forward an initial confirmatory hypothesis:

H1. Customer orientation is positively related to the innovativeness of offerings in both service and manufacturing firms.

Studies of supplier collaboration in innovation focus on the relational aspect of inter-firm value-creating processes, which has been found to be important in the development of new products and services. Traditional company-centric views place customers outside the value chain, whereas a customer-centric (or customer-oriented) view suggests that customers can influence where, when, and how value is generated (Prahalad and Ramaswamy, 2002). It is thus reasonable for customer-oriented firms to focus their own efforts and those of their collaborators' on fulfilling customer requirements. A customer orientation requires firms to identify key resources and capabilities, some of which may not be owned by the firms themselves and must be acquired from suppliers.

From the perspective of the RBV, supplier collaborations are valuable and unique resources that can help firms achieve their strategic objectives and create sustained competitive advantages. Supplier collaborations can be rare, non-substitutable, and hard to imitate, as inter-firm relationships are usually dependent on particular historical or past collaborative experiences and interactions, which are often socially complex (Barney, 1991). Petersen et al. (2005) and Koufteros et al. (2007) found that collaboration with suppliers that possess product development capabilities contributes to product innovation. Therefore, customer-oriented firms are more likely to maintain and strengthen their relationship with suppliers and rely on suppliers' development capabilities, and these efforts will lead to the development of innovative products or services for their customers. We thus put forward the following hypothesis:

H2. Supplier collaboration positively mediates the relationship between customer orientation and the innovativeness of offerings in both service and manufacturing firms.

Technological capability is a critical asset embedded in a firm's products or services. It is often the driving force of a firm's innovation and the source of a firm's long-term competitive advantage (Hsieh and Tsai, 2007). To respond to the changing needs and requirements of customers, firms usually need to continually use new technologies to make improvements to existing products or to create new products and services. Technological capability is valuable to firms because it may lead to product/service improvements that increase the value for customers or reduce a firm's cost structure. In addition, the competitive advantage created by a firm's technological capability is often causally ambiguous (Barney, 1991), as firms without similar technological knowledge and skills usually have difficulty understanding what or how improvements in products or services are made. As such, technological capability is an important concern of customer-oriented firms aiming at continuously satisfying unmet customer needs with superior products or services. Hence we hypothesize that the following:

H3. Technological capability positively mediates the relationship between customer orientation and the innovativeness of offerings in both service and manufacturing firms.

3.2. The comparison between service and manufacturing innovation

Our literature review indicates that there is limited and inconsistent empirical evidence on whether customer orientation–supplier collaboration relationships and technological capability–innovation relationships are the same in service and manufacturing firms. Some scholars have argued that a customer orientation has a greater effect on innovation in service firms than in tangible product firms (Alam and Perry, 2002; Hartline et al., 2000), as service is inherently customer-oriented (Vargo and Lusch, 2004, 2008). Further, previous studies, including those by Kerby (1972) and Lawton and Parasuraman (1980), have questioned the effects of customer-oriented behavior on innovations in the manufacture of physical products. Therefore, we expect the following:

H4. The effect of customer orientation on the innovativeness of offerings is stronger in service firms than in manufacturing firms.

To our knowledge, no empirical studies have compared the importance of supplier collaboration in the development of new products and services. Nevertheless, supplier collaboration in manufacturing firms tends to be more standardized, and there are established best practices in terms of processes and evaluation standards to achieve a customer orientation (e.g., Shin et al., 2000; Swink, 2000). In contrast, although many scholars do emphasize the importance of collaborating with suppliers or network partners (e.g., Frambach et al., 1998; Ordanini and Parasuraman, 2011; Tomlinson and Fai, 2013), there is no consensus on the standards and best practices of supplier collaboration in service innovations. This fact implies that supplier collaboration may not be a rare and imperfectly imitable resource (Barney, 1991) for manufacturing firms, whereas it might be for service firms. Further, as innovations in services are more easily copied than innovations in manufactured goods (Tufano, 1989), the absence of standards and best practices in supplier collaboration may help service firms to build up rareness and imperfect imitability by successfully and uniquely collaborating with key suppliers or network partners. Therefore, we expect the following:

H5. The mediation effect of supplier collaboration on the relationship between customer orientation and the innovativeness of offerings is stronger in service firms than in manufacturing firms.

