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REVIEW: INFORMATION TECHNOLOGY AND ORGANIZATIONAL PERFORMANCE: AN INTEGRATIVE MODEL OF IT BUSINESS VALUE[1]

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Abstract

Despite the importance to researchers, managers, and policy makers of how information technology (IT) contributes to organizational performance, there is uncertainty and debate about what we know and don't know. A review of the literature reveals that studies examining the association between information technology and organizational performance are divergent in how they conceptualize key constructs and their interrelationships. We develop a model of IT business value based on the resource-based view of the firm that integrates the various strands of research into a single framework. We apply the integrative model to synthesize what is known about IT business value and guide future research by developing propositions and suggesting a research agenda. A principal finding is that IT is valuable, but the extent and dimensions are dependent upon internal and external factors, including complementary organizational resources of the firm and its trading partners, as well as the competitive and macro environment. Our analysis provides a blueprint to guide future research and facilitate knowledge accumulation and creation concerning the organizational performance impacts of information technology.

[1]Jane Webster was the accepting senior editor for this paper.

Keywords: Business value, competitive advantage, cost reduction, country characteristics, economic impacts, efficiency, industry characteristics, information technology, IT business value, IT payoff, macro environment, performance, productivity, resource-based view, trading partners, value

Introduction

IT business value research examines the organizational performance impacts of information technology. Researchers have adopted myriad approaches to assessing the mechanisms by which IT business value is generated and to estimating its magnitude. Previous research has shown that information technology may indeed contribute to the improvement of organizational performance (Brynjolfsson and Hitt 1996; Kohli and Devaraj 2003; Mukhopadhyay et al. 1995). Moreover, the dimensions and extent of IT business value depend on a variety of factors, including the type of IT, management practices, and organizational structure, as well as the competitive and macro environment (Brynjolfsson et al. 2002; Cooper et al. 2000; Dewan and Kraemer 2000). The research also suggests that firms do not appropriate all of the value they generate from IT; value may be captured by trading partners or competed away and captured by end customers in the form of lower prices and better quality (Bresnahan 1986; Hitt and Brynjolfsson 1996).

By and large, our knowledge has resulted from an organization-centric perspective based on internal business processes, organizational structure, and workplace practices (Bharadwaj 2000; Lichtenberg 1995; Mata et al. 1995). This approach is consistent with computing paradigms that dominated in pre-Internet eras, typically defined by mainframes, minicomputers, and personal computers used primarily for storing and processing information within a single organization. To continue advancing knowledge, however, an expanded conceptualization of IT business value is required.

In the network era, electronic linkages within and among organizations are proliferating, altering the ways in which firms acquire factor inputs, convert them into products and services, and distribute the result to their customers (Hammer 2001; Straub and Watson 2001). This raises new questions about how IT can be applied to improve organizational performance. For example, how do electronically connected trading partners impact a firm's ability to execute IT-based strategies for improved efficiency and competitive advantage? How does the evolving competitive environment shape IT business value? Although emerging studies are beginning to examine pieces of the network-era IT business value puzzle (Chatfield and Yetton 2000; Mukhopadhyay and Kekre 2002), our knowledge remains underdeveloped and unsystematic.

The purpose of this review is to add to knowledge accumulation and creation in the IS academic discipline by summarizing what we know about IT business value and suggesting how we might learn more about what we don't know. Specifically, the objectives of this review are to (1) develop a model of IT business value based in theory and informed by existing IT business value research; (2) use the model to synthesize what is known about IT business value; and (3) guide future research by developing propositions and putting forward a research agenda. The review is unique among other reviews of the IT business value literature in its application of resource-based theory to analyze how IT impacts organizational performance. This approach enables the integration of research assessing both the efficiency implications of IT application as well as its ability to confer a competitive advantage, heretofore separate research conversations. The review is also unique in its extension of the locus of IT business value to the external competitive and macro environment. Another distinction is the inclusion of research studies spanning the entire range of theoretical paradigms and research methods.

There is some ambiguity regarding what constitutes IT business value research, so we begin by

introducing terminology and delineating the scope of the research stream. Next, we review theoretical paradigms and modeling approaches employed in prior research. We then develop an integrative model of IT business value using the resource-based view of the firm as a principal theory base. The model provides a basis for structuring our review of accumulated knowledge, for identifying gaps in knowledge, and for developing propositions to guide future research. We conclude by summarizing the findings and limitations of our analysis and by proposing an agenda for future research.[2]

IT Business Value Research: Definition Through Distillation

IT business value scholars are motivated by a desire to understand how and to what extent the application of IT within firms leads to improved organizational performance. Researchers have adopted diverse conceptual, theoretical, and analytic approaches and employed various empirical methodologies at multiple levels of analysis (Brynjolfsson 1993; Brynjolfsson and Yang 1996; Dedrick et al. 2003; Wilson 1995). Moreover, the literature includes contributions from several academic disciplines in addition to information systems, including economics, strategy, accounting, and operations research.

Although our knowledge has been enriched by such diversity, an ancillary consequence has been separate research conversations, hampering cross-pollination of ideas and findings and making it difficult for those working outside the area to understand what we have learned (Chan 2000). We, therefore, lay the foundation for model development by analyzing how IT business value researchers have conceptualized IT and IT business value and by defining the research stream, thereby taking a first step toward unification of this vast and diverse body of accumulated knowledge.

Conceptualizing Information Technology in IT Business Value Research

Information systems scholars have adopted diverse conceptualizations of information technology, extending beyond hardware and software to include a range of contextual factors associated with its application within organizations (Kling 1980; Markus and Robey 1988). As a precise specification of what we mean by IT business value is dependent upon what we mean by IT, we briefly analyze how IT business value researchers have treated the core construct. The result exposes how underlying assumptions about what constitutes IT shape our accumulated knowledge of its organizational performance impacts. Understanding how IT has been conceptualized in prior research also provides a firm foundation from which to derive a systematic and theoretically based definition of information technology within our model derivation.

Five conceptualizations of the IT artifact have been adopted in IS research: (1) tool view, (2) proxy view, (3) ensemble view, (4) computational view, and (5) nominal view (Orlikowski and Iacono 2001). In the first conceptualization, IT is viewed as an engineered tool that does what its designers intended, for example, productivity enhancement and reshaping social relations. Such a view is frequently used within IT business value research, i.e., IT is assumed to be a tool whose intended purpose is to generate value (Table 1). In the proxy view, IT is conceptualized by its essential characteristics, which are defined by individual perceptions of its usefulness or value, the diffusion of a particular type of system within a specific context, and its investment or capital stock denominated in financial units. IT business value researchers often adopt this conceptualization in empirical studies using measures such as capital stock denominated in dollars. The ensemble view is the third conceptualization, focusing on the interaction of people

[2]Appendix A describes the method used to identify IT business value research articles.

Table 1. IT Artifact Conceptualizations Used in IT Business Value Research*

Tool IT is a tool intended to generate value, whether productivity enhancement, cost reduction, competitive advantage, improved supplier relationships, etc. Specific intention for IT is often unknown. Studies of specific system and implementation contexts enable examination of tool view assumptions.
Proxy IT is operationalized via proxies such as capital stock denominated in dollars. Wide range of potential proxies exists, but few have been adopted. Adoption of diverse proxies enables triangulation and enhances accumulated knowledge.
Ensemble Assessment of IT business value generation in rich contexts, often using case or field studies. Organizational structure and co-innovations such as workplace practices may be included as moderators or mediators of value.
Nominal IT is not conceptualized and appears in name but not in fact. Abstraction enables model precision at the expense of generality.

