

**Information Systems, Alliance Portfolios, and Firm
Performance: A Theoretical and Empirical Analysis**

by

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Dedication

To my teachers and family members

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Abstract

A longstanding body of information systems (IS) research has been devoted to identifying the role of information technology (IT) in enhancing organizational performance. As interorganizational relationships have become an important source of competitive advantage, recent research has examined the role of IT in facilitating interactions between business partners. Much less attention, however, has been paid to the role of IT in developing firm-level internal capabilities for managing such relationships, which become increasingly complex as the number and scope of interorganizational interactions increase. Drawing on theories of dynamic capabilities, the knowledge-based view of the firm, and organizational learning, I develop a theoretical model that posits how IT contributes to the development of firm-level capabilities that enhance alliance performance (Chapter 2). This model suggests that digitized process and knowledge supported by IT contribute to the development process by facilitating organizational learning of alliance-specific tasks, institutionalizing alliance management processes, and increasing the capacity to exploit the knowledge obtained from alliance partners. In Chapter 3, using the event-study methodology, I empirically analyze the influence of a firm's use of IT-enabled knowledge platforms on the stock price response to a new alliance announcement. In Chapter 4, by employing a social network analysis (SNA) technique, I investigate the interactions between a firm's IT investment and the alliance network of the firm, as well as their consequent influence on the performance of the firm. In summary, this dissertation presents a new theoretical perspective and empirical evidence regarding the role of IT in the

interorganizational relationship management context, with a particular focus on strategic alliances. The prospective contribution of this dissertation to the business value of IT literature is mainly twofold. First, this dissertation investigates the role of IT within a wider range of interorganizational collaborations (i.e. strategic alliances) that goes beyond the primary focus of prior IS studies, which emphasized the supplier-buyer relationship. Second, this dissertation advances understanding of the relations between firm-level IT and organizational capability building.

Chapter I. Introduction

I-1. Motivation and Research Questions

The performance implications of investment in information technology (IT) comprise a central issue in IT business value literature (Melville, Kraemer, and Gurbaxani 2004). While earlier studies demonstrated the significant contribution of IT on a firm's overall performance, the focus of more recent inquiries on the business value of IT evinces an increasing desire to open the "black-box" and understand the "underlying mechanisms" through which IT improves organizational performance (Sambamurthy, Bharadwaj, and Grover 2003). In particular, these latter studies have highlighted the context and conditions under which IT exerts a beneficial impact on business (Melville et al. 2004). This dissertation thus represents a natural progression of prior works aimed at extending general knowledge of the business value of IT, but differentiates itself by examining the performance effect of firm-level IT in the context of strategic alliances¹. I have chosen this particular context due to (1) its strategic and economic significance in modern business environments and (2) insufficient theoretical framework and empirical evidence to show performance implication of firm-level IT in strategic alliances, despite of plentiful anecdotal examples that suggest significant value creation.

Alliances have become an integral part of corporate strategy. Contemporary business environments often described as "networked-economies" (Van de Ven 2005), "loosely-coupled organizations" (Sahaym, Steensma, and Schilling 2007), and "extended-enterprises" (Krishnan, Rai, Arun, and Zmud, Robert 2007), the phenomena which reveal the degree to which

¹ Formally, an alliance is defined in strategy research as "a voluntary arrangement between firms involving exchange, sharing, or co-development of products, technologies, or services"(Gulati 1998). Schreiner, Prashant Kale, and Corsten (2009) refined this definition to "a medium- to long-term contractual arrangement in which two or more independent organizations acknowledge their mutual interdependence and strive to pool their resources to jointly create an outcome that neither of the exchange parties can easily attain on its own (p.1402)."

interorganizational collaborations such as alliances have become engrained in modern businesses. The number of new alliances created annually around the world has exceeded 4,000², even as the scope of alliances has been extended from relatively simple peripheral activities to more advanced stages of the value chain (Lavie 2007). According to a report by Partner Alliances, over 80% of Fortune 1000 CEOs believed that alliances would account for almost 25% of their companies' revenue in 2007-08 (Kale, Singh, and Bell 2009). In line with such trends, the alliance has gained cachet as an attractive strategic tool, a hybrid form that merges considerations of market transactions and full-fledged acquisitions and potentially offers benefits that combine the advantages of both. Alliances provide access to proprietary resources which might not be available from market transactions, while obviating the need for long-term commitment such as that required by acquisitions. Therefore, some alliance researchers suggest that the essential value of alliances lies in providing real options that enable firms to access additional resources and explore new business activities by making sequential investments with limited risk. Indeed, today's fast-changing and highly uncertain business environments have only enhanced the attractiveness of alliances (Brown and Eisenhardt 1997; Hoffmann 2007; Kogut 1991; Steinhilber 2008).

The advance of IT, including enhanced communication technologies and cheap bandwidth, have been frequently noted as a key enabler of alliances (Prahalad and Krishnan 2008; Steve Steinhilber 2008). This assessment has arisen from the confluence of the proliferation of alliances with the advance of IT in the 80's-90's. Recently, Sahaym, Steensma, and Schilling (2007) investigated this relationship and empirically showed whether IT investment has blurred boundaries between firms resulting from alliance formation. This result

² The data is obtained from Thomson Corporation, SDC Platinum, which is one of the data sources used in Chapter 3 and Chapter 4.

substantiates the role of IT as a facilitator in alliances and raises a subsequent question: does IT also make firms perform better in alliances? Various IT applications supporting alliance activities have reinforced this speculation (Table 1). The performance implication of IT in alliances, however, has rarely been examined at length in Information Systems (IS) literature.

Table I-1. Examples of IT resources for alliance management	
IT Applications	Brief Descriptions
Process Guidelines	Dow Corning Corporation provides IT-enabled guideline tools for alliances, which provide an activity checklist, best practices, and critical success factors, allowing alliance managers to save time and improve the quality of alliances by reducing the risk of neglecting important steps in the processes or sequencing activities incorrectly.
Contact Directory	Hewlett-Packard has incorporated a contact directory for alliances in its intranet, which provides alliance participants with access to expertise from inside and outside the company. This system allows users to search directories by multiple criteria depending on their particular needs.
Alliance Status Database	Fedex has an alliance database which provides (near) real-time information on all existing partnerships. Alliance participants can easily access this database (on a tiered basis) to get information about on-going partnerships. This system helps Fedex prevent conflicts of interests between alliances and/or leverage current partnerships for future business opportunities.
	Ernst & Young uses a sophisticated groupware for reporting and tracking the firm's alliances. This digitalized system helps the alliance team manage detailed information and the progress of existing alliances. In addition, through the company's electronic network, field personnel can access this database from anywhere and quickly locate necessary information about their current and prior alliances. Through a digitalized platform, a firm can enhance its ability to track progress, estimate performance, and manage the ongoing relationship with partners (Gomes-Casseres 1998).
Partnership Candidate Assessment	Cisco Systems utilizes a tool which assists in evaluating potential alliances and partners based on a variety of criteria, both quantitative and qualitative. The criteria include a candidate's current market position, future outlook, and strategic fit with Cisco.
Alliance portal	Cisco Systems has a Web-based alliance-dedicated portal accessible through the corporate intranet. This portal not only provides a single-point access to all alliance resources, but also provides a repository of alliance news and information. It allows alliance participants to reduce the need to search for scattered tools and information.

Source: Corporate Strategy Board (2000), Gomes-Casseres (1998)

Building on IS studies of interorganizational relationships and the business value of IT, my dissertation explores three new areas that remain relatively uninvestigated in IS research. First, the strategic alliance has rarely been considered as a research context in IS research. Prior studies employing the term “alliance” used it indiscriminately to denote both a contract-based supplier-buyer relationship and a more expansive definition of the word and generally failed to distinguish between the two concepts (e.g. Rai and Tang 2010). However, a strategic alliance comprises a wider range of inter-organizational collaboration than that embodied in supplier-buyer relationships. Alliances have penetrated into a broad set of business activities such as marketing, research and development (R&D), and globalization. For example, Cisco Systems partnered with Hewlett-Packard (HP) for the manufacturing and marketing of networking solutions, an alliance which allowed Cisco to focus on its core technology while providing customers vertically integrated solutions by leveraging HP’s products and technologies. Google, T-Mobile, Qualcomm, Motorola and 30 other companies formed an alliance in 2007 for the development of Android, the first open platform for mobile devices. This partnership enabled developers, wireless operators and handset manufacturers to lower the cost of developing and distributing mobile devices and services with Android, contributing to its rapid growth³. The French food giant Groupe Danone, meanwhile, leveraged several alliances with Chinese companies such as Hangzhou Wahaha Group Co. Ltd. in the course of penetrating the local market and securing a market-leading position (Wassmer, Dussauge, and Planellas 2010). Indeed, the upsurge in alliance partnerships attests not only to their increasing advocacy in the business world, but to a robust diversity in the type and purpose of such partnerships as well. The distinction between alliances and supplier-buyer relationships in terms of the purpose of the

³ The market share of Android increased from 7% in February 2010 to 27% in May 2011. During the same period, Apple’s iPhone increased its share of the smartphone market from 8% to 17%. Source: <http://tech.fortune.cnn.com/2011/06/30/nielsen-androids-growth-curve-flattened-in-2011-while-the-iphones-got-a-boost/>

interactions, the types of activities involved, and the scope and depth of collaboration, raises questions over the applicability of conclusions from prior IS research to the alliance context. The discrete nature of the strategic alliance necessitates the development of a new theory, one providing deeper insight on the role of IT resources within such relationships.

Second, the influence of firm-level IT resources in interorganizational relationships has been heretofore only sparsely investigated. Prior interorganizational relationship studies in IS have tended to focus on relationship-specific or partnering issues, such as relationship-specific IT systems (e.g. electronic data exchange), the compatibility or flexibility of IT architecture (e.g. the use of standard interfaces or service-oriented architecture), and the supporting role of IT in aligning business processes directly linked to the relationship (e.g. Malhotra et al. 2007; Rai and Tang 2010; Saraf et al. 2007; Tafti 2009; Yao et al. 2009). However, many examples shown in Table 1 suggest that firm-level internal-purpose IT resources have also played a central role in initiating and managing alliance relationships. Scholarly analysis of whether and how these investments lead to better alliance performance, however, remains in an incipient stage in IS research. The consistent outperformance of some firms in alliances (Anand and Khanna 2000) and the discrepancy between values appropriated by partners from an alliance (Lavie 2007) suggest that organizations diverge widely in their capability to manage and utilize alliance partnerships. The distinctive characteristics of capability required for managing individual alliances⁴ call for a systematic approach to managing alliance processes and knowledge, a strategy that has proven to be a key driver for superior alliance performance⁵ (Anand and

⁴ In Strategy literature, this capability is referred to as an alliance capability, “a firm’s ability to identify partners, initiate alliances, and engage in the ongoing management and possible restructuring and termination of these alliances” (Tarun Khanna 1998 p. 351).

⁵ The performance of an alliance can be measured in terms of the performance of the alliance relationship itself and the performance of firms entering alliances (Gulati 1998). In this dissertation, I will use the term *alliance performance* to refer to the latter concept. It will be discussed in detail in Chapter 2.

Khanna 2000; Kale, Dyer, and Singh 2002; Kale and Singh 2007). Among the initiatives to develop this organizational capability, IT resources have played a central role (Table 1); but the question of whether and how these investments lead to better alliance performance has remained unanswered.

Third, the focus on relationship-specific issues has also led to the neglect of cross-relationship management within alliances, a critical area of concern as firms increasingly engage in multiple partnerships. Scholars have argued that a valuable alliance as a stand-alone may not necessarily be value-creating from an alliance portfolio perspective because of potential interdependencies (Hoffmann 2007; Wassmer 2010). Multiple simultaneous engagements in alliances have become common in businesses. For example, at the time of the Cisco-HP alliance, Cisco already had partnerships with several other companies, including EDS, IBM, Intel, Microsoft, Motorola, and Sony. Similarly, HP also maintained partnerships with Accenture, Deloitte, Disney, Intel, Oracle, etc. (Casciaro and Darwall 2003). Noting the frequency with which many firms engaged in multiple alliances, scholars have argued that firms should view these partnerships as a part of their overall alliance portfolio (Hoffmann 2007), because “managing a portfolio of 30 or more alliances is fundamentally different from managing a few scattered joint ventures”, as noted by Anderson Consulting⁶. In addition to the capability to manage individual alliances, firms with multiple alliances need the capability to strategically allocate, coordinate, and exploit the available internal and external resources accessible through such partnerships. If a firm lacks this capability, having multiple partnerships can destroy the collective value of alliances, especially when a newly formed alliance overlaps in product or market scope with an existing partner’s business operations (Hoffmann 2007; Wassmer 2010).

⁶ From “Dispelling the myths of Alliances”, cited in Corporate Strategy Board (2000)

For example, the alliance between Danone and Wahaha Group mentioned earlier was terminated due to Danone's other competing joint ventures with local companies in China, leading to the loss of almost US \$3 billion in revenue for Danone (Wassmer et al. 2010). A multipartner alliance among Singapore Airline, Delta Airline, and Swissair was also terminated, mainly due to a conflict with the new code-sharing agreement between Deutsche Lufthansa and Singapore Airlines (Wassmer et al. 2010). Such contingencies do not necessarily lead to the termination of pre-existing relationships, but the focal company may still incur increased costs for managing interdependencies and resolving conflicts. Thus, some researchers suggest that firms should view a discrete alliance as one component of an overall alliance portfolio (Hoffmann 2007). In an attempt to prevent potential conflicts and to cross-pollinate relationships with multiple partners, firms such as Fedex, Cisco, and Ernst & Young utilize IT resources that allow managers to obtain real-time information on all of the company's on-going partnerships (Corporate Strategy Board 2000). Prior interorganizational relationship studies in IS research, however, are inherently silent on these cross-relationship management issues due to their limited focus on individual relationships.

To summarize, this dissertation aims at filling these gaps in knowledge and expanding understanding of the business value of IT. More specifically, the goals of this dissertation are:

1. To provide a theoretical framework of the business value of IT in interorganizational relationships in order to articulate the role of IT within a broader set of interorganizational business collaborations, i.e. strategic alliances, which go beyond supplier-buyer relationships.

2. To understand the underlying processes through which the investment in firm-level IT (as opposed to relationship-specific ones) influences the performance consequences for firms from interorganizational relationships such as alliances.
3. To understand the effect of a focal firm's IT in coordinating across relationships and exploiting external resources obtained from business partners connected through alliance partnerships.

I-2. Summary of Dissertation Research

This dissertation comprises three related studies that explore questions about the role of IT in alliances. In the second chapter (Chapter 2), I develop a theoretical framework which places emphasis on the function of IT as a platform for developing and improving a firm's capability to manage and leverage alliances. The two subsequent chapters empirically examine the performance effect of IT for firms from the perspectives of individual alliances (Chapter 3) and of overall alliance portfolios⁷ (Chapter 4), while the final chapter provides conclusions (Chapter 5). A brief overview of these studies follows below.

⁷ An alliance portfolio refers to the collection of alliance relationships in this dissertation.

Table I-2. Overview of dissertation

Title	Research Question	Type	Description
Chapter 1. Introduction	This chapter explains the motivation of this dissertation and posits the central research question: What are the performance implications of IT in the context of strategic alliances?		
Chapter 2. The Role of IT in Orchestrating Extended Enterprise through Alliances	How do IT resources contribute to modern organizations whose businesses are extended to partner firms through alliances?	Conceptual	This chapter uses a multitheoretical framework to argue that firm-level IT contributes to alliance performance by providing platforms to develop the capability to strategically leverage and orchestrate alliance partnerships.
Chapter 3. The Effect of IT-enabled Knowledge Platforms on the Market Value Effects of Alliance Announcements	Is there an association between the use of IT-enabled knowledge platforms and alliance performance outcomes?	Empirical	This empirical event-study analyzes the effect of the use of IT-enabled knowledge platforms on the stock market response to a new alliance announcement. The analysis of 439 alliance announcements provides results which are broadly supportive of the hypothesis that the use of firm-level IT-enabled knowledge platforms enhances the performance consequence for firms from individual alliances.
Chapter 4. IT Investment Payoff and Alliance Networks: The Effect of Network Centrality and Partner Diversity	Do a firm's network centrality and the diversity of its partner composition in an alliance network influence the payoff of the firm's IT investment?	Empirical	Using a social network analysis (SNA) technique, this chapter investigates the interaction effects between a firm's IT investment and alliance network variables – network centrality and partner diversity – on financial performance. This chapter provides evidences that IT investment provides greater benefits for firms that are at a central position in the alliance network and that have diverse alliance partners.
Chapter 5. Conclusions	The final chapter summarizes the theoretical and managerial implications from the three studies and identifies directions for future research.		

Chapter 2: The Role of IT in Orchestrating Extended Enterprise through Alliances

The second chapter develops a theoretical framework which explains the role of IT within modern business organizations, which have become nodal entities in interorganizational networks consisting of diverse alliance partners (Prahalad and Krishnan 2008). My review of literature reveals that the prior approach of IS literature concerning the business value of IT and interorganizational relationships has traditionally restricted itself to analyzing relationship-specific or partnering issues, such as information exchange and process integration between partners mainly in supply chains. However, noting the increasing number and scope of alliances that a typical firm engages, recent alliance research emphasizes the firm-level capability to manage alliances as a key driver for alliance performance (Anand and Khanna 2000; Kale et al. 2002). Moreover, these studies provide strong theoretical incentives to examine the role of IT in developing this capability (Kale and Singh 2007). Accordingly, this chapter places particular emphasis on learning and capability-building perspectives.

By drawing upon dynamic capabilities (Teece, Pisano, and Shuen 1997), organizational learning (Huber 1991), and a knowledge-based view of a firm (Kogut and Zander 1992), I employ a multitheoretical framework to argue that firm-level IT contributes to alliance performance by providing platforms to develop the capability to strategically leverage and orchestrate alliances. This capability includes not only a firm's ability to manage individual alliances, but also the ability to coordinate across relationships and exploit external knowledge obtained from alliance partners. In particular, this chapter proposes digitalized processes and digitalized knowledge as key mechanisms through which IT resources develop this capability. I elaborate on how the digitalization of internal processes and knowledge can influence the extent

to which firms leverage their interorganizational relationships, and conclude the chapter with a set of testable propositions, some of which are tested in the following two empirical studies.

Chapter 3. The Effect of IT-enabled Knowledge Platforms on the Market Value Effects of Alliance Announcements

Does the investment in firm-level IT resources lead to better alliance performance? This chapter proposes to answer this question by empirically examining the effect of a firm's use of IT-enabled knowledge platforms on the performance of individual alliances. In this chapter, IT-enabled knowledge platforms mainly refers to the knowledge-oriented IT applications such as knowledge repositories, expert directories, and groupware, which are developed "to support and enhance the organizational process of knowledge creation, storage/retrieval, transfer, and application (Alavi and Leidner 2001 p. 114)". Drawing upon previous works on organizational learning and capability-building, I identify and discuss key mechanisms that convert the use of IT-enabled knowledge platforms into individual alliance performance. Following an event-study approach, this empirical study analyzes the effect of use of IT-enabled knowledge platforms on the stock market response to a new alliance announcement. Assuming that stock market responses accurately reflect the expectations for the success of an alliance, I analyze 186 firm-year level observations of 67 firms involved in 439 alliances from 1999 to 2003 using the event-study approach. The results are supportive of the hypothesis that the use of IT-enabled knowledge platforms enhances the performance of a firm from individual alliances. However, the hypothesis that predicts the positive interaction between the use of IT-enabled knowledge platforms and alliance experience is not supported. Theoretical contributions and managerial implications are discussed.

Chapter 4: IT Investment Payoff and Alliance Networks: The Effect of Network Centrality and Partner Diversity

In this chapter, I examine the impact of a firm's alliance network on the payoff of IT investment. By employing a social network analysis (SNA) technique, this chapter focuses on a firm's egocentric alliance network (Wassmer 2010), an approach that allows consideration of not only a firm's alliance partners, but also a firm's broader network of alliance relationships. Specifically, I investigate the impact of two factors in the alliance network on IT investment payoff: (1) network centrality, the degree to which a firm is at a central position within the alliance network; and (2) partner diversity, the degree of heterogeneity in partner composition. The research question of this chapter is "does a firm's IT investment payoff is greater for the firm that are at a central position in the alliance network and that have diverse alliance partners?"

Based on earlier works exploring the effect of IT on a firm's information processing and dynamic capabilities, I propose a conceptual model which tackles this question and details the workings of a potential underlying mechanism. To test the hypotheses developed from the model, I examined the performance of 242 public firms in the United States, which provide 825 observations during an 8-year span from 1998 to 2005. By looking at the interaction effect of a firm's IT investment and its alliance network variables (network centrality and partner diversity) on financial performance, the corresponding chapter provides evidence that a firm's investment in IT generates greater positive performance impact if the firm maintains a central position within the alliance network or the firm has diverse partners.

Chapter 5: Conclusions

The final chapter summarizes the academic and managerial implications gleaned from this dissertation study.

I-3.Reference

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Chapter II. The Role of IT in Orchestrating Extended Ecosystems

II-1.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). The strategic alliance is one salient example of such relationships. 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). This capability also involves "the skills to configure [and manage] an alliance portfolio in order to create a set of complete, noncompetitive, and complementary alliances" (Kale and Singh 2009 p. 57). 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. This capability is also imperative for preventing potential conflicts and

fostering inter-alliance complementarities, the interdependences which determine the collective benefit transferred to the firm from its multiple alliance relationships (Hoffmann 2007).

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 plays 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 (e.g. Rai and Tang 2010). Much less attention, however, has been paid to the role of IT in developing firm-level internal capabilities for managing such interorganizational relationships, whose ties become increasingly complex as the number and scope of interfirm interactions expand. A traditional bias towards relationship-specific issues has primarily resulted from the prevailing transaction-oriented perspective of the value of IT and interfirm interactions. While our understanding remains rooted in the original scholastic legacy, interorganizational relationships have nevertheless undergone continual restructuring aimed at realizing higher-order and more strategic goals beyond achieving transactional efficiencies (Gosain et al. 2004). For this reason, Krishnan, Rai, and Zmud (2007) have called for further research on “how IT-enabled process capabilities across the extended enterprise enable firms to leverage resources, exploit competencies, manage partner relationships, and explore opportunities (p.233)”. Therefore, a new perspective on IT is required if we are to deepen our understanding of the role of IT in managing and exploiting the proliferation of interorganizational relationships.

In this chapter, I examine the role of IT in modern firms that are interwoven via strategic alliances. Among the various forms of interfirm relationships, I have chosen to study strategic alliances due to the fact of (1) their profound impact and importance in modern business organizations and (2) the surprisingly scant attention historically paid to the subject in IS research, barring a few recent exceptions (Sahaym et al. 2007; Tafti et al. 2013; Thrasher et al. 2010). The selection of this topic was also motivated by the many examples in business practice (Table 1 in Introduction) and recent academic works that provide a strong theoretical incentive to examine the role of IT in strategic alliances. My own work is, in a sense, a direct descendant of the recent theoretical development in alliance research that focuses on the evolution of alliance capability. Drawing upon the theories of dynamic capability, knowledge-based perspective, and organizational learning, I suggest that the firm-level capability to leverage alliance relationships can be shaped and developed by utilizing the focal firm's IT that provides digitized platform of processes and knowledge. This perspective is consistent with a recent growing body of literature in IS that has incorporated organizational capability into IT business value questions.

In a general sense, the purpose of this chapter is to broaden our understanding of IT business value by first summarizing the accumulating but still diffuse findings of prior literature and then proposing a new theoretical perspective to foment scholarly discussion on the role of IT in strategic alliances. Specifically, the objectives of this chapter are to (1) systematically review the traditional approaches of prior IS research to interfirm relationship management issues, identify their analytical limitations, and discuss other theoretical perspectives that have been widely used in other managerial disciplines to explain the performance of strategic alliances; (2) develop a theoretical model of the underlying process through which IT creates value in strategic

alliances; and (3) set the course for future research by offering a set of propositions for additional investigation.

I begin by briefly introducing how strategy researchers have conceptualized strategic alliances, and then discuss how the concept of alliance capability has evolved in strategy and management literature. Next, I review the IT constructs and theoretical paradigms employed in prior interorganizational relationship studies in IS research in order to provide a basis for knowledge building. This is followed by a discussion on the theoretical perspectives that have been frequently employed in alliance research to explain differences in alliance performance across firms. Based on this review, I develop a theoretical model and research constructs that help explain the influence of IT on a firm's overall alliance performance and suggest a set of propositions. Finally, I conclude by summarizing the findings and limitations of my analysis and by discussing the implications for research in the area of IS and interorganizational relationship management research.

II-2. Research Scope

Before proceeding with the discussion, it is necessary to clarify the scope of this chapter. I will approach the main subject of this chapter – the performance implications of firm-level IT, which supports the digitization of internal processes and knowledge, in strategic alliances – by framing my discourse in three overlapping dimensions of research. First, the discussion about strategic alliances will focus on issues associated with the performance-related consequences of such partnerships. The precedent alliance literature has investigated a diverse set of management issues, such as the formation of alliances (e.g. drivers for the decision to enter into an alliance and the choice of partners) (Doz 1996; Gulati 1995; Lavie and Rosenkopf 2006), their

governance structure (e.g. choice of contract and hierarchical controls), dynamic evolution over time (Ahuja 2000a), and the factors affecting their success or failure (Gulati 1998). This current chapter focuses on the issues of whether and how firms benefit from entering into strategic alliances and what factors influence the resulting performance.

Second, I consider alliance performance to be the performance consequences for a firm resulting from its engagement in alliances (Gulati 1998). Though there may be a high correlation, the performance consequences of alliances for a given firm can differ substantially from the performance of the alliances themselves because the extent of benefits extended by an alliance can vary significantly from partner to partner, depending on their ability to appropriate economic rents from the relationship (Lavie 2007). As this chapter focuses on the effect of a firm's IT on a firm-level capability to generate higher value from alliance relationships, the performance measure from a focal firm's perspective seems to be more relevant than the performance of the alliances themselves.

Third, this chapter focuses on the performance impact of IT in interorganizational relationships. Prior IS research within this interorganizational relationship context can be broadly categorized into two streams: (1) studies on the adoption and governance of interorganizational systems (IOS) and industry standard for information exchange (e.g. XML); and (2) studies on the performance implications of such systems and IT-enabled interorganizational processes. Prior works in the first stream have suggested various determinants regarding the adoption of IOS, such as trust, buyer and supplier power, information processing needs, institutional pressures, network externalities, technology readiness, and instrumental benefits (e.g. Riggins et al. 1994; Teo et al. 2003). However, these issues is not discussed in this chapter. Robey, Im, and Wareham

(2008) is recommended as further reading for those desiring a more comprehensive review of adoption, and governance issues in interorganizational relationships.

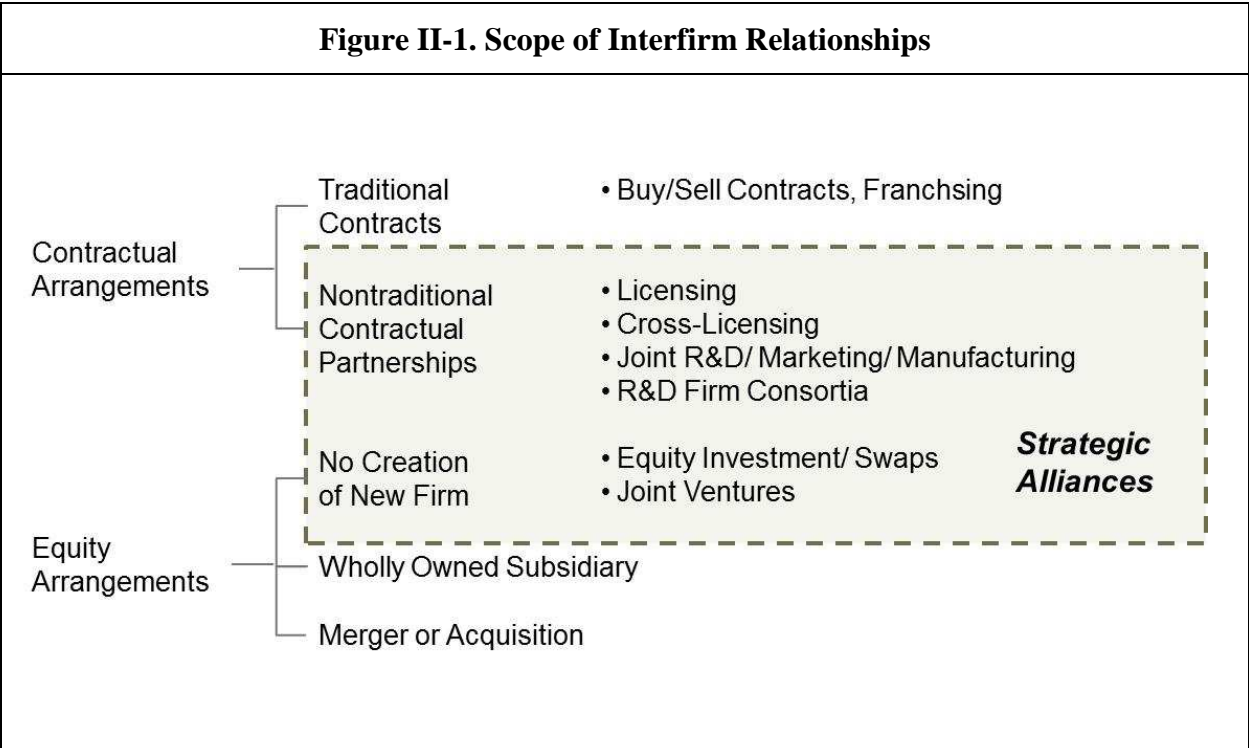
II-3.Strategic Alliances and Alliance Capability

II-3.1.What is a strategic alliance?

