

The joint effects of IT resources and CEO support in IT assimilation

Evidence from large-sized enterprises

IT resources
and CEO
support in IT
assimilation

1321

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Peiran Gao

School of Management,

Huazhong University of Science and Technology, Wuhan, China

Yeming Gong

Emlyon Business School, Lyon, France

Jinlong Zhang

School of Management,

Huazhong University of Science and Technology, Wuhan, China

Hongyi Mao

School of Business Administration,

Guizhou University of Finance and Economics, Guiyang, China, and

Shan Liu

School of Management, Xi'an Jiaotong University, Xi'an, China

Abstract

Purpose – The purpose of this paper is to explore the joint effects of different types of IT resources and top management support. Especially, the authors attempt to mainly examine a negative synergy or substitution relationship between IT infrastructure resources and CEO support, and a positive synergy or complementary relationship between IT human resources and CEO support among the large-sized enterprises.

Design/methodology/approach – A research model that integrates IT infrastructure resources, IT human resources, CEO support and the degree of usage of IT for business objectives (i.e. IT business spanning capability) is developed. Based on a sample of 112 large-sized enterprises, partial least squares is used to analyze the research model.

Findings – Whereas the positive moderating role of CEO support in the effectiveness of IT human resources is insignificant, CEO support and IT infrastructure resources have a substitution relationship in predicting IT business spanning capability. Furthermore, the results can explain under which conditions IT infrastructure resources insignificantly or significantly affect IT business spanning capability in large-sized enterprises. Specially, IT infrastructure resources significantly affect IT business spanning capability only when CEO support is low. Thus, in the presence of high CEO support, IT executives in large-sized enterprises should prioritize developing highly effective IT resources, such as IT human resources.

Originality/value – This paper highlights the joint effects of two critical IT resource types (i.e. IT infrastructure and IT human resources) and CEO support in the IT assimilation process among the large-sized enterprises, ultimately contributing to information systems theories and practices.

Keywords IT human resources, IT infrastructure resources, IT assimilation, CEO support, IT business spanning capability, Large-sized enterprises

Paper type Research paper



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1. Introduction

IT assimilation generally refers to the success achieved by enterprises in effectively using IT to support business strategies, activities and goals (Armstrong and Sambamurthy, 1999). By emphasizing the embeddedness of IT applications into business processes and incorporating IT into business practices, IT assimilation enables enterprises to realize the business value of IT (Larsen and Myers, 1999; Mu *et al.*, 2015). However, an increasing number of managers of large-sized enterprises have frequently stated that they have not obtained any business value from IT since the failure rate of IT assimilation is high (Liang *et al.*, 2007). For this reason, the question of how to enhance IT assimilation among the large-sized enterprises has attracted the attention of researchers and practitioners.

Table AI shows the main studies that aim at identifying the antecedents of IT assimilation, which are categorized into three perspectives. The first is the resource perspective, arguing that IT resources positively affect IT assimilation and that effective management of IT resources contributes to IT assimilation (Ross *et al.*, 1996; Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005; Bhatt and Grover, 2005; Zhou *et al.*, 2018; Tai *et al.*, 2019). The second is the top management support perspective, stating that top management support significantly affects IT assimilation and that we can also take advantage of top management support to enhance IT assimilation (Kearns and Sabherwal, 2006; Liang *et al.*, 2007; Rai *et al.*, 2009; Shao *et al.*, 2017; Shao, 2019). The third is the combined resource and top management support perspective, highlighting that IT resources and top management support collectively affect IT assimilation (Armstrong and Sambamurthy, 1999; Wade and Hulland, 2004). However, little is known about how IT resources and top management support affect IT assimilation in large-sized enterprises.

First, although several studies have examined that the effectiveness of IT resources in the IT assimilation process (e.g. Ravichandran and Lertwongsatien, 2005), the findings on the effectiveness of IT resource types in the IT assimilation process are not fully consistent (Bhatt and Grover, 2005; Zhou *et al.*, 2018). Moreover, IT infrastructure resources in large-sized enterprises have evolved into large-scale intelligent enterprise systems due to the advent of Big Data, Internet of Things and artificial intelligent technologies (Lobaziewicz, 2018). Therefore, the way in which critical IT resources, such as IT infrastructure and IT human resources, influence IT assimilation in large-sized enterprises requires further examination.

