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The effects of firm IT capabilities on firm performance: the mediating effects of process improvement

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The Effects of Firm IT Capabilities on Firm Performance: The Mediating Effects of Process Improvement

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Abstract

Prior research has examined the direct relationship between the firm IT capabilities and firm performance. Here, we extend that stream of literature and examine the mediating effects of performance at the process level on the relationship between firm IT capabilities and firm performance. This paper draws on the resource-based theory and the dynamic capabilities perspective to develop a theoretical framework to examine the mediated effects. The results suggest that the effect of firm IT capabilities on firm performance is mediated through performance at the process level.

Keywords

Firm performance, business value of IT, resource-based view, dynamic capabilities, process improvement.

INTRODUCTION

Researchers have extensively investigated the effects of IT investments on firm performance. Early studies conducted in the 1980's analysing this relationship suggested that IT investments were not associated with productivity gains, a finding later termed as the "Productive Paradox" (Roach et al. 1987; Solow 1987; Strassmann 1990). Later empirical studies, though, reported a positive effect of IT investments on firm performance (Brynjolfsson et al. 1996). Those studies also articulated a number of alternative explanations for the initial productivity paradox findings. These included the unavailability of appropriate data, the possibility of inaccurate measurements, time lags due to learning and adjustment, redistribution and dissipation of profits, and not accounting for indirect benefits of IT (Brynjolfsson et al. 2000; Brynjolfsson et al. 1996; Devaraj et al. 2003).

The literature examining the productivity paradox has generated a number of insights. One interesting finding emerging from that stream of research is the mediating effect of process change on the relationship between IT investments and firm performance. Prior literature has argued that examining the effects of IT directly at the firm level do not account for the intangible/indirect benefits of IT capabilities (Brynjolfsson et al. 2000; Brynjolfsson et al. 1996; Mooney et al. 1996). Our objective in this paper is to extend that stream of research. Specifically, the research question we investigate in this paper is the effect of specific capabilities of IT on performance gains at both the process level and the firm level. Examining the influence of IT capabilities at the process level enables us to investigate how IT capabilities renew the existing ways of performing activities in the intermediate processes of the firms (Barua et al. 1995; Mooney et al. 1996). To do that, the paper draws on the resource based theory and the dynamic capabilities perspective to develop and test a model of the effect of IT capabilities on firm performance. The paper begins with an overview of the extant literature and develops a theoretical model. Next, it presents the constructs and instruments employed to operationalise the constructs. A description of the data collection methodology and the analytic techniques employed to test the research model follows. The results support a presence of mediating effect of process-level performance. The paper concludes with a discussion of theoretical and practical implication, the limitations and directions for future research.

LITERATURE REVIEW

The resource-based theory (RBT) has been one of the key theoretical perspectives employed to explain the

relationship between IT and firm performance (Barney 1991). According to this perspective, firms achieve competitive advantage and superior firm performance through the synergistic mix of valuable, rare, inimitable and non-substitutable (VRIN) resources that they possess (Barney 1991). RBT posits that the resources that enable firms to achieve competitive advantage are heterogeneously distributed across firms and that these differences between firms remain stable over time (Barney 1991). Further, RBT asserts that firms use these resource to implement strategies by effectively and efficiently developing capabilities that can be leveraged to sustain competitive advantage (Barney 1991).

The dynamic capabilities (DC) perspective extends the RBT by emphasising the importance of continuous renewal of resources for improved firm performance (Eisenhardt et al. 2000; Teece et al. 1997). This contrasts with RBT, where the role of resource picking is emphasised (Barney 1991). The DC perspective, in contrast, focuses on resource creation through a reconfiguration of existing resources (Eisenhardt et al. 2000). The DC perspective argues for the significant role of organisational and strategic routines in firm performance. A firm's strategic routines must integrate, reconfigure, gain and release available resources to adapt to changes in the external environment (Eisenhardt et al. 2000; Teece et al. 1997).

A key finding from prior research is that there is no direct relationship between IT and firm performance (Barua et al. 1995). Rather, the effect of IT on firm performance is mediated through a complex chain of intermediate variables (Mooney et al. 1996). Firms must utilise the capabilities of their IT to improve the performance of their business processes; this is where the first order effects of IT emerge. Examining the effects of IT at a firm's process level has been shown to provide deeper insights on the contributions of IT towards firm performance (McAfee et al. 2008; Mooney et al. 1996).The process-oriented framework advocates a process view approach to examining the business value of IT.