Technology is traditionally viewed as less important for services and NSD than for manufacturing (Cooper and de Brentani, 1991) and, although technology is changing the way that services are delivered and designed (Menor et al., 2002), service innovations do not require much R&D (Brouwer and Kleinknecht, 1997). Technologies (especially information technologies) do change the way that services are delivered and designed, but service primarily uses technology as a way to support the service delivery process and customer contact (Froehle and Roth, 2004). In contrast, in manufacturing firms, technology is usually part of the product and characterized by patents (Mazzola et al., 2015) embedded in these products; as a result, it cannot be easily separated from the products. Therefore, we suggest that technological capability is more influential in manufacturing firms, and service firms are less dependent on their own technological capability than manufacturing firms. We thus expect the following:

H6. The mediation effect of technological capability on the relationship between a customer orientation and the innovativeness of offerings is stronger in manufacturing firms than that in service firms.

4. Research Methodology

4.1. Measures

To ensure that the measurement items used in this study were appropriate for both manufacturing and service firms, we reviewed previous studies and interviewed academics and practitioners in the manufacturing and service industries. We invited three operations management experts and one marketing expert, all of whom were actively involved in teaching and research at two Chinese universities. Thirty operations and marketing managers from 30 organizations (including both manufacturing and service firms) were invited to pilot-test the questionnaire, and face-to-face interviews were conducted with them to examine whether the measurement items were appropriate and relevant to their practices and whether any important aspect might be missing. Based on these results, the measurement items were developed (as listed in Appendix A).

Customer orientation is a widely studied construct and has been measured in many different ways. Some scales used two items (Hillebrand et al., 2011), six items (Narver and Slater, 1990), or as many as nine items (Deshpandé et al., 1993). In this study, we generated a five-item scale with items borrowed items from Narver and Slater (1990) and Deshpandé et al. (1993), with some minor adaptations in wording.

The items for supplier collaboration were developed from previous studies, such as Koufteros et al. (2007) and Ahuja (2000), and from interviews with practitioners. We measured supplier collaboration in product/service development with four items; two directly addressed supplier's involvement in product/service development and two addressed the communication of and participation in key design and quality improvement activities.

Technological capability was measured by four items that consider the use of new technologies and knowledge in design, the use of information technology in production/service process, the renovation of equipment and evaluation of current technologies, and the improvement of technological capability. This measurement is consistent with a conceptualization of technological capability that encompasses both tacit technological knowledge and the continuous evaluation and reconfiguration of technological competencies to address changing environments (Franco et al., 2009). We also developed an item related to information technology, as Jin and Zedtwitz (2008) suggested that information and communication technologies are an important aspect of technological capability.

For all of the items, responses were recorded on a 6-point scale, with 1 indicating that the firm does not engage in the practice at all and 6 indicating that it engages in the practice to a very great extent. Although 6-point Likert scales have been widely used in disciplines such as psychology (Lei, 1994), sociology (Ng and Chan, 2000), medical science (Botelho and O'Donnell, 2001), library science (Gronemyer and Deitering, 2009), business and management research has commonly used 5-point, 7-point, or even 11-point Likert scales. Only a few scholars have used a 6-point scale (e.g., Aurand et al., 2005; Moyes et al., 2006), although it has the advantage of eliminating the "neutral" opinion. We adopted a 6-point Likert scale to avoid offering the choice of a neutral opinion to the Chinese respondents. Chinese culture is dominated by Confucianism (Rainey, 2010), which emphasizes “the doctrine of the mean” (Legge, 2009), and as a result, moderation in all things is valued. Chinese respondents are comfortable choosing a 4 on a 7-point scale, or a 3 on a 5-point scale, and this may distort the normality of the sampling distribution.

Four aspects of service/product innovativeness were measured: newness to the market, impact on industry, the adoption of new techniques, and creativeness. Newness to the market and impact on the industry have been used as indicators for innovativeness (e.g., Avlonitis et al., 2001; Booz et al., 1982; Cooper and Kleinschmidt, 1993), and the technological aspect of innovativeness has also been found to be important (Danneels and Kleinschmidt, 2001; Swink, 2000). All four items were measured on a 6-point scale to maintain consistency with the constructs mentioned above, with a 1 indicating strong disagreement and a 6 indicating strong agreement.

To ensure the reliability of the questionnaire, it was developed in both Chinese and English, with two-way translations double-checked by Chinese professors and Western professors on the research team. To identify and correct any possible confusion in wording, the questionnaire was pilot-tested at several manufacturing companies and service companies before the full-scale launch of the survey.