Second, although Wade and Hulland (2004) propose that top management support positively affects the effectiveness of IT resources, this proposition has not been empirically examined. Furthermore, Mao *et al.* (2015a, 2016) have empirically proven that various IT resources are more effective with high levels of top management support, indicating positive synergy or complementary relationships between various IT resources and top management support. Limited evidence has shown that there exists a negative synergy or substitution relationship between some types of IT resources and top management support, whereas there is a positive synergy or complementary relationship between other types of IT resources and top management support. Nevertheless, such a situation is possible with regard to large-sized enterprises. For example, Red Collar Group (RCG), founded in 1995, is famous for manufacturing personalized-customized suits, coats, shirts and trousers. To improve competitive advantages, RCG restructures its business model driven by IT infrastructure resources (e.g. KuteSmart platform). Nowadays, The IT assimilation process in RCG is made possible by the decision-making rules embodied in KuteSmart platform as well as top management experience with IT practices (Hu *et al.*, 2016; Ying *et al.*, 2018). Under such circumstance, IT infrastructure resources in large-sized enterprises may substitute top management support despite other types of IT resources, such as IT human resources, still complementing top management support. The question of the joint effects of IT resources and top management support (e.g. CEO support) in the assimilation process with regard to large-sized enterprises has yet to be definitively answered.

This study attaches importance to CEO support because a CEO acts as an agent of the enterprises, responsible for directing and evaluating the performance of IT units. CEO support refers to the degree to which a CEO supports IT practices and the closeness between CEOs and IT units (Earl and Feeny, 2000; Law and Ngai, 2007; Stemberger *et al.*, 2011). Prior studies have found that CEO support is critical for IT assimilation (Earl and Feeny, 1994). For example, a CEO who regards IT as a responsibility does not improve IT assimilation, whereas a CEO who regards IT as an asset extracts value from IT and transforms his or her business successfully (Earl and Feeny, 1994). Since CEO support reflects a critical type of top management support that directs IT activities to achieve business objectives, our research focuses on CEO support and its interaction with IT resources. Therefore, we attempt to mainly address the following two research questions:

RQ1. How do IT resources affect IT assimilation in large-sized enterprises?

RQ2. How does CEO support differentially change the IT resource–IT assimilation relationship in large-sized enterprises?

Understanding these questions is necessary to practical problems because IT resources might positively affect IT assimilation in a particular large-sized enterprise context but might insignificantly affect IT assimilation in others. Finer grained knowledge about this disparity can assist the managers of large-sized enterprises in investing IT resources and IT expenditures.

2. Theoretical development

2.1 IT resources

The resource-based view (RBV) argues that resources are the key sources to achieving competitive advantages (Barney, 1991). Resources must be valuable, not easily imitated, rare and not easily substituted, and include assets, capabilities, knowledge and business processes (Wernerfelt, 1984). Grant (1991) further differentiates resources from capabilities. Resources are reservoirs composed of available factors that enterprises can easily access or control. Capabilities, by comparison, are an enterprise's abilities to use business processes and employ various resources to accomplish business objectives (Grant, 1991).

Similar to Grant (1991), most studies on information systems (IS) also distinguish resources from capabilities and confirm that IT resources are critical sources of various capabilities (Chen, 2012; Xu *et al.*, 2014; Sedera *et al.*, 2016). In this study, we chose IT infrastructure resources and IT human resources for two reasons. First, the definitions of IT resources as a socio-technical system, IT infrastructure resources as a technical subsystem and IT human resources as a social system were widely applied in prior studies (Mata *et al.*, 1995; Chen, 2012; Wang *et al.*, 2016). Second, business value from IT generally results from the combination of IT infrastructure resources and IT human resources (Melville *et al.*, 2004). While "IT infrastructure resources" refers to the extent to which an enterprise possesses sufficient platforms and databases, "IT human resources" refers to the extent to which IT employees have sufficient abilities to provide technical solutions and solve business problems. In line with prior studies (Mata *et al.*, 1995; Chen, 2012; Wang *et al.*, 2016), these two types of IT resources (i.e. IT infrastructure resources and IT human resources) are also included.

2.2 The joint effects of IT resources and CEO support in the IT assimilation process

Contingency theory argues that there is no one optimal way to design an enterprise (Flynn *et al.*, 2010) and that enterprises should match their resources and structures to their business environments to achieve the best business performance. This theory suggests that the effectiveness of IT resources is contingent on factors in the business environment, such as top management support (Chae *et al.*, 2018). In addition, this paper presents some studies that have tried to investigate constructs relevant to IT resources and top management support (Table AI).

In Table AI, Wade and Hulland (2004) contend that the effectiveness of IT resources can be moderated by top management support, which indirectly affects the IT assimilation process, but this assertion has not been empirically tested in large-sized enterprises. Therefore, this study examines how a critical type of top management support (i.e. CEO support) interacts with IT resources in the IT assimilation process with regard to large-sized enterprises.

2.3 *IT business spanning capability as a dependent variable*

The dependent variable of our research is IT business spanning capability, which refers to the extent to which an enterprise leverages IT resources to support and enhance business objectives with both inside and outside analyses (Lu and Ramamurthy, 2011; Mao *et al.*, 2015b). This capability reflects the degree of usage of IT for business objectives, which captures IT practices that aim to achieve IT assimilation. Therefore, this capability is appropriate to choose as the dependent variable.

3. **Research model and hypothesis development**

Figure 1 presents the relationships among the constructs that are investigated in this study. According to the RBV and contingency theory, IT resources influence IT business spanning capability as well as the IT resources–CEO support interaction affects IT business spanning capability. The proposed hypotheses are elaborated as follows.

