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Abstract

Purpose – The purpose of this paper is to examine the impact of chief information officer's (CIO's) strategic knowledge and structural power on enterprise systems (ES) success in the context of systems usage.

Design/methodology/approach – Drawing upon knowledge-based view, this study links CIO's strategic knowledge, structural power, ES assimilation and firm performance in an integral model. Sample data were collected in China and partial least squares technique was used to test the model.

Findings – Empirical results suggest that CIO's strategic information technology (IT) knowledge, strategic business knowledge and structural power have significant influence on ES assimilation. While ES assimilation mediates the association between CIO's strategic knowledge, CIO's structural power and firm performance. Another interesting finding in the study is that the imbalance of CIO's strategic business knowledge and strategic IT knowledge is negatively associated with ES assimilation.

Originality/value – This study enriches the extant literatures in IS leadership by showing the significant role of CIO's knowledge balance and authority in promoting the assimilation of ES within the organization. The empirical findings can provide guidelines for the top executive to select a person who is familiar with both strategic business and IT knowledge to take charge of ES, also, to provide the person with appropriate structural power, in order to achieve the benefits of ES successfully.

Keywords CIO, Enterprise systems assimilation, Strategic business knowledge, Strategic IT knowledge, Structural power

Paper type Research paper

1. Introduction

Enterprise systems (ES) are defined as commercial software that enable the integration of transactions-oriented data and business processes throughout an organization (Markus and Tanis, 2000). As integration software, ES represent a complete or near-complete re-architecting of an organization's portfolio of transactions-processing applications and business processes to achieve the integration of business processes, information systems and information-along with corresponding changes in the supporting computing platform and value chain activities, and promised a seamless integration of all information flowing through an organization (Davenport, 1998; Markus and Tanis, 2000).

With the uncertainty of market environment and variety of customer requirements, more and more organizations choose to implement ES such as enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM) to improve competitive advantage and firm performance, the number of ES implementations has been growing at a significant rate worldwide in the last three decades. In developing countries such as China, the government has launched the policy of using information technology (IT) technologies to speed up

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industrialization, and more and more firms have used ES in support of business process (Shao *et al.*, 2012). However, the complexity of ES imposes great challenges on the adopting organizations. Although a large amount of firms' annual revenues is spent on ES, a significant proportion of ES projects do not succeed (Hendricks *et al.*, 2007; Kanaracus, 2010), and the failure rate of ES projects is especially high in China (Zhu *et al.*, 2010).

In order to manage environment uncertainties and increase the success rate of ES, large amounts of research have attempted to identify the critical success factors. Drawing upon the extant literature, factors that influence ES success can be classified into three categories: human/organizational factors, technical factors and economic factors (Sarker and Lee, 2003). Resource-based view (RBV) indicates that the technology resources such as IT software and hardware are the easiest resources for competitors to copy, so they represent the most fragile source of sustainable competitive advantage for a firm. While the human resources are not easy to imitate, and this kind of resources are often critical drivers of business success (Wade and Hulland, 2004).

As one of the most important human resources, IT leader has the responsibility to strategically leverage the full potential of IT as well as to overcome resistance to change. Since the mid-1980s this individual has typically been titled chief information officer (CIO). With business dependence on ES – both operationally and strategically – has grown, CIO has increasingly been considered as the highest ranking executives in charge of their firms' IT management practices, and the knowledge possessed by this person is consistently considered as the most important factor affecting ES success (Gottschalk, 2002; Chun and Mooney, 2009; Ding *et al.*, 2014).

By a thorough analysis of the extant literature, we found that although studies have called for a great attention on improving CIO's role within the firm, most of extant literatures are merely descriptive in nature, and few studies have empirically examined the specific effect of CIO' strategic and business knowledge on ES success, especially in the Chinese context. When studying the state and impact of CIOs in China, it was found that most organizations have not created a professional position of CIOs, and CIOs were in fact operating at the departmental director level, thus some CIOs were unable to bring about strategic applications of IT, to show cross-functional leadership, and to manage consolidation of IT to satisfy business requirements (Zuo and Mao, 2005).

Given the significant role that CIO plays within the organization, we argue that a theory-driven empirical study needs to be done to enrich the extant literatures in IS leadership and ES success in the Chinese context. In this study, we aim to examine the impact of CIO's strategic knowledge and structural power on ES success from a knowledge-based view (KBV). Specifically, we integrate ES assimilation as a mediator in the theoretical model since the firm can derive benefits only after the organization has applied the system effectively (Liang *et al.*, 2007; Ke and Wei, 2008; Liu *et al.*, 2011).

The structure of the paper is organized as follows. We first provide a review of the theoretical foundations surrounding the main topics of CIO's strategic knowledge, structural power and ES assimilation. This leads to an illustration of the research framework, followed by the development of the hypotheses employed in this research. The research method section describes and explains the research approach pursued by this study, followed by the discussions of the empirical findings and implications. Finally we provide conclusions and future research directions.

2. Literature review

2.1 KBV

KBV has emerged within strategic management literature. Building upon the RBV, the KBV considers knowledge as the most strategically significant resource of the firm. Researchers argue that knowledge-based resources are usually difficult to imitate and socially complex, thus heterogeneous knowledge bases and capabilities among firms are the major determinants of sustained competitive advantage and superior corporate performance (Spender, 1996; Grant, 1996). Drawing from KBV, firms are an economic structure for integrating the knowledge of different individuals in the superior production of value-added products and services (Conner and Prahalad, 1996; Schultze and Leidner, 2002). To date, KBV has extended beyond the traditional concerns of strategic management and has been applied to many fields to addresses some fundamental concerns of the firm, notably the nature of coordination within the firm, the role of management and allocation of decision-making rights, and the knowledge integration within the top management team (TMT) (Loeser *et al.*, 2013; Blome *et al.*, 2014).

