

Effects of technical IT capabilities on organizational agility

The moderating role of IT business spanning capability

IT capability
effects on
organizational
agility

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Abstract

Purpose – The purpose of this research is to investigate how critical managerial IT capabilities, such as IT business spanning capability, interact with two pivotal types of technical IT capabilities (i.e. IT flexibility and IT integration) to affect organizational agility. Especially, the authors mainly examine a positive synergy or complementary relationship between IT business spanning capability and IT flexibility and a negative synergy or substitution relationship between IT business spanning capability and IT integration.

Design/methodology/approach – The authors develop a research model that integrates IT flexibility, IT integration, IT business spanning capability and organizational agility. Based on a matched-pair, cross-sectional field survey of IT and business managers, they use partial least squares (PLS) to analyze this research model.

Findings – IT flexibility and IT integration have been empirically proven to be positively associated with organizational agility. Furthermore, the research results indicate a positive synergy or complementary relationship between IT business spanning capability and IT flexibility, whereas they indicate a negative synergy or substitution relationship between IT business spanning capability and IT integration with regard to organizational agility. This finding demonstrates that IT business spanning capability can differentially influence organizational agility depending on its interaction with specific technical IT capability types. In addition, the effects of IT flexibility on organizational agility are high, whereas the effectiveness of IT integration decreases in the presence of high IT business spanning capability. Each type of technical IT capability displays different effectiveness under high IT business spanning capability. Thus, appropriate technical IT capability types should be carefully deployed, and highly effective technical IT capability types, such as IT flexibility, should be prioritized under high levels of IT business spanning capability.

Originality/value – This research highlights the joint effects of IT business spanning capability and two pivotal types of technical IT capabilities (i.e. IT flexibility and IT integration) on organizational agility, ultimately contributing to OM theories and practices.

Keywords Information technology, Organizational agility, Technical IT capabilities, Managerial IT capabilities, IT business spanning capability

Paper type Research paper

1. Introduction

Faced the impacts of globalization, hypercompetition and time-to-market pressures, organizational agility has been considered as one of the most critical issues of contemporary



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organizations (Gligor *et al.*, 2016). Organizational agility is the capability of an organization to sense market changes quickly and respond effectively and efficiently to enhance competitive advantages (Zhang and Sharifi, 2000; DeGroote and Marx, 2013). The benefits of organizational agility have been addressed by a variety of previous studies (e.g. Swafford *et al.*, 2006; Zhang, 2011; Gligor *et al.*, 2015). For example, the report released by a Project Management Institute has indicated that projects in organizations with high agility are more successful than those in low-agile organizations (Mao *et al.*, 2015). In the current turbulent environments, organizations are required to be agile and be able to deal with rapidly changing business requirements to achieve business success. Given that organizational agility is important, how to develop organizational agility has garnered considerable attention of researchers and practitioners.

With the embeddedness of information technologies (ITs) into business practices, some scholars in the field of operations management (OM) attempt to explore how to develop organizational agility from the perspective of IT (e.g. Bharadwaj, 2000; Huang *et al.*, 2012; Chen *et al.*, 2014). Nevertheless, to develop organizational agility, different organizations display significant disparities in their ITs. For example, although both Carrefour and Walmart in China achieve business success owing to their agile operations, Carrefour and Walmart show great disparities in ITs (Liu *et al.*, 2019). While Carrefour does not depend on any advanced ITs to manage its operations, Walmart develops its satellite communication systems with great data analysis capabilities. Yet, Carrefour's agility has been as high as Walmart's in China. Therefore, to clarify the role of ITs in the development of organizational agility, this study focuses on how to leverage ITs to develop organizational agility.

Recently, two research streams have emerged on the influence of ITs on organizational agility (Appendix 1). The first stream states that technical IT capabilities significantly affect organizational agility and that the effective deployment of IT infrastructure contributes to organizational agility. The second stream argues that managerial IT capabilities significantly affect organizational agility and that managers can take advantage of IT skills, assets and managerial stances to develop organizational agility. Although previous studies in these two research streams have examined the influence of technical and managerial IT capabilities on organizational agility, three research gaps have been identified in the extant literature.

First, numerous studies have focused on the identification of technical IT capability types (Bardhan *et al.*, 2010; Saraf *et al.*, 2007; Rai and Tang, 2010). However, the relationship between technical IT capability types and organizational agility should be further examined. Prior studies have presented two pivotal types of technical IT capabilities, namely, IT flexibility and IT integration (Saraf *et al.*, 2007). IT flexibility, also referred to as IT reconfiguration (Duncan, 1995; Byrd and Turner, 2000), is an organization's ability to recombine IT infrastructure for business purposes with minimal penalty to current cost, effort, time or performance (Conboy, 2009), whereas IT integration represents the extent to which IT infrastructure is linked and information in business processes is shared among different department (Rai *et al.*, 2006). In literature, IT flexibility and IT integration can be considered as representing flexibility and efficiency (Adler *et al.*, 1999). Although IT flexibility and IT integration conceptually are viewed as at odds, previous studies demonstrate that appropriate IT designs (e.g. cloud computing) can facilitate both IT flexibility and IT integration in organizations (Liu *et al.*, 2018). Therefore, IT flexibility and IT integration can be achieved at the same time. Although Ngai *et al.* (2011) have examined the impacts of both IT flexibility and IT integration on organizational agility by employing a multicase study method, there is little empirical evidence on how these two technical IT capability types simultaneously affect organizational agility. In addition, contradictory findings on the relationship between technical IT capabilities and organizational agility have been obtained by prior studies. For example, some studies have examined that technical IT capabilities positively affect organizational agility (Overby *et al.*, 2006; Fink and Neumann, 2007), whereas other studies have found that technical IT capabilities might play a mixed role

in the development of organizational agility (Seo and La Paz, 2008) or even have a negative effect on organizational agility (Rettig, 2007). Thus, further empirical studies are necessary for a better understanding of this issue.

