IT Capabilities and Firm Performance: A Contingency Analysis of the Role of Industry and IT Capability type

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Abstract

Previous empirical studies examining the relationship between IT capability and accounting-based measures of firm performance report mixed results. We argue that extant research (1) has relied on aggregate overall measures of the firm’s IT capability, ignoring the specific type and nature of IT capability; and (2) has not fully considered important contextual (environmental) conditions that influence the IT capability-firm performance relationship. Drawing on the resource-based view (RBV), we advance a contingency perspective and propose that IT capabilities’ impact on firm resources is contingent on the “fit” between the type of IT capability/resource a firm possesses and the demands of the environment (industry) in which it competes. Specifically, using publicly available rankings as proxies for two types of IT capabilities (internally-focused and externally-focused capabilities), we empirically examines the degree to which three industry characteristics (dynamism, munificence, and complexity) influence the impact of each type of IT capability on measures of financial performance. After controlling for prior performance, the findings provide general support for the posited contingency model of IT impact. The implications of these findings on practice and research are discussed.

Keywords: Business value of IT; IT Capability; Resource-based Theory; Contingency Models

Data Availability: Data used in this study are available from public sources identified in the body of the paper.

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1. INTRODUCTION

Understanding the link between information technology (IT) and firm performance has been the subject of considerable and enduring interest among IS researchers and practitioners. While much progress has been made, significant gaps in our understanding remain. For example, while a number of studies [8,33] have shown that IT spending is associated with increased firm output—thus dispelling the so-called “productivity paradox” at the firm level—empirical studies examining the contemporaneous relationship between IT spending and measures of financial performance report mixed findings [16,32].

Drawing on the Resource Based View (RBV), the contemporary theory of competition in the strategy literature, IS scholars have argued that performance differential from IT rests on differences in IT capabilities [6, 30, 37, 39, 44, 45, 47] as opposed to differences in IT spending per se. However, the few empirical studies examining the relationship between aggregate measures of IT capability and accounting-based (profit and cost) measures of firm performance also show mixed results. In particular, using appearance on the list of “leaders” in the InformationWeek 500 as a proxy for IT capability, Bharadwaj’s [6] univariate analysis suggests a link between IT capability and accounting-based measures of firms performance. However, subsequent analysis by Santhanam and Hartono [44] that controls for prior financial performance found no association between many (21 out of 24, in one case) performance measures and IT capability. Additionally, in some cases, the effects on some performance measures were opposite of expectations.

In this paper, we attempt to reconcile these seemingly conflicting results and advance our understanding of the relationship between IT capabilities and firm performance. We argue that extant research (1) has largely ignored potentially distinct types of IT capabilities, relying on an
overall aggregate measure of the firm’s IT capability; and (2) has not fully considered important contextual (environmental) conditions that influence the IS resources-firm performance relationship. Drawing on RBV, and the work of Wade and Hulland [47] among others, we advance a contingency perspective and propose that IT capabilities’ impact on firm resources is contingent on the “fit” between the type of IT capability/resource a firm possesses and the demands of the environment (industry) in which it competes. This general proposition is developed in this paper into a set of specific hypotheses that are then tested using archival data.

While similar hypotheses have been suggested in the literature [47], this—to the best of our knowledge—is the first study to empirically assess the contingency perspective regarding the impact of IT capabilities. Specifically, we employ publicly available rankings as proxies for two types of IT capabilities (internally-focused and externally-focused) to empirically examine the degree to which three industry characteristics (dynamism, munificence, and complexity) influence the impact of each type of IT capability on measures of financial performance. We also show that because a firm may excel in one type of IT capability while being average or below average in the other, focusing only on how an overall aggregate (coarser grained) measure of IT capability are correlated with firm performance can generate misleading conclusions about the performance implication of IT capabilities. Our study (a) responds to the calls by Li and Ye [28], Wade and Hulland [47], Chiasson and Davidson [14] to consider industry as an important contextual factor when developing and testing theory regarding IT impacts; and (b) affirms the need to take into consideration the fact that firms may excel in certain types of IT capabilities but not others and that the value of such capabilities is influenced by the firm’s industry context.

The rest of this paper is organized as follows. In the next section, the theoretical framework and hypotheses are developed. The model and research method used to test the
hypotheses are presented in section three. Section four describes the data and the results of the data analysis. Section five concludes with a discussion of the results and implications for future research.

2. THEORY AND HYPOTHESES

2.1. The Value of IT resources: A Contingency Perspective

The resource-based view (RBV) [2, 3, 42, 48], which has emerged as a potential integrating paradigm for strategy research, seeks to explain sources of competitive advantage, sustained or otherwise. Differences in performance are explained in resource-based logic in terms of the types of resources and capabilities that different firms control. According to resource-based logic, resources that are valuable but common can only be a source of competitive parity; resources that are valuable and rare can be a source of temporary competitive advantage; and resources that are valuable, rare, and costly to imitate can be a source of competitive advantage [3]. A resource can be imperfectly imitable in the presence of insulating mechanisms, such as path dependence, causal ambiguity, social complexity, or team-embodied skills [3, 42].

RBV and IS Scholars generally acknowledge that the competitive potential of both IT and non-IT resources/capabilities can only be realized if they are leveraged to improve the efficiency and effectiveness of key business processes, since it is through business processes that a firm’s resources and capabilities get exposed to the market where their value can be recognized.

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1 A variety of labels (inputs, assets, capabilities, competencies) have been used to describe a firm’s resource endowments. Following Grant [23], Amit and Schoemaker [2], and Makadok [29], in this paper the label ‘resource’ is used in the general sense to refer indistinctly to all these concepts. The term ‘capability’ is defined as a special type of resource, encompassing a firm’s capacity to coordinate and deploy other resources to effect a desired end [42].
However, as Barney [4] observes, “Firm resources are not valuable in a vacuum, but rather are valuable only when they exploit opportunities and/or neutralize threats” in the environment in which the firm operates. The market’s recognition of the ultimate value of a resource/capability and its ability to generate competitive advantages is contingent on industry conditions. Indeed, a distinguishing feature of the strategic management and industrial organization literatures is the emphasis they place on the firm’s competitive environment [36] and the notion of “strategic fit” as a core concept in normative models of strategy formulation [22, 34]. An organization must find a match between the demands of its competitive environment and its internal features/capabilities in order to survive and succeed [46].

It follows therefore that environmental/industry conditions affect the value-adding potential of the firm’s IT resources. In other words, the relative importance and value of an IT resource depends on the characteristics of the environment/industry in which the firm competes: a fit between the firm’s IT resources/capabilities and the demands of the environment will positively affect performance; a misfit may (in the worst case) negatively influence the firm’s competitive position².

The principal aim of this paper is to apply this contingency approach to examine the relationship between IT resources/capabilities and firm performance. To accomplish this, it is necessary to first characterize those resources and capabilities and the environmental conditions that may influence the payoff from those resources/capabilities.