*Adapted from Orlikowski and Iacono (2001). Computational conceptualization is not applicable to IT business value research and is omitted from the table.

and technology in both the development and use of IT. Case studies examining IT business value within specific organizations often adopt the ensemble view (Kraemer et al. 2000; Williams and Frolick 2001). In addition, as quantitative IT business value research has evolved beyond examining the productivity paradox—low aggregate productivity growth during a period of high IT spending—to explore how firms use IT to generate value, researchers have begun to incorporate the role of organizational co-innovations such as workplace practices (Brynjolfsson et al. 2002). As the emphasis of the fourth view is on algorithm and systems development and testing as well as data modeling and simulation, it is less applicable to IT business value research. Finally, studies adopting the nominal view invoke technology in name but not in fact. An example is the derivation of a two-stage game analyzing the impact of IT application on total factor productivity in the context of oligopolistic competition, which introduces IT solely via its posited impact on cost reduction and product differentiation (Belleflamme 2001).

Examining conceptualizations of IT by IT business value researchers reveals that prevailing assumptions have delimited accumulated knowledge in three principal respects. First, IT is frequently operationalized using aggregate variables measured in dollars or counts of systems (proxy view), limiting our understanding of the differential impacts of alternative types of IT as well as the role of usage (Devaraj and Kohli 2003). Furthermore, software is often treated implicitly via assumptive measures or sometimes omitted entirely from the analysis. Given evidence of its association with firm performance (Hitt et al. 2002), there is a need to incorporate software when conceptualizing IT. Second, IT is frequently assumed to lead to an outcome intended by managers (tool view), limiting our understanding of unintended consequences (Markus and Robey 2004). Third, the treatment of the role of IT employees is unsystematic and often excluded from the analysis (ensemble view), hindering our understanding of the role of IT management and technical expertise in generating IT business value. When included, IS employees have been incorporated in an

additive fashion with IT stock (Hitt and Brynjolfsson 1996), as a separate construct that is complementary to IT (Black and Lynch 2001; Brynjolfsson et al. 2002), or conceptualized as being inextricably intertwined with IT within business processes (Kraemer et al. 2000). The problem is exacerbated by increasing adoption of networked systems spanning multiple organizations—and hence multiple IS stakeholder groups.

To summarize, IT business value research is characterized by diverse treatment of the IT construct, which has bounded and shaped accumulated knowledge. A systematic explication and definition based on theory is a necessary first step toward knowledge advancement and model building (undertaken shortly). We now turn to the second core construct of the research stream: IT business value.

Defining IT Business Value Research

The term IT business value is commonly used to refer to the organizational performance impacts of IT, including productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance (Devaraj and Kohli 2003; Hitt and Brynjolfsson 1996; Kriebel and Kauffman 1988). For example, Mukhopadhyay et al. (1995, p. 138) refer to the "business value of IT" as the "impact of IT on firm performance." Based on our analysis of the IT business value literature (Appendix A), there is no convention regarding the incorporation of costs of system development and implementation. Moreover, researchers have used the term performance to denote both intermediate process-level measures as well as organizational measures. Emphasizing the salience of this distinction, Barua et al. (1995, p. 7) develop a model incorporating both "first-order effects on operational level variables" such as inventory turnover, as well as "higher level variables" such as market share.

Our analysis also revealed the existence of two formulations of performance: efficiency and effectiveness. The former emphasizes an internal perspective employing such metrics as cost reduction and productivity enhancement in the assessment of a given business process, or "doing things right" (Drucker 1966). In contrast, effectiveness denotes the achievement of organizational objectives in relation to a firm's external environment and may be manifested in the attainment of competitive advantage, i.e., effecting a unique value-creating strategy with respect to competitors (Barney 1991). To emphasize, IT may enable a firm to improve efficiency regardless of whether mimicked by competitors, or may yield performance impacts unique to a particular firm relative to its competitors, i.e., competitive impacts. Synthesizing these observations, we define *IT business value* as *the organizational performance impacts of information technology at both the intermediate process level and the organization-wide level, and comprising both efficiency impacts and competitive impacts.*

Several reviews of the literature focus on studies using quantitative empirical methodologies (Brynjolfsson and Yang 1996; Dedrick et al. 2003; Dehning and Richardson 2002).[3] Based on our definition of IT business value, the scope of IT business value research includes conceptual, theoretical, analytic, and empirical studies. Conceptual and theoretical studies apply theory and grounded observation to explicate IT business value (Mata et al. 1995; Porter 2001; Soh and Markus 1995). Analytic studies utilize game theoretic and other modeling techniques to develop models of IT business value whose solutions inform our understanding of the organizational performance implications of alternative IT investment and ownership regimes as well as the role of the competitive environment (Bakos and Nault 1997; Belleflamme 2001; Clemons and Kleindorfer 1992). Finally, empirical studies include qualitative research—case studies and field studies (Clemons and Row 1988; Cooper et al. 2000)—and quantitative studies estimating IT business value at the process, business unit, firm, industry, and country levels of analysis (Alpar and Kim

[3]See Kohli and Devaraj (2003) for a meta-analysis of quantitative empirical IT business value studies.

1990; Dewan and Kraemer 2000; Siegel 1997). Combining these observations, we define *IT business value research* as *any conceptual, theoretical, analytic, or empirical study that examines the organizational performance impacts of IT.*

Having demonstrated how prevailing assumptions about the IT artifact in IT business value studies have delimited what we know and defined the research stream, we now turn to the derivation of our integrative model.

Integrative Model of IT Business Value

The organizational application of information technology may improve, reduce, or have no effect on firm performance. Our objective is to develop a descriptive model of the value generating process. The primary theory base is the resource-based view (RBV) of the firm, which combines the rationale of economics with a management perspective. As trading partners and the competitive environment shape the degree to which IT may improve organizational performance, we also appeal to secondary theory bases, including microeconomics and the related industrial organization literature. To motivate the selection of RBV as our primary theory base, we begin by summarizing the theoretical paradigms that have been used in prior studies.

Theoretical Paradigms Used in IT Business Value Research

Researchers have employed several theoretical paradigms in examining the organizational performance impacts of IT, including microeconomics, industrial organization theory, and sociology and socio-political paradigms.

Microeconomic Theory

Microeconomic theory provides a rich set of well-defined constructs interrelated via theoretical models and mathematical specifications. The theory of production has been particularly useful in conceptualizing the process of production and providing empirical specifications enabling estimation of the economic impact of IT (Brynjolfsson and Hitt 1995; Dewan and Min 1997; Lichtenberg 1995). Researchers have also employed growth accounting (Brynjolfsson and Hitt 2003; Jorgenson and Stiroh 1999), consumer theory (Brynjolfsson 1996; Hitt and Brynjolfsson 1996), data envelopment analysis (Lee and Barua 1999), and Tobin's *q* (Bharadwaj et al. 1999; Brynjolfsson and Yang 1997). To account for the inherent risk and uncertainty of IT investments, option pricing models have been applied to the IT context. Conducting a real-options analysis of point-of-sale (POS) debit services by an electronic banking network, Benaroch and Kauffman (1999, p. 84) describe "the logic of option pricing" as "how it can handle getting the timing right, scaling up or even abandonment, as the organization learns about its business environment with the passage of time." Although the assumptions of microeconomic theory must be carefully assessed within the specific research context, its application within IT business value research has enhanced our understanding of wide-ranging phenomena.

