THE ROLE OF INFORMATION TECHNOLOGY IN ALLIANCE CAPABILITIES: THEORETICAL MECHANISMS AND EMPIRICAL EVIDENCE

Completed Research Paper

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Abstract

A longstanding body of information systems (IS) research in interorganizational relationship management has examined the role of IT resources in facilitating interactions between business partners. Much less attention, however, has been paid to the role of IT resources in developing firm-specific capabilities for managing such relationships, which become increasingly complex as the number and scope of interorganizational interactions increase. Drawing upon previous works on organizational learning and dynamic capability, we propose a theoretical framework and discuss key mechanisms that convert firm-level IT resources into alliance capability, which influences the performance of individual alliances. Following an event-study approach, this empirical study analyzes the effect of IT expenditure and the deployment of knowledge management systems (KMS) on the stock market response to a new alliance announcement. Our analyses of 1,389 firm-alliances announcement data from 1998 to 2003 provide generally strong support for our hypotheses.

Keywords: IT Business Value, Strategic Alliance, Alliance Capability

Introduction

Information technology (IT) and electronic linkages within and among organizations have fundamentally remapped the boundaries of organizations (Melville et al. 2004; Sahaym et al. 2007; Straub and Watson 2001; Straub et al. 2004; Zammuto et al. 2007). Modern business organizations build and maintain multiple relationships with diverse business partners, creating the interfirm connections that comprise an essential competitive advantage (Dyer and Singh 1998; Dyer et al. 2001; Gomes-Casseres 1994). One salient example of such relationships is a strategic alliance, which refers to a contractual arrangement between two or more independent firms that involves the exchange, sharing, or co-development of resources or capabilities to achieve mutually relevant benefits (Gulati 1998; Kale and Singh 2009). The enhanced capacity to manage complex inter-organizational activities through IT resources has enabled firms to engage more aggressively in strategic alliances (Sahaym et al. 2007; Tafti et al. *forthcoming*). The growing number, as well as the increasing scope and importance attributed to alliances within corporate strategy has made it clear to alliance managers and researchers that, even though strategic alliances represent an essentially dyadic exchange, the processes and outcomes associated therewith are critically dependent on the firm's internal management capability (Kale and Singh 2009). This firm-level capability is referred to as an alliance capability, or a firm's ability "to identify [alliance] partners, initiate alliances, and engage in the ongoing management and possible restructuring and termination of these alliances" (Khanna 1998 p. 351). Alliance researchers argue that an alliance capability is vital to a firm's success in strategic alliances because it can provide a platform for a firm to replicate its achievements in prior alliances or to apply the lessons gleaned from past failures to future partnerships.

The proliferation of interfirm interactions has provided fertile ground for information systems (IS) research. Much IS research has been devoted to identifying the role that IT resources play in facilitating interactions between business partners in various forms of interorganizational relationships, such as those with suppliers and channel partners. For example, early studies examined the value of specific IT systems such as electronic data integration (EDI) that enable seamless connection between business partners (e.g. Mukhopadhyay and Kekre 2002). More recent studies, meanwhile, have investigated the compatibility and flexibility of IT infrastructure between partners, components that support business process integration and bilateral knowledge sharing (i.e. Rai and Tang 2010; Tafti et al. *forthcoming*). Much less attention, however, has been paid to the role of IT resources in developing firm-specific internal capabilities for managing such interorganizational relationships, whose ties become increasingly complex as the number and scope of interfirm interactions expand. It is a commonplace observation that IT resources now assume a critical function in the management of alliance activities. For example, many high-performing firms involved in strategic alliances, including Hewlett-Packard, Cisco Systems, FedEx and Xerox, have invested in IT applications and electronic databases in order to support various aspects of alliance-related tasks, such as partner selection, process management, decision making, and performance evaluation (Corporate Strategy Board 2000). Interest in IT investment remains high, as attested to by numerous practitioner-oriented business articles that indicate these examples as best practices for firms to benchmark (Corporate Strategy Board 2000; Dyer et al. 2001; Gomes-Casseres 1998). However, there is a relative paucity of empirical and theoretical examinations of the performance implications for IT resources in strategic alliances, barring a few notable exceptions (Chi et al. 2010; Tafti et al. *forthcoming*). Few studies have empirically investigated the effect of IT resources on managing alliance relationships from the focal firm's perspective. As a result, we know little about whether the application of IT resources can improve, reduce, or have no effect on alliance outcomes. We thus ask the following Research Question: *Is there an association between the application of IT resources and alliance outcomes, and if so, what are the underlying theoretical mechanisms*?

This study proposes that IT resources can serve as a critical enabler for the development of alliance capabilities. We build on the recent IT literature that suggests that IT resources enable higher-order business capabilities, which in turn influence firm performance (Mithas et al. 2011; Pavlou and El Sawy 2006; Rai and Tang 2010; Ray et al. 2004, 2005; Tanriverdi 2005; Whitaker et al. 2010). Drawing upon the theories of dynamic capabilities (Eisenhardt and Martin 2000; Teece et al. 1997) and organizational learning (Huber 1991), we hypothesize that firms with more IT resources are expected to achieve higher performance because IT resources contribute to the development of an alliance capability by facilitating organizational learning and encouraging alliance managers to follow discipline routines. We examined our hypotheses by investigating the relationship between the stock market response to a new alliance announcement and the IT resources of a firm in terms of annual IT expenditure and the deployment of knowledge management systems (KMS). Here, the unit of analysis is the firm-alliance level. Assuming that expectations for the success of alliances are accurately reflected in the stock market responses to the announcements, we analyzed 1,389 firm-alliances of 131 firms involving 1,337 alliances from 1998 to 2003 using the event-study approach. The results provide generally strong support for our hypotheses.