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² Venkatraman [46] defines “fit” from six different perspectives: matching, moderation, mediation, gestalts, co-variation, and profile deviation. The notion of fit here is consistent with Venkatraman’s “fit as moderation” perspective. It is not to be confused with the “fit as matching” and “fit as profile deviation” perspectives adopted in the IS alignment literature (e.g., [10, 12, 19, 46]) where the emphasis is on internal/organizational congruencies rather than external/environmental contingencies (the focus of this study).
2.2. IT Capability Types

As noted in the introduction, IS scholars have recently turned to RBV to reason about and seek better answers to the question of IT business value and competitive advantage from IT. Drawing on RBV, these scholars have argued that competitive advantage from IT rests less on the level of IT investments, per se, and more on the quality of the firm’s “IT capabilities”.

There is, however, no consensus around a typology of IT resources/capabilities. The primary empirical studies published to date by Bharadwaj [6] and Santhanam and Hartono [44] treat IT capability as an aggregate concept/feature of the firm. Prior conceptual theoretical efforts have considered a variety of potential typologies. Ross et al. [41] identified three “IT assets” (human, technology, and relationships) which when managed appropriately could lead to business value, while Feeny and Willcocks [20] proposed a set of nine “core IT capabilities” (IS/IT Governance, business systems thinking, relationship building, designing technical architecture, making technology work, informed buying, contract facilitation, contract monitoring, and vendor development) that firms require. Bharadwaj et al. [7] conceptualize “enterprise-wide IT capability” as a multidimensional construct encompassing 30 IT resources/capabilities, organized into six dimensions (IT business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure). Wade and Hulland [47] discuss how eight “key IS resources” described in previous work (external relationships management, market responsiveness, IS-business partnership, IS planning and change management, IS infrastructure, IS technical skills, IS development, and cost effective IS operations) might be organized, in accordance to Day’s [15]
typology of marketing capabilities, into three classes of capabilities: inside-out, outside-in and spanning.

One common thread in these typologies of IS resources/capabilities is that they are developed from the perspective of the IS unit (i.e., they tend to focus on the functional skills and resources of the IS unit) rather than from the perspective of the business and the firm’s choices about how and where such IS resources are deployed. For example, in Wade and Hulland’s typology, IS infrastructure is labeled as an “inside-out” resource, regardless of the nature of the business process or activity that is affected by the infrastructure; i.e., whether that process is internally-focused or externally-focused. Though it may be of intrinsic interest to IS scholars and practitioners, a typology focusing on the raw assets or technical skills of the IS unit has at least one important limitation when it comes to assessing the business value of IT. As noted earlier, firms that fail to appropriately deploy and use their resource endowment to enhance business capabilities cannot expect to realize the competitive advantage potential of these resources. The benefits of IT assets can only be realized if they are leveraged to improve the efficiency and effectiveness of key business processes. Focusing on the direct relationship between IT assets and firm performance ignores the important role of business processes in translating those assets into actions that have value in the market place. This is consistent with Byrd [9] and others [5,11] who suggest that IT resources impact performance by enabling improvements in key business processes and certain “core competencies”. Accordingly, rather than focusing on explicit functional skills or generic resource endowment of the IS unit and assume that they have a direct effect on performance as has been suggested in prior literature, we focus on higher level meta-IT capabilities that capture the manner in which the IS unit’s resource endowments are deployed in support of organizational processes.
For the purpose of this research, and consistent with Amit and Schoemaker’s [2] and Day’s [15] definitions of capabilities and Hamel’s [24] concept of meta-competencies, we define organizational IT capabilities as *complex bundles of IT-related resources, skills and accumulated knowledge, exercised through business processes, that enable firms to coordinate activities and make use of their IT assets to affect desired ends*. We further distinguish between two types of IT capabilities—externally-focused and internally-focused capabilities—on the basis of the primary business process areas supported, thus reflecting the firm’s choices regarding where and how IT resources are deployed\(^3\). *Externally-focused IT capabilities* are bundles of IT-related resources, skills and accumulated knowledge that help the firm sense, understand, and respond in a timely manner to changes in its markets and shifts in the needs of customers and suppliers. Examples of IT capabilities that are externally-focused include IT resources and skills deployed to support market research, customer-facing e-commerce interfaces and CRM processes. *Internally-focused IT capabilities*, by contrast, are bundles of IT-related resources, skills and accumulated knowledge that help the firm offer reliable products and services and minimize costs associated with back-office production, operational support, and fulfillment processes. Enterprise resource planning (ERP) systems are one example of internally-focused IT resource that tends to be aimed at better integrating internal operations and data to enhance efficiency and reliability.

Because of a history of IT portfolio choices regarding the acquisition and deployment of IT resources and related learning that occurs over time, a firm may have a fairly well-developed externally- or internally-focused IT capability, but not necessarily both. Path dependency, which reflects the role of the firm’s past and the cumulative nature of capability building, means that

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\(^3\) Our categorization parallels Day’s [15] broad distinction between outside-in and inside-out organizational capabilities as well as Hamel’s [24] distinction between market-access and integrity-related meta-competencies in his hierarchy of competencies.
certain capabilities may be more mature than others at a given point in the firm’s history. Similarly, shifts in strategy/tactics, changes in stakeholders (internal and external social actors), or technological changes may result in the firm emphasizing the building and continued nurturing of one type of IT capability over another at certain junctures. Finally, consistent with RBV, for a capability to be a source of competitive advantage, it must be considered relative to the other firms with which a firm competes. In the face of change and competitive pressure (innovation and imitation action), continuous development and nurturing of any capability is a necessary but not sufficient condition for sustained leadership. A firm with a superior externally-focused IT capability, for example, may lose its leadership status with the passage of time if it fails to upgrade that capability at a rate faster than its competitors.

2.3. The Role of Environmental/Industry Characteristics

As noted before, prior studies have tended to ignore industry differences that may confound the results, and the few studies that control for industry fixed-effects have largely focused on the average impact across industries. At the same time, event studies examining the shareholders wealth effects of IT-related announcements suggests that the nature and significance of the impact of such announcements may differ across industries depending on the dominant role IT plays within each industry [13, 18, 27]. More recently, IS scholars [14, 28, 47] have highlighted the importance of industry as a critical contextual variable with regards to IT impact. In this paper, we draw on Dess and Beard’s [17] widely accepted conceptualization and measures of the environment. Drawing on prior theoretical typologies by Aldrich [1], Pfeffer and Salavcik [35] and others, Dess and Beard [17] evaluated a wide variety of important environmental dimensions that had been previously considered within the literature. Through a
factor analysis of different environmental measures, Dess and Beard [17] showed that these dimensions could be reduced to a more parsimonious set of three primary environmental characteristics: *environmental turbulence (dynamism), munificence, and complexity*. We focus on these three aspects in our examination of the impact of the fit between IT capabilities and the environmental conditions. Figure 1 reflects the research model for this study.

![Figure 1: The Overall Contingency Model](image)

*Environmental Turbulence*

Environmental turbulence (dynamism) is defined as the rate and the instability of environmental change [17]. Such change is often the product of several forces such as changes in customer preferences, new products, technology shocks, or changes in the nature or basis of competition.