Few studies investigating the relationship between IT and firm performance have accounted for the impacts of IT at the process level and have generated valuable insights. For instance, Soto-Acosta and Meririo-Cerdan (2008) focused solely on a specific process, the online procurements process and its impact on the creation of business value. Similarly, Jeffers et al.(2008) focused on the effects of customer service process performance on firm performance. Anand and Fosso Wamba (2013) examined the effects of RFID capabilities on firm performance mediated through intermediate variables. While the above studies investigate the first order effects of IT, they tend to focus narrowly on specific processes or technology. There remains a need to extend prior research by examining the mediating role of performance at the process level on the relationship between firm IT capabilities and performance at the organisational level. In particular, there remains a need to examine the direct and indirect effects of IT on firm performance. To examine these effects, we propose the following research model (Figure 1).

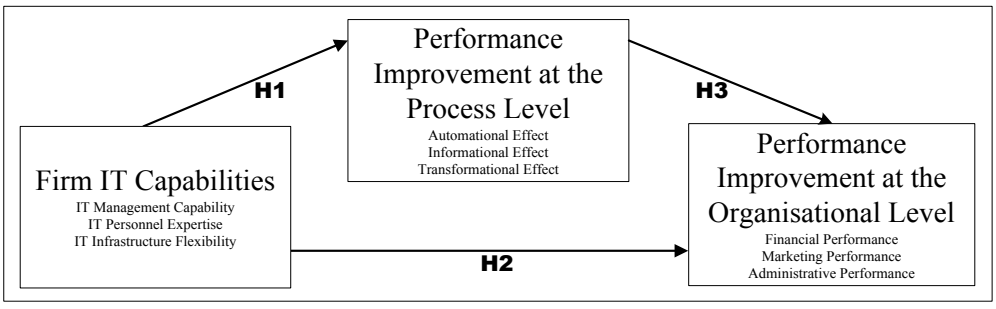

Figure 1: Research Model

Theory and Hypotheses

We argue here that firms can leverage their firm IT capabilities to improve the performance of their process. Process-level performance improvements, in turn, influence performance at the organisational level. These linkages form the basis of the research hypotheses indicated in Figure 1. These are more fully developed in the following discussion.

Firm IT Capabilities

Organisational capabilities reflect the ability of an organisation to combine its resources in such a way that better quality and performance at the organisational level are achieved (Amit et al. 1993). IT capabilities refer to the ability of an organisation to combine its IT resources to adapt to changing environments and to sustain its

competitive advantage. Kim et al. (2011) identified three dimensions of a firm's IT capabilities: IT management capabilities, IT personnel expertise and IT infrastructure flexibilities. They argued that these dimensions are interrelated and that the synergies between these dimensions enable firms to change their business processes, which in turn, lead to superior firm performance.

IT management capabilities are defined as the ability of an organisation's IT and management staff to administer IT resources and transform them for the creation of business value (Peppard 2007). IT management capability refers to the management of all heterogeneous IT components within the firm. IT management capability is noticeable in the areas of planning, investment decision making, coordination and control (Bhatt et al. 2005; Kim et al. 2011). Management staff within a firm must observe the transitions and changes in external markets to identify opportunities and threats. Changes in the external environment may necessitate manipulation of existing business strategies to sustain competitive advantage. In order to support these renewed strategies, IT management must take appropriate actions to ensure the alignment of IT resources with business strategies. IT resources and business strategies are interwoven. Feeny and Willcocks (1998) argue that IT resources influence business strategies, and that business strategies have an influence on IT resources. Ravichandran and Lertwongsatien (2005) identify that when a firm's IT resources are controlled by a higher level of management, they receive better support. This, in turn, influences the effectiveness of changes in the business processes, products and services of the firm. Melville (2004) noted that successful implementation of business process innovations requires the deployment of the right IT in the right business process.