The remainder of this study is organized as follows. In the following section, we provide a review of the relevant background literature and then supply examples of IT resources in the management of strategic alliances. Next, we develop the pertinent theoretical framework and discuss the hypotheses. A description of our research design and data are followed by a discussion of results and the conclusion.

Literature Review

IT Business Value in Interorganizational Relationship

We begin by reviewing prior IS studies germane to our own study. The number of IS studies in the strategic alliance context is somewhat limited, however, necessitating a broad consideration of the IS research examining interorganizational relationships. IS researchers studying interorganizational issues have applied a wide range of theoretical lenses to examine the impact of IT resources on organizational performance in interorganizational relationships, such as transaction cost economics (TCE), information-processing theory, the resource-based or relational view (RBV) of firms, and the competitive dynamics perspective. Some studies examine the effect of efficiency gains via IT advances on the firm size (Brynjolfsson et al. 1994; Clemons and Row 1992; Gurbaxani and Whang 1991) and the number of suppliers of a firm (Banker et al. 2006; Malone et al. 1987). Other researchers view interorganizational systems (IOS) as a mechanism to reduce potential opportunistic behavior, and investigate the bargaining power of firms and its effect on performance (Kim and Mahoney 2006; Subramani and Venkatraman 2003). The studies espousing the information processing perspective have examined the alignment between the needs and the capability for information processing with the consideration of IT resources as a key determinant of a firm's information processing capability (Bensaou and Venkatraman 1995; Malone and Rockart 1991; Mani et al. 2010; Premkumar et al. 2005). The studies espousing the RBV view IOSs or IT integration as relation-specific assets or capability that support tightly-integrated interorganizational routines (Barua et al. 2004; Rai et al. 2006; Subramani 2004). Other studies emphasize the flexibility of IT resources that support dynamic adjustments of their procedures, processes, and structure to changing environments and partners (Gosain et al. 2004; Klein and Rai 2009; Malhotra et al. 2005, 2007; Rai and Tang 2010; Saraf et al. 2007).

The preceding review concurs with the assertion of Malhotra et al. (2005) that IS studies on interorganizational relationship issues have tended to focus either on the supporting IT interface between partners or the relational aspect of IT-supported interorganizational interactions. Though studies in this vein provide insights for improving the effectiveness of interorganizational processes, largely focusing on transactional improvements, application of these frameworks to strategic alliances is somewhat limited in scope. Strategic alliances involve a diverse set of business activities, which tend to pursue longer-term strategic goals rather than immediate operational improvement. Though recent IS studies place increasing emphasis on strategic information sharing and long-term benefits, the limited scope of activities such as supply-chain management raises doubts concerning the applicability of conclusions from prior IS research to more strategy-oriented and knowledge-intensive interorganizational collaborative efforts, which tend to demand a relatively lower level of IT and process integration than in supply-chain relationships. The discrete nature of the strategic alliance in terms of the purpose of the interactions, the types of activities involved, and the scope and depth of collaboration necessitates the development of a new theoretical perspective, one providing deeper insight on the role of IT resources within such relationships. We address this knowledge gap in this study.

Developing Alliance Capability

Noting the significant unobserved heterogeneity across firms in alliance performance, alliance researchers suggest the existence of firm-specific internal capabilities, the alliance capability which has garnered much attention in strategy literature as a critical firm capability that is rare, distributed unequally across firms, and difficult for competitors to imitate (Barney 1991; Kale and Singh 2009). Recent alliance research investigates the question of how this capability develops in a firm. One key finding in this stream is the significant effect exerted by alliance experience. Several studies have shown that firms "learn by doing" by engaging in alliances, and that firms with ample breadth of experience tend to notch better alliance performance measured as the impact on firm valuation

(Anand and Khanna 2000), long term performance (Kale et al. 2002) and patent activities (Sampson 2005). These studies argue that, based on such experience, firms develop the knowledge to identify alliance opportunities, form alliances, manage alliance relationships, and transfer information to and from alliance partners. However, Kale et al. (2002) assert that the mere possession of experience is insufficient in and of itself, and that firms require an additional mechanism which explains "how prior experience translated into a capability (p.749)". Kale and his colleagues argue that firms need disciplined processes and a learning mechanism and show that a dedicated alliance function, which governs all alliance activities in an organization, explains a significant portion of the performance variances in alliances, because the function serves as a critical mechanism for the coordination of alliance activities and knowledge management for sharing best practices. Their subsequent study empirically shows that dedicated alliance functions facilitate a firm's "alliance learning process", which involves articulation, codification, sharing, and internalization of alliance management know-how (Kale and Singh 2007). Still, as the authors also noted, having a dedicated function is only one of a wide range of actions that firms can undertake to develop an alliance capability, a phenomenon that demands further research.