Second, managerial IT capabilities often affect the effectiveness of technical IT capabilities. Such managerial IT capabilities include IT business spanning capability, which denotes the alignment between IT and business strategic planning (Mata *et al.*, 1995; Lu and Ramamurthy, 2011). Our research attaches importance to IT business spanning capability for the following reasons. IT business spanning capability is the capability of an organization's management to leverage IT infrastructure to support business objectives (Mao *et al.*, 2015). During several decades, IT business spanning capability has been one of the top 10 priorities for IT and business executives (Liang *et al.*, 2017). Furthermore, extant studies reveal that IT business spanning capability is critical for organizational agility (Tallon and Pinsonneault, 2011). Yet, contradictory view still exists on whether IT business spanning capability improves or impedes organizational agility. Whereas most previous studies assert that IT business spanning exerts a positive effect on organizational agility (Tallon and Pinsonneault, 2011; Liang *et al.*, 2017), Shpilberg *et al.* (2007) argue that a high IT business spanning capability requires technical IT resources to be deeply embedded into critical business activities and can lead to rigid business activities that may hurt organizational agility. Take into consideration the fact that no consensus on whether IT business spanning capability improves or impedes organizational agility has been achieved, we choose IT business spanning capability as our investigated managerial IT capability. Although researchers have argued that managerial IT capabilities should be integrated into technical IT capabilities to examine their joint effects on organizational agility (Tallon, 2008), IT business spanning capability has not been integrated. Uncovering the contingent role of IT business spanning capability can provide new knowledge about how to take advantage of such a managerial IT capability effectively. However, prior studies either investigate the effects of general capabilities that involve various IT skills, assets and managerial stances (Lu and Ramamurthy, 2011; Chakravarthy *et al.*, 2013) or examine the effects of some specific aspects of IT capabilities on organizational agility (Liu *et al.*, 2013), the joint effects of IT business spanning capability and technical IT capabilities have been overlooked. Omitting the joint effects of IT business spanning capability and technical IT capabilities tends to result in partial, erroneous or incomplete interpretations, overstating or understating the main effect. Therefore, whether critical managerial IT capabilities, particularly IT business spanning capability, significantly affect the effectiveness of technical IT capabilities should be examined.

Third, although managerial IT capabilities affect the effectiveness of various technical IT capabilities, such effects on each type of technical IT capability are positive, indicating that various technical IT capabilities and managerial IT capabilities are complements (Aral and Weill, 2007). Limited empirical evidence has revealed that some technical IT capability types and managerial IT capabilities are substitutes, while others and managerial IT capabilities are complements. Nevertheless, such a situation is possible for IT business spanning capability. IT business spanning capability emphasizes the collaboration between IT and business executives that leads to effective information sharing and process collaboration, thus responding to business requirements quickly (Ross *et al.*, 1996; Lu and Ramamurthy, 2011). Under such circumstance, IT integration-enabled information sharing and process collaboration are redundancies. The functions and objectives of IT business spanning capability and IT integration overlap. A high level of IT integration is not needed to improve organizational agility in the presence of high IT business spanning capability. On the other hand, organizations that overly emphasize IT flexibility may ignore necessary alignment IT components dynamically with evolving business requirements (Lu and Ramamurthy, 2011), whereas IT business spanning capability exerts an important role in exploiting IT

components to support evolving business requirements, compensating for the weaknesses of IT flexibility (Rai and Tang, 2010). Therefore, IT integration may substitute IT business spanning capability despite other technical IT capability types, such as IT flexibility, still complement IT business spanning capability. Examining how IT business spanning capability alters the relationships between different technical IT capability types and organizational agility is critical. Managers can thus deploy appropriate technical IT capability types to develop organizational agility in the presence of high IT business spanning capability.

Our research attempts to fill the aforementioned gaps by addressing the following two research questions:

- (1) How do technical IT capability types affect organizational agility?
- (2) How does IT business spanning capability differentially interact with technical IT capability types to affect organizational agility?

Our research contributes to the extant literature on organizational agility in four respects. First, compared with previous empirical studies that only concentrate on certain technical IT capability types (Bhatt *et al.*, 2010; Raschke, 2010), our results further extend previous literature by revealing that organizational agility is positively affected by many different technical IT capabilities in terms of IT flexibility and IT integration. Our research indicates that technical IT capability–organizational agility contradiction may not exist in the current business environment. Second, this study introduces one of the critical managerial IT capabilities, namely IT business spanning capability. Our results further extend previous literature (e.g. Liang *et al.*, 2017) by highlighting the indirect function of IT business spanning capability instead of a simplistic research model that only associates such a managerial IT capability with organizational agility directly. Third, our research provides finer-grained knowledge by showing the mixed role of IT business spanning capability. Specially, our results find a positive synergy or complementary relationship between IT business spanning capability and IT flexibility, whereas they indicate a negative synergy or substitution relationship between IT business spanning capability and IT integration with regard to organizational agility. Finally, our results provide new knowledge by demonstrating contradictory observation that whether each technical IT capability type significantly or insignificantly affects organizational agility may result from the different levels of IT business spanning capability.