IT personnel expertise is defined as the fundamental skills that a firm's IT staff possess (Lee et al. 1995). It is critical that a firm's IT staff hold a combination of skills (e.g. awareness and management of IT), knowledge of IT elements (e.g. knowledge about operating systems, databases, networks security and programming), and knowledge of technology management for the efficient management of a firm's IT resources. However, IT personnel expertise becomes an intangible asset for firms when IT personnel understand how the firm's business strategies are combined with IT skills (Feeny et al. 1998; Rockart et al. 1996; Ross et al. 1996). As IT becomes an integral part of business operations, IT personnel who hold business knowledge are able to formulate effective IT solutions and leverage their technical skills to align the firm's strategies to changing environments. Therefore, firms with competent IT personnel have a higher chance of meeting the demands of changing environments by aligning IT strategies with business strategies, developing reliable and cost effective systems, and anticipating IT needs for business services better than their competition (Bhatt et al. 2005; Kim et al. 2011; Rockart et al. 1996).

IT infrastructure flexibility is defined as a firm's ability to develop, diffuse and maintain various information systems efficiently in the context of changing business environments, market needs and strategies (Weill et al. 2002). IT infrastructures in organisations are composed of all IT assets such as software (e.g. CRM, SCM, HR payroll), hardware (e.g. computers, servers, network and communication devices) and data to support the information systems. Duncan (1995) identified the strategic potential of IT resources as sharable and reusable possessions of a firm. Flexibility in the IT infrastructure tends to evolve independently, integrating with new technologies and supporting the continuous changes in the alignment of IT resources to business strategies. This flexibility enables the IT resources that provide the foundation for a firm's existing business processes to support future applications also (Duncan 1995). For a firm to have the ability to reengineer its business processes, it must rely on the flexibility of its resources and their applications. Greater IT infrastructure flexibility enables firms to accommodate required changes and maximise the advantages provided by their existing resources more effectively than their competition. Studies indicate that flexible IT infrastructure can facilitate the achievement of integration and modularity among and within information systems (Byrd et al. 2001).

Performance Improvements at Process Level

Prior research argues that first order effects of IT resources and IT capabilities occur at the process level (Barua et al. 1995; Grant 1991; Mooney et al. 1996). The primary influence of IT at the process level can be understood based on Zuboff's (1988) conceptualisation, which categorises the effects of IT into three distinct categories: automate, informate and transform. Automate effects refer to replacing human labour through the automation of a business process. Informate effects refer to providing information on business processes to senior management. Transform effects refer to firms redefining their business processes and relationships.

Automational effects refer to the efficiencies resulting from utilising IT, primarily by replacing human labour in the firm's business processes. In other words, efficiency in the organisation is primarily captured by automating manual processes and substituting labour based activities. Automational effects are directly associated with the performance of operational processes and are reflected by savings in labour costs and inventory costs, and in increased reliability, throughput and routinisation (Mooney et al. 1996).

Informational effects follow from IT's capability to collect, store, process and disseminate information. Improvements through automation at the operational level are also associated with enhanced data capture. Firms with centralised data are able to exert enhanced control over information processing, thereby making information and analyses available across the firm. This enables greater transparency and control over business processes. It also improves the timeliness and quality of decisions, which is reflected by improved decision quality, responsiveness, empowerment and effectiveness of resource use. Further, effective use of information improves the efficiency of administrative tasks and improves the effectiveness of control, communication and planning processes (Mooney et al. 1996). Informational effects are reflected primarily in improvements to management processes (Mooney et al. 1996).

Transformational effects refer to the value captured by firms through IT-enabled changes to their structures and processes, often referred to as reengineering of business processes. Process transformations support a firm's core processes such as customer relationship management and new product development (Mooney et al. 1996).

Performance Improvements at Organisational Level

Firm financial performance has been the primary dependent variable employed in prior studies investigating the effects of IT capabilities on organisational level performance. For example, Santhanam and Hartono (2003) investigated the direct effects of IT capabilities on firm performance. In their research, financial indicators, such as variations between the profit ratios and cost ratios were employed to operationalise firm performance. They reported that firms with superior IT capabilities exhibited superior current and sustained firm performance. In a similar study where performance was operationalised in terms of various profit and cost based performance measures, Bharadwaj (2000) reported that firms with high IT capability outperformed firms with low IT capabilities.