3.1 *The effects of IT resources on IT business spanning capability*

Infrastructure resources provide a technological foundation for large-sized enterprises (Mao *et al.*, 2015a). The RBV argues that IT infrastructure is a strategic option that enables enterprises to exploit opportunities to better support business processes than their competitors (Bowman and Hurry, 1993). Moreover, a superior intelligent infrastructure provides enterprises with the flexibility to sustain business agility in response to environmental changes (Liu *et al.*, 2018). Thus, large-sized enterprises that possess superior IT infrastructure are likely to deliver high-quality products and services that meet business requirements. Further, superior IT infrastructure resources foster the willingness of business executives to formulate business plans with IT applications and help large-sized enterprises to enhance their levels of technical knowledge and innovate IT solutions that perform business processes (Damanpour, 1991). Thus, we present the following hypothesis:

H1. IT infrastructure resources are positively related to IT business spanning capability in large-sized enterprises.

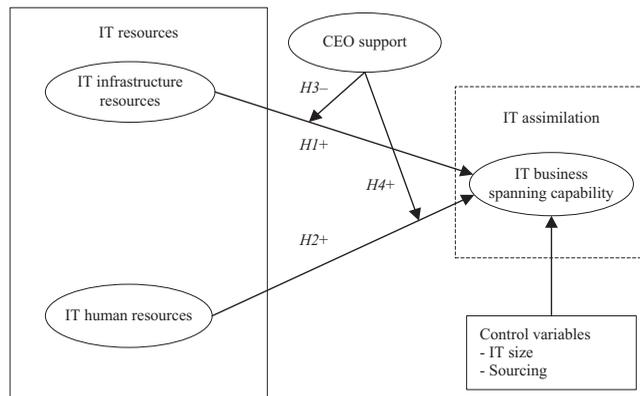


Figure 1.
Research model

IT human resources are also a key element in the IT assimilation process (Ravichandran and Lertwongsatien, 2005). To possess valuable IT human resources, IT employees not only need to have technical knowledge but also possess managerial IT skills, including business skills and firm-specific knowledge (Bharadwaj, 2000). Clark *et al.* (1997) claim that IT skills and managerial IT skills of IT employees help enterprises to effectively develop key IT systems to perform business processes. In addition, business knowledge of IT units in large-sized enterprises can enhance an ability to integrate business strategies and IT strategies. Furthermore, business knowledge of IT units has been found to positively affect the development of a shared understanding of IT practices, which directly enables the integration of IT strategies into business strategies (2009). Therefore, we propose the following hypothesis:

H2. IT human resources are positively related to IT business spanning capability in large-sized enterprises.

3.2 *The joint effects of IT resources and CEO support*

Consistent with socio-technical systems theory (Mitev, 1996), IT infrastructure resources are regarded as the technical aspect of IT, whereas IT human resources are regarded as the social aspect of IT. Because of the difference between IT infrastructure resources and IT human resources, the mechanism of how CEO support interacts with these two IT resources may also be different.

With the deepening of informationization, intelligent IT infrastructure resources (e.g. knowledge management system) have already become the critical IT platforms which are deployed by large-sized enterprises to support the business strategies. Under such circumstances, CEO support may exert a smaller impact on IT business spanning capability because IT employees can turn to these IT resources to enhance IT assimilation (Durcikova *et al.*, 2011). For instance, when IT infrastructure resources are plentiful, IT employees can turn to IT infrastructure resources (e.g. intelligent knowledge management systems) to direct IT practices, the predisposition of IT employees toward the CEO as a guide to direct IT practices becomes an alternative channel, IT employees tend to reduce reliance on the CEO, and the technical knowledge and managerial IT skills embedded in the IT infrastructure resources are more apt to make IT business synergy possible (Gregory *et al.*, 2015). Thus, we propose the following hypothesis:

H3. The IT infrastructure resources–CEO support interaction will negatively affect IT business spanning capability, indicating a negative synergy or substitution relationship in large-sized enterprises.

Hambrick and Mason (1984) find that different cognitive bases in the top management could result in different business choices. Liang *et al.* (2007) argue that the positive beliefs of CEOs about the effectiveness of IT can generate managerial decisions to direct IT human resources in order to effectively assimilate IT. In addition, Eisenberger *et al.* (1986) indicate that CEO support contributes to the perceived organizational support (POS) of IT employees, which is important for IT employees to address their psychological processes (Eisenberger *et al.*, 1997). Specifically, IT employees in large-sized enterprises who have a strong feeling of POS are more likely to feel an obligation to use IT resources to meet business objectives. The respect and care from the POS fulfill the socioemotional needs of IT employees in large-sized enterprises and increase their affective commitment, which has also been found to strengthen the effectiveness of IT human resources (Eisenberger *et al.*, 1986). Through frequent contact with CEOs, a CIO can develop

appropriate IT planning to support business objectives. Therefore, we propose the following hypothesis:

- H4. The IT human resources–CEO support interaction will positively affect IT business spanning capability, indicating a positive synergy or complementary relationship in large-sized enterprises.