In strategy research, though the details slightly vary⁸, an alliance is generally defined as a contract-based inter-organizational collaboration, which 1) involves two or more organizations that are economically independent, 2) pursues specific business purposes that are mutually necessary and beneficial for all participants, and 3) requires participants to pool their resources (both assets and capabilities) to obtain desired outcomes. Figure II-1 below appears in Kale and Singh (2009), and provides an overview of the range of interfirm relationships that can be categorized as strategic alliances. As can be seen in the diagram, alliances represent a continuum of hybrid governance between market and hierarchy.

Compared to traditional contract-based relationships, an alliance is often a longer-term connection which seeks strategic goals rather than immediate operational benefits; it also tends to require more in-depth interfirm collaboration. Accordingly, while most of the knowledge exchanged in a conventional interfirm interaction tends to be operational or tactical (e.g. point-of-sale information or inventory availability information in the case of supply chains), providing little insight for strategic redirection (Malhotra et al. 2005), the knowledge exchanged in alliances often involves tacit knowledge or proprietary know-how (Ahuja 2000b).

⁸ An alliance is defined as a set of “voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services” (Gulati 1998 p. 293). Schreiner, Kale, and Corsten (2009) refine this definition further, deeming it “a medium- to long-term contractual arrangement in which two or more independent organizations acknowledge their mutual interdependence and strive to pool their resources to jointly create an outcome that neither of the exchange parties can easily attain on its own”. Kale and H. Singh (2009 p. 46), meanwhile, suggest another definition: “a purposive relationship between two or more independent firms that involves the exchange, sharing, or co-development of resources or capabilities to achieve mutually relevant benefits.”



Note: Revised from Kale and H. Singh (2009)

On the other hand, alliances are markedly different from mergers and acquisitions (M&A), where one company takes full ownership of another. In an M&A, once the deal and post-merger process are complete, corporate governance enters a stage of internal management, where a single company determines decisions and processes. Alliances, however, are a contract-based relationship between economically independent partners whose interests may not necessarily be aligned. Therefore, alliances are inherently vulnerable to potential opportunistic behaviors of the partners involved. Any ambiguity in governance, resource investment, performance evaluation, and revenue sharing is a potential stumbling block that can undermine commitment and, in extreme cases, even cause the termination of the relationship (Park and Ungson 2001).

A strategic alliance comprises a unique management environment that combines the benefits and challenges inherent in market and hierarchy. Accordingly, the strategic alliance provides a particularly fertile research context for strategy and management literature.

II-3.2. Alliance Capability: Why Do Some Consistently Perform Better Than Others?

The question of whether and when alliances provide financial values to its participants has garnered much attention in strategy literature (Appendix A). Recent alliance research has provided strong theoretical arguments and empirical evidence that the firm-level internal capability to manage alliances, referred to as an alliance capability, plays a key role in shaping both the scope and type of benefits that a firm generates and captures from its alliance relationships. Research regarding alliance capability has examined the ability of a firm for managing (1) individual alliances and (2) alliance portfolio.

Alliance Capability for Managing Individual Alliances

Among alliance studies that have tried to explain the variance in alliance performance, the work of Anand and Khanna (2000) features significant heterogeneity in terms of a firm-level capability to manage and utilize alliance partnerships. This chapter shows that an alliance capability enables firms to repeat their alliance success and achieve improved performance. Subsequent studies examine how this capability develops in a firm (Kale and Singh 2007; Kale et al. 2002). One key finding in this stream is the significant effect exerted by alliance experience. Firms with ample breadth of experience tend to notch better alliance performance, because the firms could 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 to foster learning.

Alliance Capability for Managing Alliance Portfolio

Another stream of research looks at the alliance capability to leverage multiple relationships in its alliance portfolio. In particular, researchers have noted that a given alliance can often influence the other alliance(s) in the focal firm's portfolio, an interdependency that can positively or negatively affect the overall alliance value. On the one hand, a given alliance may jostle with another in the portfolio for the firm's physical or managerial resources, potentially degrading or offsetting any advantage the partnership would otherwise create. On the other hand, some alliances can and do complement each other and deliver additional benefits to the firm. Accordingly, the findings of recent alliance research advise firms to consider their entire set of individual alliances as a portfolio (Hoffmann 2007; Kale and Singh 2009; Wassmer 2010). The capability needed to manage alliances as a portfolio is different from that for individual alliances. Kale and Singh (2009 p. 57) describe this capability as a firm's ability that "comprises multiple dimensions, including the skills to configure an alliance portfolio (to create a set of complete, noncompetitive, and complementary alliances), to foster and maintain trust across different alliance partners in the portfolio, to resolve conflicts between alliances in the portfolio, to coordinate strategies and operations across alliances in the portfolio, to create routines to share operational know-how across alliances in the portfolio, to monitor the extra-additive benefits (and costs) that arise due to interaction between different individual alliances in the portfolio, and so on."

My review of alliance literature reveals that (1) a firm-level capability to manage alliance relationships both at an individual alliance level and at a portfolio level is a crucial determinant of alliance performance and (2) the development of this capability involves intensive knowledge management and complex coordination and control activities, findings that provide a strong incentive to examine the role of IT. However, alliance capability remains a largely uncharted area of IS research. In the following section, I review relevant IS studies and discuss how prior IS research has approached the issues facing interorganizational relationships.

II-4.Prior Approaches to Interorganizational Issues in IS Research

II-4.1.Interorganizational Relationship Studies in IT Business Value Research

In order to initiate a process of knowledge building and scholarly dialogue, I began by reviewing prior IS studies germane to my own work. 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. A description of the review process and the list of articles included in my literature review are provided in the Appendix (Appendix B). The review reveals that IS researchers have adopted diverse conceptual, theoretical, and analytic approaches and employed various empirical methodologies to identify the role of IT in interorganizational relationships. Table II-1 and Table II-2 summarize the forms in which IT has been constructed and modeled and the theories that have been employed in prior IS interorganizational relationship studies.

Table II-1. Construct Space of IT in Interorganizational Relationships Studies in IS Research

Construct	Description	Examples of studies ⁹
Asset	IT is viewed as a tool or physical asset that is developed specifically for interorganizational transaction in the context of interorganizational systems (IOS).	<ul style="list-style-type: none"> • EDI (Barua and Lee 1997; Lee, Clark, and Tam 1999; Mukhopadhyay and Kekre 2002b) • IT-based SCM (e.g. Dehning, Richardson, and Zmud 2007; Rai, Patnayakuni, and Seth 2006) • CRP (Raghunathan and Yeh 2001), VMI (Duchessi and Chengalur-Smith 2008) • Web-based integration hubs (Christiaanse 2005) • Internet referral service (Ghose et al. 2007) • Interpretive systems for interorganizational transactions (Malhotra et al. 2005; Trkman et al. 2010)
Capability	IT capability refers to a firm's ability to use IT strategically for interorganizational relationship management.	<ul style="list-style-type: none"> • IT integration: the ability of a firm to integrate data, communication technologies, and transaction and collaboration applications with business partners such as suppliers, customers, and channel partners; data consistency, real-time communication, ease of access, system compatibility, and seamless connection between partners (Barua et al. 2004; Dong et al. 2009; Grover and Saeed 2007; Rai and Tang 2010; Saraf et al. 2007) • IT flexibility/reconfiguration: the ability of a firm to extend and recombine IT with business partners; modularity (such as component design and reusability), adaptability, scalability, and the use of standards (Byrd and Turner 2000; Duncan 1995; Gosain et al. 2004; Rai and Tang 2010; Saraf et al. 2007; Tafti et al. 2013) • The use of industry standards: XML, SEBI, SOA (Gosain et al. 2003, 2004; Malhotra et al. 2007)
Use	Studies grounded in this perspective often do not specify IT constructs and focus on the use of IT or information flow as the result of the IT usage.	<ul style="list-style-type: none"> • Types of Information flow (Klein and Rai 2009) • Patterns of IT use (Sanders 2008; Subramani 2004) • Information processing capability: supply chains (Kim et al. 2005), business process outsourcing (Mani et al. 2010).

⁹ The abbreviations are defined as follows: EDI (electronic data integration), SCM (supply chain management), CRP (continuous replenishment program), and VMI (vender management inventory).

Table II-2. Theoretical Lenses Used in IS Literature on Inter-organizational Issues		
Theoretical Lens	Brief description of the theory	Applications in IS studies
Transaction cost economics	The TCE perspective offers 1) a set of determinants of the governance structure (firm versus market) and 2) implications for potential safeguard strategies in interorganizational transactions (Coase 1937; Williamson 1981).	One stream of research examines the impact of efficiency gains via IT on the firm size (Brynjolfsson et al. 1994; Clemons and Row 1992; Gurbaxani and Whang 1991; Malone et al. 1987) and the number of suppliers of a firm (Bakos and Brynjolfsson 1993; Banker et al. 2006; Malone et al. 1987). Another stream of research views interorganizational systems (IOS) as a mechanism to reduce potential opportunistic behavior, and investigates the bargaining power of firms and its effect on performance (Kim and Mahoney 2006; Subramani and Venkatraman 2003).
Information processing	The information processing perspective considers a firm as an information processing system (Galbraith 1974) and asserts that the performance of firms is determined by how well information processing needs align with information processing capabilities (Bensaou and Venkatraman 1996).	Considering IT as a key determinant of a firm's information processing capability (Malone and Rockart 1991), IS researchers have examined the alignment between the needs and the capability for information processing in the context of business process outsourcing (Mani et al. 2010) and supply chains (Bensaou and Venkatraman 1995; Premkumar et al. 2005). Some studies consider particular IT systems, such as electronic information transfer (Kim et al. 2005) and business analytics (Trkman et al. 2010) as a measure of the capability.
Resource-based and relational views of firms	RBV asserts that competitive advantages are gained and sustained by accumulating valuable and scarce resources that are difficult to imitate (Barney 1991). The relational view argues that firms can build such resources at a dyadic or network level (Dyer and Singh 1998).	IS researchers 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). IT flexibility has also been investigated as a supporting mechanism for process integration. (Klein and Rai 2009; Saraf et al. 2007).
Competitive dynamics perspective	This perspective assesses a firm's competitiveness by examining a firm's ability to sense relevant market and technological changes and to take strategic, adaptive actions accordingly.	IT-enabled sensing capability and absorptive capacity are highlighted (Chi et al. 2010; Sambamurthy et al. 2003). An additional emphasis is the flexibility of IT that support dynamic adjustments of their procedures, processes, and structure to changing environments and partners (Gosain et al. 2004; Malhotra et al. 2005, 2007; Rai and Tang 2010).

II-4.2. Identified Knowledge Gaps

The examination of IT constructs and theoretical lenses used in prior IS interorganizational relationship studies reveals four main findings. First, IT business value research on interorganizational relationships is characterized by diverse treatments of the IT construct. Second, IT has been frequently operationalized as a specific system linking partners. Third, consistent with other IS research streams, a growing body of literature conceptualizes IT as a measureable capability or usage. Fourth, the constructs of IT, however, restrict their attention to partnering issues to a dyadic level, limiting our understanding of the impact that IT exerts on firm-level capabilities dealing with alliance relationships.

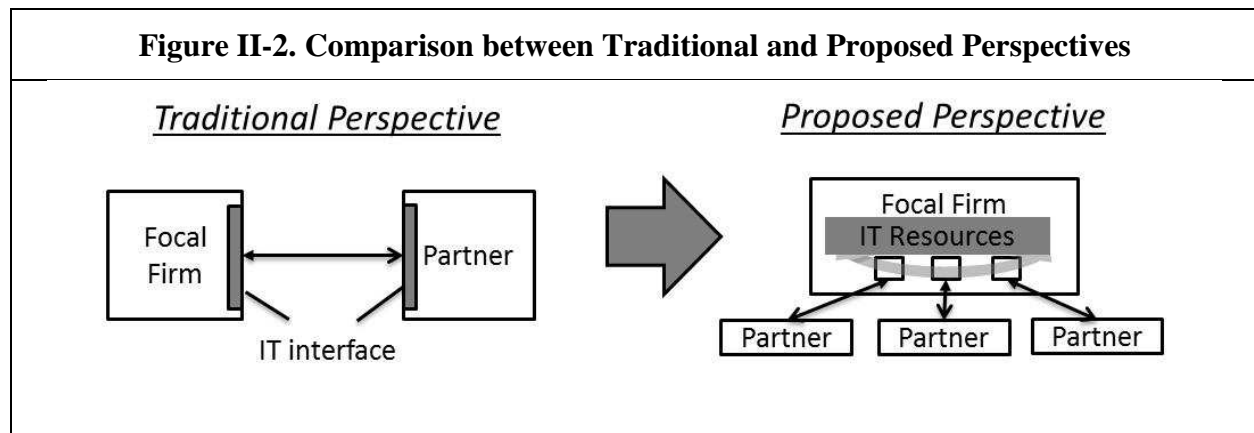
The preceding review concurs with the assertion of Malhotra et al. (2005) that IS studies on interorganizational relationship issues have tended to focus either on the supporting technology or the relational aspect of IT-supported interorganizational interactions. Though studies in this vein provide insights for improving the effectiveness of interorganizational processes, largely focusing on transactional improvements, the prospective application of these frameworks to strategic alliances is somewhat limited, mainly due to two reasons.

First, prior IS studies tend to view the organizational boundary of a firm as a dichotomy between hierarchy and market considerations. They tend to make a clear distinction between internal operations and interorganizational interactions, with strategic alliances inhabiting a middle ground between the two concepts. Strategic alliances need to be initiated, coordinated, and managed as interorganizational processes while considering the firm's own operations and its other alliances (Hoffmann 2007). Therefore, the approach of prior studies that separate interorganizational processes from the firm's internal operations and focus on issues at a dyadic level (e.g. integration of business processes and bilateral knowledge sharing) would appear ill-suited to the strategic alliance context.

Second, 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 more strategy-oriented and knowledge-intensive interorganizational collaborative efforts such as joint research and development (R&D) projects. In particular, these types of collaboration tend to demand a lower level of IT and process integration than in supply-chain relationships, and it is thus difficult to justify the value of IT in the context of prior studies that emphasized a tight inter-partner integration of IT and processes. Indeed, this stance may encourage a diminished valuation of the contribution of IT to strategic alliances. However, the theoretical framework that I will discuss in the next section illustrates how IT can generate value in strategic alliances.

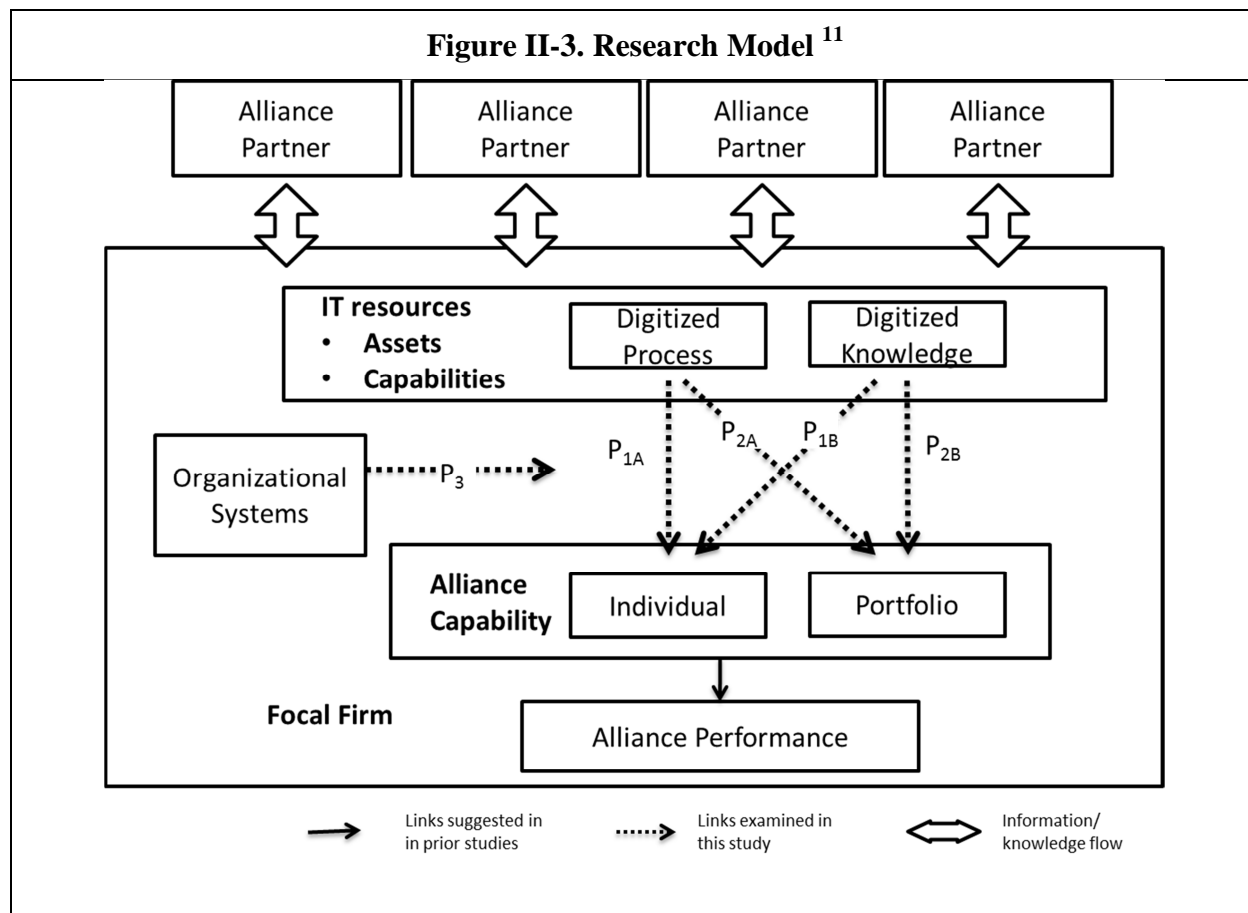
II-5. New Approach: IT as a Digital Platform for Capability Development

I propose a new theoretical perspective for interpreting the role of IT in interorganizational relationships (Figure II-2.). While the traditional approach focuses on IT connecting a focal firm and its partners, the new approach focuses on IT residing within a firm and the development of a firm-level 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 to the development of organizational capabilities (Appendix D). This approach, I believe, is not inimical to the traditional one. I view this new approach as complementing the traditional one, using a discretely focused lens to illuminate different aspects of interorganizational relationship management.



More specifically, I propose a theoretical framework¹⁰ that links IT to alliance capability in order to explain how a firm's IT determine the alliance performance (Figure II-2). This framework builds on recent moves in IS studies to emphasize the development of higher order capabilities enabled by IT. Recent studies suggests that IT enables higher-order business capabilities, which in turn influence firm performance, by providing the building blocks for business processes to form organizational capabilities (Ray et al. 2004, 2005; Whitaker et al. 2010). An alliance capability, both at an individual alliance level and at a portfolio level, has proven to be a cogent determinant of the overall success of a firm's alliances. However, relatively little research exists on the effect of IT on this capability. I start with a discussion of the theoretical lenses of this chapter (Table II-3). Then, I analyze and discuss the potential role of IT in the development of alliance capability and suggest propositions (Table II-5) that explicitly associate IT with alliance capabilities.

¹⁰ This framework is intended to provide guidance on the analysis, explanation, and prediction of phenomena regarding IT in strategic alliances, and as such, may serve as a discretionary theory (Gregor 2006). However, to distinguish this framework from the theories that have been suggested, revised, developed, tested, and validated over time by many researchers, I will use the term "theoretical framework" to refer the theory developed and described in this section.



II-5.1. Theoretical Basis

The theoretical underpinnings that are used to explicate the mechanism of alliance capability development through IT comprise the dynamic capability perspective (Eisenhardt and Martin 2000; Teece et al. 1997), the knowledge-based view of firms (Kogut and Zander 1992), and the organizational learning theory (Huber 1991). A brief description of theory and applications in alliance and IS research are summarized in Table II-3. Appendix E provides a detailed description of these theories.

¹¹ The theoretical model and propositions in this chapter are refined and empirically tested in the following two studies. Briefly, in Chapter 3, Proposition 1B and 3 are developed to the hypothesis, which predicts the positive association between the use of IT-enabled knowledge platforms and the abnormal stock market return from a new alliance announcement. In Chapter 4, based on the Proposition 2A and 2B, I examine the influence of a firm's alliance network properties on the relationship between IT investment and firm performance.

Table II-3. Theoretical Lenses

Theoretical Lens	Brief description of the theory	Application in Alliance studies	Application in IS studies
Knowledge-based view of firms	The knowledge-based view of the firm focuses on knowledge as a key resource (Grant 1996) and asserts that the growth of a firm primarily depends on its ability to generate new applications of knowledge in its knowledge base (Kogut and Zander 1992).	Alliance researchers emphasize the role of the alliance as a source of external knowledge. Knowledge includes that held by direct partners and by indirect partners with which the focal firm does not have direct interactions (Koka and Prescott 2002; Powell et al. 1996).	The knowledge-based view has provided a theoretical foundation for many IS studies that explain organizational performance and the organizational impact of knowledge management (Alavi and Leidner 2001; Tanriverdi 2005).
Dynamic capability	Dynamic capability is the firm's ability to integrate, build, and reconfigure internal and external competencies (Teece et al. 1997). Eisenhardt and Martin (2000) and Zollo and Winter (2002) suggest that dynamic capabilities develop through firms' learning efforts.	Eisenhardt and Martin (2000) state that dynamic capabilities consist of identifiable and specific routines such as "alliance and acquisition routines that bring new resources into the firm from external sources (p. 1108)".	In the interorganizational relationship context, IS studies have proceeded from this perspective to examine the value of IT flexibility that supports frequent changes in business partnerships according to strategic needs (Rai and Tang 2010; Tafti 2009).
Organizational Learning	This theory suggests that organizational learning occurs through the acquisition, distribution, and interpretation of relevant information and knowledge. Organizational memory is also required. (Crossan et al. 1999, 2011; Huber 1991; Stein and Zwass 1995; Walsh and Ungson 1991)	A learning perspective has been adopted to explain the significant link between alliance performance and prior experience (Anand and Khanna 2000; Sampson 2005). Recent studies engage in deeper scrutiny by investigating the underlying mechanism of alliance learning process (Kale and Singh 2007).	IT enhances a firm's capacity to learn by providing IT-mediated learning processes (Goodman and Darr 1998; Janson et al. 2007; Kane and Alavi 2007; Pentland 1995; Roberts et al. 2011; Tippins and Sohi 2003) and by improving organizational memory (Anand et al. 1998; Stein and Zwass 1995). In the interorganizational context, Scott (2000) shows the facilitating role of IT in bilateral knowledge sharing and learning.

Note: This table lists some representative studies and should not be construed as an exhaustive review of the relevant literature.

Table II-4. Model Constructs	
Construct	Description
Information Technology	<p>IT assets and capabilities that strengthen the organizational processes and knowledge systems. The definition of digitized process and knowledge are adopted from Sambamurthy et al. (2003, p. 247)</p> <ul style="list-style-type: none"> • “Digitized process”: “the extent to which a firm deploys common, integrated, and connected IT-enabled processes” • “Digitized knowledge”: “the comprehensiveness and accessibilities of codified knowledge in a firm’s knowledge base and the interconnected networks and systems that enhance interactions among individuals for knowledge sharing and transfer”
Alliance Capability: (1) Individual alliances	<p>A firm’s ability to manage its individual alliances, which involves “skills to identify partners, initiate alliances, and engage in the ongoing management and possible restructuring and termination of these alliances (Khanna 1998 p. 351)”. This capability comprises the management of alliance processes and alliance knowledge.</p> <ul style="list-style-type: none"> • Alliance process: the management of a set of business activities and tasks throughout the life cycle of an alliance, from initiation to termination. • Alliance knowledge: the knowledge from prior alliance experiences of a firm, which can provide insights on managerial issues in strategic alliances, such as partner selection, contract formulation, and governing processes.
Alliance Capability: (2) Alliance portfolios	<p>A firm’s ability to configure and manage its alliance portfolio (Kale and Singh 2009). This capability includes the management of the alliance portfolio and organizational knowledge base.</p> <ul style="list-style-type: none"> • Alliance portfolio: a set of business activities and tasks related to the coordination and control of multiple alliance relationships and partners. • Organizational knowledge base: a firm’s knowledge base, which consists of the knowledge developed internally and acquired externally. A firm’s alliance portfolio determines the extent of alliance-derived information benefits to the firm’s knowledge base.
Organizational Practices	<p>The organizational structure, process, and culture that support a firm’s organization-wide alliance activities.</p>
Organizational Performance	<p>A firm’s performance consequences resulting from alliances. It comprises the performance consequence of an individual alliance or to the performance consequence of multiple alliances.</p>

The knowledge-based view provides a basic explanation of how a firm is formulated, while the dynamic capability perspective helps demonstrating the process of capability development in firms. The organizational learning theory reinforces the theoretical development underscoring learning as a key mechanism for the development of alliance capability. Kale et al. (2002) have likewise noted that “the organizational learning, dynamic capabilities, and evolutionary economics [which forms a basis of knowledge-based view of firms] literature offer

some of the most useful insights with regard to capability development (p. 749).” These theories are closely interlinked concepts and are frequently used together (e.g. Kale and H. Singh 2007; Zollo and Winter 2002). I draw these theories throughout the development of propositions.

Table II-5. Summary of Propositions	
IT and Alliance Capability – Platform for managing individual alliances	
P1A	Digitized process enhances an alliance capability for managing individual alliances by imposing disciplined routines on alliance processes throughout an organization.
P1B	Digitized knowledge enhances an alliance capability for managing individual alliances by facilitating organizational learning; it provides organizational memory and supports the process of acquiring, distributing, and interpreting management expertise in strategic alliances.
IT and Alliance Capability – Platform for managing alliance portfolios	
P2A	Digitized process enhances an alliance capability for managing a portfolio of alliances by enhancing the efficiency in coordination and control of multiple simultaneous alliances.
P2B	Digitized knowledge enhances an alliance capability for managing a portfolio of alliances by supporting firms to leverage knowledge acquired from multiple alliance partners.
IT and Complementarity Organizational Practices	
P3	The impact of digitized process and knowledge on alliance capabilities will be positively moderated by complementary organizational practices.

II-5.2.IT as Digitized Process and Knowledge

IT in this model comprise IT assets¹² and capabilities¹³ that support the digitization of organizational processes and knowledge (Alavi and Leidner 2001; Sambamurthy et al. 2003; Wade and Hulland 2004). Unlike the conceptualization of IT artifacts in prior interorganizational relationship studies, IT in this model are not limited to those specifically intended for partnering issues, such as interorganizational IT systems, IT capabilities for integrating processes between partners, and IT usage in interorganizational interactions. Instead, the model broadly considers

¹² IT assets are “anything tangible or intangible the firm can use in its processes for creating, producing, and/or offering its products to a market (Wade and Hulland 2004 p. 109)”. In the alliance context, this can refer to personal IT applications, such as tools, databases, and digitalized knowledge repositories, which help alliance administrators manage processes and knowledge for individual alliances.