Drawing upon KBV, the TMT can be viewed as an organizational structure for integrating members' knowledge, and their ability to recognize valuable business and IT information, develop and apply the learning in guiding the IT innovation activities in their firm is important for IT assimilation (Armstrong and Sambamurthy, 1999; Shao *et al.*, 2010). As a member of the TMT, the CIO has been identified as a strategic visionary in charge of firms' IT deployment and utilization, and this person has the responsibility to align IT with organizational process, strategy and business requirements (Smaltz *et al.*, 2006; Chun and Mooney, 2009; Li and Tan, 2013). On the one hand, the CIO needs to possess both strategic IT and strategic business knowledge, so as to facilitate systems routines into daily business process and work activities. On the other hand, the CIO also needs to hold a strategic position within the firm to form the "dominant coalition" that makes the strategic choices for the organization (Preston *et al.*, 2008), in order to combine the two forms of knowledge together, and facilitate systems routinized into daily business process and work activities (Armstrong and Sambamurthy, 1999; Kearns and Sabherwal, 2007).

2.2 Structural power

The power and authority literature argues that an executive's power base is an important antecedent to his/her authority within the organization. Power refers to the capacity of a leader to exert his/her will, and is considered as a fundamental enabler for top managers to gain the authority, to make strategic decisions for the organization and to manage uncertainty by monitoring and controlling the behaviors of their subordinates (Finkelstein, 1992; Yukl, 2002).

Finkelstein (1992) outlines four dimensions of an executive's power base, within which structural power is the most commonly cited type of power. Structural power is based on formal organizational structure and hierarchical authority, and is strongly associated with executives' overall power level (Daily and Johnson, 1997). Hambrick and Mason (1984) posited that the TMT members hold the most strategic positions in the firm, which form the "dominant coalition" that makes the strategic choices for the organization. The greater structural power a TMT member possesses, the less he/she depends on other members of the dominant coalition when making strategic decisions (Preston *et al.*, 2008; Menz, 2012). For example, CEOs have high structural power over other members of dominant coalitions because of their formal organizational position.

As the executive in charge of ES, the structural power of the CIO is especially essential for him/her to contribute his/her skills and abilities to the organization, and the CIO remains a peripheral player without such structural power (Cappelli and Neumark, 2004; Kaarst-Brown, 2005; Chun and Mooney, 2009). Thus in this study, we add CIO's structural power as a significant antecedent in the research model to examine its impact on ES success.

2.3 ES assimilation

In the current business environment, ES are viewed to be an organization's most strategic platform. However, ES implementation is usually associated with spiraling costs, not only in monetary terms, but also account for the host organization's time, people and processes to adapt and assimilate their functionalities and capabilities (Ross and Vitale, 2000; Hendricks *et al.*, 2007).

While there is a rich body of literature on ES adoption and implementation, research on ES assimilation is scant. Most of the earlier research has judged ES success according to its earlier implementation activities, such as timeliness, costs vs benefits aspects. However, this has led to ignoring the entire ES "software lifecycle," which is viewed to be a continuous improvement process, consisting of ES adoption, implementation as well as assimilation (Liang *et al.*, 2007; Shao *et al.*, 2012). Earlier research on business values of systems applications indicated that value cannot be fully realized until the applications are extensively assimilated in an organization; therefore, ES success necessitate an understanding of systems assimilation (Purvis *et al.*, 2001; Gattiker and Goodhue, 2005; Shao *et al.*, 2015).

Drawing on a process view, ES assimilation is conceptualized as "the extent to which the use of technology diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes" (Purvis *et al.*, 2001), and the core of ES assimilation is to effectively apply systems in shaping and enabling firms' business strategies and activities, thus to realize business performance increase (Bajwa *et al.*, 2004). In this study, we adopt the definition of ES assimilation by Purvis *et al.* (2001) to develop the research model.

3. Research model and hypotheses

Drawing from KBV, we argue that as a top executive and a strategic visionary in the organization, the CIO needs to possess both strategic business and strategic IT knowledge to deploy ES in alignment with business process. Further, the structural power of the CIO is particularly important for him/her to create discretion when working with other top executives, and develop mutual understanding on IT investment and deployment issues, thus to achieve agreement within the TMT on strategic IT decisions in support of business strategy.

We propose a research model and five hypotheses to clearly articulate the relationship between CIO's strategic knowledge, structural power, ES assimilation and firm performance. In order to control other factors that have potential impact on endogenous variables, we add employee number, ES investment and systems use time as control variables in the structural model to account for the variation among organization size and experiences in using ES, as described in Figure 1. Employee number represents organization size, ES investment represents organizational financial investments in deploying and implementing ES, while ES use time represents organizational experience in using systems. We select these particular variables

because of their potential impact on ES success as suggested within the extant literature (Chatterjee *et al.*, 2002; Liang *et al.*, 2007; Shao *et al.*, 2010).

CIO's strategic IT knowledge comprises knowledge of organizational IT architecture and infrastructure, competitors' strategic IT actions, as well as the emerging information technologies to support and improve organization's business. As the top executive in charge of ES, a CIO should be familiar with the potential and limitations of an organization's IT infrastructure, strategic IT actions of its competitors and the potential of emerging information technologies for an organization's business, thus he/she can make quick decision about systems upgrade based on evaluation of internal business requirements and external environments variety (Armstrong and Sambamurthy, 1999; Shao *et al.*, 2010).

CIOs with higher strategic IT knowledge can better advise TMTs about IT issues, such as appropriate technologies to invest in, the timing of those investment choices and the level of investments (Smaltz *et al.*, 2006; Chun and Mooney, 2009), and their ability to envision likely business impacts of current and emerging ITs is instrumental to facilitate the routinization of ES, which is beneficial to foster the assimilation of systems functionalities within the organization. Thus we propose the following hypothesis:

H1. CIO's strategic IT knowledge is positively associated with ES assimilation.

CIO's strategic business knowledge comprises knowledge of business strategies, organizational work processes and structure, firm's market products and services, industry recipes for success and competitor strategic business actions. As ES assimilation is a continuous improvement process, the potential business value of systems applications cannot be fully realized until they are extensively incorporated within the daily activities of a firm (Purvis *et al.*, 2001; Liang *et al.*, 2007). As the highest leader in charge of firm's IT deployment and utilization, the CIO has the responsibility to strategically leverage the full potential of systems functionalities in support of organizational business strategy and operational processes. Extant literatures argue that an enhanced level of business-related knowledge distinguishes an IS executive from an IS functional manager (Stephens *et al.*, 1992; Chun and Mooney, 2009).

