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Search for exploratory and exploitative service innovation in manufacturing firms: The role of ties with service intermediaries

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ABSTRACT

Although the literature highlights the role of ties with service intermediaries in facilitating firms' search for innovation, the relationship between these ties and exploratory versus exploitative service innovation remains unclear. In line with the innovation search perspective, we combine search scope and search depth to analyze and examine the mechanism of how ties with service intermediaries influence exploratory and exploitative service innovation differently. We also propose that technological capability and strategic flexibility moderate the impact of the relationships on exploratory versus exploitative service innovation. Using data from a sample of manufacturing firms in China, we find that ties with service intermediaries have a positive effect on exploitative service innovation but an inverted U-shaped relationship with exploratory service innovation. We further find that technological capability strengthens the positive effects of ties on both exploratory and exploitative service innovation, whereas strategic flexibility strengthens the positive effects of ties on exploratory service innovation. This study contributes to a more nuanced understanding of the curvilinear effects of the effect of service intermediaries on exploratory and exploitative service innovation. This study also extends the literature by proposing and empirically confirming that technological capability and strategic flexibility help manufacturing firms take advantage of relationships with service intermediaries.

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Introduction

To compete in a fierce homogeneous product market and respond to the transition from a product-dominant to a service-dominant economy(Kastalli & Van Looy, 2013; Lusch & Vargo, 2006; Ordanini & Parasuraman, 2011; Visnjic Kastalli, Van Looy, & Neely, 2013), a growing number of Chinese manufacturers, such as Haier home appliances,Dongfang Steam Turbine, and Sany Heavy Industry, are increasingly offering new services. These services, either exploratory or exploitative(Blindenbach-Driessen & Ende, 2014; Morgan, Anokhin, & Wincent, 2019), are intended to create additional value for customers and, thus, gain differentiation and a competitive advantage (Tim Baines, 2015; Gebauer, Edvardsson, Gustafsson, & Witell, 2010; Reinartz & Ulaga, 2008; Vandermerwe & Rada, 1989). However, manufacturing firms are usually constrained by a shortage of service-related resources(Santamaría, Nieto, & Miles, 2012). Their existing knowledge and resources, historically developed for product innovation, may be insufficient or even counterproductive for taking advantage of service innovation (Kindström & Kowalkowski, 2014; Morgan et al., 2019). Moreover, drawing on arguments on exploration and exploitation (Levinthal & March, 1993; March, 1991), exploratory and exploitative service innovation compete for scarce organizational resources, which exaggerates the shortage of internal organizational resources for service innovation. Hence, manufacturing firms are urged to search external knowledge sources for service innovation (Kindström & Kowalkowski, 2014).

The literature highlights the critical role of ties with service intermediaries in facilitating firms' search for innovation (Howells, 2006; Howells & Thomas, 2022; Savino, Petruzzelli, & Albino, 2017). Being potentially accessible to all firms and located at a unique network position(Howells, 2006; Kokshagina, Le Masson, & Bories, 2017; McEvily & Zaheer, 1999; Wolpert, 2002), service intermediaries grant firms access to a broader range of organizations and individuals for innovation (Howells & Thomas, 2022; Y. Zhang & Li, 2010). Thus, ties with service intermediaries enable firms to join rich networks and broaden their external search scope for innovation(Lin, Zeng, Liu, & Li, 2016; Y. Zhang & Li, 2010).

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However, the literature presents some inconclusive findings about whether ties with service intermediaries lead to more exploratory or exploitative innovation.Innovation search studies suggest that close relations with service intermediaries enable firms to conduct a broader search for innovation (Lin et al., 2016; Y. Zhang & Li, 2010). As a result, extensive knowledge exploration is expected to offer a great amount of new, heterogeneous knowledge for exploratory innovation activities (March, 1991; Rosenkopf & Nerkar, 2001). In contrast, social network research indicates that strong ties with service intermediaries may compel the firm to stay with the existing relationship to search for local familiar and even redundant information (Hansen, 1999). Hence, more exploitative but not exploratory innovation activities are expected. In short, the connection between ties with service intermediaries and exploratory versus exploitative service innovation remains unclear.

We believe that these inconsistenciesderive partially from different foci. The innovation search literature tends to concentrate on the exploration of more novel knowledge (search scope), facilitated by ties with service intermediaries, whereas social network research focuses on repeated similar knowledge exploitation (search depth) supported by strong ties with service intermediaries. Drawing on each line of research, a combination view of search scope and depth (Katila & Ahuja, 2002; Lopez-Vega, Tell, & Vanhaverbeke, 2016)isnecessary to resolve the existing tension. Our premise is that exploratory and exploitative service innovation are likely to be influenced differently by manufacturing firms' search behavior, i.e., search scope and search depth and, thus, to be influenced by ties with service intermediaries differently.

Furthermore, following the view of innovation as a process of searching and recombining knowledge sources(Nelson & Winter, 1982; Petruzzelli & Savino, 2014; Savino et al., 2017),an external search for innovation maybe useless if the accessed knowledge is not properly integrated with firms' existing knowledge (Enkel & Gassmann, 2010; Kim & Park, 2013; Zahra & George, 2002). Hence, manufacturers must haveresources or capabilities to absorb and combine new knowledge with existing knowledge (Savino et al., 2017; Zahra & George, 2002). According to Zhou and Wu (2010), technological capability represents an important source of absorptive capacity (Afuah, 2002; Cohen & Levinthal, 1990)and, thus, is critical in allowing firms to recognize the value of external knowledge, assimilate it, and apply it to commercialends (Butler & Ferlie, 2020; Cohen & Levinthal, 1990; Zahra & George, 2002; Zhou & Wu, 2010). Meanwhile, strategic flexibility(Sanchez, 1995), as one type of dynamic capability (Teece & Pisano, 1994; Teece, Pisano, & Shuen, 1997), enables firms to continually integrate, build, and reconfigureinternal and external resources(Eisenhardt & Martin, 2000; Teece et al., 1997). Therefore, drawing on absorptive capacity and dynamic capability theories, technological capability and strategic flexibility may play important but differential roles in the relationships with service intermediaries for achieving exploratory and exploitative service innovation. To date, however, studies have mostly examined the moderating role of external environmental factors (Lin et al., 2016; Y. Zhang & Li, 2010), and scant attention has been given to the possible moderators from an internal capability perspective.