¹³ The term “IT capabilities”, or “repeatable patterns of actions in the use of assets to create, produce, and/or offer products to a market” (Wade and Hulland 2004 p. 109), pertains to the acquisition, deployment, and leveraging of IT assets (Pavlou and El Sawy 2006). The model primarily focuses on the leveraging capability of IT assets, which is the extent of effective usage of the IT assets discussed above. However, as Pavlou and El Sawy (2006) have noted, because the acquisition, deployment and leveraging dimensions of IT capability adhere to a sequential progress, acquisition and development are still considered critical IT capabilities.

IT that enables the digitalization of processes and knowledge for alliance management at both individual and portfolio levels. I follow the definition of digitized process and knowledge suggested by Sambamurthy et al. (2003). “Digitized processes” refers to “the extent to which a firm deploys common, integrated, and connected IT-enabled processes”, while “digitized knowledge” refers to “the comprehensiveness and accessibilities of codified knowledge in a firm’s knowledge base and the interconnected networks and systems that enhance interactions among individuals for knowledge sharing and transfer” (Sambamurthy et al. 2003 p. 247). The digitization supported by IT augments both the reach and richness of processes and knowledge for business activities (Sambamurthy et al. 2003). IT in this model can take the form of corporate-level IT applications such as ERP, which provide assistance to corporate managers in the coordination and monitoring of on-going alliances; they can comprise networking applications, such as online messenger and web 2.0 applications, which facilitate interactions among organizational members to share their experiences in strategic alliances; or they can include overarching IT infrastructure supporting all the above mentioned applications.

II-5.3.Alliance Performance

I consider alliance performance to be the performance consequences of alliances for the participating firms (Gulati 1998). Alliance performance comprises the performance consequences for firms vis-à-vis their individual alliances and their overall alliance portfolio; consequently, I will use the terms *individual alliance performance* and *alliance portfolio performance*, respectively. Examples of individual alliance performance metrics used in prior alliance research include abnormal stock market responses to alliance announcements (Anand and Khanna 2000; Kale and Singh 2007; Kale et al. 2002), patent activities from R&D alliances (Sampson 2005, 2007), and survey measures, such as whether a focal firm achieved its primary

objective and whether a particular alliance enhanced the company's competitive position (Kale et al. 2002). Alliance portfolio performance has been operationalized via various measures, such as revenue growth (Baum et al. 2000), market share (Zaheer and Bell 2005), productivity (Koka and Prescott 2002), innovativeness (Zaheer and Bell 2005), and patent counts (Ahuja 2000b; Baum et al. 2000).

II-5.4. Alliance Capability: (1) Platform for Managing Individual Alliances¹⁴

The first component of alliance capability is a firm's ability for managing individual alliances, a measure that serves as an organizational platform for repeatable alliance success. This construct is included based on the prior alliance research, which emphasizes the importance of a disciplined approach that supports systematic process management and facilitates organizational learning (Kale and Singh 2009). Here, I differentiate this capability into two components: alliance process management and alliance knowledge management. Alliance process management denotes the management of systematic processes throughout the life cycle of alliances, encompassing partner selection, contract design, and post-formation management. The latter component, meanwhile, signifies the management of the alliance knowledge that the focal firm has accumulated over time through experience.

Alliance Process Management

An individual alliance progresses through different stages in its life cycle (Gulati 1998), involving alliance initiation (based on strategic consideration), partner selection, contract design, coordination, and termination. My use of the term "alliance process", grounded in the definition of a business process as "a set of logically related tasks performed to achieve a defined business outcome (Davenport and Short 1990)", thus refers to a set of business activities and tasks

¹⁴ This section provides a theoretical basis for Chapter 3.

throughout the life cycle of an alliance, from its initiation to termination. According to the evolutionary economics perspective, as a firm engages in many alliances over time, it develops routines for executing the alliance process. However, any number of different routines for this process may exist within a firm because alliances are often initiated and managed at a business unit level. If there are insufficient interactions between business units in terms of sharing their past experience and learning from alliances, the routines are likely to reveal significant differences across business units due to their various and discrete experiences from strategic alliances.

Alliance researchers generally emphasize the need to develop a firm-level routine for the alliance process for mainly two reasons (Dyer et al. 2001; Gomes-Casseres 1998; Kale et al. 2002). First, encouraging alliance managers to take a consistent approach is likely to reduce the risk of managerial mistakes such as neglecting important steps in the process or sequencing activities incorrectly (Kale et al. 2002). Second, developing a firm-level routine can facilitate organization-wide learning efforts by enabling the replication and transfer of best practices within a firm (Kale and Singh 2007). A firm-level 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.

Prior IS research suggests that digitized process can impose a disciplined routine that all employees follow to perform their jobs by providing codified tools or embedding them into IT systems (Hitt et al. 2002). Many firms that are active in strategic alliances, such as Dow Corning Corporation, exploit IT-enabled tools that provide guidelines, checklists, or manuals incorporating best practices to manage the different phases and decisions in strategic alliances (Kale and Singh 2007). These IT-enabled digitized processes can potentially minimize process

variability across business units in their approaches to strategic alliances and encourage alliance managers to adhere to a consistent approach to alliances throughout an organization (Frei et al. 1999). In addition, the codification of knowledge and routines into technology renders the knowledge easier to apply (Galunic and Rodan 1998). Thus, I propose that

Proposition 1A: Digitized process enhances an alliance capability for managing individual alliances by imposing disciplined routines on alliance processes throughout an organization.

Alliance Knowledge Management

Firms learn various aspects of alliance management from experience, such as selecting partners, designing contract, managing processes, and so on (Anand and Khanna 2000; Sampson 2005). The knowledge from prior alliance experiences, which can be both tacit and codified, can teach firms to select appropriate management processes for current and future alliances, thereby improving the alliance's performance. The knowledge-based view suggests that, because this knowledge arises from the firm's deliberate efforts over time in its organization-specific context, it is not easily transferrable and imitable (Grant 1996; Kale and Singh 2009). In this regard, alliance knowledge is a key firm resource that generates competitive advantages. Hence, according to the dynamic capability perspective, a firm's efforts to acquire, distribute, and develop new applications of this knowledge carries much weight in determining how successful its alliance performance will be (Teece et al. 1997).

Firms can passively learn and acquire knowledge through alliance experiences, but as Zollo and Winter (2002) have noted, firms can also take more proactive actions and exert deliberate efforts to facilitate organizational learning. Prior research on knowledge management suggests that a firm's key initiatives for learning can broadly fall into three categories: (1) coding

and sharing of knowledge objects for best practices via organizational memory systems, (2) creation of corporate knowledge directories that map internal expertise as a mechanism for disseminating uncodified knowledge, and (3) creation of knowledge networks (or communication channels) that bring knowledge users together for communication and discussion so that important knowledge is shared and amplified (Alavi and Leidner 2001).

According to the organizational learning theory, digitized knowledge can be a key enabler of all of these dimensions of organizational learning by supporting (1) codified knowledge systems, (2) online expert directories, and (3) knowledge networks (Alavi and Leidner 2001; Goodman and Darr 1998; Huber 1991; Kane and Alavi 2007; Tippins and Sohi 2003).

Codified knowledge in IT-enabled organizational memory can strengthen knowledge acquisition, distribution, and retrieval by rendering organizational knowledge explicit and communicable (Stein and Zwass 1995). Organizational memory can manifest itself in digitized knowledge as “written documentation and structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes and tacit knowledge acquired by individuals and networks of individuals” (Alavi and Leidner 2001)”. Therefore, any document and knowledge object related to alliances in digitalized format can be considered as a basic unit of IT-enabled organizational memory. Notably, these knowledge resources may be diffused across business units, leading some firms to take a systematic approach and aggregate the access to these resources in a bid to enhance organization-wide accessibility. For example, the web-based alliance-dedicated portal of Cisco Systems provides a single point of access to a knowledge repository for alliance management. Because memory systems permanently store relevant information to make it accessible for reuse, they can

help human actors cope with a possible information overload, as well as support their role as information processors (Stein and Zwass 1995). In addition, these systems allow for knowledge to be accessed easily, modified promptly, and shared as necessary (Stein and Zwass 1995).

Online knowledge directories, which catalogue internal and external alliance experts, also serve as a key mechanism for the management of alliance knowledge because not all knowledge can be codified and shared through digitized systems. Many high-performing firms in alliances, such as Hewlett-Packard and Cisco Systems, maintain online contact directories that provide access to experts from inside and outside of the company (Corporate Strategy Board 2000). Digitalized online directories allow users to specify their needs by utilizing sophisticated search options and help alliance managers to acquire the most relevant knowledge for their needs. The resulting direct personal interactions can facilitate the sharing of tacit knowledge (Alavi and Leidner 2001).

IT-enabled communication channels, meanwhile, such as communication technology (e.g. email and online messenger), groupware and online communities, as well as increasingly influential social network applications (e.g. internal wikis and blogs), enhance interactions among individuals within an organization, allowing them to share and transfer real-time information and contextual knowledge. These enhanced processes of interaction and knowledge-sharing encourage the development of mutual understanding among organizational members and strengthen the social ties among them. The resultant strong ties support sense-making, perspective sharing, and the further development of tacit knowledge (Sambamurthy et al. 2003). In turn, the beneficial effects of this sense of intimacy among organizational members may contribute to more effective organizational learning and accelerated development of alliance capability.

To summarize, digitized knowledge (1) supports the codification, distribution, and retrieval of knowledge for managing individual alliances via organizational memory systems, (2) reinforces the sharing of tacit knowledge by providing online directories of internal and external experts on alliances, and (3) facilitates the development of knowledge by supporting interactions among the alliance managers who are the users of alliance knowledge. Easy and quick access to relevant information and real-time information-sharing enabled by IT facilitate the organizational learning process for alliance management. I thus propose that

Proposition 1B: Digitized knowledge enhances an alliance capability for managing individual alliances by facilitating organizational learning; it provides organizational memory and supports the process of acquiring, distributing, and interpreting management expertise in strategic alliances.

II-5.5. Alliance Capability: (2) Platform for Managing Alliance Portfolios¹⁵

The second component of alliance capability is a firm's ability to manage alliance portfolios. As was the case in my earlier discussion of the alliance capability for individual alliances, I separate issues regarding alliance portfolios into two components – alliance portfolio management and organizational knowledge management.

Alliance Portfolio Management

Strategic alliances allow firms to access the resources of outside organizations that would be difficult to obtain otherwise. The dynamic capability perspective suggests that a firm's ability to integrate newly acquired resources from alliance partners with its own resource pool and to reconfigure their optimal allocation generates competitive advantages (Eisenhardt and Martin

¹⁵ This section provides a theoretical basis for Chapter 4.

2000; Teece et al. 1997). Indeed, alliance researchers buttress a firm's ability to coordinate and control a portfolio of alliances (Hoffmann 2007; Kale and Singh 2009).

Managing an alliance portfolio requires extensive coordination and control efforts, which can be both a complex and information-intensive process. Coordination – the act of managing dependencies among a firm's various activities – is made more complicated by the formation of an alliance, which necessitates new internal coordination requirements. All alliances in a firm's portfolio are dependent on one another to some extent because they compete for the firm's limited physical and managerial resources with other alliances and internal businesses (Wassmer et al. 2010). In some instances, the dependencies become more complex when the activities of an alliance directly influence the other alliances. This increased coordination burden can clearly have a detrimental effect on organizational performance (Hoffmann 2007). Control, meanwhile, involves monitoring and evaluating alliance performance. The intricacies involved in controlling alliances stem from the difficulties of identifying, measuring, and rewarding the contribution of an individual alliance (Gulati 1998). Therefore, managers must develop appropriate metrics, and gather and process relevant information in order to exercise effective control.

Numerous studies have documented the value of IT in relation to coordination and control. For example, in the diversified and multi-business organization context, Chari et al. (2008) and Dewan, Michael, and Min (1998) empirically show that the value of IT is greater in firms that need more extensive coordination and control efforts. Enhanced reach and connectivity through electronic internal linkages can heighten the visibility and awareness of a firm's ongoing alliance partnerships and support rapid decision-making for coordinating alliances by providing the appropriate insights into operational and strategic decisions. Regarding controls, digitized process allows firms to design sophisticated performance metrics and analytics that enhance the

visibility of the performance of various processes. Mithas, Ramasubbu, et al. (2011) show that IT-enabled real-time information flow improves organizational performance by enabling firms to monitor progress on intermediate goals and metrics for timely managerial intervention.

Some companies such as FedEx and Ernst & Young have systems that allow managers to track the status of all existing alliances in real-time (Corporate Strategy Board 2000). These systems can also help manage dependencies and prevent potential conflicts of interests between alliances. More general-purpose corporate IT applications such as ERP (enterprise resource planning) can also serve in a similar role by allowing corporate managers to access essential information in a quick, reliable, and consistent format for decision-making purposes (Hitt et al. 2002). By providing information on the availability, usage, and cost of various resources, the systems can help managers maximize resource allocation across business units and alliances. I thus propose that

Proposition 2A: Digitized process enhances an alliance capability for managing a portfolio of alliances by enhancing the efficiency in coordination and control of multiple simultaneous alliances.

Organizational Knowledge Base

Several studies in alliance research suggest that some properties of a firm's alliance portfolio can represent the collective benefits from multiple alliances, such as the amount of reliable and diverse information that the firm can acquire through its multiple partnerships (Ahuja 2000b; Koka and Prescott 2008; Wassmer et al. 2010). For example, a firm with a higher number of partners is likely to have greater access to valuable, key information, as opposed to those with fewer partners (Ahuja 2000b). The cohesiveness among a firm's partners can

determine the quality of information because such intimacy can prompt the generation of trust and reduce opportunism, thus increasing the willingness to share secret information with partners (Coleman 1988). Also, a firm with partners that have distinctive knowledge resources is more likely to be exposed to diverse perspectives as well as new ideas and information from its partners (Burt 2004). The benefits of the increased volume, richness, and diversity of knowledge can generate “super-additive” value synergies from knowledge complementarities (Koka and Prescott 2002; Tanriverdi 2005). When knowledge resources from different sources are complementary, the overall return to the knowledge resource can be greater than the sum of individual returns.

However, management researchers have suggested that the ability of a firm to generate value from its external partnerships depends not only on the capabilities of its partnering relationships, but also on its internal capacities for leveraging the expanded knowledge pool (Kogut and Zander 1992; Koka and Prescott 2002; Uzzi and Lancaster 2003). This is because having broad access to relevant knowledge, while of critical importance, does not in itself guarantee the creation of new knowledge (Dosi 1988). Moreover, physical distance between individuals and a potential lack of interaction among them may impose constraints on identifying the existence and location of newly acquired available knowledge within a firm (Alavi and Tiwana 2002).

The knowledge-based view of firms emphasizes both the value of externally acquired knowledge derived from alliance partners and the capability of the firm to generate new applications of the knowledge by integrating it with existing knowledge (Kogut and Zander 1992). This perspective, which emphasizes the process of capturing, storing, interpreting, and utilizing knowledge gleaned from alliance partners, strongly suggests that digitized knowledge

significantly enhances a firm's ability to manage this knowledge development process (Malhotra et al. 2005; Zahra and George 2002).

This impact can be observed in three areas of influence. First, IT-enabled organizational memory, such as databases and knowledge repositories, can significantly upgrade a firm's capability to store within its internal knowledge repository the external knowledge acquired from multiple partners. Organizational memory can serve a critical role when a firm interacts with a number of partners. This is the case because, though multiple sources of information may benefit firms to some extent, beyond a certain point, external information can overwhelm an enterprise's cognitive capacity, leading to information overload for firms involved in interorganizational relationships (Malhotra et al. 2005). However, IT-enabled memory systems allow firms to store and maintain massive amounts of information from external sources for current and future potential use (Malhotra et al. 2005).

Second, digitization of knowledge can assist firms in interpreting and assimilating knowledge from external partners in the firm's organizational context. Newly acquired knowledge from external partners oftentimes is not ready for immediate use (Roberts et al. 2011). Knowledge, especially externally acquired information, becomes valuable only if it is incorporated into the firm-level organizational context (Malhotra et al. 2005; Roberts et al. 2011). Various IT-enabled analytics and interpretive systems, such as business intelligence systems and data analysis and mining software, allow the information obtained from external partners to be organized, rearranged, and processed. These systems help firms to process large quantities of raw data and uncover patterns therein (Malhotra et al. 2005; Trkman et al. 2010). Also, IT-enabled communication channels, such as online messengers and communities, help develop mutual

understanding and enable the sharing of contextual knowledge among employees, further accelerating knowledge assimilation.

Third, IT supports firms in the integration of knowledge that involves merging, categorizing, classifying, and synthesizing existing know-how (Alavi and Leidner 2001; Kogut and Zander 1992). Galunic and Rodan (1998) argue that the likelihood of knowledge recombination is lower when knowledge is widely dispersed, due to both the higher costs of exchange and lower detection probability. Digitized knowledge, such as knowledge repositories and directories, supports knowledge integration and combination processes by providing a platform to acquire or to locate and retrieve the necessary complementary knowledge (Alavi and Tiwana 2002; Sambamurthy et al. 2003). Internal knowledge portals provide immediate access to new knowledge from alliance partners across business units, and allow firms to identify how new external knowledge is related to that which exists in their current knowledge bases (Roberts et al. 2011). I thus propose that

Proposition 2B: Digitized knowledge enhances an alliance capability for managing a portfolio of alliances by supporting firms to leverage knowledge acquired from multiple alliance partners.

II-5.6.Organizational Practices

The application of IT alone may improve alliance capability and performance, but prior IS research has shown that the value generation potential of IT is maximized in the presence of supporting complementary organizational practices (Melville et al. 2004).

Given the complex roster of alliance-related tasks, it is imperative for firms to have a structural mechanism in place for coordination and management of its organization-wide alliance activities. Through extensive field work, Kale and Singh (2007) identified various examples of

how firms manage alliance processes and knowledge within the organization through alliance committees, task forces, and other forums that facilitate the exchange of alliance experience and best practices among intra-firm alliance managers. Their empirical study provides strong evidence linking these efforts to the development of alliance capability. These organizational practices are designed to support for (1) initiating, coordinating, and monitoring alliance activities and for (2) knowledge sharing in support of an organization-wide drive to learn and accumulate alliance management lessons and best practices within a firm (Kale and Singh 2009; Kale et al. 2002).

Organizations that do not have appropriate management practices may not experience the same benefits from the digitized process and knowledge supported by IT (Bresnahan et al. 2002; Tambe et al. 2012). Moreover, in some cases, it is possible that an existing alliance process becomes inefficient, and know-how from prior experiences becomes outdated, adversely affecting performance (Sampson 2005). Enhanced reach of process and knowledge supported by IT can aggravate the adverse effect. In this regard, it is imperative for firms to have appropriate organizational practices, which actively revise their process and knowledge, and incorporate their most recent best practices and knowledge into the systems so as to steer future actions in a positive direction (Zollo and Winter 2002). I thus propose that

Proposition 3: The impact of digitized process and knowledge on alliance capabilities will be moderated by complementary organizational practices.

II-6.Discussion

This chapter represents the first step towards a comprehensive examination of the impact of IT on the development of alliance capability and the performance of strategic alliances. It is my belief that it possesses significant contributive potential for IT business value research by

providing a theoretical framework that demonstrates how the business value of IT in strategic alliances can be generated from IT that build and develop a firm-level capability for managing alliance relationships.

As many high-performing firms in strategic alliances utilize various firm-level IT for their alliance activities, there is an urgent need for managers and decision makers who wish to improve their alliance performance to understand the performance implications of IT investment. The theoretical model of this chapter may thus be viewed as a series of guidelines for investment in IT for the management of strategic alliances, which have traditionally been considered to be less dependent on firm-level IT. The model suggests that firm-level IT can facilitate the management of individual alliances and alliance portfolios by reinforcing related capabilities through the digitization of processes and knowledge, thereby enhancing alliance performance.

Like any other academic work, however, this paper is not free from inherent limitations, and as such, encompasses potential research areas for further development. First, this work intentionally restricts its focus to firm-level IT in order to clarify the difference between the effect of firm-level IT (germane to this chapter) and relationship-specific IT (vis-à-vis approaches in prior studies) in interorganizational relationships. Therefore, the model does not address the effect of relationship-specific IT that have been shown to enhance firm performance from their interorganizational interactions. A future work may develop an overarching theory that combines the prior approach with the framework developed in the present chapter.

Second, the model and theoretical arguments regarding knowledge management are primarily developed around the role of IT in the codification and distribution of knowledge in the organizational learning process. However, the articulation and internalization of knowledge, which pertain to the transition of knowledge from an individual level to an organization level and

vice versa, are also critical components in organizational learning. Future research may elaborate further on the role assumed by IT within these domains.

Lastly, the model considers the capabilities for managing individual alliances and alliance portfolios independently, even though there can be positive or negative interactions among them. I leave these unexplored linkages for future research.

II-7. Conclusion

Interorganizational relationships have aroused the interest of IS researchers, largely due to drastic changes triggered by the advance of IT in the last two decades. The heterogeneous universe of IT has accelerated the proliferation of interfirm interactions and facilitated the evolution of relationships from efficiency-driven operational transactions to knowledge-intensive strategic collaborations.

This chapter proposes that IT plays a central role in developing alliance capability, a concept that recent works have trumpeted as a key enabler for success in strategic alliances. Based upon the relevant literature in IS and other managerial disciplines, I have identified the extant knowledge gaps and developed a general theoretical framework explaining how firm-level IT can make or break alliance capability and alliance performance. I have also synthesized the accumulating but still diffuse sources of knowledge to develop a set of propositions that may both propel and determine the course of future research. In the two following studies in the dissertation, I empirically examine parts of the framework developed in this chapter. In Chapter 3, building on the discussion on Proposition 1B and Proposition 3, I examine the interplay between the use of IT-enabled knowledge platforms, alliance experiences, and individual alliance outcomes. In Chapter 4, I refine Proposition 2A and Proposition 2B and test the effect of

an alliance portfolio on IT investment payoff. I intend to pursue some of the other aspects of the framework in future research outside this dissertation.

It is my hope this framework will provide a stimulus for further study of IT, alliance capability and organizational performance.

II-8. References

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II-9.Appendices

II-9.1.Appendix A. Brief Overview of Alliance Research in Strategy and Management Discipline

Table II-6. Strategic Management Research Related to Alliance Performance and Capability	
Issues	Study
Consequences of alliances	Early alliance literature showed the benefits of alliances, such as knowledge sharing, cost and risk reduction, and access to complementary assets (Ahuja 2000b; Mowery et al. 1996; Park et al. 2004), but empirical studies that examine the financial impact of alliances in the stock market have produced mixed results (Chan et al. 1997; Das et al. 1998).
Alliance/Firm characteristics related to performance	Das et al. (1998) show the potential effects of alliance and firm characteristics, such as the types of activities and profitability of a firm, on alliance performance. Lin, Yang, and Arya (2009) examine the effect of resource complementarity and partner status on alliance performance. Other researchers have also examined the choice of scope and governance structure of alliances and their subsequent effect on performance (Khanna 1998; Oxley 1997).
Effect of experiences	Several studies have provided strong evidence that experience is positively related to alliance performance in various measures such as firm valuation (Anand and Khanna 2000) and patent activities (Sampson 2005). Studies also show that the relationship exhibits a diminishing marginal return (Hoang and Rothaermel 2005) and that partner-specific experiences can negatively affect corporate performance (Goerzen 2007; Hoang and Rothaermel 2005). Also, Sampson (2005) suggests that the benefits of experiences depreciate over time.
Alliance capability	Anand and Khanna (2000) propose the concept of “alliance capability”, and subsequent studies have tried to identify the specific components of this capability (Schreiner et al. 2009) and how it develops in a firm. Kale et al. (2002) point to dedicated alliance functions as a key structural mechanism. Dyer et al. (2001) propose that knowledge management plays an essential role of dedicated function, and Kale and Singh (2007), empirically show how the role of a dedicated alliance functions in facilitating a firm’s “alliance learning process”.

Note: This table lists some representative studies and should not be construed as an exhaustive review of the relevant literature.

Alliances can bestow various benefits, such as cost reduction from economies of scale, risk sharing, and access to complementary assets (Ahuja 2000b; Mowery et al. 1996; Powell et al. 1996). However, the upshot of potential benefits that a firm may glean from an alliance often belies the managerial challenges inherent in such partnerships, a situation referred to as “the alliance paradox (Kale and Singh 2009)”. Indeed, alliances often fail (Harrigan 1988); one industry study reports a failure rate of between 30% and 70% (Corporate Strategy Board 2000). The investigations on the financial impact of alliances have had mixed results (Chan et al. 1997; Das et al. 1998). Accordingly, the question of whether and when alliances provide financial

values to its participants has garnered much attention in strategy literature. As mentioned in the main text, research regarding alliance performance can be broadly categorized into two branches examining performance consequences from the viewpoint of a firm's (1) individual alliances and (2) overall alliance portfolio.

Alliance studies have tried to explain the variance in alliance performance by considering the types of alliance activities and participants' profitability (Das et al. 1998), the choice of scope and governance structure of alliances (Khanna 1998; Oxley 1997), and the characteristics of alliance partners (e.g. resource complementarity and partner firms' status) (Lin, Yang, and Arya 2009).

Table II-7. Strategic Management Research Related to Alliance Performance and Capability	
Issues	Study
Structural alliance network properties	Alliance studies have shown that various structural properties of a focal firm's alliance network, such as the number of alliances (Powell et al. 1996), the number of direct and indirect partners (Ahuja 2000b), and centrality (Powell et al. 1996) influence the firm's performance in terms of growth (Baum et al. 2000; Powell et al. 1996), productivity (Koka and Prescott 2002, 2008), and patenting activity (Ahuja 2000b). Network properties at an industry level have also been considered (Schilling and Phelps 2007).
Closed vs. open network structure	In discussing the role of closure in the social structure, which develops social norms and trust among partners, Coleman (1988) advocates the value of closed networks. Burt (1992), on the other hand, favors the role of the open network (one rich in structural holes). Subsequent empirical studies (Ahuja 2000b; Baum et al. 2000; Burt 1992; Zaheer and Bell 2005) empirically investigate the benefits of each network structure.
Firm capabilities	Zaheer and Bell (2005) show that the network structure further enhances a firm's benefits derived from its internal capabilities. Lavie (2007) examines the effect of partners' properties on the focal firm's market performance (Tobin's-q).
Managing alliance portfolios	Recent studies have highlighted the need for a capability to manage alliances from a portfolio perspective (Duysters et al. 1999; Ernst and Bamford 2005; Goerzen and Beamish 2005; Parise and Casher 2003; Wassmer et al. 2010).

Note: This table lists some representative studies and should not be construed as an exhaustive review of the relevant literature.

Another group of alliance researchers argues that alliances serve as conduits through which firms obtain access to external knowledge that contributes positively and significantly to the firm's performance (Ahuja 2000b; Powell et al. 1996; Schilling and Phelps 2007). These studies view alliances as a platform for the formal and informal exchange of knowledge and argue that some valuable knowledge shared between alliance partners can migrate from one firm to another with which it is not directly allied, but with which it shares a common partner. In other words, a firm's linkages can provide it with access to not just the knowledge held by its direct partners, but also to that held by its partner's partners. Studies in this vein have shown that various structural characteristics of a firm's alliance network influence firm performance via distinctive informational benefits in terms of the volume, diversity, and richness of information (Koka and Prescott 2002). Key structural factors include the number of direct and indirect partners (Ahuja 2000b; Powell et al. 1996), the average distances to other firms in the network (i.e. closeness centrality) (Powell et al. 1996), and the local relationship configuration among

direct partners, which are often characterized as closed or open networks (Burt 1992; Chi et al. 2010; Coleman 1988). Some studies also take the attributes of the partners into consideration, such as average R&D and marketing expenditure of partners (Lavie 2007).

II-9.2. Appendix B. Review Process

For the review of IS research on interorganizational relationships, I followed the systematic process of surveying and reviewing the relevant existing scholarly work described by Webster and Watson (2002), which is similar to the approaches taken by Melville et al. (2004) and Wassmer (2010).