Theory and Hypotheses

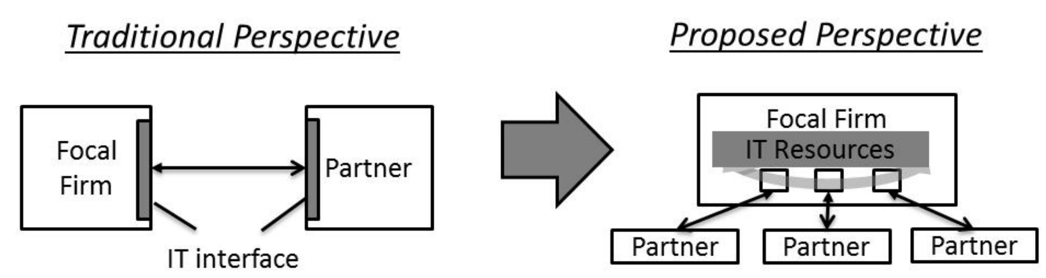

Figure 1. Theoretical Perspective

We propose a new theoretical perspective for interpreting the role of IT resources in interorganizational relationships (Figure 1). While the traditional approach focuses on IT resources connecting a focal firm and its partners, the new approach focuses on IT resources residing within a firm and the development of a firm-specific capability to leverage relationships. This perspective springs from the growing complexity in managing multiple alliances and the increasing weight placed on the contributions of IT resources to the development of organizational capabilities. We suggest that IT resources encourage firms to develop alliance capabilities and boost alliance performance. The organizational learning theory (Huber 1991) and the dynamic capability perspective (Eisenhardt and Martin 2000; Teece et al. 1997) serve as the theoretical underpinning of this study.

Dynamic Capability and Organizational Learning

An alliance capability is considered as a key dynamic capability of a firm which involves "integrat[ing], build[ing], and reconfigure[ring] internal and external competencies to address rapidly changing environments" (Teece et al. 1997 p. 516). This perspective argues that a dynamic capability develops in a firm through deliberate learning efforts aimed at articulating and codifying knowledge relevant to specific tasks (Eisenhardt and Martin 2000; Zollo and Winter 2002). However, unlike individual knowledge situated in discrete persons, the knowledge of an organization represents a collective knowledge pool spatially distributed throughout the organization. Therefore, organizational learning requires the clarification of the *mechanisms* or *processes* for firms to leverage knowledge dissipated throughout an organization. The organizational learning theory posits that the learning process of organizations involves acquiring, distributing, and interpreting information (Huber 1991; Tippins and Sohi 2003), the processes which affect organization members' shared assumptions and beliefs, modify the range of their behaviors, and thus influence the levels of organizational effectiveness and performance (Huber 1991; Stein and Zwass 1995). The theory also introduces the concept of organizational memory, which refers to "the amount of stored information or experience an organization has about a particular phenomenon" (Tippins and Sohi 2003). The IS research employing the organizational learning theory suggests that IT resources facilitate organizational learning by supporting the learning processes and helping organizational memory to store information from past activities and outcomes (Malhotra et al. 2005; Robey and Boudreau 1999; Walsh and Ungson 1991).

IT Resources and Learning in Alliances

In strategic alliances, firms can learn various aspects of alliance management from experience, such as identifying opportunities, selecting partners, designing contracts, governing processes, transferring information to and from alliance partners, etc. Throughout the lifecycle of an alliance, these prior experiences and the resultant knowledge can provide critical guidance specific to the organizational context. This advantage is possible because experience expands the repertoire of management practices and processes that a firm can draw from and apply to its new alliance (Argote et al. 1990; Baum and Ingram 1998; Chang 1995; Lieberman 1984). Empirical studies provide evidence that alliance experience has a significant and positive relationship with various measures of alliance outcomes, such as market expectation as manifested in abnormal returns (Anand and Khanna 2000), a survey-based long-term performance measure (Kale et al. 2002), and patent counts in high-tech industries (Sampson 2005).

According to the organizational learning theory and the dynamic capability perspective, however, experience alone may not be sufficient to guarantee better organizational performance. In addition, strategic alliances are often initiated and executed at a business unit level, a practice which can spawn potential complications. One is that it can create inconsistent approaches to alliances across business units. Another is that the resultant alliance knowledge is likely to be scattered across business units in an organization, inhibiting the identifying of the existence and location of available alliance-related knowledge within the firm (Alavi and Tiwana 2002). Both can work against the effective learning to enhance alliance capabilities. Alliance researchers emphasize the need to develop a firm-level routine for the alliance process (Dyer et al. 2001; Gomes-Casseres 1998; Kale et al. 2002), because developing a firm-level routine can facilitate organization-wide learning efforts. Such routine can encourage alliance managers to apply their best knowledge in managing the alliance process, such as assessing the suitability of potential alliance partners, drawing up alliance arrangements, and assaying alliance performance (Kale and Singh 2007).

We view investment in IT resources as constituting a firm’s deliberate efforts to develop alliance capability, efforts which facilitate effective learning for alliance management and encourage alliance managers to adhere to disciplined alliance procedures by embedding the best practices and know-how into IT-enabled processes.