4.2. Sampling and data collection

With the help of the China Association for Quality (CAQ), we conducted a nationwide survey across 14 provinces in China between August and November 2007. A stratified sampling method was used to weight the sample by industry (manufacturing versus service). The CAQ is a national non-profit organization administered by the central authorities responsible for economic development and quality. We mailed a questionnaire to one key informant at each of the 5,000 selected members of the CAQ. Of the 2,675 questionnaires returned by January 2008, 2,332 were usable, including 686 questionnaires from service firms and 1,646 questionnaires from manufacturing firms. As the CAQ has more members from the manufacturing industry, the manufacturing dataset has more firms than the service dataset.

4.3 Respondent profile

Table 1 shows the profiles of the respondent companies. A wide variety of industries were included, and respondents were mainly from top management or general managers. The service firms represented business services (20%), retail and wholesale trade (15.7%), transportation and logistics (9.3%), and other typical service industries. The manufacturing firms included electronics and electrical (24.9%), metal, mechanical, and engineering (20.4%), chemicals and petrochemicals (10.6%), and some other major manufacturing industries covered in GB/T 4754-2002, which is the national standard for the classification of industries in China.

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5. Analysis and Results

The bootstrapping-based partial least squares (PLS) approach to structural equation modeling (SEM) was used in this study. PLS is a second-generation modelling technique that simultaneously assesses the quality of research constructs and the proposed relationships between these constructs, and has been widely adopted in business research fields such as information systems, marketing, and operations management (Peng and Lai, 2012). We adopted PLS for the following reasons. First, our conceptual model, specified in Figure 1, contains two mediators, but the traditional mediation-testing methods such as the causal steps strategy (Baron and Kenny, 1986) and the Sobel test (Sobel, 1982) are either unsuitable for this model, or suffer from shortcomings caused by the requirement for multivariate normality in both the paths constituting the indirect effects and the total and specific indirect effects, which is rarely fulfilled in finite samples (Preacher and Hayes, 2008). Therefore, bootstrapping has been recommended as the best approach for testing the indirect effects of multiple mediators in the same model (Preacher and Hayes, 2008; Williams and MacKinnon, 2008). Second, this study compared the paths (direct, indirect, and total) in the research model across two samples (service firms and manufacturing firms), making it a moderated mediation (Baron and Kenny, 1986) problem with multiple mediators involved. Using PLS, Chin and Dibbern (2010) provided a permutation-based multi-group invariance testing method and pair-wise t-tests for more conveniently comparing the indirect/mediation effects in different groups.

PLS-Graph software was used and the parameters were estimated using maximum likelihood with a bias-corrected bootstrapping approach. As recommended, 5,000 bootstrap samples were derived from each of the service and manufacturing datasets to ensure a bias-corrected comparison. Both the service and manufacturing data were permuted repeatedly in a manner consistent with the random assignment procedure; thus, 5,000 bootstrap samples of service firms (each sample with a sample size N = 686) and 5,000 bootstrap samples of manufacturing firms (each sample with a sample size N = 1,646) were generated. These data permutations constitute the reference set for determining significance. The path coefficients of the direct effects in the 5,000 bootstrap samples were then multiplied to generate the coefficients of the mediation and indirect effects for service and manufacturing firms, respectively. Based on the coefficients of the indirect effects, further pair-wise t-tests were conducted to compare the magnitudes of the mediation effects across the two groups. The bootstrap confidence intervals for the mediation effects were derived by sorting the 5,000 values from low to high.

5.1. Non-response bias and common method bias

As in all survey-based empirical studies, non-response bias is a concern. To address this problem, the early and late (after several rounds of calls) responses for physical assets, annual sales, number of employees, and the other variables used in this study were compared (Armstrong and Overton, 1977; Stank et al., 2001); t-tests showed no significant differences, indicating that non-response bias does not appear to be a major concern in this study.

As we used one informant from each firm to answer the self-reported questionnaire in this study, the potential for common method bias in the results was assessed. First, as appropriate arrangements of the items in a questionnaire can somewhat reduce respondents' consistent motivation and thus decrease the common method bias in self-reporting (Podsakoff et al., 2003; Podsakoff and Organ, 1986), we adopted different instructions for different scales, and the adjacent variables in the conceptual model were put in distinct sections. Second, to confirm this conclusion, we conducted a test following the recommendation of Podsakoff et al. (2003). Accordingly, two measurement models were compared following the analytical procedure in PLS proposed by Liang et al. (2007), with one measurement model including all of the traits and the other model adding in a method factor. The results showed that the path coefficients were very subtle and insignificant. Third, we checked the correlation matrix to see if there were any high correlations, as Pavlou et al. (2007) suggested that common method bias is unlikely if there are no excessively high correlations (> 0.9). The results of these tests suggested that the common method bias is unlikely to exist in this study.