The identification of relevant literature involves two steps: keyword search and backward search¹⁶ (Webster and Watson 2002). The first step was a *keywords search* in scholarly peer-reviewed leading journals in IS using commonly used search engines: EBSCO Business Source Complete and Science Direct. Browsed journals include Communications of the ACM, Decision Support Systems, Information Systems Research, Journal of MIS, Management Science, and MIS Quarterly. The search terms include alliance, interorganizational, interfirm, supply chain, and supplier. The second step was *backward search*, and I used citations of identified articles from keyword search as further sources. This step allows identifying relevant articles that may have been omitted in the keyword search and articles in other leading journals.

After identifying a list of potentially relevant articles, I reviewed the titles and abstracts of the articles and decide on whether they meet search criteria: the performance implication of IS in interorganizational relationships. For cases in which a title or abstract was not conclusive about the relevance of the article, the article was scanned in more detail to determine whether it should be included in the review. The studies that do not meet the criteria were discarded. For example, the studies examine the adoption of interorganizational systems (e.g. Bala and Venkatesh 2007; Mithas et al. 2008; Teo et al. 2003; Zhu et al. 2006) are excluded from the review.

The final step was to read all relevant articles and produce a summary including key characteristics such as the study type (i.e., conceptual, case-study, empirical), the research questions, theoretical underpinning, research design, main IT construct, findings, and implications.

This systematic and comprehensive search resulted in 66 articles. This process excluded book chapters, working papers, and other articles not subjected to the peer-review process.

Table II-8. Classification of Articles in the Review Process				
No	Studies	Types of Study	IT Construct	Theoretical base
1	Bakos (1991)	Analytical	Use	Transaction cost economics
2	Bakos and Brynjolfsson (1993)	Analytical	Use	Transaction cost

¹⁶ Among the approaches suggested by Webster and Watson (2002), I did not use *forward-search*, which involves searching articles that cite identified articles from the keyword and backward steps, in order to ensure the quality of reviewed studies.

				economics
3	Bakos and Nault (1997)	Analytical	Asset	Transaction cost economics
4	Banker et al. (2006)	Analytical	Use	Transaction cost economics, Dynamic capabilities
5	Barrett and Konsynski (1982)	Conceptual	Asset	Not Explicit
6	Barua and Lee (1997)	Analytical	Asset	Game theory
7	Barua et al. (2004)	Empirical	Capability	Resource-based view
8	Bensaou (1997)	Empirical	Use	Information processing perspective
9	Bensaou and Venkatraman (1995)	Empirical	Use	Information processing perspective
10	Bensaou and Venkatraman (1996)	Conceptual	Use	Information processing perspective
11	Brynjolfsson et al. (1994)	Empirical	Use	Transaction cost economics
12	Byrd and Turner (2000)	Empirical	Capability	Not Explicit
13	Cha et al. (2008)	Analytical	NA	Organizational learning
14	Christiaanse (2005)	Conceptual	Asset	Not Explicit
15	Christiaanse and Venkatraman (2002)	Empirical	Use	Market channel theory, Resource-based view
16	Clark et al. (1996)	Case-study	Asset	Not Explicit
17	Clemon and Row(1992)	Conceptual	Use	Transaction cost economics
18	Dehning et al. (2007)	Empirical	Asset	Not Explicit
19	Dong et al. (2009)	Empirical	Capability	Transaction cost economics, Resource-based view
20	Downing (2010)	Empirical	Asset	Not Explicit
21	Duchessi and Chengalur-Smith (2008)	Empirical	Asset	Not Explicit
22	Duncan (1995)	Conceptual	Capability	Not Explicit
23	Ghose et al. (2007)	Analytical	Asset	Game theory
24	Gosain et al. (2003)	Conceptual	Capability	Not Explicit
25	Gosain et al. (2004)	Empirical	Capability	Coordination theory
26	Grohowski et al. (1990)	Case-study	Asset	Not Explicit
27	Gurbaxani and Whang (1991)	Conceptual	Use	Transaction cost economics, Agency theory
28	Im and Rai (2008)	Empirical	NA	Organizational learning
29	Kim and Mahoney (2006)	Conceptual	Asset	Transaction cost economics, Resource-based view
30	Kim et al. (2005)	Empirical	Use	Information processing perspective
31	Kim et al. (2010)	Conceptual	Use	Evolutionary economics
32	Klein and Rai (2009)	Empirical	Use	Relational-view

33	Kumar and van Dissel (1996)	Conceptual	Use	Not Explicit
34	Lee et al. (1999)	Empirical	Asset	Not Explicit
35	Li et al. (2006)	Analytical	Use	Game theory
36	Malhotra et al. (2005)	Empirical	Asset	Absorptive capacity
37	Malhotra et al. (2007)	Empirical	Capability	Adaptation, Dynamic capability, Contingency theory
38	Malone and Rockhart (1991)	Conceptual	Use	Not Explicit
39	Malone et al. (1987)	Conceptual	Use	Transaction cost economics
40	Mani et al. (2010)	Empirical	Use	Information processing perspective
41	McKinney and Whiteside (2006)	Empirical	Asset	Not Explicit
42	Mukhopadhyay and Kekre (2002)	Empirical	Asset	Not Explicit
43	Nicolaou and McKnight (2006)	Experimental	Asset	Not Explicit
44	Osborn et al. (1989)	Case-study	Asset	Not Explicit
45	Premkumar et al. (2005)	Empirical	Use	Information processing perspective
46	Raghunathan and Yeh (2001)	Analytical	Asset	Game theory
47	Rai and Tang (2010)	Empirical	Capability	Competitive dynamics perspective, Resource dependence theory
48	Rai et al. (2006)	Empirical	Asset	Resource-based view
49	Rai et al. (2009)	Empirical	NA	Social embeddedness perspective
50	Ratnasingam (2005)	Case-study	Asset	Institutional theory, Cognitive process framework
51	Riggins and Mukhopadhyay (1994)	Analytical	Asset	Game theory
52	Sanders (2008)	Empirical	Use	Organizational learning
53	Saraf et al. (2007)	Empirical	Capability	Relational-view
54	Scott (2000)	Conceptual	Capability	Not Explicit
55	Smith (2004)	Conceptual	Asset	Not Explicit
56	Steinfeld et al. (2011)	Case-study	Capability	Not Explicit
57	Straub et al. (2004)	Analytical	Use	Game theory
58	Subramani (2004)	Empirical	Asset	Organizational learning, Transaction cost economics
59	Subramani and Venkatraman (2003)	Empirical	Asset	Transaction cost economics
60	Tafti (forthcoming)	Empirical	Capability	Transaction theory Coordination theory RBV & dynamic capabilities
61	Thrasher et al. (2010)	Empirical	Capability	Interdependence theory
62	Trkman et al. (2010)	Empirical	Asset	Not Explicit
63	Wang and Seidmann (1995)	Analytical	Asset	Game theory
64	Yao et al. (2007)	Empirical	Asset	Not Explicit

65	Yao et al. (2009)	Empirical	Asset	Not Explicit
66	Zmud and Massetti (1996)	Case-study	Use	Not Explicit

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II-9.3. Appendix C. Theoretical Paradigms Used in Interorganizational Issues in IS Research

The concept of the transaction cost economics (TCE) perspective was originally introduced by Coase (1937) and further developed by Williamson (1981). Based on the assumption that firms are self-interested economic agents with bounded rationality, the TCE perspective offers 1) a set of determinants of the governance structure (i.e. firm versus market) and 2) implications for potential safeguard strategies in interorganizational transactions. Prior IS interorganizational relationship studies that rely on the TCE perspective as the overarching theoretical lens can be broadly classified into two categories: (1) research on the impact of efficiency gains that result from the use of IT in interorganizational interactions on the organizational boundaries and (2) research on the role of interorganizational systems as a mechanism to reduce the potential for opportunistic behavior in interorganizational transactions (Kim and Mahoney 2006; Subramani and Venkatraman 2003).

The information processing perspective considers a firm as an information processing system and asserts that the performance of firms is determined by how well information processing needs align with information processing capabilities (Bensaou and Venkatraman 1995). Therefore, this theoretical branch suggests that firms should create the most appropriate configuration of organizational structure, processes, and IT to facilitate the collection, processing, exchange, and distribution of information in order to fulfill their information processing needs in each relationship (Bensaou and Venkatraman 1995, 1996). Subsequent IS studies revised and examined this framework in various business context (Kim et al. 2005; Mani et al. 2010; Premkumar et al. 2005)

The resource-based view (RBV) views a firm as a bundle of resources and asserts that competitive advantages are gained and sustained by accumulating valuable and scarce resources that competitors would find difficult to imitate (Barney 1986, 1991; Dierickx and Cool 1989;

Wernerfelt 1984). The relational view of firms (Dyer and Singh 1998) extends this concept, arguing that a firm's critical resources may span its organizational boundaries. This theory suggests that pairs, or networks, of firms realize gains from their relationships with external partners, with dyadic- or network-level barriers to imitation created by tightly integrated interorganizational processes and relation-specific assets between partners. These two conceptualizations of firms have been adopted by numerous IS studies that seek to discover the process of IT business value generation (Melville et al. 2004; Ray et al. 2004). Such studies assert that commonly available IT cannot create sustainable values, and that only IT deeply embedded in organizations with complementary business processes can create value (Bharadwaj 2000; Ray et al. 2004). Accordingly, in the interorganizational relationship context, IS research focuses on (1) IT viewed as intrinsically relation-specific assets that are customized for a specific relationship or (2) higher-order capabilities (e.g. process integration and knowledge sharing between partners) supported by IT integration and IT flexibility (e.g. Barua et al. 2004; Dong et al. 2009; Rai et al. 2006; Saraf et al. 2007).

The competitive dynamics perspective, often characterized as Awareness-Motivation-Capability¹⁷ (AMC), is grounded in Schumpeter (1942)'s framework of creative destruction and asserts that a firm's competitiveness is determined by that firm's ability to sense relevant market changes and to speedily make the appropriate adjustments. Studies espousing this perspective view interorganizational relationships as a source of longer-term learning and new knowledge creation to enhance the ability of firms to adapt to their changing environment (Ring and Ven 1994). Accordingly, IS studies in this stream focus on IT that supports interorganizational learning (Chi et al. 2010; Malhotra et al. 2005) and a flexible IT architecture that supports dynamic adjustment of a business's procedures, processes, and structure to changing environment and partners (Gosain et al. 2004; Malhotra et al. 2007; Rai and Tang 2010; Tafti 2009).

II-9.4.Appendix D. Organizational Capabilities in IS Studies

Recent IT literature suggests that IT enables higher-order business capabilities, which in turn influence firm performance (Ray et al. 2004, 2005; Whitaker et al. 2010). The basic assertion of these studies is that IT provides the building blocks for business processes to form organizational capabilities, as illustrated in .

Two major theories identified in these studies are the resource-based view and dynamic capability. Studies espousing the resource-based view focus on business processes that are tightly integrated with IT, and consider these IT-enabled business processes themselves as key firm capability that generate competitive advantages. The resource-based view focuses on the exploitation of the resources that a firm has acquired and developed in the past. Therefore, though the studies in this research stream illustrate the relations, they are relatively silent on how the capability has developed in a firm and why IT can contribute to this development process. On the other hand, the dynamic capability perspective places greater significance on the acquisition or development of a capability. Therefore, I choose the dynamic capability perspective as a theoretical foundation of this study.

¹⁷ Here, "awareness" is defined as a firm's ability to sense the dynamics of a competitive environment and quickly detect external challenges and opportunities (Chi et al. 2010; Sambamurthy et al. 2003). Other key concepts are "motivation", or a firm's intent to take decisive action, and "capability", the firm's ability to react with speed and efficiency to deliver market-driven products and services.

Table II-9. Empirical Research on IT and Organizational Capability Development			
Studies	Organizational capability	IT construct	Theory base
Barua et al. (2004)	Online information capability	System integration	Resource-based view
Ray et al. (2005)	Customer service process capability	IT resource	
Tanriverdi (2005)	Cross-unit knowledge management capability	IT-relatedness across business units	
Rai et al. (2006)	Supply chain integration capability	IT infrastructure integration for SCM	
Pavlou and El Sawy (2006)	New product development capability	IT leveraging competence	Resource-based view and dynamic capabilities
Banker and Bardham (2006)	Manufacturing capability	Plant information systems	Dynamic capabilities
Rai and Tang (2010)	Competitive process capabilities (process alignment and flexibility)	IT integration and reconfiguration	ACM framework
Joshi, Chi, Datta, and Han (2010)	Knowledge capability	IT-enabled absorptive capacity	Dynamic capabilities
Mithas, Ramasubbu, and Sambamurthy (2011)	Customer process and, performance management capabilities	Information management capability	(not explicit)

Note: This table lists some representative studies and should not be construed as an exhaustive review of the relevant literature.

II-9.5. Appendix E. Theoretical Underpinnings of This Study

Knowledge-Based View of Firms

The knowledge-based view of the firm builds on a resource-based assessment (Barney 1991) and evolutionary economics¹⁸ (Nelson and Winter 1982). The knowledge-based view focuses on knowledge as a key resource (Grant 1996), asserting that the growth of a firm primarily depends on its ability to generate new applications of knowledge in its knowledge base (Kogut and Zander 1992). A firm's knowledge base, which consists of knowledge developed internally and acquired externally (e.g. from alliance partners), is chiefly valued for its ability to improve the performance of the firm. Knowledge bases of firms are significantly different from firm to firm because of the path-dependent characteristics of the knowledge accumulation. In other words, because the knowledge base incrementally changes over time, the current knowledge base of a firm is largely determined by its initial endowment and prior experiences. Furthermore, as knowledge is often deeply embedded in bundles of its organizational routines, it

¹⁸ Evolutionary economies view a firm as a historical entity that consists of routines referring to organizational protocols, process specifications, and interaction norms through which individuals apply and integrate what they know without having to communicate it explicitly. Routines are developed in a firm as it gains experience with a specific activity.

is difficult to imitate. Knowledge, therefore, is a valuable, rare, and inimitable resource that can engender competitive advantages. This theory further argues that knowledge integration, which involves synthesizing and applying current and acquired knowledge resources (Grant 1996; Kogut and Zander 1992), is a key firm capability because it enables a firm to exploit “its knowledge and the unexplored potential of the technology (Kogut and Zander 1992 p. 391)”.

Dynamic Capability

The dynamic capability perspective evolves from a resource-based view of firms. However, the critical distinction is that, rather than accentuating the exploitation of firm-level resources, this perspective emphasizes the changes in the capabilities, focusing on acquisition and development. A dynamic capability is defined as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al. 1997 p. 516)”. This perspective asserts that dynamic capabilities enable firms to unleash value derived from firm resources through innovative dynamic resource reconfiguration. It argues that dynamic capabilities are unique and idiosyncratic processes that emerge from the path-dependent processes of individual firms (Nelson and Winter 1982; Teece et al. 1997; Zollo and Winter 2002). However, the initial concept of dynamic capabilities was criticized for being too abstract and tautological. Eisenhardt and Martin (2000) refine the concept and argue that dynamic capabilities “are the organizational and strategic routines by which firms achieve new resource configurations (p.1107)” and further argue that dynamic capabilities consist of identifiable and specific routines such as “alliance and acquisition routines that bring new resources into the firm from external sources (p.1108)”. In addition, the authors argue that the path-dependency of dynamic capabilities can be better described as comprising the learning process of a firm. Zollo and Winter (2002) support this argument by proposing that a dynamic capability of the firm, one that generates and modifies the firm’s routines involving complex organizational tasks, develops through deliberate learning efforts aimed at articulating and codifying knowledge relevant to specific tasks.

Organizational Learning¹⁹

The organizational learning theory constitutes the key theoretical nexus for many alliance studies that employ it in order to explain the significant effect of past experiences on alliance performance (Kale and Singh 2009; Wassmer 2010). Organizational learning is defined as “the dynamic process of creating new knowledge and transferring it to where it is needed and used, resulting in the creation of new knowledge for later transfer and use (Kane and Alavi 2007 p. 796)”. This theory was developed to articulate associations between past actions, the effectiveness of those actions, and the genesis of future actions. Unlike individual knowledge situated in discrete persons, the knowledge of an organization represents a collective knowledge

¹⁹ Since organizational learning theory broadly considers the development of knowledge, it is closely related to the concept of knowledge management and absorptive capacity, i.e. “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal 1990). However, knowledge management tends to emphasize the static stock of knowledge held by an organization and the characteristics of that knowledge (Kane and Alavi 2007). In addition, absorptive capacity is, according to Roberts, Galluch, Dinger, and Grover (2011), biased towards external knowledge, while organizational learning encompasses both internal and external knowledge. Therefore, I use the term “organizational learning” as a broader term for consistency, but will draw insights from prior studies on knowledge management and absorptive capacity wherever necessary.

pool spatially distributed throughout the organization (Shah and Goldstein 2006). Moreover, because individuals, not organizations, are the principal agents of learning, an organization risks losing knowledge if the individual with a specific knowledge leaves the firm. Therefore, organizational learning requires the clarification of the *mechanisms* or *processes* for firms to leverage knowledge from *prior* alliance experiences for the benefit of *current and future* alliances.

The organizational learning theory posits that the learning process of organizations involves acquiring, distributing, and interpreting information (Huber 1991; Tippins and Sohi 2003). These learning processes 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 above 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). Organizational memory is considered particularly important in leveraging past experiences, as it embodies "the means by which knowledge from the past is brought to bear on present activities" (Stein and Zwass 1995).

The organizational learning theory has been employed in IS research mainly for two purposes. One branch of IS research has employed this theory to suggest that IT facilitates organizational learning by supporting processes for learning (acquisition, distribution, interpretation of information) and helping organizational memory to store information from past activities and outcomes (Malhotra et al. 2005; Robey and Boudreau 1999; Walsh and Ungson 1991). A confluent stream of research has used this theory to explain the effect of experience in IT projects and IT/business process outsourcing (Whitaker et al. 2010). This current chapter builds on the former stream of research.

Chapter III. Building Alliance Capabilities through Information Technology: The Effect of IT-enabled Knowledge Platforms on the Market Value Effects of Alliance Announcements

III-1. Introduction

In recent decades, information technology (IT) has played an increasingly significant role in generating value for business functions that span organizational boundaries (Krishnan et al. 2007; Prahalad and Krishnan 2008). The enhanced capacity to manage complex interorganizational activities using IT has enabled firms to engage more aggressively in alliances (Sahaym et al. 2007; Tafti et al. 2013), which are contractual arrangements between two or more independent firms for mutual benefits that neither firm can easily attain on its own (Kale and Singh 2009; Sahaym et al. 2007). The role of IT as a facilitator in alliance formation raises the question of whether IT also allows firms to perform better in alliances. Despite the extensive body of information systems (IS) literature on interorganizational relationship management, we know surprisingly little about the effects of firm-level IT applications on the outcomes of alliances. Most IS studies on interorganizational relationship management have primarily focused on IT that supports a tight integration of business processes between partners at a dyadic level; these studies include the investigation of electronic data interchange (EDI) developed for a specific relationship (e.g. Mukhopadhyay and Kekre 2002) and the compatibility and flexibility of IT infrastructure and applications between partners (e.g. Rai and Tang 2010; Saraf et al. 2007; Tafti et al. 2013). Close IT-enabled integration between partners, however, may not be required for all alliances. Alliances involve a diverse set of business activities, from promotional marketing programs to long-term joint research and development (R&D) projects. Accordingly,

the demand for IT for a specific alliance relationship can vary significantly from alliance to alliance. Some successful alliances may need heavy IT investment and integration, while others may not. In the latter case, it is difficult to justify the value of IT from prior studies that emphasize the value of IT to support tight business process integration. However, to conclude that IT is not relevant to some alliances would be premature, because prior studies have investigated the effect of IT with a limited focus.

Recent theoretical developments in the alliance literature provide a strong incentive to investigate the influence of IT on alliance management from the perspective of a focal firm's capabilities. Literature suggests that, although alliances are essentially dyadic exchanges, the processes and outcomes associated with them critically depend on a firm's internal management capability, which can be enhanced by organization-wide learning efforts (Kale et al. 2002; Schreiner et al. 2009). At the same time, it is a commonplace observation that various firm-level IT applications now serve as digitized knowledge platforms and assume a critical function in storing and sharing alliance-related knowledge accumulated within the firm, potentially enhancing firm's learning efforts for the management of alliances. For example, many high-performing firms involved in alliances, including Hewlett-Packard, Cisco Systems, FedEx, and Xerox, have invested in IT applications and electronic databases that support knowledge sharing for various alliance-related tasks, such as partner selection, process management, decision making, and performance evaluation. Many practitioner-oriented business articles give these examples as best practices for firms to benchmark (Corporate Strategy Board 2000; Dyer et al. 2001; Gomes-Casseres 1998). Despite high levels of interest in the effects of IT-enabled knowledge platforms in alliance management, there are few empirical or theoretical examinations of how IT-enabled knowledge platforms affect the performance of strategic

alliances²⁰. Thus, I ask the following research question: *Is there an association between the use of IT-enabled knowledge platforms and alliance performance outcomes?*

In this chapter, I propose that IT-enabled knowledge platforms can improve organizational learning, facilitating the development of firm capabilities in managing alliances. Based on the theories of organizational learning (Huber 1991), I hypothesize that firms with IT-enabled knowledge platforms are expected to achieve higher levels of performance. This expectation develops because using these platforms contributes to the development of alliance capability by facilitating organizational learning and encouraging alliance managers to follow disciplined routines. I examine my hypotheses by investigating the relationship between the stock market response to the announcement of a new alliance and whether the use of IT-enabled knowledge platforms affects this relationship. Assuming that stock market responses accurately reflect the expectations for the success of an alliance, I analyze 186 firm-year level observations of 67 firms involved in 439 alliances from 1999 to 2003 using the event-study approach. The results provide support that alliance announcements create a positive effect on the market valuation of a firm, and that the use of IT-enabled knowledge platforms is positively associated with stock market gains. However, results does not show the evidence for the synergetic effect of the use of IT-enabled knowledge platforms and alliance experience.

This chapter makes several contributions to IS literature. Most importantly, it extends the findings of recent IS studies that emphasize the IT-enabled cultivation of higher-order business capabilities, which influence firm performance (Pavlou and El Sawy 2006; Ray et al. 2004, 2005; Tanriverdi 2005; Whitaker et al. 2010). Focusing on alliance capability, considered to be an important firm capability (Kale and Singh 2007), this chapter provides a theoretical

²⁰ “Alliance performance” in this study refers to the performance consequences for firms as derived from alliances (Gulati 1998), an outcome that can be different from the performance of alliances themselves.

framework and empirical evidence that suggests the contribution of IT-enabled knowledge platforms to the development of organizational capabilities. It also presents guidelines for successful business practices, namely that firms desiring to enhance their performance in strategic alliances should invest in IT-enabled knowledge platforms; even if the platform does not directly relate to a specific alliance, it will facilitate firm-wide learning efforts in alliance management.

The remainder of this chapter is organized as follows: In the following section, I provide a review of the relevant background literature and then develop hypotheses based on relevant theories and academic literature. Anecdotal examples of the use of three types of IT-enabled knowledge platforms in the management of strategic alliances are also discussed. A description of my research design and data are followed by a discussion of my results and the conclusion.

III-2.Literature Review

Prior literature relevant to this chapter can be categorized into two broad areas. The first area encompasses studies in the alliance literature that empirically examine the performance consequences of alliances for firms and the factors that influence those outcomes. The second area involves IS research that examines how IT influences organizational capabilities and performance.

III-2.1.Alliance Outcomes and Alliance Capabilities

Two questions that are important in the field of alliance management research are whether strategic alliances ultimately benefit the participating firms and what factors influence the outcomes of alliances. However, empirically investigating the performance consequences of alliances for the participating firms is difficult, because those firms engage in many other non-

alliance activities that also influence their performance (Gulati 1998). In an attempt to isolate the effect of an alliance on firm performance, several studies have adopted the event-study approach, which primarily examines the stock market response to newly released information—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 basic premise of this approach is that firms and stock market investors are rational. Thus, a firm chooses an alliance over other investment options (e.g. engaging in internal development or market transactions, or declining to invest) only when it expects that investment in an alliance would generate the highest returns among all investment options. The expected positive benefits of the alliance will be correctly reflected by the firm's valuation by rational stock market investors with accurate information, generating robust market returns for the firms when a new alliance is announced. Using the event-study approach, Chan, Kensinger, Keown, and Martin (1997) and Das et al. (1998) found that a new alliance announcement generated a positive response in the stock market vis-à-vis a firm's valuation.

Using the event-study approach, subsequent studies investigated the factors that influence the overall performance of firms and attempted to explain the variance in alliance performance by considering the types of alliance activities engaged in, the profitability of the participants (Das et al. 1998), and their experience in alliances (Anand and Khanna 2000). In addition, Anand and Khanna's study (2000) shows the existence of firm-specific internal capabilities for alliances other than alliance experiences. This collection of capabilities is referred to as *alliance capability*, composed of 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). Kale et al. (2002) explored how this capability is developed in a firm and attempted to explain "how prior experience translated into a capability (p.749)". They also

advocated for additional mechanisms to foster the development of alliance capability. The authors showed that the presence of a dedicated alliance function, which governs all alliance activities in an organization, explains a significant portion of the variation in returns to an alliance announcement. The alliance function coordinates alliance activities and shares best practices, acting as a knowledge base for the firm. As the authors noted, though, having a dedicated function is only one of a wide range of actions that firms can undertake to develop alliance capability, a phenomenon that demands further research.

Table III-1. Strategic Management Research Related to Alliance Performance and Capability ²¹	
Issues	Study
Consequences of alliances	Early alliance literature showed the benefits of alliances, such as knowledge sharing, cost and risk reduction, and access to complementary assets (Ahuja 2000; Mowery et al. 1996; Park et al. 2004), but empirical studies that examine the financial impact of alliances in the stock market have produced mixed results (Chan et al. 1997; Das et al. 1998).
Alliance/Firm characteristics related to performance	Das et al. (1998) show the potential effects of alliance and firm characteristics, such as the types of activities and profitability of a firm, on alliance performance. Lin, Yang, and Arya (2009) examine the effect of resource complementarity and partner status on alliance performance. Other researchers have also examined the choice of scope and governance structure of alliances and their subsequent effect on performance (Khanna 1998; Oxley 1997).
Effect of alliance experience	Several studies have provided strong evidence that experience is positively related to alliance performance in various measures such as firm valuation (Anand and Khanna 2000) and patent activities (Sampson 2005). Studies also show that the relationship exhibits a diminishing marginal return (Hoang and Rothaermel 2005) and that partner-specific experiences can negatively affect corporate performance (Goerzen 2007; Hoang and Rothaermel 2005). Also, Sampson (2005) suggests that the benefits of experiences depreciate over time.
Alliance capability	Anand and Khanna (2000) propose the concept of “alliance capability”, and subsequent studies have tried to identify the specific components of this capability (Schreiner et al. 2009) and how it develops in a firm. Kale et al. (2002) point to dedicated alliance functions as a key structural mechanism. Dyer et al. (2001) propose that knowledge management plays an essential role of dedicated function, and Kale and Singh (2007), empirically show how the role of a dedicated alliance functions in facilitating a firm’s “alliance learning process”.

Note: This table lists some representative studies and should not be construed as an exhaustive review of the relevant literature.

²¹ This table appeared in Appendix A of Chapter 2.

III-2.2.Improving Organizational Capabilities through Information Technology

Recent IS literature suggests that a firm may leverage IT to enhance higher-order business capabilities, which in turn influence firm performance (Ray et al. 2004, 2005; Whitaker et al. 2010)²². For example, Ray, Muhanna, and Barney (2005) showed that shared knowledge and a flexible IT infrastructure improved a firm capability in customer service processes, leading to performance gains. In a multi-business firm context, Tanriverdi (2005) demonstrated how IT-relatedness across business units enhanced cross-knowledge management capability, which is linked to the creation, transfer, integration, and leverage of products, customers, and managerial knowledge across business units. Pavlou and El Sawy (2006) concluded that IT-enabled enhancement of efficiency and effectiveness in allocating resources, assigning tasks, and synchronizing activities improved a firm's innovation capability. Rai and Tang (2010) proposed that key process capabilities in supply chains, process alignment and offering, and partnering flexibility can be enhanced by flexible IT resources, enabling straightforward connections between the focal firm and its suppliers. Mithas, Ramasubbu, and Sambamurthy (2011) linked information processing capability to a firm's customer, process, and performance management capabilities, and argued that timeliness in transparent information sharing and communication improved these capabilities. Notably, many studies in this vein often focus on a particular business process and how IT improves the performance of that process.

