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Managing External Information Sources in Digital Extended Enterprises: The Roles of IT Enabled Business Intelligence Competence and Network Structure Strength

Lih-Bin Oh
Xi'an Jiaotong University, ohlb@mail.xjtu.edu.cn

MANAGING EXTERNAL INFORMATION SOURCES IN DIGITAL EXTENDED ENTERPRISES: THE ROLES OF IT-ENABLED BUSINESS INTELLIGENCE COMPETENCE AND NETWORK STRUCTURE STRENGTH

Completed Research Paper

Lih-Bin Oh
School of Management
Xi'an Jiaotong University
Xi'an, 710049 Shaanxi, China
ohlb@mail.xjtu.edu.cn

Abstract

Digital extended enterprises are faced with the dual challenge of managing intra-organizational information and monitoring information from the external environment. Survival requires the effective use of information and decision technologies to gather, manage, and exploit knowledge. It also entails the extensive sharing of information with business network partners through information linkages. This study examines the effects of IT-enabled business intelligence competence and business network structure strength on a firm's exploratory, transformative, and exploitative learning processes, and their associated outcomes. Based on a survey dataset of 185 firms in Singapore, results suggest that IT-enabled business intelligence competence and the strength of business network structure positively influence organizational absorptive capacity. Next, increased absorptive capacity contributes to improving exploitative and explorative innovation competences, leading to higher firm performance. The findings provide managers and researchers with insights to understand the roles of business intelligence technologies and business network structure in managing external information sources.

Keywords: Business Intelligence Technologies, Business Network Structure, Organizational Absorptive Capacity, Exploitative Innovation, Explorative Innovation, Digital Extended Enterprise

Introduction

In today's information-intensive economy where continual knowledge renewal is the basis of competitive advantage, it is strategically crucial for organizations to manage its internal information so as to augment its capacity to learn. As shorter product life-cycles and dynamic market forces drive the need for innovation, it is likewise vital for organizations to keep abreast of developments in the external environment. This will allow them to deploy strategic maneuvers to respond appropriately in a timely fashion. The need for sense-and-response capability to external information sources is further heightened with the proliferation of Web 2.0 consumer-generated content.

The importance of effective information management in organizations has been an active area of academic inquiry. Environmental scanning and knowledge management are but two research streams which share a common drive to understand the process by which organizations acquire, assimilate and manage information to improve firm performance. Environmental scanning research examines how organizations monitor and collect external information (Albright 2004; Choudhury and Sampler 1997; Hambrick 1982; Hough and White 2004; Maier, Rainer and Snyder 1997), while knowledge management research takes an internal approach by focusing on how information and knowledge is created, shared, and distributed within the organization (Alavi and Leidner 2001; Nonaka 1994). In recent years, the emergence of business intelligence (BI) technologies has renewed organizations' interest in managing external information sources. In fact, BI technologies have been rated as one of the top strategic technologies by CIOs (Gartner 2008a).

Broadly speaking, BI technologies comprise of information acquisition tools like Really Simple Syndication (RSS) feeds and subscription-based databases for monitoring industry trends. In addition, it also includes a plethora of specialized BI technologies such as digital dashboards, which visually present summaries of business data that show at-a-glance understanding of business conditions and risks through metrics and key performance indicators (Lam 2003). Many common BI tools are also equipped with Online Analytical Processing (OLAP) capability that supports interactive examination of large amounts of data by applying mathematical modeling and simulation in the measurement and analysis of the likelihood and report of the impact of possible risks. However, in order to truly exploit the capabilities of BI technologies, organizations would also need to ensure the existence of BI technologies leveraging capability whereby BI technologies are effectively used by the organizational members. Both the presence of widely accessible BI technologies and corresponding leveraging capability are needed for organizations to develop IT-enabled business intelligence competence. It is only through the nurturing of such competence can organizations achieve the objective of effectively managing external information sources.

While business intelligence is important, it should be noted that the mere acquisition and sharing of new information or knowledge do not automatically lead to improved firm performance. Rather, information has to be first internalized and transformed into new knowledge, which then has to be exploited or applied in new processes, products or services, before firm performance can be improved. The process by which organizations achieve this is represented by the concept of organizational absorptive capacity (ACAP), which refers to the firm's capacity to identify, acquire, assimilate, transform, and exploit knowledge from the environment such that the firm's behavior is modified "to reflect new knowledge and insights" (Garvin 1993; Lane, Koka and Pathak 2006).