5.2. Reliability and validity

A rigorous process was used to develop and validate the survey instruments. Prior to the data collection, content validity was supported by previous studies, executive interviews, and pilot tests. After the data collection, a series of analyses were performed to test the reliability and validity of the constructs.

We followed the commonly used two-step method (e.g., Zhao et al., 2008; Zhao et al., 2011) to test construct reliability. First, we conducted exploratory factor analyses (EFA) using both orthogonal and oblique rotations to ensure high loadings on the hypothesized factors and low loadings on cross-loadings in the datasets. All of the items loaded onto the expected factors without significant cross-loadings. Then, the reliability of each construct was tested using Cronbach's alpha. The Cronbach's alpha values, shown in Table 2, were over 0.8 for all of the constructs in both the service and manufacturing datasets, indicating that all of the constructs were reliable.

Next, convergent validity and discriminant validity (O'Leary-Kelly and Vokurka, 1998) were tested using the service and manufacturing datasets. Following Bagozzi and Yi (1988), we computed composite reliability (CR) scores to assess construct reliability. As reported in Table 2, all of the factors had CRs greater than 0.70, and the average variance extracted (AVE) suggested by Fornell and Larcker (1981) for all of the constructs satisfactorily exceeded 0.50. For our model, all of the factor loadings were greater than 0.50, and all of the *t*-values were greater than 2.0, thus convergent validity was achieved. Further, the squared correlation between each pair of constructs (see Table

3) was less than the AVE reported in Table 2 for each individual construct. These results provided strong evidence of discriminant validity.

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5.3. *Hypotheses testing results*

The research model was tested separately with the two datasets using PLS-Graph. The results of the hypothesis testing are summarized in Table 4.

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To test H1, a simple model with only customer orientation and service/product innovativeness was tested using the service dataset, and then using the manufacturing dataset. The direct effect of customer orientation on service/product innovativeness was significantly positive, with a coefficient of 0.457 for service firms and 0.385 for manufacturing firms (both *p*-values less than 0.001, with $t = 14.144$ for service and $t = 17.627$ for manufacturing). Hence H1 was supported.

To test the mediation effects (H2 and H3), a full model (Figure 1) was tested. All of the effects were significantly positive in both the service and manufacturing datasets, with the exception of the non-significant ($p > 0.05$ for both datasets, as $t = 1.411$ for service and $t = 1.679$ for manufacturing) direct effect from customer orientation to service/product innovativeness (path coefficient: -0.071 for service firms and -0.060 for manufacturing firms). We also applied the Sobel test for the two indirect effects using the formula provided by Sobel (1982) and Preacher and Hayes (2008). The Sobel test results showed that in both datasets the indirect effects associated with the two mediators had *Z* scores larger than 2.57 ($p < 0.01$), leading to a rejection of the null hypothesis that each indirect effect is zero. Due to the shortcomings of the Sobel test in a multiple-mediators context, confidence intervals for each indirect effect were computed through a numerical ordering of the bootstrapping results. The results, shown in Table 4, support both H2 and H3.

We next tested for differences between the manufacturing and service firms. First, we found that the effect of customer orientation on service/product innovativeness was significantly stronger in service firms (the difference was 0.072, $p < 0.05$), supporting H4. Second, the mediation effect of supplier collaboration (i.e., the multiplication of the two sets of 5,000 bootstrapped direct effects, customer orientation on supplier collaboration and supplier collaboration on service/product innovativeness) was significantly stronger in service firms (difference = 0.181, $p = 0.009$); thus H5 was supported. However, for the mediation effect of technological capability, the difference between manufacturing firms and service firms was not significant (difference = 0.084, $p = 0.339$); thus H6 was not supported.

6. Discussions and conclusions

This study investigates the effects of a customer orientation on innovation performance and examines the mediating roles of supplier collaboration and technological capability. It also compares the mechanisms of innovation in the manufacturing and service industries. The key findings and managerial implications are discussed below.