IT resources/capabilities that are aimed at enhancing internal business efficiencies tend to require more well-defined requirements and prolonged stability to allow organizational learning to occur and be effective. Turbulent business environments may require frequent changes to the
internal business practices and limit the value associated with new technologies, as the organization may not achieve the anticipated efficiency due to the changing business environment. Examining the impact of ERP investments, Hitt et al. [26] document a slow down in business performance and productivity shortly after ERP implementation, and attribute that to organizational need for a period of learning and adjustment for such investments to payoff. Internally-focused IT resources/capabilities are likely to be in a constant state of flux in turbulent, fast changing environments. Therefore, we believe that possession of superior internally-focused IT capabilities is likely to yield greater benefits in stable as opposed to turbulent environments.

**Hypothesis 1A:** The relationship between internally-focused IT capabilities and performance will be stronger for firms in stable (low dynamism) business environments than for firms in turbulent business environments.

Firm performance in dynamic environments, where new threats can materialize suddenly and where opportunities may be short-lived, is likely to be largely determined by its ability to quickly recognize these changes and trends and respond in a timely manner to neutralize threats and capitalize on new opportunities [3, 4, 47]. Accordingly, externally-focused IT capabilities aimed at enabling greater external orientation and at sensing the market and responding to its shifts in a timely manner will be *more valuable* for firms in turbulent environments [38]. Consistent with these arguments, Li and Ye’s [28] finds that the payoff from IT investments appears to be highest for firms operating in more dynamic environments and with externally-oriented strategy[^4]. In industries with stable environments, externally-focused IT capabilities may at best provide limited

[^4]: Though not focused on IT capabilities per se, implicit in Li and Ye’s analysis is the assumption that IT investments are deployed in support of the firm’s external orientation. However, aggregate IT investment is a coarse measure that might not be reflective of actual use in support of particular process or activity.
advantage due to the infrequent changes in the business environment. Therefore, we believe that the value adding potential of superior externally-focused IT capabilities is likely to be higher when the firm operates in a turbulent industry.

**Hypothesis 1B:** The relationship between externally-focused IT capabilities and performance will be stronger for firms in turbulent (high dynamism) business environments than for firms in stable business environments.

*Environmental Munificence*

Environmental munificence refers to the extent to which the environment can support sustained growth [17]. Markets that show consistent growth over time are considered highly munificent, whereas industries that are mature or shrinking are characterized as having low munificence. When munificence is low, competition for each sale is often intense and firms in such mature markets often compete based on price, giving low cost producers a distinctive advantage. By helping streamline operations and enhancing overall efficiencies, superior internally-focused IT capabilities can significantly enhance a firm’s competitive position in environments characterized by low munificence. These arguments suggest the following hypothesis:

**Hypothesis 2A:** The relationship between internally-focused IT capabilities and performance will be stronger for firms in low munificent environments than for firms in high munificent environments.

High munificent industries enjoy continued growth in customer demand and new requirements lead to re-purchases by existing customers. Wade and Hulland [47] argue that firms in highly munificent environments may not experience differences in firm performance regardless of their level of market sensing capabilities due to consumer’s high level of desire for the goods and services that may cause a willingness to forgive imperfections in firm products or
services. However, while such markets tend to be relatively more forgiving compared to low growth environments, we believe that being more in tune with the market can still confers distinct competitive advantages. A superior externally-focused IT capability enhances a firm’s ability to sense the market changes and customer desires is likely to help organizations prepare better levels of inventory and products suited to consumer demand, giving that firm an advantage even in munificent environment. This approach is often evident in the fashion industries where a specific color or style may be the top seller, and suppliers need to sense when this specific fashion item is desirable and also when fashion has moved on to the next fad. In short, the value adding potential of superior externally-focused IT capability is likely to be more pronounced in highly munificent environments.

**Hypothesis 2B:** The relationship between externally-focused IT capabilities and performance will be stronger for firms in high munificent environments than for firms in low munificent environments.

**Environmental Complexity**

Environmental complexity describes both the heterogeneity of product offerings by the firm and in the industry in which it operates as well as the level of knowledge sophistication that a firm must have about the products and consumers [1]. Dess and Beard [17] suggest that the complexity is related to the heterogeneity of and range of inputs and output, while Pfeffer and Salancik [35] argue that environmental complexity is also a function of the number of external actors that a firm must actively attend to in order to achieve marketplace success. Both contend that firms facing a more complex environment will perceive greater uncertainty and have greater information processing requirements than firms operating within a simpler environment. This is consistent with Galbraith’s [21] information processing view of the firm: “the greater the task uncertainty, the greater the amount of information that must be processed among decision
makers during task execution in order to achieve a given level of performance.” Both types of IT capabilities are likely to be important in highly complex environments, since IT, when properly deployed, increases the overall information processing capacity of the firm. Firms with superior externally-focused IT capabilities are better able to collect, process, and assimilate complex external information and knowledge and to formulate and coordinate effective competitive response in a timelier manner. Similarly, firms with superior internally-focused IT capabilities are better able to cope with the complexity induced by characteristics of the processes or products needed to serve the market and to coordinate such complex operations more effectively and efficiently. These arguments suggest the following two hypotheses regarding the moderating role of environmental complexity:

**Hypothesis 3A:** The relationship between internally-focused IT capabilities and performance will be stronger for firms in high complexity environments than for firms in low complexity environments.

**Hypothesis 3B:** The relationship between externally-focused IT capabilities and performance will be stronger for firms in high complexity environments than for firms in low complexity environments.

**Synergy Among Environmental Conditions**

The prior hypotheses propose that individually, each environmental condition moderates the relationship between the IT capability type and firm performance. Within these prior hypotheses, each of the other environmental conditions is assumed to be held constant. However, interactions of all three aspects of the environment may compound the moderating role of environmental condition on the relationship between IT capability type and performance. In particular, consistent with hypotheses 1A, 2A, and 3A, superior
internally-focused IT capabilities are likely to be even more consequential in stable, low
munificent, complex environments. Similarly, consistent with hypotheses 1B, 2B, and
3B, having a superior externally-focused IT capability is likely to be even more important
and valuable in dynamic environments that are also munificent and complex. Thus:

**Hypothesis 4A:** The relationship between internally-focused IT capabilities and
performance will be stronger for firms operating in environments characterized
by low dynamism, low munificence, and high complexity.

**Hypothesis 4B:** The relationship between externally-focused IT capabilities and
performance will be stronger for firms operating in environments characterized
by high dynamism, high munificence, and high complexity.