With the availability of a multitude of inter-organizational technologies, organizations are increasingly transforming themselves into digital extended enterprises to allow more seamless information sharing with external partners. Recent technologies such as service-oriented architecture (SOA) and software-as-a-service (SaaS) have further facilitated the forging of stronger inter-organizational business networks. Consequently, the strength of a digital extended enterprise's business network structure is likely to have an impact on its absorptive capacity. This leads to the study's main research question: "How does the use of BI technologies and extended business network structure impact an organization's ability to absorb and transform external information to increase firm performance?" To shed light on the enabling roles of IT-enabled BI competence and business network structure strength on organizational absorptive capacity, the study synthesized prior research in IS, organizational learning and strategic management to develop and test a structural model for managing external information sources in digital extended enterprises. It advances renewed understanding of the antecedents and outcomes of organizational absorptive capacity in the context of digital extended enterprises.

Conceptual Development

Figure 1 presents the research model depicting the proposed relationships between IT-enabled BI intelligence competence, business network structure strength, organizational absorptive capacity, innovation competences, and firm performance.

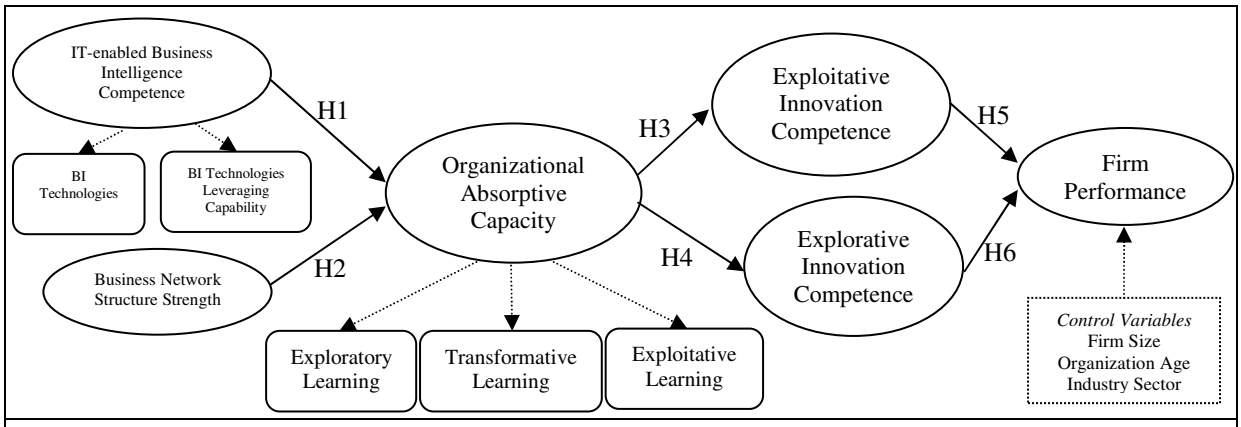

Figure 1. A Framework for Managing External Information Sources in Digital Extended Enterprises

Organizational Absorptive Capacity

Absorptive capacity (ACAP) refers to an organization's ability to identify and acquire valuable new information, and to assimilate or internalize the information such that the new knowledge thus generated may be commercially exploited or applied in innovations (Cohen and Levinthal 1990). It represents the organization's capacity to absorb information and exploit the knowledge thus gleaned. It has been noted that absorptive capacity can "reinforce, refocus, or complement an organization's knowledge base", the successful exploitation of which is crucial to long-term organizational success, continued relevance, and innovativeness (Lane et al. 2006). It is noteworthy that unlike environmental scanning - the monitoring and collection of external information, and knowledge management - the management of internal knowledge to facilitate utilization, absorptive capacity subsumes the two in that it places equal emphasis on both the acquisition and subsequent exploitation of information and knowledge.

Zahra and George (2002) provided a dynamic capability view of ACAP by reconceptualizing it as comprising of four complementary and combinative capabilities which "build on each other to yield ACAP". These four ACAP processes are: knowledge acquisition, assimilation, transformation, and exploitation. These capabilities enable the firm to leverage upon knowledge that is indispensable in the creation and utilization of other organizational capabilities from which the firm may derive further business advantage (Zahra and George 2002). Drawing upon the theoretical works of Cohen and Levinthal (1990) and Zahra and George (2002), Lane et al. (2006) reconceptualized ACAP as three sequential processes: *exploratory learning*, the equivalent of the knowledge acquisition capability; *transformative learning*, which subsumes the knowledge assimilation and transformation processes; and *exploitative learning*, the equivalent of the knowledge exploitation process. Implicit to such a model is the emphasis on learning in each process, and on the flow of knowledge from one process to the next, starting from exploratory learning. Unlike Zahra and George's (2002) conceptualization of the four processes into potential and realized ACAP and their focus on the latter, the process view places equal emphasis on both the gathering and utilization of information and knowledge. Furthermore, while previous definitions largely restricted learning to the knowledge assimilation, transformation, and exploitation processes, this recent reconceptualization by Lane et al. (2006) explicitly highlights that learning occurs in all ACAP processes, including the acquisition process.