3.3 Control variables

Our research model includes two control variables: IT size and sourcing. IT size is the ratio of full-time employees in the IT unit to full-time employees in the whole intelligent enterprise. Sourcing is a binary variable for which 1 represents outsourced IT services and 0 represents IT services performed in-house. Given that IT size and sourcing have been proposed to influence the business value extracted by IT (Lu and Ramamurthy, 2011; Liu and Wang, 2014), it is necessary to add IT size and sourcing as control variables.

4. Research method

4.1 Data collection

The survey was conducted among a sample of 112 large-sized enterprises from different industries. To guarantee the validity of the sample, this study considered the major three factors when selecting the enterprises from a contact list that included the InformationWeek 500 in 2013, the Red Herring Europe 2012 Top 100, the Asia Global 500 and the Top 500 Informatization Companies. First, the small and medium enterprises were not considered. Second, we communicated with executives of the selected enterprises and checked their websites to make sure that IT infrastructure resources in the selected enterprises had remarkably evolved into large-scale intelligent enterprise systems. Second, the selected enterprises relied heavily on intelligent enterprise systems to enable their business operations.

We contacted the IT executives of these large-sized enterprises. Then, we sent 220 questionnaires to the enterprises that agreed to answer the questions. Specifically, the IS executive was asked to answer the questions related to the IT practices of their enterprises (e.g. IT resources, CEO support and IT business spanning capability). With a response rate of 50.9 percent, we received 112 usable questionnaires from these large-sized enterprises. The IT executives had worked for their respective organizations for an average of 11.0 years. The demographics of the sample are listed in Table I.

Then, we used the Liang *et al.* (2007) method to evaluate common method biases in our research by creating a partial least squares (PLS) model. Our results showed that the principal variable loadings were all significant at the 0.001 level, whereas each loading of the common method factor was insignificant (Table AII). Therefore, we concluded that common method biases did not threaten our quantitative data.

4.2 Measures

The questionnaire was pretested by 22 enterprises in China and France. The average age of these enterprises is 46.8 year and the average number of the full-time employees in the whole enterprises is 77,371. IT executives/managers of these enterprises were required to examine the questionnaire for clarity and meaningfulness. Our questionnaire used at least three measurement items for each construct. The measurement items for each construct were presented in Appendix 3. IT infrastructure resources was measured by the three-item scale adapted from Ross *et al.* (1996) and Lu and Ramamurthy (2011), IT human resources was measured by the three-item scale adapted from Ross *et al.* (1996) and Bhatt and Grover (2005), CEO support was measured by the three-item scale adapted from

Characteristic	Range	Frequency	Percentage
Industry sector	Automotive	11	9.82
	Banking and financial services	8	7.14
	Biotechnology and pharmaceuticals	9	8.04
	Consumer goods	12	10.71
	Electronics	7	6.25
	Information technology	10	8.93
	Manufacturing	12	10.71
	Retail	11	9.82
	Telecommunications	8	7.14
	Logistics and transportation	6	5.36
	Energy and utilities	5	4.46
	Others	13	11.61
Total		112	100
Enterprise age	≤20	19	16.96
	21–40	37	33.04
	41–60	13	11.61
	61–100	22	19.64
	101–120	12	10.71
	> 120	9	8.04
Total		112	100
Enterprise size (number of employees)	≤10,000	21	18.75
	10,001–50,000	44	39.29
	50,001–100,000	20	17.86
	100,001–200,000	17	15.18
	> 200,000	10	8.93
	Total		112

Table I.
Demographics
of the sample

Earl and Feeny (2000), Law and Ngai (2007) and Kearns (2006), and IT business spanning capability was measured by the three-item scale adapted from Lu and Ramamurthy (2011). We employed a seven-point Likert-style scale to measure the items, with the scale ranging from 1 (strongly disagree) to 7 (strongly agree).

5. Analysis results

5.1 Measurement model

This study used the PLS method for the analysis, since the PLS method not only maximizes the variance found in the dependent variable (Fornell and Bookstein, 1982) but also requires only a relatively small sample size (Hair *et al.*, 2011). We selected SmartPLS 2.0 for the data analysis and model validation. All the constructs in our measurement model were reflective (Petter *et al.*, 2007).

We first checked the convergent validity of all the constructs (Jarvis *et al.*, 2003). Table II presents the item-to-construct loading. The minimal cross-loading of all items was 0.765. The principal loadings of each construct were 0.1 higher than the other loadings (Gefen and Straub, 2005). Below that, Table III shows the average variance extracted (AVE), Cronbach's α and the composite reliability of each construct, as well as construct correlations. Cronbach's α and the composite reliability of each construct were higher than 0.7 (Peng and Lai, 2012), and the AVE was above 0.5 (Fornell and Larcker, 1981). The discriminant validity was evaluated by examining whether the square root of each AVE was higher than the variable correlations. As Table III indicates, the conditions for this validity were satisfied. Thus, the results provide strong evidence for measurement validity.