In order to bridge the gap between ES and the strategic business objectives of the firm, the CIO not only needs to be familiar with IT strategic knowledge, but also be familiar with organizational business strategies and organizational work processes, industry recipes for success and competitor potential actions, thus to make an effective deployment of systems functionalities in support of business strategy. Since high level of strategic business knowledge increase the prospects for the "push-pull" dynamics necessary for ES assimilation, a CIO must possess "a broad business perspective" and be knowledgeable in organizational strategy and business process, thus to foster the

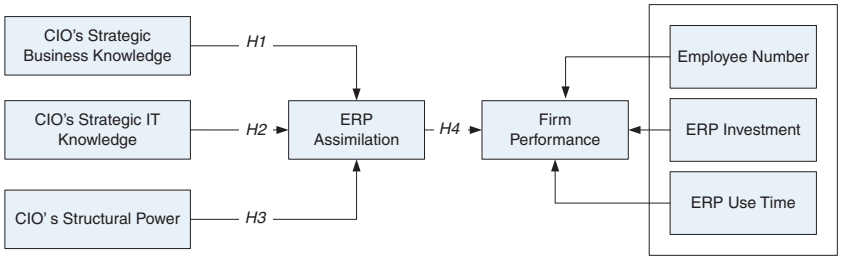


Figure 1.
The research model

assimilation of systems functionalities and actualize the improvement of business performance (Applegate and Elam, 1992; Armstrong and Sambamurthy, 1999; Shao *et al.*, 2010). This leads to the following hypothesis:

H2. CIO's strategic business knowledge is positively associated with ES assimilation.

Drawing from power and politics literature, an executive's power base is an important antecedent to his/her authority and a fundamental enabler for the executive to gain the authority and make strategic decisions for the organization (Finkelstein, 1992; Yukl, 2002; Preston *et al.*, 2008). Structural power is one of the most important dimensions of power base that provides a legitimate basis for the executive to influence the corporation (Ocasio, 1994).

As the highest ranking executives in charge of IT, the CIO is expected to have a greater latitude in making strategic IT decisions when the organization officially legitimizes his/her level of power within the organization (Preston *et al.*, 2008), and an appropriate structural power is important for him/her to blending in the firm's inner circle and achieving success in advising, persuading and influencing other senior executives with regards to ES deployment and utilization (Earl and Feeny, 1994; Chatterjee *et al.*, 2001). When the CIO is legitimized a high level of power within the firm, he/she is more likely to have greater latitude in making strategic IT decision, and utilizing the abilities of ES in support of firm's business strategies and enhancing business performance (Preston *et al.*, 2008). Thus we argue that in addition to CIO's strategic IT and business knowledge, a CIO's structural power also plays as a significant role in facilitating the assimilation level of systems functionalities, and propose the following hypothesis:

H3. CIO's structural power is positively associated with ES assimilation.

Based on Liang *et al.*'s (2007) study, ES assimilation is defined as the extent to which the systems functionalities is used in facilitating business processes and the degree it is routinely used to support business operations, and the final objective of ES assimilation is to assimilate the technical features of systems functionalities into the business routines so that the expected benefits of ES can be actually realized, which is beneficial for the improvement of firm performance. Following this line of logic, we hypothesize that:

H4. ES assimilation is positively associated with firm performance.

4. Research methodology

4.1 Construct operationalization

We used field survey to test the proposed research model. The survey instrument was developed based on a comprehensive review of the existing literature. The questionnaire was then translated into Chinese, and a few revisions were made to adapt to the new context in China. All items except for structural power, ES assimilation and control variables were measured using seven-point Likert scales.

4.1.1 CIO's strategic knowledge and structural power. Armstrong and Sambamurthy's (1999) study was used as a reference to measure CIO's strategic business knowledge and strategic IT knowledge, and three items were designed to measure each construct. Drawing from Smaltz *et al.*'s (2006) study, we measure CIO's structural power by the CIO's formal membership in the TMT and the CIO's reporting

level with respect to the organization's CEO (Smaltz *et al.*, 2006; Preston *et al.*, 2008). The CIO in each firm is asked to self-evaluate his/her strategic knowledge and structural power.

4.1.2 ES assimilation. We referred to Liang *et al.*'s (2007) study and operationalized ES assimilation as a formative construct in terms of volume, diversity and depth (Liang *et al.*, 2007). The three dimensions can comprehensively reflect the extent to which the enterprise systems is used in facilitating business processes and the degree it is routinely used to support business operations. The target respondent of ES assimilation is the CIO.

4.1.3 Firm performance. Delone and Mclean (2003) argued that the ultimate objective of ES is business performance improvement, and they provided a framework to measure ES success. Following Delone and Mclean's (2003) study, we measured firm performance from top executive's perception of revenue increase, operation cost reduction and productivity improvement after using ES (Delone and Mclean, 2003; Petter *et al.*, 2008). The target respondent is the top executive who is familiar with firm's financial operation and can provide a more accurate evaluation of firm performance from financial perspective. The CEO or vice president in charge of financial business is the ideal respondents in most firms.

The items and descriptions of all the constructs are illustrated in Table I.

Constructs	Items	Descriptions
CIO's strategic business knowledge	Busiknow1	I am acquainted with firm's present and future products and services
	Busiknow2	I am acquainted with industry practices
	Busiknow3	I am acquainted with firm's business strategy, process and structure
CIO's strategic IT knowledge	ITknow1	I am familiar with the newest information technology and pay attention to the development of information technology
	ITknow2	I understand the timing and investment strategies in enterprise systems
	ITknow3	I understand how to utilize enterprise systems to support firm's strategy and needs
CIO's structural power	TMT membership	Are you a formal member of your organization's top management team? (Yes/No)
	Report level	How many reporting levels are between you and the CEO?
Enterprise systems assimilation	Volume	Percentage of the firm's business processes that are using the enterprise systems
	Diversity	Number of functional areas that are using the enterprise systems
	Depth	For each functional area identified above, identify the level at which the enterprise systems is used: a. operation; b. management; c. decision making
Firm performance	Revenue increase	Sales revenue in our firm is increased after the enterprise systems became operational
	Cost reduction	Operational cost in our firm is reduced after the enterprise systems was devoted into daily use
	Productivity improvement	Productivity in our firm is improved after the enterprise systems became operational

Table I.
Constructs and items

4.2 Data collection

Before the data collection, a pretest was employed to validate the content validity of the questionnaire. Five experts from industry and academic have examined the questionnaire and several items were corrected and edited to ensure that the questions are simple and easy to understand.