Impact of IT-enabled Business Intelligence Competence and Business Network Structure Strength on Organizational Absorptive Capacity

The present study adopted the conceptualization of Lane et al. (2006) and regarded ACAP as a second-order construct comprising of exploratory learning, transformative learning, and exploitative learning. It further

conceptualized IT-enabled BI competence as a second-order factor comprising of two first-order factors, namely BI technologies and BI technologies leveraging capability.

BI technologies encompass a broad range of applications and practices for the collection, integration, analysis, and presentation of external business information, with the overriding objective to support better business decision making. In the past, BI tools like decision support systems were only available to senior executives. With the advent of Internet and proliferation of Web 2.0 applications, business intelligence has been made accessible to employees at lower levels. While senior managers and business analysts have access to more specialized BI tools like digital dashboards, OLAP and data mining, more junior employees can now also use search engines and subscribe to RSS feeds to monitor competitors' actions (e.g., press releases) and customers' feedback on social media such as blogs. Coupled with the access to fee-based subscription databases (e.g., industry indicators, statistics and technological developments news), the acquisition process of external information has been markedly increased.

An organization's absorptive capacity is partly comprised of the absorptive capacities of its individual members (Cohen and Levinthal 1990; Lane et al. 2006). Human resource capability has been found to be a complementary resource to investments in IT assets to facilitate transactional, informational and strategic purposes (Aral and Weill 2007). It has been pointed out that IT investments and spending without the presence of effective IT leveraging competence do not directly lead to enhanced performance (Pavlou and El Sawy 2006). Likewise, while the provision of BI technologies can impact the building of ACAP, the presence of BI technologies leveraging capability is also required to derive business value from BI technologies investments. Collectively, BI technologies and effective leveraging capability would enhance the information-intensive absorptive capacity processes significantly. Thus,

Hypothesis 1 (H1): The level of IT-enabled business intelligence competence is positively related to the degree of organizational absorptive capacity.

Firms accumulate valuable network resources which reside outside of the firm's boundaries in the form of embedded ties with business partners and clients over time (Gulati 1999; Powell 1990). The network structure of a firm comprises of the structural pattern of its network of relationships that enables information sharing, which can boost the firm's sensitivity and responsiveness to external threats and competition (Gulati, Nohria and Zaheer 2000). Strong network structures can allow firms to extend its reach in gathering information, sharing information, and allowing them to tap into partners for advanced knowledge of impending events. In the context of digital extended enterprises, the effect of business network structure strength is particularly significant. Thus,

Hypothesis 2 (H2): The strength of the organization's business network structure is positively related to the degree of organizational absorptive capacity.

Impact of Organizational Absorptive Capacity on Innovation Competences

As aforementioned, the mere acquisition of new information does not result in improved firm performance. Rather, it is the firm's ability to incorporate and exploit new information in its innovation processes that enhances its business advantage. Firms emphasizing acquisition and assimilation at the expense of exploitation may thus "suffer … the costs of acquisition without gaining benefits from exploitation" (Jansen, Van den Bosch, and Volberda 2005). This is so because recognizing and gathering valuable new information determine the breadth and diversity of the firm's knowledge base, which expands the range of knowledge that the organization can draw from, enhances the firm's future viability, and augments its potential to innovate beyond its current operations. However, firms overemphasizing exploitation at the expense of acquisition may fall prey to the propinquity trap, in which the organization favors the "search for solutions near to existing solutions" (Ahuja and Lampert 2001). It is thus not a question of which ACAP processes to invest in, but of striking a proper balance between information acquisition and exploitation, to ensure the firm's future viability while maintaining its current competitiveness (Lane et al. 2006; Levinthal and March 1993).