IMDS 119,6		CEO support (CS)	IT infrastructure Resources (ITIR)	IT human resources (ITHR)	IT business spanning capability (IBSC)
1328	CS1	<i>0.864</i>	0.333	0.401	0.301
	CS2	<i>0.914</i>	0.378	0.478	0.309
	CS3	<i>0.802</i>	0.330	0.357	0.273
	ITIR1	0.305	<i>0.832</i>	0.645	0.294
	ITIR2	0.412	<i>0.821</i>	0.574	0.400
	ITIR3	0.279	<i>0.839</i>	0.678	0.400
	ITHR1	0.402	0.582	<i>0.820</i>	0.381
	ITHR2	0.454	0.639	<i>0.854</i>	0.408
	ITHR3	0.306	0.641	<i>0.765</i>	0.334
	IBSC1	0.320	0.388	0.411	<i>0.817</i>
	IBSC2	0.326	0.362	0.424	<i>0.836</i>
	IBSC3	0.230	0.425	0.356	<i>0.806</i>
	IBSC4	0.220	0.256	0.286	<i>0.800</i>

Table II.
The item-to-construct loadings

	Mean (SD)	AVE	CR	Cronbach's α	CS	ITIR	ITHR	IBSC
CEO support (CS)	5.595 (0.989)	0.741	0.895	0.824	<i>0.861</i>			
IT infrastructure resources (ITIR)	5.446 (0.895)	0.690	0.870	0.777	0.403	<i>0.830</i>		
IT human resources (ITHR)	5.298 (0.945)	0.663	0.855	0.745	0.481	0.760	<i>0.814</i>	
IT business spanning capability (IBSC)	5.326 (0.940)	0.664	0.888	0.833	0.343	0.448	0.462	<i>0.815</i>

Table III.
Descriptive statistics

Notes: The square root of the AVE shown on the diagonal of the matrix is italicized. The construct correlation is shown off the diagonal

5.2 Hypotheses testing

In our study, using the procedure recommended by Sharma *et al.* (1981), we employed SmartPLS 2.0 to perform a hierarchical regression analysis. Table IV summarizes the results of the analysis. As shown in Table IV, the effects of IS size and sourcing on IT business

	Model 1	Model 2	Model 3	Model 4
<i>Control variables</i>				
IT size	0.140	0.077	0.071	0.028
Sourcing	0.092	0.076	0.062	0.081
<i>Independent variables</i>				
ITIR		<i>0.224*</i>	<i>0.210*</i>	0.142
ITHR		<i>0.285*</i>	<i>0.230*</i>	<i>0.274*</i>
CS			0.138	0.065
<i>Interaction terms</i>				
ITIR \times CS				-0.351**
ITHR \times CS				0.127
ΔR^2 (IBSC)		0.223	0.014	0.061
f^2 (effect size)		0.295	0.019	0.090
R^2 (IBSC)	0.021	0.244	0.258	0.311
F hierarchical		<i>31.857</i>	2.019	<i>9.405</i>

Table IV.
Results of hierarchical analysis

Notes: The sample size is 112. All path coefficients are standardized. * $p < 0.05$; ** $p < 0.01$, one-tailed tests

spanning capability are assessed in Model 1. *H1* and *H2* are assessed in Model 2. *H3* and *H4* are evaluated in Models 3 and 4.

In Model 1, all control variables insignificantly influence IT business spanning capability. This result indicates that both IT size and sourcing insignificantly impact IT business spanning capability, implying that large-sized enterprises with a large IS size do not necessarily have a high level of IT assimilation. Moreover, large-sized enterprises with outsourced IT services or IT services performed in-house exhibit similar levels of IT assimilation. In Model 2, IT infrastructure and human resources explain a significant amount of variance in IT business spanning capability, and the influence of these two types of IT resources on IT business spanning capability was significantly positive ($\beta = 0.224, p < 0.05$; $\beta = 0.285, p < 0.05$). Therefore, *H1* and *H2* were supported. Models 3 and 4 tested the joint effects of different types of IT resources and CEO support. The interaction term between IT infrastructure resources and CEO support ($\beta = -0.351, p < 0.01$) was significantly negative, whereas the interaction term between IT human resources and CEO support ($\beta = 0.127, p > 0.05$) was insignificantly positive. Further, following the procedure used by Titah and Barki (2009), the effects of IT infrastructure resources on IT business spanning capability are reduced and even insignificant when the level of CEO support is increased (Table V), similarly, the effects of CEO support on IT business spanning capability decrease when the level of IT infrastructure increases (Table VI). As a result, *H3* was supported, and *H4* was not supported.