Industrial Organization Theory

IT business value researchers have drawn from the industrial organization literature to examine how firms jointly interact in IT investment decisions and how the resulting benefits are divided. Game theory has been used to examine the role of strategic interaction among competitors in IT business value generation and capture. Belleflamme (2001) constructs a two-stage game of IT investment and production choice under oligopolistic competition. Other researchers have drawn from agency theory and the incomplete contracts literature (Bakos and Nault 1997; Clemons and Kleindorfer 1992). Transaction cost theory has also informed understanding of the role of IT in reducing transaction costs (Clemons and Row 1991b; Gurbaxani and Whang 1991).

Sociology and Socio-Political Perspectives

Although the system rationalism perspective—maximization of organizational efficiency and effectiveness through IT as the common goal of all organizational stakeholders (Kling 1980)—is widespread within IT business value research, other perspectives have also informed understanding. Economic activity is embedded in social networks (Granovetter 1985); according to Uzzi (1997, p. 35) "embeddedness is a logic of exchange that promotes economies of time, integrative agreements, Pareto improvements in allocative efficiency, and complex adaptation." IT researchers have applied the theory of embeddedness to inform understanding of how interorganizational relationships impact IT business value in the context of EDI (Chatfield and Yetton 2000). The socio-political perspective has been used to examine the relationship between IT investment and firm performance (Hoogeveen and Oppelland 2002). Kumar et al. (1998) propose a rationality of information systems that stresses relationships and trust within and across organizations and apply it to explain the failure of an interorganizational information system implemented in the textile industry.[4]

The complex problem of linking IT to organizational performance is informed by the insights of multiple theoretical paradigms. However, the absence of a unified theoretical framework has led to a fractured research stream with many simultaneous but non-overlapping conversations (Chan 2000). We thus seek to develop a conceptual model that is not only based in theory, but rooted in one that is inherently suitable for analyzing the complexity of IT and firm performance. Ideally, it would have a robust logical formulation, while enabling study of the rich contextual processes associated with managing IT for business value.

[4]For a summary of the positivism, realism, critical theory, and constructivism paradigms as they relate to IT business value, see Cronk and Fitzgerald (2002).

Chosen Theory Base: Resource-Based View of the Firm

The resource-based view of the firm (RBV) emphasizes heterogeneous firm resource endowments as a basis for competitive advantage (Table 2). It is grounded in the seminal work of economists concerned with firm heterogeneity and imperfect competition (Chamberlin 1933; Robinson 1933). These early theorists emphasize the importance of firm heterogeneity—as against market structure—in conferring above normal profits and in driving imperfect competition. In her theory of firm growth, Penrose (1959) refines these ideas by conceptualizing the firm as a bundle of resources within an administrative framework. Evolutionary economists combining Schumpeterian competition with tacit processes and routines further extend thinking away from static equilibrium models of classical microeconomics (Nelson and Winter 1982). A seminal contribution to resource-based theory is provided by Wernerfelt (1984), who proposes the notion of resource position barriers, i.e., barriers to imitation, and links resource attributes to profitability. Subsequent research studies examine how resource attributes lead to competitive advantage (Amit and Schoemaker 1993; Dierickx and Cool 1989; Peteraf 1993) and extend the RBV in various ways, including the analysis of resources in the context of interconnected organizations (Dovev 2002).

In contrast to undifferentiated factor inputs with well-defined property rights, resources are firm-specific, difficult to imitate, and often valuable, i.e., they enable the firm to improve efficiency (Teece et al. 1997). Barney (1991) specifies the conditions required for a resource to confer a competitive advantage. If the valuable resource is rare, i.e., few firms have access to it, it confers a temporary competitive advantage. If it is also imperfectly imitable—for example, competitors don't know what factors lead to success and therefore what to imitate—and there are no readily available substitutes, the resource confers a sustained competitive advantage. In this case, the firm is using the resource to implement "a value creating strategy not simultaneously being implemented by

Table 2. Resource-Based Theory: Intellectual Foundations and Theory Development

Intellectual Foundations

- Theory of imperfect competition (Robinson 1933)
  Industries are neither perfect monopolies nor do they operate under perfect competition. Critique of neoclassical economic theory—each of many competing firms has some monopoly power.

- Theory of monopolistic competition (Chamberlin 1933; Chamberlin 1937)
  Merges theory of monopoly (but no free entry) and perfect competition (but allows for product differentiation) in a model of monopolistic competition. Supplier has some control over price.

- Theory of firm growth (Penrose 1959).
  Distinction between services rendered by inputs to production upon purchase versus the larger set of resulting services when integrated in the firm. The speed of accumulation and assimilation of resources is key to firm growth, as are opportunities arising from underutilization of its resources. Firms continually search for new ways to increase productivity and efficiency. New knowledge yields new ways of using existing resources or new ways of combining sets of resources. The firm thus "is basically a collection of resources" (Penrose 1959, p. 77).

Theory Development

- Resource-based view of the firm (Wernerfelt 1984)
  Resources are anything that can be viewed as a strength or weakness of a firm. Resource position barriers, i.e., imitation barriers, can lead to above-normal profit. Strategy comprises current resource exploitation and new resource development, emphasized in the resource-product matrix that contrasts a firm's resources with its products.

- Resource heterogeneity and above normal firm performance
  Resource factors differ in the extent to which they can be identified and their monetary value assessed via strategic factor markets (Barney 1986b). Through isolating mechanisms, once homogenous firms become differentiated and in possession of difficult to imitate resources (Rumelt 1984). Economic rent is derived from time compression diseconomies in trying to imitate resources of other firms as well as in limited substitutability (Dierickx and Cool 1989).

- Identification of resources that confer a sustained competitive advantage
  Proposed sets of conditions for a resource to confer a sustained competitive advantage include (1) value, rareness, inimitability, and non-substitutability (Barney 1991) and (2) heterogeneity of efficiency in industry, ex post limits to competition, ex ante limits to competition, and immobility (Peteraf 1993). Specific resources examined include entrepreneurship (Rumelt 1987), culture (Barney 1986a), routines (Nelson and Winter 1982), invisible assets (Itami 1987), human resources (Amit and Schoemaker 1993), and information technology (Bharadwaj 2000; Mata et al. 1995).

- Bundling of resources
  Distinction between resources and the capability to deploy groups of resources successfully (Grant 1991; Teece et al. 1997).

any current or potential competitors" and one that its rivals are unable to duplicate (Barney 1991, p. 102). In summary, the four conditions necessary for a resource to confer a sustainable competitive advantage are value, rareness, inimitability, and non-substitutability. We adopt Barney's formulation as it is readily applicable to analyzing the fundamental questions of IT business value.