Herein, this study aims to fill the research gaps by addressing two questions. First, what is the relationship between manufacturing firms' ties with service intermediaries and exploratory versus exploitative service innovation? Second, how do a manufacturer's resources or capabilities, characterized by technological capability and strategic flexibility, moderate this relationship? By answering these two questions, this study contributes to the literature in the following ways. First, in line with existing studies, we take an innovation search perspective to provide a more nuanced understanding of the differential impacts that ties with service intermediaries may have on exploratory versus exploitative service innovation. Specifically, we combine search scope and search depth (Katila & Ahuja, 2002; Lopez-Vega et al., 2016)to analyze and examine the mechanism of how ties with service intermediaries influence exploratory and exploitative service innovation differently. Second, drawing on absorptive capacity (Cohen & Levinthal, 1990; Zahra & George, 2002; Zhou & Wu, 2010)and dynamiccapability theories(Eisenhardt & Martin, 2000; C. L. Wang, Senaratne, & Rafiq, 2015), we empirically propose and confirm the moderating effects of technological capability and strategic flexibility. Finally, we discuss the implications of our results for the enhancement of service innovation activities in manufacturing firms.

Theoretical background and hypothesis

The dimensions and determinants of service innovation: the manufacturing context

With the recognition of services and service innovation as central drivers of broader economic growth and innovation (Cuthbertson & Furseth, 2022; F. Gallouj, 2002; I. Miles, 1993), an increasing focus on service innovation has been identified in academic research (Droege, Hildebrand, & Forcada, 2009; Ordanini & Parasuraman, 2011). Coombs and Miles (2000) categorize existing research into three different perspectives: assimilation, demarcation, and synthesis. Although there are interesting differences in understanding service innovation, the view of service innovation as a new service (offering) is shared by the three perspectives (Witell, Snyder, Gustafsson, Fombelle, & Kristensson, 2016). Moreover, according to Witell et al. (2016), synthesis is replacing assimilation and demarcation in research on service innovation (Carlborg, Kindstrom, & Kowalkowski, 2014). This is especially true in the manufacturing sector. Service innovation is increasingly appearing in manufacturing firms, as it provides unique opportunities for developing competitive advantages through new services and integrated product-service bundles (Kindstrom, Kowalkowski, & Sandberg, 2013; Ulaga & Reinartz, 2011). Responding to this phenomenon, the synthesis perspective argues that service innovation should be broad enough to encompass innovation in both services and manufacturing (Choo, Narayanan, Srinivasan, & Sarkar, 2021; Coombs & Miles, 2000; Shin, Kim, Jung, & Kim, 2022)and should provide an integrative perspective that is not limited to technological innovations(Gonzalez-Blanco, Coca-Perez, & Guisado-Gonzalez, 2019). This encourages us to apply a synthesis perspective to understand and characterize service innovation in the manufacturing sector.

Drawing on the synthesis perspective, we use an integrated approach that includes nontechnological aspects (e.g.,services, processes, knowledge) along with technological (product) forms and nests both services and goods into an overarching service view (Gonzalez-Blanco et al., 2019; Lusch & Vargo, 2006; Ordanini & Parasuraman, 2011). We define service innovation as an offering not previously available to manufacturers' customers, either as an addition to the current service offering or a change in the service delivery process that requires modifications in the sets of competences (technological or nontechnological) applied. Furthermore, by regarding service innovation processes as similar to product innovation processes (Atuahene-Gima, 1996; Blindenbach-Driessen & Ende, 2014; Nijssen, Bas Hillebrand, & Kemp, 2006; Ordanini & Parasuraman, 2011), we employ March's(1991) exploration-exploitation framework to characterize two basic types of service innovation (Myhren, Witell, Gustafsson, & Gebauer, 2017; Sok & O'Cass, 2015). Exploratory service innovation relates to the introduction of radical service offerings to the market in pursuit of new opportunities, whereas exploitative service innovation refers to extensions and refinements to existing services as well as improvements to service delivery processes to satisfy and retain existing customers. Thus, exploratory service innovation relates to the search and pursuit of completely new knowledge and skills, whereas exploitative service innovation refers

to the use and refinement of existing knowledge and skills (He & Wong, 2004; Menor, Tatikonda, & E.Sampson, 2002; Zhou & Wu, 2010).

Because service innovation provides manufacturers with unique opportunities for developing competitive advantages(T. Baines et al., 2017; Choo et al., 2021; Cusumano, Kahl, & Suarez, 2015; F. H. Liu & Huang, 2018), existing scholars have suggested exploring the determinants of service innovation in manufacturing firms (Spring & Araujo, 2013). The resource-based view (RBV) of the firm is often considered to offer potential insights into understanding the determinants leading manufacturers to engage in service innovation and affect the possibilities of successful service innovation. For example, some studies explore the influence of information technology resources on service innovation (Bantau & Rayburn, 2016; Chen, Chen, Liu, & Xu, 2020; Suppatvech, Godsell, & Day, 2019). However, the competitive advantage can be derived in part from resources existing outside the firm (Fernandes, Milewski, Chaudhuri, & Xiong, 2022). Scholars have pointed out that firms must build relationships with external sources to seek knowledge dispersed beyond their boundaries (e.g., Corso, Martini, Paolucci, & Pellegrini, 2011; Hervas-Oliver, Sempere-Ripoll, & Boronat-Moll, 2021). Thus, a firm's networks may be critical for competitive success (Dyer, Singh, & Hesterly, 2018).

In line with this logic, the importance of social relationships or networks in service innovation has been acknowledged in manufacturing settings, as social capital affects firms' access to both tangible and intangible resources (Dyer et al., 2018; Savino et al., 2017; Syson & Perks, 2004). Additionally, the rise of open service innovation (Chesbrough, 2011)indicates the critical role of external ties in facilitating service innovation in manufacturing firms. Thus, the identification of external sources and developing relationships with external sources are related to the processes of service innovation. Savino et al. (2017) argue that the search for the needed external knowledge could be delegated to service intermediaries. The critical role of service intermediaries as external sources of knowledge for innovation is widely recognized in the literature (Colombo, Dell'Era, & Frattini, 2015; Howells, 2006; Howells & Thomas, 2022; Lin et al., 2016; Y. Zhang & Li, 2010). However, the research mainly focuses on how intermediaries drive product innovation (Lin et al., 2016; Tran, Hsuan, & Mahnke, 2011; Y. Zhang & Li, 2010).Few empirical studies examine how manufacturing firms' ties with service intermediaries impact their service innovation activities.

In summary, although existing research highlights the determinants of service innovation from the perspective of RBV, the relational view and social network theories offer novel and important insights into the value of external relationships for service innovation. Since developing ties with service intermediaries may be a vital option for manufacturing firms to access new stocks of knowledge for service innovation, we are encouraged to analyze and examine the determinants of manufacturers' service innovation from the perspective of relationships.