2. Theoretical development

2.1 Technical IT capabilities

Technical IT capabilities are the capabilities of an organization to deploy shareable platforms, for instance, application portfolio services, network communication services and data management services (Lu and Ramamurthy, 2011; Liu *et al.*, 2018). By contrast, managerial IT capabilities are the capabilities of an organization's management to leverage existing IT infrastructure to support business objectives or create business opportunities (Tallon, 2008; Lu and Ramamurthy, 2011). In extant information systems research, as one of the critical dimensions of integrated IT capabilities, technical IT capabilities include a set of physical IT infrastructure-related resources, which are crucial for an organization to generate value from IT (Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005). Liu *et al.* (2018) further claim that technical IT capabilities can be categorized into the following two types: IT flexibility and IT integration. Similar to Liu *et al.* (2018), Ngai *et al.* (2011) also distinguish IT flexibility from IT integration and propose that both IT flexibility and IT integration are positively associated with organizational agility by employing a multicase study method. However, this proposition has never been empirically examined. In line with previous studies

(Ngai *et al.*, 2011; Liu *et al.*, 2018), these two types of technical IT capabilities (i.e. IT flexibility and IT integration) are also included in our research.

2.2 The joint effects of technical IT capability types and managerial IT capability on organizational agility

Although resource-based view (RBV) explains how resources can be deployed for higher performance, it falls short in identifying the boundary conditions that make the same resources useful in some contexts and not in others (Sedera *et al.*, 2016). Therefore, as an extension to RBV, Aragon-Correa and Sharma (2003) put forward contingent resource-based view (CRBV) by emphasizing that the usefulness of primary resources can be contingent on other resources. In line with CRBV, Aral and Weill (2007) propose that IT resources or capabilities rarely alone create competitive advantages and that organizations should combine and integrate these IT capabilities to create competitive advantages.

In the IS literature, the IT enablers of organizational agility can be categorized into technical and managerial perspectives (Tallon, 2008). Technical perspective contains capabilities around IT infrastructure, whereas managerial perspective mainly includes people, structure and relationship (Mao *et al.*, 2016). We adopt CRBV to conduct an integrated analysis of managerial and technical perspectives to empirically investigate the synergy of managerial and technical factors further. According to the CRBV, the effects of technical IT capabilities are contingent on those critical managerial IT capabilities. In addition, previous IS studies also propose that managerial factors (e.g. top management commitment to IT) can play a moderating role in the effects of technical IT capabilities (Wade and Hulland, 2004). Therefore, based on CRBV and the technical–managerial perspective, IT business spanning capability is introduced as a contingent variable in the technical IT capability–organizational agility relationship.

In addition, this study also summarizes studies that have tried to examine the effectiveness of technical IT capabilities and managerial IT capabilities on organizational agility (Appendix 1). As shown in Appendix 1, prior studies either investigate that the effects of general capabilities that involve technical IT capabilities and managerial IT capabilities (Lu and Ramamurthy, 2011; Chakravarthy *et al.*, 2013) or examine the effects of some specific aspects of IT capabilities on organizational agility (Liu *et al.*, 2013). Apart from Tiwana and Konsynski (2010), the joint effects of managerial IT capabilities and technical IT capabilities have been overlooked. Thus, our research investigates how a crucial type of managerial IT capability (i.e. IT business spanning capability) interacts with technical IT capabilities to affect organizational agility.

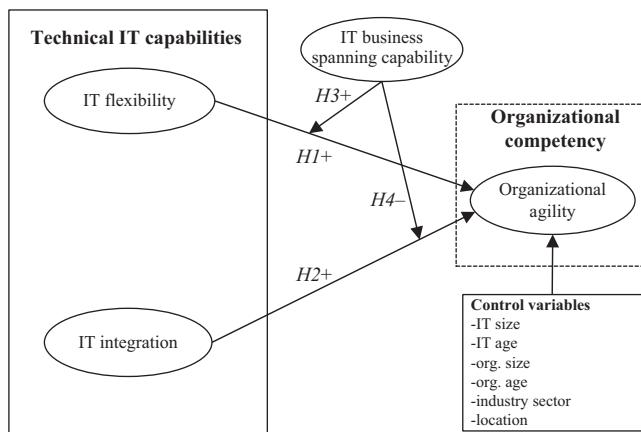
3. Research model and hypothesis development

Our research model is presented in Figure 1. IT flexibility and IT integration positively affect organizational agility. Meanwhile, whereas the IT flexibility–IT business spanning capability interaction positively affects organizational agility, the IT integration–IT business spanning capability interaction negatively affects organizational agility. The proposed hypotheses are elaborated as follows.

3.1 The effects of technical IT capabilities on organizational agility

Drawing on standardized interface and modularized IT components, IT flexibility enables an organization to easily adapt its IT components and integrate these with channel partners' IT components, thus allowing them to quickly respond to environmental change without increase in time or cost (Saraf *et al.*, 2007). For example, when an organization needs to scale up transactional volume with channel partners, a flexible IT infrastructure allows local

Figure 1.
Research model



adjustments in their IT components easily. IT flexibility reduces the specificity of IT infrastructure that may otherwise restrict or damage organizational agility (Oosterhout, 2006). In addition, Liu *et al.* (2013) examine that a flexible IT infrastructure shapes organizational agility by facilitating absorptive capability. Thus, we present our following hypothesis:

H1. IT flexibility is positively related to organizational agility.

IT integration does not only provide support to the flow of information, it also leads to a smooth flow of resources. With a well-integrated IT system, different parties can access the business information of other functions (Ngai *et al.*, 2011). IT integration facilitates information sharing and process collaboration among appropriate parties along the supply chain, which helps organizations reduce response time to market demand changes (Rai and Tang, 2010). For example, suppliers can access production schedule and inventory information of their customers, thus keeping track of the need of their customers quickly. Moreover, IT integration is also conducive to a smooth flow of resources and helps an organization to relocate resources based on market changes in a responsive manner. Thus, we present our following hypothesis:

H2. IT integration is positively related to organizational agility.

3.2 The joint effects of technical IT capabilities and IT business spanning capability on organizational agility

In this study, the joint effects of technical IT capabilities and IT business spanning capability on organizational agility are mainly reflected in two aspects: the complementary effect of IT flexibility and IT business spanning capability and the substitution effect of IT integration and IT business spanning capability.