However, alliance capability has not been comprehensively examined in IS research, despite its strategic importance in modern business. Additionally, the focus of prior IS research in interorganizational relationship management and IT integration implicitly restricts our understanding of other ways IT enhances organizational capability, such as how it facilitates

²² See Appendix D of Chapter 2 for a more comprehensive review.

firm-wide knowledge sharing and learning efforts: topics that I will discuss in the following section.

*III-3.Theory and Hypotheses*²³

This section provides the theoretical background of this chapter, which suggests that an IT-enabled knowledge platforms can boost alliance performance. How can the improved alliance outcomes of firms using IT-enabled knowledge platform be explained? Based on organizational learning theory (Huber 1991), I argue that the learning capacity of an organization can be greatly influenced by IT-enabled knowledge platforms, which can facilitate organizational learning and improve the participatory firms' alliance management capabilities and resultant outcomes (Kane and Alavi 2007). Organizational learning is defined as “the dynamic process of creating new knowledge and transferring it to where it is needed and used, resulting in the creation of new knowledge for later transfer and use (Kane and Alavi 2007 p. 796)”. The organizational learning theory posits that the learning process of organizations involves acquiring, distributing, and interpreting information (Huber 1991; Tippins and Sohi 2003)²⁴.

In strategic alliances, firms can learn various aspects of alliance management from experience. These management aspects include identifying opportunities, selecting partners, designing contracts, governing processes, and transferring information between alliance partners. Throughout the lifecycle of an alliance, knowledge gained from these experiences can provide critical guidance specific to the organizational context for later alliances, because experience expands the repertoire of management practices and processes that a firm can use in new alliance (Argote et al. 1990; Baum and Ingram 1998; Chang 1995; Lieberman 1984). Empirical studies

²³ This section is built on the theory-based discussion for Proposition 2B in Chapter 2, which has explicated the role of digitized knowledge in the development of an alliance capability.

²⁴ Appendix E of Chapter 2 provides a more comprehensive review.

have shown 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 organizational learning theory, however, alliance experience alone may not be sufficient to guarantee better organizational performance. Organizational knowledge is the collective knowledge pool throughout an organization, rather than the knowledge of individuals (Shah and Goldstein 2006). Because individuals, not organizations, are the principal agents of learning, an organization risks losing knowledge if an individual with specific knowledge leaves the firm. Moreover, strategic alliances are often initiated and executed at a business-unit level. Thus, the knowledge gained from that alliance would likely be scattered across business units in an organization, inhibiting its identification and use (Alavi and Tiwana 2002). Therefore, to explain how firms improve their alliance performance with knowledge gained from prior alliances, the mechanisms or processes that firms use to leverage that knowledge towards current and future alliances must be clarified.

I suggest that using IT-enabled knowledge platforms facilitates effective learning for alliance management. In this paper, the term “IT-enabled knowledge platforms” mainly refers to the IT applications also known as knowledge management systems (KMS), which are developed “to support and enhance the organizational process of knowledge creation, storage/retrieval, transfer, and application (Alavi and Leidner 2001 p. 114)”. Although these two concepts have many aspects in common, especially in terms of IT applications used, I have chosen to adopt the terminology of IT-enabled knowledge platforms instead of KMS to conceptually distinguish between digitized platforms that support dynamic learning process (IT-enabled knowledge

platforms) and systems used to manage static stocks of knowledge held by an organization (KMS), following the approach taken by Kane and Alavi (2007, p. 797). I propose that IT-enabled knowledge platforms can facilitate organizational learning in developing alliance capability by supporting dynamic processes for learning to manage alliances. These processes include acquiring, distributing, and interpreting information (Huber 1991; Tippins and Sohi 2003), as well as managing organizational memory, which is “the amount of stored information or experience an organization has about a particular phenomenon” (Tippins and Sohi 2003). Most organizations use multiple IT-enabled knowledge platforms to support organizational learning processes and organizational memory management (Goodman and Darr 1998; Kane and Alavi 2007), and these systems are often broadly categorized into three groups: (1) knowledge repository, (2) expert directories, and (3) groupware.

III-3.1. Knowledge Repository

One key component of an IT-enabled knowledge platform is a knowledge repository, which facilitates the communicability of organizational knowledge. A knowledge repository stores codified organizational knowledge and enables easy access, modification, sharing, and reuse of that knowledge (Alavi and Leidner 2001; Stein and Zwass 1995). A knowledge repository also preserves knowledge despite organizational turnover (Kane and Alavi 2007). Guidelines, checklists, or manuals available in a knowledge repository can encourage alliance managers to make consistent decisions during the different phases of strategic alliances, and can potentially minimize process variability across business units (Frei et al. 1999; Kale and Singh 2007). Knowledge repositories can also facilitate organization-wide learning efforts by encouraging the replication and transfer of best practices within a firm by making new practices easier to apply (Galunic and Rodan 1998).

For example, Dow Corning Corporation uses an IT-enabled knowledge repository, which provides guidelines to alliance participants by specifying working procedures for tasks. These tools help alliance managers save time and improve the quality of the process by reducing the risk of neglecting important steps in the process or sequencing activities incorrectly. Furthermore, these tools also have built-in best practices with descriptions of each process step. These functions further facilitate the use of prior knowledge because alliance managers can refer to the best practices without needing to consult a separate system. Cisco Systems also uses an IT-enabled knowledge repository, known as the 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 using this database cannot totally obviate the search process, it can certainly improve a firm's ability to identify good alliance opportunities by providing more information for the firm to use to vet the applicant. Moreover, this kind of database can also encourage alliance managers to account for corporate-level alliance considerations (such as corporate partnering objectives, strategic implications, and partnering trends) in their partner selection processes.

III-3.2.Expert Directories

Firms often provide other means to access knowledge difficult to codify into knowledge repository systems. These means include corporate expert directories that compile internal and external experts, facilitating direct interactions to share knowledge (Alavi and Leidner 2001). Online expert directories allow alliance managers to search for experts well-versed in the issues they require counsel in; managers can 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 relevant to their specialty and provide guidance for future courses of action. Many organizations, including Eli Lilly and Company, Cisco Systems, and Hewlett-Packard, provide alliance managers with easy access to alliance experts inside and outside of the organization. Online expert directories can be particularly useful for sharing knowledge on contract issues, because this type of knowledge may be too tacit or politically sensitive to be codified and shared systematically.

III-3.3.Groupware

Groupware is a combination of communication technology and knowledge repositories used to create a secure learning environment in which employees can share and discuss task-specific knowledge with one another (Kane and Alavi 2007). Enhanced interactions among alliance managers enabled by groupware can facilitate the acquisition, distribution, and interpretation of alliance-related knowledge and information throughout the organization (Alavi and Leidner 2001; Goodman and Darr 1998; Huber 1991; Kane and Alavi 2007; Tippins and Sohi 2003). In addition, these systems also stimulate mutual understanding among alliance managers and strengthen the social ties that support understanding, perspective sharing, and development of tacit knowledge (Sambamurthy et al. 2003). For example, firms form alliance committees, task forces, and other forums to facilitate the exchange of alliance know-how and best practices among alliance managers within a firm (Kale and Singh 2007). Groupware can be used to enhance the effectiveness of these efforts by providing communication channels and online forums. The beneficial effects of this intimacy among organizational members may contribute to more effective organizational learning and the accelerated development of alliance capability.

III-4.Hypothesis Development

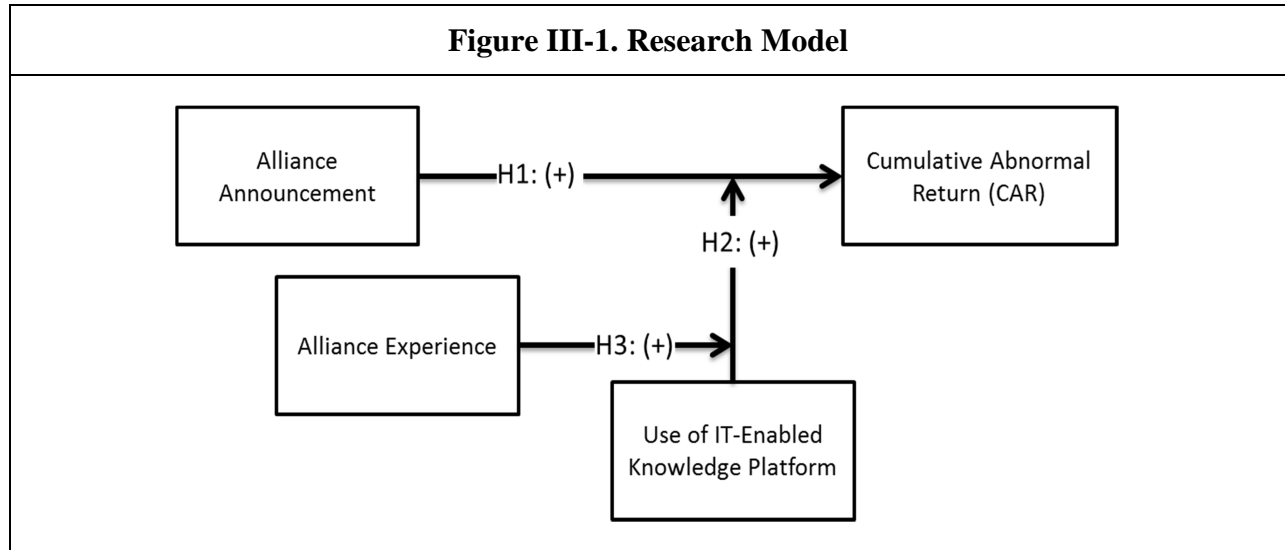


Figure III-1 shows the research model of this chapter. Alliance literature has shown that alliances provide substantive benefits, such as knowledge sharing, risk reduction, resource complementarity, and the scale effect (Ahuja 2000; Gulati 1998; Mowery et al. 1996; Park et al. 2004). Based on prior research that provides empirical evidence that a new alliance announcement generates a positive abnormal stock market return (Anand and Khanna 2000; Chan et al. 1997; Das et al. 1998), I hypothesize the following:

Hypothesis 1. Alliance announcements from firms will be associated with positive abnormal stock market returns.

As the theory-based discussion has explicated (see the previous section and Chapter 2), IT-enabled knowledge platforms (1) support the codification, distribution, and retrieval of knowledge for managing alliances via knowledge repositories, (2) reinforce the sharing of tacit knowledge by providing online directories of internal and external experts on alliances, and (3) facilitate the development of knowledge by supporting interactions among alliance managers,

who are the users of alliance knowledge. Easy and quick access to relevant information and real-time information sharing enabled by IT-enabled knowledge platforms facilitates organizational learning in alliance management. Thus, firms using IT-enabled knowledge platforms are more likely to effectively facilitate the type of organizational learning that develops alliance capability. The enhanced alliance capability with the use of IT-enabled knowledge platforms would enable firms to identify appropriate alliance partners through a thorough screening process and to design appropriate contract terms by leveraging internal and external experts.

It is plausible that the use of knowledge platforms may not affect investor's evaluation of a firm's alliance outcomes, because investors may not know whether a firm is equipped with IT-enabled knowledge platforms. However, an alliance is often announced with the details about the partners and the contract terms, and the well-designed alliance with appropriate partners and contract terms will be considered favorable to the firm by stock market investors (Kale et al. 2002). Thus, even though investors may not have direct knowledge of the firms' use of IT-enabled knowledge platforms, the positive expectation based on the information revealed with the announcement will be reflected on the abnormal returns. Thus, I hypothesize that

***Hypothesis 2.** Alliance announcements from firms that use IT-enabled knowledge platforms will, on average, result in higher abnormal stock market returns than announcements from firms that use IT-enabled knowledge platforms less.*

Prior studies view alliance experience as a key source of organizational learning for alliance management. This relationship exists because trial-and-error experience better prepares firms to find solutions to issues that arise in an alliance. IT-enabled knowledge platforms are expected to allow experienced firms with more accumulated know-how to exploit their rich base of alliance-related knowledge more effectively, leading to the following hypothesis:

Hypothesis 3. *The positive effect of IT-enabled knowledge platforms on abnormal stock market returns generated from alliance announcements is greater for firms with more alliance experience than for firms with less.*

III-5. Research Methodology: Event-Study Analysis

To assess the relationship between the use of IT-enabled knowledge platforms and alliance outcomes, I use the event-study approach, which has been extensively used in finance and accounting as well as in IS and alliance research. As briefly discussed earlier, this methodology is based on the efficient market assumption, in which stock prices incorporate all relevant information about the value-creation and growth prospects of a firm (Anand and Khanna 2000; Dehning et al. 2003; Dos Santos et al. 1993). With the release of new information about an event, investors assess the value of investment in response to the event. If the investment is expected to outweigh the costs, the additional benefit exceeding the costs derived from the investment will be reflected on firm valuation, and the firm will enjoy greater market returns.

III-5.1. Use of the Event-Study Method in IS Research

Several IS studies have used the event-study approach to examine the impact of IT investment-related events on the market value of a firm. For example, IS researchers have examined the reactions of the stock market to announcements of investments in innovative IT applications (Dos Santos et al. 1993), enterprise resource planning (ERP) (Ranganathan and Brown 2006), and electronic commerce (Subramani and Walden 2001). The creation of the CIO position (Chatterjee et al. 2001) and e-business outsourcing (Agrawal et al. 2006) have also been examined. Later studies investigated the factors that influence the announcement's impact on firm value, such as the types of IT used (IT infrastructure versus IT applications) (Chatterjee et al. 2002), the strategic role of IT (Dehning et al. 2003), and the countries of the firms (Meng and

Lee 2007). A recent study by Barua and Mani (2011) raised the concern of using the event-study method to investigate IT investment announcements, because this approach may not consider the potential heterogeneity of firm capabilities when analyzing the impact of IT investment.

The effect of IT on the reaction to announcements of other business activities has not been widely investigated in IS research. One notable exception is a paper by Tafti (2009), which examines the influence of IT investment in the acquirer and target companies on the market response to the associated merger and acquisition (M&A) announcements. To the best of my knowledge, no study has examined the impact of IT investment on the generation of excessive returns from an alliance announcement. Specifically, this chapter focuses on an alliance announcement by a firm. I view stock market responses to alliance announcements as measures of alliance outcomes, and examine them as a function of the associated firms' use of IT-enabled knowledge platforms and relevant controls.

III-5.2.Measures

Dependent Variable: Average Cumulative Abnormal Return (AVGCAR)

The dependent variable used in the main analysis is the average cumulative abnormal returns (CAR) across all the alliances forged by a firm over the course of a year. CAR of an individual alliance is the sum of the excess returns surrounding the announcement of an event: a firm's alliance announcement in this case. This measure reflects the value that the market expects the firm will capture by entering into that alliance. This measure is an *ex ante* expectation held by stock market investors, which may not perfectly predict *ex post* outcomes. In the strategic alliance context, Kale et al. (2002) provided a validation for the use of *ex ante* market 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, as assessed by the firm managers in charge of the associated alliance.

Mathematically, abnormal return is measured by the deviation of realized returns from normal returns. In other words, it is the estimated prediction error from a standard capital asset-pricing model (CAPM). More specifically, the following market model is estimated over a 200-day period, ending 10 days prior to an announcement:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \epsilon_{it}$$

Here, r_{it} denotes the daily realized returns for firm i on day t , r_{mt} denotes the corresponding daily returns on the CRSP value-weighted market index, α_i and β_i are firm-specific parameters, and ϵ_{it} is the market model residual, which is assumed to be i.i.d. normal. The estimates obtained from this model are then used to predict the daily returns for each firm i over a window period surrounding the event day, written as:

$$\hat{r}_{it} = \hat{\alpha}_i + \hat{\beta}_i r_{mt}$$

where \hat{r}_{it} are the predicted daily returns and $\hat{\alpha}_i, \hat{\beta}_i$ are the model estimates. Thus, the daily firm-specific excess returns are written as:

$$\hat{\epsilon}_{it} = r_{it} - \hat{r}_{it}$$

where $\hat{\epsilon}_{it}$ represents the daily firm-specific excessive returns. CAR was calculated by aggregating these excess returns over a five-day period surrounding the announcement, from two days before to two days after. This measure was tested using shorter (2-day) and longer (7-day, 10-day) time windows to check the robustness of the results, accounting for the possibility of information leakage before an announcement, a slow market response, or variation in identifying

the exact announcement date. Then, using CAR of individual alliances, I calculate AVGCAR, the dependent variable, by taking the average CARs across all the alliances established by a firm in a given year to create cross-sectional time-series data. I chose this approach, which is consistent with Kale et al. (2002), for several reasons. First, this approach addresses the concern that a few firms with many alliances greatly influence the analysis, biasing the results and observations. This issue is particularly important because the variable of interest, the use of IT-enabled knowledge platforms, is a firm-level variable, which does not vary across alliances for a firm in a given year. By using the variables at a firm-year level, the level of analysis of the outcome variable will be consistent with the key explanatory variable. Second, this chapter focuses on how IT-enabled knowledge platforms contribute to the development of firm-level capabilities that produce consistently better alliance performance. The performance of an individual alliance can be affected by several partner-specific factors. By taking the average at the firm-level, the effects of these alliance-specific factors can be ruled out, isolating the overall alliance performance. While the average CAR across alliances is used as the dependent variable in the main analysis, I also examine the model at a firm-alliance level by using the CAR of individual alliances.

Explanatory Variables

IT-enabled knowledge platforms (KP). The effects of IT-enabled knowledge platforms are examined by analyzing data on the use of three types of knowledge platforms within a company. In the Information Week (IWeek) survey, the data source for IT-related practices that will be discussed in the next section, firms were asked to provide information on which systems

they used in their knowledge-management strategy from the following²⁵: (1) knowledge repository, (2) expert directories, and (3) groupware. As Kane and Alavi (2007) noted in their simulation study, the effect of combining IT-enabled knowledge platforms can be different from the summed effect of the individual systems. Therefore, I examine the impact of the use of these knowledge platforms by formulating a second-order measure using these items as formative indicators. These indicators are formative indicators because they are not necessarily interchangeable, and because the direction of causality flows from these indicators to the main construct. An unrotated principal components analysis (PCA) shows that all the items load positively onto the first principal component, with weightings between 0.45 and 0.63. Hence, I used the first principal component in the main analysis. In the supplementary analysis, I also examine the effect of using each individual system.

Table III-2. Measure and Data Source		
Variable	Description	Source of Data
AVGCAR	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)
KP	The first component of an unrotated principal component analysis (PCA) using the use of (1) knowledge repository, (2) expert directories, and (3) groupware as indicators.	Information Week survey
IT	The percentage of annual IT budget with regard to the total sales.	
SIZE	Log-transformed total assets for each firm	Compustat
EXP	Log-transformed count of total alliances formed by each firm for the past ten years.	SDC Platinum

²⁵ The survey question is “What are the systems, if any, used in your organizations knowledge management strategy?” Respondents were asked to choose all that apply among the following: (1) group memory/context management (knowledge repository), (2) expertise profiling (expert directories), (3) data mining tools, (4) groupware, (5) data warehouse, (6) relational databases, (7) teamware, (8) text/document search, (9) expert databases/artificial intelligence. Among them, I chose three types of systems (group memory, expertise profiling, and groupware), which are most relevant to the systems that support organizational learning. I also formulated alternative measure for the IT-enabled knowledge platforms by considering all systems mentioned in the survey for the robustness checks. The analyses results are robust to the alternative measures.

Prior alliance experience (EXP). Prior research suggested that a firm's alliance experience would be positively related to its overall alliance outcome because learning from prior experience can benefit a new alliance (Anand and Khanna 2000; Kale et al. 2002). To measure the experience, I count the number of alliances formed by each firm for the past ten years, consistent with prior alliance research using similar event methodology (Anand and Khanna 2000; Kale et al. 2002). To account for potential depreciation of the value of experience (Sampson 2005), I also examine alternative measures of experience with shorter time windows of three and five years. Additionally, this measure is log-transformed to account for non-linearity of the effect caused by potential depreciation. This experience measure is not differentiated by types of alliance activities or governance structures, because firms may exploit any type of prior alliance experience to learn to manage not only specific alliance activities and governance structure, but also the coordination of difficulties inherent to such partnerships (Sampson 2004). This approach is consistent with that of Anand and Khanna (2000).

Control Variables

IT Intensity (IT). I included the IT intensity of a firm as a proxy measure for the overall information intensity of a firm's operations. This measure is the ratio of a firm's annual IT expenditures to the total sales of the firm. This construct has been used as a proxy for the overall IT resources of a firm in prior studies, comprehensively capturing all of a firm's IT-related expenses, including hardware, software, data communication, and the salaries and recruitment costs of IT professionals (Bardhan et al. 2006; Bharadwaj et al. 1999; Chari et al. 2008). This measure serves as a good indicator of the level of support from IT when forming alliances.

Firm size (SIZE). Firm size is included as a control. Controlling for the size of firm is important because the percentage change of stock market returns can be smaller for larger firms. Also, larger firms may have more resources, increasing the probability of alliance success. Large firms are also likely to have more alliance experience because they have had more opportunities to engage in alliances. It is also possible that large firms are more likely to invest in IT and have IT-enabled knowledge platforms available within the firm. I measured firm size (SIZE) as the total assets of a firm after log-transformation.

III-5.3.Data

Hypotheses were tested using a dataset of publicly traded U.S. firms that involved at least one alliance during the five-year time period from 1998 to 2003. Firms were selected based on the availability of variables required for empirical modeling. Firms and alliances are distributed non-uniformly over all industries from high-tech manufacturing to research services (Table III-10 in Appendix).

Data Sources

I obtained information on firms' use of IT-enabled knowledge platforms from the Information Week (IWeek) annual surveys from 1999 to 2003. The IWeek survey has been recognized as a reliable source of secondary data on firm-level IT-related practices, and has been widely used in IT business value literature (Bharadwaj et al. 2007; Chari et al. 2008; Ray et al. 2009). The firms included in the survey are large US-based firms, most of which are Fortune 500 companies. Though five hundred firms participated in this survey each year, the firms who participated varied slightly over the years. Accordingly, the data have missing years for some

firms, creating an unbalanced panel. Among the companies listed in the survey, only publicly listed and identifiable firms were retained for further analyses.

I retrieved information on alliances involving at least one IWeek surveyed firm from the Securities Data Company (SDC) Platinum Database on Joint Ventures and Alliances. The data originate from publicly available sources, such as trade publications, SEC filings, and news and wire sources. It provides alliance announcement data and related information, including the agreement date, contract type (equity vs. non-equity alliances), the identities of the participating firms, primary alliance activities (e.g. marketing, research and development, manufacturing, etc.), and the industry classification (SIC codes) of the alliances.

The SDC database is reliable, comprehensive, and the most commonly used database in empirical studies published in top strategy journals (Anand and Khanna 2000; Sampson 2007; Schilling and Phelps 2007). Anand and Khanna (2000) cross-checked the accuracy of the data (contract type, industry of activity, alliance dates) in the SDC database by comparing them with information obtained from relevant news articles. Their analysis showed that the SDC data are quite accurate, especially for the contract type and industry of activity. The authors noted, however, that the listed alliance dates were less accurate and had some discrepancies, mostly varying within a few days. Because the alliance announcement date is extremely important when using the event-study approach, I tried to find information about the actual alliance announcement date from non-SDC sources, including news and wire reports. I used only alliances that had announcement dates verified by other sources; thus, the dates used in this analysis are substantially different from those provided by SDC. Additionally, some firms announced more than two alliances within a week, which was the longest event window used in

the main analysis. These alliances were excluded from the final sample to minimize potentially noisy data.

I started with a list of all alliances entered into by public firms in the IWeek survey inclusively between 1999 and 2003. For each alliance announcement, I retrieved the CAR around the announcement date using the software program Eventus, which performs event studies using the Center for Research in Security Prices (CRSP) stock database²⁶. Additionally, I retrieved financial information for firms from the Compustat North America database to create the *SIZE* variable.

III-5.4. Model Estimation Techniques

To determine whether a firm's use of IT-enabled knowledge platforms significantly explains its alliance outcome as measured by abnormal stock returns, I formulated the following equation at a firm-year level:

$$AVGCAR_{it} = \beta_{CONS} + \beta_{KP}KP_{it} + \beta_{IT}IT_{it} + \beta_{EXP}EXP_{it} + \beta_{SIZE}SIZE_{it} + \varepsilon_{it}$$

where *i* represents a firm and *t* represents each year.

The model uses a fixed-effect robust panel regression instead of a random-effect panel for both conceptual and analytical reasons. The underlying assumption of the random-effect panel model is that, after controlling for variables included in the model, the firms will have similar capabilities in managing alliances and perform similarly on average. Prior research has shown the existence of large differences in the unobserved capabilities of firms in managing alliances (Anand and Khanna 2000). Hence, omitting these effects would bias the estimates if any systematic relationships exist between the estimated variables and unobserved heterogeneity.

²⁶ Available from Wharton Research Data Services (WRDS).

Using fixed-effects for firms controls for differences in the average performance across firms and allows for unobserved heterogeneity in alliance capabilities from organization to organization. Additionally, using robust standard errors corrects for possible heteroskedasticity in the error terms. Because the dataset is an unbalanced panel, firms with only one observation have been removed from my analysis.

III-6.Results

III-6.1.Summary Statistics

The sample consists of 186 firm-year observations, involving 67 firms and 439 alliances. Of the 439 alliances, 21 of them (5% of the total) involve two or more firms within the sample, creating 21 additional observations at the firm-alliance level. The rest involved an alliance between an IWeek sample firm and out-of-sample partners with no IT-related data. Table III-3 and Table III-4 provide descriptive statistics and the correlation matrix for the key variables.

	Obs.	Mean	Std. Error	MIN	MAX
AVGCAR	186	0.9177964	6.376383	-18.92654	54.50238
KP	186	0.000000004	1.243877	-1.753659	1.883115
IT	186	4.114946	3.284575	0.5	21
EXP	186	3.128608	1.376941	0	6.056784
SIZE	186	9.1855	1.110902	5.667039	11.37676

	AVGCAR	KP	IT	EXP	SIZE
AVGCAR	1				
KP	0.163*	1			
IT	0.0878	0.0643	1		
EXP	-0.0992	0.235**	0.179*	1	
SIZE	-0.0697	0.188*	0.0242	0.429***	1

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

III-6.2. Basic Event Analysis for Alliance Announcement

Before examining the effect of IT-enabled knowledge platforms on value creation from alliance formation, I first summarize the basic results of the event analysis in Table III-5. The announcement day is defined as day zero. The cumulative abnormal returns over the event window are positive and significant.

The average abnormal returns are positive and statistically significant, supporting Hypothesis 1. However, the abnormal returns are smaller in magnitude than those reported by Anand and Khanna (2000). Kale et al. (2002) also noted that average alliance value creation had tended to decline over time in their sample. Considering that the sample in Kale et al. (2002) consists of alliances from 1993–1997, this trend may have continued, leading to less value creation for the time period used in this chapter. Though the value creation effect is not as strong as those reported in previous studies, alliances still appear to create significant value for the firms involved.

Table III-5. Event Study Results		
Cumulative excess returns for the sample fox 439 alliances for public firms with available CRSP returns data and IT practice data during 1999-2003. Excess returns are the residuals from a value-weighted market model used to predict firm returns. The announcement day is defined as day 0.		
Event Windows	AVGCAR	INDCAR
2 Days (-1, 0)	0.5998**	0.3362*
5 Days (-2,+2)	0.9177**	0.5880**
10 Days (-5,+3)	1.221**	1.0569***
	N=186	N=460

One-tailed t-test; All numbers are in percentages; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

III-6.3. IT Resources and Alliance Capability

Table III-6 presents the results of the main analysis. In Model I, I first analyze the impact of alliance experiences, which can influences alliance capability and success, as demonstrated in

prior research. I treat Model I as the base case for the remaining models, and control for the effects of alliance experiences and other controls.