Innovation has been regarded as an important outcome of enhanced organizational learning and absorptive capacity. The building of exploitative innovation competence is necessary for firms to respond to current opportunities and threats to survive in the short term. Concurrently, they must develop exploratory innovation competence that provides strategic options for meeting future demands. Organizational survival requires a balance of engaging in sufficient exploitation for current viability, and at the same time, devoting enough energy to exploration to ensure future viability (Levinthal and March 1993). Ambidextrous organizations have the capacities to compete in both mature markets (where cost and efficiency are essential) and develop new products and services for emerging

markets (where innovativeness and speed are critical) (O'Reilly III and Tushman 2004). In increasingly turbulent markets, organizations need to be flexible so that they can respond quickly to competitive threats yet remain stable so they can learn and grow based on their strengths (Osborn 1998). Hence,

Hypothesis 3 (H3): The degree of organizational absorptive capacity is positively related to the level of exploitative innovation competence.

Hypothesis 4 (H4): The degree of organizational absorptive capacity is positively related to the level of explorative innovation competence.

Impact of Innovation Competences on Firm Performance

Firms are able meet current business demands through more efficient operations by leveraging on their exploitative innovation competence (O'Reilly and Tushman 2004). Exploitative innovation competence enables firms to innovate by improving on existing products and services, and thereby increase efficiency of existing distribution channels to reduce operating costs substantially (Abernathy and Clark 1985). Explorative innovation competence affords firms the capacity to attract new customers (Benner and Tushman 2003). Firms with explorative competence can explore new opportunities and develop customer segments based on changing market conditions. They can also innovate quickly by creating new markets and develop new capabilities based on emerging technologies (Abernathy and Clark 1985). Such capacities allow them to garner new market share and increase revenue growth. Hence,

Hypothesis 5 (H5): The level of exploitative innovation competence is positively related to firm performance.

Hypothesis 6 (H6): The level of explorative innovation competence is positively related to firm performance.

Control Variables

An organization's firm performance may be influenced by its firm size and organizational age. This is because an established firm may have accumulated knowledge over the years such that it is better positioned to exploit opportunities and mitigate threats than a relatively new firm with a less developed knowledge base. Thus, the organization size and age were included as control variables in the model. Furthermore, as the ability of firms to generate economic returns also depends in part on the external environment in which the organization operates, the effects of industry sector on firm performance were also controlled.

Research Method

Survey Data Collection

The empirical data used to test the model was collected through a large scale survey in Singapore. The survey organizations were drawn from the Singapore 1000 company directory, a listing of the largest companies by revenue. The final sampling frame comprised of 868 companies after screening firms that are holding companies with no commercial activities. The survey employed a three-wave mailing procedure advocated by Dillman (1999). A survey package with a postage-paid return envelope was mailed to the top executive (CEO equivalent level) of each company. Two weeks after the initial mailing, a reminder postcard was sent to the companies. After another two weeks, a complete survey package was remailed to the non-respondents. A usable sample of 185 was obtained. The response rate of 21.3 percent was considered satisfactory because the survey was unsolicited and involved the participation of senior management. Common method bias as well as non-response bias were tested and were not found to be evident in the dataset. Table 1 presents the characteristics of the survey sample.

Table 1. Characteristics of Survey Sample			
	Category	**Number**	**%**
Respondent Position	CEO, CFO, CIO, Managing Director	111	60.0
	Department Managers, Middle Managers	52	28.1
	Executives	12	6.5
	Others	10	5.4
Industry Sector	Services (e.g., IT, Healthcare, Hospitality etc)	32	17.3
	Shipping and Transport	25	13.5
	Retail	13	7.0
	Property and Construction	18	9.7
	Utilities	6	3.2
	Finance	15	8.1
	Wholesale – Equipment and Machinery, Electrical and Electronics	18	9.7
	Wholesale – Petroleum, Chemical Products and Raw Materials	18	9.7
	Manufacturing – Equipment and Machinery, Electrical and Electronics	25	13.5
	Manufacturing – Petroleum, Chemical Products and Raw Materials	15	8.1
Number of Employees	100 and below	56	30.3
	101-400	57	30.8
	401-1000	34	18.4
	1001-5000	21	11.4
	5001 and above	17	9.2
Company Age (Years)	10 and below	37	20.0
	11-25	63	34.1
	26-40	54	29.2
	41 and above	31	16.8

Constructs Operationalization

IT-enabled BI competence was measured as a second-order factor comprising of two first-order factors, namely BI technologies and BI technologies leveraging capability. *BI technologies* was assessed as the extent to which the organization uses RSS feeds, subscription databases, specialized BI tools and dashboard reporting. These measures covered the acquisition, assimilation and exploitation of external information, and draw from relevant literature on business intelligence systems. *BI technologies leveraging capability* was measured by adapting scales on IT human capability (Aral and Weill 2007; Pavlou and El Sawy 2006). *Business network structure strength* was assessed by adapting the scales from past studies on business relationships in supply chain management literature (e.g., Kleindorfer and Saad 2005; Tan et al. 1999).

