Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective

T. RAVICHANDRAN AND CHALERMSAK LERTWONGSATIEN

T. RAVICHANDRAN is an Associate Professor in the Lally School of Management and Technology, Rensselaer Polytechnic Institute. He holds a joint appointment in the School of Information Technology and the Decision Sciences and Engineering Systems Department. His research expertise and interests are in the following areas: strategic implications of information technology, supply chain management and business model innovations, innovation diffusion and assimilation, and organizational renewal and growth through innovations. His research in some of these areas has been funded by grants from the National Science Foundation, John Broadbent Endowment for Research in Entrepreneurship, and Pontikes Center for the Management of Information. His research has been published in academic journals such as *Communications of the ACM, Decision Sciences, European Journal of Information Systems, IEEE Transactions on Engineering Management, Logistics Information Systems, Journal of Management Information Systems,* and *MIS Quarterly.* In addition, he has published more than 40 papers in national and international conference proceedings. He currently serves as an Associate Editor of *MIS Quarterly.* He is also a member of the Editorial Review Board of *IEEE Transactions on Engineering Management.* He has served as a guest editor for the *ACM Database for Advances in MIS.*

CHALERMSAK LERTWONGSATIEN is an Information Technology Specialist at the Information & Communication Technology Center at the Ministry of Finance, Thailand. He has also served as a visiting lecturer at several universities in Thailand. He holds a Ph.D. in Management Information Systems from Rensselaer Polytechnic Institute, New York. His research interests include strategic implications of information technology and e-commerce diffusion. He has published articles in the *Proceedings of the International Conference in Information Systems, Proceedings of the Americas Conference on Information Systems,* and the *Journal of Global Information Technology Management.*

ABSTRACT: We draw on the resource-based theory to examine how information systems (IS) resources and capabilities affect firm performance. A basic premise is that a firm's performance can be explained by how effective the firm is in using information technology (IT) to support and enhance its core competencies. In contrast to past studies that have implicitly assumed that IS assets could have direct effects on firm performance, this study draws from the resource complementarity arguments and posits that it is the targeted use of IS assets that is likely to be rent-yielding. We develop the theoretical underpinnings of this premise and propose a model that interrelates IS resources, IS capabilities, IT support for core competencies, and firm performance. The model is empirically tested using data collected from 129 firms in the United States. The results provide strong support for the research model and suggest

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that variation in firm performance is explained by the extent to which IT is used to support and enhance a firm's core competencies. The results also support our proposition that an organization's ability to use IT to support its core competencies is dependent on IS functional capabilities, which, in turn, are dependent on the nature of human, technology, and relationship resources of the IS department. These results are interpreted and the implications of this study for IS research and practice are discussed.

KEY WORDS AND PHRASES: competitive advantage, core competencies, information technology and strategy, resource-based theory.

THE POTENTIAL OF INFORMATION TECHNOLOGY (IT) to provide firms competitive advantage has been a topic of interest to practitioners and academicians. This interest is reflected in the large number of studies that have examined the strategic value of IT and its effect on firm performance. In part, this attention to IT value stems from the significant investments organizations have made in information systems (IS) and the increasing role IT plays in the strategic thinking of most organizations.

Despite significant work in this area, the need to examine the IT–firm performance relationship exists for two reasons. First, although studies have found that IT affects firm performance, the underlying mechanisms by which IT relates to firm performance remain underexamined in both the IS and the management literatures [17, 99]. Past studies have investigated the IT–firm performance relationship at an aggregate level and have attempted to quantify the marginal effects of IT investments on firm productivity, profitability, and consumer surplus (e.g., [22, 48, 61, 82]). Although, recent studies have provided evidence that IT contributes to firm performance (e.g., [61, 89, 96, 124]), the cumulative results of the IT–firm performance research have been mixed.

Second, the underlying theories to explain why and how IT innovations contribute to firm performance have undergone a paradigm change, creating a need for more current examination [109]. Previously, the structure-conduct-performance model of industrial organizations economics [90, 91] was the most dominant theory influencing the thinking of IS researchers. The positioning arguments that underlie this paradigm have been questioned in the strategy literature [13, 33, 52, 128], where it has been suggested that there is a need to focus on factors internal to the firm in addition to the industry structure in understanding the sources of competitive advantage. Researchers have argued that the resource-based theory [13, 52, 128] and its extensions [122], with their focus on firm resources and capabilities, provide the appropriate theoretical lens to examine how factors internal to the firm can be a source of competitive advantage.

In this paper, we draw from the resource-based theory to examine how IS resources and capabilities affect firm performance. A basic premise of this paper is that a firm's performance is influenced by how effective the firm is in using IT to support and

enhance its core competencies. In contrast to past studies that have implicitly assumed that IS assets could have direct effects on firm performance, this study draws from the resource complementarity arguments [29, 30] and posits that it is the targeted use of IS assets that is likely to be rent-yielding. We develop the theoretical underpinnings of this premise and propose a model that interrelates IS resources, IS capabilities, IT support for core competencies, and firm performance.

IT and Firm Performance Research: A Critical Review

PAST RESEARCH LINKING IT AND FIRM PERFORMANCE has largely focused on the competitive advantage derived from IT applications and the relationship between IT investments and firm performance. Early research drew from the industrial organization perspective and proposed conceptual frameworks to examine the competitive advantage offered by key IT applications (e.g., [9, 16, 63, 77, 90, 91, 110]). This research stream argued that IT innovations have the potential to alter a range of strategic and industry factors such as cost positions, scale economies, and power relations with buyers and suppliers, and thereby provide competitive advantage.

However, the focus on strategic applications as a source of competitive advantage has been critiqued. IT applications might provide only limited advantages to innovators before being copied by competitors, which essentially extends current competitive positions, but at increased costs [126]. Strategic applications create switching costs, which in turn, were expected to be a source of competitive advantage. The conceptual limitations of attributing the source of competitive advantage from IT-based switching costs have been pointed out [73]. These include the inability of firms to profit from switching costs because of potential customer backlash in competitive markets and the emergence of open systems that considerably reduce, if not eliminate, switching costs.

Adopting a more macro perspective, another research stream has examined the relationship between IT investments and firm performance and found mixed results. Some studies [11, 14, 23, 40, 49, 115] have reported a positive relationship between IT investments and firm financial performance, whereas others have found no significant relationships [10, 48, 65, 72].

In resolving these inconsistent findings, researchers have stressed the need to shift the analytical focus to a more granular level and to refine the operationalization of firm performance variables. Since the immediate effects of IT manifest in process improvements, more conclusive results are expected when IT investments are related to process performance [83, 113]. Empirical studies using intermediary performance measures such as process efficiency and quality have reported more consistent results [86, 98], though only very few studies have been undertaken so far. The scope of the performance measures has also been expanded to include consumer surplus, based on the argument that the value created by IT need not be appropriated by firms in a manner that manifests in improved financial performance [61]. Instead, it could enhance the value customers get through improved product and service offerings. The

effect of IT investments on firm productivity has also been examined [23], with mixed results.

The contingencies under which IT investments become valuable to a firm have also been examined. The performance effects of IT investments has been found to differ under monopolistic and duopolistic conditions, and market sensitivities to price and product quality have also been found to affect the relationship between IT investments and firm performance [96, 124]. Moreover, these relationships have been found to vary across industries. Although a few industry-specific studies have been reported so far [40, 69, 75, 78, 96], further research is needed to develop deeper knowledge about the contingencies under which IT investments enhances firm performance.

Investing in IT is not a necessary and sufficient condition for improving firm performance, since IT investments might be wasted [38, 81, 116, 119]. Adopting a process view, Soh and Markus [116] proposed that IT investments should be converted into IT assets such as IT infrastructure and applications. Furthermore, the IT assets would have to be put to appropriate use for them to be of value to the firm. Appropriate use is expected to create intermediary effects, such as IT being embedded in products and services, streamlined business processes, improved decisions, and dynamic organizational structures, which in turn can be expected to affect firm performance.

Whereas conceptual models have emphasized the importance of IS capabilities in converting investments into IT assets, and that of targeted IT use, for firms to benefit from IT investments [81, 104, 110], limited research has been undertaken to elaborate both of these concepts. In this paper, we seek to address this gap by theorizing about targeted IT use, IS resources, and IS capabilities. Adopting an approach similar to the process perspective proposed by Soh and Markus [116], we examine how IS resources, IS capabilities, and targeted IT use interrelate to affect firm performance. We draw from the resource-based theory to develop the theoretical explanations underlying these causal links.

Theoretical Background

THE RESOURCE-BASED THEORY PRESCRIBES that firm resources are the main driver of firm performance [13, 41, 52, 54, 55, 128]. The resources needed to conceive, choose, and implement strategies are likely to be heterogeneously distributed across firms, which in turn are posited to account for the differences in firm performance [13, 52]. This theory posits that firm resources are rent-yielding when they are valuable, rare, imperfectly imitable, and nonsubstitutable [13]. Moreover, resources tend to survive competitive imitation because of isolating mechanisms such as causal ambiguity, time-compression diseconomies, embeddedness, and path dependencies [13].