The final survey was distributed to firms of Shandong province in China, since economy in Shandong province has developed rapidly in the past decades and more and more small and medium-sized firms are using ERP systems to support daily business operations. Questionnaires were collected through electronic e-mails. When selecting the sample firms, we required that the firms should have set up a position of CIO or have appointed a top executive in charge of the ERP systems. In addition, all of the sample firms should have used ERP systems for at least half a year. In order to avoid the social bias, we selected two respondents in each firm, one is the IS executive who is responsible of the ERP systems while another is the CEO or vice president who is familiar with financial performance of the firm. Accordingly, we designed two types of questionnaires and sent them to the IS executive and the business executive separately in each firm. The IS executive was required to evaluate his/her strategic knowledge, structural power and the assimilation level of ERP systems within the organization, while the business executive was asked to evaluate the increase of firm performance after using ERP systems.

The data collection was conducted from July of 2012 to June of 2014. Of the 300 firms we contacted, 190 firms agreed to complete the questionnaire. We sent 380 questionnaires to the 190 firms and returned back 305 questionnaires. After deleting the questionnaire with missing data, we collected 278 valid questionnaires. We then matched the questionnaires of the IS executives and the business executive in each firm, and finally got 240 matched questionnaires from 120 firms. Demographics characteristics of the sample firms are described in Table II.

We conducted an ANOVA analysis to compare CIO's strategic IT knowledge with its strategic business knowledge using the 120 samples. The result suggests that CIO's strategic business knowledge is significantly higher than his/her strategic IT knowledge. This result showed that the knowledge structure of CIOs is not very balanced. This may result from the work background of CIOs since most of the CIOs are selected from the business or financial departments instead of IT departments.

4.3 Assessing common method bias (CMB)

Since all of the data are self-reported, there is a potential for CMB in our study. Following Podsakoff and Organ (1986), we first conducted a Harman one-factor test to assess the CMB in SPSS. We included the five constructs of CIO's strategic IT knowledge, CIO's strategic business knowledge, CIO's structural power, ES assimilation and firm performance in the exploratory factor analysis. The analysis results show that all of the five constructs are present and the most covariance explained by one factor is 19.72, which is no more than 30 percent, suggesting that CMB is not a major concern in our study (Podsakoff and Organ, 1986).

Podsakoff *et al.* (2003) posited that some other statistical remedies were needed to further examine the CMB since Harman one-factor test may not statistically control for method effects. We then followed Williams *et al.*'s (2003) and Liang *et al.*'s (2007) study, and added a common method factor in the partial least squares (PLS) model including all the principal constructs' indicators. We calculated each indicator' variances substantively explained by the principal construct, as shown in Table III.

	Category	Percentage
Firm ownership	State owned	28.2
	Joint venture	20.6
	Private	27.5
	Foreign invested	18.4
	Others	5.3
Industry type	Manufacturing	49.6
	Electronic	15.4
	Real estate	5.3
	Service	8.7
	Agriculture	7.9
	Others	13.1
Number of employees	< 100	3.5
	100-500	41.2
	501-1,000	28.5
	1,001-5,000	21.5
	> 5,000	5.3
Enterprise systems use time (Year)	< 1	5.3
	1-2	21.8
	2-3	9.8
	3-4	21
	4-5	23.7
	> 5	18.4

Table II. Responding company demographics

We first compared the substantive factor loadings with the method factor loadings. Table III indicates that all of the substantive factor loadings are positive and significant, while most of the method factor loadings are insignificant or negative. We then calculated indicator's variances explained by the principal construct (R_1^2)

Construct	Indicator	Substantive factor loading	R_1^2	Method factor loading	R_2^2
CIO's strategic business knowledge	Busiknow1	0.859**	0.738	−0.025	0.001
	Busiknow2	0.913**	0.834	0.027	0.001
	Busiknow3	0.770**	0.593	−0.005	0.000
CIO's strategic IT knowledge	ITknow1	0.823**	0.677	−0.127*	0.016
	ITknow2	0.918**	0.843	0.165*	0.027
	ITknow3	0.944**	0.891	−0.051	0.003
CIO's structural power	TMT membership	0.966**	0.933	−0.067	0.004
	Report level	0.967**	0.935	0.065	0.004
Enterprise systems assimilation	Volume	0.830**	0.689	−0.110	0.012
	Diversity	0.860**	0.740	−0.050	0.003
	Depth	0.829**	0.687	0.118	0.014
Firm performance	Revenue increase	0.854**	0.729	−0.308*	0.095
	Cost reduction	0.960	0.922	0.066	0.004
	Productivity improvement	0.898	0.806	0.223*	0.050

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

Table III. Common method bias analysis

and indicator's variances explained by the method construct (R_2^2), as illustrated in Table III. The average variances explained by the principal and method construct are 0.787 and 0.017 separately, and the ratio of substantive variance to method variance is about 46:1. Given the small magnitude of method variance, we infer that the method is not a serious concern in our study (Liang *et al.*, 2007).

5. Data analysis and results

5.1 Structural equation modeling analysis

We used SmartPLS to analyze the structural equation model (Ringle *et al.*, 2005). Following the two-step analytical procedures, the measurement model was first examined and then the structural model was assessed. A bootstrapping procedure with re-sampling method was used to estimate the statistical significance of the parameter estimates.

5.1.1 Measurement model. Convergent validity and discriminant validity analysis was conducted to examine the measurement model. Convergent validity refers to the degree to which the items measuring the same construct agree, and it was usually examined by checking the item loadings, composite reliability and the average variance extracted (AVE). Extant literature suggests that composite reliability score and item loadings of each construct should be at least 0.7. Besides, the square root of the AVE of each construct should be greater than 0.707(AVE > 0.5) (Pavlou and Fygenson, 2006). Table IV describes the item loadings, *t*-statistics, composite reliability and AVE of each construct.