Innovation search via ties with service intermediaries

Service intermediaries refer to professional service organizations that rely heavily on professional knowledge(Desyllas, Miozzo, Lee, & Miles, 2018; Jamkhaneh, 2021; I. Miles et al., 1995).According to I. Miles et al. (1995), service intermediaries are experts in offering specific knowledge in multiple expertise domains(De Silva, Howells, & Meyer, 2018; Villani, Linder, Lechner, & Muller, 2021), such as technological consulting, market research, legal and financial services. Although service innovation researchers mainly focus on service intermediaries' role in offering knowledge services (Chiaroni, Chiesa, De Massis, & Frattini, 2008; De Silva, Howells, Khan, & Meyer, 2022; Drejer & Vinding, 2003), the specific networking role of service intermediaries has been increasingly recognized by academic research (Gundlach & Hofmann, 2021; Howells & Thomas, 2022; Pinheiro & Pinheiro, 2021; Savino et al., 2017). Specifically, parallel to the rise in developing ties with external sources to access new stocks of knowledge, research on ties with service intermediaries has burgeoned (Lin et al., 2016; Savino et al., 2017).

Compared with prominent firms, universities and research institutions, service intermediaries are potentially available to all firms. More importantly, service intermediaries usually sit at the intersection of many firms, organizations and industries acting as network intermediaries for interaction and information exchange among firms (Howells, 2006; Kokshagina et al., 2017). Thus, it is not surprising that the literature on innovation search highlights the critical role of service intermediaries in facilitating firms' search for innovation. Being potentially accessible to manufacturing firms and located at a unique network position(Howells & Thomas, 2022; Pinheiro & Pinheiro, 2021), service intermediaries are argued to have the potential to facilitate firms searching a broader range of firms, organizations, and industries for service innovation.

Drawing on the above arguments, Y. Zhang and Li (2010) argue that ties with service intermediaries can provide an entry ticket for firms to join rich networks and, thus, enable them to broaden their external search scope and reduce search costs(Clayton, Feldman, & Lowe, 2018). In their empirical study, Y. Zhang and Li (2010) provide evidence that new ventures' ties with service intermediaries have a significantly positive impact on product innovation. Usinga sample of Chinese manufacturing firms, Lin et al. (2016)show that manufacturing firms' ties to intermediaries contribute to corporate innovation performance. Similarly, W. Zhang, Wang, and Zhao (2015)find that ties with service intermediaries have positive relationships with both service innovation and product innovation.

However, the extant research mainly focuses on search scope to explain the relationshipswith service intermediaries without considering the function of search depth. Moreover, scholars have largely treated exploratory and exploitative innovation as a collective bundle and thus have failed to shed light on how relationships with service intermediaries may be differently related to exploratory versus exploitative innovation. Because exploration involves the pursuit of new knowledge, whereas exploitation builds on the use and development of existing knowledge(Bernal & Toro-Jaramilo, 2019; Rojas-Cordova, Williamson, Pertuze, & Calvo, 2022; Wenke, Zapkau, & Schwens, 2021), exploratory and exploitative service innovation require different knowledge components. Thus, exploratory and exploitative service innovation are likely to be facilitated by manufacturing firms' different search behaviors (Angelidou, Mount, & Pandza, 2022; Katila & Ahuja, 2002; Mun, 2022), i.e., search scope and search depth and are, therefore, influenced by ties with service intermediaries differently. By combining search scope and search depth, our research aims to fill the gap by examining the differential effects that ties with intermediaries might have on exploratory versus exploitative service innovation.

Ties with service intermediaries and exploratory service innovation

A manufacturing firm is expected to connect to various kinds of organizationswith which it has no direct contacts before it develops relationships with service intermediaries. Correspondingly, the manufacturing firm is bridged and exposed to a variety of knowledge sources (Howells, 2006; Howells & Thomas, 2022; Wolpert, 2002), enabling it to search in rich networks rather than searching only within immediate personal networks (Lin et al., 2016; Y. Zhang & Li, 2010). The more interaction with service intermediaries there is, the greater the search scope of the manufacturing firm to access multiple knowledge domains (Y. Zhang & Li, 2010). Hence, a greater amount of novel and heterogeneous knowledge beyond existing technologies and markets may be sourced for the development of exploratory service innovation (Kitsios & Kamariotou, 2021; March, 1991; Rosenkopf & Nerkar, 2001). Moreover, repeated interactions with service

intermediaries enable manufacturers to gain more insights into the value of new information and opportunities, which in turn offers the potential for new, truly innovative combinations of knowledge for exploratory service innovation.

However, although ties with service intermediaries may start as nonredundant contacts, they are likely to become redundant over time in terms of indirect contacts and knowledge (Burt, 1992; Hansen, 1999). This is especially true when relationships with service intermediaries become strong. Consequently, the manufacturing firm is enabled to search similar knowledge repeatedly, which likely brings in ideas for minor refinement or extension of existing knowledge for exploitation, although not the discovery of novel ideas.

Therefore, after reaching a certain point, an increase in the strength of the relationship is more likely to lead to an increase in search depth and a decrease in search scope. This tendency may encourage the manufacturing firm to source familiar or similar knowledge for exploitation instead of sourcing new knowledge for exploration, which, in turn, results in a decrease in the positive effect of strong ties with exploratory service intermediaries.

H1:The stronger the ties with service intermediaries are, the more likely the manufacturing firm is to develop exploratory service innovation. However, after reaching a specific level of tie strength, the stronger the ties with service intermediaries are, the less likely the manufacturing firm is to develop exploratory service innovation.

Ties with service intermediaries and exploitative service innovation

Exploitative service innovation involves the ongoing use of a firm's knowledge base (Blindenbach-Driessen & Ende, 2014; He & Wong, 2004; Wenke et al., 2021; Z. G. Zhang & Luo, 2020). Following network research(Neulandtner & Scherngell, 2022), it seems reasonable to argue that strong ties may enable manufacturing firms to conduct deep searches, which in turn facilitates exploitative service innovation.

First, close links with service intermediaries reflect an intense use of those indirect knowledge sources, resulting in an increase in the depth of knowledge search (M. X. Wang & Wang, 2022). In this case, ongoing and repeated accessing and acquiring specific knowledge in similar knowledge fields is available, which deepens a manufacturing firm's understanding of how to integrate these specific elements of knowledge within the existing knowledge base. Second, as the manufacturing firm accumulates the experience of interacting with service intermediaries and develops a common language, unique processes and routines, the knowledge search becomes more reliable and predictable. Henceforth, the manufacturing firm becomes more competent in searching for new knowledge in its own expertise fields, which, thus, strengthens the exploitation of existing know-how. Third, network inertia resulting from strong relationships(Hansen, 1999) may lead the manufacturing firm to stay with existing links and correspondingly encourage them to rely on existing, specialized domains to engage in a deep search for exploitative service innovation.

Therefore, we contribute to the literature by proposing that strong ties with service intermediaries may facilitate exploitative service innovation at an accelerated rate, such that a greater strengthof the ties between the manufacturing firm and service intermediaries relates to increasingly higher levels of exploitative service innovation.

H2: The stronger the ties with service intermediaries, the more likely it is for the manufacturing firm to develop exploitative service innovation.