Table III-6. IT Resources and Expected Outcomes of Alliances							
Dependent variable is the average percentage cumulative abnormal returns (AVGCAR) around the alliances (5 days) per firm and year, except Model VI where CAR of individual alliances is used (INDCAR). Standard errors are estimated using White robust estimators.							
	Model I (Base)	Model II (Main)			Model III (Interaction)	Model IV	Model V (Ind. alliances)
	FE Panel	FE Panel	OLS	RE Panel	FE Panel	IV FE Panel	OLS w/ firm- dummy
KP (H2)		1.649*** (0.589)	1.022** (0.458)	1.023** (0.402)	1.650*** (0.593)	11.67** (5.458)	1.158* (0.600)
KP × EXP (H3)					0.0112 (0.332)		
EXP	-0.409 (1.915)	-0.337 (1.604)	-0.665 (0.310)	-0.666** (0.314)	-0.342 (1.658)	0.968 (3.726)	-0.471 (1.666)
IT	0.427 (0.282)	0.399 (0.297)	0.197 (0.123)	0.198* (0.117)	0.399 (0.298)	0.0174 (0.576)	0.432 (0.342)
SIZE	-8.757** (3.746)	-8.130** (3.356)	-0.275 (0.341)	-0.275 (0.289)	-8.124** (3.360)	-3.117 (5.973)	-2.558 (2.670)
Cons	80.88** (31.57)	75.00** (28.70)	4.717 (2.932)	4.718* (2.502)	73.90** (30.54)	19.08 (34.19)	20.79 (22.62)
Num. of obs.	186	186	186	186	186	166	460
Num. of firms	67	67	67	67	67	64	67
F	2.875**	4.302***	2.84*		3.623***		1.457***
Chi-sq				12.46**		60344***	
R ²	0.0798	0.1443	0.0591	0.0855	0.1443	-	0.0226

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ for two-tailed t-test; KP is composite measure of the use of knowledge repository, expert systems, and groupware. In Model IV, instruments are one-year lagged IT expenditure, the degree of related diversification, and the return on equity. Model V, includes additional alliance controls, which are MULTIACT, MULTIPART, CROSSBORDER, firm- and industry-fixed effects. A more comprehensive description of the analysis is provided in Appendix.

While earlier studies showed that more alliance experiences led to better alliance outcomes (Anand and Khanna 2000; Sampson 2005), the results of Model I fail to show that alliance experience is a statistically significant contributor to alliance success. The other models

also do not show any significant effect of alliance experiences. Though the direct effect of alliance experiences is not the primary focus of this chapter, it will be worth discussing the potential explanations for this observation. A possibility is that the mere possession of more experiences has lost its significance in predicting the success of future alliances. The data used in this chapter are more recent (from 1998 to 2003) than those of prior studies, which used data from the early '90s, a period when relatively few firms had extensive alliance experience. Thus, firms may have eventually engaged in so many strategic alliances that the effect of additional experiences became insignificant over time. Additionally, the seemingly undiscerning participation in strategic alliances by some firms in the late '90s may have spawned anxiety in stock investors, predisposing them toward negative impressions of alliances. Kale and Singh (2007) also found no significant direct link between alliance outcomes and alliance experiences in some analyses, arguing that the possession of mechanisms to manage expertise acquired from experience is a more significant predictor of a firm's alliance success than the simple count of alliance experiences.

In Model II, I examine the effect of the use of IT-enabled knowledge platforms as one of the mechanisms that support the firm-wide learning for alliance management. The estimated results using the fixed-effect panel, random-effect panel, and the pooled OLS models are compared. Including firm-fixed effects in the pooled OLS model improves the R^2 significantly from 0.0591 (when not included) to 0.144. The result of Hausman test comparing the fixed- and random-effect models indicates significant differences between model estimates at the 1% level ($p=0.0051$), advocating the use of a fixed-effect model. These results substantiate that large differences exist in the unobserved capabilities of firms for managing alliances. Even after controlling for experience and the average performance differences across firms, a firm's use of

an IT-enabled knowledge platform appears to significantly explain its abnormal stock market returns; the coefficients of KP are positive and significant ($p < 0.05$). This finding suggests that the market rewards firms that use IT-enabled knowledge platforms, providing empirical support for the hypothesis. Including this variable into Model II increases the R^2 significantly from 0.079 (Model I) to 0.144 (Model II, FE Panel Model). These results suggest that, even within the same firm, using an IT-enabled knowledge platform creates greater value.

Model III examines whether using IT-enabled knowledge platforms more greatly affects firms with more alliance experiences than firms with fewer alliance experiences. The coefficient of interaction term is positive but not statistically significant, failing to support Hypothesis 3. Again, the insignificant interaction effect may be attributed to the fact that the measure of alliance experience in this chapter, the count of alliances, is no longer a valid measure for the extent of expertise accumulated and shared within the firm. This result may support the concept that the firm-wide learning efforts enabled by IT more greatly influence a firm's alliance success than the mere possession of more experiences, consistent with Kale and Singh (2007).

In Model IV²⁷, I consider the potential for endogeneity between the use of IT-enabled knowledge platforms and alliance experiences by using instrumental variable regression with firm-fixed effects. To evaluate a firm's use of IT-enabled knowledge platforms in a given year, I use as instrumental variables their one-year lagged IT expenditure, level of diversification, and return on equity. The F-statistic of the first-stage regression model indicates that these instruments have strong relevance. The Sargan statistic is not statistically significant and does not cast doubt on the orthogonality of the excluded instruments with model residuals. Together, these tests suggest that the instrumental variables are valid.

²⁷ The sample size is reduced because one of instrument variables, IT expenditure of the previous year, is not available for all firms in the main analysis.

Model V shows the results of analysis that uses the abnormal stock gains associated with individual alliances as the dependent variable²⁸. The coefficient of KP is positive and statistically significant, providing more support for Hypothesis 2. The relatively marginal significance of the coefficient ($p < 0.1$) compared to those of the firm-level analyses might be caused by the factors discussed earlier, such as alliance-specific factors that determine the outcomes of individual alliances and the lack of variability in the firm-level variable (KP) in the alliance-level analysis.

I conducted additional analyses to check the robustness of these findings. First, using different measures of the number of experiences did not substantially alter the results. I examined different time intervals for measuring experiences, using three- and five-year windows, and also examined the number of experience without using a log-transformation. The significance of the results remained unchanged for all of these cases. Second, the results are robust for different event windows. Using a shorter (2-day) or longer (10-day) window surrounding the event day to compute the abnormal gains does not change the substantive meaning of the results. Additionally, for analysis at an individual-alliance level, I estimated the model with and without the associated alliance-level controls. I also checked whether the results are preserved with broader industry categories based on a 1-digit SIC code, which did not substantially change the meaning of the analytical results.

III-7. Discussion

III-7.1. Summary of Findings

²⁸ A more comprehensive description of the analysis is provided in Appendix.

Does a firm's use of IT-enabled knowledge platforms lead to a more likely success in their strategic alliances? In this chapter, I examine this question by investigating the relationship between a firm's use of IT-enabled knowledge platforms and its alliance outcomes, quantified by the stock market response to the announcement of a new alliance by the company. Based on the theory of organizational learning, I argue that IT-enabled knowledge platforms contribute to the development of alliance capability. These platforms contribute to alliance capability by supporting organizational memory of alliance management skills and best practices and by facilitating the organization-wide learning processes of acquiring, distributing, and sharing managerial knowledge. The empirical findings are consistent with prior studies and support Hypothesis 1, which predicts a positive value creation effect of an alliance announcement on firm valuations measured as abnormal stock market returns. The results are also supportive of Hypothesis 2, which predicts a positive influence of the use of IT-enabled knowledge platforms on the positive abnormal returns. Results of various analyses show that a firm's use of IT-enabled knowledge platforms is positively related to abnormal returns from alliance announcements, even after controlling for experience and the average performance differences across firms. This result provides evidences that organization-wide IT-enabled knowledge platforms enhance the likelihood of alliance success by supporting capturing and sharing alliance management knowledge. However, Hypothesis 3, which predicts the positive interaction effect between the use of IT-enabled knowledge platforms and alliance experiences on alliance outcomes, is not supported. A possible reason for this finding is insufficient information in the simple count of alliance experiences for the management expertise within the firm.

III-7.2.Potential Limitations and Contributions

This chapter has some potential limitations that leave opportunities for further research. First, the alliance capability, in terms of the specific managerial skills required to administer various aspects of alliance tasks, was not directly measured in this chapter. Rather, based on the assumption that using IT-enabled knowledge platforms cultivates alliance capabilities and better outcomes, the empirical analysis related a firm's use of IT-enabled knowledge platforms to market expectations of alliance success. Therefore, one path for future research is to directly examine whether using IT-enabled platforms improves the elements constituting a firm's alliance capability.

Second, the use of each type of IT-enabled platform in this chapter is measured as a dichotomous indicator variable. However, firms may use these platforms to different degrees, leading to possible differences in the use of the platforms for nurturing alliance capabilities. Collecting detailed data on the contents of alliance-related knowledge shared through these IT-enabled knowledge platforms would be useful in future research. Additionally, studying the contributions of IT-enabled knowledge platforms for codifying, sharing, and exploiting knowledge is also a useful direction. Future research that uses fine-grained information about the use of IT-enabled knowledge platforms in alliance management and its effect on alliance capabilities would bolster the model presented in this chapter. In addition, examining the organizational and environmental conditions that can influence the use of IT-enabled knowledge platforms could be considered in future studies.

Third, there may be overlap between the role of IT-enabled knowledge platforms and the role of dedicated alliance functions, which is the primary focus in Kale et al. (2002). Both the knowledge platform and alliance function support and foster organizational learning efforts. Accordingly, it remains unclear to what extent the findings of this chapter are distinguished from

their study, because this chapter does not control for the effect of a dedicated alliance function. I attempted to obtain information about the existence of dedicated alliance functions for firms during 1999–2003 from archival data sources, but information was not available. Even if limited information were available for some firms, using it would have been difficult because of reliability concerns. Therefore, future studies may try to conduct a survey that considers both dedicated alliance functions and IT-enabled knowledge platforms, as well as explores the synergy between the two.

Fourth, 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 chapter.

Finally, the financial information and data related to IT practices used in this chapter may limit the generalizability of its findings, as only publicly listed firms that participated in the IWeek survey were retained for the analysis. For example, one would assume that this survey excludes small- and medium-sized companies from the analysis.

Despite these potential limitations, I believe that this chapter provides several important contributions. First, broadly speaking, it contributes to 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-enabled knowledge platforms play in developing alliance capability, this chapter advances prior works that examined the relationship between IT and the organizational capabilities and performance of a firm. Whereas previous IS research examined IT that is tightly integrated with specific business processes or functions, I suggest that firm-level IT can enhance firm-level capability by supporting organizational learning.

Second, this chapter expands our understanding of the factors underlying a firm's alliance capability and alliance outcomes. Kale and Singh (2007) showed that alliance capability develops in firms through learning. By examining IT-enabled knowledge platforms that are designed for learning purposes, I show that the use of IT-enabled knowledge platforms can facilitate learning and help develop a firm's alliance capability.

Third, this chapter represents a nascent attempt to explore the role of IT in strategic alliances. Despite increasing numbers of interfirm alliances, IS literature focusing on strategic alliances remains sparse.

Fourth, from a methodological standpoint, this chapter examines the value of IT in developing organizational capabilities using an event-study approach with market-based outcome measures. Unlike previous IS studies using the event-study method to analyze IT-related announcements (Chatterjee et al. 2002; Das et al. 1998; Dehning et al. 2003), this chapter examines whether a firm's IT influence stock market responses to other business activities, specifically alliance announcements.

Finally, the findings of this chapter have important practical implications. Congruent with the increasing strategic importance of alliances, managers increasingly need to determine whether and how they should utilize IT to enhance their firm's performance in strategic alliances. The findings of this chapter suggest that firms can use firm-level IT-enabled knowledge platforms to develop alliance capability, which can improve alliance outcomes. This improvement is because firm-level IT platforms can help alliance managers fully exploit organization-wide alliance knowledge and best practices. Indeed, an IT-enabled knowledge platform can be used as a medium to increase interactions among alliance managers. The findings of my work suggest that companies desiring to improve alliance capabilities and

performance should consider investing in firm-level IT-enabled knowledge platforms to serve as critical learning mechanisms.

III-8. Conclusion

Strategic alliances have become indispensable in most industries, allowing companies to keep abreast of fast-changing business environments. Despite speculation on the value of IT in strategic alliances, an important channel of interfirm interaction, the diversity of strategic alliances (including purpose, activity, depth of interaction, and type of knowledge exchanged) obfuscates whether and how IT contributes to alliance performance. This work is an initial examination of the role of IT in managing strategic alliances. In this chapter, I propose a theoretical framework in which IT-enabled knowledge platforms facilitate the development of alliance capability and performance. By using the theory of organizational learning as a point of discursive departure and by using relevant data on U.S. firms, I empirically examine how IT-enabled knowledge platforms affect strategic alliances. I found that market expectations on alliance outcome are positively associated with the firm's use of IT-enabled knowledge platforms. This finding expands our understanding of the influence of IT on strategic alliances, and suggests that businesses can enhance their alliance performance by leveraging organization-wide learning efforts through IT-enabled knowledge platforms, even if they are not designed for a specific alliance. It is my hope that my research stimulates further exploration of the interplay between IT, organizational capability, and interorganizational interactions through alliances.

III-9. References

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III-10. Appendix

I conducted the analysis that uses the abnormal stock gains associated with individual alliances as the dependent variable. The model includes additional alliance controls (Table III-7). Table III-8 and Table III-9 provide descriptive statistics and the correlation matrix. Industry categories are identified using three-digit SIC code (Table III-10).

Table III-7. Additional Control variables (Individual Alliances)

Variable	Description
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.
FIRM	Dummy variables of each firm
IND	Dummy variables indicating industry classification of alliance activities identified based on the three-digit SIC code (See Table III-10).

Table III-8. Summary Statistics (Individual Alliances)

	Obs.	Mean	Std. Error	MIN	MAX
INDCAR	460	0.5880423	6.948495	-22.75604	54.50238
MULTIACT	460	0.5	0.5005444	0	1
MULTIPART	460	0.1543478	0.3616752	0	1
CROSSBORDER	460	0.397826	0.4899821	0	1

Table III-9. Correlation Matrix (Individual Alliances)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) INDCAR	1							
(2) KP	0.0188	1						
(3) IT	0.106*	-0.0198	1					
(4) EXP	-0.0440	0.313***	0.111*	1				
(5) SIZE	-0.101*	0.344***	0.0698	0.509***	1			
(6) MULTIACT	0.0255	0.0267	0.0558	-0.0310	-0.0432	1		
(7) MULTIPART	-0.0438	-0.0464	-0.0273	0.0299	0.0347	-0.0181	1	
(8) CROSSBORDER	0.0168	0.0556	-0.0007	0.0263	0.0638	-0.0311	0.0707	1

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table III-10. Industry Categories				
Industry Categories		SIC Code	Num. of alliances in the sample	Number of firms in the sample
High-tech manufacturing	Chemical	28 excluding 283	5	15
	Pharmaceutical	283	5	12
	Computer	357	8	25
	Telecommunication	366	9	10
	Semiconductor	367	11	12
	Automotive	37	13	10
	Instrument	38	5	8
Other manufacturing		20 through 39 except above	17	16
Service	Finance	6 except 679	7	2
	Patent	679	24	-
	Computer service	737	177	17
	Research service	873	22	-
	Management service	874	42	-
	Other service	70 through 89 except above	11	14
Others	Mining/construction	1	9	3
	Transportation	4	45	14
	Trade	5	43	28
	Others	9	7	-
Total			460	186

The model is estimated using ordinary least squares (OLS) regression. Standard errors are corrected using White robust estimator to account for possible heteroskedasticity. To distinguish the effects of using IT-enabled knowledge platforms and experiences from the firm-specific effects captured by firm dummy variables, I restricted the data to include only firms with data from at least three observations (alliances), consistent with Anand and Khanna (2000).

Chapter IV. IT Investment Payoff and Alliance Networks: The Effect of Network Centrality and Partner Diversity

IV-1. Introduction

“We have found very few sectors where a single class of partners or even a single partner within a group enables us to address our key concerns. Our approach has been to generally follow a multipronged approach, with different time horizons and priorities across our partner portfolio.” –Steve Steinhilber, Vice President of Strategic Alliances at Cisco (Steinhilber 2008)

Multiple-alliance partnerships have become indispensable in today’s business environment, as industrial knowledge bases have become increasingly large and complex (Powell et al. 1996). Through alliances, firms exchange, share, or co-develop resources or capabilities to achieve mutually relevant benefits (Gulati 1998; Kale and Singh 2009). An emerging consensus in the corporate world asserts that firms can no longer rely on single high-profile alliances and must instead leverage a portfolio of alliances that provides access to the external resources that they need to survive (Gomes-Casseres 1998; Hoffmann 2007). As a result, many firms try to achieve their strategic goals by leveraging several coordinated alliances with multiple partners. A corporate “snapshot” provided by Dyer et al. (2001), for example, revealed that the top 500 global business organizations had an average of 60 major alliances apiece²⁹. These complex webs of interfirm alliances, often referred to as alliance networks, have

²⁹ On average, the sample firms in this chapter have eight alliance relationships with about seven partners. Though these figures are substantially smaller than the ones reported in Dyer et al. (2001), they still support the claim that firms are involved in a considerable number of alliances with multiple partners. A potential reason for the difference is that the sample firms were drawn from U.S. based firms only, and thus, they might be relatively less active in alliances than the firms considered in Dyer et al. (2001). Another possibility is that relatively minor alliances were not captured in the dataset of this chapter because the dataset includes only alliances that were publicly announced. These factors are discussed in the discussion section IV-7.

been shown to greatly influence a firm's scale and scope of business activities and the amount of resources it can manage and utilize (Ahuja 2000; Gulati 1998; Schilling and Phelps 2007).

Increased scale and scope of a firm's alliance portfolio and interdependency among alliances raise new and important administrative issues that are distinct from the issues that arise from the management of internal processes or individual alliances. New challenges include coordinating the internal and external resources accessible through such partnerships (Duysters et al. 1999; Gulati 1998; Hoffmann 2007; Parise and Casher 2003; Wassmer 2010) as well as resolving potential conflicts between alliances. Firms have responded by employing various forms of information technologies to meet these new information-based challenges.

Many firms active in alliances, such as FedEx, Cisco Systems, and Ernst & Young employ IT applications and databases that provide real-time information on all existing partnerships and that allow alliance managers easy access to this database to obtain information about ongoing alliances. These information technologies enable firms to prevent any potential conflict of interest between alliances, to leverage current partnerships for future business opportunities, and potentially maximize the value of their alliance networks (Corporate Strategy Board 2000; Gomes-Casseres 1998). In addition, corporate-level IT, such as Enterprise Resource Planning (ERP) systems, instant messaging, and knowledge portals, may be used to facilitate coordination, communication, and knowledge sharing among employees who are working for different alliances. The extent of involvement in various alliance activities could potentially increase or decrease the needs and benefits of such information technologies. Overall then, the aggregate use of various forms of information technologies would appear to support and leverage effective management of alliance networks to achieve business value.

However, prior IS studies focused on the business value of IS have not focused on this issue (see Melville et al. 2004 for review). Earlier studies examined the direct link between IT investment and firm performance (Brynjolfsson and Hitt 1996; Hitt and Brynjolfsson 1996), while more recent studies focused on the conditions in which such IT investment provided higher returns. Researchers have also identified several contexts and conditions that influence the payoff of IT investment. These studies tended to focus on a firm's characteristics and organizational factors, such as firm size (Dewan et al. 1998), work composition (Francalanci and Galal 1998), the level of diversification (Chari et al. 2008), and the level of vertical integration (Ray et al. 2009). IS business value studies in the alliance realm have focused on relationship-specific issues at a dyadic level, but are relatively silent with respect to issues concerning the impact of a firm's multiple-alliance relationships and resultant networks on the payoff of their IT investment. As Chi et al. (2010) have noted, "issues such as designing a firm's technology infrastructure to better exploit the benefits afforded by alliance networks are important aspects that deserve research attention yet remain underexplored."

This chapter addresses one aspect of this knowledge gap by exploring how alliance network characteristics moderate the performance impact of information technology. Conceptually, this chapter adopts a perspective that focuses on a firm's egocentric alliance network (Wassmer 2010), an approach that allows consideration of not only a firm's alliance partners, but also a firm's broader network of alliance relationships.

Specifically, I focus on network centrality (the degree to which a firm is at a central position within the alliance network) and partner diversity (the degree of heterogeneity in partner composition) within a firm's alliance network, and examine their impact on the payoff of IT investment. I hypothesize that firms will derive higher benefits from their IT investments

when they are centrally positioned in their alliance networks and have diverse partners. The hypothesis is grounded in the literature on the information processing perspective and the dynamic capability perspective. Prior IS studies have shown greater return on IT investment when there are greater needs and demands for coordination and control and when firms face rapidly-changing business requirements. I elaborate on information processing and dynamic resource management challenges faced by central firms with diverse partners in their alliance networks and suggest that high network centrality and partner diversity provide the context that enables firms to best leverage IT-enabled information processing and coordination.

By employing social network analysis (SNA), I empirically investigate the hypotheses by analyzing the interaction effect between a firm's IT investment and the network constructs – network centrality and the diversity of its partner composition— on firm performance. I use data from 242 U.S. public firms, which provides 825 observations during an eight-year span from 1998 to 2005. Results provide evidence that IT investment provides greater benefits for firms (1) that are at a central position in the alliance network in terms of the number of partners, the number of relationships, and the extent to which a firm is connected with other well-connected partners; and (2) that have diverse alliance partners, in the sense that there is a high level of heterogeneity of its partners' nationality and industries and that the partners are from different parts of the alliance network.

The findings of this chapter constitute a potentially significant contribution to the business value of IT literature by providing theoretical and empirical evidence that the payoff of IT investment is influenced by a firm's alliance network. Considering that business today is built on interwoven inter-firm alliance networks that are transforming the nature of competitive dynamics in various industries (Gulati et al. 2000), the failure to accurately assess the alliance

networks in which firms are embedded could lead to an incomplete understanding of the IT investment payoff. Likewise, any examination of the performance implications of alliance networks that neglects a firm's information processing needs and ability to leverage and exploit the resources accessible through a network could leave a major source of performance variance unexplained (Zaheer and Bell 2005). The present chapter will fill gaps in knowledge in both research areas. My research also contains important managerial implications for firms in relation to alliance and IT strategy by suggesting that a firm's alliance networks should be considered carefully when making strategic decisions about IT investment. Based on the findings of this chapter, I recommend greater IT investment when a firm is at a central position in the alliance network and has diverse partners, because such aggressive IT investment might be justified with a higher investment payoff.

The rest of this chapter is organized as follows. In the next section, I provide a review of the relevant background literature. Then, I develop a theoretical framework and discuss hypotheses. Next, I describe the research design and data. Empirical analysis results are followed by a discussion of results and conclusions.

IV-2. Background Literature

IV-2.1. IT Business Value

The payoff of IT investment has been a central issue in IS research. Earlier studies tried to find a direct link between IT investment and performance (e.g. Brynjolfsson and Hitt 1996), but the emerging consensus in the literature is that IT investment payoffs are contingent on various factors. These include the presence of complementary factors or contexts (Melville et al. 2004), such as work composition (Francalanci and Galal 1998), diversification (Chari et al.

2008), and manufacturing capabilities (Banker and Bardham 2006). However, with a few recent exceptions (Chi et al. 2010; Chiasson and Davidson 2005; Melville et al. 2007), the performance implication of firm's general IT or overall IT investment with the consideration of its external relationships, especially alliance networks, have rarely been investigated in depth.

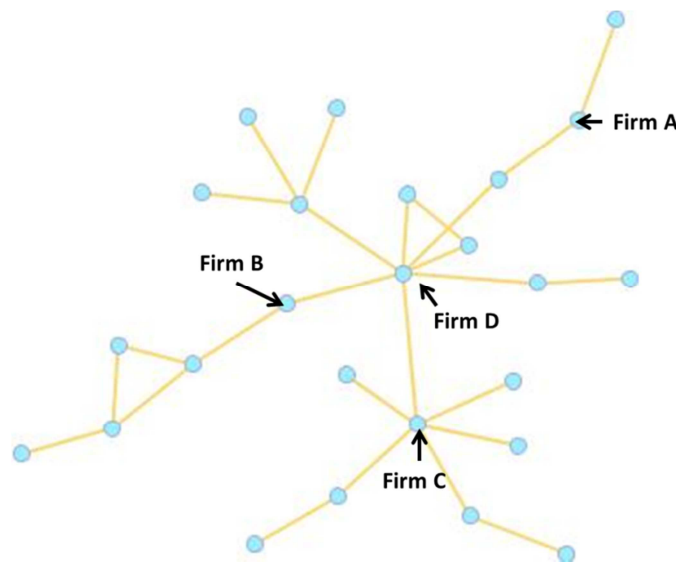
IS researchers studying interorganizational relationship management examined the effect of efficiency gains via IT on firm size (Brynjolfsson et al. 1994; Clemons and Row 1992; Gurbaxani and Whang 1991) and the number of suppliers of a firm (Banker et al. 2006; Malone et al. 1987). Studies also examined a firm's ability to use IT for its partnering issues, such as IT integration and IT flexibility (Gosain et al. 2004; Klein and Rai 2009; Malhotra et al. 2005, 2007; Rai and Tang 2010; Saraf et al. 2007; Tafti et al. *forthcoming*). My 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 or the relational aspect of IT-supported interorganizational interactions. Though studies in this vein provide insights for improving the effectiveness of interorganizational processes, because of their primary focus on the issues that arise at a dyadic level, the prospective application of these frameworks to the issues that pertain to the influence of a firm's complex relationship management in alliance networks on overall IT investment payoff is somewhat limited.

IV-2.2.Alliance Networks

Alliance networks have recently come to the forefront in management research by virtue of their significant influence on a firm's actions and resultant performance (Gulati 1998). An alliance network is a representation of interfirm connections through alliance relationships. Figure IV-1 provides an illustration of an alliance network, where each node represents a firm, and a link between two firms indicates an alliance relationship between them. Multiple studies

have shown that alliance networks are key external constituents that influence a firm's actions and its resultant performance (Ahuja 2000; Baum et al. 2000; Koka and Prescott 2008; Wassmer et al. 2010). Alliance network studies proceed from a social network perspective, which argues “that economic actions are influenced by the social context in which they are embedded and that actions can be influenced by the position of actors in social networks” (Gulati 1998 p. 295). Building on this perspective, the studies have provided empirical evidence that the performance of a firm is influenced by how a firm is connected with others in its alliance network (Ahuja 2000; Baum et al. 2000; Jiang et al. 2010).

Figure IV-1. Illustration of Alliance Network



Note: It is one of the alliance networks created using the actual dataset of this chapter. The network construction procedure is described in Section IV-5.2.

Alliance network studies have identified various network properties of a firm in an alliance network, which can be broadly grouped into two overarching constructs – network centrality and partner diversity (Koka and Prescott 2002, 2008). Network centrality measures the extent to which a firm is located at a central position within its alliance network. Key constructs that are widely used to measure network centrality are (1) the number of alliance partners; (2) the

number of alliance relationships³⁰; and (3) the extent to which a firm is connected with other well-connected partners (Ahuja 2000; Koka and Prescott 2008; Powell et al. 1996). The greater the number of partners, the number of alliances, and the connectedness with other well-connected partners, the more central the firm is. For example, Firm C and Firm D in Figure 1 are more central firms than others in the network, such as Firm A, B, or E, because of their higher number of connections with other firms. Between Firm A and Firm B, even though both firms have the same number of alliance partners, Firm B is a more central firm than Firm A, because of Firm B's connection to Firm D, which is one of the most central firm in the network.

Partner diversity refers to the degree of variation in partners in the alliance network (Goerzen and Beamish 2005; Jiang et al. 2010). Given network centrality, some firms may pursue alliance relationships with diverse partners, while some firms may pursue relationships with homogeneous partners or firms in the same group. The diversity of a firm's partners can be approached in two ways: (1) the characteristics of partners themselves; and (2) the structural relationships among the partners. The former approach considers partner heterogeneity—for example, the industry of the partner's main business (an indicator of its target segment or technologies) or its nationality (an indicator of its target regional market). The latter approach considers the local structural relationship configurations among a firm's alliance partners, which are often characterized as structure holes. Structure holes describe the degree of disconnection between a firm's partners (Burt 1992; Chi et al. 2010; Coleman 1988). For example, Firm C connects unconnected partners that come from different parts of the network (i.e. span more structural holes), while Firm D has connections with a group of firms that are connected with

³⁰ The number of alliance relationships can differ from the number of partners, because some alliances involve multiple partners, or some partners might have multiple alliance arrangements.

each other. When the partners of Firm C and Firm D show a similar level of diversity in their partners' characteristics, Firm C is considered to have partners that are more diverse than Firm D.