As shown in Table IV, all the item loadings of the reflective constructs are greater than 0.75, and most of the loadings have exceeded 0.9. *t*-Values test suggests that the item loadings are all significant at the 0.01 level. The composite reliability of each construct is greater than 0.85 while the AVE of each construct were greater than 0.7, indicating a good convergent validity. Since ES assimilation is a formative construct, the covariance-based estimates such as reliability and AVE are not applicable for evaluating formative constructs (Chin *et al.*, 2003), we conducted the *t*-value test of the path loadings of the three items to check if they significantly contribute to ES assimilation. As illustrated in Table IV, we can see that all the three path loadings are

Constructs	Items	Loadings	*t*-Statistic	Composite reliability	AVE
Strategic IT knowledge	ITknow1	0.832	39.48	0.924	0.803
	ITknow2	0.914	92.74		
	ITknow3	0.938	130.63		
Strategic business knowledge	Busiknow1	0.825	23.70	0.884	0.718
	Busiknow2	0.933	88.25		
	Busiknow3	0.776	18.28		
Structural power	TMT membership	0.963	149.08	0.966	0.934
	Report level	0.970	186.13		
Firm performance	Revenue increase	0.854	47.18	0.931	0.819
	Cost reduction	0.961	184.76		
	Productivity improvement	0.896	78.37		
Enterprise systems assimilation (formative construct)	Volume	na	6.19	na	na
	Diversity	na	14.94		
	Depth	na	9.84		

Table IV.
Item loadings of the latent constructs

significant at 0.01 level, suggesting that they contribute significantly from different paths to form the construct of ES assimilation. The analysis results implied that the convergent validity of the measurement model is satisfactory (Liang *et al.*, 2007).

Discriminant validity refers to the degree to which items differentiate between constructs, and it can be tested by applying the following two criterion: first, the square root of the AVE of each latent variable should exceed that construct's correlation with other constructs; second, the items should load more highly on constructs they are intended to measure than on other constructs (Chin *et al.*, 2003; Limayem and Cheung, 2008). In this study, we analyzed both the correlation between each two constructs and the item cross-loadings of each construct, as shown in Tables V and VI separately.

As shown in Table V, the AVE of each latent construct is greater than that construct's correlation with other constructs. Further, Table VI indicated that all of the items load more highly on constructs they are intended to measure than on other constructs. Overall, the results exhibited sufficient support for discriminant validity of the measurement instrument.

5.1.2 Structural model. The PLS structural model and hypotheses were assessed by examining path coefficients and their significance levels. Figure 2 illustrates the results of the structural model.

Constructs	Strategic IT knowledge	Strategic business knowledge	Structural power	Firm performance	ES assimilation
Strategic IT knowledge	*0.896*				
Strategic business knowledge	0.395	*0.847*			
Structural power	0.579	0.281	*0.966*		
Firm performance	0.590	0.553	0.590	*0.905*	
Enterprise systems assimilation	0.565	0.326	0.681	0.712	*na*

Note: Diagonal italic values are the square roots of AVE of each construct

Table V. Correlations among latent constructs

	Strategic IT knowledge	Strategic business knowledge	Structural power	Firm performance
ITknow1	*0.835*	0.185	0.471	0.445
ITknow2	*0.912*	0.509	0.563	0.580
ITknow3	*0.937*	0.364	0.519	0.559
Busiknow1	0.347	*0.828*	0.226	0.511
Busiknow2	0.321	*0.933*	0.308	0.503
Busiknow3	0.359	*0.803*	0.155	0.403
TMT membership	0.546	0.246	*0.963*	0.431
Report level	0.571	0.295	*0.970*	0.513
Revenue increase	0.346	0.358	0.358	*0.853*
Cost reduction	0.560	0.516	0.516	*0.962*
Productivity improvement	0.610	0.447	0.447	*0.897*

Table VI. Item cross-loadings of the latent constructs

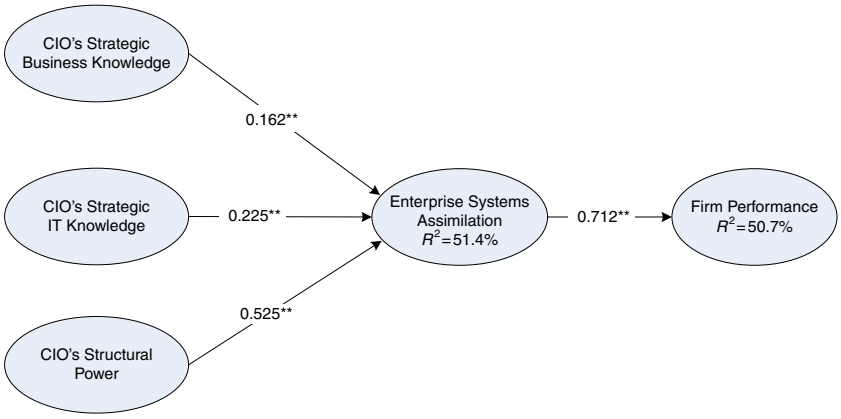


Figure 2.
PLS analysis results of the research model

Path coefficients of the structural model suggest that CIO's strategic business knowledge has positive effect on ES assimilation ($\beta = 0.162$, $p < 0.01$), while CIO's strategic IT knowledge is also positively related with ES assimilation ($\beta = 0.225$, $p < 0.01$), thus supporting *H1* and *H2*.