Prior studies (e.g., Ahuja and Katila 2001) examining the effects of ACAP on innovation have used patents or new products as measures for innovation and as proxies for ACAP itself, which unfortunately undermines the validity of the findings. Operationalizing innovations as patents also overlooks important intangible innovations such as improvements in processes or routines. Following Lane et al. (2006)'s recommendations, a process-oriented view of *organizational absorptive capacity* was taken as three processes of exploratory learning, transformative learning, and exploitative learning. ACAP was conceptualized as a second-order construct comprising of these three dimensions through the synthesis of scales from several key ACAP papers (e.g., Jansen et al. 2005; Lane et al. 2006; Zahra and George 2002) to arrive at a set of keywords with which questions were framed. The items captured the essence of the information search and acquisition, assimilation and internalization, and subsequent exploitation activities carried out in the respective ACAP processes. The scales for *exploitative and explorative innovation*

competences were based on He and Wong (2004), Jansen et al. (2006), and O'Reilly and Tushman (2004), measuring the frequency and emphasis of organizations' emphasis on various innovation activities.

Since not all organizations in this sample are public listed companies, objective firm performance measures were not available for many of them. Furthermore, some responses were not identifiable as the option to respond to the questionnaire anonymously was provided to respondents. Tallon and Kraemer (2007) suggested that executives' perceptions of firm performance can be an accurate proxy measure in the absence of objective data on IT payoffs. Management assessments are generally consistent with secondary published performance data external to the organization. Following Wade and Hulland's (2004) recommendation, *firm performance* was measured as comprising six indicators namely, revenue growth, profit growth, market share growth, profitability, return on investments, and return on assets, measured relative to major competitors over the past three years.

Data Analysis and Results

Analysis Technique

Partial Least Squares (PLS) technique as implemented in Smart-PLS version 2.0M3 was used for the data analysis (Ringle et al. 2005). PLS was found to be appropriate for the following reasons. First, PLS is able to handle errors of measurement in exogenous variables better than other methods such as multiple regression technique (Chin 1998; Chin, Marcolin and Newsted 2003). Second, given that there was little prior research or well-tested theories in the area of study, the flexibility of PLS to accommodate both exploratory and confirmatory analysis made it a suitable method for the research context (Gefen, Straub and Boudreau 2000). Finally, PLS is able to accommodate smaller data sample models and latent constructs under conditions of non-normality in small to medium sample sizes (Chin 1998).

Measurement Model Validation

Discriminant Validity

Discriminant validity, which refers to the degree to which items differentiate between constructs was examined by checking the correlations between the measurement items of distinct constructs against the average variance extracted (AVE) by construct (Fornell and Larcker 1981). Table 2 reports the results of the discriminant validity test for the constructs. The diagonal elements are the AVE for each construct, and they are all shown to be higher than the squared inter-construct correlations depicted in the off-diagonal elements.

Table 2. Results of Discriminant Validity Tests

Construct	BIC	NSS	ACAP	EXPLOIT	EXPLORE	PERF
IT-enabled Business Intelligence Competence (BIC)	**0.770**					
Business Network Structure Strength (NSS)	0.163	**0.661**				
Organizational Absorptive Capacity (ACAP)	0.374	0.279	**0.831**			
Exploitative Innovation Competence (EXPLOIT)	0.098	0.149	0.245	**0.744**		
Explorative Innovation Competence (EXPLORE)	0.078	0.096	0.231	0.373	**0.696**	
Firm Performance (PERF)	0.076	0.059	0.138	0.131	0.113	**0.688**

Reliability and Convergent Validity

Table 3 shows the descriptive statistics and first-order item loadings for the constructs. All constructs had Cronbach's alpha value of 0.707 or larger indicating adequate internal consistency (Nunnally and Bernstein 1994). Convergent validity refers to the degree to which the items measuring the same construct agree (Cook and Campbell 1979). Three tests were used to determine the convergent validity of the constructs: item loading, composite reliability of construct and the AVE extracted by construct. All item loadings for these first-order components were greater than 0.7.

Table 4 presents the loadings, composite reliability and the average variance extracted (AVE) of all second-order constructs. All composite reliability scores were greater than 0.7, the criterion recommended by Nunnally and Bernstein (1994), thus demonstrating sufficient reliability for all constructs. Average variances extracted were also all above the recommended threshold of 0.5, proving further convergent validity. These tests therefore provided evidence for adequate convergent validity of the constructs in the study.