3. RESEARCH METHODOLOGY

3.1. Sample and Measures

*Measurement of IT Capabilities*

The rankings provided by *Information Week (IW)* in their annual special issue, IW 500,
were used in this study to identify firms with superior IT capabilities. However, unlike
Bharadwaj [6] and Santhanam and Hartono [44], who use IW’s leader designation as a proxy for
aggregate IT capability, we rely on a set of IW rankings from 2000-2001 to serve as proxies for
the two distinct types of IT capabilities stated in our hypotheses. Since 1989, Information Week
has annually produced a special issue that examines the top 500 users of information technology.
The criteria used and composition of the identified users of technology has changed over the
years, from an initial list focused on the largest users of IT to one which identifies the most
innovative users of technology. During the two-year period, 2000-2001, Information Week
editors identified the top 500 innovative users of technology and also ranked each firm in the list
based on that firm’s “early adoption and creative use of technologies that can help create
significant business value” in two categories: *e-business* and *technology enabled business practices*. To make the overall list, a company must “demonstrate a pattern of technological, procedural, and organizational innovation.” Subsequently, IW ranked the firms innovative use of IT in e-business and business practices by assigning them a gold, silver or bronze medal in each of these two categories. The rankings were performed on a curve and for each category of IT capability, a third of the companies received a gold medal, a third received a silver medal and the other third of companies received a bronze medal.

Information Week describes the e-business technology innovation category as focusing on e-commerce and supply-chain management. Both involve the deployment of innovative externally-facing systems to serve customers and suppliers; therefore, we employ innovation in this category as a proxy for a firm’s externally-focused IT capabilities. We identify a firm as having superior externally-focused IT capability if it received a gold medal in the e-business innovation category. We believe that this is an appropriate proxy for externally-focused IT capability as innovation is a key component to developing unique capabilities and e-commerce is directly related to a firm’s ability to understand and fulfill customers’ requirements. Similarly, IW ranking in the technology enabled business practices category is used as a proxy for internally-focused IT capabilities. IW cites ERP implementation and information system integration across business processes as examples of technology enabled business practices. Since such efforts are typically aimed at improving the day to day operations and enhancing overall efficiency, we designate a firm as having superior internally-focused IT capability if it received a gold medal in the business practices innovation category.

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5 Information Week methodology statement for the year 2000 is available at [http://informationweek.com/803/methodology.htm](http://informationweek.com/803/methodology.htm).
Although the IW specific rankings we use as proxies for IT capability types have not been previously employed in the literature, we are not first to use IW rankings as proxies for superior IT capability. Both Bharadwaj [6] and Santhanam and Hartono [44] employed aggregate rankings (albeit yielding somewhat mixed results, which partly motivates our work) as measures of aggregate IT capability. In fact, the tradition of using secondary data and appropriate proxies in theory testing is well-accepted in the strategy, finance and management literatures (see Stratopoulos and Dehning [45], for example).

The measure used in our study is developed by IW through an analysis of each firm’s response to the specific technologies that they have implemented and how the firms use these technologies. This allows IW to create the rankings based on the firm’s “early adoption and creative use of technologies” to support the business practices in each area. This is consistent with the conceptualization of IT capabilities as a set of IT resources exercised through specific business processes. Additionally, these IW rankings are performed using a comparative methodology where the results are relative to the other members of the IW500 who have also been similarly analyzed for their success in technology adoption and innovative use.

In using appearance on the list of gold medalists as a proxy for superior IT capability, we are assuming that failure to be included in the list of companies receiving a gold medal indicates that the firm does not have superior IT capability. To the extent that this assumption is invalid, we decrease our ability to reject the null hypothesis. Thus, any IW’s possible misclassification actually makes it more difficult for us to reject the null hypothesis. One other concern with the use of such rankings is that the rankings themselves might be influenced by prior financial performance. Bharadwaj [6] tests for a financial halo in earlier IW’s rankings of IT capability
Santhanam and Hartono [44] argue that the halo may exist and that the most appropriate treatment is to control for previous financial results when examining the association between current performance and the rankings. We follow Santhanam and Hartono’s (more conservative) approach and control in our statistical tests for firm performance in the year prior to the IW 500 listing.

**Data Sample**

As described above, Information Week identified the top 500 innovators and then identified their relative innovation abilities in the areas of E-business and business practices. Our sample is made up of the firms listed in the IW 500 rankings during a two year period (2000-2001), since these are the only two years IW provided such rankings across the two innovation categories. This approach differs from that of previous IT capability research that employed a matched sample research design [6, 44, 45]. These studies utilized an overall IT capability metric that was relative to all other firms in the industry and therefore it is appropriate to consider all the matched firms as not being a technology leader. By comparison, the measures that we employ in this study are relative only to the other firms in the IW 500, and thus we examine differences among listed firms only. This—we believe—is a more conservative approach, since by examining differences among listed firms only we avoid the possibility of

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6 The choice of the proxy measure is important. For example, Stratopoulos and Dehning [45] identify associations between IT capability (measured using Computerworld Premier 100 as a proxy) and firm performance; however, as they readily acknowledge, because growth rate in profits are used to select firms in the Premier 100 list, the findings might be tautological.

7 In 1998 and 1999, Information Week also provided medals about information technology capabilities. During this period, medals for the e-business category were awarded; however, the business practices category was labeled as business processes / ERP. This category was relabeled to business practices in 2000; therefore, for consistency, we limit our sample to the rankings published in 2000 and 2001. Our inferences remain unchanged when we expand our sample to cover the entire four year period.
detecting performance effects solely because of biases in IW’s selection process of the 500 innovative users.

**Dependent Measures**

Our research model and hypotheses focus on examining the relationship between IT capability types and firm performance. Previous studies have identified many possible measures for firm performance and we choose to follow Bharadwaj [6] and Santhanam and Hartono [44] who employ a series of accounting measures as proxies for firm performance. The use of a series of performance measures considers that the benefits of some types of IT capabilities are likely to be reflected within certain measures but not others. This choice also allows our results to be compared with previous studies that consider the impact of IT capability, and it allows for detecting differences in the results based on the type of performance measure.

The performance measures that we use are: return on sales (ROS), return on assets (ROA), operating income to sales (OIS), operating income to assets (OIA), operating income to employees (OIE), cost of goods sold to sales (COG/S), selling and general administration expense to sales (SGA/S).\(^8\) Return on assets and return on sales are widely used as measures of performance; however, these measures include the impact of interest and other revenues and expenses not directly related to firm operations. Therefore, we also consider operating income to sales and operating income to assets to provide more direct measures of the IT impact on operations [31]. Scaling the dependent variables by sales, assets, or the number of employees, assist in controlling for size differences amongst firms in our sample. We also examine the cost of goods sold (COGS) and sales expense (SG&A) as some business impacts may only be noticed

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\(^8\) Bharadwaj [6] and Santhanam and Hartono [44] also consider operating expense to sales; however, in our dataset few companies report this information, and as such, we do not consider this cost ratio.
through measures of internal business operation and may not necessarily be visible in overall measures of business performance due to the performance of other firm capabilities [40]. Data for all these measures were obtained from the Compustat database for the fiscal year ending prior to the ranking in Information Week. The use of Compustat reduces our data set, since Compustat provides data only for publicly traded firms and some of these companies do not report all of the specific data required. The availability of data reduces our sample of firm-year observations to between 686 and 537 depending on the specific measure of performance.