RBV and IT Business Value

The resource-based view has been used to examine the efficiency and competitive advantage implications of specific firm resources such as entrepreneurship (Rumelt 1987), culture (Barney 1986a), and organizational routines (Nelson and Winter 1982). It is also useful in the IT context, providing a robust framework for analyzing whether and how IT may be associated with competitive advantage. Strategy researchers have applied RBV to theoretically analyze the competitive advantage implications of information technology (Mata et al. 1995) and to assess empirically the complementarities between IT and other firm resources (Powell and Dent-Micallef 1997). IS researchers have also begun to employ the resource perspective to expand and deepen our understanding of IT business value (Bharadwaj 2000; Caldeira and Ward 2003; Clemons 1991; Jarvenpaa and Leidner 1998; Santhanam and Hartono 2003). Such research provides a firm foundation from which to derive our integrative model. Thus, due to its firm roots in microeconomics, its focus on resource attributes, and its usefulness in examining the IT resource, we choose the resource-based view of the firm as the primary theoretical foundation. Its "integration of a management perspective with an economics perspective" (Peteraf and Barney 2003, p. 309) provides the balance that we require for the development of an integrative IT business value model.[5]

A limitation of the conventional resource-based view is that it assumes that resources are always applied in their best uses, saying little about how this is done. In effect, the RBV provides a set of necessary conditions to the attainment of sustainable competitive advantage via a firm resource, but does not specify the underlying mechanisms by which this is accomplished. We, therefore, rely on secondary theory bases such as microeconomics as well as accumulated IT business value knowledge to inform understanding of how the IT resource is applied within business processes to improve performance. Having described our chosen theory base, we begin derivation of the model by examining how other researchers have modeled IT business value.

Prior Models. An examination of IT business value models employed in prior research informs our choices concerning which constructs to include and how to model their interrelationships. The widely used production function approach relates production inputs such as labor, IT, and other capital to output via mathematical specifications derived from microeconomic theory. Other researchers have developed process-oriented models linking IT to organizational performance. Barua et al. (1995) argue that the association between IT investment and performance attenuates as the distance between cause and effect widens. The authors develop a model of IT business value in which the impact of IT on firm performance is mediated by intermediate processes. A similar perspective is adopted by Weill (1992), who focuses on the ability of firms to convert IT assets into organizational performance, identifying several *conversion effectiveness* factors that mediate the IT-performance relationship. Francalanci and Galal (1998) propose that managerial choices regarding the mix of clerical, managerial, and professional employees mediate the relationship between IT and firm performance. In a synthesis of process models, Soh and Markus (1995) develop a conceptual framework which posits that IT investment leads to IT assets (IT conversion process), IT assets to IT impacts (IT use process), and IT impacts to organizational performance (competitive process).

[5]For a debate of the merits of the resource-based view, see the critique of Priem and Butler (2001) and response by Barney (2001).

Production function and process-oriented models describe the relationship between IT investment and firm performance via an input-output perspective that sometimes includes intermediate factors such as managerial choices and organizational structure. However, the external environment of trading partners, industry characteristics, and socio-political conditions is also important, but rarely incorporated (cf. Chatfield and Yetton 2000; Jarvenpaa and Leidner 1998). Moreover, production function and process models typically treat the IT artifact in a stylized fashion.

Other researchers have taken an alternative approach in modeling IT business value by focusing on the attributes of IT and other organizational resources that together may confer a competitive advantage. Bharadwaj (2000) models three key IT resources and their relationship to a firm's capability to deploy IT for improved performance: IT infrastructure, human IT resources, and IT-enabled intangibles. Clemons and Row (1991b) argue that IT is widely available to all firms and can only confer a sustainable competitive advantage if applied to leverage differences in strategic resources. Mata et al. (1995) derive a resource-based conceptual framework mapping the attributes of IT to competitive advantage. According to the framework, the extent to which IT is valuable, heterogeneous, and imperfectly mobile determines the level of competitive advantage. If IT is valuable in lowering costs or enhancing revenue for all firms, then competitive parity results. If it is also heterogeneous, i.e., if one firm possesses it and others do not, then the firm receives a temporary competitive advantage. Finally, if IT is also imperfectly mobile—firms without the resource face a cost disadvantage in acquiring it, the sources of which may include the role of history, causal ambiguity, and social complexity—then IT confers a sustained competitive advantage. Although Mata et al. conclude that only IT management skills may lead to sustained competitive advantage, they acknowledge that "there may be other attributes of IT whose competitive implications have not been fully evaluated" (p. 500).

As with production function and process-oriented models, models analyzing the attributes of IT and complementary firm resources typically do not incorporate the external environment of trading partners, industry characteristics, and country characteristics. Moreover, based on an analysis of emergent research, there is no consensus regarding approaches to modeling such factors. For example, Mukhopadhyay et al. (1995) relate EDI penetration, EDI program launching, and EDI penetration volume to inventory turnover, obsolete inventory, and premium freight. In contrast, Chatfield and Yetton (2000) extend the MIT 90s model (Scott Morton 1991) to explore the relationship between EDI imitator and EDI adopter.

In summary, analyzing prior IT business value models reveals that (1) IT impacts organizational performance via intermediate business processes; (2) other organizational resources such as workplace practices interact with IT, whether as mediator or moderator, in the attainment of organizational performance impacts; (3) the external environment plays a role in IT business value generation; and (4) it is important to disaggregate the IT construct into meaningful subcomponents. The received wisdom of IT business value models can thus be summarized as follows: if the right IT is applied within the right business process, improved processes and organizational performance result, conditional upon appropriate complementary investments in workplace practices and organizational structure and shaped by the competitive environment. Although a compelling narrative, as evidenced by the wide array of modeling approaches, we lack a systematic approach supported by theory for examining associated questions. What is meant by IT? What is meant by business process? What is the *right* IT for the *right* business process? What is the role of other firm resources, trading partners, and the competitive environment? We develop a theoretically based model of IT business value that systematizes and extends accumulated knowledge and addresses these questions.

Model Derivation. Based on our analysis of how other researchers have modeled IT business value, we conclude that the locus of IT business value generation is the organization that invests in