The complementary effect of IT flexibility and IT business spanning capability is embodied in the complementarity of their functions and objectives. In other words, IT flexibility and IT business spanning capability can compensate for each other's weaknesses. Though IT flexibility emphasizes maintaining adaptable links between various IT components to support emergent business requirements (Duncan, 1995; Byrd and Turner, 2000; Sambamurthy *et al.*, 2003), organizations that are overly continuously adapting their IT components may lead to directing too many resources to explore new business opportunities while neglecting necessary alignment of IT components dynamically with evolving business

requirements (Lu and Ramamurthy, 2011). IT business spanning capability enables an organization to promote a mutual trust and respect that encourages information sharing between IT and business executives (Ross *et al.*, 1996). Such information sharing exerts an important role in exploiting IT components to support evolving business requirements (Rai and Tang, 2010). By contrast, without close collaboration between IT and business units, organizations may foster an unstable foundation and cannot fully extract the value of the adaption of their IT components. Therefore, IT flexibility and IT business spanning capability operate as complements with regard to organizational agility, which lead us to present the following hypothesis:

- H3. The IT flexibility–IT business spanning capability interaction will positively affect organizational agility, indicating a positive synergy or complementary relationship.*

The substitution relationship of IT integration and IT business spanning capability is embodied in the overlaps of their functions and objectives. IT business spanning capability emphasizes the collaboration between IT and business executives (Lu and Ramamurthy, 2011). The IT–business collaboration not only brings about more strategic applications, IT and business joint decision-making, but also engenders information sharing between IT and business executives to better deal with rapidly changing business requirements (Ross *et al.*, 1996). Under such circumstance, IT integration-enabled information sharing and process collaboration are redundancies. Conversely, without close collaboration between IT and business executives, information sharing and process collaboration enabled by IT integration tend to be core enablers of organizational agility. Both IT business spanning capability and IT integration are aimed at enhancing information sharing and process collaboration, thus enhancing an organization's capability to be agile. Therefore, IT integration and IT business spanning capability operate as substitutes with regard to organizational agility, which lead us to present the following hypothesis:

- H4. The IT integration–IT business spanning capability interaction will negatively affect organizational agility, indicating a negative synergy or substitution relationship.*

4. Research method

4.1 Data collection

Data for our research were collected through a matched-pair, cross-sectional field survey. We included a wide range of industries to enhance the generalizability of our findings. However, traditionally labor-intensive industries (e.g. agricultural and toy manufacturing industries) were avoided to concentrate on industries that frequently leverage ITs for their operations and strategic activities. We randomly selected these organizations from a contact list that consists of Red Herring Europe 2012 Top 100, Asia Global 500 and Top 500 Informatization Companies and InformationWeek 500 in 2013. Then, we developed two questionnaires for our research, contacted IT and business manager of each organization and sent the questionnaire to them. IT manager was required to assess IT-related questions (e.g. IT flexibility, IT integration and IT business spanning capability), whereas business manager was asked to answer business-related questions (e.g. organizational agility). Matched-pair data were gathered to reduce the threat of common method bias (Podsakoff and Organ, 1986). Finally, 106 useable questionnaires from selected organizations were returned, giving us a response rate of 48.2%. Table I provides the demographics of our sample.

Liang *et al.*'s (2007) method has been wide applied by IS studies (e.g. Gao *et al.*, 2019) to examine common method bias. Following Liang *et al.*'s (2007) method, we create a partial least squares (PLS) model to assess common method bias in this study. Our results indicated that all the loadings of these principal variable were significant at the level of 0.001, while the

Table I.
Demographics of the sample

	Characteristic	Range	Number	%
Organization size	≤10,000		18	16.98
	10,001–50,000		44	41.51
	50,001–100,000		19	17.92
	100,001–200,000		15	14.15
	>200,000		10	9.43
Organization age	≤20		18	16.98
	21–40		35	33.02
	41–60		13	12.26
	61–100		22	20.75
	101–120		11	10.38
	>120		8	7.55
	Industry sector			
Industry sector	Equipment manufacturing		11	10.38
	Automotive		10	9.43
	Retail		9	8.49
	Information technology		9	8.49
	Consumer goods		12	11.32
	Biotechnology and pharmaceuticals		9	8.49
	Banking and financial services		8	7.55
	Telecommunications		8	7.55
	Electronics		6	5.66
	Logistics and transportation		6	5.66
Others	Energy and utilities		5	4.72
	Others		13	12.26

common method factor loadings were insignificant (as shown in [Appendix 2](#)), suggesting that common method biases are not a threat in our research.

4.2 Measures

We pretested the two questionnaires for our research among 22 organizations from France and China. Specifically, IT and business managers of these organizations were asked to examine the two questionnaires for meaningfulness and clarity. As shown in [Table II](#), we listed the constructs, items and their relevant references. A seven-point Likert-type scale, which ranges from 1 (strongly disagree) to 7 (strongly agree), was adopted.

4.3 Control variables

IT size refers to the ratio of number of full-time IT employees to full-time employees in the whole organization. IT age refers to the years IT unit has been founded. Organization size refers to the number of full-time employees in the whole organization. Organization age refers to the years the organization has been in place. Industry sector refers to a binary variable for which 0 represents manufacturing industry and 1 represents service industry. For the location variable, our samples are categorized into three locations, including Europe, Asia and North America. We set two dummy variables for three different locations. Given that IT size, IT age, organization size, organization age, industry sector and location have been proposed to impact IT business value ([Lu and Ramamurthy, 2011](#)), IT size, IT age, organization size, organization age, industry sector and location as control variables are added in this study.