CEO support	Different levels of CEO support		
	Coef. IT infrastructure resources	SE	t-Value
7	-0.322	0.281	-1.142
6	0.020	0.148	0.138
5.595	0.159	0.114	1.395
5	0.362	0.121	2.989
4	0.704	0.240	2.939
3	1.046	0.388	2.700
2	1.388	0.541	2.565
1	1.730	0.697	2.483

Notes: Levels of CEO support: 1 = lowest level of CEO support, 7 = highest levels of CEO support; coef. IT infrastructure resources = 0.151–0.320 CEO support (mean-centered); SE (standard error of coef. IT infrastructure resources) = $\sqrt{\text{Var}(\beta_{\text{IT infrastructure resources}}) + \text{CEO support}^2 \times \text{Var}(\beta_{\text{CEO support} \times \text{IT infrastructure resources}}) + 2 \text{CEO support} \times \text{COV}(\beta_{\text{IT infrastructure resources}}, \beta_{\text{CEO support} \times \text{IT infrastructure resources}})}$

Table V.
The relationship between IT infrastructure resources and IT business spanning capability at different levels of CEO support in large-sized enterprises

IT infrastructure resources	Different levels of IT infrastructure resources		
	Coef. CEO support	SE	t-Value
7	-0.465	0.295	-1.579
6	-0.123	0.156	-0.793
5.446	0.066	0.105	0.629
5	0.219	0.107	2.037
4	0.561	0.221	2.537
3	0.903	0.369	2.446
2	1.245	0.523	2.380
1	1.587	0.679	2.337

Notes: Levels of IT infrastructure resources: 1 = lowest level of IT infrastructure resources, 7 = highest levels of IT infrastructure resources; coef. CEO support = 0.066–0.342 IT infrastructure resources (mean-centered); SE (standard error of coef. CEO support) = $\sqrt{\text{Var}(\beta_{\text{CEO support}}) + \text{IT infrastructure resources}^2 \times \text{Var}(\beta_{\text{CEO support} \times \text{IT infrastructure resources}}) + 2 \text{IT infrastructure resources} \times \text{COV}(\beta_{\text{CEO support}}, \beta_{\text{CEO support} \times \text{IT infrastructure resources}})}$

Table VI.
The relationship between CEO support and IT business spanning capability at different levels of IT infrastructure resources in large-sized enterprises

6. Discussion

6.1 Implications for research

Our research presents several theoretical insights by showing how IT resources interact with top management support in the IT assimilation process in large-sized enterprises. At least four theoretical implications of our research are presented below. First, our research provides new knowledge about IT resources by exploring the effectiveness of various IT resource types in the IT assimilation process in large-sized enterprises. We demonstrate that both IT infrastructure and human resources positively influence IT business spanning capability. Thus, IT assimilation in large-sized enterprises also requires both technical (e.g. IT infrastructure resources) and social (e.g. IT human resources) elements of IT resources. Our findings are consistent with the general opinion that the effectiveness of various IT resource types is significantly positive (Bharadwaj, 2000; Tai *et al.*, 2019).

Second, this study presents a combined perspective that integrates top management support with IT resources for IS researchers. Our findings contradict the general opinion that top management support interacts with IT resources to positively affect the IT business value (Wade and Hulland, 2004; Mao *et al.*, 2016). On the one hand, the IT infrastructure resources–CEO support interaction negatively affects IT business spanning capability. Due to the advent of Big Data, Internet of Things and artificial intelligent technologies, intelligent IT infrastructure resources predominate in large-sized enterprises (Lobaziewicz, 2018). Under such circumstance, IT practices can be under the guidance of IT infrastructure resources (e.g. intelligent knowledge management systems) besides the guidance of top management (Durcikova *et al.*, 2011). This result indicates that IT infrastructure resources can substitute the effect of CEO support, but not complement the effect of CEO support in large-sized enterprises. On the other hand, although CEO support can play a positive moderating role in the effectiveness of IT human resources, this contingent role is insignificant. This outcome may have various explanations. Owing to intelligent IT systems, large-sized enterprises operate as a well-functioning organism and clarify problem-solving methods, goal-achieving methods and external as well as internal communication. By this, IT employees are able to skillfully implement business objectives, thus reducing reliance on guidance from CEOs (Piotr, 2016). Other explanation is that CIOs, who are responsible for IT initiatives, might have the strongest predictive power in IT assimilation, not CEOs (Hambrick, 1995). Generally speaking, our findings indicate that CEO support does not influence IT assimilation directly but instead affects IT assimilation by interacting with the strategies of how IT resources are employed. Therefore, IT executives cannot ignore the role of CEO support and should combine CEO support with various IT resources to enhance IT assimilation in large-sized enterprises.

