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# INFORMATION TECHNOLOGY AND PROCESS PERFORMANCE: AN EMPIRICAL INVESTIGATION OF THE COMPLEMENTARITIES BETWEEN *IT* AND *NON-IT* RESOURCES

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## Abstract

*Drawing on the resource-based view of the firm, which has emerged as a potential integrating paradigm for strategy research, this research proposes and tests an integrated framework to explain how IT may influence firm performance. The framework recognizes that IT is most likely to affect a firm's performance through its impact on intermediate processes, and draws on resource-based theory to examine how IT resources and capabilities can create business value and provide a competitive advantage. Specifically, we develop hypotheses regarding the differential and complementary role of various IT resources and non-IT (Human and Business) resources and capabilities in achieving quality customer-centric focus for the firm, a critical cross-functional intermediate performance metric. These hypotheses are currently being empirically tested in the context of the third party logistics (3PL) industry, in which this customer focus is widely perceived as being strategically important with IT playing a significant, if not pivotal role. The potential contributions of the work are discussed.*

**Keywords:** Competitive advantage, resource-based theory, IT resources and managerial capability, IT complementarities, business value of IT

## Introduction

The rapid growth in IT investments during the last decade has generated significant interest among academics and practitioners as to whether, and if so, how IT investments are paying off. Although recent empirical studies (Brynjolfsson and Hitt 1996; Lee and Barua 1999; Menon et al. 2000) show that IT spending is associated with increased firm output (thus dispelling the so-called “productivity paradox” at the firm level), empirical studies examining the relationship between IT investments and measures of financial and competitive performance report mixed findings (Strassmann 1990, 1997; Hitt and Brynjolfsson 1996; Brynjolfsson and Yang 1997; Bharadwaj et al. 1999). Such mixed empirical findings call for better models to explain the relationship between IT and firm performance. Researchers, for example, have argued that IT impact should be examined at the level of a business process, as opposed to the firm-level, because it is at the level of the process where their first-order effects of IT are expected to be realized (Barua et al. 1995, Mooney et al. 1995). Others have argued for a contingency perspective that takes into consideration IT managerial aspects that may mediate or moderate the payoff from IT spending (Weill 1992, Soh and Markus 1995).

The focus of this research is to propose and test a new theoretical framework that integrates the above two perspectives together with a third perspective focusing on the complementary role of IT. Specifically, drawing on the resource-based theory, we argue that the mixed empirical findings to date may be on account of singular focus on IT spending and failure to control for the direct effects of non-IT resources and capabilities and the complementarities between IT and those non-IT resources and capabilities. While a number of IS scholars have drawn on resource-based view (RBV) to address the question of competitive advantages from IT, most of the work to date has been largely conceptual (Mata et al. 1995; Ross et al. 1996; Jarvenpaa and Leidner 1998). The

few recent empirical tests of RBV in the IT domain were either conducted at the level of the firm (Powell and Dent-Micallef 1997; Bharadwaj 2000), used perceptual peer ratings of firms as an indicator of IT capability (Bharadwaj 2000), did not consider the role of IT managerial capabilities in translating IT investments into business values (Powell and Dent-Micallef 1997) or the complementarities between IT and non-IT resources (Ray et al. 2002). Using our proposed integrated framework, specific hypotheses are developed and discussed. These hypotheses are currently being tested by examining the determinants of the effectiveness of the customer service process in a sample of companies in the third party logistics (3PL) industry.

The rest of this paper is organized as follows. In the next section two, the theoretical framework is proposed. Specific hypothesis are then developed and discussed. Subsequently, we describe the research methodology designed to test these hypotheses by examining the determinants of the effectiveness of the customer service process in a sample of companies in the third party logistics (3PL) industry.