IT resources can refer to IT applications, such as tools, databases, and digitalized knowledge repositories, which help alliance administrators manage processes and knowledge for individual alliances. IT-enabled guidelines, checklists, or manuals can encourage alliance managers to take a consistent approach to decision making during the different phases of strategic alliances and potentially minimize process variability across business units (Frei et al. 1999; Kale and Singh 2007). These disciplined process enabled by IT resources can also facilitate organization-wide learning efforts by encouraging the replication and transfer of best practices within a firm by rendering a new practice easier to apply (Galunic and Rodan 1998). For example, Dow Corning Corporation uses IT-enabled tools which provide guidelines to alliance participants by specifying working procedures for task execution. These tools help alliance managers save time and improve the quality of process management by reducing the risk of neglecting important steps in the processes or sequencing activities incorrectly. Furthermore, such tools also have built-in best practices with the description of each process step. Such integration can further facilitate the usage of prior knowledge because alliance managers can refer to their best practices during the processes without the need to consult a separate system for necessary information. Another example is Cisco System’s Partner Candidate Assessment database. It contains a list of potential candidates for alliances with brief evaluations that include both quantitative and qualitative information, such as a candidate’s current market position, future outlook, and its strategic and organizational fit with Cisco (Corporate Strategy Board 2000). While the use of IT resources cannot totally obviate the search process, they can certainly contribute to the improvement of a firm’s ability to identify good alliance opportunities through the rigorous vetting involved in the action. Moreover, the system can also encourage alliance managers to account for corporate-level alliance considerations in their partner selection processes, such as corporate partnering objectives, strategic implications, and partnering trends.

IT resources that potentially contribute to the development of alliance capabilities can also take the form of networking applications, such as online messenger and web 2.0 applications. Enhanced interactions among organizational members enabled by IT resources can facilitate the acquisition, distribution, and interpretation of alliance-related knowledge throughout the organization (Alavi and Leidner 2001; Goodman and Darr 1998; Huber

1991; Kane and Alavi 2007; Tippins and Sohi 2003). An extensive web of communication channels constructed by emails, online messenger, groupware, online communities, and now pervasive social network applications (e.g. internal wikis and blogs) can facilitate the sharing and transfer of information and knowledge among alliance managers. In addition, these systems also stimulate mutual understanding among alliance managers and strengthen the social ties that support sense-making, perspective sharing, and development of tacit knowledge (Sambamurthy et al. 2003).

Taken together, IT resources may contribute to the development of alliance capability by encouraging disciplined routines for alliance management and facilitating organizational learning efforts. Therefore, the enhanced alliance capability can increase the likelihood of alliance success.

> ***Hypothesis 1.*** *Alliance announcements from firms with more IT resources will result in higher abnormal stock market returns than announcements from firms with lesser IT resources.*

Among IT resources, the Knowledge Management System (KMS) can be particularly useful from the organizational learning perspective in that these systems are developed "to support and enhance the organizational process of knowledge creation, storage/retrieval, transfer, and application (Alavi and Leidner 2001 p. 114)". One key component of KMS is IT-enabled group memory systems, which can nurture the communicability of organizational knowledge by enabling easy access, modification, share, and reuse (Alavi and Leidner 2001; Stein and Zwass 1995). Moreover, because memory systems permanently store relevant information, they can help human actors overcome information overload and support their role as information processors (Stein and Zwass 1995). High-quality and multiple informational media with interrelated informational items situated in context can further support organizational members in internalizing and interpreting new knowledge (Stein and Zwass 1995). In addition, for knowledge that is difficult to codify into memory systems, KMS often provides supplementary mechanisms, such as corporate knowledge directories that compile internal and external experts, facilitating direct interactions to share tacit knowledge (Alavi and Leidner 2001). For example, online expert directories allow alliance managers to search for experts well-versed in the issues for which they require counsel and narrow down their search by multiple criteria depending on their particular needs, including by alliance type and specific relationship (Corporate Strategy Board 2000). Experts can share insights germane to their bailiwick and provide guidance for future courses of action.

Therefore, firms with KMS are more likely to effectively facilitate the type of organizational learning that develops alliance capability, which positively influences the likelihood of alliance success.

> ***Hypothesis 2.*** *Alliance announcements from firms with more KMS will result in higher abnormal stock market returns than announcements from firms are more likely to success in alliances than firms with less KMS.*

Research Methodology: Event-Study Analysis

The performance consequences of alliances for participating firms are difficult to investigate empirically, because a firm engages in many other non-alliance activities that influence its performance (Gulati 1998). In attempting to mitigate this difficulty and to assess the effect of individual alliances on firm performance, several studies have adopted the event study approach, which primarily examine how the stock market responds to information newly released to the market – in this case, the announcement of a new alliance (Anand and Khanna 2000; Chan et al. 1997; Das et al. 1998; Kale et al. 2002). The event-study approach has been extensively exploited in finance and accounting as well as in alliance and IS research that examine whether investments in IT increase the market value of a firm (Chatterjee et al. 2002; Dehning et al. 2003; Dos Santos et al. 1993). The underlying assumption of this methodology is that the stock market is efficient; stock prices incorporate all relevant information about the value-creation and growth prospects of a firm. With the release of new information about an event, investors assess the value of investment associated with the event. If the investment is expected to outweigh the costs, the additional benefit exceeding costs derived from the investment will be correctly reflected on firm valuation, and the firm will enjoy excessive market returns. Cumulative abnormal return (CAR) is calculated by aggregating these excess returns surrounding the announcement of an event, an alliance announcement by a firm in our case. The use of CAR as a measure of performance is a standard approach in event studies. We used a five-day period from two days before to two days after. We examine the CAR as a function of IT resources of the firm and relevant controls. It is important to note that this measure is an *ex ante* expectation held by stock market investors and may not perfectly predict *ex post* outcomes.In the strategic alliance context, Kale et al. (2002) provide a validation for the use of *ex ante* market