5. Analysis results

5.1 Measurement model

PLS method was applied to analyze the measurement model since PLS method maximized explained variance by requiring a small sample size. Each construct used in our research

Construct	Item no	Item	Reference
IT flexibility (ITF) ^a	ITF1	The IT systems can be easily adapted to new business functions	Fichman (2004), Saraf <i>et al.</i> (2007), Rai and Tang (2010)
	ITF2	The IT systems can be easily extended to accommodate new functions or applications	
	ITF3	The IT systems adopt IT standards that are easily accepted by most potential and current business partners	
	ITF4	The IT systems have modular software components, most of which can be easily reused in other business functions	
IT integration (ITI) ^a	ITI1	The IT systems can be leveraged to integrate business processes	Swafford <i>et al.</i> (2008), Roberts and Grover (2012)
	ITI2	The IT systems allow integrated access to business data	
IT business spanning capability (IBSC) ^a	ITI3	All IT systems are seamlessly connected	Lu and Ramamurthy (2011)
	IBSC1	My organization integrates IT planning into business planning	
	IBSC2	My organization enables the ability of managers in functional areas and general management to understand the value of IT investment	
	IBSC3	My organization designs an efficient and effective IT process	
Organizational agility (OA) ^b	IBSC4	My organization aligns business process with IT application portfolios	Tallon (2008), Lu and Ramamurthy (2011), Chen <i>et al.</i> (2014)
	OA1	My organization constantly attempts to reengineer itself to better meet market needs	
	OA2	My organization treats market-related changes and apparent chaos as opportunities to capitalize quickly	
	OA3	My organization proactively changes the various functionalities and features of products/services as necessary to better meet customers/markets needs	

Note(s): ^aMarked constructs assessed by IT managers; ^bMarked constructs assessed by business managers

Table II.
Construct and
measures

model was reflective. Convergent validity of each construct was first checked in our research. Table III provides all the item-to-construct loadings. All cross loadings exceeded 0.707 and were 0.1 higher than the loadings between the items and other constructs. Then, the mean, SD, average variance extracted (AVE), composite reliability (CR), Cronbach's alpha and construct correlation are shown in Table IV. All the values of the Cronbach's alpha and CR exceeded 0.7, and all the values of AVE exceeded 0.5. Finally, we evaluated discriminant validity by examining if each construct correlation was lower than the square root of AVE. Table IV indicates that this validity was acceptable. Therefore, our results presented strong evidence that the measurement model exhibited satisfactory properties.

5.2 Hypotheses testing

Previous studies (e.g. Liu *et al.*, 2016) have widely applied SPSS to evaluate interacting effects. Following the procedure recommended by Sharma *et al.* (1981), we adopted SPSS17.0 to

Table III.
The item-to-construct loadings

		IT flexibility (ITF)	IT integration (ITI)	IT business spanning capability (IBSC)	Organizational agility (OA)
	ITF1	<i>0.896</i>	0.335	0.480	0.532
	ITF2	<i>0.850</i>	0.451	0.617	0.627
	ITF3	<i>0.841</i>	0.403	0.427	0.481
	ITF4	<i>0.849</i>	0.398	0.493	0.451
	ITI1	0.424	<i>0.905</i>	0.374	0.557
	ITI2	0.396	<i>0.902</i>	0.247	0.493
	ITI3	0.410	<i>0.836</i>	0.289	0.416
	IBSC1	0.513	0.355	<i>0.769</i>	0.354
	IBSC2	0.336	0.113	<i>0.749</i>	0.254
	IBSC3	0.573	0.329	<i>0.850</i>	0.431
	IBSC4	0.461	0.277	<i>0.848</i>	0.468
	OA1	0.411	0.275	0.443	<i>0.736</i>
	OA2	0.587	0.542	0.438	<i>0.888</i>
	OA3	0.519	0.532	0.345	<i>0.855</i>

Note(s): The “Italic” value shows the cross loading between the item and its construct

Table IV.
Descriptive statistics

	Mean (SD)	AVE	CR	Cronbach's alpha	ITF	ITI	IBSC	OA
ITF	5.366 (1.094)	0.738	0.918	0.883	<i>0.859</i>			
ITI	5.601 (1.030)	0.777	0.913	0.857	0.464	<i>0.881</i>		
IBSC	5.297 (0.928)	0.648	0.880	0.822	0.595	0.347	<i>0.805</i>	
OA	5.258 (1.044)	0.687	0.868	0.773	0.618	0.560	0.485	<i>0.829</i>

conduct a hierarchical regression analysis. Six models, shown further, were developed in our hierarchical analysis.

Model 1: Control variables

Model 2: Control variables, IT flexibility and IT integration

Model 3: Control variables, IT flexibility, IT integration and IT business spanning capability

Model 4: Control variables, IT flexibility, IT integration, IT business spanning capability and interaction term between IT flexibility and IT business spanning capability

Model 5: Control variables, IT flexibility, IT integration, IT business spanning capability and interaction term between IT integration and IT business spanning capability

Model 6: Control variables, IT flexibility, IT integration, IT business spanning capability, interaction term between IT flexibility and IT business spanning capability and interaction term between IT integration and IT business spanning capability

Table V summarizes the results of hierarchical analysis. As provided by **Table V**, the effects of control variables, namely IT size, IT age, organization size, organization age, industry sector and location, on organizational agility are assessed in Model 1. **H1** and **H2** are assessed in Model 2. **H3** and **H4** are evaluated in Model 4, Model 5 and Model 6.