Despite the significant influence of alliance networks on various aspects of the firm's operations and performance, alliance networks remain under-studied in IS research. Chi et al. (2010) showed in their pioneering study that the use of IT influences a firm's strategic actions differently in dense and sparse alliance networks. Still, we know very little about whether variances in IT investment payoffs exist that can be explained by a broader consideration of a firm's alliance relationships and their underlying mechanisms.

IV-3.Theoretical Background

The framework of this chapter builds on two theoretical perspectives: the information processing perspective and the dynamic capability perspective. The former perspective views a firm as an information processing entity and IT investment as a means to enhance internal information processing capabilities (Galbraith 1974; March and Simon 1993; Radner 1992). The latter perspective views the IT investment as a means to build digital options that constitute the basis for a firm's dynamic capability (Sambamurthy et al. 2003; Teece et al. 1997). These theoretical perspectives have provided a solid base for explaining higher IT investment payoff in certain conditions, such as firms that are more diversified (Chari et al. 2008) and firms in rapidly changing industries (Melville et al. 2007; Pavlou and El Sawy 2006) .

IV-3.1.Information Processing Perspective and IT investment Payoff

The information processing perspective considers a firm as an information processing system and asserts that the performance of firms is determined by how well information processing needs align with information processing capabilities (Bensaou and Venkatraman

1995; Galbraith 1974; Radner 1992). This perspective asserts that the bounded rationality of organizations limits the amount of information that can be effectively processed within an organization. The use of IT improves internal information processing capabilities and thus increases the firm's capacity to process information. The studies from this perspective suggest that the highest performance benefits from IT should be observed when there is a high level of information processing requirement (Chari et al. 2008; Dewan et al. 1998).

A key consideration in this stream of research is the demand for coordination and control activities, which comprise complex and information-intensive tasks. Numerous studies have documented IT's significant role in a firm's coordination and control efforts (Brynjolfsson et al. 1994; Chari et al. 2008; Dewan et al. 1998; Malone et al. 1987). IT helps firms to share and distribute appropriate information in a quick, reliable, and consistent format through electronic internal linkages (Mithas et al. 2011). In addition, the use of IT can heighten the performance visibility of various processes. This enables firms to monitor progress on intermediate goals for timely managerial intervention, which constitutes a key component of effective control (Davenport and Beers 1995; Gurbaxani and Whang 1991; Mithas et al. 2011). Thus, IS research suggests that information technologies are more productive when firms face a higher demand for coordination and control efforts.

IV-3.2. Dynamic Capabilities Perspective and IT Investment Payoff

The dynamic capabilities perspective asserts that dynamic capabilities, or "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al. 1997 p. 516), enable firms to unleash value derived from resources through innovative dynamic resource reconfiguration (Eisenhardt and Martin 2000; Teece et al. 1997). The dynamic capability perspective asserts that long-term competitive

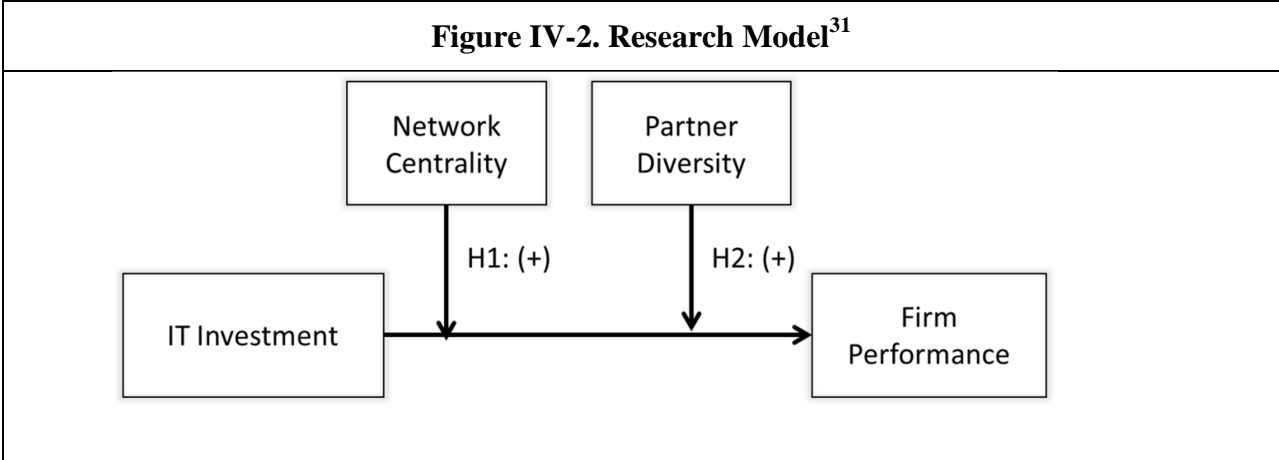
advantage is rarely achieved, so firms must compete by seizing a series of short-term advantages through many competitive actions (Brown and Eisenhardt 1997).

IS researchers from this perspective argue that the value of IT is generated from its influence on a firm's ability to identify and respond to changes in a firm's competitive environment (Chi et al. 2010; Pavlou and El Sawy 2006, 2010; Sambamurthy et al. 2003; Tambe et al. 2012). This stream of research suggests that IT is most productive when it allows firms to quickly respond to changes in the competitive environment. These researchers argue that, in dynamic environments, firms should accelerate the speed of their strategic decision-making processes, and thus must make sure that up-to-date, accurate information is available to decision makers. Various digitized platforms of processes and knowledge that become available through IT investment can serve as key tools for addressing such managerial challenges.

Both theoretical frameworks have many aspects in common, in that IS studies from the dynamic capability perspective also emphasize enhanced information processing capabilities through IT investment. I use the dynamic capability perspective as a distinct theoretical pillar of this chapter because of its emphasis on the dynamic changes in information processing requirements and its explicit consideration of the influence of external environment, which can be particularly useful in the alliance context.

IV-4.Hypothesis Development

In this chapter, I suggest that returns on IT investment are higher when firms are positioned centrally within their alliance networks and when firms have a diverse set of alliance partners. Figure III-1 shows the research model of this chapter.



IV-4.1. Network Centrality and IT Investment Payoff

The benefits as well as challenges from being at a central position in the alliance network arise out of access to external resources, increased volume of information flow, and potential interdependencies between alliances. Below, I elaborate the benefits and challenges and how they are related to a firm’s IT investment payoff, building on the theory-based discussion provided above and Section II-5.5.

Dynamic Resource Reconfiguration

A firm’s ability to initiate and leverage alliances constitutes a key dynamic capability, because alliances transfer new resources into the firm from external sources, allowing access to resources that would be difficult to obtain otherwise (Ahuja 2000; Eisenhardt and Martin 2000). According to the dynamic capability perspective, under the new resource configuration, firms are required to integrate external resources from alliance partners with their own resource pools and reconfigure the optimal allocation of these assets to generate competitive advantages (Eisenhardt and Martin 2000; Teece et al. 1997). The central firm’s active engagement in alliances may

³¹ This model is derived based on the discussion for Proposition 2A and 2B in Chapter 2.

amplify the significance of its active interventions and deliberate efforts to utilize newly accessible resources from alliance partners. As explicated in the discussion on the role of digitized process in the management of alliance portfolio in Section II-5.5 (Proposition 2A), improved visibility and transparency in resource management supported by IT, and enhanced reach and connectivity through electronic internal linkages, can help firms get insights for operational and strategic applications of existing resources under a new resource configuration.

Interdependencies between Alliances

A potential source of higher IT investment payoff may originate from the higher coordination and control requirements that occur when firms have a larger number of partners and relationships. Recent research has begun to emphasize that interactions with multiple alliance partners through multiple alliances can bring significant managerial challenges to a firm (Hoffmann 2007; Wassmer 2010). This research focuses on the managerial issues generated by interdependencies between alliances and internal processes. Because alliances are often initiated and executed at a business unit level in many organizations, and alliance managers tend to cultivate a narrow focus that is specific to the scope of their discrete markets, managers “may be completely unaware of any impact their decisions might have on the broader cross-company relationships” (Steinhilber 2008). On the one hand, a given alliance may conflict with another in the portfolio for the firm’s physical or managerial resources, potentially degrading or offsetting any advantage the partnership would otherwise create. On the other, the value of an alliance can be enhanced by the presence of another alliance in the portfolio. For example, it might provide a complementary offering and promote similar standards or infrastructure (Parise and Casher 2003). Such positive or negative dependencies prevail among alliances.

An understanding of the dynamics related to all existing and prospective alliances and associated partners is vital to firms' ability to manage interdependencies among alliances (Hoffmann 2007; Wassmer 2010). As discussed in the previous section and Chapter 2 (Proposition 2A), IT support these intensive information-gathering and processing activities concerning the initiating and selecting of alliance partnerships. For example, Cisco Systems uses a Partner Candidate Assessment database that 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). The benefits of enhanced coordination and control capabilities resulting from IT investment are likely to be magnified in central firms in their alliance networks.

Greater Volume of Information Flow

Alliance network researchers suggest that central firms in their network have significantly more access to critical, valuable information than less central firms in the network, because the linkages in the alliance network serve as conduits through which companies receive external information (Owen-Smith and Powell 2004). Based on the assumption that each partner or alliance adds information to the network, firms with a greater number of partners and relationships are likely to have greater access to key information (Ahuja 2000; Koka and Prescott 2002). In addition to the firm's linkages, the linkages of its partners can matter, because connection with other well-connected partners increases the opportunity to quickly access valuable market information (Koka and Prescott 2008).

The large volume of information flow from alliance networks requires that firms have enough capacity to absorb this information, as well as the mechanisms for effective information processing (Malhotra et al. 2005; Roberts et al. 2011). The use of IT-supported organizational memory, such as databases and knowledge repositories, can significantly upgrade a firm's capacity to store external knowledge acquired from alliance partners. IT memory assists firms in overcoming information overload resulting from the massive amount of externally derived information by expanding an enterprise's cognitive capacity (Malhotra et al. 2005). In addition, business intelligence (BI) applications and data analysis and mining software can assist firms in interpreting and assimilating information from alliance partners. External information becomes valuable only if it is incorporated into the firm-specific organizational context (Malhotra et al. 2005; Roberts et al. 2011). Various IT-enabled analytics and interpretive systems facilitate organizing, rearranging, and processing externally obtained information. These systems help firms to process massive quantities of raw data and identify the underlying patterns (Malhotra et al. 2005; Trkman et al. 2010). The discussion in Chapter 2 (Proposition 2B) and the IS studies grounded on the information processing perspective suggest that information-rich environment of central firms in alliance networks would increase the effectiveness of IT use, leading to a higher level of IT investment payoff.

Taken together, dynamic resource reconfiguration requirements, potential interdependencies across alliances, and greater information flow in central firms increase the demand for a higher level of information processing and dynamic capability—the context in which IT investments have been shown to provide greater payoff. Thus, I hypothesize the following:

Hypothesis 1. For firms participating in an alliance network, the impact of IT investment on firm performance will be greater for firms with higher network centrality than firms with lower network centrality.

IV-4.2.Partner Diversity and IT Investment Payoff

The benefits from partner diversity arise out of both information diversity and entrepreneurial opportunities. At the same time, partner diversity may increase potential conflicts among alliances and increase managerial complexities. I elaborate each of these benefits and challenges and discuss how these factors influence a firm's IT investment payoff.

Resource Diversity

Firms with greater partner diversity can access a wider range of information. Out of two firms having the same number of alliances, the firm with more diverse contacts is more likely to have more non-redundant and diverse information (Koka and Prescott 2008). Partners in different market segments and with different technologies can be sources of distinctive resources. Additionally, unconnected partners that come from different parts of the network provide diverse perspectives, new ideas, and information that is more additive than overlapping (Burt 1992; Koka and Prescott 2002).

Accordingly, the primary benefit of partner diversity is the opportunity for firms to recombine diverse resources into novel combinations that enable them to provide unique offerings to the market (Nelson and Winter 1982). Digitized platforms for managing various business processes and knowledge facilitate integration and combination processes by supporting the location and retrieval of the necessary complementary resources and information within a firm (Alavi and Tiwana 2002; Sambamurthy et al. 2003). Therefore, the value of digital

platforms provided by IT investment would be heightened in firms with diverse partners that have a higher potential for innovative recombination of diverse resources.

Entrepreneurial Opportunities and Alertness

Alliance network researchers suggest that firms with diverse partners have a higher chance for entrepreneurial opportunities because of their exposure to diverse information and their ability to control information flow surrounding the firm (Baum et al. 2000; Burt 1992). Partners from different industries or countries may provide new opportunities and allow firms to enter new markets. Structural holes provide entrepreneurial opportunities from brokering connections between groups that are otherwise disconnected. Firms with diverse partners are more likely to explore new markets. Accordingly, firms in such position face a greater need for the ability to quickly mobilize their resources and operations, which are the dynamic capabilities that can be enhanced through IT investment.

At the same time, an entrepreneurial position may lead to greater innovation with respect to the use of IT, which increases the payoff of IT investment. Sambamurthy et al. (2003) suggest that managers' entrepreneurial alertness facilitates the conversion process from IT investment to competitive actions, which can ultimately influence firm performance. Being at an entrepreneurial position within an alliance network enhances a firm's entrepreneurial alertness by increasing its exposure to diverse perspectives (Burt 1992; Koka and Prescott 2002). Also, the fact that a firm pursues diverse partnerships in its alliance network may be an indicator that the firm has a high level of entrepreneurial alertness. Access to diverse perspectives and keeping an entrepreneurial position may enable a firm to leverage its investment in IT more effectively.

Managerial Complexity

Network diversity, however, may adversely affect firm performance. Increased diversity can bring more complexity, the potential for more conflicts, and increased coordination and managerial costs (Goerzen and Beamish 2005; Jiang et al. 2010). For example, when firms are from different industries or countries, they may have different routines and processes that make coordination difficult (Jiang et al. 2010). In addition, the lack of norms, trust, and alignment of interests between the unconnected partners in networks rich in structural holes may ultimately have an impact on network management efficiency (Chi et al. 2010; Duysters et al. 1999; Koka and Prescott 2008). Therefore, a high level of partner diversity can create excessive coordination demands, and may require special managerial attention and relationship management that can require intensive information processing (Duysters et al. 1999; Jiang et al. 2010). The higher coordination and control requirement again provides a context where IT investment exhibits greater benefits.

Taken together, the higher chance of innovative recombination of resources, more entrepreneurial opportunities, and increased managerial complexities leads firms to get the most out of their IT investment, leading to higher IT investment payoff:

Hypothesis 2. For firms participating in an alliance network, the impact of IT investment on firm performance will be greater for firms that have more diverse partners than for firms that have less diverse partners.

IV-5. Research Design and Methodology

IV-5.1. Data

To test my hypotheses, I examined the interaction effect of IT investment and network constructs (network centrality and partner diversity) on firm performance, using a dataset of

publicly traded U.S. firms that participated at least one alliance during the eight-year time period from 1998 to 2005. The sample firms are distributed non-uniformly over all industries and were selected based on the availability of variables required for empirical analysis. Table IV-6 provides a more comprehensive description of the data used in this chapter.

I obtained data from multiple sources: an *InformationWeek* (IWeek) survey, which provides firm IT investment data for an eight-year span from 1998 to 2005; the Securities Data Company (SDC) Platinum database on Joint Ventures and Alliances, which provides alliance data gathered from various sources; Compustat North America; and the Compustat Segment for financial and industry data.

The IWeek survey has been recognized as a reliable source of secondary data on firm-level IT-related practices, and has been widely used in IT business value literature (Bharadwaj et al. 2007; Chari et al. 2008; Ray et al. 2009). The firms included in the survey are large US-based firms, most of which are Fortune 500 companies. Exactly five hundred firms participated in this survey each year, but the sample firms slightly varied slightly over the years. Accordingly, the data is missing in some years for some firms, creating an unbalanced panel. Among the companies listed in the survey, only publicly listed and identifiable firms and all of which participated in at least one alliance during the sample period were retained for further analysis.

The Securities Data Company (SDC) Platinum Database on Joint Ventures and Alliances provides alliance announcement data and related information. The SDC database is reliable, comprehensive, and the most commonly used database in empirical studies published in top strategy journals (Anand and Khanna 2000; Sampson 2007; Schilling and Phelps 2007). The data originates from publicly available sources, such as trade publications, SEC filings, and news and wire sources. The use of publicly announced alliances is a well-established approach in alliance

network research in management disciplines (Schilling 2009), based on the assumption that public firms would, due to government regulations, announce most inter-firm alliances that may have financial and strategic impact on their market value.

IV-5.2.Measures

Network Constructs

Using the data from the SDC database concerning all alliances that were formed during the 1996 to 2005 period, I created a network for each year with three-year windows (Chi et al. 2010). For example, a network for 1998 includes all alliances formed between 1996 and 1998; a network for 2004 includes all alliances formed between 2002 and 2004, and so forth. Three-year windows were used to incorporate the changes in networks, under the generally employed assumption that alliances typically last for three years (Chi et al. 2010; Schilling and Phelps 2007). The two composite network variables – network centrality and partner diversity – were obtained for each firm from the networks. I used multiple indicators for each network construct in order to capture the different aspects of each construct, following the prior approaches (Koka and Prescott 2002, 2008).

Table IV-1. Measures and Data Sources

Type	Variable	Description	Data Sources
Dependent Variable	PERFORMANCE	A log-transformed dollar value of operating profit per employee.	Compustat North America
Main Variable	ITINV	The ratio of annual IT budget to total sales	Information Week
	CENTRALITY	The extent to which a firm is located at a central position within its alliance network. The factor score for the first component developed from the PCA using six indicator variables.	SDC Platinum
	DIVERSITY	The degree of variation in partners in the alliance network. The factor score for the second component developed from the PCA using six indicator variables.	
Indicator Variables	PARTNERS	The count of firms with which a focal firm has at least one alliance partnership	
	ALLIANCES	The count of alliance relationships.	
	EVCENT	The values of the first eigenvector of the graph adjacency matrix.	
	HOLE	The degree of disconnectivity among a firm's partners in a network. Burt's network constraint index subtracted from one .	
Indicator Variables	INDUSTRY	Blau's heterogeneity index of partners' two-digit SIC industry classification codes.	SDC Platinum
	NATIONALITY	Blau's heterogeneity index of nations where partners' headquarters are located.	
Controls	SIZE	A log-transformed dollar value of total asset SIZE = log (total asset)	Compustat North America/ Compustat Segment
	MS	The market share of all the industries the firm participates in, weighted by its sales in those industries. $MS = \sum MS_i P_i$, where MS _i is a firm's market share in each of its industries i, and P _i is the proportion of the firm's sales in the industry.	
	DIV	$DIV = \sum P_t \ln(1/P_t) - \sum P_u \ln(1/P_u)$, where P _t is the percentage of sales in each 4-digit SIC industry and P _u is the percentage of sales in each 2-digit SIC industry.	
	IND_PERFORM	$IND_PERFORM = \sum OP_i P_i$, where OP _i is the average operating profit per employee in industry I, and P _i is the proportion of a firm's sales in the industry.	
	IND_CAP	$IND_CAP = \sum C_i P_i$, where C _i is the capital intensity for industry i (Assets /Sales), and P _i is the proportion of a firm's sales in the industry.	
	IND_CONC	$IND_CONC = \sum CR_{4i} P_i$, where CR _{4i} is the sum of the top four firms' market share in the industry i, and P _i is the proportion of a firm's sales in the industry.	

Network Centrality: I used three measures to assess network centrality³²: (1) the number of alliance partners, or degree centrality (PARTNERS) (Ahuja 2000); (2) the number of alliance relationships (Koka and Prescott 2002, 2008), or network ties (ALLIANCES); and (3) the eigenvector-based centrality (EVCENT) (Bonacich 1987, 2007; Lin et al. 2009; Nadkarni and Narayanan 2007; Yang et al. 2010). Alliance partners (PARTNERS) are the firms with which a focal firm has at least one alliance partnership; these partners are a direct indicator of the size of the firm's network. The number of alliance relationships (ALLIANCES) is used to capture the multiple ties that a firm may have with certain of its partners. The eigenvector centrality (EVCENT) is calculated from a reciprocal process in which the centrality of each firm is proportional to the sum of the centralities of its partners³³ (Bonacich 1987, 2007). This measure allows us to capture the extent of access that the firm has to industry information and resources through its well-connected partners. All three measures provide a means of determining the centrality of the firm in the alliance network.

Partner Diversity: Similarly, three indicators were used to operationalize network diversity²: (1) structural holes (HOLES) (Ahuja 2000; Baum et al. 2000; Burt 1997); (2) industry heterogeneity index (INDUSTRY) (Jiang et al. 2010; Koka and Prescott 2002, 2008; Powell et al. 1996); and (3) nationality heterogeneity index (NATIONALITY) (Jiang et al. 2010; Koka and Prescott 2002, 2008). To measure a firm's access to structural holes, I used Burt's network constraint index (Burt 1992), and subtracted this index from one. Higher values indicate a firm's

³² Each indicator variable has been widely used in alliance network studies (shown by citations) because of its conceptual simplicity and relevance to managerial implications. However, though each variable measures unique features, the significant conceptual overlap and high correlations between these variables prohibit including all these variables. The studies by Koka and Prescott (2002, 2008), which provide construct validity of these variables for higher-level network measures, reinforced the approach to use these variables as indicators and develop composite measures.

³³ In network theory, EVCENT corresponds to the values of the first eigenvector of the graph adjacency matrix.

access to more structural holes in its network, a method that is commonly used in alliance research (Ahuja 2000; Baum et al. 2000; Chi et al. 2010)³⁴.

The other two measures, INDUSTRY and NATIONALITY, are used to reflect the heterogeneity of partners in terms of their industry and nationality. Following the approach taken by Koka and Prescott (2008), I use Blau's heterogeneity index to calculate the extent to which a firm's partners exhibit heterogeneity (Koka and Prescott 2002, 2008; Powell et al. 1996).

$$\text{Blau's heterogeneity index: } 1 - \sum P_j^2$$

where P_j is the proportion of partners in the j category. The category used to determine the firm's industry is the two-digit SIC industry classification code of the firm's main business. For the firm's nationality, I used the country where the firm is headquartered.

	Mean	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) CENTRALITY	0	1							
(2) PARTNERS	7.412	0.948***	1						
(3) ALLIANCES	8.001	0.944***	0.997***	1					
(4) EVCENT	0.016	0.838***	0.861***	0.890***	1				
(5) DIVERSITY	0	3.33e-08	-0.260***	-0.300***	-0.456***	1			
(6) HOLES	0.531	0.633***	0.439***	0.408***	0.234***	0.613***	1		
(7) NATIONALITY	0.321	0.436***	0.268***	0.248***	0.120***	0.597***	0.498***	1	
(8) INDUSTRY	0.507	0.497***	0.308***	0.289***	0.193***	0.531***	0.526***	0.226***	1

Composite Measures: Using these variables as indicators, I conducted a principal component analysis (PCA) to develop a composite measure for each of the network constructs. Before discussing the results of the PCA, it would be useful to discuss the descriptive statistics of these indicator variables to ensure the validity of these indicators for the main network constructs,

³⁴ Mathematically, this measure is computed as $1 - \sum_j (p_{ij} + \sum_q p_{iq}p_{qj})^2$ for $q \neq i, j$, where p_{ij} is the proportion of i 's direct relations invested in partner j . $\sum p_{iq}q_{qj}$ represents the extent to which another i 's partner q is also connected to j .

network centrality and partner diversity. The descriptive statistics (Table IV-2) reveal significant correlations between the measures. Network centrality (CENTRAL) is positively correlated with indicator variables for this construct. The centrality measure (CENTRAL) has a high correlation to the number of partners (PARTNERS) (0.948; $p < 0.01$) and the number of alliances (ALLIANCES) (0.944, $p < 0.01$). The correlation between CENTRAL and the eigenvector centrality measure (EVCENT) is also high and statistically significant (0.838; $p < 0.01$). The high correlation between the indicators and the operationalized variable suggests that they measure the same underlying component, indicating a convergent validity. On the other hand, the correlations between network centrality (CENTRAL) and the indicator variables for network diversity (INDUSTRY, COUNTRY, HOLES) are relatively low.

A similar pattern is observed for the network diversity (DIVERSITY). The correlations between the network diversity (DIVERSITY) and its indicator variables provide further support for convergent validity. Industry heterogeneity (INDUSTRY) and nationality heterogeneity (COUNTRY) are highly correlated with the diversity measure (DIVERSITY) (0.597, $p < 0.01$; 0.531, $p < 0.01$, respectively). The correlation between the diversity measure and structural holes (HOLES) is also positive and statistically significant (0.613; $p < 0.01$). On the other hand, the correlations between network diversity (DIVERSITY) and the indicator variables for network centrality (PARTNERS, ALLIANCES, EVCENT) are relatively low. Thus, these results provide supports for the convergent as well as discriminant validity of the network measures.

The result of the PCA (Table IV-3) shows the six indicator variables loaded onto two factors. The two-factor model was supported by a variety of criteria, such as eigenvalues (larger than 1), variance explained, and factor loading. Hence, I used the factor scores for the first two components developed from the PCA as a composite measure for each of the network constructs.

Table IV-3. Eigenvectors of Principal Components						
Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
PARTNERS	0.5196	-0.2215	0.0338	-0.0366	-0.4762	-0.6721
ALLIANCES	0.5173	-0.2553	0.0352	-0.0121	-0.3522	0.7361
EVCENT	0.4592	-0.3884	0.0038	0.124	0.7852	-0.0798
HOLES	0.3469	0.5218	-0.0365	-0.7582	0.1763	0.0109
NATIONALITY	0.2388	0.508	0.7034	0.4343	0.0397	0.0009
INDUSTRY	0.2723	0.4523	-0.7082	0.4687	-0.0056	0.0044
Eigenvalue	3.3312	1.38091	0.772052	0.378987	0.135366	0.0014878
Variance explained	0.5552	0.2302	0.1287	0.0632	0.0226	0.0002

IT investment

The key explanatory variable, ITINV, is measured as the ratio of annual IT expenditure to the total sales of a firm. IT expenditure includes hardware, software, network infrastructure, salaries and recruitment of IT professionals, internet-related costs, and IT-related services and training. Given the comprehensiveness of this measure in capturing all of a firm's IT-related expenses, this construct has been frequently used as a proxy for the overall IT available within the firm (Bharadwaj et al. 1999; Chari et al. 2008; Tafti et al. 2013).

Firm Performance and Control Variables

I operationalized the dependent variable of this chapter, firm performance, as operating profits per employee after log-transformation (Bharadwaj 2000)³⁵. In a broad sense, it is consistent with prior IS studies that consider output per employee as performance measures (Banker and Bardham 2006; Zhu and Kraemer 2002). It serves as a measure of the productivity

³⁵ The measure for firm performance could have utilized market-based, forward-looking measures, such as Tobin's Q, rather than historical accounting measures, such as operating profits used in this study. However, the sample of this study includes many firms in internet-service related industries (e.g. SIC 357, 737 – computer manufacturing and computer services), which experienced severe turbulence in their firm valuation during the sample period (1998-2005). For example, the Tobin's Q measure of CISCO plummeted from 14.6 in 1999 to 2.55 in 2002, and Microsoft's dropped from 12.02 in 1999 to 2.57 in 2004. Therefore, I avoided this measure due to concerns over the effect of the hoopla over the internet services in the sample period.

and efficiency of the firm's operation. Of various output measures, I used operating profits instead of total sales or net profits. The use of total sales may not reflect the effect of IT on the cost side of a firm's operations, associated with coordination and control efforts, which are the central focus of this chapter. Net profits may contain potential confounding effects of idiosyncratic asset valuation and local tax treatment (Goerzen 2005, 2007; Koka and Prescott 2008). Bharadwaj (2000, p.180) noted "operating income is regarded as a more appropriate measure of the direct value of IT [than net income]." Along the lines of extant studies (e.g. Ray et al. 2009), I used natural log transformation for the absolute dollar terms due to high variances and skewness in this firm performance metric.