6.1. Major findings and implications

First, the results of the statistical analyses indicate that a customer orientation has significant positive effects on the innovation performance of firms due to the mediating effects of two firm resources: supplier collaboration and technological capability. The finding that a customer orientation has a significant positive effect on innovativeness in both manufacturing firms and service firms is consistent with past research (Atuahene-Gima, 1996; Grinstein, 2008; Hult et al., 2004). These results help us to understand the underlying mechanism through which customer orientation affects innovation. From the perspective of the RBV, supplier collaboration and technological capability can both be seen as important resources needed for innovation. The results of this study indicate that to convert customer needs and requirements into innovative products or services, appropriate relational capital resources and physical capital resources have to be developed. Therefore, to improve innovation capability and performance in the market place, companies must invest in their technological capabilities or leverage their suppliers' capabilities through collaborations.

Second, the comparison of service and manufacturing firms reveals that the direct effect of customer orientation on innovativeness is significantly stronger in service firms than in manufacturing firms (H4). One implication of this result is that service firms may have adopted more of the SDL versus goods-dominant logic than manufacturing firms (Vargo and Lusch, 2004). As firms adopting SDL are more inherently customer-oriented, we expect that service firms are more likely to pursue a customer-oriented strategy and that its effect on innovation and performance are stronger in service firms than in manufacturing firms. Furthermore, the mediation effect of supplier collaboration was also significantly stronger in service firms than in manufacturing firms (H5). SDL may help explain this difference; as the service-centered view of SDL is more relational and emphasizes value co-creation, supplier collaboration as an important relational asset is likely to be more influential in firms guided by SDL.

However, the mediation effect of technological capability was not statistically different between service firms and manufacturing firms (H6 was not supported). At first sight this finding seems surprising, as it goes against the evidence of earlier research that found stronger effects of technology in manufacturing firms. Historically, service firms have not had a separate R&D department (Djellal and Gallouj, 2001) and it has been argued that service innovation involves the development of new procedures and concepts rather than new core technologies (Preissl, 2000). Our results indicate that this is no longer the case. We argue that probably because of digitalization, the context of services has changed, and technology plays a much more significant role in service industries than it did in the past. We conclude that technological capability has become an equally critical competence for both manufacturing and service firms.

We conducted further analyses to compare the mediation effects of technological capability versus supplier collaboration within manufacturing firms, and then within service firms. The results showed that for manufacturing firms, the mediation effect of technological capability was stronger than the mediation effect of supplier collaboration (difference = 0.250, p = 0.009), which to certain extent supports the traditional view. For service firms, there was no significant difference in the magnitude of the mediation effects of technological capability and supplier collaboration (difference = -0.014, p = 0.921), supporting the importance of technological capability in both manufacturing and service firms. The mix of similarities and differences between manufacturing and service firms echoes the results of previous studies that compared innovation in the service and manufacturing industries (Ettlie and Rosenthal, 2011; Prajogo, 2006; Song et al., 1999).

These findings have significant managerial implications. First, both manufacturing and service firms need to invest in their technological capabilities and supplier collaborations to enhance innovation and performance. For manufacturing firms, technological capability seems to be more effective than supplier collaboration and thus may deserve more resources, whereas for service firms, technological capability and supplier collaborations seem to be of equal importance. As service innovations are usually copied by others, service firms may need to invest more in valuable, rare, imperfectly imitable, and non-substitutable resources, whether they are technologies or relationships, or more safely, both.

6.2. Contributions and future research

Using a large dataset collected from Chinese service and manufacturing firms, this study found that a customer orientation has a strong positive effect on innovation in both service and manufacturing firms, a finding that helps resolve the ongoing debate over the effects of a customer-oriented strategy on innovation and performance. Furthermore, we investigated the mechanisms through which customer orientation influences innovation and compared the magnitudes of the different effects in the relationships between customer orientation, supplier collaboration, technological capability, and innovation performance in service and manufacturing firms. We discovered that supplier collaboration and technological capability significantly mediate the effects of customer orientation on innovation. The mediation effects of supplier collaboration were significantly stronger in service firms than in manufacturing firms, whereas the effect of technological capability did not differ between the two. Managerially, the results will help customer-oriented firms to make better decisions about capability building and resource allocation. This study also contributes insights into the differences in innovation in the service and manufacturing industries by empirically investigating the similarities and differences between their innovation mechanisms from both the RBV and SDL perspectives. Although both theories can be used to explain phenomena in service and manufacturing industries, service firms seem to adopt more of an SDL perspective and tend to place more emphasis on relational capital than manufacturing firms.