Another perspective on firm-level performance is provided by Tallon et al.(2000), who identified four different foci of performance: operations focus, market focus, dual focus and unfocused approach. These were employed to describe how each firm utilised IT resources/IT capabilities. In an operations focus, the focus of IT investments is to reduce operating costs while improving the quality, speed and time to market. Market focused firms utilise IT to create and enhance value propositions for their customers. Dual focused firms employ a mixture of operations focus and market focus, while unfocused firms do not have a specific focus.

Tallon et al.'s (2000) perspective opens up many more avenues for research investigating the effects of IT capabilities on performance. Their perspective contrasts with prior research that focuses on improvements in financial performance at the organisational level. It also argues for a contingency-based approach towards selecting firm-level measures of performance when investigating the relationship between IT and firm performance. Specifically, Tallon et al. argued that financial performance measures can be appropriate when investigating firms that are operations focused; however, utilising the same measures to investigate firms that are market focused would be inappropriate.

Evan (1966) and Damanpour and Evan (1984) investigated the linkage between technological innovations and administrative innovations. They emphasise that firms introduce changes to their structures and processes in order to maintain or improve performance. While IT resources/IT capabilities enable firms to improve financial performance and marketing performance, they also enable firms to achieve better control over their resources, enhance better coordination across a firm and allow firms to better plan for the future. Hence, IT investments also result in improved administrative performance.

Following from the above discussion, this research treats performance improvement at the organisational level as a multidimensional construct consisting of three dimensions: financial performance, marketing performance and administrative performance. Financial performance refers to a firm's profitability and cost position. Marketing performance refers to an organisational focus towards creating value for customers through customer satisfaction, price reduction, and providing new products and services. Administrational performance refers to a firm's improved control over its resources, enhanced co-ordination among and within organisations, and the ability to foresee the future and prepare for changes.

Following from the above discussion, we propose the following three hypotheses:

H1: Firm IT Capabilities have a significant positive effect on performance improvement at the process level.

H2: Firm IT Capabilities have a significant positive effect on performance improvement at the organisational level.

H3: Firm IT Capabilities have a significant positive indirect effect on performance improvement at the organisational level, which is mediated through a positive effect on performance improvement at the process level.

RESEARCH METHODOLOGY

The methodology employed in this research is adapted from Seddon and colleagues (Bhattacharya et al. 2010; Seddon et al. 2010). It involves collecting secondary data from archival sources, coding the data on the constructs in the research model, and testing the hypotheses based on the coded data. Specifically, Seddon and colleagues collected data on cases of ERP implementation published on SAP's website. Following their strategy, this research collected data on cases of the implementation of healthcare IT applications, such as electronic health records, computerised physician order entry, picture archiving and communication systems, enterprise resource planning and enterprise application integration. The cases were collected from the websites of leading vendors and consultants in the IT products and solutions industry (USmetros 2012). The websites search included Thomson Reuters, SAP, IBM, Cisco, TCS, McKesson, Cerner, Microsoft, iSoft and RFID Journal. The search was limited to case studies documented between 2002 and 2012. A total of 100 cases were identified for inclusion in the analysis.

Each case was analysed individually by the first author to rate it on the items operationalising the constructs in the research model. Specifically, the case studies were coded on IT management capabilities, IT personnel expertise, IT infrastructure flexibility, automational effect, informational effect, transformational effect, financial performance, marketing performance, and administrative performance (see Figure 1). A 3-point scale (2-4) was employed to rate the strength of the constructs: 2 corresponds to a low value, 3 corresponds to a medium value and a value of 4 corresponds to a high value. Where there was no evidence to rate a construct, it was treated as a missing value and labelled as 1.Table 1shows some sample excerpts based on which the constructs were rated, and the corresponding ratings. Table 2 shows an extract from the data file generated through the coding process.