Testing of the Structural Model

With sufficient evidence of good psychometric properties from the reliability and validity tests, the structural model was next assessed to evaluate its explanatory power and the significance of the hypothesized paths. Figure 2 shows the path analysis results of the structural model. Since Smart-PLS does not directly permit the modeling of second-order constructs with first-order constructs, the approach employed by Yi and Davis (2003) was used. The first-order factor scores were first computed and then used as manifest indicators of the second-order constructs.

The R^2 value of the endogenous constructs represents the amount of variance explained of a construct and is an indication of the explanatory power of the structural model. On the other hand, path coefficients represent the strength and direction of the relationships between the dependent and independent constructs, and thus serve as verifications of the hypotheses in the model. The standard errors and the significance of the path coefficients were determined by performing a boot-strap re-sampling procedure.

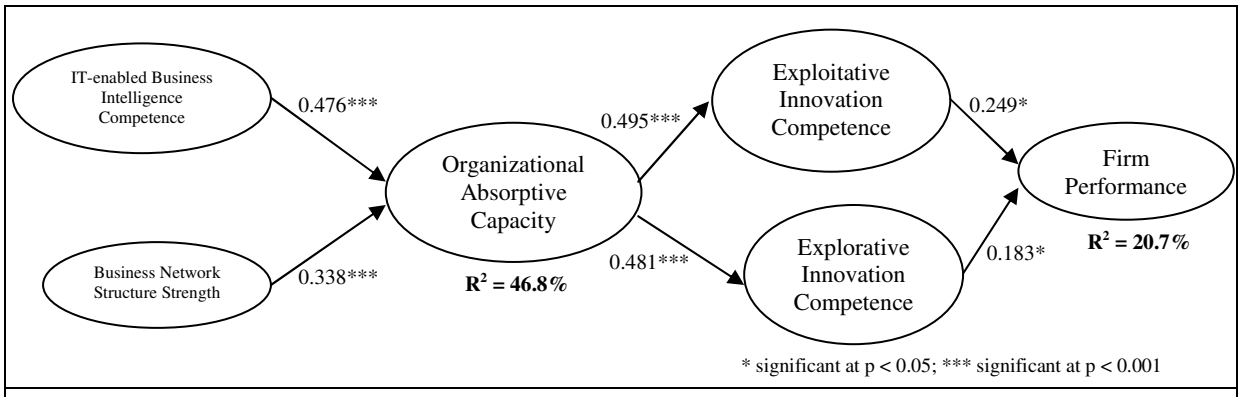

Figure 2. Results of PLS Analysis

Table 3. Descriptive Statistics of Constructs and Item Loadings for First-Order Components

Constructs (Measurement Items) – All items measured on 7-point Likert scales	Item Loading
IT-enabled BI Competence: BI Technologies (*Cronbach's Alpha* = 0.779; Mean = 4.115, Std. Dev. = 1.208)	
We provide our staff with push technologies tools that automatically deliver information on subscribed keywords and topics (e.g. RSS news feeds and Google Alerts).	0.783
We provide our staff with fee-based subscription databases (e.g. Industry indicators, statistics or technological developments databases).	0.891
We provide our staff with specialized business intelligence software.	0.865
We provide our staff with real-time IT dashboard reporting.	0.728
IT-enabled BI Competence: BI Technologies Leveraging Capability (*Cronbach's Alpha* = 0.914; Mean = 4.823; Std. Dev. = 1.108)	
Our staff regularly utilize the available IT tools to identify and recognize valuable external information.	0.908
Our staff frequently use IT tools to monitor the important news and events in our industry.	0.883
Our staff are able to make use of the available IT tools to analyze, process, interpret and internalize new knowledge.	0.900
Our staff are able to utilize IT to incorporate new knowledge into business processes.	0.873
Business Network Structure Strength (*Cronbach's Alpha* = 0.830; Mean = 5.027; Std. Dev.= 0.864)	
We have built an extensive network with our external business partners.	0.876
We have established reliable relationships with our external business partners.	0.878
We share a great deal of information with our business partners.	0.756
We often receive timely feedback about our organization from our external partners.	0.733
Organizational Absorptive Capacity: Exploratory Learning (*Cronbach's Alpha* = 0.871; Mean = 4.786; Std. Dev. = 0.866)	
We are able to collect sufficient information from our external environment to meet our needs.	0.847
We are able to quickly identify valuable external information through multiple means and sources.	0.910
We are able to recognize the value of new information easily.	0.881
We have effective processes in place to understand new knowledge.	0.752
Organizational Absorptive Capacity: Transformative Learning (*Cronbach's Alpha* = 0.897; Mean = 4.664; Std. Dev. = 0.908)	
We are able to quickly relate newly acquired knowledge with what is already known.	0.871
We are able to combine newly acquired knowledge with existing knowledge effectively.	0.892
We have effective processes to share new knowledge between different parts of the organization.	0.838
We have adequate routines to assimilate new knowledge into our business processes.	0.902
Organizational Absorptive Capacity: Exploitative Learning (*Cronbach's Alpha* = 0.923; Mean = 4.700; Std. Dev. = 0.935)	
We have routines in place to facilitate the access to knowledge.	0.886
We are able to use assimilated knowledge to further create new knowledge.	0.926
We are able to incorporate new knowledge into our operations.	0.930
We are effective in applying new knowledge in our provision of products and services.	0.871
Exploitative Innovation Competence (*Cronbach's Alpha* = 0.882; Mean = 5.235; Std. Dev. = 0.952)	
We regularly make incremental changes to existing products and services.	0.856
We frequently make improvements to products and services based on demands of current customers.	0.881
We continuously improve on the efficiency of our provision of products and services.	0.909
We strive to lower costs when providing products and services to our existing customers.	0.801
Exploitative Innovation Competence (*Cronbach's Alpha* = 0.854; Mean = 5.047; Std. Dev. = 0.998)	
We frequently explore new opportunities in unfamiliar markets.	0.803
We regularly search for and approach new customers in emerging markets.	0.811
We extend our current products and services range to attract new customers.	0.896
We frequently develop new capabilities that increase our future viability.	0.824
Firm Performance (*Cronbach's Alpha* = 0.907; Mean = 4.881; Std. Dev. = 0.785)	
revenue growth	0.805
profit growth	0.862
market share growth	0.709
profitability	0.830
return on investment (ROI)	0.871
return on assets (ROA)	0.885