*Environmental Measures*

Following the procedure described by Dess and Beard [17], the dynamism and munificence of each industry represented in our sample were assessed using archival data extracted from Compustat at the level of the two-digit SIC industry segment. For each industry segment and each year in our sample, the industry-level total sales for five years (t0 to t-4) were regressed on the year variable. Munificence was operationalized as the growth rate in annual industry sales, which was measured as the regression slope coefficient (the coefficient on the time variable) divided by the average annual sales over the five year period. Dynamism was operationalized as the variability in annual industry sales and measured as the standard error of the regression slope coefficient of annual industry sales divided by the industry mean for the five year period.

Dess and Beard [17] frame industry complexity in terms of homogeneity-heterogeneity of its inputs and outputs, and we follow their suggested measure, input/output concentration, as a proxy for the level of industry complexity.9 We use the Bureau of Economic Analysis input-

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9 The tables and analyses presented use input concentration as a proxy for complexity; however, similar results are found when output concentration is used instead.
output tables to calculate the concentration of each industry’s inputs (source of supply), measured as the ratio of the sum of the square of dollar volume of inputs from different industries to the square of the sum of the inputs from the different industries, $C_i = \frac{\sum I_k^2}{(\sum I_k)^2}$.

This measure increases with the number of industries supplying the inputs and as the inputs become more evenly distributed across the different suppliers, capturing both the structural differences and distributive differences in complexity that may occur across industries [17].

For each of the three industry characteristics, we rank the values by year and split the industries into two (high and low) groups based on the median value for that characteristic. Each firm-year observation in the sample is then assigned three dichotomous variables to proxy for its industry's munificence, dynamism, and complexity high/low scores for that year. Table 1 provides key summary statistics.