Resources are stocks of available factors of production owned or controlled by a firm [4]. Capabilities, in contrast, refer to a firm's capacity to deploy resources using organizational processes [4]. Capabilities can be viewed as the capacity of a team of resources to perform some task or activity [52], and are often developed in functional and subfunctional areas by combining physical, human, and technological resources [4].

From a resource-based perspective, IS resources that are inimitable and valuable can be rent-yielding. Technology assets such as networks and databases are unlikely to be rent-yielding, since they could be easily procured in factor markets [76]. However, combining hardware and software assets to create a flexible and sophisticated IT infrastructure can be inimitable, because creating such an infrastructure requires carefully melding technology components to fit firm needs and priorities [43, 106]. In addition to a sophisticated IT infrastructure, skilled human resources, relationships between the IS department and user departments, and IS managerial knowledge are valuable resources that are posited to be rent-yielding [76, 106].

A related research stream has focused on the functional capabilities of the IS department as a source of competitive advantage. Feeny and Willcocks [45] identified nine critical IS capabilities—leadership, business systems thinking, relationship building, architecture planning, making technology work, informed buying, contract facilitation, contract monitoring, and vendor development—and used anecdotal evidence to argue that these capabilities can have a direct effect on firm performance. Moreover, the competencies of the IS department in acquiring, deploying, and leveraging IT in pursuit of business strategies are likely to have a positive effect on firm performance [17, 104]. Ravichandran and Lertwongsatien [99] identified two dimensions of IS competence—transformational competence, which represents the ability to transform the organization using IT; and operational competence, which represents the ability to provide reliable and consistent IT support to the business. They argued that these IS competencies are likely to have a direct effect on firm performance.

Whereas these studies posit a direct relationship between IS resources/capabilities and firm performance, others have questioned the direct-effect argument and emphasized that IS resources/capabilities are likely to affect firm performance only when they are deployed to create unique complementarities with other firm resources [30, 93]. In the resource-based view (RBV) literature, resource complementarities have been conceptualized in two broad ways. Firm resources are considered complementary when the presence of one resource enhances the value or effect of another resource. This interaction perspective of complementarity is typically operationalized using multiplicative terms in statistical analyses. For example, Powell and Dent-Micallef [93] used interaction terms to test the effects of complementarities between human resource practices and IT use on retail store performance.

Another perspective conceptualizes resource complementarity based on how resources are channeled and utilized. It is not the copresence of resources or capabilities that results in complementarities. Rather, firms have choices about how resources/capabilities are deployed. Complementarities arise when resources/capabilities are used in a mutually reinforcing manner. Clemons and Row [30], for example, argued that IT can provide sustainable competitive advantage when it is used to leverage structural differences between firms, such as the degree of vertical integration and diversification. The IS alignment literature [60, 89, 112] also reflects this perspective of resource complementarities, even though this literature stream does not make any explicit reference to the resource-based theory. The central premise of this research stream is that mutual coherence between IS priorities and initiatives and firm strategies is necessary

to effectively prioritize IT activities and channel IS resources toward areas of strategic importance to the firm. Empirical studies have found that firms with a higher IS alignment are more likely to utilize IT for strategic purposes [108], arrange IT resources and capabilities to support market positions [60], and focus IT efforts on areas most critical to the firm [35].

In summary, although previous IS research has examined the contributions of IS resources and capabilities to firm performance, the research is fragmented, and key gaps exist in the literature. First, although several IS resources/capabilities have been identified and their direct effects on firm performance posited, the relationships between IS resources and capabilities have not been systematically examined. Resources are the raw materials in the development of capabilities, and examination of the relationships between IS resources and IS capabilities can provide a better understanding of how resources could be deployed to develop capabilities. Two distinct mechanisms—resource picking and capability-building—underlie the resource-based arguments about how economic rents can be created by firms. The former mechanism asserts that firms create economic rents by being more effective than their rivals in selecting resources [72]. This Ricardian perspective stresses that heterogeneity in performance is due to ownership of resources that have differential productivity [12, 13, 80, 121]. In contrast, the capability-building mechanism asserts that firms create economic rents by being more effective than their rivals at deploying resources. While past IS studies have examined these two mechanisms independently, Makadok [72] argued that resource picking and resource deployment are not necessarily independent and may complement each other. One dependency stressed in the literature is that resources are the raw materials to build capabilities [128] and that resource availability determines a firm's ability to develop capabilities.

Second, while the complementarities between IS assets and other firm resources have been emphasized, limited work has been undertaken to examine the effects of complementarities on firm performance. In this study, we adopt the channeling view of complementarity discussed earlier, and posit that one way to achieve mutual coherence between IT activities and firm priorities is to use IT to support and enhance a firm's core competencies. We argue that it is primarily through such targeting that firms create inimitable competencies likely to be rent-yielding.

Research Model and Hypotheses

WE PROPOSE A RESEARCH MODEL that interrelates four constructs: firm performance, IT support for core competencies, IS capabilities, and IS resources (Figure 1). Drawing from the notion of resource complementarities, we posit that a firm's ability to create competitive advantage using IT is a function of its ability to use IT to develop and enhance its core competencies. We also posit that this competence is dependent on having strong functional capabilities within the IS department, which in turn is influenced by the nature of human, technological, and relationship resources possessed by the IS department. In this section, we define the constructs in the model and develop the relationships between them.

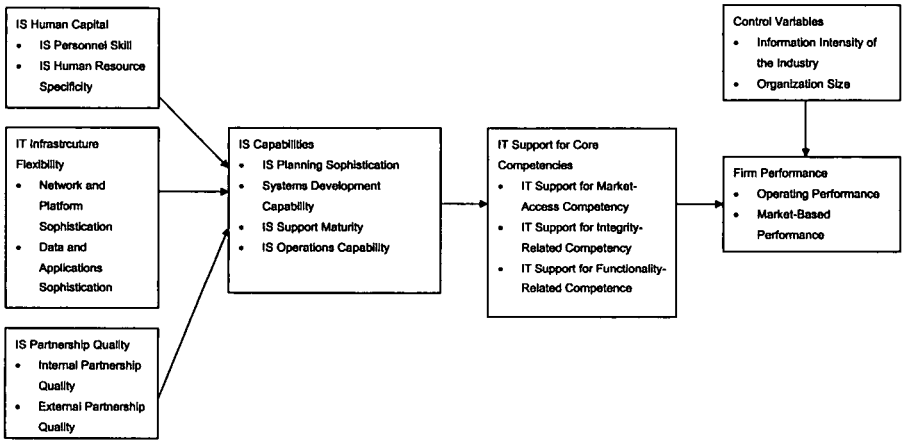

Figure 1. Research Model

IT Support for Core Competencies

Core competencies are the basis for firms to compete in the market. Hamel [56] categorized core competencies into market-access, integrity-related, and functionality-related competencies. Market-access competencies include all those that allow a firm to be in close proximity to its customers, identify their needs effectively, and respond in a timely manner to shifts in customer needs and tastes. Capabilities to segment and target markets precisely and tailor offerings to match the demands of customers are examples of market-access competency. Integrity-related competencies include those that allow a firm to offer reliable products and services at competitive prices and deliver them with minimal inconvenience. Efficient manufacturing operations, streamlined supply chains, and integrated business processes are some indicators of integrity-related competencies. Finally, functionality-related competencies are those that enable a firm to offer unique products and services with distinctive customer benefits. This competency reflects strengths in product development and the innovation potential of an organization.

Firm competencies are developed over a period of time and reflect choices made by the organization about resource acquisition and deployment. All firms have limited IT resources and have to make choices about how these resources are deployed. Choices that result in embedding IT within areas of critical importance to the organization are likely to yield resource bundles and capabilities that are dissimilar to those of the competitors, which in turn, can be rent-yielding. Embedding IT within areas of core competence makes the IS assets inimitable by making it difficult for competitors to create similar bundles of complementary IS and organizational assets as well as understand the contributions of IS assets to firm performance. Thus, other things being equal, firms that target IS initiatives toward their core competencies are likely to realize greater value from their IS assets than those that are less focused in their IT deployment.

The well-publicized case of how Dell uses IT to improve its business operations illustrates the importance of IT support for core competencies. Dell competes on being able to deliver products and services reliably and at low costs to its customers (integrity-related competency). In order to develop and enhance its integrity-related competencies, Dell has invested significant resources in developing IT systems to support its direct selling business model as well as integrating its supply chain [5, 71]. Similarly, Wal-Mart has positioned itself as a retailer that competes on low cost and customer service. Over the years, this firm has consistently targeted its IS capabilities to improve its inventory management, procurement, and logistics, and in tailoring its product assortments to the unique needs of individual stores. In fact, many have argued that Wal-Mart's ability to sustain its competitive advantage over time can be attributed to the complementarities between its business practices and IT use [17, 93].