Table 1. Measure and Data Source

Variable	Description	Source of Data
CAR	Aggregated abnormal returns of a five-day period surrounding the alliance announcement, from two days before to two days after.	Eventus (which uses the CRSP database)
ITEXP	The percentage of annual IT budget with regard to the total sales.	Information Week survey
KMS	The first component of unrotated principal component analysis (PCA) of the indicators variables for systems used for knowledge-management strategy within a firm, including the following: (1) group memory/context management, (2) expert profiling, (3) data mining, (4) groupware, (5) data warehouse, (6) relational databases, (7) text/document search, (8) expert databases/artificial intelligence, and (9) data-mining tools.	
EXP	Log-transformed count of total alliances formed by each firm, up to and including the specific alliance in question for the past five years.	SDC Platinum
MULTIACT	Dummy variable that indicates whether the alliances involve more than two types of alliance activities	
MULTIPART	Dummy variable that indicates whether more than two firms involve in the alliance	
INTERNATIONAL	Dummy variable that indicates international alliances.	Compustat North America
SIZE	Log-transformed total assets for each firm	
FIRM	Dummy variables of each firm	
YEAR	Dummy variables of each year	SDC Platinum
IND	Dummy variables indicating industry classification of alliance activities identified at the one-digit SIC level.	Eventus (which uses the CRSP database)

expectations as predictive indicators of alliance outcomes by showing that the initial stock market response to an alliance announcement is positively and significantly correlated with the long-term alliance performance that is assessed by firm managers who were in charge of a given alliance.

The level of a firm's IT resources is measured with two constructs. One of key explanatory variables, ITEXP, is calculated as the ratio of annual IT expenditure to the total sales of a firm. For the comprehensiveness in capturing all of a firm's IT related expenses, such as hardware, software, data communication, and salaries and recruitment of IT professional, this construct has been used as a proxy for overall IT resources of a firm in prior studies (Bharadwaj, Bharadwaj, and Konsynski 1999; Chari, Devaraj, and David 2008). The effect of KMS is examined by using data on the deployment of KMS (KMS) within a company. In the IW survey, firms responded which systems are used in their knowledge-management strategy among the following: (1) group memory/context management, (2) expert profiling, (3) data mining, (4) groupware, (5) data warehouse, (6) relational databases, (7) text/document search, (8) expert databases/artificial intelligence, and (9) data-mining tools. An unrotated principal components analysis (PCA) reveals that all items comprising the measure of KM load positively onto the first principal component. Hence, we used the first principal component of PCA in all subsequent analysis. One potential concern for these measures is that information concerning these IT resources is not publicly available to stock market investors and thus may not affect an investor's evaluation of a firm's alliance capability. However, major IT investment and projects are often publicly announced, albeit without exact figures. Therefore, it may not be unreasonable to assume that stock market investors can come to a general conclusion about the level of IT resources available within a firm.

We obtained IT expenditure and KMS data from the Information Week annual surveys (1998-2003) and retained only publicly listed and identifiable firms for further analyses. We retrieved alliance information, in which at least one Information Week sample firm was involved, from the Securities Data Company (SDC) Platinum database on Joint Ventures and Alliances. For each alliance announcement, we calculated the CAR around the announcement date. We removed the cases where a firm announced two or more alliances on the same day. Table 1 presents the measure of other variables with their sources.

To determine whether IT resources constitute a significant explanatory factor for alliance outcome as measured by abnormal stock returns, we formulated the following equation:

$$\begin{aligned} CAR_{ijt} = {} & \beta_{CONS} + \beta_{IT} IT_{jt} + \beta_{KM} KM_{jt} + \beta_{EXP} EXP_{ijt} + \beta_{SIZE} SIZE_{jt} \\ & + \beta_{MULTIACT} MULTIACT_i + \beta_{MULTIPART} MULTIPART_i \\ & + \beta_{INTERNATIONAL} INTERNATIONAL_i \\ & + \boldsymbol{\beta_{FIRM}} FIRM_j + \boldsymbol{\beta_{YEAR}} YEAR_t + \boldsymbol{\beta_{IND}} IND_i + \varepsilon_{ijt} \end{aligned}$$

where *i* represents each alliance announcement of firm *j* in year *t*. In this regression model, the dependent variable is cumulative abnormal returns (*CAR*) that occur around the time of the alliance announcement. The Feasible Generalized Least Square (FGLS) estimation method was used in this study. It should be noted that not all errors in the model are independent. A firm may have multiple observations in a given year, representing the firm's participation in multiple alliances. FGLS allows us to relax one of the ordinary least square (OLS) assumptions, namely that the variances of error terms are constant across observations. We grouped observations at a firm level and allowed the variances of error terms to vary across firms. This procedure allows for potential correlation between error terms across the observations within alliances announced by a given company[1].

Results

The sample consists of 1,389 firm-alliance observations, involving 131 firms and 1,337 alliances. Of the 1,337 total alliances, 47 of them (4% of the total) involved two or more firms within the sample, creating 52 additional observations at a firm-alliance level. The rest involved an alliance between an Iweek sample firm and out-of-sample partners for which there is no IT-related data. In the sample, most firms announced less than ten alliances in a year, with the maximum number of alliances for a given firm standing at 50. Table 2 and Table 3 provides descriptive statistics and the correlation matrix for the key variables.