Table 1.Sample Item Ratings from the Cases

Case No.	Sample Excerpts	Item rated	Assigned Score
83	"Because we can be more efficient, we feel that patients may have a higher level of satisfaction"	Marketing Performance	2
37	"Our meetings are more productive and focused because we get some things done in real time using this collaborative tool (IT system) that has us all engaged"	Automational Effect	2
59	"With the automated processes in SQL Server 2012 and in SQL Server 2012 Analysis Services and Reporting Services, we've cut the time needed to maintain some reports from one or two days to a few hours per month."	Automational Effect	3
82	"Significant cost savings thanks to a reduction in the number of point-to-point connections… we have reduced our IT support costs by 50%"	Financial Performance	3
54	"To enhance the operational efficiencies, [The hospital] felt the need to improve its procurement system We knew what the bottlenecks were. After we looked closely at the IT systems, it became obvious that we had some infrastructure related issues. What we needed was a solution that would facilitate collaboration, automate internal processes, provide a central location for sharing information and, above all, provide complete transparency." "With the implementation of the Store Indent Management system developed on SharePoint, the hospital can now automate the full cycle of putting in a requisition for approval along with real time information of stock availability... With process automation, we have streamlined our internal procurement operations, so that we can focus on our strategic work… [The hospital] has eliminated several manual IT tasks and saves considerable time through process automation"	IT Management Capabilities	4

Table 2.Sample Extract from the Dataset

Case No.	ITMC	ITPE	ITIF	AE	IE	TE	FP	MP	AP
62	1	1	1	2	2	2	2	2	2

63	1	1	1	2	2	2	2	2	2
64	2	2	2	2	2	2	2	2	2
65	2	2	2	3	3	3	4	4	4
66	3	3	3	2	2	2	2.5	3	2
67	2	2	2	2	2	2	1	1	1

ITMC: IT Management capabilities, ITPE: IT Personnel expertise, ITIF: IT Infrastructure flexibility, AE: Automational effect, IE: Informational effect, TE: Transformational effect, FP: Financial performance, MP: Marketing performance, AP: Administrative performance

ANALYSIS

The item scores collected through the rating process were employed to create construct scores as per the discussion in the Theory and Hypotheses section. Specifically, firm IT capabilities was computed as the sum of IT management capabilities, IT personnel expertise and IT infrastructure flexibility; performance improvement at the process level was computed as the sum of automational effect, informational effect and transformational effect; and performance improvement at the organisational level was computed as the sum of financial performance, marketing performance, and administrative performance.

A key issue in computing the construct scores was how to treat missing values in item scores (see Table 2). The number of missing values for items ranged from 14 to 66 across the 100 cases in the dataset. Following Cohen et al. (2002), the mean substitution protocol was employed to replace the missing values. This protocol involves replacing the missing values by the mean values of the items for which the data is available. This is a valid protocol under the assumption that items reflect the same construct. The constructs computed employing this protocol displayed acceptable levels of internal reliability. Cronbach alphas for the constructs firm IT capabilities, performance improvements at the process level and performance improvements at the organisational level were .81, .71 and .79 respectively.

The hypotheses are tested employing Preacher and Hayes' Bootstrapping Procedure for testing meditated effects. The computations were performed utilising SPSS-based macros from Preacher and Hayes (2004). In addition to the results from the bootstrapping procedure to test the indirect effects, Preacher and Hayes' macro also provides analysis of descriptive statistics and the results from two alternative protocols for testing mediated effects, viz. Baron and Kenny's multiple regression procedure and Sobel's test. The Preacher and Hayes protocol avoids validity threats arising from the assumptions of normality distribution and measurement errors associated with Baron and Kenny's Multiple Regression Procedure and Sobel's Test (Preacher et al. 2004).

RESULTS

Table 3 reports the correlation matrix and Table 4 reports the results from Preacher and Hayes' bootstrapping protocol.

Table 3. Correlation Matrix

	Firm IT Capabilities	Performance at the Process Level
Performance at the Process Level	**.25*** (N= 86)	1.000
Performance at the Organisational Level	**.29**** (N= 79)	**.33*** (N= 87)

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table 4. Results from Preacher and Hayes' Bootstrapping Procedure

VARIABLES IN SIMPLE MEDIATION MODEL
Y: Performance at the Organisational Level, X: Firm IT Capabilities, M: Performance at the Process Level

DIRECT AND TOTAL EFFECTS

	Coeff	s.e.	t	Sig(two)
b(YX)	.2754	.0960	2.8686	.0053
b(MX)	.1914	.0999	1.9168	.0590
b(YM.X)	.2613	.1068	2.4461	.0168
b(YX.M)	.2253	.0952	2.3668	.0205