The recent decoding of the human genome illustrates how Celera improved its functionality-related competency by targeting IT toward its research and development efforts. By using sophisticated computing capabilities, the firm came up with a decoding process radically newer than the one used by the researchers in the Human Genome Project, which in turn is credited with accelerating the process of sequencing the human genome [101]. Boeing significantly slashed the cost and design lead time for its 777 model by using sophisticated computer-aided design platforms that allowed the firm to finalize the design without creating physical prototypes [7]. Merck credits its knowledge management systems for the drastic reduction in the time it takes to get new products approved by the Food and Drug Administration [18, 106], and for improving the drug discovery process by sharing experimental procedures and findings quickly between its various research labs. All three examples illustrate how IT was used to enhance core competencies in research and development and allow the firms to maintain their competitive positions in industries where product development is considered a prime driver of firm performance. Thus, we propose the following hypothesis.

H1: There is a positive relationship between IT support for core competencies and firm performance.

IS Capabilities

Capabilities are socially complex routines that determine the efficiency with which firms transform inputs into outputs [32]. IS capabilities are the routines within the IS department that enable it to deliver IT services to the organization. While a variety of IS capabilities have been identified in the literature, we limit our focus to the capabilities in the core functional areas such as planning, systems development, IS support, and IS operations [46, 120]. We do this for two reasons. First, the emphasis on functional capabilities is consistent with prior research in strategy, where Grant observed, "Capabilities can be identified and appraised using a standard functional classification of the firm's activities" [52, p. 120]. Second, despite their strategic value, IS functional capabilities have not been the focus of prior IT–firm performance research.

Building on the notion that capabilities are determined by organizational routines, we adopt a process focus and define IS capabilities in terms of the quality and sophistication of IS processes. Any reference to performance, either at the firm level or at the functional level, has been purposefully avoided in this definition of capability in order to avoid the well-known tautology of defining capability as an improvement in performance. Although functional capabilities are likely to be correlated with performance, this association is neither necessary for the definition of capabilities nor required for theorizing about how capabilities are combined to create organizational competencies. We note that a similar approach has been adopted by Gold et al. [51], where they defined knowledge management capabilities in terms of knowledge management process attributes and knowledge management infrastructure characteristics.

Drawing from Grant's [52] architecture of organizational capabilities, we posit that an organization's ability to enhance its core competencies using IT is likely to be dependent on IS functional capabilities. Using IT to enhance core competencies requires that firms make choices about how technology resources are deployed, taking into account the strategic thrusts of the organization. IS planning is an important process that enables organizations to identify business priorities and ensure that IS goals and initiatives are aligned with business priorities. It is likely that with sophisticated IS planning, a greater convergence between IS and business managers on IT priorities can be achieved [19]. Such convergence enables the synergistic integration of IT and business knowledge [19], which in turn improves the identification and development of strategic IT applications [102].

In addition to making choices about targeting IT resources, firms have to successfully develop and implement technology solutions and ensure their effective utilization in order to improve their core competencies. Ability to develop high-quality applications in a timely and cost-effective manner is a critical capability that is likely to affect technology deployment [103]. In addition, a mature IS support process can ensure that systems are effectively utilized by end users. Since firms cannot reap benefits from IT unless it is effectively used, IS support could determine how successful a firm is in using IT to improve its core competencies.

For many organizations, continuity of business operations is dependent on efficient and reliable IS operations. With the increased penetration of IT into business operations, system failures can lead to significant business disruptions and losses. For example, losses to the tune of $6.5 million per hour in the case of a brokerage operation, $2.6 million per hour for a credit card sales authorization system, and $14,000 per hour in automated teller machine (ATM) fees are expected if respective systems are shut down [97]. Moreover, ineffective IS operations have the potential to damage carefully built reputations for quality and reliability in product and service offerings, as was seen when system outages affected Charles Schwab's online trading systems [34].

In summary, organizations that do not have strong IS functional capabilities might find it difficult to initiate and sustain innovative projects targeted at enhancing the firm's core competencies, or in providing reliable IS services that might be critical for smooth business operations. Thus,

H2: There is a positive relationship between IS functional capabilities and IT support for core competencies.

IS Resources

As discussed earlier, resources are the raw material in the development of capabilities. This relationship is implicit in the definition of capabilities as an organization's ability to deploy resources [4]. The causal relationship between resources and capabilities is more formally stated in the dynamic capabilities perspective, where asset positions are posited to affect capability development [122]. Teece et al. argued that while "the essence of competencies and capabilities are embedded in organizational processes of one kind or another the content of these processes and the opportunities they afford for developing competitive advantage are shaped by the assets the firm possesses and by the evolutionary path it has adopted. Hence organizational processes are shaped by a firm's asset positions" [122, p. 518]. Consistent with these arguments, we posit a direct positive relationship between IS resources and IS capabilities.

Three broad categories of resources have been identified in the IS literature—human, technological, and relationship resources [17, 106]. Consistent with prior IS research, which has emphasized the importance of intangible resources, we focus on the intangible dimensions of these three resources. Specifically, our research model includes IS human capital, IT infrastructure flexibility, and IS relationship quality, and posits that each of these resource will have a direct positive relationship with IS functional capabilities.

IS human capital is an important input in the development of IS capabilities. We focus on two key indicators of human capital—skills and specificity. Skills pertain to the extent to which IS personnel have the requisite technical and business skills, and specificity pertains to the extent to which IS personnel have firm-specific knowledge such as an understanding of the culture and routines of the organization.

IS activities are generally considered knowledge-intensive and requiring specific technical skills [66, 123]. Moreover, appropriate business and interpersonal skills are needed to effectively deliver IS services to end users [66, 123]. Thus, it is reasonable to argue that organizations that have highly skilled IS personnel are better positioned to develop strong functional capabilities than those that do not. In addition to generic technical and business skills, firm-specific knowledge is critical in developing functional capabilities. As discussed earlier, capabilities are essentially reflected in organizational routines [85]. Deep understanding of the organization's culture and norms is necessary to develop routines that fit the organizational context in which IS activities have to be carried out. Thus, it can be expected that firm-specific knowledge would be critical in the development of appropriate functional capabilities.

H3: There is a positive relationship between IS human capital and IS functional capabilities.

IT infrastructure is a set of shared technology resources that provide a foundation enabling present and future business applications [43, 44, 87]. We focus on one intan-

gible, but important, aspect of the IT infrastructure that has been stressed in the literature—flexibility—and posit that IT infrastructure flexibility will have a positive relationship with IS functional capability. A flexible IT infrastructure enhances the firm's ability to deliver technical solutions quickly and more effectively. Platform readiness for new software, easy access to relevant data, and the presence of necessary networking systems enable a firm to provide faster, more cost-effective IS solutions to end users [98, 100]. Reusable data and application assets can speed up application delivery by reducing the need for new development and facilitating integration with legacy systems. Moreover, a flexible IT infrastructure allows easy integration of new technologies with existing platforms, thereby allowing the IS unit to deliver cutting-edge technology capabilities quickly and cost effectively.

H4: There is a positive relationship between IT infrastructure flexibility and IS functional capabilities.

Rockart and Short [104] argued that the ability of the IS unit to deliver its services is dependent on an effective partnership between IS and line managers. IS and line managers must develop an appreciation and understanding of each other's environment [58], which has been found necessary for IS to deliver value to the firm [100]. In addition to internal partnerships, the relationship an IS unit has with vendors and service providers can be an important determinant of its functional capabilities. The rapid rate at which new technologies emerge makes it impossible for IS units to invest resources in developing the knowledge to assimilate and deploy these technologies effectively. Thus, technical knowledge and other resources needed to effectively deliver IS solutions might be dispersed within and outside the firm. IS firms intending to develop strong functional capabilities will have to develop effective partnerships with vendors to tap into these resources, and IS units with good vendor relationships can be expected to tap into external resources better than those that do not have effective external partnerships. Thus,

H5: There is a positive relationship between IS partnership quality and IS functional capabilities.

Control Variables

Control variables are used to account for factors other than the theoretical constructs of interest, which could explain variance in the dependent variable. In this study, organization size, organization age, and the information intensity of the industry are used as control variables. Organization size reflects past success and may influence current performance [1, 2]. Organization age is perceived as an indication of external legitimacy of the existence of interfirm relationships, of the staying power, and of the pervasiveness of internal routines [47, 64], all of which can affect current performance. On the other hand, young firms can be subject to the liability of newness, which can confound their performance [2, 57, 117]. The potential payoff from using IT could vary across industries, which is reflected in the extent of IT use in the industry. Since we are

using a cross-industry sample, controlling for the effect of information intensity of the industry is necessary.