The moderating role of technological capability and strategic flexibility

While prior studies have examined the moderating role of external environmental factors, such as industry growth (Y. Zhang & Li, 2010), environmental munificence and complexity (Lin et al., 2016), scant attention has been given to the possible moderators from the internal resource or capability perspective.Both absorptive capacity and dynamic capability theories can be considered as extensions of RBV and have been employed in several service innovation studies (e.g. Tsou & Chen, 2020). Absorptive capacity theory has been applied mainly to analyze possible determinants of service innovation (e.g., Koch & Strotmann, 2008; Xie, Wang, & García, 2021). Dynamic capability enables firms to continually integrate, build, and reconfigure internal and external resources (Eisenhardt & Martin, 2000; Randhawa, Wilden, & Akaka, 2022; Teece et al., 1997). Thus, activating dynamic capabilities is considered critical in helping firms continually recombine resources to develop new services (Fischer, Gebauer, Gregory, & Ren, 2010; Janssen, Castaldi, & Alexiev, 2016).

Following the view of innovation as a process of searching and recombining knowledge sources(Nelson & Winter, 1982; Petruzzelli & Savino, 2014; Savino et al., 2017), external searches maybe useless if the accessed knowledge is not properly integrated with firms' existing knowledge (Enkel & Gassmann, 2010; Kim & Park, 2013; Zahra & George, 2002).Thus, it is suggested that manufacturers have matched absorptive capacity or dynamic capabilityto absorb and recombine externally accessed knowledge with internal knowledge for service innovation (Savino et al., 2017; Xie et al., 2021). On the one hand, according to Cohen and Levinthal (1990), a firm's knowledge base underpins how well it can use new knowledge to achieve desired innovation outcomes. For product-centric manufacturers, technological capability is regarded as the core component of internal capabilities and represents an important source of absorptivecapacity (M. K. Srivastava, Gnyawali, & Hatfield, 2015; Zhou & Wu, 2010). Hence, the accumulation of technological capability increases a manufacturer's ability to evaluate and use new technologies and skills in service innovation (Zahra & George, 2002).

Although it is challenging for manufacturers to effectively apply existing limited knowledge stocks to combine externally accessed knowledge, the dynamic resource management view suggests that resource portfolios can be extended by accumulating multifunctional resources and reconfiguring resource bundles (Sanchez, 1995, 1997). Strategic flexibility, as a special type of dynamic organizational capability to reconfigure and redeploy resources (Brozovic, 2018; Sanchez, 1995), may have a significant influence on the relationship between ties with service intermediaries and exploratory versus exploitative service innovation.

We propose, therefore, that technological capability, representing an important source of absorptive capacity, and strategic flexibility, as one type of dynamic capability (Brozovic, 2018; Sanchez, 1995; Zhou & Wu, 2010), may play important and differential roles in achieving the potential of ties with service intermediaries for exploratory and exploitative service innovation.

The moderating role of technological capability

Service innovation in the manufacturing context involves both technological and nontechnological aspects (F Gallouj & Savona, 2009; Faïz Gallouj & Weinstein, 1997), which indicates that technological knowledge is one basic element for service innovation, such as technologies on product development, service design, customer interaction, and service delivery(F Gallouj & Savona, 2009; Faïz Gallouj & Weinstein, 1997; L. Wang, Zheng, & Huang, 2018). Thus, a high technological capability not only allows manufacturing firms to identify and integrate diverse technological knowledge beyond their

current knowledge boundaries but also enables manufacturing firms to be more sensitive to opportunities within their existing technological trajectory. The accumulation of technological capability increases manufacturing firms' ability to evaluate, absorb and use new technologies and skills in exploratory and exploitative service innovation (Seo, Song, & Jin, 2022; Zahra & George, 2002). Specifically, a prior technological knowledge base facilitates focusing the search for new knowledge on the most likely areas of novel opportunity and eliminating search areas likely to be fruitless.

It is worth noting that technological capability not only facilitates the absorption of technical-related knowledge but also provides a manufacturing firm with more technical expertise to discern the potential value of market-related knowledge (Song, Droge, Hanvanich, & Calantone, 2005)and combine it with its current technological knowledge for the development and commercialization of service innovation.

Based on the above arguments, we propose that ties with service intermediaries have stronger positive effects on both exploratory and exploitative service innovation in the presence of higher levels of technological capability.

H3a: Technological capability strengthens the positive effect of ties with service intermediaries on exploratory service innovation.
H3b: Technological capability strengthens the positive effect of ties with service intermediaries on exploitative service innovation.

The moderating role of strategic flexibility

In the extant literature, strategic flexibility, resource flexibility and coordination flexibility stand out as the most critical capabilities of strategic flexibility (Y. Li, Su, & Liu, 2010; Sanchez, 1995). Resource flexibility focuses on the inherent flexibility ofthe resources available to the firm, while coordination flexibility focuses on the firm's flexibility in applying those resources toalternative courses of action (Sanchez, 1995). Thus, we propose that, together, theyinfluence the linkageswith service intermediaries and exploratory versus exploitative service innovation.

Resource flexibility reflects the mechanism of resource accumulation for the flexible bundle of diverse internal resources (Sanchez, 1995, 1997). When resource flexibility is low, manufacturing firms' existing resources are strongly attached to specified targets and can hardly be employed for the targeted service innovation, either exploratory or exploitative. Moreover, it is costly to find complementary resources for assimilating and using external knowledge and opportunities during the service innovation process (Gerwin, 1993; Koste, Malhotra, & Sharma, 2004). In contrast, a high level of resource flexibility ensures that the matched resource bundles can be used in combination with external knowledge for service innovation, and the time along with the cost spent on seeking new resources and switching one resource to another may decrease (Y. Liu, Li, & Wei, 2009; Matthyssensa, Pauwelsc, & Vandenbempta, 2005; Wei, Yi, & Guo, 2014). In this case, resource flexibility enhances the value of relationships with service intermediaries for exploratory and exploitative service innovation.

Moreover, it has been argued that service innovation follows a different logic than product innovation (Janssen et al., 2016)and violates manufacturing firms' existing systems of organizational routines (Kindström & Kowalkowski, 2014). Hence, service innovation requires the support of a new set of processes that may be incompatible with existing ones and, thus, in the great need for higher coordination flexibility (Sanchez, 1995). In fact, due to the inherent problems of inertia and core rigidity (Gilbert, 2005), internal resources developed for product innovation tend to become obsolete more often (Kraatz & Zajac, 2001). Hence, external service-related resources tend to become more difficult to integrate (M. K Srivastava & Gnyawali, 2011). According to Grewal and Tansuhaj (2001), coordination flexibility reflects a firm's capabilities in defining, configuring, and deploying diverse resources, which indicates that it can overcome routine inertia and enables the exploration of new bundles of resources; thus, it encourages manufacturers to efficiently integrate and recombine externally acquired knowledge with their internal resources for service innovation opportunities (Katsuhiko & Hitt, 2004).