I controlled for various firm-level and industry-level factors that affect firm performance. First, I controlled for the effect of economies of scale and scope by including a measure for firm size (*SIZE*), market share (*MS*), and the level of diversification (*DIV*). These constructs are measured as $SIZE = \log(\text{total assets})$ and $MS = \sum MS_i P_i$, where MS_i is a firm's market share in each of its industries i and P_i is the proportion of the firm's sales in the industry. *DIV* is measured as $\sum P_i \ln(1/P_i) - \sum P_u \ln(1/P_u)$, where P_i is the percentage of sales in each four-digit SIC industry and P_u is the percentage of sales in each two-digit SIC industry. Second, because this is a cross-industry study and performance varies from industry to industry, I included three industry-level factors: industry average operating profit per employee (*IND_PERFORM*), industry capital intensity (*IND_CAP*), and industry concentration (*IND_CONC*). Each construct is measured as $IND_PERFORM = \sum OP_i P_i$, $IND_CAP = \sum C_i P_i$, and $IND_CONC = \sum CR4_i P_i$, respectively, where P_i is the proportion of a firm's sales in the industry, OP_i is the average operating profit per employee, C_i is the capital intensity (Assets/Sales), and $CR4_i$ is the sum of the top four firms' market share in the industry i .

From the IWeek sample, I retained only publicly listed and identifiable firms for my analyses and obtained relevant financial information to use as controls from the Compustat databases. I retrieved alliance network constructs for the firms that participated in the alliance networks constructed from the procedure discussed before. The final sample consists of 825 firm-year level observations of 242 public firms in the U.S. from 1998 to 2005. This creates unbalanced panel information.

IV-5.3. Statistical Method: Fixed Effect Robust Panel Regression

The unit of analysis is a firm-year level observation. Though I controlled for several important confounding factors, ordinary least square (OLS) estimation remains inefficient because cross-section time-series data often violates the assumption of exogeneity and homoscedasticity of error terms due to firm-specific unobserved heterogeneity. The model is thus estimated using a fixed effect robust panel regression, which can mitigate some of these issues. Mathematically, the panel model can be expressed as $y_{it} = \mathbf{x}_{it}\beta + c_i + u_{it}$, where \mathbf{x}_{it} is a $1 \times K$ matrix of observable explanatory and u_{it} are idiosyncratic errors that change across t as well as across i . In this panel model, c_i is the unobserved, time-constant variable, which is often referred to as the unobserved effect. The choice between fixed-effect and random-effect models depends on the assumption concerning the correlation between explanatory variables and unobserved effects, which is $Cov(\mathbf{x}_{it}, c_i)$. While a random-effect model imposes the assumption of zero correlation between observable and unobservable variables ($Cov(\mathbf{x}_{it}, c_i) = 0$) and estimates β by placing c_i into the error term, a fixed effect relaxes this assumption and allows arbitrary correlation between these variables. Therefore, a fixed-effect analysis can be viewed as being more robust than random-effect analysis. One drawback of using the fixed-effect model is that time-constant observable factors cannot be estimated; however, this is not a critical issue

because time-constant factors are not of direct interest to this chapter. Thus, I chose a fixed-effect model for the model estimation. Accordingly, firms with a single observation were excluded from the analysis. In addition to controlling for firm-fixed effects, I also controlled time effects by introducing each year as a dummy variable. This variable captures any variation in performance that is time-specific, which again provides for a conservative test of the hypotheses.

To account for potential heteroscedasticity across firms, I estimated the standard errors using White's robust estimator. For easy interpretation of interaction terms, I centered IT and alliance network variables to their respective means.

IV-6.Results

The sample consists of 825 firm-level observations of 242 public firms in the United States from 1998 to 2005. Table IV-4 provides descriptive statistics and the correlation matrix for the key variables. A more comprehensive description of the sample of this chapter is provided in Appendix.

The results from the fixed-effect robust panel analysis are shown in Table 1. I treated the model with IT, network constructs, and control variables as a base case (Model I) and expanded the model by including the interactions. In all models, the coefficient of ITINV, the direct effect of IT investment, is statistically insignificant, substantiating the view that emphasizes contingencies of IT investment payoff. In all models except Model I, the effect of IT investment should be interpreted with consideration of the coefficients of its interaction terms with network constructs.

Table IV-4. Descriptive Statistics and Correlation Matrix

	MEAN	STD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) PERFORMANCE	3.208614	0.9469	1									
(2) ITINV	3.158606	2.455	0.105**	1								
(3) CENTRALITY	-1.20e-09	1.825	0.167***	0.142***	1							
(4) DIVERSITY	-8.25e-09	1.175	0.0625	0.0752*	3.33e-08	1						
(5) SIZE	8.808693	1.323	0.424***	0.0864*	0.360***	0.231***	1					
(6) MS	0.123606	0.1367	-0.246***	-0.185***	-0.0580	-0.0719*	0.105**	1				
(7) DIV	0.148461	0.2660	0.0504	-0.0736*	0.0200	0.132***	0.236***	0.0670	1			
(8) IND_PERFORM	3.482238	0.8323	0.670***	0.201***	0.0765*	0.0870*	0.381***	-0.294***	0.0831*	1		
(9) IND_CAP	1.253276	1.736	0.316***	0.283***	-0.0310	0.0195	0.307***	-0.0863*	0.0689*	0.382***	1	
(10) IND_CONC	0.563412	0.1809	-0.367***	-0.251***	-0.192***	-0.0720*	-0.152***	0.698***	0.0403	-0.354***	-0.0592	1

* $p < 0.15$, ** $p < 0.05$, *** $p < 0.0$

Table IV-5. IT Interactions with Alliance Networks—Fixed-Effect Robust Panel

Regression

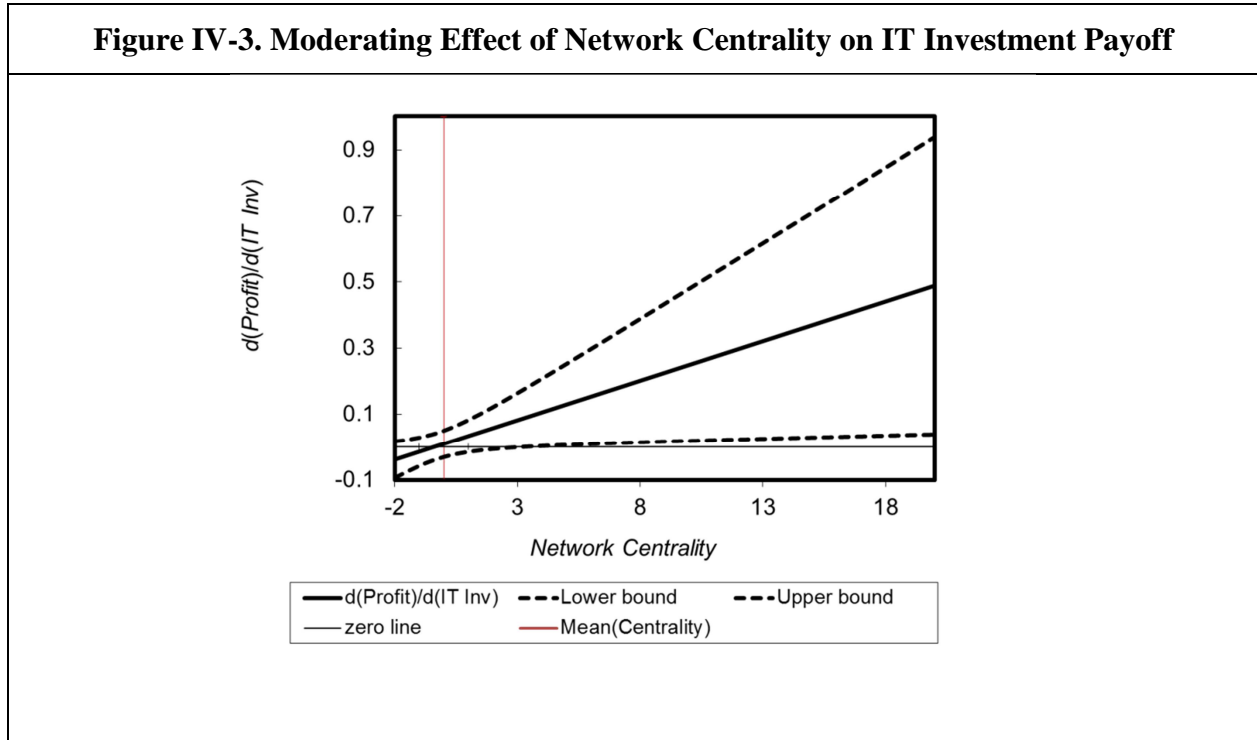
Dependent variables: PERFORMANCE - log (operating income per employee)					
	Model I (Base)	Main II (Main)	Model III (Selection- Bias)	Model IV (5-yr Tenure)	Model V (2SLS IV Regression)
IND_PERFORM	0.0910* (0.0476)	0.0896* (0.0480)	0.0882* (0.0481)	0.0904* (0.0475)	0.0545 (0.0861)
SIZE	0.0908 (0.0971)	0.0640 (0.0936)	0.0627 (0.0939)	0.0810 (0.0906)	-0.0247 (0.160)
MS	0.240 (0.257)	0.115 (0.239)	0.102 (0.240)	0.183 (0.240)	-1.064 (0.650)
DIV	-0.268 (0.164)	-0.254 (0.154)	-0.260* (0.155)	-0.251 (0.161)	-0.0937 (0.309)
IND_CAP	-0.0384 (0.0451)	-0.0103 (0.0454)	-0.0100 (0.0453)	-0.0114 (0.0466)	0.0940 (0.116)
IND_CONC	-0.148 (0.306)	-0.0278 (0.299)	-0.0127 (0.301)	-0.134 (0.292)	0.849 (0.725)
ITINV	0.0475 (0.0379)	0.00951 (0.0204)	0.00926 (0.0203)	0.0173 (0.0207)	-0.186 (0.287)
CENTRALITY	0.0237* (0.0138)	0.0173 (0.0141)	0.0162 (0.0141)	-0.0186 (0.0181)	0.00173 (0.0324)
DIVERSITY	0.00795 (0.0185)	0.0114 (0.0180)	0.0112 (0.0181)	-0.0338 (0.0236)	0.0202 (0.0332)
ITINV × CENTRALITY (H1)		0.0240** (0.0112)	0.0240** (0.0112)	0.0275* (0.0152)	0.157** (0.0762)
ITINV × DIVERSITY (H2)		0.0217** (0.00986)	0.0225** (0.00991)	0.0256* (0.0153)	0.229** (0.105)
Constant	2.325*** (0.852)	2.455*** (0.818)	2.471*** (0.822)	2.378*** (0.795)	4.086** (1.614)
Selection indicator			0.0231 (0.0284)		
Firm/Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	825	825	825	825	810
Number of groups	242	242	242	242	242
F-statistics	4.197***	4.346***	4.145***	4.169***	4.7e+09***
R ²	0.144	0.182	0.182	0.182	0.779

1. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%
2. Model III examines whether the firms were dropped out randomly in the unbalanced panel dataset.
3. Model IV shows the robustness check for the choice of the span of alliances (3yr vs. 5yr).
4. Model V examines the effects of possible simultaneity in firm performance, IT investment, and network variables. The one-year lag of performance variable is used as an instrument. A chi-square statistic is reported instead of an F-statistic.

The inclusion of the interaction terms between IT investment and network variables increase R^2 ; the LR test for the model comparison between Model I and Model II is statistically significant (LR $\chi^2=37.35$, $p<0.01$). In Model II, the coefficient of the interaction between IT investment and network centrality is positive and significant ($p<0.05$), supporting Hypothesis 1, which predicts greater IT investment payoff in firms with high network centrality. The insignificant coefficient of the network centrality shows that network centrality does not have a performance effect when IT investment is at its mean. This finding corroborates the argument in the alliance literature that firms may not be able to realize performance gains from high centrality, unless they do not have adequate coordination and control mechanisms to leverage expanded resource pools, handle increased information flow, and manage potential interdependencies among the alliances in their alliance portfolios (Hoffmann 2007; Wassmer 2010). The positive interaction effect of IT investment and network centrality suggests that firms' investment in IT generates a greater positive performance impact if they maintain a central position within their alliance network (e.g. a greater number of partners and alliances) than the average firms.

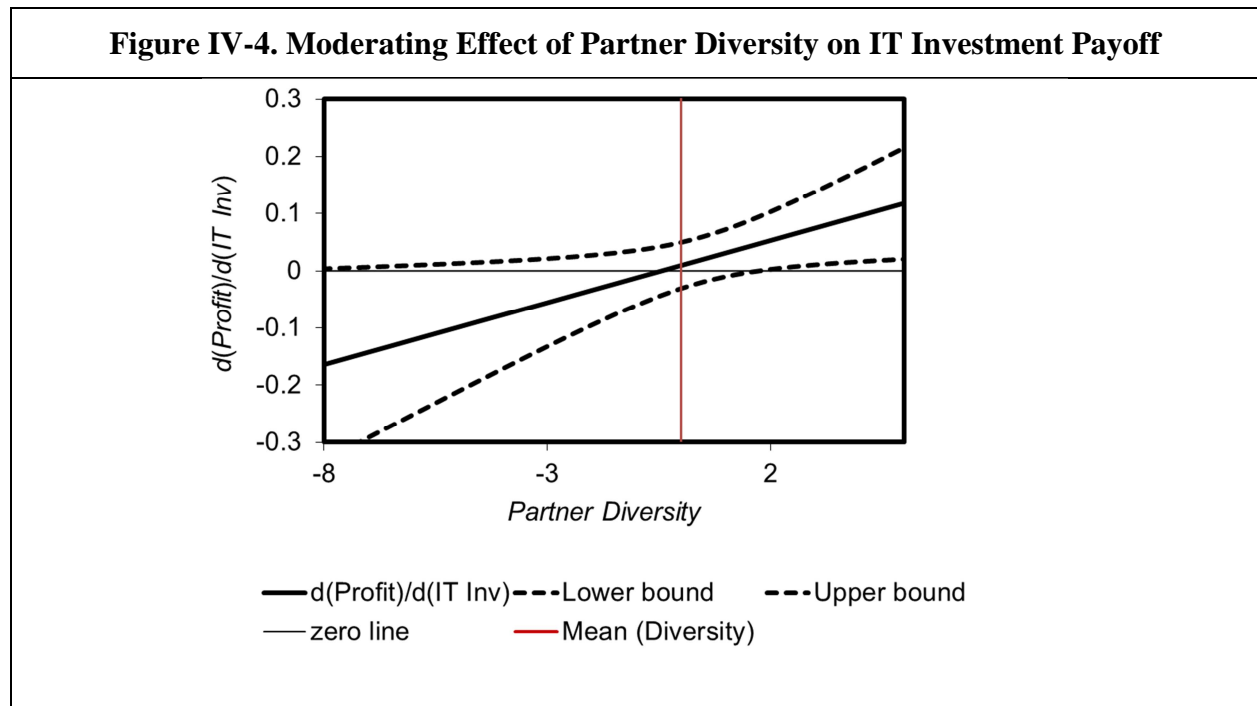
For better interpretation of the overall impact of IT investment on firm performance, I plotted the marginal effect of IT investment on performance as a function of network centrality, holding other variables at their means. The x -axis is the measure of network centrality, and the values correspond to the range of values within the sample. The solid line shows the marginal effects that are based on coefficient estimates in fixed-effect panel regression, and the dashed lines show 10% confidence intervals. For firms with average number of alliance partners, the 1% point increase in IT investment does not have substantial impact on firm performance. However,

as a firm's centrality increases, the marginal impact of IT investment on performance increases as well.



Second, the interaction effect of IT investment and partner diversity is positive and significant ($p < 0.05$), supporting Hypothesis 2, which predicts higher IT investment payoff in firms with diverse partners. The insignificant coefficient of the partner diversity indicates that partner diversity may not have a performance effect when IT investment is at its mean. This finding substantiates the contention in the alliance literature that firms may not be able to realize performance gains from high diversity in their partner composition, unless they do not have adequate coordination and control mechanisms to handle increased managerial complexities that arise from the interactions with diverse partners. The positive interaction effect of IT investment and partner diversity suggests that firms' investment in IT generates greater positive performance impact when they deal with more diverse partners than the average firms. Similar to the analysis for network centrality, I plotted the marginal impact of IT on firm performance as a function of

partner diversity (Figure IV-3). For firms with an average level of partner diversity, the 1% point increase in IT investment does not have a substantial impact on firm performance. However, as a firm's partner diversity increases, the marginal impact of IT investment on performance increases as well.



I conducted several robustness checks. First, in Model III, I considered potential sample selection bias due to the nature of our sample's unbalanced panel data; some time periods are missing for some firms. To check whether the firms were dropped out randomly and did not violate the assumption of exogeneity of independent variables, I followed the approach taken by Tafti et al. (2013), which was originally developed by Nijman and Verbeek (1992) and refined by Wooldridge (2002) for a fixed-effect panel model. I included the lagged selection indicator, which represents whether a firm's observation for the prior time period is also included in the sample. The significance of this indicator shows whether selection in the previous time period is

significant in the equation at the current time. The result provides no evidence of selection biases (Model III).

Second, I checked whether the results are robust to the choice of the span of alliances (Model IV). To demonstrate the sensitivity of my results, I expanded the window from three years to five years. The results using the five-year alliance tenure assumption appear in Model IV. Comparing the results in Model II and Model IV, I observe that the relative effect sizes and the directionality of the interaction terms are stable and preserved.

Finally, I tested for the effects of possible simultaneity in firm performance, IT investment, and network variables (Model V). I conducted a two-stage least square regression using a one-year lagged dependent variable and a one-year lagged firm productivity (return on equity) as instruments. The results of the model (Model V) show the same direction and statistical significance as in the main model (Model II). The Hausman test statistic comparing these two models is insignificant, suggesting that any possible endogeneity in the IT investment has no significant influence on the hypothesized relationships. The F statistics of the first-stage regression model indicate that these instruments have strong relevance. The results of the Sargan (1958) test of overidentifying restrictions are insignificant, suggesting that excluded instruments are not correlated with the error term in the main equation.

IV-7.Discussion

Before discussing this chapter's potential contribution to IS literature, it is necessary to first acknowledge its limitations. First, the theoretical framework noted a firm's information processing and dynamic capabilities that can be significantly influenced by IT investment, but these capabilities were not directly measured in an empirical setting. Rather, based on the

assumption that IT investment may improve the overall level of these firm capabilities, the empirical analysis was limited to examining the interactions between IT investment and structural properties. Therefore, one potential path for future research would be to directly examine whether IT investment actually improves these capabilities and to identify their effect on the relationship between structural properties and a company's performance. Second, this chapter focused exclusively on publicly reported contractual alliance arrangements; thus, the data presented does not include the countless informal collaborations that could potentially promote knowledge transferal. Moreover, this chapter does not address the specific characteristics of the resources and information that are transmitted within the network.

Despite these limitations, the present chapter presents several important theoretical contributions and managerial implications. This chapter contributes to the IT investment payoff literature by showing that a firm's alliance network is an important external constituent that can explain the variances in the payoff of IT investment. Despite the critical role played by interfirm alliances as an external source of valuable resources and information, and the increasing interest in the IT investment payoff for the management of various types of business collaborations, there is a general dearth of empirical examinations of the performance impact of IT investment in alliances, minus the occasional exception (Chi et al. 2010; Tafti et al. *forthcoming*). Given the rapid proliferation of alliances today, the traditional focus on firm characteristics and the failure to conscientiously study the networks in which firms are embedded may lead to an incomplete understanding of IT investment payoff. This chapter improves the understanding of the performance impact of IT investment in an economically significant context that has been overlooked by scholars in extant IS research.

On the level of practical applicability, these findings help justify the investment in IT when firms expand their business activities through alliances with multiple partners. Increasing IT investment in tandem with a firm's alliance partnerships with many partners may be justified by the greater performance impact of such an investment. My findings also suggest that alliance partner diversity is relevant in justifying the increase in IT investment. This chapter recommends that companies carefully assess whether their IT infrastructure is adequately designed to support the burden of increasing managerial complexity and to fully leverage new business environments.

IV-8.Conclusion

A firm's portfolio of alliances and the resultant properties in its alliance networks are key to determining the relative success or failure of a firm's performance. Despite high expectations for the value of IT investment in managing and leveraging expanded resource pools through multiple alliance relationships, a paucity of theoretical and empirical examination persists in the relevant literature. This chapter represents an initial effort to thoroughly parse the interactions between IT investment and alliance networks. By employing social network analysis (SNA) techniques and consulting relevant data on U.S firms, I empirically examined the moderating effect of alliance networks as it relates to the link that exists between IT investment and firm performance. My findings will expand general understanding of the influence of IT resources within the alliance context.

IV-9.References

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IV-10.Appendix

Table IV-6 shows the descriptive statistics by industry category. Firms are distributed non-uniformly over all industries from high-tech manufacturing to healthcare services. Firms in computer-related industries (manufacturing: SIC 357; service: SIC 737) take the biggest portion of the sample (17%). Firms in the computer manufacturing industry have 36 alliances with 32 partners, on average. Firms in the computing service industry have 20 alliances with 18 partners, on average. Other high-tech manufacturing industries make up 27% of the sample. Firms in the high-tech industries have a significantly larger number of alliances and partners than those in other industries. Accordingly, their centrality is higher than the average.

With respect to DIVERSITY, this measure also tends to be higher for firms in high-tech industries, except computer-related industries. This may seem erroneous, as their values of indicator variables (HOLE, NATIONALITY, and INDUSTRY) are relatively higher than those of other industries. However, considering that CENTRALITY and DIVERSITY are composite measures that are orthogonal to each other, the low value of DIVERSITY of these firms might be driven by their exceptionally high centrality values. It is likely that the heterogeneity measures are partially proportional to the number of partners by the definition of heterogeneity measures. Therefore, DIVERSITY should be interpreted as relative diversity in a firm's partners given its centrality.

The bottom row in Table IV-6 shows the mean of variables for the U.S.-based public firms. The comparison of the sample and the other public firms reveals that the sample firms engage more alliances than other public firms do. The average number of partners and alliances are greater than those the number for the average U.S. public firm. The large portion of firms in high-tech manufacturing and computing service industries in the sample might be a potential reason. Another reason could be the fact that the sample firms are relatively larger than the average public U.S. firm is. The average total assets of the sample firms are 37.8 billion dollar, while the average total assets of other U.S. public firms are 9.2 billion. The tendency to include larger firms could be attributed to the sample selection criteria of InformationWeek, which conducts surveys primarily with Fortune 500 firms.

Table IV-6. Descriptive Statistics by Industry

Industry categories	N (obs.)	PERFOR MANCE	ITINV	CENTRA LITY	DIVERSI TY	PARTNE RS	ALLIAN CES	EVCENT	HOLE	NATION ALITY	INDUST RY
High-tech manufacturing	270 (33%)	3.48275	3.191481	.5964114	.2596782	11.67407	12.68148	.0328776	0.671317	0.427488	.5251489
AUTO	47 (6%)	3.11575	2.742553	.194743	0.314711	8.319149	8.87234	0.010959	0.561922	0.399963	0.573128
CHEM	53 (6%)	3.66044	2.320755	-0.258967	0.149353	4.849057	5.037736	0.000498	0.574356	0.430851	0.370498
COMP	49 (6%)	3.38415	3.906122	2.752722	-0.359742	32.02041	36.65306	0.148744	0.794352	0.396360	0.696228
Instruments	25 (3%)	3.01929	3.28	0.376997	0.831772	7.36	7.48	0.006386	0.689266	0.48913	0.627176
PHARMA	40 (5%)	4.28231	4.1875	0.252547	0.457133	9	9.05	0.001921	0.756791	0.445744	0.425640
SEMICON	33 (4%)	3.27078	3.069697	-0.143254	0.204222	4.545455	4.575758	0.013205	0.638111	0.403358	0.395827
TELECOM	23 (3%)	3.45063	2.93913	0.692200	0.835406	10.47826	10.6087	0.016293	0.735661	0.478166	0.666705
Other manufacturing	216 (26%)	3.02973	2.456435	-0.490991	-0.082144	3.282407	3.365741	0.001629	0.436309	0.300027	0.470008
Computer service	59 (7%)	3.30072	5.88678	1.127409	-0.069340	18.37288	20.40678	0.055960	0.725904	0.349375	0.533073
Other services	89 (11%)	2.81789	3.87382	-0.581046	-0.267683	3.258427	3.370787	0.000886	0.411046	0.171941	0.514292
Others	191 (23%)	3.17699	2.730209	-0.365345	-0.128037	4.60733	4.95288	0.006355	0.439568	0.257130	0.515257
Total	825 (100%)	3.208614	3.158606	-1.20e-09	-8.25e-09	7.412121	8.001212	0.016755	0.531960	0.321521	0.507817
U.S. public firms*	12,628	3.163807	-	-	-	2.769243	2.873377	0.003857	0.477800	0.263808	0.379968

1. Industry categories are identified using the three-digit SIC code.

2. High-tech industries include chemical (SIC: 28, excluding 283), pharmaceutical (SIC: 283), computer (SIC: 357), telecommunication (SIC: 366), semiconductor (SIC: 367), automotive (SIC: 37), and instrument (SIC: 38).

3. Examples of other manufacturing (SIC: 20-39, except high-tech manufacturing) include food and fashion manufacturing industries.

4. Examples of other services (SIC: 60-89; except the computing services, SIC: 737) include financial (SIC: 6), lodging (SIC: 700), and health (SIC: 806) services.

5. Others include mining/construction (SIC: 1), transportation (SIC: 4), trade (SIC: 5), and others (SIC: 9)

6. The description of measures is provided in Table IV-1.

6. CENTRALITY and DIVERSITY are composite measures developed from the PCA using six indicator variables: PARTNERS, ALLIANCES, EVCENT, HOLE, NATIONALITY, and INDUSTRY.

* Firms in this category satisfy the following criteria: (1) Firms publicly traded in the U.S.; (2) Firms appeared in the SDC database for their alliance activities; (3) Firms did NOT participate in the InformationWeek survey during 1998-2005. These firms are excluded from the sample due to the lack of IT investment information. These observations span eight years, from 1998 to 2005.

Chapter V. Summary and Conclusion

This dissertation study contributes to the IS literature by developing a theory and providing empirical evidences linking IT resources, alliance capability, and alliance performance.

In Chapter 1, I provide anecdotal evidences which motivated this dissertation study and introduce each chapter of this dissertation by summarizing the goal and main findings.

In Chapter 2, I begin by discussing the concept of alliance capability that has evolved in strategy and management literature. The review of IT constructs and theoretical paradigms employed in prior interorganizational relationship studies in IS research reveals that the prospect application of the prior frameworks to strategic alliances is somewhat limited, mainly due to their primary focus on transactional issues between partners at a dyadic level. Drawing upon the theories of organizational learning, dynamic capabilities, and knowledge-based view, I propose a theoretical framework linking IT, alliance capability, and alliance performance, the model that help explain the contribution of IT to the success and failure of a firm's overall alliance performance. A set of propositions are developed based on this theoretical framework.

In Chapter 3, I empirically examined a part of the framework, which provides evidences for the role of firm-level IT in developing alliance capability for individual alliances. More specifically, I examined whether there is an association between the use of IT-enabled knowledge platforms and a firm's overall alliance performance outcomes. I hypothesize that the use of IT-enabled knowledge platforms contributes to the development of alliance capability by facilitating organizational learning and encouraging alliance managers to follow disciplined routines, ultimately leading to higher alliance performance.

In Chapter 4, I examine IT investment payoffs under the consideration of a firm's alliance network, which has recently come to the forefront in management research by virtue of their significant influence on a firm's actions and resultant performance (Gulati 1998), but they remain under-studied in IS research. The results of this dissertation study shows the positive moderating effect of network centrality and partner diversity on a firm's IT investment payoff, implying greater IT investment payoff for firms that are at a central position in the alliance network and that have diverse alliance partners.

Taken together, the studies contribute to enhance collective understanding of how IT resources influence the firm performance in their strategic alliances. My dissertation will hopefully enlarge the scope of interorganizational relationship research in IS studies to include issues that arise from managing and leveraging strategic alliances, which comprise a wider range of business activities than the management of supply chains. From a theoretical perspective, this dissertation study seeks to contribute to the business value of IT literature by providing both the theoretical foundation and empirical evidence to support the argument that IT resources designed for internal process and knowledge management significantly influence the extent to which firms leverage their interorganizational relationships, and thus strongly influence their organizational performance. From a managerial perspective, meanwhile, this dissertation study proposes that firms adopt a complementary outlook when considering IT investment to enhance the value that they derive from their alliance partnerships; especially because the investment might be needed for building internal capabilities, and not for resolving relationship-specific or partnering issues.