Table 2. Summary Statistics

	Obs.	Mean	Std. Error	MIN	MAX
CAR	1389	.0014433	.0633112	-.3880819	.6793082
ITEXP	1389	4.51635	3.7751	.5	30
KMS	1389	.0772002	1.390862	-5.471045	1.566396
EXP	1389	3.722299	1.231816	0	5.916202
SIZE	1389	10.09289	1.331258	6.603042	13.55533
MULTIACT	1389	.4802016	.4997878	0	1
MULTIPART	1389	.1396688	.346768	0	1
CROSSBORDER	1389	1.483081	.4998937	1	2

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3. Correlation Matrix

	CAR	ITEXP	KMS	SIZE	EXP	MULTI-ACT	MULTI-PART	CRPSS-BORDER
CAR	1							
ITEXP	0.0126	1						
KMS	0.0379	0.104^{***}	1					
EXP	0.00804	-0.0356	0.383^{***}	1				
SIZE	-0.0513	0.0136	0.340^{***}	0.495^{***}	1			
MULTIACT	0.0375	0.0544^{*}	-0.00218	-0.0190	-0.0301	1		

[1] We still assume that the errors are independent from firm to firm (no cross-firm correlation).

MULTIPART	-0.0379	0.00344	-0.0100	0.0769**	0.0416	-0.0339	1	
CROSSBORDER	0.00558	-0.0114	0.0991***	0.125***	0.108***	-0.0381	0.130***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

IT Resources and Alliance Capability

The results from the FGLS estimation are shown in Table 4. First, in Model I, the result shows that IT expenditure and the deployment of KMS are both significant factors in explaining abnormal stock market returns; the coefficients of IT expenditure and KMS are positive and significant (p<0.01), even after controlling for experience and the average performance differences across firms. This finding suggests that the market rewards firms that invest in IT and KMS when those firms enter alliances, thus providing the empirical support for both hypotheses (Hypothesis 1 and 2). The significant effects of both IT expenditure and KMS imply that the benefits reaped from IT resources arise not only from general IT resources but also from the facilitating of learning through KMS.

Next, we analyzed the data at a firm level by taking average CARs across all the alliances forged by a firm over the course of a year (Model II). This analysis was conducted to address potential concerns that a few firms in the sample which account for a large number of observations might exert an inflated influence that would bias the results. To mitigate the potential bias of implication due to the diverging number of observations by firms, we averaged abnormal stock returns across all alliances established by a firm in a given year, creating cross-section time-series data. Because we do not have observations of firms for all years, the panel is necessarily unbalanced. Each firm has, at most one observation per year in this new dataset, which is estimated with the FGLS panel model with firm dummy variables[2]. Model II shows the FGLS panel regression results, with the firm's average abnormal stock returns per alliance (AVGABNORMAL) as the dependent variable. The findings of Model II provide further support for Hypothesis 1 and Hypothesis 2, demonstrating that the effects of IT expenditure and KMS are positive and significant at the 1 percent level.

Table 4. FGLS Result: Excessive Returns from Alliance Announcement[3]

	Model I	Model II	Model III		Model IV	
	All	Firm-Level	Non-equity	Equity	NON-TECH	TECH
ITEXP	0.00373**	0.00411***	0.00396**	0.00394	0.00623***	0.000277
	(0.00166)	(0.00146)	(0.00160)	(0.00361)	(0.00223)	(0.00291)
KMS	0.00515***	0.00275***	0.00589***	0.00293	0.00172	0.00635**
	(0.00166)	(0.00103)	(0.00157)	(0.00324)	(0.00159)	(0.00252)
Firm Size	0.00316	-0.0154***	-0.00239	0.0818***	-0.000303	0.00805
	(0.00980)	(0.00582)	(0.0103)	(0.0245)	(0.0115)	(0.0144)
EXP	-0.000344	-0.00484	-0.00226	-0.0341**	-0.0190***	0.0165*
	(0.00568)	(0.00464)	(0.00526)	(0.0148)	(0.00562)	(0.00873)
MULTIACT	0.00458**		0.00196	0.00539	0.00227**	0.00364^{+}
	(0.00179)		(0.00174)	(0.00425)	(0.00102)	(0.00230)

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[2] Mathematically, in the following panel model, FGLS allows the idiosyncratic errors, u_i to be heteroskedastic:
$y_{it} = \alpha +_{it} +c_t + u_i + e_{it}$

[3] A split-sample approach is equivalent to an analysis that includes interaction terms between category variables (dummies indicating equity/non-equity or tech/non-tech alliances in our case) and all other variables in a model (i.e. full-dummy interactions). This approach allows the effect of all variables to vary depending on the types of alliances and has been commonly used in alliance research using an event-study approach (Anand and Khanna 2000; Das et al. 1998; Kale et al. 2002). We also conducted a simplified analysis that includes the interaction terms between categorical and IT variables only, but the implications from the results are not substantially different from the discussion presented here.