INDIRECT EFFECT AND SIGNIFICANCE USING NORMAL DISTRIBUTION

	Value	s.e.	LL95CI	UL95CI	Z	Sig(two)
Effect	.0500	.0348	-.0182	.1183	1.4363	.1509

BOOTSTRAP RESULTS FOR INDIRECT EFFECT

	Data	Mean	s.e.	LL99 CI	UL99CI	LL95CI	UL95CI
Effect	.0500	.0502	.0326	-.0146	.1608	.0002	.1269

NUMBER OF BOOTSTRAP RESAMPLES: 5000 and SAMPLE SIZE: 78

Table 4 shows the bootstrap estimates of the indirect effect and the 95% and 99% confidence intervals for the estimate. The statistics are interpreted as: b(YX) is the total effect of firm IT capabilities on performance improvement at the organisational level (test of H2); b(MX) is the effect of firm IT capabilities on performance improvement at the process level (test of H1); b(YM.X) is the effect of performance improvements at the process level on performance improvements at the organisation level (test of H3), controlling for the firm IT capabilities; and b(YX.M) is the direct effect of the firm IT capabilities on the performance at the organisational level, controlling for performance at the process level (test of H3).

Overall, the results from the analysis support all the three proposed hypotheses (Table 5).

Table 5. Results[1]

No	Hypothesis	Test Statistic (Table 4)	Results
H1	Firm IT Capabilities have a significant positive effect on performance improvement at the process level	b(MX)	Supported
H2	Firm IT Capabilities have a significant positive effect on performance improvement at the organisational level	b(YX)	Supported
H3	Firm IT Capabilities have a significant positive indirect effect on performance improvement at the organisational level, which is mediated through a positive effect on performance improvement at the process level.	b(YM.X) b(YX.M)	Supported

[1] The results are based on excluding three outliers. See Discussion for analysis of outlier data points.

DISCUSSION

This paper has developed and tested a theoretical model hypothesising a partial mediating effect of performance improvement at the process level on the relationship between firm IT capabilities and performance improvement at the organisational level. The results find that the effects of firm IT capabilities on performance improvement at the organisational level are mediated through performance improvements in process level performance.

This research makes a number of contributions to the research streams examining the effects of IT on firm performance. In particular, while prior research has investigated the direct effects of firm IT capabilities on financial performance (Bharadwaj et al. 1999; Kim et al. 2011), this paper argues that relationship between firm IT capabilities and firm performance is much more complex than simple direct effects. The theoretical framework developed in this paper accounts for the influences of the web of intermediate factors that mediate the effects of firm IT capabilities on firm performance.

Further, while prior research examining the process level effects has provided valuable insights, these studies were limited to specific business processes such as online procurement processes and customer service processes (Fink et al. 2007; Jeffers et al. 2008; Soto-Acosta et al. 2008) or specific technologies such as radio frequency identification (Anand et al. 2013). Therefore, in order to examine the aggregated effects of firm IT capabilities on performance improvements at the process level, in this paper we have operationalised the construct performance improvements at the process level by three factors: automational, informational and transformational effects (Mooney et al. 1996; Zuboff 1988). As per our knowledge, the findings from this research is novel as it is one of the first attempts to empirically test the aggregated effects of firm IT capabilities on process level improvements of the firms.

While Tallon et al. (2000) study provided valuable insights on organisational level measures and identified four different foci of firm performance: operations focus, market focus, dual focus and unfocused approach. This paper extends their work as the framework developed extends the firm level measures into marketing and administrative performance to capture the indirect effects in additional to the financial performance measures. This is in contrast to prior research, which has primarily employed financial performance as the key indicators of organisational performance. Therefore, the framework in this paper can also be employed to examine the effects of IT of firms that are market focused, operation focused, dual focused and unfocused. Accordingly, in additional to the results supporting most of the prior studies (Bharadwaj 2000; Bharadwaj et al. 1999; Karimi et

al. 2007), the proposed framework in this research is distinct and has extended the construct of firm level performance using multiple measures.

Extending the resource-based theory, the results from this study suggest that possession of VRIN resources may not automatically result in firms capturing sustained competitive advantage. Rather, sustained competitive advantage may depend on the ability of firms to create synergetic effects between resources through various organisational capabilities. We speculate that organisational capabilities adapt their business processes to take advantage of IT capabilities may be critical to capturing sustained competitive advantage. This research suggests that examining the effects of firm IT capabilities at the process level may be a fruitful area for future research.