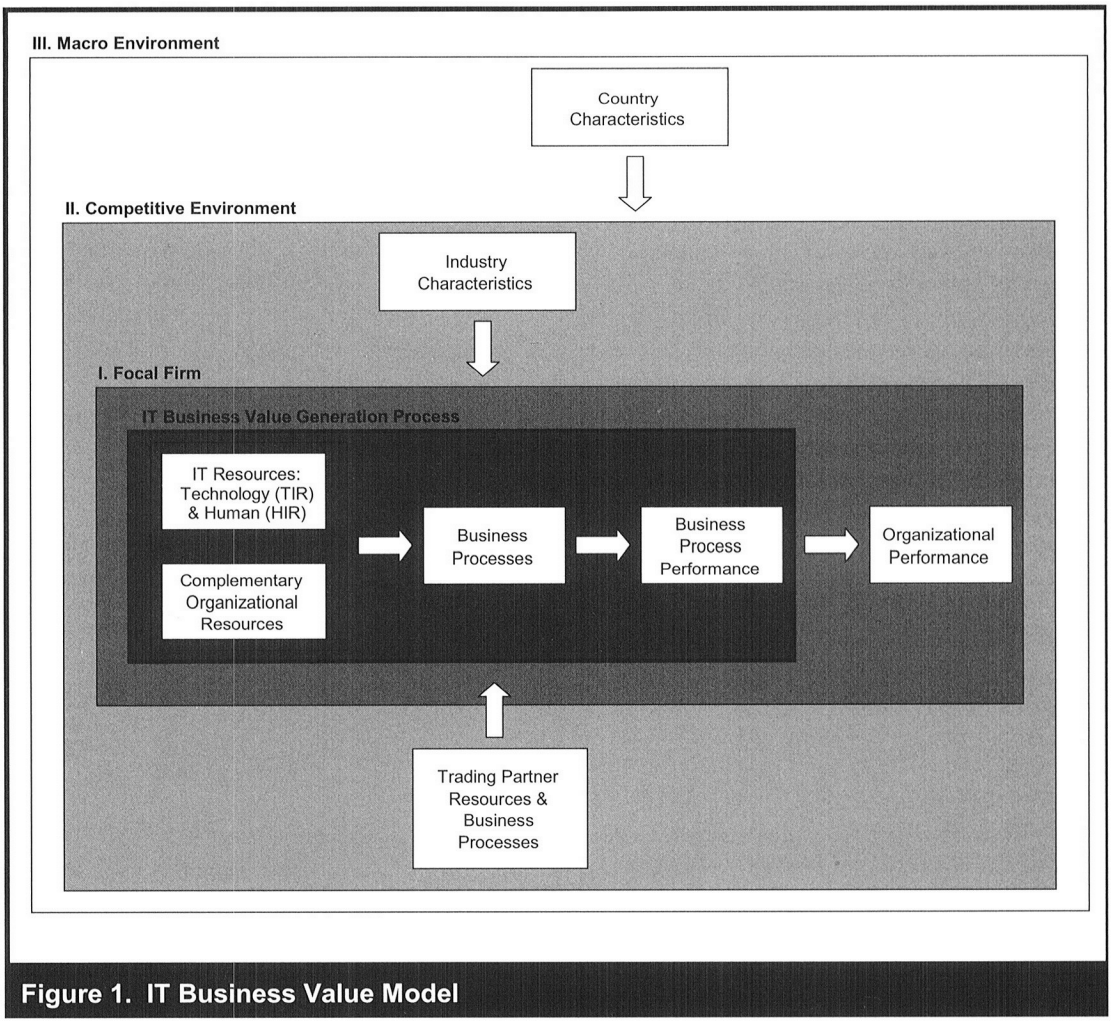

Figure 1. IT Business Value Model

and deploys IT resources, which we call the *focal firm*. But external factors also play a role in shaping the extent to which IT business value can be generated and captured. In particular, the competitive environment, including industry characteristics and trading partners, as well as the macro environment are salient to IT business value generation. We thus derive an integrative model of IT business value that comprises three domains: (1) focal firm; (2) competitive environment; and (3) macro environment. Using the resource-based view as a primary theoretical lens, the model describes how phenomena resident within each domain shape the relationship between IT and organizational performance (Figure 1).

Focal Firm

The first domain is the organization acquiring and deploying the IT resource—the focal firm. Within the focal firm, IT business value is generated by the deployment of IT and complementary organizational resources within business processes. As illustrated in Figure 1, application of IT and complementary organizational resources may improve business processes or enable new ones, which ultimately may impact organizational performance (Brynjolfsson and Hitt 2000). The focal firm domain thus comprises the IT resource, complementary organizational resources, business processes, business process performance, and organizational performance.

Information Technology Resource. Based on the analysis of how IT business value researchers have treated the IT artifact, the predominant approach has been either (1) to use aggregate variables such as IT capital or counts of systems in quantitative empirical studies, or (2) to take a holistic approach in exploring the interdependencies between IT and human resources in the creation of business value within case and field studies. Other researchers have attempted to develop a more generalized view of IT. For example, in their review and synthesis of quantitative empirical IT business value research, Dehning and Richardson (2002) identify three different formulations of IT: IT spending, IT strategy (type of IT), and IT management/capability. Likewise, Bharadwaj (2000) derives IT infrastructure, human IT resources, and IT-enabled intangibles such as customer orientation and knowledge as principal IT-based resources. Based on a survey of top IT executives at 50 firms, Ross et al. (1996) identify three IT assets underlying a firm's IT capability: human, technology, and relationship.

To operationalize the IT resource, we meld these formulations with Barney's (1991) classification of firm resources into physical capital, human capital, and organizational capital resources, the former two containing components of the IT resource, while all three contain components of complementary organizational resources.

Physical capital resources comprise plant and equipment, geographic location, access to raw materials, and physical technology, a subset of which is the *technological IT resource* (TIR). TIR can be further categorized into (1) IT infrastructure, i.e., shared technology and technology services across the organization, and (2) specific business applications that utilize the infrastructure, i.e., purchasing systems, sales analysis tools, etc. (Broadbent and Weill 1997). TIR thus includes both hardware and software (Table 3). The separation of TIR into infrastructure and business applications is consistent with how companies view their physical IT assets, an important consideration as firms view the two in different ways when making investment decisions and setting performance expectations (Weill et al. 2002).

The second resource is the firm's human capital, which refers to expertise and knowledge (Barney 1991), and we thus call the second component of the IT resource the *human IT resource* (HIR). Similar to prior characterizations (Bharadwaj 2000; Dehning and Richardson 2002; Ross et al. 1996), HIR denotes both technical and managerial knowledge. Examples of technical expertise include application development, integration of multiple systems, and maintenance of existing systems; managerial skills include the ability to identify appropriate projects, marshal adequate resources, and lead and motivate development teams to complete projects according to specification and within time and budgetary constraints. Although technical and managerial expertise are often intertwined, they are nonetheless distinct concepts, and their conceptualization as such is necessary for precision in describing IT investment impacts. Human IT expertise may be associated with the entire technological infrastructure of the organization or may reside locally within business units and be associated with specific business applications.

Complementary Organizational Resources. Although it is possible to apply IT for improved organizational performance with few organizational changes (McAfee 2002), successful application of IT is often accompanied by significant organizational change (Brynjolfsson and Hitt 2000; Brynjolfsson et al. 2002; Cooper et al. 2000), including policies and rules, organizational structure, workplace practices, and organizational culture. When synergies between IT and other firm resources exist, we call the latter complementary organizational resources. The RBV literature provides guidance regarding the classification of complementary organizational resources. Returning to Barney's (1991) classification of firm resources, complementary organizational resources may include non-IT physical capital resources, non-IT human capital resources, and organizational capital resources, e.g., formal