## **Theory and Research Hypotheses**

The resource-based view focuses on competitive advantages accruing to firms that control scarce firm-specific resources—the tangible and intangible assets and capabilities that firms use to develop and implement their business strategies. 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 sustained competitive advantage (Barney 1991). A resource can be imperfectly imitable in the presence of isolating mechanisms, such as path dependence, causal ambiguity, social complexity, team-embodied skills, and so forth (Barney 1991).

While competitive advantage, sustained or otherwise, is often thought of as a firm-level notion, several researchers have identified business processes as the basic unit of competitive advantage, arguing that business processes are the way that firms exploit their resources and capabilities to implement their strategies (Porter 1991; Stalk et al. 1992). The approach proposed here is therefore consistent with the broader work on process and process-level advantages as well as the process perspective to the question of IT business value.

Resource-based view suggests that IT can influence the ability of processes within a firm to generate competitive advantages in at least three ways. First, if a firm possesses valuable, rare, and costly to imitate IT resources, the application of those resources to information intensive processes in a firm can generate process-level competitive advantages, even if there are no other sources of competitive advantage involved in these processes. In this case, IT resources, per se, can be a source of sustained competitive advantage for a firm. However, even if a firm's IT resources are not a source of sustained competitive advantage, if these resources are used to realize the full competitive potential of non-IT resources that are valuable, rare, and costly to imitate, IT can enable a firm to gain sustained competitive advantages. For this reason, any effort to study the competitive implications of IT should also include non-IT determinants of competitive advantage, especially those resources whose use is facilitated or enhanced by IT resources. Finally, a firm that has valuable, rare, and costly to imitate IT resources may be able to apply these resources to realize the full competitive potential of a resources that are also valuable, rare, and costly to imitate. In this context, IT resources can have both a direct and indirect effect on the ability of a firm to gain sustained competitive advantages.

An examination of the literature has led to the identification of two classes of IT resources that influence process performance. The first class of resources is represented by generic IT applications (Mata et al. 1995; Powell and Dent-Micallef 1997; Ray et al. 2002). Though valuable, such resources are typically neither rare nor difficult to imitate, and as such are not likely to be associated with above average process performance, in equilibrium. The second class of IT resource is represented by IT Managerial capabilities (Mata et al. 1995; Boynton et al. 1994; Ray et al. 2002) that influence how the first class (pure technology) resources are deployed and used in support of a process. Such resources, because they tend to be tacit and firm specific, are rare and difficult to imitate, and as such likely to be sources of competitive advantages.

Finally, an examination of the literature (Powell and Dent-Micallef 1997) has also led to the identification of two general classes of non-IT resources that are likely to influence performance: human resources and business resources. Both resources, owing to their tacit nature, tend to be heterogeneously distributed, and as such likely to be sources of distinctive advantages. Moreover, we hypothesize that their full competitive potential is more likely to be realized in the presence of high levels of IT resources.

## **Research Methodology**

The empirical analysis is based on the performance of the customer-centric process. Levitt (1989) argues that the secret to the firm's success is its ability to clearly understand the nature of its business, and that those best able to sustain their profitability

are firms that can tailor their operations to address customers' recognized or anticipated needs, ensuring *efficient* delivery of maximum utility at the lowest possible cost. In this customer-centric approach, retaining market share through customer satisfaction is of central importance; and while the relationship between customer satisfaction, loyalty and retention is not without its own controversies, there is wide consensus that customer satisfaction is an essential prerequisite for long-term profitability of the firm (Reichheld et al 1990; Copacino, 1997; Griffin et al 1999; Reichheld 2000).

The analysis is conducted in the context of the third party logistics (3PL) industry, in which customer service is widely regarded as being strategically important with IT playing a key role (Copacino 2001). A 3PL provider company typically designs, engineers and implements supply chain solutions for the back-end processes of a client company after an order has been received, which it then operates and manages under contract, on behalf of another company. Today's 3PL providers are a \$46 billion industry offering complete supply chain solutions that extends beyond traditional services like shipping and warehousing to include kitting, order assembly and compliance, labeling, as well as real-time inventory management information.