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<th>Characteristic</th>
<th>Min.</th>
<th>Max.</th>
<th>Avg.</th>
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<tr>
<td>Internal IT Cap.</td>
<td>0</td>
<td>1</td>
<td>.313</td>
</tr>
<tr>
<td>External IT Cap.</td>
<td>0</td>
<td>.344</td>
<td></td>
</tr>
<tr>
<td>Dynamism</td>
<td>0</td>
<td>1</td>
<td>.416</td>
</tr>
<tr>
<td>Munificence</td>
<td>0</td>
<td>1</td>
<td>.439</td>
</tr>
<tr>
<td>Complexity</td>
<td>0</td>
<td>.955</td>
<td></td>
</tr>
<tr>
<td>ROS</td>
<td>-566</td>
<td>549</td>
<td>0.049</td>
</tr>
<tr>
<td>OIS</td>
<td>-2.06</td>
<td>806</td>
<td>-1.51</td>
</tr>
<tr>
<td>OIA</td>
<td>-231</td>
<td>800</td>
<td>0.083</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)
```

Table 1: Correlation Table

---

10 The industry characteristic variables for munificence, growth and complexity are non-normally distributed based on Shapiro-Wilks tests; therefore we split the industries into high and low groups and use dichotomous variables to represent the industry characteristics.

11 The dichotomous variables are set to 1 (0) for industries in the high halves, and set to 0 for industries in the low halves.
4. DATA ANALYSIS

4.1. Direct Effects of IT Capability Types

**Aggregate IT Capability**

Previous studies focused on the relationship between IT capability and performance have utilized an aggregate measure of IT capability. This paper argues that researchers should utilize disaggregate measures where possible as the aggregation results in a noisy coarse-grained indicator that confounds the effects of different types of IT capabilities, leading to incorrect conclusions about the performance implication of IT capabilities. To demonstrate that and provide a base-line comparison with prior work, we first examine the IT capability – firm performance relationship using an aggregate measure of IT capability.

Information Week’s research articles refer to the top 100 as the “leaders” in IT and the more recent Information Week 500 listings only rank the top 100 and identify 400 additional followers. Therefore, as a method of considering the aggregate effect of IT capabilities for our dataset, we adopt this convention and designate a firm as having superior aggregate IT capability if it appears in the list of 100 leaders.

To assess the direct effects of the aggregate IT capabilities on firm performance, we estimate the following base model:

\[
FP_t = FP_{t-1} + \text{Aggregate IT Cap.} + \text{munificence} + \text{dynamism} + \text{complexity} + \text{industry dummies} + \text{year dummies}
\]

\(FP\) denotes financial performance, \(t\) represents the time period, and \text{Aggregate IT Cap} is a dichotomous variable that represents the aggregate IT capabilities. We also include industry
dummies and year dummies to control for fixed effects (e.g., effects of macroeconomic factors on stock prices). If correlated with the independent variables, these effects may bias the regression coefficients. Similarly, we include dummies to control for environmental conditions (munificence, dynamism, complexity) that may explain variation in performance values across industries.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Prior N</th>
<th>Performance</th>
<th>Aggregate IT Cap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>686</td>
<td>.548 ***</td>
<td>-.004</td>
</tr>
<tr>
<td>ROA</td>
<td>686</td>
<td>.482 ***</td>
<td>.001</td>
</tr>
<tr>
<td>OIS</td>
<td>666</td>
<td>.926 ***</td>
<td>.005</td>
</tr>
<tr>
<td>OIA</td>
<td>666</td>
<td>.825 ***</td>
<td>-.003</td>
</tr>
<tr>
<td>OIE</td>
<td>640</td>
<td>.986 ***</td>
<td>3.60</td>
</tr>
<tr>
<td>COGS/S</td>
<td>686</td>
<td>.978 ***</td>
<td>-.007</td>
</tr>
<tr>
<td>SGA/S</td>
<td>537</td>
<td>1.01 ***</td>
<td>.005 *</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 2: Association of Aggregate IT Capability and Firm Performance

Table 2 summarizes the regression results. (To facilitate presentation, only the coefficients on prior performance and IT Capability are tabulated.) Aggregate IT capability is found to be associated with only one performance measure (SGA/S), and the sign is opposite of what one would expect. These results are consistent with Santhanam and Hartono [44] findings of no association between most performance measures and aggregate measure of IT capability. As suggested earlier, one potential reason is that a firm may excel in one category of IT capabilities but not the other. An aggregate IT capability measure that lumps all firms together regardless of which category they excel in, is not likely to explain variation in performance.

---

12 The residuals for all models reported in the paper satisfy distributional assumptions. The normal probability plot of the standardized residuals suggested that the residuals are normally distributed. The plot of standardized residuals against the standardized predicted values indicated linearity and equality of variance. The residual plots also did not indicate the presence of any influential outliers. Multicollinearity was consistently low evidenced by VIF values.
Similarly, an additive aggregate measure that requires superior IT capabilities across categories may not explain variations in performance, since under the right environmental conditions, firms that excel in only one category of IT capabilities (and therefore classified as not having superior aggregate IT capability) may actually perform better. The risk involved in using aggregate measure of IT capability therefore is that a researcher may conclude that the posited association between IT capabilities and firm performance is not supported (a type II error).

*IT Capability Types*

To test our contingency model, we first examine the direct effects of externally-focused and internally-focused IT capabilities. To accomplish this, we estimate a similar model to that used in Table 2:

\[
FP_t = FP_{t-1} + Ext_{IT\_Cap} + Int_{IT\_Cap} + munificence + dynamism + complexity + industry dummies + year dummies
\]

where *Ext_{IT\_Cap}* and *Int_{IT\_Cap}* are dichotomous variables that respectively represent the externally-focused and internally-focused IT capabilities. The coefficients on these variables will indicate whether the externally-focused and internally-focused IT capabilities have a statistically significance association with performance. Table 3 provides the regression results.
In comparison with the aggregate IT capability associations reported in Table 2, we find IT capability types demonstrating positive and negative contemporaneous results. The results show that, on average, externally-focused IT capabilities have a positive impact on performance (positively associate with profit measures and negatively associated with cost measures). By contrast, the analysis suggests that the contemporaneous impact of internally-focused IT capabilities is negative, on average. This is consistent with Hitt et al. [26] who document that ERP projects may result in reduction of productivity and efficiency due to the learning and implementation of a new system as well as potential maintaining an existing system. Hitt’s work also demonstrates a positive relationship between ERP implementation and the Tobin’s q value of a firm. This suggests that shareholders believe that these investments may help firms over the long run. This is consistent with other IS literature which indicates that there may be a learning curve associated with IS investments.

Due to data restrictions, Hitt et al. were unable to test the association in future years on actual performance; however, our archival data set allows us to examine the association between performance and the IT capability types in the year immediately following the IW listing (t+1) and also in the following year (t+2) as shown in Table 4.

Table 3: Main Effects of Externally-focused and Internally-focused IT Capabilities

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Prior Performance</th>
<th>External IT Cap.</th>
<th>Internal IT Cap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>686</td>
<td>.568 ***</td>
<td>.011 *</td>
</tr>
<tr>
<td>ROA</td>
<td>686</td>
<td>.504 ***</td>
<td>.012 **</td>
</tr>
<tr>
<td>OIS</td>
<td>666</td>
<td>.939 ***</td>
<td>.008 **</td>
</tr>
<tr>
<td>OIA</td>
<td>666</td>
<td>.860 ***</td>
<td>.005</td>
</tr>
<tr>
<td>OIE</td>
<td>640</td>
<td>.988 ***</td>
<td>7.38 ***</td>
</tr>
<tr>
<td>COGS/S</td>
<td>686</td>
<td>.991 ***</td>
<td>-.007 **</td>
</tr>
<tr>
<td>SGA/S</td>
<td>537</td>
<td>1.002 ***</td>
<td>-.001</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>654</td>
<td>.324 ***</td>
<td>-.011</td>
<td>.003</td>
<td>626</td>
<td>.526 ***</td>
<td>-.004</td>
<td>.009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROA</td>
<td>654</td>
<td>.442 ***</td>
<td>-.011</td>
<td>.009</td>
<td>626</td>
<td>.407 ***</td>
<td>-.017 *</td>
<td>.011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIS</td>
<td>637</td>
<td>.792 ***</td>
<td>-.005</td>
<td>.017 **</td>
<td>610</td>
<td>.812 ***</td>
<td>-.004</td>
<td>.016 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIA</td>
<td>637</td>
<td>.683 ***</td>
<td>-.008</td>
<td>.019 ***</td>
<td>610</td>
<td>.614 ***</td>
<td>-.009 *</td>
<td>.014 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIE</td>
<td>613</td>
<td>.750 ***</td>
<td>45.94 *</td>
<td>-14.47</td>
<td>591</td>
<td>.492 ***</td>
<td>40.71</td>
<td>-26.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COGS/S</td>
<td>654</td>
<td>.992 ***</td>
<td>-.000</td>
<td>-.008</td>
<td>626</td>
<td>1.000 ***</td>
<td>.002</td>
<td>-.006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGA/S</td>
<td>515</td>
<td>1.032 ***</td>
<td>-.004</td>
<td>-.007</td>
<td>494</td>
<td>1.041 ***</td>
<td>.002</td>
<td>-.007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 4: Association of IT Capabilities and Firm Performance in Future Years