Empirical Study

DATA FOR TESTING THE RESEARCH MODEL was collected though a mail survey of Fortune 1000 firms. Due to fundamental differences in profit motive and subsequent focus of IS objectives between private and public organizations, educational institutions and governmental agencies were not included in the theoretical population for this study. Names, titles, addresses, and phone numbers of senior IS executives in the Fortune 1000 firms were obtained from the *Directory of Top Computer Executives* [42]. Some Fortune 1000 firms were not listed in the directory. These firms were eliminated from the database, resulting in an effective mailing list of 710 firms. Three mailings were undertaken, each spaced three weeks apart. A total of 129 responses were received, resulting in a response rate of 18.2 percent (Table 1). Of these, 10 responses were discarded as unusable because of missing data and incomplete information.

The profile of the respondents was compared with those in the mailing list on variables such as organization size and IS department size. The chi-square analysis revealed no systematic response bias. Chi-square tests comparing early and late respondents on organization size, industry, and IS department size also revealed no significant response bias. The organizations that responded represented diverse industry groups. Sixty-five percent of the responding firms were in manufacturing; 17.8 percent were in the financial services, banking, and insurance industries; 6.2 percent were in retail; and 7.8 percent were in transportation and utilities. The mean size of the responding organization was 17,221 employees. The average size of the IS department in these organizations was 665 employees.

The survey was targeted at the senior mangers in the IS department, as they are likely to be the most informed about the strategic issues pertaining IT use in the organization. A significant proportion (55.7 percent) of the respondents were either chief information officers or vice presidents of the IS department. The job titles of the other respondents (senior vice president, vice president of technology, assistant vice president, director of information technology) also indicate that they were senior IS executives. Of the respondents, 89.9 percent indicated that they were within two levels from the highest position in their organization's hierarchy.

Measures

Table 2 provides our conceptual definition of the constructs and a summary of the sources from which the items for the scales were derived. Firm performance was measured by the respondent's assessment of the firm's performance during the three-year period from 1997 to 1999 on two dimensions: (1) operating performance and (2) market-based performance. *Operating performance* was measured using a four-item scale that assessed the extent to which the profitability, productivity, and finan-

Table 1. Profile of Respondents by Industry

Number	Industry	Effective number of questionnaires mailed	Number of responses received	Response rate (percent)
1	Banks	31	5	16.1
2	Financial services	26	5	19.2
3	Insurance	55	13	23.6
4	Manufacturing and services	462	83	18.0
5	Retails	57	8	14.0
6	Transportation	21	5	23.8
7	Utilities	35	5	14.3
8	Others	23	5	21.7
Total		710	129	18.2

Table 2. Contributing Literature for Construct Definition and Operationalization

Constructs	Indicators	References
IS human resource capital	IS personnel skill	[27, 67, 99]
	IS human resource specificity	[31, 81]
IT infrastructure flexibility	Network and platform sophistication	[8, 43, 99]
	Data and core application sophistication	
Partnership quality	Internal partnership quality	[59, 84, 100]
	External partnership quality	[45, 53, 68, 99]
IS capabilities	IS planning sophistication	[95, 107, 112, 113]
	Systems development capability	[86, 100]
	IS support maturity	[15, 70, 79]
	IS operations capability	[19, 104]
IT support for core competencies	IT support for market-access competencies	[8, 74, 114, 125]
	IT support for integrity-related competencies	
	IT support for functionality-related competencies	
Firm performance	Operating performance	[26, 93, 108]
	Market-based performance	
Information intensity	Information intensity	[24, 92]

cial performance exceeded those of their competitors in the past three years (i.e., 1997–99). *Market-based performance* was measured using a three-item scale that assessed the success of the firm in entering new markets and in bringing new products and services to the market during the past three years.

Whereas perceived measures of firm performance were used in this study, we validated these measures using standard financial ratios such as return on sales and sales growth. The operating performance was correlated with the average change in return on sales in a three-year period (1997–99). Similarly, market-based performance was correlated with average sales growth during the same three-year period. The analyses indicate strong positive correlations between operating performance and changes in return on sales (0.401; $p \leq 0.01$) and between market-based performance and sales growth (0.282; $p \leq 0.05$). These results suggest that our perceived measures are valid indicators of firm performance.

We define IT support for core competencies as the extent to which IT is used to support and enhance the development of a firm's market access, integrity-related and functionality-related competencies. We used a five-item scale to measure *IT support for market-access competency,* which assessed the extent of use of IT in improving responsiveness to customer inquiries, analyzing customer information, identifying groups of customers whose needs are not being met, and determining customer requirements. A five-item scale to measure *IT support for integrity-related competency* measured the extent to which IT is used to reengineer business processes, enhance process flexibility, integrate supply chains, and improve the efficiency of logistics. Seven items were used to measure *IT support for functionality-related competency,* which assessed the extent to which IT is used in developing new products and services, improving the speed of key business activities, identifying new markets, redefining the scope of business, and entering new markets.

We defined IS capabilities in terms of four constructs: IS planning sophistication, systems development capability, IS support maturity, and IS operations capability. *IS planning sophistication* pertains to the characteristics of the IS planning process, such as its formality, comprehensiveness, and the participation of key stakeholders in the planning process, and was measured using a six-item scale developed from existing instruments [95, 107, 113]. *Systems development capability* pertains to the quality of the systems delivery process and the routines that lead to a reliable and controlled systems delivery process. This construct was measured using a six-item scale that assessed the maturity, flexibility, and degree of control of the systems development process. *IS support maturity* is defined in terms of the attributes of the support process, such as its responsiveness and service orientation, and was measured using a six-item scale. *IS operations capability* is defined in terms of the sophistication of the operations processes, such as emergency planning, backup recovery, security control, performance tuning, maintenance, and systems control. This construct was measured using a six-item scale developed based on the descriptive information provided in past studies [19, 104].

As mentioned earlier, three resources—IS human capital, IT infrastructure flexibility, and IS partnership quality—were included in the research model. IS human capital is defined in terms of two constructs: *IS personnel skill* and *IS human resource specificity.* IS personnel skill was measured using a four-item scale that assessed the extent to which IS personnel possessed critical business, technology, managerial, and interpersonal skills [27, 66, 106]. IS human resource specificity was defined as the

extent to which IS personnel had firm-specific knowledge. This construct was measured using a six-item scale that assessed the extent to which IS personnel had a good understanding of the organization's products and services, its business processes, its unique culture and routines, and the extent of their acquaintanceship with people in the organization [73, 84].

IT infrastructure flexibility was measured by assessing (1) network and platform sophistication and (2) data and core application sophistication. By adapting items from existing instruments [21, 43], a six-item scale and a four-item scale were developed to measure *network and platform sophistication* and *data and core applications sophistication,* respectively. The items for the former measured the connectivity, speed, capacity, and the extent of standardization of the networks and computer platforms in the organization. The items for the latter measured the shareability and reusability of the corporate data and application modules in core business applications.

We conceptualized IS partnership quality in terms of two dimensions. *Internal partnership quality* pertains to the quality of the relationships between the IS department and other business units, and *external partnership quality* pertains to the relationships the IS department has with vendors and IT service providers. Internal partnership quality was measured using six items that assessed the extent to which the relationship between IS and line management reflects benefits and risk sharing, trust, communication, and coordination [58]. External partnership quality was measured using a six-item scale that assessed the extent to which relationships with key IT vendors and service providers reflect communication, trust, and cooperation, and the extent to which conflicts between vendors and the IS department are resolved through mutual dialog and not through litigation.

In addition to the theoretical variables, three control variables (information intensity of the industry, organization size, and organization age) were included in the research model. Information intensity was measured using a three-item scale that assessed the extent to which suppliers, competitors, and business partners in the industry used IS. The natural logarithm of the number of full-time employees in the firm was used as a measure of organization size, and organization age was measured by the number of years since the firm was incorporated.

Scale Validation

The scales were validated using the standard procedures recommended in the literature [25, 28, 118]. Items of scales in a related domain were pooled and factor analyzed to assess their convergent and discriminant validity. A scale is assessed to have adequate convergent validity when all its items load highly on one factor. If all the scale items also have low cross-loadings on other factors, then the scale is deemed to exhibit adequate discriminant validity. An iterative process of dropping items with high loadings on multiple factors or with loadings on factors other than the one representing the scale they pertain to, and reassessing the factor loadings, was followed in refining the scales. Overall, five items were dropped to yield a set of scales that had adequate convergent and discriminant validity. The reliability of these refined scales was then assessed. The

Cronbach's alpha values for all scales were greater than 0.65, indicating that the scales have adequate reliability. The factor loadings, Cronbach's alpha values of all the refined scales, and the details of the scale validation procedures are presented in the Appendix.

Statistical Analyses and Results

THE RESEARCH MODEL WAS TESTED using partial least squares (PLS) techniques. The model includes six latent constructs—firm performance, IT support for core competencies, IS capabilities, IS human capital, IT infrastructure sophistication, and IS partnership quality. All latent constructs were defined as formative constructs. The respective factors as conceptualized in our theoretical model were used as formative indicators of the latent constructs in the model. IS personnel skills and IS human resource specificity were used as formative indicators of IS human capital. IS planning sophistication, systems development capability, IS support maturity, and IS operations capability were used as formative indicators of IS capability. IT support for market access competency, IT support for integrity-related competency, and IT support for functionality-related competency were used as formative indicators of IT support for core competency. Operating performance and market-based performance were used as formative indicators of firm performance.