The findings of this study also need to be interpreted in light of several limitations. First, the current study considered only two critical firm resources as mediators, supplier collaboration (an organizational capital resource) and technological capability (a physical capital resource). As such, this study focused on supply side resources and capabilities, and examined how to use supplier collaboration capability and internal technological capability to satisfy the needs of customers, but neglected the development of collaborations with the customer from the demand side. Customer participation in development could be an important resource for innovation, and an important difference between service and manufacturing firms. To improve our understanding of the indirect effect of customer orientation on innovation, and of service innovation versus manufacturing innovation, future studies need to investigate other factors that mediate the relationship between customer orientation and innovation.

Second, this study measured technological capability in general, which may have made it more difficult to detect differences. It is possible that a particular technological advancement may be more influential in certain industries than in others.

Third, the sample was drawn from China, which is still relatively dominated by manufacturing firms, whereas most developed economies are undoubtedly dominated by service firms. It would be interesting to replicate the present study with data from other countries.

Finally, the data used in this study were cross-sectional, but the rapidly changing environment in terms of technological advances may have affected innovation mechanisms and the results found by this research. As such, it would be interesting and necessary to use more recent data to test whether the findings of this study can hold over time, and whether there is a changing pattern in the mechanisms that customer orientation as a strategic orientation influences the development of capabilities, and subsequently innovation and performance.

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Appendix A: Measurement Items

Customer orientation

CO1. The company divides customers into different groups to better understand and define customers' needs.

CO2. The company systematically listens to and understands the needs and preferences of different groups of customers.

CO3. The features of our products/services are designed based on the voice of customers.

CO4. The company continually improves customer service processes to help customers acquire information, make transactions, and file complaints.

CO5. The company systematically measures the level of customer satisfaction and loyalty for the improvement of product/service processes.

Supplier collaboration

SC1. We maintain intensive communication with suppliers with regard to the key factors influencing product/service quality and changes in design.

SC2. The company proactively requires suppliers to participate in our activities to improve the product/service quality.

SC3. We often ask for our suppliers' ideas and opinions about product/service design.

SC4. Suppliers often participate in our firm's projects during the product/service design stage.

Technological capability

TC1. The company incorporates new technologies and new knowledge into the design of production/service processes.

TC2. The company uses information technologies to reform the production/service process.

TC3. The company emphasizes the renovation of equipment and timely evaluation of current technologies.

TC4. The company continuously improves its technological capability.

Service (Product) innovativeness

SI1. The services (products) designed by our company are very creative.

SI2. The services (products) designed by our company are often new to the market.

SI3. The services (products) designed by our company have great impact on the industry.

SI4. The services (products) designed by our company often involve new techniques.