Third, our findings can explain under which conditions IT infrastructure resources insignificantly or significantly affect IT business spanning capability in large-sized enterprises. Previous studies indicate that the findings on the effectiveness of IT infrastructure resources in the IT assimilation process are not fully consistent (Bhatt and Grover, 2005; Zhou *et al.*, 2018). For example, some researchers claim that IT infrastructure can facilitate IT assimilation, a finding that appears to be intuitively appealing (Zhou *et al.*, 2018). Other researchers, however, argue that the effects of IT infrastructure are insignificant (Bhatt and Grover, 2005). Our results show that IT infrastructure resources significantly affect IT business spanning capability when CEO support is low. Conversely, IT infrastructure resources insignificantly affect IT business spanning capability when CEO support is high (Table V). This evidence reveals that these inconsistent observations may result from different levels of CEO support.

Fourth, the results of our research show that different types of IT resources exert various effects in the presence of high levels of CEO support in large-sized enterprises. In particular, whereas IT human resources still exert a significantly positive effect on IT business

spanning capability in the presence of high levels of CEO support, the influence of IT infrastructure resources on IT business spanning capability is insignificant when high levels of CEO support are present (Table V). Therefore, IT executives should take advantage of critical top management support (e.g. CEO support) because such support is also a type of IT-related resource that substitutes the effects of IT infrastructure resources in large-sized enterprises.

6.2 Implications for practices

Our research also has implications for business practice in large-sized enterprises. First, given that both IT infrastructure and human resources positively affect IT business spanning capability, IT executives should develop appropriate IT strategies to leverage these IT resources. On the one hand, enterprises should invest in a technical foundation to enhance IT assimilation. On the other hand, enterprises should also establish an education training system to ensure that IT employees possess adequate knowledge to achieve business objectives.

Second, IT executives should understand that the role of CEO support might be more complicated than they anticipate in large-sized enterprises. It is beneficial for managers to realize that IT infrastructure resources and CEO support have a substitution relationship and to learn how to take advantage of CEO support in the IT assimilation process. If the technical foundation is weak, CEOs can use their prior experience and knowledge to provide detailed guidelines on the procedures of IT projects. They can also meet with IT employees to explore problems related to IT development and form a clear picture of how large-sized enterprises can extract business value from IT.

Finally, IT executives should also be aware of how to employ various types of IT resources efficiently and effectively in the presence of high levels of CEO support. Our results reveal that IT human resources positively and significantly affect IT business spanning capability, whereas the positive effects of IT infrastructure resources on IT business spanning capability are low with high levels of CEO support. Thus, IT executives in large-sized enterprises should prioritize developing IT human resources if CEO support is high. When high levels of CEO support are present, they should avoid spending too much time on managing resources related to IT infrastructure.

6.3 Limitations and future research directions

Our research has several limitations that provide a few directions for future research. First, similar to other relevant IS studies (e.g. Liu and Wang, 2014; Liu *et al.*, 2017; Liu *et al.*, 2019), the results of our research based on a small sample size since obtaining a large sample size at the large-sized enterprise level is difficult. Future research can collect data in additional large-sized enterprises to enhance the generalizability of our results. Second, we use single respondents in the sample, which may raise the issues about common method bias. The employment of a matched-pair survey wherein more than one respondent answer questions related to variables will prevent common method bias significantly. Moreover, instead of subjective scales, future research can also use objective scales to measure IT assimilation, which may reduce the impact of a single-respondent sample greatly. Third, IT assimilation is developed after a long-term process; therefore, it is desirable to design a longitudinal study further to examine the relationships between these constructs.

7. Conclusion

Our research contributes to IS studies by investigating the joint effects of IT resources and CEO support in the IT assimilation process. We found that both IT infrastructure resources and IT human resources positively affect IT business spanning capability. This result

implies that these two types of IT resources can be used to enhance IT assimilation in large-sized enterprises. Moreover, we find a negative synergy or substitution relationship between IT infrastructure resources and CEO support, which underscore the great importance of considering the nonlinear relationship between these key constructs. Our results reveal that CEO support does not directly influence IT assimilation but interact with IT resources to influence IT business spanning capability. The influence of IT infrastructure resources on IT business spanning capability decreases significantly and even becomes insignificant in the presence of high levels of CEO support, whereas the effectiveness of IT human resources remains significantly positive with high levels of CEO support. This result also implies that IT infrastructure resources may exert a significantly positive effect on IT business spanning capability only under low levels of CEO support, thereby explaining prior inconsistent findings on the effectiveness of IT infrastructure. In the IT assimilation process, IT executives in large-sized enterprises should carefully select appropriate types of IT resources, and highly effective IT resource types, such as IT human resources, should be employed in the presence of high levels of CEO support.