Table 3. Model Constructs

I. Focal Firm	
IT Resources	
Technological IT resources (TIR)	Infrastructure: shared technology and technology services across the enterprise. Business applications: utilize the infrastructure, e.g., purchasing, sales, etc.
Human IT resources (HIR)	Technical skills: programming, systems integration, database development, etc. Managerial skills: collaboration with business units and external organizations, project planning, etc.
Complementary Organizational Resources	Organizational resources complementary to IT, categories of which include non-IT physical resources, non-IT human resources, and organizational resources (Barney 1991), including organizational structure, policies and rules, workplace practices, culture, etc.
Business Processes	Activities underlying value generating processes (transforming inputs to outputs). Inbound logistics, manufacturing, sales, distribution, customer service, etc.
Performance	
Business process performance	Operational efficiency of specific business processes, measures of which include customer service, flexibility, information sharing, and inventory management.
Organizational performance	Overall firm performance, including productivity, efficiency, profitability, market value, competitive advantage, etc.
II. Competitive Environment	
Industry Characteristics	Industry factors shaping the way in which IT is applied within focal firm to generate business value, including competitiveness, regulation, clockspeed, etc.
Trading Partner Resources and Business Processes	IT and non-IT resources and business processes of trading partners such as buyers and suppliers.
III. Macro Environment	
Country Characteristics	Macro factors shaping IT application and IT business value generation, including the level of development, basic infrastructure, education, research and development investment, population growth rate, culture, etc.

reporting structures and informal relationships within and among firms.[6]

Business Processes. According to Davenport (1993, p. 5), a business process is "the specific ordering of work activities across time and space, with a beginning, an end, and clearly identified inputs and outputs." In essence, business processes are the activities residing in the black box of microeconomic production theory that transform a set of inputs into outputs. From the perspective of resource-based theory, business processes provide a context within which to examine the locus of direct resource exploitation. Examples of business processes include order taking, PC assembly, and distribution. A single firm executes numerous business processes to achieve its strategic objectives, thereby providing a range of opportunities for the application of information technology to improve processes and organizational performance (Porter and Millar 1985). In the net-enabled organization (Straub and Watson 2001), IT not only may improve individual processes, but also may enable process synthesis and integration across disparate physical and organizational boundaries (Basu and Blanning 2003).

Performance. Performance comprises *business process performance* as well as *organizational performance*. The former denotes a range of measures associated with operational efficiency enhancement within specific business processes, such as quality improvement of design processes and enhanced cycle time within inventory management processes. Examples of business process performance metrics used in prior IT business value research include on-time shipping (McAfee 2002), customer satisfaction (Devaraj and Kohli 2000), and inventory turnover (Barua et al. 1995). In contrast, organizational performance denotes aggregate IT-enabled performance impacts across all firm activities, with metrics capturing bottom-line firm impacts such as cost reduction, revenue enhancement, and competitive advantage. IT business value researchers have operationalized these measures via operations measures (cost reduction, productivity enhancement, etc.) and market-based measures (stock market valuation, Tobin's *q*, etc.) (Dehning and Richardson 2002). However, the range of potential measures is not limited to financial metrics, and may include perceptual measures, usage metrics, and others (Tallon et al. 2000).

Resource-based theory informs understanding of the linkage between the type of IT and the nature of business process and organizational performance impacts. For example, upon its introduction, the SABRE airline computerized reservation system was valuable and rare, thus conferring a temporary competitive advantage (Hopper 1990). However, imitation over time and diminished rareness weakened such advantages. Regarding the conversion of business process performance impacts to improved organizational performance, several factors are salient, including the scope of the business process, the extent to which it is core to the organization, the rareness of the particular IT in question, as well as the competitive environment (Kohli 2003).

Competitive Environment

The second domain in the integrative model is the competitive environment in which the focal firm operates, which we separate into two components: industry characteristics and trading partners. Industry characteristics include competitiveness, regulation, technological change, clockspeed, and other factors that shape the way in which IT is applied within the focal firm to generate business value (Devaraj and Kohli 2003; Hill and Scudder 2002; Jorgenson et al. 2003; Kettinger et al. 1994; Kraemer et al. 2000). In addition to industry characteristics, the competitive environment also includes the focal firm's trading partners. When IT spans firm boundaries, the business processes, IT resources, and non-IT resources of trading partners play a role in the IT business value generation of the focal firm (Chatfield and Yetton 2000; Mukhopadhyay and Kekre 2002; Williams and Frolick 2001). We thus

[6]Similarly, Grant (1991) classifies non-IT resources into five categories: (1) physical, (2) human, (3) organizational, (4) reputation, and (5) financial.

include industry characteristics and trading partners in the competitive environment domain.

Industry Characteristics. The organization of industries—concentration, supply chain configuration, etc.—as well as their salient features—technological change, regulation, IT standards, etc.—can shape how IT is used within focal firm business processes to create IT business value. For example, the competitive characteristics of strategic factor markets, including the IT resource, affect the degree to which a firm can enjoy above-normal returns (Barney 1986b). Another example is the high degree of unionization in such industries as telecommunications and auto manufacturing that may hamper a firm's ability to substitute IT for labor or to implement complementary work practices such as cross-functional work teams. The resulting suboptimal application of IT may limit IT business value generation. Alternatively, in time-sensitive industries such as personal computers and apparel, there is ample opportunity to apply IT to reduce cycle times, better manage inventory, and improve customer satisfaction (Ghemawat and Nueno 2003; Kraemer et al. 2000). The findings of quantitative empirical studies that certain industries attain higher IT productivity impacts and greater cost reduction than others provide further support for the inclusion of industry characteristics in our model (Lewis et al. 2002; Morrison 1997).

Industry characteristics apply to all firms in an industry. However, the response of industry competitors vis-à-vis information technology is not necessarily uniform. It is thus necessary to account for heterogeneity across industries as well as alternative response strategies among industry competitors to the same set of industry stimuli when examining the role of industry characteristics on IT business value.

Trading Partner Resources and Business Processes. Information technology increasingly permeates organizational boundaries, linking multiple firms via electronic networks and software applications and melding their business processes (Basu and Blanning 2003; Hammer 2001; Mukhopadhyay and Kekre 2002; Straub and Watson 2001). As a result, trading partners increasingly impact the generation of IT business value for the focal firm (Bakos and Nault 1997; Chatfield and Yetton 2000; Clemons and Row 1993). For example, inefficient business processes and antiquated technology within trading partner firms may inhibit the attainment of IT business value of an interorganizational system initiated by the focal firm. In some cases, this may give rise to incentives for the focal firm to team with the trading partner for joint improvement (Williams and Frolick 2001). We, therefore, adapt our formulation of IT, business processes, and organizational complements to the focal firm's trading partners, which provides the conceptual foundation for understanding their impact on focal firm IT business value generation. For example, the ability to partner with external IT units in development and implementation would be included in the human IT resource of both the focal and external organization. Another example is poor work practices within a supplier firm that inhibit its full use of a procurement system introduced by the focal buyer firm.

Macro Environment

The third and final layer in the integrative model is the macro environment, denoting country- and meta-country specific factors that shape IT application for the improvement of organizational performance. Examples include government promotion and regulation of technology development and information industries, IT talent, and information infrastructure, as well as prevailing information and IT cultures. As an example, firms in developing countries face constraints in applying information technology in the areas of education, expertise, infrastructure, and culture (Jarvenpaa and Leidner 1998). Inclusion of country factors in our model emphasizes their role in shaping the attainment of IT business value, especially salient to public policy makers. It also highlights the need to better understand the specific elements that apply in differing political, regulatory, educational, social, and cultural contexts (Dewan and Kraemer 2000; Jelassi and Figon 1994; Kumar et al. 1998; Lee et al. 2000; Tam 1998; Teo et al. 1997).