Figure 1
Click here to download high resolution image

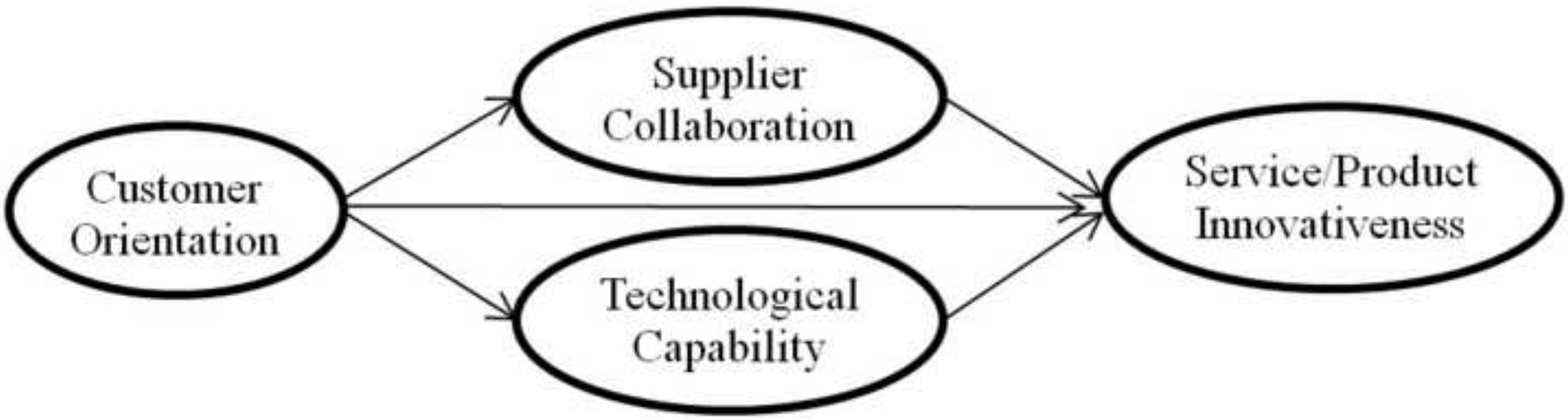

Figure 1. Conceptual Model

Tables

Table 1. Company profiles of the service dataset

Service dataset (N=686)			Manufacturing dataset(N=1646)		
Industry	N	p	Industry	N	p
Business services	137	20%	Electronics & electrical	410	24.9%
Retail & wholesale trade	108	15.7%	Metal, mechanical & engineering	335	20.4%
Transportation & logistics	64	9.3%	Chemicals & petrochemicals	174	10.6%
Real estate & property management	50	7.3%	Textiles & apparel	166	10.1%
Hotel & catering	47	6.9%	Food, beverage & alcohol	131	8.0%
IT and communication services	33	4.8%	Instruments & meters	48	2.9%
Public utilities and services	25	3.6%	Pharmaceutical & medical	43	2.6%
Construction	22	3.2%	Rubber & plastics	35	2.1%
Finance & insurance	17	2.5%	IT and communication devices	31	1.9%
Education & entertainment	13	1.9%	Wood & furniture	28	1.7%
Other	170	24.8%	Publishing & printing	27	1.6%
			Other	218	13.2%

Table 2. Construct reliability and validity

Constructs and items	Service Dataset				Manufacturing Dataset			
	α	CR	Factor loading	AVE	α	CR	Factor loading	AVE
Customer Orientation (CO)	0.930	0.947		0.781	0.930	0.947		0.781
CO1			0.878				0.883	
CO2			0.893				0.895	
CO3			0.884				0.875	
CO4			0.890				0.888	
CO5			0.872				0.878	
Supplier Collaboration (SC)	0.886	0.922		0.748	0.860	0.905		0.706
SC1			0.863				0.832	
SC2			0.870				0.870	
SC3			0.866				0.866	
SC4			0.860				0.790	
Technological Capability (TC)	0.906	0.934		0.780	0.898	0.929		0.766
TC1			0.862				0.869	
TC2			0.882				0.841	
TC3			0.894				0.882	
TC4			0.895				0.907	
Service/Product Innovativeness(SI)	0.925	0.947		0.817	0.923	0.945		0.812
SI1			0.893				0.902	
SI2			0.917				0.904	
SI3			0.920				0.909	
SI4			0.886				0.890	

Table 3. Correlation between the constructs

Service Dataset	CO	SC	TC	SI
Customer Orientation (CO)	1			
Supplier Collaboration (SC)	0.778	1		
Technological Capability (TC)	0.767	0.809	1	
Service/Product Innovativeness (SI)	0.457	0.586	0.555	1
Manufacturing Dataset	**CO**	**SC**	**TC**	**SI**
Customer Orientation (CO)	1			
Supplier Collaboration (SC)	0.765	1		
Technological Capability (TC)	0.752	0.789	1	
Service/Product Innovativeness (SI)	0.376	0.451	0.471	1

Table 4. Results of the hypothesis testing

Path in the structural model	Path coefficient		Percentile 95% CI		Outcome
	Simple Model	Full Model	Lower	Upper	
CO → SI (H1$_S$)	0.457***	-0.071			Supported
CO → SI (H1$_M$)	0.385***	-0.060			Supported
CO → SC → SI (H2$_S$)		0.780***, 0.432***	0.246	0.444	Supported
CO → SC → SI (H2$_M$)		0.783***, 0.225***	0.107	0.235	Supported
CO → TC → SI (H3$_S$)		0.773***, 0.261***	0.112	0.306	Supported
CO → TC → SI (H3$_M$)		0.767***, 0.361***	0.179	0.312	Supported
(CO → SI)$_{S-M}$ (H4)	0.072*				Supported
(CO → SC → SI)$_{S-M}$ (H5)		0.181**			Supported
(CO → TC → SI)$_{M-S}$ (N6)		0.084			Not supported

*$p < .05$, **$p < .01$, ***$p < .001$.