Based on the above arguments, we propose that resource flexibility and coordination flexibility together facilitate the integration and combination of external knowledge accessed through relationships with service intermediaries, enhancing the positive effects of ties with service intermediaries on exploratory and exploitative service innovation.

H4a: Strategic flexibility strengthens the positive effects of ties with service intermediaries on exploratory service innovation.
H4b: Strategic flexibility strengthens the positive effects of ties with service intermediaries on exploitative service innovation.

Research framework is demonstrated in Fig. 1.

Methods

Sampling and data collection process

We administered a survey to manufacturing firms located in Chongqing and Ningbo, China. Our reasons for collecting data in these two cities are as follows. First, both are the main manufacturing cities in China. Chongqing is one of the most important manufacturing bases in southwestern China, while Ningbo, located in southeastern China, has a large number of innovative small- and medium-sized manufacturing firms. Second, local governments in Chongqing and Ningbo actively advocate the transition from a product-based economy to a service-oriented economy, which allows us to observe service innovation activities among the sampled firms. Third, the first author used to provide consulting services for the local Economy Commerce Committee in Chongqing and Ningbo, which was keyfor the research team obtaining the committee's assistance.

We hired and trained research assistants from the local Economy Commerce Committee to deliver our surveys. These local officers often personally know the managers of manufacturing firms well, and such personal relations are highly valued in Chinese culture, which ensures respondents' qualifications for and speed of survey completion. We obtained a list of 858 manufacturing firms compiled by the local Economy Commerce Committee. We searched on the internet as well as company websites to obtain information and news about the 858 manufacturing firms and finally identified 388 manufacturing firms that meet two criteria: (1) they carry out a mix of product-service design and development activities and (2) they hold a certain solid relationship with outside service intermediaries,

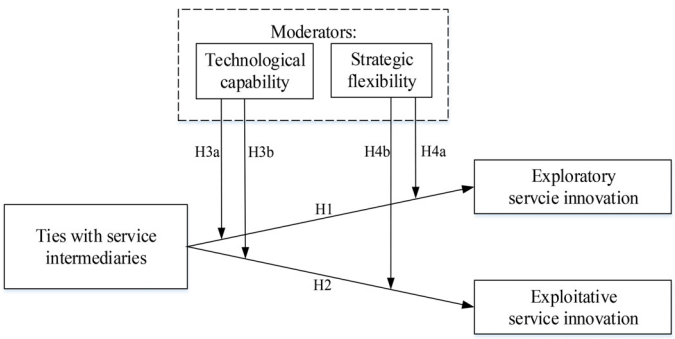

Fig. 1. Research framework

either formally or informally. The research assistants contacted senior or middle managers of 388 sampled manufacturing firms via phone, e-mail or on-site visits to seek participation. Managers from 283 firms agreed to respond to our questionnaire in e-mail format, while 105 firms welcomed on-site interviews.

The questionnaire was originally prepared in English and then translated into Chinese by three scholars competent in both languages with substantial research experience in the service innovation field in China. The survey questionnaire was adopted after all three scholars agreed on the Chinese translation. To ensure the content and face validity of the measures, we conducted 5 initial, semistructured interviews with 5 senior managers from 5 manufacturing firms to learn their views about the importance of service innovation for them and the role of service intermediaries in their service innovation. Meanwhile, we invited them to verify the relevance and completeness of the questionnaire items and revised a few questionnaire items to enhance the clarity of the questionnaire based on their responses.

Finally, we acquired 125 usable responses via emailand 90 usable responses in person. In total, we obtained 215 usable responses, generating a usable response rate of 55.4 percent. Sampling firms represent a wide span of industries. As Table 1 shows, our sample involves automobiles and motorcycles (Industry 1: 20%), telecommunication and computers (Industry 2: 22%), mechanical and electric equipment (Industry 3: 18%), pharmaceutical and bioengineering (Industry 4: 13%), the textile and garment industry (Industry 5: 11%), and new energy environmental protection (Industry 6: 16%), which allowed us to increase the external generalizability of our results to different industry contexts. To assess the nonresponse bias, we compared responding manufacturing firms with those that were unresponsive and found no significant difference in firm size or age.

Measures

Multi-item scales were used to measure the study constructs (see Table 1). We operationalized the constructs using reflective measures; we controlled the number of items to ensure that the questionnaire was reasonably short and that the response rate was reasonable. A 7-point Likert scale from 1 ("strongly disagree") to 5 ("strongly agree") was used to measure all constructs based on the literature.

Ties with service intermediaries

Based on Miles et al.'s (1995) classification of service intermediaries, we followed Y. Zhang and Li (2010) by asking the respondents to indicate the extent to which their manufacturing firms had close relationships with (1) engineering/design service firms, (2) scientific R&D firms, (3) computer system service firms, (4) accounting and financial service firms, (5) legal service firms, and (6) management consulting service firms. By averaging all six items, we created a composite measure of ties with multiple service intermediaries. This subjective measure captures the extent of manufacturers' ties with service intermediaries.

Table 1
Sample

Industry	Number	Percent
Automobile and motorcycle	43	20%
Telecommunication and computer	47	22%
Mechanical and electric equipment	39	18%
Pharmaceutical and bioengineering	28	13%
Textile and garment industry	24	11%
New energy environmental protection	34	16%
Total	215	100%

Exploratory and exploitative service innovation

Based on the definition of service innovation in the manufacturing context (Helkkula, Kowalkowski, & Tronvoll, 2018; Kindström & Kowalkowski, 2014; Ordanini & Parasuraman, 2011), we developed 4 items for exploratory service innovation and 4 items for exploitative service innovation (Zhou & Wu, 2010), which reflect the extent to which a manufacturing firm uses existing or explores new knowledge or skills in its development of new service offerings or new service delivery processes. We explicitly highlighted to respondents that we were not interested in product innovation. We gave examples to enable respondents to separate their judgments for service innovation from product innovation.

Technological capability

Based on previous studies(Song et al., 2005; Zhou & Wu, 2010), we developed 4 items to assess a manufacturing firm's ability to use various technologies. We reminded respondents to focus not only on product-related technologies but also on technological resources about service design, customer interfaces and service delivery systems.

Strategic flexibility

We used Sanchez's (1995) theoretical work and adapted items from Zhou and Wu (2010), Wei et al. (2014), and J. Li, Poppo, and Zhou (2008) by focusing on a manufacturing firm's capability of flexible allocation and coordination of resources in response to changing environments.