A PLS model is usually analyzed and interpreted in two stages. First, the measurement model is assessed and refined, followed by the evaluation of the structural model. The results of the measurement model evaluation (Table 3) indicate that the weights for all except two indicators (IS support maturity and IT support for integrity-related competency) were statistically significant. These two indicators were dropped and the model was reassessed. No further weaknesses were detected (Table 3).

Figure 2 shows the path coefficients and the R^2 values of the structural model. The results indicate that 52 percent of the variance in IS capabilities, 31.6 percent of the variance in IT support for core competencies, and 29.5 percent of the variance in firm performance were explained by the model. In addition to the full model, two nested models were evaluated to assess the additional explanatory power of the theoretical constructs after the variance explained by the control variables had been accounted for. One model included only the theoretical variables of interest in this study and excluded the control variables, and the other model included only the control variables. The results, summarized in Table 4, indicate that the control variables accounted for a small proportion of the variance in firm performance (4.5 percent), and the addition of the theoretical variables resulted in an increase of 25 percent in the R^2 value of firm performance (29.5 – 4.5 = 25.0 percent). In contrast, the addition of the control variables to the theoretical variables accounted for a very small increase (29.5 – 27.8 = 1.7 percent) in the R^2 value of firm performance.

The results indicate that all path coefficients were statistically significant. IS human capital (0.38, $p \leq 0.001$), IT infrastructure flexibility (0.23; $p \leq 0.01$), and IS partnership quality (0.25; $p \leq 0.01$) positively affect IS capabilities. IS capabilities (0.56; $p \leq 0.001$) significantly affects IT support for core competencies, which in turn, has

Table 3. Weights and Loadings of the Original and Revised Models

		Original model		Revised model	
Constructs	Indicators	Weights	Loadings	Weights	Loadings
IS human capital	IS personnel skill	0.43**	0.82**	0.45**	0.83**
	IS human resource specificity	0.69**	0.94**	0.68**	0.93**
IT infrastructure flexibility	Network and platform sophistication	0.63**	0.89**	0.63**	0.89**
	Data and core application sophistication	0.52**	0.84**	0.52**	0.84**
IS partnership quality	Internal partnership quality	0.82**	0.95**	0.83**	0.95**
	External partnership quality	0.33**	0.65**	0.33**	0.65**
IS capabilities	IS planning sophistication	0.24*	0.69**	0.25**	0.69**
	Systems development capability	0.52**	0.88**	0.56**	0.89**
	IS support maturity	0.11	0.74**	—	—
	IS operations capability	0.37**	0.79**	0.41**	0.79**
IT support for core competencies	IT support for market-access competencies	0.48**	0.91**	0.47**	0.91**
	IT support for integrity-related competencies	0.04	0.69**	—	—
	IT support for functionality-related competencies	0.58**	0.94**	0.61**	0.94**
Firm performance	Operating performance	0.51**	0.76**	0.51**	0.70**
	Market-based performance	0.70**	0.88**	0.69**	0.91**
Organization age	Years since inception	1.00	1.00	1.00	1.00
Organization size	Natural log of number of full time equivalent	1.00	1.00	1.00	1.00
Information intensity	Information Intensity	1.00	1.00	1.00	1.00

* $p \leq 0.05$, ** $p \leq 0.01$.

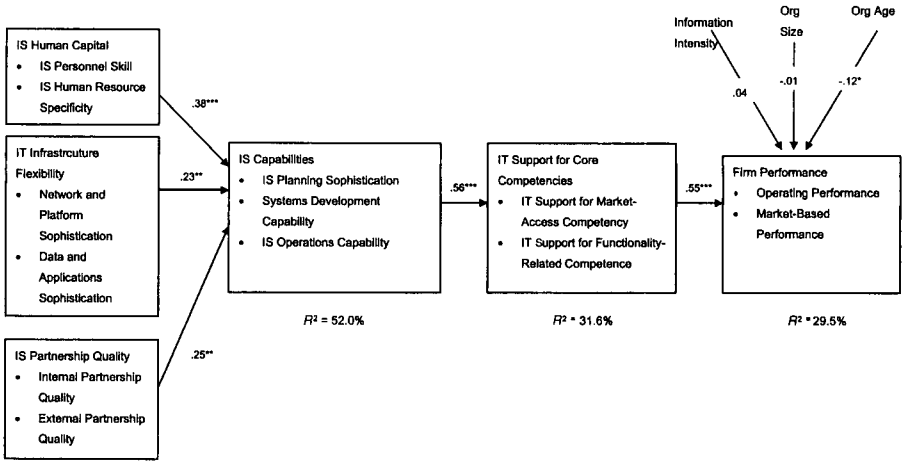

Figure 2. Path Coefficients and R^2 Values of the Structural Model.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4. Comparison of the Structural Models

Results	Full model	Control-variables-only model	Theoretical-variables-only model
Number of paths in the model	8	3	5
Number of significant paths in the model	6	1	5
Variance explained in firm performance (percent)	29.5	4.5	27.8
Additional variance explained by the theoretical variables		29.5 – 4.5 = 25 percent	
Additional variance explained by the control variables		29.5 – 27.8 = 1.7 percent	

a positive relationship with firm performance (0.55; $p \leq 0.001$). Overall, these results provide strong support for all the hypothesized relationships in the model.

Analysis with Objective Performance Data

To further validate our findings, we tested our model with objective firm performance data collected from secondary sources. Past IS research has used a myriad of financial ratios and stock market–based variables to operationalize firm performance. Rate-of-return ratios such as return on assets (ROA) and return on sales (ROS) have been widely used as indicators of operating performance in the IS literature [3, 22, 58, 65, 73]. Consistent with past studies, we use ROS and ROA as indicators of operating performance. ROS represents the net contribution of the revenues to profits, which is

an indicator of the operating costs associated with revenue generation. Effective use of IT can be expected to improve efficiencies by streamlining business processes and reducing wastes, thereby reducing operating costs. ROA, on the other hand, assesses the ability of the firm to put its capital assets to productive use. Inefficient plant operations and bloated supply chains, for example, necessitate higher capital outlays to sustain revenue streams as compared to efficient plants and streamlined supply chains. These capabilities are increasingly dependent on effective use of IT, and organizations with better IS capabilities can be expected to utilize their capital assets more effectively.

Consistent with past studies [22, 60], we used sales growth as an indicator of market-based performance. Sales growth assesses how well the firm is doing in the marketplace and is dependent on the introduction of new products/services and better customer targeting, and satisfying customer needs. Effective IT use could speed product development, enable better understanding of customer needs, and be responsive to customer service requests, thereby resulting in better performance in the marketplace.

We ran three models with each of the three performance indicators (ROS, ROA, and sales growth) as the dependent variable. Firm performance was operationalized as a composite of the annual performance during the focal period of this study (1997–99). In the first model, for example, firm performance was modeled as a reflective construct, with ROS for 1997, 1998, and 1999 as indicators of the construct. Similarly, ROA in 1997, 1998, and 1999 were used as indicators of firm performance in the second model, and the average sales growth from 1997 to 1999 was used as an indicator of firm performance in the third model. All other specifications were identical to the model tested with perceptual firm performance measures.

The measurement model was supported for two of the three models, and all indicator loadings were significant. In the model with ROA as the dependent variable, one indicator (ROA for 1998) had a negative loading. We dropped this indicator and reassessed the model, and no further weaknesses were detected.

The results of the structural models are depicted in Figures 3, 4, and 5. It is seen from these figures that, in general, the results are consistent with those obtained with perceptual performance measures. The relationships between IS capabilities and IT support for core competencies, and those between IS resources and IS capabilities, are supported in all three models. The relationship between IT support for core competencies and operating performance is supported in both models (Figures 3 and 4), while that between IT support for core competencies and market-based performance is not supported (Figure 5).