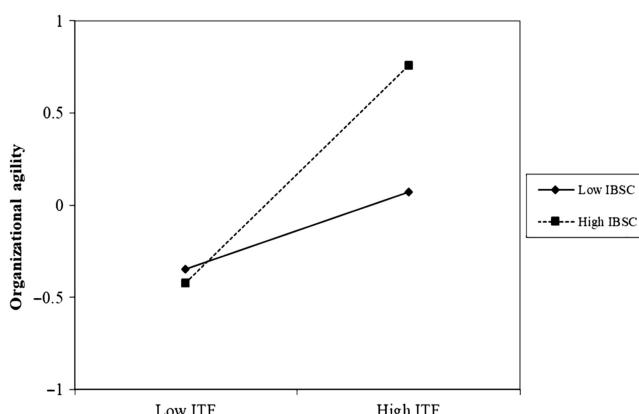
In Model 1, IT size, IT age, organization size, industry sector and location insignificantly affect organizational agility, whereas organization age negatively affects organizational

Table V.
Results of hierarchical
analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>Control variables</i>						
IT size	0.167	0.040	0.047	0.025	0.070	0.054
IT age	-0.150	-0.018	-0.032	0.006	-0.075	-0.047
Organization size	-0.094	0.001	0.009	0.002	0.025	0.025
Organization age	-0.251*	-0.219*	-0.208*	-0.200*	-0.203*	-0.187*
Industry sector	0.099	-0.050	-0.047	-0.042	-0.028	-0.009
Location dummy 1	-0.007	0.116	0.092	0.066	0.089	0.050
Location dummy 2	-0.098	0.088	0.082	0.143	0.037	0.095
<i>Independent variables</i>						
ITF		0.376***	0.330**	0.400***	0.317**	0.410***
ITI		0.373***	0.355***	0.366***	0.300**	0.280**
IBSC			0.101	0.153	0.073	0.129
Interaction terms						
ITF × IBSC				0.216*		0.313***
ITI × IBSC					-0.160*	-0.264**
R ²	0.205	0.519	0.525	0.557	0.544	0.603
Adjusted R ²	0.148	0.474	0.475	0.505	0.491	0.552

Note(s): * $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$; Each path coefficient is standardized; The sample size is 106

agility. This result implies that organizations that established for a long time exhibit significantly low levels of organizational agility. In Model 2, a significant amount of variance in organizational agility is explained by IT flexibility and IT integration. The effects of these two types of technical IT capabilities on organizational agility are significantly positive ($\beta = 0.376$, $p < 0.001$ and $\beta = 0.373$, $p < 0.001$). Thus, H1 and H2 are supported. Model 4 examines the joint effect of IT flexibility and IT business spanning capability. The interaction term between IT flexibility and IT business spanning capability is significantly positive ($\beta = 0.216$, $p < 0.05$). Model 5 examines the joint effect of IT integration and IT business spanning capability. The interaction term between IT integration and IT business spanning capability is significantly positive ($\beta = -0.160$, $p < 0.05$). Then, we depict interaction plots to better explain the joint effects of technical IT capabilities and IT business spanning capability. Figure 2 shows that the effect of IT flexibility on organizational agility is high when IT business spanning capability is high (simple slope = 0.591, $p < 0.001$). Figure 3


Figure 2.
Moderating effect of IT
business spanning
capability on the
relationship between
IT flexibility and
organizational agility

shows that the effect of IT integration on organizational agility is high when IT business spanning capability is low (simple slope = 0.440, $p < 0.001$). Thus, H3 and H4 are supported. Meanwhile, we put these two interaction terms in one full model (i.e. Model 6), in which we also empirically examined that the interaction term between IT flexibility and IT business spanning capability is significantly positive ($\beta = 0.313$, $p < 0.001$), whereas the interaction term between IT integration and IT business spanning capability is significantly negative ($\beta = -0.264$, $p < 0.01$), thus H3 and H4 are further supported.

The results of hypothesis testing are summarized in Table VI.

6. Discussions

This study examines how technical IT capability interacts with managerial IT capability to influence organizational agility. By analyzing a sample of 106 organizations, we find that two critical technical IT capability types, namely IT flexibility and IT integration, positively affect organizational agility. Moreover, we find that IT business spanning capability plays mixed roles in the technical IT capability–organizational agility relationship. Our results indicate a positive synergy or complementary relationship between IT business spanning capability and IT flexibility, whereas they indicate a negative synergy or substitution relationship between IT business spanning capability and IT integration with regard to organizational agility. These findings not only generate new insights into OM literature but also provide managerial implications to assist managers in configuring IT capabilities to enhance organizational agility.

6.1 Theoretical implications

The theoretical implications of our research are fourfold. First, our results extend previous organizational agility literature that only concentrates on certain technical IT capability types by revealing that organizational agility is positively affected by many different

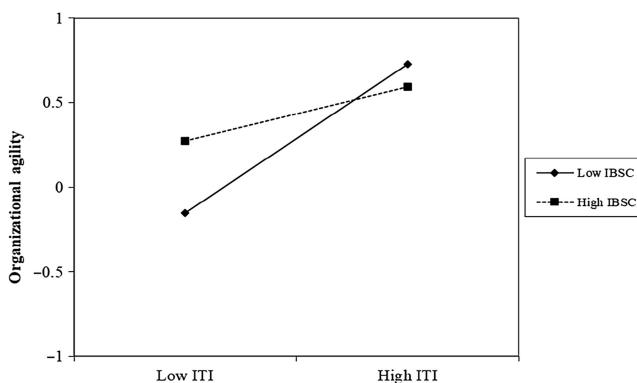


Figure 3.
Moderating effect of IT business spanning capability on the relationship between IT integration and organizational agility

Table VI.
Results of hypothesis testing

Hypothesis	Effect	Result
H1: IT flexibility → Organizational agility	Positive	Supported
H2: IT integration → Organizational agility	Positive	Supported
H3: IT flexibility × IT business spanning capability → Organizational agility	Positive	Supported
H4: IT integration × IT business spanning capability → Organizational agility	Negative	Supported

technical IT capabilities in terms of IT flexibility and IT integration. This finding further supports prior arguments and observations that technical IT capabilities are positively associated with organizational agility (Ngai *et al.*, 2011). Our research indicates that technical IT capability–organizational agility contradiction may not exist in the current business environment. One possible explanation is that ITs have remarkably evolved into next-generation ITs including cloud computing, big data, Internet of things and artificial intelligence. These next-generation ITs are more likely to improve organizational agility. For example, compared with traditional information systems (e.g. ERP, CAD), resource pooling of clouding computing can easily facilitate information sharing among organizations and their customers, which enables an organization to quickly sense and respond to customer requirements (Liu *et al.*, 2018).