Control variables

To account for the effects of extraneous variables, following Y. Zhang and Li (2010) and Lin et al. (2016), we employed firm age, firm size, firm state ownership, environmental uncertainty, and industry type as control variables. Firm age equals the number of years the firm has been in operation. We used the logarithm of the number of employees as an indicator of firm size. Firm state ownership was dummy coded (1=yes, 0=no). To measure environmental uncertainties, we developed three items based on Y. Zhang and Li (2010) and Zhou and Wu (2010). Finally, because the sample consists of manufacturing firms in 6 industries, we coded 5 industry dummy variables, with new energy environmental protection as the baseline.

Adequacy of the measures: reliability and validity

We took several steps to ensure data validity and reliability. As previously stated, we pretested the survey with 5 senior managers from 5 manufacturing firms. In the questionnaire itself, we used previously validated measurement items whenever possible to help ensure the validity of our measures. We assessed the reliability of the multi-item constructs with Cronbach's alpha, and all scales had reliabilities greater than the recommended 0.70 (see Table 2).

We conducted a confirmatory factor analysis to assess the convergent and discriminant validity of the multi-item constructs. As presented in Table 1, the results of the confirmatory factor analysis indicated that the measurement model achieves a satisfactory fit to the data (goodness-of-fit index [GFI]=0.90, comparative fit index [CFI]=0.91, incremental fit index [IFI]=0.91; and root mean square error of approximation [RMSEA]=0.05), all of which confirmed the unidimensionality of each construct in the model. Convergent validity is observed when the path coefficients from the latent constructs to their corresponding manifest indicators are statistically significant (Anderson & Gerbing, 1988). All items loaded significantly on their corresponding latent construct, providing evidence of convergent validity.

To assess discriminant validity, we conducted a chi-square difference test for all of the multi-item constructs in pairs to see if they

Table 2
Construct measurement and confirmatory factor analysis results (N=215)

Measures of Constructs	Factor loadings	Alpha
Ties with service intermediaries:Indicate the extent to which your firm had close relationships with the following: (1: not at all, 7: very much)		
1. Engineering/design service firms	0.811	**0.790**
2. Scientific R&D	0.802	
3. Computer system service firms	0.776	
4. Accounting and financial service firms	0.821	
5. Legal service firms	0.812	
6. Management consulting service firms	0.779	
Exploratory service innovation: In the new service development processes, to what extent has your firm: (1: very low, 7: very high)		
1. Acquired new technologies and skills entirely new to the firm.	0.784	
2. Learned service development skills and processes entirely new to the industry.	0.853	**0.823**
3. Acquired entirely new knowledge and skills that are important for new service development.	0.826	
4. Strengthened service innovation skills in areas where it has no prior experience	0.793	
Exploitative service innovation: In the new service development processes, to what extent has your firm: (1: very low, 7: very high)		
1. Upgraded current knowledge for existing service offerings.	0.821	
2. Strengthened the skills to improve the efficiency of existing services.	0.863	**0.848**
3. Enhanced abilities in exploiting knowledge to improve the efficiency of existing service delivery process.	0.871	
4. Upgraded skills in service development processes in which the firm already possesses rich experience.	0.851	
Technological capability: Compared to your major competitors, evaluate your firm's capabilities in the following areas: (1: much worse; 7: much better)		
1. Acquiring important technology information.	0.831	**0.811**
2. Identifying new technology opportunities.	0.763	
3. Responding to technology changes.	0.801	
4. Mastering the state-of-art technologies.	0.739	
Strategic flexibility:Rate the degree to which each of these statements describes your firm. (1: very low, 7: very high)		
1. There is a large range of alternative uses to which our major resources can be applied.	0.864	**0.805**
2. The time of switching the use of key resources to an alternative one is very short.	0.821	
3. The cost of switching the use of key resources to an alternative one is very low.	0.773	
4. Internal units often collaborate to find a new use for internal resources.	0.831	
5. We can rapidly redeploy resources through organizational systems and processes to targeted uses.	0.780	
6. We can reconfigure resources in support of various activities aimed at responding to changing environment.	0.848	
Environmental uncertainty: Rate the degree to which each of these statements describes your principal industry over the last three years. (1: very low, 7: very high)		
1. Competitors' actions have been high unpredictable.	**0.702**	**0.768**
2. Market conditions have been changing very fast.	**0.790**	
3. Technologies in this industry have been changing rapidly.	**0.811**	
Overall model fit: χ^2= 928.30, p < 0.001; GFI = 0.90; CFI = 0.91,IFI=0.91; RMSEA=0.05		

were distinct from one another. The process involved collapsing each pair of constructs into a single model and comparing its fit with that of a two-construct model (Anderson & Gerbing, 1988). In every case, a two-factor model had a better fit than a single-factor model, thus supporting the discriminant validity of the constructs.

Common method bias assessment

Based on a comprehensive literature review, Podsakoff, MacKenzie, Lee, and Podsakoff (2003)suggested that common method variance (CMV) is often a problem in behavioral research (often involving self-report data collected by surveys). Following the recommendation by Podsakoff et al. (2003), we implement both preprocedural and poststatistical techniques to reduce the potential of CMV.

The procedural methods were as follows. (1) We discussed our questionnaire in two rounds with experts in both academia and industry and performed a pilot study. This way, we resolved all issues with the measuring items that might have confused the respondents or inclined them toward social desirability, and we reduced the length of the questionnaire to a reasonable level. Additionally, we provided our contact information and encouraged the respondents to contact us if they had problems during the process of completing the questionnaire. This procedure guaranteed the content validity of the constructs. (2) We assured the respondents that their answers were confidential and that there were no right or wrong answers to the questions in the survey. Moreover, the questionnaire was distributed anonymously. We also informed the respondents that if they had no interest in ourresearch topic or did not have enough time to complete the questionnaire, they should not accept our survey, and we conveyed our appreciation for their responsible rejection. These procedures likely reduced the respondents' evaluation apprehension and helped "make them less likely to edit their responses to be more socially desirable, lenient, acquiescent, and consistent with how they think the researcher wants them to respond" (Podsakoff et al., 2003, p. 888). (3) To encourage the respondents to participate in our survey actively and seriously, we informed them that if they were interested in our research results, we would send the results to their email address, which they provided on the questionnaire.

For the postmeasure to remedy CMV, Harman's one-factor test was conducted to examine whether this problem affected our data. An exploratory factor analysis with all items yielded no single factor that accounted for a threshold of 50% of the total variance before rotation, indicating that the CMV problem is not severe. Harman's one-factor test of our data demonstrated that the first factor before rotation accounted for less than half of the total variance (i.e., 33%). This result suggests that CMV is unlikely to have caused any significant relationships among the variables in our study.