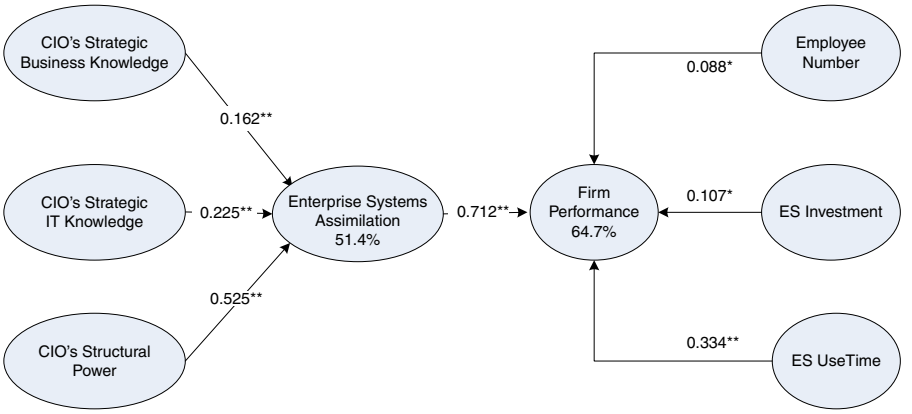
As expected in *H3*, CIO's structural power is significantly associated with ES assimilation ($\beta = 0.525$, $p < 0.01$), and it has a higher influence on ES assimilation than CIO's strategic business and IT knowledge, suggesting that a CIO's power base and authority plays a significant role in facilitating the assimilation level of ES.

R^2 value of the endogenous construct represents the amount of variance explained by the exogenous constructs. PLS analysis results indicate that 33.3 percent variance of ES assimilation can be explained by CIO's strategic business knowledge and CIO's strategic IT knowledge, and the variance increases to 51.4 percent after adding the construct of CIO's structural power. Overall, the four exogenous variables can explain 50.7 percent variance of firm performance, demonstrating a good explanatory power of the research model.

We then added control variables of employee number, ES investment and ES use time in the research model, and the results of the structural model are illustrated in Figure 3. We found that all of the three control variable were significantly associated with firm performance, and the variance of firm performance increases to 64.7 percent after adding the control variables.

In order to further examine if there is a mediating effect of ES assimilation between CIO's strategic knowledge, CIO's structural power and firm performance, we followed the procedure suggested by Baron and Kenny (1986). Baron and Kenny (1986) indicated that the mediation hypothesis is supported if the following conditions are satisfied: the independent variable is associated with the dependent variable without the mediator; the effect of independent variable on the dependent variable is reduced to zero (full mediation) or reduced by a significant amount (partial mediation) after adding the mediator; the mediator is associated with the dependent variable.

Drawing upon Baron and Kenny's (1986) procedure, we followed Liang *et al.*'s (2007) study and conducted the following analysis in SmartPLS: remove ES assimilation from the model and run the model to see if there is direct link between CIO's strategic business knowledge, CIO's strategic IT knowledge, CIO's structural power and firm



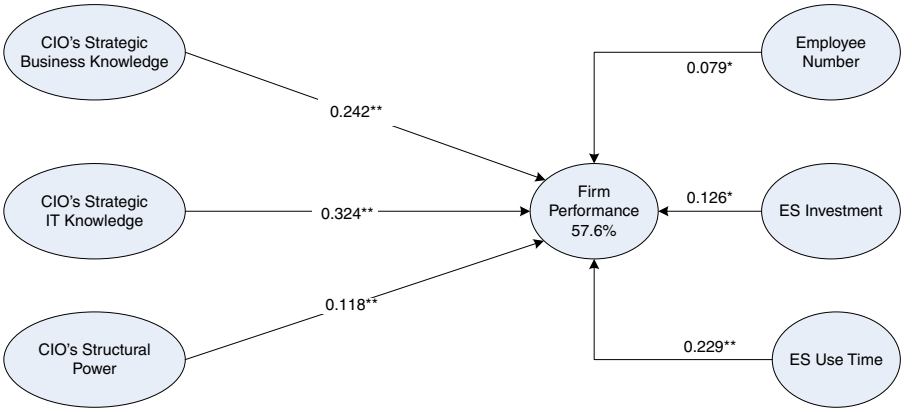
Notes: *$p<0.05$; **$p<0.01$

Figure 3.
PLS analysis results of the research model by adding control variables

performance; add a direct link between CIO's strategic business knowledge, CIO's strategic IT knowledge, CIO's structural power and firm performance without removing ES assimilation, and rerun the model to examine the path coefficient and the significance of the direct link.

We first removed ES assimilation from the model and run the structural model in SmartPLS. The analysis results suggest that the link between CIO's strategic business knowledge and firm performance ($\beta = 0.242$), the link between CIO's strategic IT knowledge and firm performance ($\beta = 0.324$), and the link between CIO's structural power and firm performance ($\beta = 0.118$) are all significant ($p < 0.01$), as shown in Figure 4.

We then added ES assimilation in the structural model and made a direct link between CIO's strategic business knowledge, CIO's strategic IT knowledge, CIO's structural power and firm performance, and rerun the model to examine the significance of the direct link. The analysis result of the structural model is shown in Figure 5.



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

Figure 4.
PLS analysis results of the research model after removing ERP assimilation

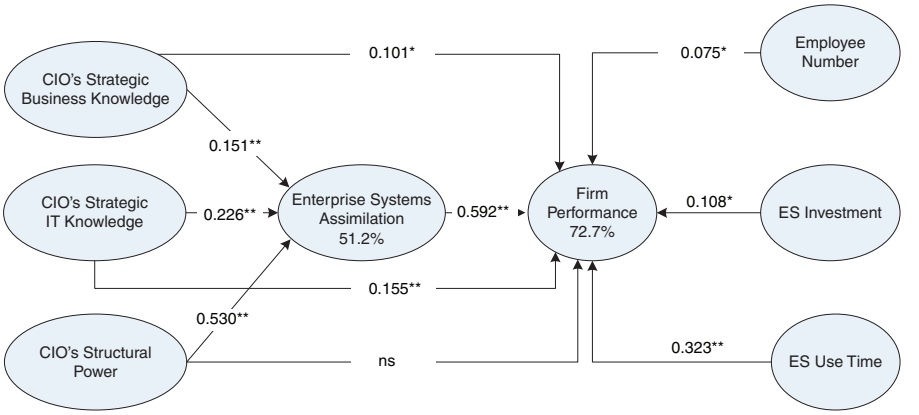


Figure 5.
PLS analysis results of the research model-mediating effect of ERP assimilation

Notes: ns, Not significant. *$p<0.05$; **$p<0.01$

From Figures 4 and 5 we can see that after adding ES assimilation, the path coefficient between CIO's strategic business knowledge and firm performance reduced from 0.242 ($p < 0.01$) to 0.101 ($p < 0.05$), indicating that the relationship between CIO's strategic business knowledge and firm performance is partially mediated by ES assimilation. While the path coefficient between CIO's strategic IT knowledge and firm performance reduced from 0.342 ($p < 0.01$) to 0.155 ($p < 0.01$), suggesting that the association between CIO's strategic IT knowledge and firm performance is also partially mediated by ES assimilation.