As the table shows, internally-focused IT capabilities have a positive, though not always significant, relationship with most profit variables in both of the future years. These findings are consistent with the shareholder’s expectations in Hitt et al. [26] analysis of the association between a firm’s Tobin’s q value and ERP implementation. The externally-focused IT capabilities no longer demonstrate a significant and positive association with the profit measures. This suggests that this source of competitive advantage may be temporary which may be due to the potential for competitors to more readily observe and copy capabilities that are directly aimed at assisting customers and external agents.

4.2. Moderating Role of Environmental Conditions

We examine the moderating effects of the environmental factors through two sets of analyses for each of the environmental factors. First, we conduct sub-sample analysis by first splitting our sample into high and low groups that represents the specific environmental factor

---

13 For both of these analyses, t+1 and t+2, we control for prior performance by using performance data from the year before selection to the IW 500 list, time period t-1. The inclusion of prior performance was to control for any performance halo that may have resulted in the firm being included in the Information Week 500. Therefore, prior performance variable is measured at time period t-1 to represent the performance of the organization when it was selected for the IW 500.
and running the model with only direct effects on each sub-sample separately to allow the coefficients and significance level of all variables to freely vary across the high and low groups. Secondly, we run a modification to the base model where we add the dichotomous variable to represent the specific (high and low) environmental factor as well as two interaction terms, one between the environmental factor and the internally-focused IT capability type and one between the environmental factor and the externally-focused IT capability type. \(^{14}\) For example, to test H1a and H1b regarding the moderating role of dynamism, we estimate the following two models.

\[
FP_1 = FP_{(t-1)} + Ext_{-IT\_Cap.} + Int_{-IT\_Cap.} + munificence + complexity + industry dummies + year dummies \quad ^{15}
\]

\[
FP_1 = FP_{(t-1)} + Ext_{-IT\_Cap.} + Int_{-IT\_Cap.} + munificence + dynamism + complexity + dynamism* Ext_{-IT\_Cap} + dynamism* Int_{-IT\_Cap} + industry dummies + year dummies \quad ^{16}
\]

The first model is run separately for each sub sample (high and low groups of dynamism) and allows us to examine how the internally-focused and externally-focused capabilities are associated with performance within these groups. The second model is run on the entire sample and contains interaction terms between dynamism and the IT capability types, while controlling for the other two environmental aspects. A significant coefficient on the interaction term would indicate support for the relevant moderation hypothesis.

\(^{14}\) We have also tested a complete model that includes controls for the two IT capability types, the three environmental conditions and the six interaction terms. Results of the complete model are similar to the results presented within the separate models; however, multicollinearity is a source of concern in the complete model as indicated by variance inflation factors.

\(^{15}\) In testing the potential moderation by munificence, the control for munificence is dropped and a control for dynamism is added. Similarly in testing the moderation by complexity, the control for complexity is dropped from the model and controls are used for munificence and dynamism.

\(^{16}\) In testing the potential moderation by munificence or by complexity, the interaction terms are changed to be either (munificence * ext_IT_cap + munificence * int_IT_cap) or (complexity* ext_IT_cap + complexity* int_IT_cap).
Environmental Dynamism

Table 5 provides the results of our analysis of the moderating role of industry dynamism on the relationship between the two types of IT capabilities and measures of firm performance. It shows the results from analyses on each of the low and high dynamism sub-samples separately, as well as key results from an extended model that includes interaction terms involving dynamism.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ROS</th>
<th>ROA</th>
<th>OIS</th>
<th>OIA</th>
<th>OIE</th>
<th>COGS/S</th>
<th>SGA/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>416</td>
<td>.006</td>
<td>-.013</td>
<td>270</td>
<td>.013 **</td>
<td>-.022 **</td>
<td>686</td>
</tr>
<tr>
<td>ROA</td>
<td>416</td>
<td>.010</td>
<td>-.008</td>
<td>270</td>
<td>.004</td>
<td>-.012 *</td>
<td>686</td>
</tr>
<tr>
<td>OIS</td>
<td>414</td>
<td>.001</td>
<td>.000</td>
<td>252</td>
<td>.017 **</td>
<td>-.013 *</td>
<td>666</td>
</tr>
<tr>
<td>OIA</td>
<td>414</td>
<td>-.001</td>
<td>.001</td>
<td>252</td>
<td>.009 **</td>
<td>-.006</td>
<td>666</td>
</tr>
<tr>
<td>OIE</td>
<td>404</td>
<td>.876</td>
<td>-.1.14</td>
<td>236</td>
<td>15.86 ***</td>
<td>-6.06</td>
<td>640</td>
</tr>
<tr>
<td>COGS/S</td>
<td>416</td>
<td>-.002</td>
<td>-.004</td>
<td>270</td>
<td>-.013 **</td>
<td>.011</td>
<td>686</td>
</tr>
<tr>
<td>SGA/S</td>
<td>363</td>
<td>-.001</td>
<td>.001</td>
<td>174</td>
<td>-.003</td>
<td>.004</td>
<td>537</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 5: The Moderating Role of Environmental Dynamism on the Relationship between Firm Performance and Internally-focused and Externally-focused IT Capabilities

The externally-focused IT capabilities are positively and significantly associated with the profit ratios and negatively associated with the cost of goods ratio under high dynamism. Additionally, there is no significant association under low dynamism. These results are consistent with our hypothesis 1B that externally-focused IT capability is more consequential when the industry is experiencing turbulence. We also see moderating effects (pooled sample with interaction terms) for dynamism on key variables (ois, oia, and oie), providing additional support for hypothesis 1B.
The internally-focused IT capabilities appear to be significant only in the high dynamism industries. However, contrary to expectation, the association is negative (and significant for three of the five) profit ratios and positive (and insignificant) for the cost ratios. Thus, hypothesis 1A is not supported by the data. One suggestion for these results is that as industries experience turbulence, internal IT capabilities may restrict business agility and limit its ability to respond [43]. The only significant relationship identified for the interaction model (pooled sample test for moderation) is COGS/S that indicates weak positive moderation.

**Environmental Munificence**

Table 6 provides the regression results of our analysis of the moderating role of industry munificence on the relationship between the two types of IT capabilities and measures of firm performance.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Low Munificence</th>
<th>High Munificence</th>
<th>Pooled w/ Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>396</td>
<td>.017 *</td>
<td>-.021 **</td>
</tr>
<tr>
<td>ROA</td>
<td>396</td>
<td>.018 **</td>
<td>-.014</td>
</tr>
<tr>
<td>OIS</td>
<td>393</td>
<td>.005</td>
<td>-.003</td>
</tr>
<tr>
<td>OIA</td>
<td>393</td>
<td>.005</td>
<td>-.003</td>
</tr>
<tr>
<td>OIE</td>
<td>384</td>
<td>3.87 *</td>
<td>-.4.55 *</td>
</tr>
<tr>
<td>COGS/S</td>
<td>396</td>
<td>-.003</td>
<td>.000</td>
</tr>
<tr>
<td>SGA/S</td>
<td>353</td>
<td>-.002</td>
<td>.003</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 6: The Moderating Role of Environmental Munificence on the Relationship between Firm Performance and Internally-focused and Externally-focused IT Capabilities

The analysis finds few significant associations between external capabilities and measures of firm performance under either high or low munificence. Additionally, an examination of the models with interaction terms finds no evidence of moderation for externally-focused capabilities. Externally-focused resources were expected (hypothesis 2B) to have a stronger association with performance in the high munificent industries as the market sensing
capabilities may assist in identifying new trends. Wade and Hulland [47] suggest one possible explanation for these results: as markets become more munificent, consumers may focus only on the availability of the goods or services and the capabilities of the firm may not be a significant factor. The association between performance and internally-focused capabilities is generally negative, which is a similar pattern of results observed in the overall sample (Table 3). Internal resources were expected (hypothesis 2A) to have a stronger association with performance in the low munificent industries as strong internal capabilities were predicted to make a firm more competitive in this environment. Thus, both hypotheses (2A and 2B) are not supported by the data.

Environmental Complexity

IT capabilities of all types are expected (H3) to be more beneficial when industry complexity is high, since they enhance the firm’s ability to process information and cope with complexity. Table 7 provides the results of our analysis of the moderating role of complexity on the relationship between the types of IT capabilities and financial performance.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Low Complexity</th>
<th></th>
<th></th>
<th></th>
<th>High Complexity</th>
<th></th>
<th></th>
<th></th>
<th>Pooled w/ Interactions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>273</td>
<td>.003</td>
<td>-.005</td>
<td>413</td>
<td>.018 *</td>
<td>-.025 **</td>
<td>686</td>
<td>.015</td>
<td>-.018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROA</td>
<td>273</td>
<td>.004</td>
<td>-.007</td>
<td>413</td>
<td>.018 **</td>
<td>-.012 *</td>
<td>686</td>
<td>.013</td>
<td>-.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIS</td>
<td>270</td>
<td>.000</td>
<td>.006</td>
<td>396</td>
<td>.016 ***</td>
<td>-.012 **</td>
<td>666</td>
<td>.016 *</td>
<td>-.016 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIA</td>
<td>270</td>