MULTIPART	-0.00706***		-0.00578	-0.0101^{+}	-0.00172	-0.0122**
	(0.00218)		(0.00453)	(0.00640)	(0.00487)	(0.00474)
CBPART	-0.000332		-0.00340*	0.00607	0.000300	-0.00131
	(0.00178)		(0.00175)	(0.00501)	(0.00311)	(0.00223)
Cons	-0.0257	0.106^{+}	0.0361	-0.942***	-0.0146	-0.108
	(0.0856)	(0.0687)	(0.0893)	(0.297)	(0.121)	(0.119)
Firm Dummy	Yes	No	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Ind. Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Num. of obs.	1389	327	1162	227	646	743
Num. of firms	131	131	130	85	121	112

Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01, Estimates of firm, industry, and year fixed effects are suppressed.

We conducted additional analyses to check the robustness of the findings. First, we checked whether the results are preserved when the industry is controlled with two-digit SIC level dummy variables. I used one-digit SIC level dummy variables in the main model in order to alleviate the loss of degree of freedom in the estimation, because the model also includes firm-level dummy variables. The use of two-digit SIC level dummy variables does not change the substantial meaning of the analytical results. Second, different measures of experiences did not substantially alter the meaning of the results. We examined different time intervals for measuring experiences, using three- and nine-year windows, and also examined the count of experience without taking log transformation. The significance of the results, however, remained unchanged.

IT-Enhanced Alliance Capability and Types of Alliance Activities and Governance Structure

Alliances comprise a wide range of collaborative activities between firms. Alliances involve a mix of the features of hierarchies and markets, and equity and non-equity alliances – alternative alliance forms – straddle the continuum between hierarchy and market. Also, the depth of collaboration, types of knowledge shared between partners, and levels of complexities and uncertainties surrounding alliances largely depend on the specific types of alliance activities. Therefore, it would be worthwhile to examine whether the impact of IT resources vary significantly across different types of alliances.

While a non-equity alliance relies on the specifications of alliance activities in a contract, an equity alliance, also known as a joint venture, establishes a new corporate entity which is crafted specifically for alliance activities, and which remains separate from the participating parent organizations (Mayer and Argyres 2004). Prior alliance studies have shown that equity alliances derive greater benefits from having more extensive alliance experiences or having a dedicated alliance function, the factors which are likely to enhance alliance capabilities, because equity alliances involve more complex and ambiguous situations in general (Anand and Khanna 2000; Kale et al. 2002; Sampson 2005). To test whether the impact of IT expenditure and KMS also varies under different governance structure (equity versus non-equity alliances), we conducted the analysis separating the sample into two groups according to the contract types (Model III). The results show that the coefficients of both variables are positive and significant only for non-equity alliances. However, the difference in the effect sizes is statistically significant only for KMS.

Next, we examined whether the effect of IT resources varies according to the type of alliance activity (Model VI). Following the related studies, we categorized alliances that involve the joint development of new technology or technological process, such as manufacturing, software development, research and development as technological alliances. Das et al. (1998) have demonstrated that technological alliances generally provide greater benefits than non-technological alliances because technological alliances involve more valuable and hard-to-transfer knowledge, which provide long-term benefits. However, technological alliances involve generally a higher level of uncertainty and ambiguity because firms tend to enter into them in the relatively earlier stage of the life cycle of their products or services, making it difficult to establish property rights over knowledge generated from alliances in advance (Das et al. 1998). Prior empirical studies have shown more potent effects of alliance experiences on performance in technological alliances than in non-technological partnerships when the performance is measured by abnormal returns in the stock market (Anand and Khanna 2000) and by the patenting activities of high-tech firms (Sampson 2005). Similar to the analyses for the contract types, we conducted an analysis separating the sample into two groups according to their main activities (Model IV).

Discussion

Summary of Findings

Does investment in IT resources enhance the likelihood of the success of a firm in strategic alliances? In this study, we examine this question by investigating the relationship between a given firm's IT resources and its alliance outcomes, quantified as the stock market response to the announcement of a new alliance by the company. Drawing upon the theory of organizational learning and dynamic capabilities, we argue that IT resources contribute to the development of alliance capability by supporting the implementation of firm-wide disciplined routines for alliance management and facilitating the process of acquiring, distributing, and sharing alliance management skills and best practices. The empirical findings are generally supportive of this hypothesis.

The results of Model I and Model II support the hypotheses that a firm's IT expenditure and KMS deployment are positively related to abnormal returns from alliance announcements (Hypothesis 1 and 2), even after controlling for experience and the average performance differences across firms. This result suggests that firm-specific IT resources contribute to developing alliance capability, which enhances the likelihood of alliance success. The significant effects of both IT expenditure and KMS imply that the benefits reaped from IT resources arise not only from the facilitating of learning through KMS, but also from general IT resources.

The results of Model III show that the effect of IT-enabled alliance capability of a firm is significant and positive for non-equity alliances. This finding is notable, because the factors identified in prior studies were relatively less critical for non-equity alliances, while our results imply that IT resources may provide greater benefit for non-equity alliances than for equity types. A potential explanation is that IT resources may provide different types of benefits for non-equity alliances, the benefits that might be difficult to obtain from alliance experiences or dedicated functions. Though the complexity or uncertainty associate with non-equity alliances is relatively lower, non-equity alliances still face significant managerial challenges because they do not have formal mechanisms for governance and solely depend on contract specifications. Implementing routines, which can be supported by IT resources, may provide significant benefits in the absence of equity-based governance mechanisms. The study conducted by Zollo and Winter (2002) also suggests that implementing routines, which can be supported by IT resources, can provide higher benefits in the absence of equity-based governance mechanisms because a non-equity agreement lacks incentive alignment and control properties. Prior IS literature showing IT resources as having a greater effect in facilitating markets than in coordinating activities in hierarchies also provides support for this view (Brynjolfsson et al. 1994; Dewan et al. 1998; Gurbaxani and Whang 1991).