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Further reading

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Perspectives	Studies	IT resources	Top management support
The resource perspective	Ross <i>et al.</i> (1996)	IT assets	n/a
	Bharadwaj (2000)	IT-enabled intangibles, human IT resources and IT infrastructure	n/a
	Ravichandran and Lertwongsatien (2005)	IS partnership quality, IT infrastructure flexibility and IS human capital	n/a
	Bhatt and Grover (2005)	IT infrastructure quality, IT business expertise, IT relationship infrastructure	n/a
	Zhou <i>et al.</i> (2018)	IT knowledge of business people, business knowledge of IT professionals	n/a
	Tai <i>et al.</i> (2019)	Flexible technology assets, acquiring technology skills, understanding business situations, interacting with users	n/a
	The top management support perspective	Kearns and Sabherwal (2006)	n/a
Liang <i>et al.</i> (2007)		n/a	Top management support
Rai <i>et al.</i> (2009)		n/a	Top management support
Shao <i>et al.</i> (2017)		n/a	Transactional leadership, transformational leadership
Shao (2019)		n/a	Idealized influence, inspirational motivation
The combined resource and top management support perspective	Armstrong and Sambamurthy (1999)	systems of knowing, IT infrastructure sophistication	Senior leadership knowledge
	Wade and Hulland (2004)	IT resources	Top management commitment

Table A1.
Selected studies on the effectiveness of IT resources and top management support in the IT assimilation process

Appendix 2

IT resources
and CEO
support in IT
assimilation

Construct	Indicator	Substantive factor loading		Method factor loading	
		(R_1)	R_1^2	(R_2)	R_2^2
CEO support	CS1	0.867***	0.752	-0.008	0.000
	CS2	0.893***	0.797	0.030	0.001
	CS3	0.821***	0.674	-0.026	0.001
IT infrastructure resource	ITIR1	0.987***	0.974	-0.142	0.020
	ITIR2	0.683***	0.466	0.140	0.020
	ITIR3	0.819***	0.671	0.010	0.000
IT human resource	ITHR1	0.845***	0.714	-0.034	0.001
	ITHR2	0.767***	0.588	0.092	0.008
	ITHR3	0.836***	0.699	-0.066	0.004
IT business spanning capability	IBSC1	0.688***	0.473	0.130	0.017
	IBSC2	0.772***	0.596	0.086	0.007
	IBSC3	0.980***	0.960	-0.262**	0.069
	IBSC4	0.786***	0.618	0.033	0.001
Average		0.826	0.691	-0.001	0.012

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

1337

Table AII.
Common method
bias analysis

Appendix 3. Construct measurement

IT infrastructure resources (ITIR)

- ITIR1: The data-management services and architectures in my organization are sufficient.
- ITIR2: The quality of IT applications and services meets the organization's needs.
- ITIR3: IT management services can coordinate the physical infrastructure and manage the relationship with business units effectively and efficiently.

IT human resources (ITHR)

- ITHR1: IT employees are knowledgeable in business strategies.
- ITHR2: IT staff in my organization are able to rapidly develop IT solutions to solve business problems.
- ITHR3: My organization has an adequate IT skill base.

CEO support (CS)

- CS1: Our CEO looks to IT for ways of doing business.
- CS2: Our CEO is very supportive of IT projects.
- CS3: Our CEO works closely with our CIO/IT manager.

IT business spanning capability (IBSC)

- IBSC1: My organization clearly understands how IT contributes to competitive advantages.
- IBSC2: My organization integrates strategic business planning into IT planning.
- IBSC3: My organization has designed an effective and flexible IT planning process.
- IBSC4: My organization ensures the consistency of IT application portfolios with business processes.

About the authors

Peiran Gao is Postdoctoral Researcher at the School of Management, Huazhong University of Science and Technology. His research interests include organizational impact of information technology. Peiran Gao is the corresponding author and can be contacted at: gaopeiran@hust.edu.cn

Yeming Gong is Professor in Emlyon Business School. His research interests include IT-enabled operations strategy and sustainable operations strategy. He has published articles in journals like *Production and Operations Management*, *IIE Transaction*, *European Journal of Operational Research*, *International Journal of Production Economics*, *International Journal of Production Research* and *Logistics Research*.

Jinlong Zhang is Professor at the School of Management, Huazhong University of Science and Technology. His research interests include the management of information systems and mobile commerce. He has published articles in journals like *Information Systems Journal*, *International Journal of Information Management*, *International Journal of Project Management*, *International Journal of Mobile Communications*, *Information Development*, *Social Science Information*, *Expert Systems with Applications*, *Knowledge-Based Systems*, *International Journal of Approximate Reasoning* and *Discrete Dynamics in Nature and Society*.

Hongyi Mao is Associate Professor at the School of Business Administration, Guizhou University of Finance and Economics. His research interests include IT capabilities, organizational impact of IT and IT-enabled operations strategy. He has publications in *International Conference on Information Systems*, *Hawaii International Conference on System Science*, *Information Development* and *International Journal of Information Management*.

Shan Liu is Professor at the School of Management, Xi'an Jiaotong University. His research interests focus on IT project management and mobile commerce. He has published articles in *Journal of Operations Management*, *Information Systems Journal*, *European Journal of Information Systems*, *International Journal of Project Management*, *Management Decision*, *International Journal of Medical Informatics* and *International Journal of Information Management*.