<td>.000</td>
<td>-.003</td>
<td>396</td>
<td>.009 *</td>
<td>-.001</td>
<td>666</td>
<td>.008</td>
<td>.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIE</td>
<td>265</td>
<td>3.63</td>
<td>.168</td>
<td>375</td>
<td>9.59 ***</td>
<td>-3.97</td>
<td>640</td>
<td>4.61</td>
<td>-1.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COGS/S</td>
<td>273</td>
<td>.002</td>
<td>-.005</td>
<td>413</td>
<td>-0.015 ***</td>
<td>.007</td>
<td>686</td>
<td>-.018 **</td>
<td>.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGA/S</td>
<td>233</td>
<td>-.002</td>
<td>-.001</td>
<td>304</td>
<td>-.001</td>
<td>.003</td>
<td>537</td>
<td>.001</td>
<td>.003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 7: The Moderating Role of Environmental Complexity on the Relationship between Firm Performance and Internally-focused and Externally-focused IT Capabilities

Table 7 uses concentration of inputs as the proxy for complexity. Analysis with concentration of outputs as the proxy provides similar results.
The regression results shown in Table 7 indicate that under high complexity, externally-focused IT capabilities are significantly associated with various performance indicators, and the direction of the association is as expected. There is also some evidence of moderation (OIS and COGS/S) for the externally-IT focused capabilities and complexity. Additionally, review of coefficients for the prior performance and fiscal year controls suggest a structural difference between the high and low complexity groups which accounts for the significant relationships in the split sample and less findings in the pooled sample. Therefore, hypothesis 3B receives mixed support. Under high complexity, the internal IT capabilities are negatively associated with the profit ratios and the evidence for moderation for internally-focused IT capabilities is weaker and the direction is opposite of the predicted result. Therefore, hypothesis 3A is not supported.

Combined Effects of Environmental Conditions

Overall, our results suggest that environmental conditions moderate the relationship between IT capability types and performance. However, the results are mixed and this may be because the analysis so far has focused on one environmental characteristic at a time. The relative importance and value of an IT capability depends on the overall environmental condition, and the fit along one dimension (e.g., dynamism) may be counteracted by a misfit along another dimension (e.g., complexity). In other words, the performance implication of an IT capability type depends on its net effect under various environmental characteristics.

We have hypothesized that internally-focused IT capabilities are more likely to have positive performance implications when the firm operates in low munificence, low dynamism and high complexity environments (H4A), and that externally-focused IT capabilities are more likely to have positive performance implications under conditions of high munificence, high
dynamism and high complexity (H4B). To test these hypotheses, we develop two composite metrics to characterize the overall environmental condition in which a firm operates. Consistent with the statements of these two hypotheses, our two composite environmental measures (ext_IT_environmental_composite and int_IT_environmental_composite), corresponding to the two IT capability types, are dummy variables taking the values of one for industries having the specific combination of conditions as shown in Table 8, and zero otherwise.

<table>
<thead>
<tr>
<th>Environmental Condition</th>
<th>Ext_IT_Environmental_Composite</th>
<th>Int_IT_Environmental_Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munificence</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Dynamism</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Complexity</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 8: Environmental Condition Combinations for Dichotomous Variables

The model used in the analysis includes our measures for the IT capability type, the two dichotomous variables indicating the combination of environmental conditions, year and industry dummies, and two interaction terms.\(^\text{18}\) Specifically, we estimate the following model:

\[
FP_t = \alpha_0 + \alpha_1 FP_{t-1} + \alpha_2 \text{Int}_\text{IT}_\text{Cap} + \alpha_3 \text{Ext}_\text{IT}_\text{Cap} + \alpha_4 \text{Int}_\text{IT}_\text{Environmental}_\text{Composite} + \alpha_5 \text{Ext}_\text{IT}_\text{Environmental}_\text{Composite} + \alpha_6 \text{Int}_\text{IT}_\text{Cap} \times \text{Int}_\text{IT}_\text{Environmental}_\text{Composite} + \alpha_7 \text{Ext}_\text{IT}_\text{Cap} \times \text{Ext}_\text{IT}_\text{Environmental}_\text{Composite} + \text{industry dummies} + \text{year dummies}
\]

\(^{18}\text{A full model with individual controls for IT capability types and environmental conditions along with first, second and third level interaction terms produces similar results; however, variance inflation factors are greater than 25 indicating potentially high levels of multicollinearity between the control variables and the interaction variables.\)
The regression results, shown in Table 9, provide support for the hypothesis 4B positing that the relationship between externally-focused IT capabilities and measures of firm performance are moderated by the environmental condition. The effects are positive and strongly significant for three out of the five profit ratios and negative and significant for one of the two cost ratios. However, consistent with our earlier results, the contingency relationship (H4A) involving internally-focused IT is not supported by the data.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>N</th>
<th>Ext Composite</th>
<th>Int Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS</td>
<td>686</td>
<td>.002</td>
<td>-.011</td>
</tr>
<tr>
<td>ROA</td>
<td>686</td>
<td>.005</td>
<td>-.007</td>
</tr>
<tr>
<td>OIS</td>
<td>666</td>
<td>.019 **</td>
<td>-.003</td>
</tr>
<tr>
<td>OIA</td>
<td>666</td>
<td>.025 **</td>
<td>.002</td>
</tr>
<tr>
<td>OIE</td>
<td>640</td>
<td>13.74 **</td>
<td>-1.88</td>
</tr>
<tr>
<td>COGS/S</td>
<td>686</td>
<td>-.016 *</td>
<td>-.001</td>
</tr>
<tr>
<td>SGA/S</td>
<td>537</td>
<td>.001</td>
<td>.000</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.01 (All tests are two-tailed)

Table 9: Test of Moderation of IT Capabilities and the Composite Environmental Conditions

5. CONCLUSION

The findings of this study suggest that the relationship between IT capabilities and firm performance is more complex than scholars have theorized. In particular, the external environment appears to be a significant contingency. More specifically, our analysis provides general support to the proposition that the impact of an IT capability depends on the characteristics of the environment/industry in which the firm competes. Our results also suggest that a fit between the type of IT resources/capabilities possessed by the firm and the demands of the environment will positively affect performance, specifically with regards to externally-oriented IT capabilities. Additionally, our results highlight the risk involved in using overall
aggregate measure of IT capability, showing that it could lead to misleading conclusions (type II errors).

Our analysis of the proposed contingency model contributes to the literature investigating the relation between IT resources and the performance of firms in a number of ways. First, it offers an explanation for the seemingly conflicting findings in the extant literature regarding the impact of aggregate IT capability. Second, it suggests that aggregate measures of IT investments or capability should be used with caution. Indeed, not all IT spending pays off, and a firm may excel in one dimension or type of IT capability, be only average in others, and be below average in still others. The association between aggregate measures of IT capabilities and firm performance depends on, among other things, the net effect of individual components of IT capability in the context of the environment in which the firm operates.

One of the primary limitations of this effort is the ability to understand the impact over time of these investments. Future research should therefore focus on developing and longitudinally tracking direct measures of individual dimensions or components of IT capability and examining their differential impact on process and firm performance. This research focuses on examining the difference in business performance when considering specific types of IT capability based on how IT resources are deployed within the business processes; however, additional research is also needed to explore other possible alternative taxonomies of IT capabilities. As there are many different business models, the characterization of externally and internally focused IT capabilities may be refined into more granular components to support each business model and identify specific business components that will benefit from IT resources under dynamic, munificent or complex environments.
For practitioners responsible for developing and nurturing such capabilities, our findings reinforce the need to align IT investment and deployment decisions with the demands of the environment in which the firm operates since the proper match is likely to increase the payoff from IT. The research results especially suggest that firms operating in environments characterized by high dynamism, high munificence, and high complexity, should place greater emphasis on the development and maintenance of externally-focused IT capabilities in order to maximize the payoffs from their IT investments. Overall, our findings suggest firms should consider their unique industry conditions before making the case for and adopting the latest technology. Improved understanding of these environmental conditions may help firms determine which parts of their business stands to benefit the most from investments in information technology and act proactively.
REFERENCES


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