Table 4. Psychometric Properties of Second-Order Measurement Model			
Constructs	**Loading**	**Composite Reliability**	**AVE**
IT-enabled BI Competence (BIC)		0.869	0.770
BI Technologies	0.808		
BI Technologies Leveraging Capability	0.942		
Organizational Absorptive Capacity (ACAP)		0.936	0.831
Exploratory Learning	0.923		
Transformative Learning	0.933		
Exploitative Learning	0.877		

Discussion and Implications

Key Findings

46.8% of the variance in organizational absorptive capacity and 20.7% of the variance in firm performance can be explained by the variables in the research model. All the hypotheses were supported at $p < 0.05$ and all control variables were insignificant at $p < 0.05$. Overall, the results provide empirical support for the enabling roles of IT-enabled BI competence and business network structure strength in building absorptive capacity to manage external information sources in digital extended enterprises. The study also offers insights into the performance outcomes of developing higher levels of absorptive capacity.

Antecedents of Organizational Absorptive Capacity

The antecedents of IT-enabled BI competence and business network structure strength both significantly impact absorptive capacity. The path coefficient for the hypothesis (H1) between BI competence and absorptive capacity ($b = 0.476$, $p < 0.001$) is larger than the hypothesis (H2) on business network structure strength and absorptive capacity ($b = 0.338$, $p < 0.001$). IT-enabled BI competence is enterprise-centric in that it is developed through investments into BI technologies and nurturing its corresponding leveraging capability. Firms have more control over these aspects and expectedly, these should have a greater impact on its absorptive capacity. On the other hand, the strengthening of business network structure with external partners through the utilization of IT is relatively more external focus and is subjected to various factors such as inter-firm IT interoperability. While firms can depend on its extensive business networks to receive early information, developing its internal IT-enabled BI competence seems likely to have more impact in enhancing absorptive capacity.

Performance Outcomes of Organizational Absorptive Capacity

Results indicate that a higher degree of absorptive capacity have significant contributions to both exploitative innovation competence as well as explorative innovation competence. The findings dovetail with the recent process-oriented operationalization of absorptive capacity as three constituent processes of exploratory learning, transformative learning, and exploitative learning. These absorptive capacity processes enhance the frequency, speed, and scale of innovation, which in turn produces new knowledge and information to enrich the knowledge base on which ACAP depends (Lane et al. 2006). In particular, it has been argued that ACAP which draws on a knowledge base with a narrow range but in-depth and highly correlated knowledge domains lends itself to incremental innovations, which in turn yields new information and knowledge closely related to the existing knowledge domains to further increase the depth of the knowledge base. Correspondingly, more emphasis on exploratory learning results in an ACAP that draws from a broad-ranging knowledge base with diverse knowledge domains that lends itself to radical innovations, which in turn yields new knowledge and information to further increase the breadth of the knowledge base (Van den Bosch, Volberda, and De Boer 1999).