Data analysis

We used the statistical software program SPSS 26.0 to analyze the data. SPSS was employed to analyze the descriptive statistics, CFA, Cronbach's alpha, and EFA. Descriptive statistics were used to describe the profiles of the sample firms; CFA was employed to assess the convergent and discriminant validity of the multi-item constructs; Cronbach's α was used as a criterion for reliability, as it reflects the internal consistency of the indicators of individual constructs; and EFA was applied to estimate cross-loading issues and to identify common method variance (CMV) based on Harman's single-factor test. SPSS was further employed to run a stepwise hierarchical regression analysis.

Results

Table 3 presents the means, standard deviations and Pearson correlations for the independent and dependent variables. Ties with service intermediaries are positively related to exploratory service innovation and exploitative service innovation, providing some initial evidence for H1 and H2. Both technological capability and strategic flexibility are positively associated with relationships with service intermediaries, suggesting that the examination of interaction is necessary to understand the roles of technological capability and strategic flexibility in service innovation.

To test our hypotheses, we employ a stepwise hierarchical regression approach to assess the explanatory power of each set of variables. Table 4 presents the results of the standardized regression estimates to allow for a direct comparison between coefficients with respect to their relative explanatory power of the dependent variables. Model 1 and Model 4 only included controls. In Model 2 and Model 5, we added the main effects of ties with service intermediaries, the square of ties with service intermediaries, and the moderating variables (technological capability and strategic flexibility). Model 3 and Model 6 added the interaction terms. To reduce the potential problem of multicollinearity, the predictor and moderator variables were meancentered prior to the creation of interaction terms (Aiken & West, 1991).

With H1, we consider the effect of ties with service intermediaries on exploratory service innovation. As Model 2 shows, ties with service intermediaries positively relate to exploratory service innovation (b=0.26, $p < 0.01$), whereas the square of ties with service intermediaries negatively affects exploratory service innovation (b=−0.18, $p < 0.05$). Therefore, relationships with service intermediaries have an inverted U-shaped relationship with exploratory service innovation, in support of H1.

H2 addresses the relationship between ties with service intermediaries and exploitative service innovation. As Model 5 shows, both ties with service intermediaries (b=0.22, $p < 0.01$) and the square of ties with service intermediaries (b=0.17, $p <0.01$) positively affect exploitative service innovation, suggesting that ties with service intermediaries are positively related to exploitation service innovation, which supports H2.

To test the moderate effects of technological capability and strategic flexibility on the relationship between ties with service intermediaries and exploratory service innovation, all of the relevant interactions were entered to run Model 3. Model 3 shows that the first-order interaction between technological capability and ties with service intermediaries positively (b=0.21, $p < 0.01$) affects exploratory service innovation, whereas their second-order interaction negatively (b=-0.16, $p < 0.05$) relates to exploratory service innovation. This indicates that technological capability strengthens the positive effects of ties with service intermediaries on exploratory service innovation, which supports H3a. Model 3 also shows that the first-order interaction between strategic flexibility and ties with service intermediaries positively (b=0.29, $p < 0.05$) affects exploratory innovation, whereas their second-order interaction negatively (b=-0.18, $p < 0.05$) relates to exploratory innovation, which indicates that strategic flexibility strengthens the positive effects of ties with service intermediaries on exploratory innovation, which supports H4a.

To test the moderating effect of technological capability and strategic flexibility on the relationship between ties with service intermediaries and exploitative service innovation, all of the relevant interactions were entered to run Model 6. Model 6 shows that the first-order interaction between technological capability and ties with service intermediaries positively (b=0.25, $p < 0.01$) affects exploitative service innovation, while their second-order interaction positively (b=0.20, $p < 0.05$) relates to exploitative service innovation, which indicates that technological capability strengthens the positive effects of relationships with service intermediaries on exploitative service innovation, which supports H3b. Model 6 also shows that both the first-order and the second-order interaction between strategic flexibility and ties with service intermediaries are not significant; hence, H4b is rejected. One possible explanation for this finding is that applying new knowledge to develop exploitative service innovation is usually consistent with the manufacturing firm's current knowledge, organizational processes and routines, which require less support of a new set of capabilities and processes offered by strategic flexibility. In contrast, exploratory service innovation usually requires the manufacturing firm to acquire new capabilities rapidly or to ensure the presence of knowledge that may be beyond existing internal capabilities. As a result, strategic flexibility becomes a less valuable and useful tool for exploitative service innovation.

Discussion and Conclusion

By viewing innovation as a process of searching and recombining knowledge (Petruzzelli & Savino, 2014; Savino et al., 2017), we combine search scope and search depth (Katila & Ahuja, 2002; Lopez-Vega et al., 2016) to examine the effects of ties with service intermediaries on manufacturing firms' exploratory and exploitative service innovation.We find that ties with service intermediaries have a positive effect on exploitative service innovation but an inverted U-shaped relationship with exploratory service innovation. We further draw on absorptive capacity and dynamic capabilities theories to examine the moderating effects of technological capability and strategic flexibility on theimpacts of ties with service intermediaries on exploratory and exploitative service innovation. We find that technological capability strengthens the positive effects of ties on both exploratory and exploitative service innovation, whereas strategic flexibility strengthens the positive effects of ties on exploratory service innovation. Our findings thereby contribute to the literature in two major ways.

Table 3
Means, Standard Deviations and Correlation Matrix (N=215)

Constructs	1	2	3	4	5	6	7	8	9
1. Ties with service intermediaries	1								
2. Technological capability	0.15**	1							
3. Strategic flexibility	0.22**	0.18*	1						
4. Exploratory service innovation	0.23**	0.26*	0.20*	1					
5. Exploitative service innovation	0.21**	0.20*	0.14*	0.24*	1				
6. Firm size	0.01	0.03	0.01	0.06*	0.01*	1			
7. Firm age	-0.04	-0.01	-0.02	0.01	0.02	-0.02	1		
8. State ownership	0.12	0.13	0.15*	0.12*	-0.31	0.22	-0.17	1	
9. Environmental uncertainty	0.04	0.04	0.05	0.06	0.04	0.07	-0.05	0.03	1
Mean	4.32	3.73	4.17	3.27	3.78	5.30	10.01	0.14	4.10
SD	1.02	0.80	1.34	1.14	1.39	1.15	8.9	0.24	0.20

Note: ** $p < 0.01$, * $p < 0.05$.