We then examined the mediating effect of ES assimilation on the relationship between CIO's structural power and firm performance. Interestingly, we found that after adding ES assimilation, the link between CIO's structural power and firm performance is not significant anymore, demonstrating that ES assimilation fully mediates the relationship between CIO's structural power and firm performance.

5.2 Correlation analysis

In order to further examine the relationship between CIO's strategic knowledge imbalance and ES assimilation, in terms of volume, diversity and depth, we then conducted a correlation analysis and included all the indicators and control variables. Following Yilmaz and Ergun's (2008) study, the degree of CIO's strategic knowledge imbalance is operationalized as the absolute values of the pair-wise differences between CIO's strategic business knowledge and strategic IT knowledge. The result of the correlation analysis was illustrate in Table VII.

As illustrated in Table VII, CIO's strategic knowledge imbalance is negatively related with ES assimilation, in terms of volume ($\gamma = -0.221$, $p < 0.01$), diversity ($\gamma = -0.153, p < 0.05$) and depth ($\gamma = -0.220, p < 0.01$), suggesting that a person who is skilled at one type of business (strategic business or strategic IT knowledge) but not familiar with the other type of knowledge is not beneficial to foster the assimilation of systems functionalities within the organization. Table VII also demonstrates that CIO's report level and TMT membership (the two dimensions of CIO's structural power) is negatively related with CIO's knowledge imbalance ($\gamma_1 = -0.250$, $\gamma_2 = -0.318$, $p < 0.01$), while CIO's report level and TMT membership is positively related with

Table VII. Correlation analysis results

	ES use time	Employees	ES investment	Report level	TMT membership	Know imbalance	Volume	Diversity	Depth	RI	CR	PI
ES use time	1											
Employees number	0.318**	1										
ES investment	0.114	0.284**	1									
Report level	0.500**	0.025	−0.011	1								
TMT membership	0.472**	−0.034	0.081	0.869**	1							
Know imbalance	−0.028	0.281**	0.157	−0.250**	−0.318**	1						
Volume	0.450**	0.128	0.156	0.577**	0.586**	−0.221**	1					
Diversity	0.293**	0.328**	0.423**	0.457**	0.417**	−0.153*	0.650**	1				
Depth	0.141	0.179	0.084	0.627**	0.489**	−0.220**	0.499**	0.559**	1			
Revenue increase (RI)	0.524**	0.396**	0.315**	0.378**	0.310**	0.121	0.490**	0.466**	0.534**	1		
Cost reduction (CR)	0.492**	0.308**	0.199*	0.549**	0.442**	0.099	0.596**	0.490**	0.648**	0.749**	1	
Productivity improvement (PI)	0.520**	0.190*	0.184*	0.454**	0.409**	−0.123	0.565**	0.486**	0.494**	0.585**	0.844**	1

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

the volume ($\gamma_1 = 0.577$, $\gamma_2 = 0.586$, $p < 0.01$), diversity ($\gamma_1 = 0.457$, $\gamma_2 = 0.417$, $p < 0.01$) and depth ($\gamma_1 = 0.627$, $\gamma_2 = 0.489$, $p < 0.01$) of ES assimilation. In addition, CIO's report level and TMT membership is also positively associated with firm performance, in terms of revenue increase ($\gamma_1 = 0.378$, $\gamma_2 = 0.310$, $p < 0.01$), cost reduction ($\gamma_1 = 0.549$, $\gamma_2 = 0.442$, $p < 0.01$) and productivity improvement ($\gamma_1 = 0.454$, $\gamma_2 = 0.409$, $p < 0.01$). The above results further indicate that CIO's structural power is a significant factor in fostering ES assimilation and firm performance.

6. Discussions and implications

6.1 Discussions

As ES such as ERP systems plays a more and more significant role within the organization, the role of CIO has changed from an operational manager to a farsighted strategist, who is expert in deploying ES resources, designing systems architecture and managing systems infrastructure in support of business strategy. Although there is a rich body of literature focussing on CIO's role and responsibility, most of the extant literatures are descriptive in nature, and few studies have empirically examined the specific effect of CIO's strategic business knowledge, strategic IT knowledge and structural power on ES success, especially in the context of post-implementation phase across the systems lifecycle.

Drawing upon KBV, we developed a theoretical model to examine the impact of CIO's strategic knowledge and structural power on ES assimilation and firm performance. We argue that CIO's strategic knowledge and structural power are significant antecedents of ES assimilation, while ES assimilation mediates the relationship between the antecedents and firm performance. The research model was examined with a large scale of sample data and most of our hypotheses were supported. Further, we empirically examined the relationship between CIO's knowledge imbalance and ES assimilation. The results show that the imbalance between CIO' strategic business and strategic IT knowledge is negatively associated with the assimilation of systems functionalities. On the one hand, a CIO needs to be familiar with business vision, processes and organizational structure, thus to formulate business strategy with IT technology; on the other hand, the CIO also needs to be acquainted with technology development and be sensitive to external technology change, thus to promote IT within the enterprise as a strategic tool for firm's growth and innovation.

Another significant finding in our study is that CIO's structural power has a strong impact on ES assimilation and firm performance, and the influence is even higher than CIO's strategic business knowledge and CIO's strategic IT knowledge. The result is consistent with our argument, indicating that the structural power of a CIO is important and indispensable to create discretion when working with other individual senior executives within the TMT, thus to make strategic decision on IT investment, to foster the diffusion of ES across organizational projects and work processes in support of organizational daily process.