The findings of this research also have important implications for practice. Specifically, the results suggest that organisations that develop capabilities to reconfigure business processes to take advantage of IT capabilities may be in a better position to capture performance gains from their IT investments and obtain sustained competitive advantage. For managers undertaking investments in IT, the findings suggest that developing capabilities to redefine their business processes may be equally important. The findings also suggest that once organisations are able to capture performance gains at the process level, there is a high likelihood of those gains will translate to performance gains at the organisational level. Managers can argue with confidence for the role of IT in implementing business strategies and improving firm performance.

Analysis of validity threats

The results of this research are subject to a number of validity threats and need to be interpreted with caution. One validity threat arises from the effect of outliers on the findings. The results reported in Tables 3, 4 and 5 exclude three data points that were identified as outliers. We conducted multiple regression diagnostics, including data plots, residual plots, outlier analysis and influence analysis to test for the assumptions of linearity, independence, homoscedasticity and normality that underpin the computation of regression coefficients (Cohen et al. 2002; Pedhazur et al. 1991). The analysis identified 3 data points as outliers: the studentised residual values were greater than |2| (Cohen et al. 2002; Pedhazur et al. 1991). Those three data points were excluded from further analysis.

Table 6. Regression Diagnostics

Outlier Analysis					
Case No.	PRE	RES	ZPR	ZRE	SRE
65	2.804	1.195	-0.625	2.124	2.163
86	3.255	-1.255	2.219	-2.230	-2.320
87	2.731	1.268	-1.084	2.254	2.294

PRE: Unstandardised predicted value, RES: Unstandardised residual, ZPR: Standardised predicted value, ZRE: standardised residuals, SRE: studentised residuals.

Another validity threat arises from testing an underspecified research model (Figure 1). Specifically, the research model and the analysis do not control for the effect of a number of variables that have been hypothesised in prior research to influence process level performance as well as organisational level performance, for instance, variables such as size, agility, and prior performance. Further, the findings are based on firms in the healthcare industry only and may not be generalisable to other industries. In addition, the cases were rated by one rater only and it is not possible to report an inter-rater reliability for the ratings.

An important validity threat arises from the manner in which missing values were treated. As reported in the Analysis section, the number of missing values for items ranged from 14 to 66 across the 100 cases in the dataset. Excluding all data points with missing values would have resulted in only 18 cases being available for analysis. A mean substitution protocol allowed us to increase the number of data points available for analysis. However, it is not possible to evaluate if the results would hold if the mean substitution protocol had not been employed.

The study also reveals a number of issues that raise concerns for the applicability of the methodology employed here. Since data collection relies on case studies published by vendors primarily as a public relations exercise, there is no guarantee that variables included in any research model tested retrospectively on such a data set would be included in the case descriptions. We speculate that research conducted employing this methodology is likely to encounter a large number of missing values. The findings from studies employing this methodology for data collection may not be able to address the validity threat arising from the treatment of missing values. The primary data in the methodology is publicly available case descriptions of successful cases published by vendors. Such descriptions are likely to include exaggerated claims as well as restrictions on the data published.

Specifically, we did not encounter any cases where there were negative impacts of IT on performance. Anecdotal evidence from a number of sources suggests that IT failures are fairly common. Such biases in the sources of primary data raise concerns regarding the validity of findings generated from such a data set. A richer understanding of the phenomena examined would require other data collection strategies, including fieldwork, observations and interviews. Overall, while the methodology employed provides easy access to data, the findings are subject to a number of validity threats.

CONCLUSION

The research framework proposed in this study is a direct response to the calls of a more inclusive and comprehensive approach to measure the intangible benefits of IT. This study theorised that firm IT capabilities exert a direct effect on performance improvements at the organisational level as well as an indirect effect mediated through performance improvements at the process level. The findings show that the effect of firm IT capabilities on firm performance is mediated through process level performance. The findings from this research challenge the traditional views that focus on firm level performance as the primary indicator to examine the effects of IT capabilities. Further, the findings support a critical argument underpinning the dynamic capabilities perspective that firms capture performance gains from IT when they employ the capabilities of IT to reconfigure their business processes.

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