A two-part survey instrument was designed to measure perceived *operational* and *relational* performance, as well as IT and additional internal resources of the firm. The survey instruments used by Stank et al (1999) were adopted for measuring the two dimensions of firm performance: *operational* and *relational* performance. Where possible, existing scales were used to measure latent independent variables (see Table 1). The targeted respondents were 350 CEOs and other executive-level contacts of firms with \$1m+ revenue as identified by a database obtained from the Supply Chain Management Research Center at The Ohio State University, used by that organization in recent research.

Our research model (see Figure 1) aims at testing a total of fifteen hypotheses:

**Table 1. Summary of Variables and Measures**

|   |
|---|
| <p>1. <i>Human Resources-related IT Complementarities</i> (adapted from Powell and Dent-Micallef, 1997)</p> <ul style="list-style-type: none"> <li>• Open Communications Environment: an open environment that promotes knowledge, transparency and 'learning.'</li> <li>• Executive-level IT Commitment: Executive management is committed to strategic deployment of IT.</li> <li>• Organizational Flexibility: The organization readily adapts to new IT technology.</li> </ul> <p>2. <i>Business Process-related IT Complementarities</i></p> <ul style="list-style-type: none"> <li>• Building Strategic Alliances and Partnerships: The organization has ability to build strategic alliances and partnerships with its suppliers and customers (adapted from Powell and Dent-Micallef, 1997).</li> <li>• Customer/Information Focus Capability: A centralized database is the core of a strategic planning policy aimed at actively attempting to anticipate and surpass its customers' needs. (adapted from Day, 1994, and Day's unpublished manuscript, 2001)</li> <li>• Use of Process-oriented Teams: The organization is acclimated to working as cross-functional teams where necessary to attain a customer-focused orientation (adapted from Powell and Dent-Micallef, 1997).</li> <li>• Benchmarking: The organization routinely measures and compares its performance against standards in its industry (adapted from Powell and Dent-Micallef, 1997).</li> </ul> <p>3. <i>IT Managerial Capability</i></p> <ul style="list-style-type: none"> <li>• Managerial IT Knowledge/Competence: (adapted from Ray et al. 2002) <ul style="list-style-type: none"> <li>– IT management command both the necessary technical skills and business acumen to strategically deploy IT resources.</li> <li>– Line managers' ability to apply IT to solving business-related issues in general.</li> <li>– Managers' explicit knowledge and depth of training regarding IT.</li> </ul> </li> <li>– Structural/Process Integration of IT: The organization has fully integrated all of its resources including IT into its strategic planning process (adapted from Powell and Dent-Micallef, 1997).</li> </ul> <p>4. <i>IT Resources</i></p> <ul style="list-style-type: none"> <li>– Information Technology (adopted from Armstrong &amp; Associates, <i>Who's Who in Logistics</i>, 2000 Edition) IT: hardware software and related infrastructure.</li> </ul> |
|---|