6.2 Theoretical implications

For theoretical contributions, our study extends the extant literatures in IS leadership by integrating CIO's strategic knowledge and structural power into a theoretical model and empirically examining their effects on ES assimilation and firm performance. The power literature suggests that a CIO's structural power is an important antecedent

to his/her authority within the organization. However, most of the empirical studies focussed on CIO's knowledge, capability or experience, and few studies have empirically examined the effect of CIO's structural power on ES success. To our knowledge, this is the first empirical study that examined the synthetic effect of CIO's strategic knowledge and structural power on ES success. The research model can explain above 50 percent variance of the endogenous variables, indicating a good explanatory power of the theoretical model. The empirical results show that CIO's structural power is a significant antecedent in fostering ES success, which indicates that CIO's formal membership in the TMT and his/her reporting level with respect to the CEO is indispensable for him to make IT strategy in accordance with organizational business strategy. The empirical results are consistent with KBV (Spender, 1996).

Second, our study enriches the extant literatures in KBV by emphasizing the balance of CIO's strategic business and strategic IT knowledge. Although CIO's knowledge has been considered as a critical antecedents of ES success, few studies have examined the impact of CIO's knowledge balance on ES success. Our empirical results suggest that the degree of imbalance between CIO's strategic business and strategic IT knowledge will impede the diffusion of system functionalities into organizational routine work, in terms of volume, diversity and depth. As the highest ranking executives in charge of firms' IT planning and management practices, the CIO needs to be balanced in both strategic business knowledge and strategic IT knowledge, in order to leverage the full potential of ES in shaping and enabling firms' business strategies and activities.

Third, our study contributes to ES assimilation theory by unpacking the mediating effect of ES assimilation between CIO's strategic knowledge, CIO's structural power and firm performance. Liang *et al.* (2007) argued that business values of systems applications cannot be fully realized until the applications are extensively assimilated in an organization. Although CIO has been identified as the highest ranking executives in managing organizational IT practices and fostering IT success, few studies have examined the relationship between CIO' strategic knowledge and ES success in the context of post-implementation phase, when the implementation was completed and the system was devoted into daily use. Drawing upon ES assimilation theory, our study identified that the assimilation level of ES was a critical mediator between CIO's strategic knowledge, structural power and firm performance, and the empirical findings can support most of our hypotheses.

6.3 Practical implications

For practical contribution, this study emphasized the ambidexterity of a CIO's strategic knowledge, and provides guidelines for the selection of an appropriate candidate to hold the position of CIO in charge of ES. The empirical findings indicate that in order to foster the assimilation of ES within the firm, the CIO needs to be skilled in both strategic IT knowledge and strategic business knowledge. On the one hand, the CIO needs to pay attention to IT development and be familiar with the newest technology, thus he/she can recognize the best time to make investment in ES project, know clearly what type of ES is appropriate for the firm, be acquainted with the management of ES architecture and infrastructure, and understand how to utilize ES to support firm's business strategy and operational requirements. Meanwhile, the CIO also needs to pay close attention to strategic business issues of the firm, such as the external marketing environments and industry recipes for success, the firm's present and future products

and services, and the mission, strategy and process of the firm, thus he/she can make a better deployment of ES according to firm's business strategies and marketing orientations, and facilitate the achievement of business performance through ES assimilation. This research finding is especially instructive for Chinese companies. Since in China, most of the CIOs are selected from the business or financial departments instead of IT departments, thus the knowledge structure possessed by the CIOs are usually not very balanced, which may impede the assimilation level of ES.

Our study also found that CIO's structural power plays as an intensifier that strengthens the explanatory power of CIO's strategic knowledge on ES assimilation. The results provide guidelines for the board of directors to officially legitimize the power of the CIO by entitling a greater latitude to him/her in making IT-related strategic decisions. Specifically, the board should empower the CIO a formal position within the TMT and cut down the report levels between the CIO and the CEO. This is beneficial for the CIO to have an appropriate authority and legitimacy to engage in strategic decision making, to advise and influence other senior executives with regards to ES utilization by blending in the firm's inner circle, further, to utilize the abilities of system functionalities in support of firm's business strategies and achieve the improvement of business performance.

7. Conclusion and future research directions

Drawing from KBV, this study develops a research model to examine the impact of CIO's strategic knowledge and structural power on ES assimilation and firm performance. Using a sample of 120 firms that have utilized ES for more than half a year and have appointed a top executive in charge of the ERP systems, we tested the theoretical model and corresponding hypotheses. The empirical findings indicate that: both CIO's strategic business knowledge and CIO's strategic IT knowledge have significant impact on ES assimilation; the imbalance of CIO strategic business knowledge and strategic IT knowledge is negatively associated with ES assimilation; CIO's structural power has a significant impact on ES assimilation and contributes a lot to the explanatory power of the research model; ES assimilation partially mediates the association between CIO's strategic knowledge and firm performance; ES assimilation fully mediates the association between CIO's structural power and firm performance. The empirical findings overcome gaps in the extant literature by exploring the impact mechanism of senior leadership on ES success from a knowledge-based perspective.

To date, this study appears as novel for conceptualizing simultaneous links between CIO's strategic knowledge, structural power, ES assimilation and organizational performance in an integral model, and opens a new research stream that examines the effectiveness of CIO's role in the context of ES assimilation. However, there are several limitations in our study and there is still much to be explored in the future. First, this study aims to examine the impact of CIO's IT knowledge, business knowledge and structural power on the success of any ES, and we use ERP systems as the sample frame for data collection and analysis. Future studies need to include sample firms that implemented various types of ES such as SCM, CRM etc. to further examine our research model. Second, in this study all data were collected in China, thus we are limited in generalizing our finding widely. Future studies need to be conducted with large-scale empirical data in different parts of the globe, in order to guarantee the generalization of our research model. Third, since all of the data are self-reported by the respondents, there is a potential for CMB in our study. We conducted the Harmon

one-factor test and followed Liang *et al.*'s (2007) analytical approach to examine if CMB exists. The analysis results suggest that CMB is not a serious concern in our study. Future studies should use objective financial indicators to measure firm performance, so as to better reduce the social bias. Last but not least, this study is conducted at the organizational level, yet future studies can extend the organizational-level model to the individual level to further examine the impact mechanism of CIO's strategic knowledge, capability and structural power in fostering individual-level assimilation of ES, thus to provide a comprehensive understanding of CIO's role in fostering ES success from a multi-level perspective.

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