Table 4
Standardized Regression Estimates (N=215)

	Exploratory service innovation			Exploitative service innovation		
	M1	**M2**	**M3**	**M4**	**M5**	**M6**
Predictors						
TSI		0.26**	0.28**		0.22**	0.19**
TSI^2		-0.18*	-0.14*		0.17**	0.21*
TC		0.16*	0.10**		0.02*	0.06*
SF		0.11	0.09		0.15	0.18
Interactions						
TSI* TC			0.21**			0.25**
TSI^2*TC			-0.16*			0.20*
TSI* SF			0.29*			0.19
TSI^2*SF			-0.18*			-0.17
Controls						
Firm size	0.10**	0.11**	0.07**	0.11**	0.09**	0.08**
Firm age	0.02	0.01*	0.03*	0.02*	0.00*	0.04*
State ownership	0.03†	0.04	0.05	0.01†	0.02	0.02*
Environmental uncertainty	0.11*	0.14†	0.13*	0.09†	0.10*	0.12*
Industry 1	0.05	0.04	0.05	0.04	0.04	0.04
Industry 2	0.04	0.05	0.03	0.07	0.09	0.03
Industry 3	0.06*	0.02	0.04	0.07	0.07	0.09
Industry 4	0.07	0.05	0.08	0.08	0.03	0.08
Industry 5	0.03	0.04	0.03	0.06	0.05	0.07
Adjusted R^2	0.14**	0.19**	0.20**	0.15**	0.20**	0.20**
R^2 change		0.05**	0.01**		0.04**	0
F value	8.93**	9.41**	9.89**	7.71**	7.85**	8.22**

Note: ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$.TSI, TC, and SF are all meancentered. TSI: ties with service intermediaries, TC: technological capability, SF: strategic flexibility

First, our findings provide a more nuanced understanding of the curvilinear effects ofrelationships with service intermediaries on manufacturing firms' exploratory and exploitative service innovation. Although the specific role of service intermediaries in the search for innovation has been increasingly recognized by academic research in recent years (Gundlach & Hofmann, 2021; Howells & Thomas, 2022; Pinheiro & Pinheiro, 2021; Savino et al., 2017), the literature mainly focuses on how intermediaries drive product innovation (Lin et al., 2016; Tran et al., 2011; Y. Zhang & Li, 2010). Few empirical works examine how manufacturing firms' ties with service intermediaries impact their service innovation. Our findings reveal that ties with service intermediaries encouragemanufacturers to search broadly to obtain knowledge resources for service innovation. More interestingly, we find that the stronger the ties with service intermediaries are, the more likely the manufacturing firm is to develop exploitative service innovation. This is because strong ties may enable manufacturing firms to conduct deep searches (Katila & Ahuja, 2002), which, in turn, facilitate the use and refinement of existing knowledge and skills to develop exploitative service innovation.

Even more novel is our finding that ties with service intermediaries have an inverted U-shaped relationship with exploratory service innovation: a moderate level of ties with service intermediariesrelates to the highest degree of exploration, whereas a high level of ties with service intermediariesinhibits manufacturing firms' exploration of new alternatives.

Second, we advance the extant literature by proposing and empirically confirming that technological capability and strategic flexibility help manufacturing firms take advantage of their ties with service intermediaries. Since firms cannot benefit from external knowledge searches if the accessed knowledge is not properly integrated with their existing knowledge, manufacturers must have the inner capacity to absorb and recombine externally accessed knowledge with internal knowledge for service innovation (Savino et al., 2017; Xie et al., 2021). Although research has shown that technological capability and strategic flexibility influence a firm's innovation activities (Y. Li, Li, Wang, & Ma, 2017; Miroshnychenko, Strobl, Matzler, & De Massis, 2021; Zhou & Wu, 2010), it has not yet examined whether manufacturing firms with high levels of technological capability and strategic flexibility can take advantage of ties with service intermediaries for service innovation more efficiently. Therefore, we make a first attempt, suggested by Savino et al. (2017), to examine the moderating effects of technological capability and strategic flexibility.This approach is different from previous studies that have typically examined the moderating role of external environmental factors, such as industry growth (Y. Zhang & Li, 2010) and environmental munificence and complexity (Lin et al., 2016). The findings show that technological capability strengthens the positive effects of ties with service intermediaries on exploration and exploitation, which supports the prediction of the absorptive capacity view (Cohen & Levinthal, 1990)and suggests that when firms accumulate technological capability, the more external accessed knowledge sought through ties with service intermediaries can be used or combined for exploration or exploitation. The findings also show that strategic flexibility strengthens the positive effect of ties with service intermediaries on exploration, with no moderating effect on exploitation, which supports the prediction of the dynamic management view (Wei et al., 2014) and suggests that manufacturers with a higher level of strategic flexibility achieve greater potential from their ties with service intermediaries for exploratory service innovation.

Our findings also provide some important managerial implications. First, to overcome the resource limitation in pursuing service innovation, developing good relations with service intermediaries becomes an important strategy option for manufacturing firms. In China, with the support of local governments, a great number of professional service organizations, such as accounting and finance, engineering and design, legal, management consulting, and technology service firms, have quickly grown and prospered. Thus, manufacturing firms in pursuit of service innovation can use service intermediaries as critical channels for searching for and absorbing innovation (Savino et al., 2017).Second, manufacturing firms should balance their tie strength with service intermediaries when developing both exploration and exploitation simultaneously.Manufacturing firms must be aware of the limitations of their existing ties with service intermediaries.Although ties greatly enhancemanufacturers' search

for new knowledge, strong ties may lock manufacturers in existing service intermediaries, trap them in searching for similar knowledge repeatedly, and prevent them from exploring new options. Third, to realize the full value of ties with service intermediaries for service innovation, manufacturing firms should recognize the critical role of both technological capability and strategic flexibility. Accumulated technological capability can facilitate manufacturing firms to assimilate and combine accessed technological or market knowledge for exploratory or exploitative service innovation. In particular, the current findings urge manufacturing firms to build and strengthen their strategic flexibility to embrace exploratory service innovation. By developing strategic flexibility in their resource allocation and coordination, manufacturing firms can stimulate greater exploration of technologies and market opportunities.

Despite its contributions, this study also has limitations that should be addressed in future research. First, our analysis of exploration and exploitation is limited to the domain of service innovation. Further research should examine exploration and exploitation in other domains and investigate the role of ties with service intermediaries in those contexts. For example, exploration and exploitation can also be identified in product innovation. Based on the argument that ties with service intermediaries facilitate product innovation, more studies are expected to differentiate the impacts of ties with service intermediaries on exploratory versus exploitative product innovation. Second, in this study, we use the innovation search perspective and combine search scope and depth to analyze and examine the relationship between ties with service intermediaries and service innovation; this indicates that search scope and depth may be two important mediating variables between independent and dependent variables. Thus, further research is needed to measure search scope and direct searches and examine the processes through which ties with service intermediaries affect manufacturing firms' service innovation. Third, another limitation comes from our measurement. The assessment of exploratory service innovation, exploitative service innovation, and the strength of tiesrelies on managers' subjective judgments. However, objective measures are useful for validating our proposition. For example, future research may operationalize ties with service intermediaries with other measures, such as the number, frequency and quality of the relationships. Fourth, although our research focuses on ties with service intermediaries, manufacturing firms may also build connections with other entities for external innovation search. We encourage future research to pay more attention to a broader set of external ties in which manufacturing firms are embedded.

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