Table 4. IT Business Value Research Questions

Question	Domain
1. Is the IT resource associated with improved operational efficiencies or competitive advantage?	Focal firm
2. How does the IT resource generate operational efficiencies and competitive advantage?	Focal firm
3. What is the role of industry characteristics in shaping IT business value?	Competitive environment
4. What is the role of the resources and business processes of electronically linked trading partners in impacting the value generated and captured by the focal firm?	Competitive environment
5. What is the role of country characteristics in shaping IT business value?	Macro environment

Summary

The integrative model of IT business value is the first step toward a systematic theory of IT business value. The model is grounded in the resource-based view of the firm, chosen for its tenet that strategic resources, such as information technology, are not distributed equally among firms as well as its explication of the resource attributes required to achieve competitive advantage. The integrative model builds upon accumulated modeling knowledge to disaggregate the locus of IT business value into three domains: focal firm, competitive environment, and macro environment. Further development of a systematic theory is provided in the next section, in which we synthesize existing knowledge and develop propositions based on theory.

Literature Synthesis and Proposition Derivation

Using the integrative model as a lens through which to interpret the objectives and findings of more than 200 reviewed IT business value articles (Appendix A), we identified five research questions corresponding to the three domains of the model (Table 4). Studies emphasizing focal firm phenomena fall into two groups. The first group comprises studies examining whether and to what extent IT is associated with organizational performance, leading to research question 1: *Is the IT resource associated with improved operational efficiencies or competitive advantage?* The second group of studies in the focal firm domain analyzes how business value is generated via IT application. These studies incorporate the larger organizational context within which IT is applied, stated as research question 2: *How does the IT resource generate operational efficiencies and competitive advantage?* Studies in the second domain extend the scope of IT business value generation to incorporate the role of the competitive environment in shaping IT business value. The first group in this domain emphasizes industry characteristics, leading to research question 3: *What is the role of industry characteristics in shaping IT business value?* The second group in the competitive environment domain examines the role of trading partner resources and business processes in shaping the focal firm's ability to generate value from IT applications, stated as research question 4: *What*

is the role of the resources and business processes of electronically linked trading partners in impacting the value generated and captured by the focal firm? Finally, studies in the third domain explore the cultural, economic, political, social, legal, technical, educational, and other characteristics associated with countries and how they shape the organizational application of IT for performance improvement. Correspondingly, research question 5 is stated as: *What is the role of country characteristics in shaping IT business value?*

Two sets of propositions are developed (see Tables 5, 6, and 7). Assessment of what we know within each research question leads to a set of principal propositions summarizing knowledge accumulation. Instantiation of principal propositions leads to a second set of propositions illustrating how the model can be used to facilitate knowledge accumulation and providing guidance for future research.

Focal Firm

Research Question 1: Is the IT resource associated with improved operational efficiencies or competitive advantage?

Studies responding to this question focus on identifying, measuring, or estimating the relationship between IT and various measures of organizational performance. We categorize and review the findings of these articles according two perspectives: (1) the IT resource and (2) the type of performance impact.

Many empirical studies using large-sample data sets find support for a positive association between aggregate measures of the technological IT resource and organizational performance (Bharadwaj et al. 1999; Lehr and Lichtenberg 1997; Lichtenberg 1995; Siegel 1997). In a study of roughly 400 U.S. firms spanning the years 1987 to 1991, Brynjolfsson and Hitt (1996) find that the gross marginal product for computer capital is 81 percent and the return on IT investment exceeds that on non-IT capital investment. The basic structure of such results—the technological IT resource confers economic value—is preserved when considering alternative econometric specifications, assumptions, data sets, and time frames (Brynjolfsson and Hitt 1995, 2003; Dewan and Min 1997; Morrison 1997). Although fewer in number, some studies find mixed or inconclusive evidence concerning the relationship between the technological IT resource and organizational performance (Cron and Sobol 1983; Stiroh 1998).

In contrast to studies aggregating diverse technological IT resources into a single measure, researchers have also examined specific information systems and types of IT. Evidence exists for IT business value associated with computerized reservation systems (Banker and Johnston 1995) and ATM networks (Banker and Kauffman 1988). Several studies find a positive impact on cost reduction, whether in the context of a production data management system in the clothing industry (Tatsiopoulos et al. 2002), supply chain management in the food industry (Hill and Scudder 2002), or the jewelry appraisal process (Newman and Kozar 1994). There is also evidence for the existence of IT business value for the application of innovative IT (Dos Santos et al. 1993) and transaction processing systems (Weill 1992). Enterprise resource planning systems are associated with higher financial market valuation, although short-term effectiveness is dampened after implementation (Hitt et al. 2002).

The human IT resource (HIR) has been posited to confer not only operational performance improvements such as productivity but also competitive advantage (Mata et al. 1995). The conceptual analysis by Mata et al. suggests that managerial IT skills, but not technical IT skills, are valuable and able to confer a sustainable competitive advantage. Empirically, Brynjolfsson and Hitt (1996) include an IS labor term in a productivity regression and find that the output generated by IS labor spending is many times that generated by non-IS labor spending and expenses, consistent with the findings of Lichtenberg (1995). Bharadwaj (2000) includes human IT resources as one of three IT-based resources, but does not examine this dimension by itself. Rather, human IT re-

Table 5. Focal Firm Propositions	
1A	The IT resource—including both technology and human expertise—creates economic value for a focal firm by conferring operational efficiencies that vary in magnitude and type depending upon the organizational and technological context.
1B	Human IT expertise complementary to technological IT resources may create temporary competitive advantages that underlie performance differences among firms.
2A	Certain organizational resources are complementary to the IT resource in the generation of IT business value for the focal firm; the existence and magnitude of the complementarity between any two specific instantiations of these resources varies depending upon the organizational and technological contexts.
2B	The greater the inimitability of rare organizational resources that are complementary to IT and lacking substitutes, the greater the degree to which the focal firm can obtain a sustained competitive advantage.

sources are implicitly linked to IT capabilities, which are found to be positively related to firm performance. The study by Santhanam and Hartono (2003) replicates and extends these results using a similar data set and methodology. Such results suggest a relationship between HIR and operational efficiency. However, our knowledge of which component of HIR—technical versus managerial IT expertise—may be driving such results and whether they may also underlie a competitive advantage is slim.

Thus far we have reviewed the findings from prior literature according to the two components of the IT resource. Another perspective is examining performance impacts themselves, which may underlie conflicting empirical results. Many of the empirical IT business value studies finding a positive association between IT and performance use productivity or other measures of operational performance. A growing number use financial metrics, and some also find positive impacts (Bharadwaj et al. 1999; Brynjolfsson et al. 2002). However, research also indicates that the former may not always lead to the latter: operational improvements gained from applying IT within the organization may not translate to financial measures of performance (Barua et al. 1995; Hitt and Brynjolfsson 1996). One implication is that a firm is not able to capture all of the value it generates from IT.

Even if a firm is able to obtain financial performance improvements from its operational improvements, the question of competitive advantage via IT remains. One approach to assessing the implications for competitive advantage is to identify information technology applied for strategic reasons and examine its impact on sustained performance and competitive advantage. A study of the valve manufacturing industry indicates a weakly negative association between strategic IT and performance (Weill 1992). In contrast, an event study finds that the stock market reacts favorably to announcements that firms are using strategic information systems (Brown et al. 1995). Moreover, in subsequent years those firms tend to be more productive and more profitable than their industry rivals. There is also evidence that firms making investments in strategic information systems achieve sustainability via their established technology base (Kettinger et al. 1994). Another approach is to assess the attributes of IT and their ability to confer competitive advantage—Mata et al. conclude that only managerial IT skills confer a competitive advantage.