Second, this study provides new perspective for information systems researchers by integrating technical IT capabilities into managerial IT capabilities. Previous studies have either investigated the direct effect of general IT capabilities (Lu and Ramamurthy, 2011; Chakravarthy *et al.*, 2013) or examined the direct effect of some specific aspects of IT capabilities on organizational agility (Liu *et al.*, 2013; Panda and Rath, 2016). However, the results of our research suggest that one of the critical managerial IT capabilities, IT business spanning capability, can indirectly influence organizational agility depending on its interaction with specific technical IT capability type. Therefore, researchers can concentrate on the indirect function of IT business spanning capability instead of a simplistic research model that only associates such a managerial IT capability with organizational agility directly.

Third, our results highlight the mixed role of IT business spanning capability and reveal how IT business spanning capability differentially interacts with technical IT capability types to influence organizational agility. Our research provides new knowledge by showing that IT business spanning capability is a double-edged sword with regard to technical IT capabilities. Specially, our results indicate a positive synergy or complementary relationship between IT business spanning capability and IT flexibility, whereas they indicate a negative synergy or substitution relationship between IT business spanning capability and IT integration with regard to organizational agility. This finding supports the previous argument that managerial IT capabilities interact with technical IT capabilities to influence the IT business value (Aral and Weill, 2007). Our research also addresses the gap in the literature wherein IT business spanning capability is found to positively and negatively affect organizational agility (Liang *et al.*, 2017). In fact, our research demonstrates that IT business spanning capability exerts mixed roles in the technical IT capability–organizational agility relationship.

Fourth, our results can explain under which conditions each technical IT capability type significantly or insignificantly affects organizational agility. Prior studies show that the findings on the effects of technical IT capabilities on organizational agility are not fully consistent (Swafford *et al.*, 2008; Ngai *et al.*, 2011). For example, some studies argue that IT integration exerts a positive effect on organizational agility directly (Ngai *et al.*, 2011), whereas other studies claim that IT integration enhances organizational agility only via other mediating variables (Swafford *et al.*, 2008). Our findings reveal that the direct effect of IT integration is insignificant (significant) when the level of IT business spanning capability is high (low), whereas the direct effect of IT flexibility is insignificant (significant) when the level of IT business spanning capability is low (high). These findings imply that these contradictory observations may result from the different levels of IT business spanning capability.

6.2 Managerial implications

Three managerial implications can be drawn from our findings. First, given that both IT flexibility and IT integration positively affect organizational agility, the integrative usage of

IT flexibility and IT integration is an available option. In literature, IT flexibility and IT integration can be viewed as representing flexibility and efficiency (Adler *et al.*, 1999), their combination can keep the balance of flexibility and efficiency and enhance organizational agility via reconciling long-term and short-term business objectives. Therefore, managers can employ appropriate IT designs that facilitate both IT flexibility and IT integration to enhance organizational agility. In particular, organizations should not only invest in modular and standardized IT components but also maintain syntactic and semantic integration between IT components to enhance organizational agility.

Second, given that IT business spanning capability exerts both positive and negative effects on technical IT capability effectiveness, IT management should not only evaluate the benefit engendered by managerial IT capabilities but also analyze the challenge offered by managerial IT capabilities. IT business spanning capability represents the extent of the alignment of IT and business strategy. The effect of IT business spanning capability could be negative when facing environmental change because IT strategy is aligned with the old business strategy. In particular, the tightly integrated IT infrastructure can make it harder for the organizations to balance the degree of flexibility and efficiency. Therefore, IT management should consider not only the benefit generated by IT business spanning capability but also the possibility of unsatisfactory outcomes.

Finally, managers should also understand how to leverage various technical IT capability types effectively and efficiently to foster organizational agility. Our results show that the positive effect of IT flexibility on organizational agility is significant, whereas the effectiveness of IT integration is low in the presence of high IT business spanning capability. Therefore, managers should prioritize developing IT flexibility with high levels of IT business spanning capability. Moreover, managers should avoid too much spending in developing IT integration with high levels of IT business spanning capability. This is critical for small and medium-sized companies, since the IT-related budgets are often limited and should be applied to develop the most useful technical IT capability type.

6.3 Limitations and future research directions

This study has several limitations. First, the hypotheses are tested using a relatively small sample size of 106 since receiving a larger sample size at the organization level is difficult. A larger sample size should be obtained to improve statistical power. Second, our findings are based on cross-sectional data. Since the development of IT-enabled organizational agility is a gradual process, it is desirable to conduct a longitudinal study to extend our understanding of these issues. Third, although each type of technical IT capability is effective in enhancing organizational agility, the effects of different dimensions of combining IT flexibility and IT integration may differ in munificent environment (Cao *et al.*, 2009). Therefore, future research can be designed to compare the effect of the high complementing dimension (focusing on a close relative match between IT flexibility and IT integration) with that of the high balancing dimension (maintaining a synergy between IT flexibility and IT integration) in munificent environment. Fourth, in the literature, several other managerial IT capabilities (e.g. IT ambidexterity) have also been recognized as important capabilities that can foster organizational agility. Therefore, we can further extend our research model by examining the joint effects of IT ambidexterity and technical IT capabilities on organizational agility.