The three models account for approximately 10 percent of the variance in firm performance (10.4 percent for ROS, 10.0 percent for ROA, and 10.3 percent for sales growth). Although lower than the variance in firm performance explained by our original model (see Figure 2), these results are similar to the results reported in past IS studies that have used financial ratios as indicators of firm performance. Considering the attendant problems of using secondary data sources such as Compustat and that a host of factors unaccounted for by our model can explain variance in firm financial performance, the results reported here are significant and reinforce our findings that IS re-

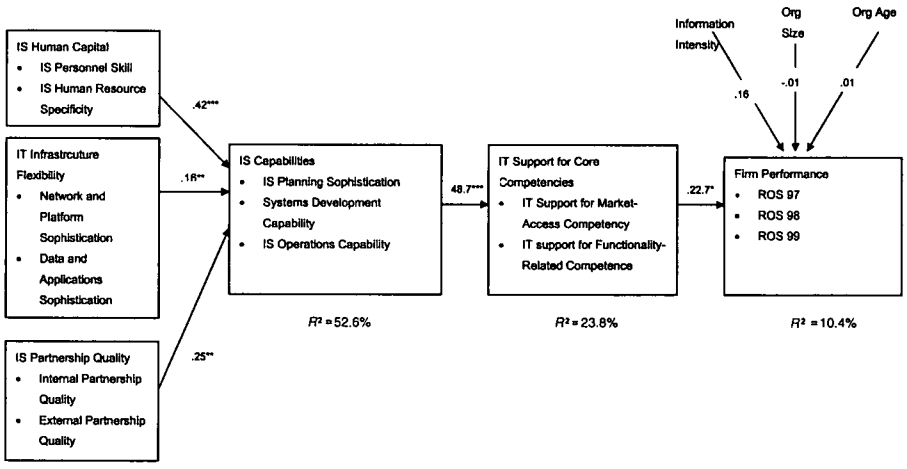

Figure 3. Path Coefficients and R^2 Values of the Structural Model with Objective Firm Performance Variables (ROS).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

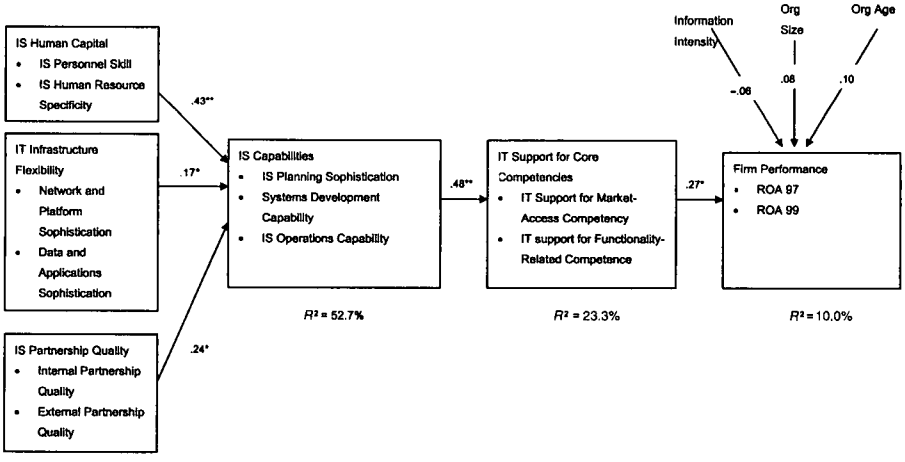

Figure 4. Path Coefficients and R^2 Values of the Structural Model with Objective Performance Variables (ROA).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

sources, IS capabilities, and IT support for core competencies interrelate as posited to affect firm performance.

Discussion

IN THIS STUDY, WE DREW FROM the resource-based theory to examine how IS resources and capabilities affect firm performance. We posited and found that variation in firm performance is explained by the extent to which IT is used to support and

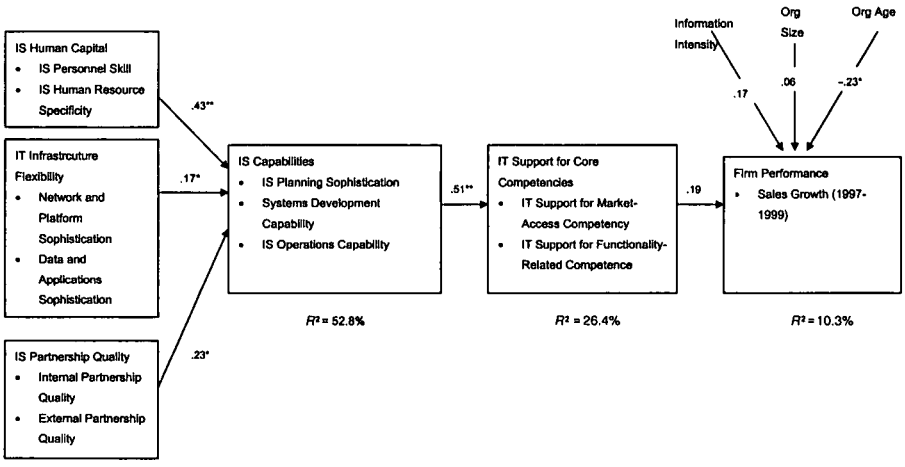

Figure 5. Path Coefficients and R^2 Values of the Structural Model with Objective Performance Variables (Sales Growth).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

enhance a firm's core competencies. We also posited and found that an organization's ability to use IT to support its core competencies is dependent on IS functional capabilities, which in turn is dependent on the nature of human, technology, and relationship resources of the IS department.

The results provide empirical support for the notion that IS has the potential to improve firm performance when its capabilities are channeled to develop distinctive firm competencies. Using IT to improve activities that are integral to a firm's core competencies results in resource bundles that are unlikely to be easily imitated by competitors because of isolating mechanisms such as causal ambiguity and resource connectedness. For example, Wal-Mart's ability to perform better than most of its competitors in the retail industry is partly due to the complementarities between its business practices and its use of IT. Despite attempts by other retailers to copy Wal-Mart's IT systems, they fail to replicate its success in reaping returns from IT investment because of difficulties in understanding how IT and business capabilities interact to affect Wal-Mart's performance [17, 127].

Our findings about the causal relationship between IS capabilities and IT support for core competencies and those between IS resources and IS functional capabilities highlight the path and time dependencies involved in using IT in pursuit of firm strategies. Organizations that have successfully used IT to gain competitive advantage have been able to do so because of a history of choices about the acquisition and deployment of IS resources. IS capabilities are developed over time through the development, evaluation, and refinement of routines within the IS department. Substantial learning and embedding of learned theories of action in organizational processes occur in the development of these routines [94]. For example, it takes an average of four to six years to develop mature systems delivery processes when organizations systematically implement software process improvement models such as the capability maturity model (CMM).

Moreover, resources such as a flexible IT infrastructure, skilled personnel, and effective internal and external partnerships take time to develop. Our results suggest that organizations that have failed to systematically develop IS functional capabilities or invest in the acquisition of IS resources could find themselves lacking the necessary capacity to leverage IT in the creation and sustenance of competitive positions.

Whereas the IS literature has emphasized the rent-yielding potential of IT management capabilities [17, 45, 104], very limited attention has been paid to the strategic value of IS functional capabilities. One reason for this could be an implicit belief that IS functional capabilities are nondifferentiating commodity services that could be outsourced with little consequence [62]. In fact, some scholars have proposed a utility model of information services that advocates that value resides only in the information and not in the processes and technologies to deliver information, and, consequently, core IS processes such as systems development should be managed with a cost reduction focus [36, 37]. Our results question these assumptions and suggest that strong IS functional capabilities can be rent-yielding by enabling an organization to use IT to develop distinctive competencies. Recent anecdotal evidence that firms with strong IS functions have been successful in leveraging the Internet to enhance their competitive position bolsters the claim made here that IS functional capabilities have significant strategic value. For example, Charles Schwab attributes its success in emerging as a leader in online stock trading partly to its in-house IS capabilities that have been nurtured for more than 20 years [20]. Similarly, Amazon considers its Web development and systems operations capabilities central to business value creation and has aggressively sought to acquire technological and personnel resources to build these capabilities [6]. These anecdotal evidences and our empirical results suggest that organizations might be better served when they understand the strategic value of IS functional capabilities and choose to systematically invest resources in building these capabilities.

The empirical results reported here explain some of the inconsistencies in the IT value research where studies have related either IT investment dollars (e.g., [23]) or IT intensiveness measured in terms of number of specific hardware and software systems installed [93] to firm performance and found inconsistent results. We found that intangible IS resources, such as human, technological, and relationship resources, and IS functional capabilities, are important determinants of firm performance. More importantly, we found that these IS resources and capabilities may not affect firm performance directly. Rather, it is their targeted deployment that is likely to be rent-yielding. IT investments and IT intensity may not be good indicators of either the IS capabilities or how these capabilities are actually used by the organization. As Bharadwaj points out, "Given the complexities involved in creating firm wide IS capabilities, in any sample of IT spenders only a subset is likely to have the right capabilities to achieve competitive advantage. Other firms are more likely to have incurred the IT expenses without comparative parity in IT capability. Mean returns for the total sample may therefore be non-significant or even slightly negative as reported in Hitt and Brynjolfsson [61]" [17, p. 186]. Thus, it is likely that firms that are getting better returns from their IT investment are doing more than acquiring

technological resources. Our findings suggest that they are likely to be using their investments in the development of functional capabilities and utilizing these capabilities synergistically with firm resources. Moreover, these firms are likely to be investing in the development of intangible IS resources in addition to acquiring the latest technologies and systems. These findings are consistent with past studies that have reported that spending on IS personnel and skill development were more positively correlated with firm performance than computer capital [112].