Findings indicate that both forms of innovation competences significantly impact firm performance. This is consistent with prior research which found that organizations devoting resources to meet the needs of current customers in existing markets at the expense of addressing emerging markets ran the risks of unsustainable performance (Christensen and Bower 1996). Those firms that focus exclusively on serving current customers may lead them to ignore potential customers, thus resulting in missed market opportunities (Danneels 2003).

Limitations and Future Research

The present analysis, however, remains incomplete for a variety of respects. First, the interpretation of the findings should take into consideration that data was collected in Singapore. Although the dataset comprises of local as well as foreign companies from diverse industry sectors with a good mix of organizational characteristics, future research should attempt to replicate the study in other countries. Second, although rigorous statistical tests have been performed to address potential respondent bias, it should be noted that there could still be possible biases due to single informant responses. It would certainly be ideal to collect the data from multiple respondents. Third, there is a need to refine the conceptualization and definition of BI technologies as the technology develops and matures. Finally, longitudinal studies would be a fruitful pursuit to study the effects of IT on ACAP, and the subsequent impact on innovations and firm performance. In addition, it is also possible to examine the effects of contingency factors such as environmental dynamism on the relationships between innovation competences and firm performance.

Managerial and Theoretical Implications

Findings from this exploratory study has laid the groundwork to address the role of IT, in particular BI technologies in building organizational absorptive capacity, innovation competences, and firm performance. The results advance our understanding about the knowledge-intensive organizational processes to which IT can lead to firm performance in digital extended enterprises. There are numerous managerial and theoretical implications that can be derived.

The results provide substantial empirical support that IT-enabled BI competence can have a direct positive impact on a firm's ability to improve its absorptive capacity for managing external information sources. Findings suggest that the provision of BI technologies in the organization, when combined with effective BI technologies leveraging capability, strongly enhance the information-intensive processes of absorptive capacity. In the present difficult business environment, BI technologies' ability to let users make faster, better and more-informed decisions are particularly important. Next, extended enterprises should also be mindful of the role that its external business network plays in enhancing its absorptive capacity. Hence, it pays for firms to forge strong relationships with their business partners and also build seamless digital conduits to share information with them. Finally, results reveal that a high degree of absorptive capacity plays a very crucial role in enhancing organizational innovation competences. This suggests that the ability to leverage on appropriate information and communication technologies to improve organizational absorptive capacity would remain to be a priority for digital extended enterprises.

This paper contributes new perspectives to current stream of work on ACAP by incorporating the construct as a core component in the research model for the digital extended enterprise context. Past studies citing ACAP have mainly included it as a mere ritual citation, contributing to the reification of the concept (Lane et al. 2006). This study offers a rejuvenated examination of ACAP and innovations in the context of BI technologies and business network structure. Second, this study has examined the ACAP-enhancing effects of IT-enabled BI competence and business network structure strength, thereby extending the understanding of both as integral aspects of an organization's knowledge management capability, which is an increasingly crucial factor in business responsiveness. Third, by synthesizing the more recent process-oriented view of ACAP, and by linking it to innovation outcomes, this research provides a more holistic view of ACAP as second-order construct composed of three equally important processes. By operationalizing ACAP as processes and innovation as an outcome separately, it also rectified the common problem of previous studies which measured both ACAP and innovation in an outcome-oriented manner, as patents and new products. This research also has some implications for researchers interested in the role of IT for designing knowledge-intensive ambidextrous organizations.

Conclusion

The present information explosive era offers both opportunities and threats to digital extended enterprises. Competitiveness hinges on the organization's ability to effectively leverage on IT to acquire, manage, assimilate and exploit information. While technologies to manage internal knowledge have become quite matured, the use of IT to manage external information is still in a relatively nascent stage. BI technologies present an immense opportunity for firms to dramatically improve their ability to make more informed decisions through better management of external information. By taking a process-oriented perspective of organizational absorptive capacity, and examining its IT and business network enablers as antecedents and innovation competences as outcomes, findings from this research would be useful for further research on the role of IT in enhancing organizational absorptive capacity and innovation activities in digital extended enterprises.

Acknowledgements

This research was partially supported by the National Natural Science Foundation of China (NSFC Grant No. 70890081). The author would like to thank Hock-Hai Teo for his insightful comments and Min-Jia Ng for her assistance in the conduct of this study.

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