7. Conclusion

This study contributes to OM studies by investigating the joint effects of technical IT capability and managerial IT capability on organizational agility. We find that IT flexibility and IT integration positively affect organizational agility. This finding implies that these two

technical IT capability types can effectively facilitate organizational agility. Moreover, our results also indicate a complementary relationship between IT flexibility and IT business spanning capability, whereas they indicate a substitutive relationship between IT integration and IT business spanning capability. This result demonstrates that IT business spanning capability is a double-edged sword and reveals the mixed moderating role of IT business spanning capability in the technical IT capability–organizational agility relationship. This study also highlights the different effectiveness exhibited by each type of technical IT capability under high IT business spanning capability. Especially, the effectiveness of IT flexibility increases in the presence of high IT business spanning capability, whereas the effect of IT integration is low. Thus, appropriate types of technical IT capabilities should be carefully exercised, and highly effective technical IT capability types, such as IT flexibility, should be deployed in the presence of high IT business spanning capability.

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Further reading

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Appendix 1

References	Qualitative or quantitative	Technical IT capabilities	Managerial IT capabilities	Main findings
Swafford <i>et al.</i> (2008)	Quantitative	IT integration	–	IT integration facilitates supply chain flexibility, which leads to higher supply chain agility indirectly
Bhatt <i>et al.</i> (2010)	Quantitative	IT infrastructure flexibility	–	IT infrastructure flexibility facilitates information generation and dissemination, which enhance organizational responsiveness
Raschke (2010)	Quantitative	IT infrastructure flexibility	–	IT infrastructure flexibility facilitates business process agility that affects quality outcomes and process efficiency
Ngai <i>et al.</i> (2011)	Qualitative	IT integration, IT flexibility	–	Both IT integration and IT flexibility are positively associated with the agility of supply chain
Queiroz <i>et al.</i> (2018)	Quantitative	IT application orchestration capability	–	The effectiveness of IT application orchestration capability is moderated by an organization's strategic orientation
Lee <i>et al.</i> (2015)	Quantitative	–	IT ambidexterity	Operational ambidexterity fully mediates the effects of IT ambidexterity on organizational agility. These relationships are affected by environmental dynamism
Liang <i>et al.</i> (2017)	Quantitative	–	Intellectual alignment, Social alignment	While intellectual alignment impedes organizational agility by enhancing inertia, social alignment enhances organizational agility by increasing IT-business coordination

(continued)

Table AI.
Summary of primary studies on the effectiveness of technical and managerial IT capabilities on organizational agility

References	Qualitative or quantitative	Technical IT capabilities	Managerial IT capabilities	Main findings
Zhou <i>et al.</i> (2018)	Quantitative	–	IT competence of business professionals, business competence of IT people, operational IT alignment	IT competence of business professionals and business competence of IT people jointly enhance organizational agility by the mediation of operational IT alignment
Lu and Ramamurthy (2011)	Quantitative	IT infrastructure capability	IT proactive stance, IT business spanning capability	IT infrastructure capability, IT proactive stance and IT business spanning capability are three dimensions of general latent IT capabilities. In addition, general latent IT capabilities are positively associated with organizational agility
Tiwana and Konsynski (2010)	Quantitative	IT architecture	IT governance structure	IT governance structure complements IT architecture with regard to agility
Chakravarthy <i>et al.</i> (2013)	Quantitative	IT infrastructure	IT capabilities	As comprising IT capabilities and IT infrastructure, IT competencies enable organizational agility
Tallon <i>et al.</i> (2008)	Quantitative	Technical IT capabilities	Managerial IT capabilities	Managerial IT capabilities are more important for organizational agility than technical IT capabilities in stable settings, whereas the opposite is true in volatile settings
Liu <i>et al.</i> (2013)	Quantitative	Flexible IT infrastructure	IT assimilation	Flexible IT infrastructure and IT assimilation insignificantly affect supply chain agility directly, but enhance supply chain agility by shaping absorptive capacity
Panda and Rath (2016)	Quantitative	Technical IT capability	Managerial IT capability	Both technical IT capabilities and managerial IT capabilities act as enablers for market responsive and business process agility

Table AI.

(continued)

Table AI.

References	Qualitative or quantitative	Technical IT capabilities	Managerial IT capabilities	Main findings
Cai <i>et al.</i> (2019)	Quantitative	IT objects	IT knowledge, IT operations	IT objects, IT knowledge and IT operations are three dimensions of general latent IT capabilities. In addition, the relationship between general latent IT capabilities and organizational agility is mediated by knowledge management capability

Appendix 2

Construct	Indicator	Substantive factor loading (R_1)	R_1^2	Method factor loading (R_2)	R_2^2
IT flexibility	ITF1	1.042***	1.086	-0.165	0.027
	ITF2	0.459***	0.211	0.417**	0.174
	ITF3	0.978***	0.956	-0.141	0.020
	ITF4	0.950***	0.903	-0.099	0.010
IT integration	ITI1	0.928***	0.861	0.089	0.008
	ITI2	0.949***	0.901	-0.067	0.004
	ITI3	0.870***	0.757	-0.024	0.001
IT business spanning capability	ITBS1	0.680***	0.462	0.125	0.016
	ITBS2	1.037***	1.075	-0.318***	0.101
	ITBS3	0.727***	0.529	0.145	0.021
	ITBS4	0.795***	0.632	0.034	0.001
Organizational agility	OA1	0.688***	0.473	-0.134	0.018
	OA2	0.772***	0.596	0.127	0.016
	OA3	0.980***	0.960	-0.015	0.000
Average		0.847	0.743	-0.002	0.000

Note(s): ** $p < 0.01$, *** $p < 0.001$ Table AII.
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