Limitations of the Study

As with any research, this study does have some limitations. The research model was tested using cross-sectional data. Since the data represents a snapshot in time, the imputation of cause–effect relationships between the constructs in the model must be made with caution. Although we established the associations between the causing and the caused constructs statistically, we argued for the sequential relationships between the constructs based on theory. Thus, although the only firm way of testing causal relationships among constructs is through longitudinal studies, we reasoned our model through appropriate theoretical arguments.

Our empirical analyses revealed that IT support for integrity-related competency and IS support maturity did not fit the nomological network of relationships, as represented by our research model. Although we excluded these constructs from our model, further empirical evidence and theoretical support are required to determine if, indeed, these constructs do not fit the nomological network of relationships linking IS resources, IS capabilities, IT support for core competences, and firm performance. We recommend that future research test the model proposed here using different data sets before recommendations for model refinements are made.

We used a key informant method for data collection. This method, while having its advantages, also suffers from the limitations that the data reflects the opinions of one person. However, our data represents the perceptions of senior IS executives who, most likely, are responsible for directing how IS resources and capabilities are acquired, deployed, and used. Hence, their views are likely to be valid representations of IS activities in their organization. Nevertheless, we recommend that future studies consider research designs that allow data collection from multiple respondents within an organization. Increasingly, IS capabilities are dispersed throughout the firm. Thus, research that involves respondents from multiple functional areas might allow for a richer measurement of the constructs used in this study.

The constructs used in our model are latent variables that are not directly observable. Hence, it is necessary to measure manifestations of constructs using indicators. Since a large number of indicators could reflect a construct, we adopted a sampling approach where indicators well aligned with our conceptual definitions were included in the measurement scales for the constructs. Given the constraints of survey length, it is possible that we may not have sampled all items from a construct's domain. Recognizing this limitation, we recommend that future research refine both our conceptual definitions and the measurement scales for the constructs. Such incremental

refinement is in the tradition of cumulative research that could build on and extend the findings reported here.

Contributions and Implications

While significant research has focused on the IS–firm performance relationship, the mechanisms through which IS assets affect firm performance remain underexamined. This study is one attempt to bridge this gap, where we drew from the resource-based theory and argued that IS assets, per se, may not be rent-yielding. Rather, it is their targeted use that is likely to be rent-yielding. Our findings provide general support to the resource complementarity arguments put forth in the IS literature. Among the past studies that have addressed the issue of complementarities between IS and firm resources, Clemons and Row [30] focused on how IT could be used to exploit the unique structural characteristics of a firm, and Powell and Dent-Micallef [93] focused on how the value of IS resources could be enhanced in the presence of other business resources such as an innovative culture. This study extends this line of research by examining the complementarities that could be achieved by focusing IT initiatives on firm competencies.

The model developed can serve as a basis for IS performance evaluation. While a number of performance evaluation models have been proposed, these models assess IS performance in one or a few of the functional areas such as systems development, planning, or systems acceptance and use. Moreover, the IS success models [39, 111] have focused on the individual effect of IS and implicitly assumed that individual effect will lead to organizational effects. This position has been critiqued, where researchers have pointed out that the link between individual level system use and organizational performance improvement is not automatic [50, 110], and that IS success models have to more directly link IS activities with firm performance. Moreover, since successful IS units do more than develop easy-to-use and usable IS, success models have to incorporate other core IS activities in addition to systems development. The model developed here addresses some of the shortcomings of the current IS success models by providing a more direct assessment of the organizational effect of IS activities and by including core IS functional activities such as planning, systems development, IS operations, and IS support. Thus, this study complements and adds to the IS performance research and provides a basis for the development of IS performance assessment tools for managerial use.

From a practical standpoint, this study makes several contributions. Before we discuss these contributions, we should highlight that the findings reported here should be viewed as preliminary evidence, and further research aimed at both refining the constructs and their measures and testing the model with other data are needed before definitive guidelines for practice could be derived. Nevertheless, this study does offer some useful insights for practice.

By providing empirical evidence that IT support for core competencies has a positive effect on firm performance, this study highlights that IS managers have to do more than invest in the latest technologies or develop a strong IS department. The

results indicate that IS managers have to clearly understand the strategic thrust of the organization and institute mechanisms to ensure that IS capabilities are channeled toward areas of importance to the organization. Among other things, this requires close interactions with business managers and coopting business leaders to play an active role in IT deployment decisions.

By providing empirical evidence of the strategic value of core IS functions, this study stresses the importance of investing in the development of a strong IS department. While senior executives acknowledge the strategic value of IT, they tend to view IS activities as commodity services, and target these activities for cost cutting. Our findings that strong IS functional capabilities enable organizations to effectively leverage IT in pursuit of firm strategies suggest that such a cost-focused approach to managing IS might be dysfunctional. IS managers who understand the strategic value of IS capabilities must proactively educate the senior management on the value of IS activities and seek the necessary funding to renew and improve these capabilities.

Our findings that resource endowments affect capability development suggest that IS managers have to develop effective resource acquisition strategies in order to maintain a valuable asset base comprising of personnel, technology, and relationships to support IS initiatives. Given the difficulties in hiring and retaining skilled IS personnel, IS units have to think creatively to design attractive careers paths for IS recruits, invest in training and development, and adopt novel recruitment strategies such as countercyclical hiring to hire and retain skilled personnel. Similarly, careful planning in the acquisition of technology platforms is required to ensure that the IT infrastructure remains state-of-the-art. Coopting key vendors as partners and adopting sound vendor management practices are critical for developing close vendor partnerships. While IS units might have adopted some of these practices, it is possible that they might be more successful in acquiring some IS resources and not others. For example, it is not uncommon to find organizations that are quick in investing in the latest technologies, but lag in the human resources practices needed to retain technical personnel. IS managers have to recognize that all three types of resources are equally important and ensure a balanced approach to the acquisition and renewal of IS resources.

Conclusion

IN THE PAST DECADE, ORGANIZATIONS HAVE INCREASED their investments in IS significantly with the expectation that these investments will improve firm performance. However, some organizations continue to be able to garner better value from IS than others. This has created a need to better understand the sources of such differences and, consequently, the mechanisms by which IS contributes to firm performance. This study is one attempt to answer this question. We drew from the resource-based theory to posit that intangible IS resources and IS functional capabilities are critical determinants of how IT is deployed in the organization, which in turn can affect firm performance. This study departs from past IS–firm performance research by using resource-based theory as the theoretical lens to define and interrelate resources, capabilities, competencies,

and firm performance. Moreover, this study extends IS performance research by providing a conceptual foundation to link IS activities to firm performance. It is hoped that the theoretical model and the empirical results presented here provide a useful starting point for future empirical studies that examine the IS–firm performance relationship from a resource-based perspective.

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Appendix

Scale Validation

THE SCALES WERE VALIDATED using the standard procedures recommended in the literature [25, 28, 118]. Items of scales in a related domain were pooled and factor analyzed to assess their convergent and discriminant validity. A scale is assessed to have adequate convergent validity when all items load highly on one factor. If all the scale items also have low cross-loadings on other factors, then the scale is deemed to exhibit adequate discriminant validity. An iterative process of dropping items with high loadings on multiple factors or with loadings on factors other than the one representing the scale they pertain to and reassessing the factor loadings was followed in refining the scales.

Scale items for constructs measuring IS human capital (SKILLS and SPEC) were pooled and factor analyzed. Similarly, scale items for constructs measuring IT infrastructure flexibility (NETPLAT and DATAAPP), IS partnership quality (INTQUAL and VENQUAL), IS capabilities (PLAN, DEVELOP, SUPPORT, and OPER), IT support for core competencies (MKTC, INTC, and FUNC) and firm performance (MKTPFM and OPRPFM), respectively, were pooled and factor analyzed. The results, summarized in Tables A1 through A7, indicate that two items constituting IS planning sophistication, one item constituting internal partnership quality, one item constituting external partnership quality, and one item constituting IT support for market-access competency did not load highly on the factors constituting their respective scales. These items were dropped from the respective scales and the analyses were rerun. The results indicate that all items in the refined scales load highly on the factors representing their scales and the cross-loadings of all items are below the recommended value of 0.50. These results indicate that all the scales are unidimensional and have acceptable convergent validity and discriminant validity.

The reliability of the refined scales was assessed using Cronbach's alpha. A minimum alpha value of 0.60 is recommended for new scales [88]. It is seen (Table A8) that the alpha values range from 0.65 to 0.92. These results indicate that all the scales have acceptable reliability.

Table A1. Factor Analysis of IS Human Resource Skills and Specificity

Items	IS human resource specificity	IS personnel skill
Our IS staff has very good technical knowledge; they are one of the best technical groups an IS department could have.	0.074	**0.830**
Our IS staff has the ability to quickly learn and apply new technologies as they become available.	0.155	**0.863**
Our IS staff has the skills and knowledge to manage IT projects in the current business environment.	0.418	**0.605**
Our IS staff has the ability to work closely with customers and maintain productive user or client relationships.	0.389	**0.620**
Our IS staff has excellent business knowledge; they have a deep understanding of the business priorities and goals of our organization.	**0.719**	0.253
Our IS staff understands our firm's technologies and business processes very well.	**0.713**	0.311
Our IS staff understands our firm's procedures and policies very well.	**0.779**	0.200
Our IS staff is aware of the core beliefs and values of our organization.	**0.612**	0.159
Our IS staff often does not know who are responsible for important tasks in this organization. (R)	**0.659**	0.034
Our IS staff is conversant with the routines and methods used in the IS department.	**0.553**	0.359

Notes: (R) is reverse-coded. Item loadings greater than 0.50 are indicated in boldface.