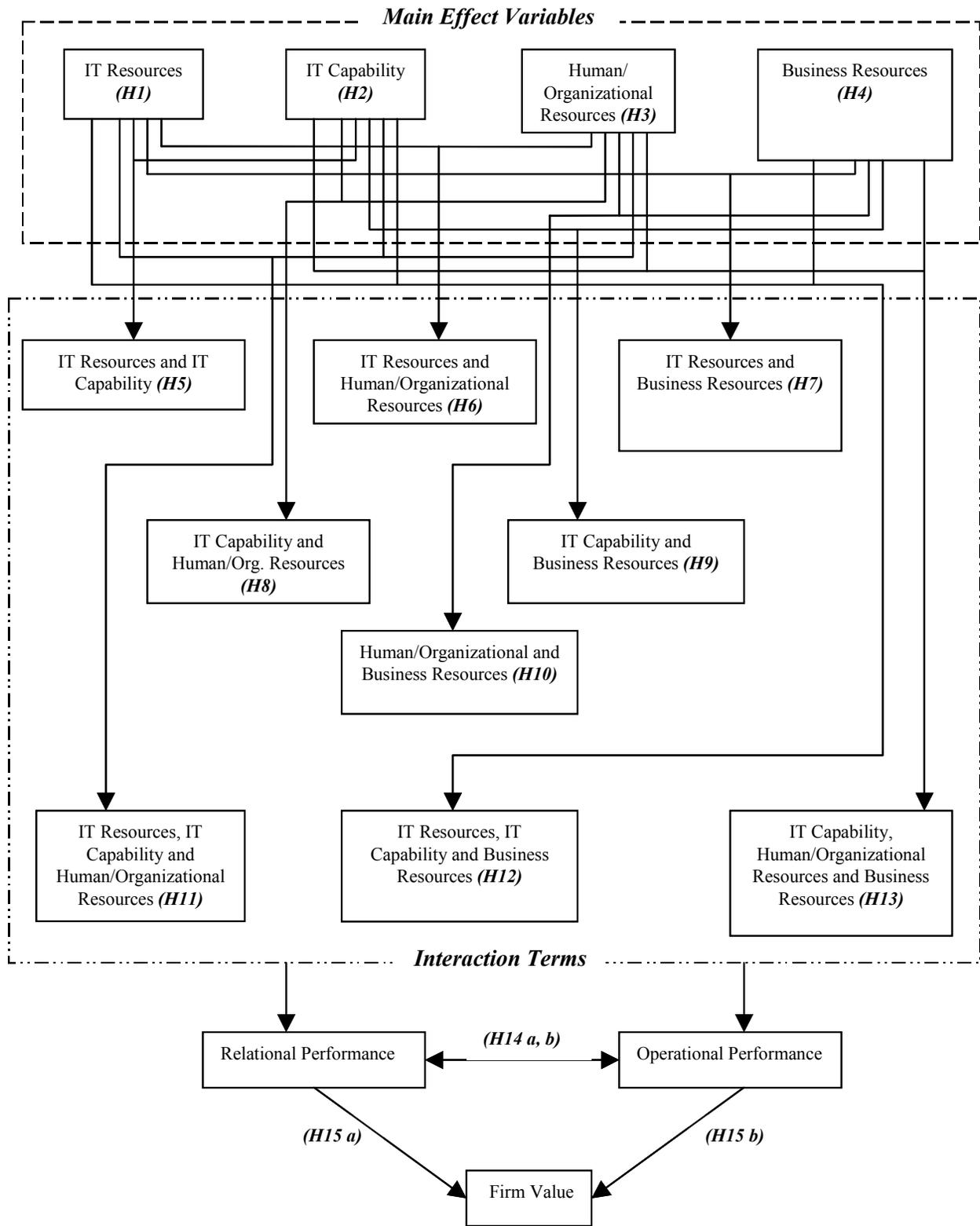


Figure 1. Research Model

Hypotheses 1-4 test for the significance of the main effects variables of our model which represent three categories of firm-specific IT complementarities: Human Resources, Business Processes IT Managerial Capabilities; the fourth variable is pure IT applications.

Hypotheses 5–10 test for significant two-way interaction among the four main effects variables with regard to their impact on both operational and relational performance. In Hypotheses 11 – 13 we look for significant three-way interaction between the following subsets of variables: (i) IT Resources, IT Managerial Capability and Human Resources, (ii) IT Resources, IT Managerial Capability and Business Processes, and (iii) IT Resources, Human Resources and Business Processes.

Hypothesis 14 tests for positive association operational and relational performance levels. Hypothesis 15 tests for positive association between operational and relational performance levels and firm performance.

The hypothesis will be tested using moderated regression analysis (Aiken and West 1991). Data collection for this research is well underway, and it is expected that preliminary results of the actual analysis will soon be available.

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