The findings of Model IV show that the effect of IT expenditure is positive and significant only in non-technological alliances. On the other hand, the effect of KMS is positive and significant only for both technological alliances. A potential explanation for this finding is that discrete alliance types call for different types of support from IT resources. The insignificant effect of IT expenditure for technological alliances may be attributable to the fact that the management of technological alliances tends to involve more subtle issues, thus limiting the benefits gained from general IT resources, such as informal IT-enabled communications and digitalized guideline applications. The positive and significant effect of KMS may imply that KMS do support the sharing of more tacit knowledge that is beneficial for both technological and non-technological alliances.

Though this is not the primary focus of our study, it would be useful to discuss the effect of alliance experience on a firm's alliance outcome as observed during the analyses. While earlier studies have shown that greater alliance experience leads to better alliance outcomes (Anand and Khanna 2000; Sampson 2005), we observe that the influence of alliance experience is not significant, and can even be negative in some cases. We weighed two potential explanations for this observation. One is the different timeframe of the sample. The data used in this study are more recent (from 1998 to 2003) compared to prior studies, which used data from the early '90s, when relatively few firms had extensive alliance experience. Thus, one possibility is that firms eventually engage in so many strategic alliances that the effect of incremental experience might become insignificant over time. Even worse, the seemingly undiscerning participation in strategic alliances by some firms in the late '90s may have spawned anxiety among and given negative impressions to stock investors. Another possibility is that the effect of alliance experience may not directly affect alliance outcomes, but rather that its influence is manifested through the effective management of knowledge acquired from experience. Kale and Singh (2007) also found no significant direct link to alliance experience when they accounted for alliance functions, arguing instead that alliance function is a more significant predictor of a firm's alliance success than the experience variable. Likewise, the result of this study may uphold the firm-wide discipline routines and learning efforts enabled by IT resources as a more important explanation for alliance success than the mere possession of more experience.

Limitations and Contributions

This study encompasses limitations that suggest opportunities for further research. First, we did not directly measure alliance capability in terms of the specific managerial skills required to administer various aspects of alliance tasks. Rather, based on the assumption that IT resources cultivate alliance capabilities that lead to better alliance outcomes, the empirical analysis related a firm's IT resources to market expectations for alliance success. Therefore, one path for future research is to directly examine whether IT resources improve the elements constituting an alliance capability. Second, we examined the IT resources of firms as measured by IT expenditure and KMS deployment. However, prior studies suggest that a mere deployment of IT resources may not be sufficient for firm to generate quantifiable values, instead stressing that the actual use of IT resources (Devaraj and Kohli 2003) or the ability to leverage them (Mithas et al. 2011) is more important. Therefore, future research investigating the actual usage or capability of leveraging IT resources in alliance management and its effect on alliance capabilities would buttress the model presented in this study. Finally, a survey approach would allow future work to measure *ex-post* actual alliance outcomes, such as managerial assessment of long-term performance (Kale et al. 2002), and examine the robustness of the findings of this study.

This study potentially comprises several important contributions. First, broadly speaking, it contributes to the vein of IT business value literature that considers organizational capabilities as key intermediates (Banker and Bardham 2006; Melville et al. 2004; Ray et al. 2005). By examining the role that IT resources play in developing alliance capability, this study advances prior works that examined the relationship between IT and organizational capabilities. Second, this study expands our understanding of the factors underlying firms' alliance capability and overall alliance outcomes. Though we still do not fully understand how a firm develops alliance capability, we believe this study will help illumine the black box in which the process's underpinnings are obscured. Third, this study represents a nascent attempt to explore the role assumed by IT resources in strategic alliances. Despite increasing interfirm interactions via alliances, the expanse of IS literature focusing on strategic alliances remains a sparsely populated realm. This work's alliance-level analysis enables a deeper examination of the influence of IT resources, such as their various impacts within different regimes of alliances vis-à-vis alliance activities and governance structures. Finally, the study's findings have important practical implications. Congruent with the increasing strategic importance of alliances, there has emerged a need for managers to determine whether and how they can utilize IT resources to enhance the performance of strategic alliances. The findings of this study suggest that firms can engage organization-specific IT resources to develop alliance capability, which, in turn, can enhance the performance of their strategic alliances. The findings of our work suggest that companies desiring to possess alliance capabilities and enhance alliance performance should invest in firm-specific IT resources that can serve as a critical mechanism for developing the capabilities and engendering improved alliance outcomes.

Conclusion

Strategic alliances have become an indispensable choice in most industries, allowing companies to keep abreast of fast-changing business environments. Despite speculation on the value of IT resources in strategic alliances, which have become an important channel of interfirm interaction, the diversity of strategic alliances in terms of purpose, activity, depth of interaction, and type of knowledge exchanged between partners, obfuscates whether and how IT resources contribute to alliance performance. We hope that our research stimulates further explorations on the interplay between IT resources, organizational capability, and interorganizational interaction.

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