Table A2. Factor Analysis of IT Infrastructure Flexibility

Items	Network and platform sophistication	Data and core applications sophistication
The technology infrastructure needed to electronically link our business units is present and in place today.	**0.814**	0.234
The technology infrastructure needed to electronically link our firm with external business partners (i.e., key customers, suppliers, alliances) is present and in place today.	**0.743**	0.136
The technology infrastructure needed for current business operations is present and in place today.	**0.699**	0.310
The capacity of our network infrastructure adequately meets our current business needs.	**0.809**	0.130
The speed of our network infrastructure adequately meets our current business needs.	0.801	**0.089**
Corporate data is currently sharable across business units and organizational boundaries.	0.135	**0.806**
The complexity of our current application systems seriously restricts our ability to develop modular systems with reusable software components. (R)	0.116	**0.807**
Our application systems are very modular; most program modules can be easily reused in other business applications.	0.428	**0.603**
We have standardized the various components of our technology infrastructure (i.e., hardware, OS, network, database).	0.407	**0.510**

Notes: (R) is reverse-coded. Item loadings greater than 0.50 are indicated in boldface.

Table A3. Factor Analysis of IS Partnership Quality

Items	Internal partnership quality	External partnership quality
Critical information and knowledge that affect IT projects are shared freely between our business units and IS department.	**0.752**	0.160
Our IS department and business units understand the working environment of each other very well.	**0.828**	0.137
There is a high degree of trust between our IS department and business units.	**0.854**	0.234
The goals and plans for IT projects are jointly developed by both the IS department and business units.	**0.763**	0.119
Conflicts between IS departments and business units are rare and few in our organization.	**0.774**	0.171
Conflicts between IS departments and business units are always resolved through dialog and mutual adjustment.*		
We seldom have conflicts with our IT vendors and service providers.	0.176	**0.699**
Conflicts with our IT vendors and service providers are resolved through discussions and not through litigation.*		
We get timely information from our vendors about unexpected problems that could affect their ability to meet our technology needs.	0.170	**0.820**
We can rely on our IT vendors and service providers to respond to our IT needs in a timely and effective manner.	0.063	**0.877**
A very trusting relationship exists between the IS department and our key IT vendors and service providers.	0.164	**0.878**
We have long-term partnerships with our key IT vendors and service providers.	0.238	**0.657**

Notes: * Items were dropped during scale refinement. Item loadings greater than 0.50 are indicated in boldface.

Table A4. Factor Analysis of IS Capability

Items	IS planning sophistication	Systems development capability	IT support maturity	Systems operation capability
IS planning is an ongoing process in our organization; planning is not a once-a-year activity.*	**0.852**	0.059	0.158	0.064
Business units' participation in the IS planning process is very high.	**0.778**	0.099	−0.085	0.051
IS planning is initiated by senior management; senior management participation in IS planning is very high.	**0.694**	0.199	0.279	0.217
We have a formalized methodology for IS planning.	**0.655**	0.340	0.299	0.263
Our planning methodology has many guidelines to ensure that critical business, organizational, and technological issues are addressed in evolving an IS plan.	0.258	**0.680**	0.150	0.188
We try to be very comprehensive in our planning, our IS plans cover every facet of IT needs of our organization.*	0.329	**0.722**	0.242	0.052
Our systems development process can be easily adapted to different types of development projects.	0.244	**0.733**	0.290	0.198
The systems development process is continuously improved using formal measurement and feedback systems.	−0.019	**0.759**	0.148	0.110
Our systems development process has adequate controls to achieve development outcomes in a predictable manner.				
Our systems development process is flexible to allow quick infusion of new development methodology, tools, and techniques.				

Our systems development process facilitates reuse of software assets such as programs, design, and requirement specifications.	–0.042	**0.807**	0.187	0.087
We have a mature systems development process, the process is well defined and documented.	0.234	**0.638**	0.189	0.389
We have clear guidelines on how to prioritize service requests from users.	0.104	0.230	**0.626**	0.266
We have well-defined service quality criteria for all IS support tasks.	0.235	0.312	**0.752**	0.220
We have established service level agreements with all user groups for IS support.	0.251	0.250	**0.778**	0.138
We have appropriate performance standards to monitor IS service quality.	0.048	0.224	**0.794**	0.257
We have sophisticated systems to record, track, and respond to service requests.	–0.029	0.119	**0.664**	0.340
We have automated most systems operation tasks; very little manual intervention is required to run our computer systems.	0.052	0.120	0.268	**0.707**
We use automated tools to monitor and fine-tune the performance of our computer systems, networks, databases, and telecommunication infrastructure.	0.152	0.117	0.302	**0.632**
We have detailed procedures for responding to unplanned system outages.	–0.038	0.179	0.246	**0.726**
Backup procedures are strictly enforced in all our data centers.	0.072	–0.016	0.105	**0.827**
We periodically do mock trials to test our disaster recovery plans.	0.235	0.319	0.158	**0.703**
We continuously review our security systems and procedures to assess our vulnerability.	0.246	0.237	0.170	**0.750**

Notes: * Items were dropped during scale refinement. Item loadings greater than 0.50 are indicated in boldface.

Table A5. Factor Analysis of IT Support for Core Competencies

Items	IT support for market-access competencies	IT support for integrity-related competencies	IT support for functionality-related competencies
The extent of use of IT including the Internet and the World Wide Web in			
Enhancing the responsiveness to customer service requests.*			
Providing necessary information to customers.	**0.701**	0.276	0.390
Identifying groups of customers whose needs are not being met.	**0.741**	0.029	0.387
Determining customer requirements (i.e., products, preference, pricing, and quantity).	**0.659**	0.256	0.338
Tailoring the products/services to match customers' needs.	**0.630**	0.303	0.230
Reengineering business processes.	0.080	**0.776**	0.311
Enhancing business process flexibility.	0.038	**0.779**	0.424
Integrating the firm's supply chain.	0.346	**0.712**	−0.105
Integrating internal business units.	0.262	**0.654**	0.190
Increasing the speed of logistic activities.	0.418	**0.583**	0.318
Developing new products/services.	0.285	0.231	**0.780**
Improving the speed of product development.	0.169	0.442	**0.642**
Increasing the speed of products/service delivery.	0.243	0.417	**0.652**
Increasing the speed of responding to business opportunities/threats.	0.455	0.256	**0.715**
Identifying new market segments.	0.390	0.120	**0.781**
Redefining the scope of our business.	0.255	0.174	**0.709**
Entering new markets.	0.322	0.108	**0.794**

Notes: * Item was dropped during scale refinement. Item loadings greater than 0.50 are indicated in boldface.

Table A6. Factor Analysis of Firm Performance

Items	Market-based performance	Operating performance
We have entered new markets very quickly.	0.127	**0.832**
We have brought new products and services to the market faster than our competitors.	0.058	**0.897**
The success rates of our new products and services have been very high.	0.274	**0.612**
Our productivity has exceeded that of our competitors.	**0.745**	0.192
Our profit has exceeded that of our competitors.	**0.904**	0.184
Our financial performance has been outstanding.	**0.881**	0.132
Our financial performance has exceeded that of our competitors.	**0.912**	0.126

Note: Item loadings greater than 0.50 are indicated in boldface.

Table A7. Factor Analysis of IT Intensity

Items	IT intensity
IT is used extensively by our competitors.	0.820
IT is used extensively by our suppliers and business partners.	0.776
IT is a critical means to interact with customers in this industry.	0.715

Table A8. Reliability Assessment

Constructs	Number of items in original scale	Number of items in refined scale	Cronbach's alpha
IS human capital			
IS personnel skills	4	4	0.7835
IS human resource specificity	6	6	0.7925
IT infrastructure flexibility			
Network and platform sophistication	5	5	0.8617
Data and core application sophistication	4	4	0.7303
IS partnership quality			
Internal partnership quality	6	5	0.8669
External partnership quality	6	5	0.8654
IS capabilities			
IS planning sophistication	6	4	0.8215
Systems development capability	6	6	0.8788
IT support maturity	5	5	0.8679
Systems operation capability	6	6	0.8741
IT support for core competencies			
IT support for market-access competency	5	4	0.8155
IT support for integrity-related competency	5	5	0.8382
IT support for functionality-related competency	7	7	0.9189
Firm performance			
Market-based performance	3	3	0.7187
Operating performance	4	4	0.9004
Control variable			
IT intensity	3	3	0.6535