In summary, abundant empirical evidence supports the claim that in the aggregate, the technological IT resource has economic value (Kohli and Devaraj 2003). Moreover, studies of specific systems support and extend these findings by demonstrating the importance of organizational

and technological context. Evidence linking the TIR to competitive advantage is less conclusive. Although fewer studies have examined the human IT resource (HIR), emerging research suggests that the HIR enables operational efficiencies, although it is not clear whether managerial or technical HIR may underlie such results. We summarize these findings in the following:

> *Proposition 1A: The IT resource—including both technology and human expertise—creates economic value for a focal firm by conferring operational efficiencies that vary in magnitude and type depending upon the organizational and technological context.*

Studies examining the competitive advantage implications of the technological IT resource are too few in number to draw any robust conclusions, although early evidence indicates both a positive impact (Brown et al. 1995) and no association between TIR and sustainable performance advantages (Powell and Dent-Micallef 1997). In addition, there has been a lack of attention to the human IT resource in IT business value research. An association between the two components has been suggested, but synergies between TIR and HIR remain understudied. We thus specialize Proposition 1A by examining the nature of such synergies and the implications for competitive advantage.

Both components of the IT resource are valuable. Mata et al. argue that managerial IT skills confer a competitive advantage, which implies that these human IT expertise resources are valuable and which is consistent with empirical results (Bharadwaj 2000; Brynjolfsson and Hitt 1996; Lichtenberg 1995). Based on the abundant empirical research reviewed above, the technological IT resource is clearly valuable. But what of the competitive implications of the synergies between the two?

We do not argue that TIR or HIR confers a competitive advantage by itself. Rather, we propose that competitive advantage can result from the appropriate combination of technological and human IT resources. As has been argued by Carr (2003), the TIR is increasingly "commoditized." Even application software, once largely custom developed, is increasingly sourced as a package or service. However, customization of standard software and hardware offerings and adaptation to the business processes of the focal firm is complex, often valuable, and difficult to imitate. Thus, when complementarities exist between TIR and HIR, they are likely to lead to temporary competitive advantage.

Our argument extends that of Mata et al., which posits a temporary competitive advantage from technical IT skills but a sustainable advantage from managerial IT skills. With the increasing maturity and institutionalization of IT service markets, even these managerial and technical skills and capabilities can be sourced externally. Thus, even if competitive advantage is achieved, it is not likely to be sustainable due to the possibility of imitation.

This logic is consistent with the co-innovation literature from economics as well as the literature on complementarities (Bresnahan et al. 2002; Brynjolfsson and Hitt 2000). However, it differs in that we specialize prior arguments pertaining to IT and other organizational resources to the two components of the IT resource itself developed herein: technological and human IT resources. In other words, the physical IT resource must be present, and it must be managed well, in order to confer a temporary competitive advantage.

> *Proposition 1B: Human IT expertise complementary to technological IT resources may create temporary competitive advantages that underlie performance differences among firms.*

To emphasize, limited attention has been paid to the human component of the IT resource—our knowledge of the value of specific capabilities and our understanding of the nature of the complementarity of these capabilities with the TIR is slim. Thus, although Proposition 1B may appear somewhat straightforward, it adds to knowledge accumulation by emphasizing the salience of the human component of the IT resource and by providing a refutable claim about its synergy with the technological IT resource.

Research Question 2: How does the IT resource generate operational efficiencies and competitive advantage?

Studies examining the deployment of IT resources within organizations to improve performance are diverse in methodological and conceptual approach, but generally fall within one of two categories. The first assesses the degree to which complementary organizational resources moderate organizational performance impacts. These studies use quantitative empirical methods applied to large samples of firms. Studies in the second strand use case and field studies to analyze the highly contextual value generation process. The two groups offer unique insights into how IT generates operational efficiencies and competitive advantage for organizations, and we now review each in turn.

The resource-based view of the firm specifies that resources are valuable firm-specific assets. In the context of IT, firms must not only customize technological systems and deploy and maintain them, but also must manage teams of IT and non-IT resources that together generate greater value than they do alone (Brynjolfsson and Hitt 2000). The latter include organizational practices and structures that complement the varied functions of information systems. Empirically, decentralization of decision authority is found in greater application in firms with higher levels of IT investment (Hitt and Brynjolfsson 1997). Moreover, firms with greater use of IT and the use of teams, decentralized decision making, and wider breadth of job responsibilities are found to have disproportionately higher market valuations (Brynjolfsson et al. 2002). However, synergies between IT and other organizational practices do not always exist. For example, in a study of the impact of the use of computers, TQM, profit sharing, and employee participation on labor productivity, Black and Lynch (2001) find synergies among various workplace practices, but no consistent evidence of synergies with the use of computers.

Another set of organizational resources that may be complementary to IT are firm characteristics such as worker composition, size, financial condition, and culture. Francalanci and Galal (1998) find that IT business value, as measured by productivity, differs according to employee category: firms with higher IT investment that have also decreased their clerical and professional ranks have higher productivity. In the retail industry, complementarities leading to sustainable performance advantages exist between IT and human and business resources such as culture (Powell and Dent-Micallef 1997). Using the event study methodology, Im et al. (2001) find a negative association between firm size and price reaction to IT investments, hypothesizing two possible reasons: (1) greater predisclosure information in smaller firms and (2) smaller firms are better positioned to reap decreasing price-performance ratios than are larger firms. Another event study finds that a firm's financial condition moderates the market's reaction to an IT investment announcement (Oh and Kim 2001).

The few empirical studies discussed above that examine the impact of work practices and organizational structure on the performance impacts of IT application indicate the potential for complementarities with certain factors. However, such studies say little about which factors are important in which settings and the detailed mechanisms by which they combine. We now review case and field studies, which are able to provide a richer picture of the mechanisms by which IT improves organizational performance.

In an early case study of the order entry and distribution system Economost at McKesson Drug Co., Clemons and Row (1988, p. 40) document widespread IT-enabled efficiencies at McKesson and its customers, the latter benefitting substantially from "rationalizing operations in preparation for Economost," i.e., initiating complementary organizational resources in the form of work practices. Cooper et al. (2000) describe how a shift in corporate strategy at First American Bank drives information requirements, necessitating a new IT infrastructure based on a data warehouse. The data warehousing application is examined through the lens of a shift in corporate strategy and IT's complementarity with radical organizational transformation. The authors find

that a change in organizational thinking accompanied by appropriate IT investment lead to improved and transformed business processes and competitive advantage. Similarly, in a study of how IT supports online buying and build to order, organization-wide application of IT throughout a range of business processes enables synergies and competitive advantage (Kraemer et al. 2000). Other case and field studies examining the processes by which IT generates operational efficiencies and competitive advantage examine the travel industry (Clemons and Row 1991a), the cotton industry (Lindsey et al. 1990), and package delivery (Williams and Frolick 2001).

Despite management's best intentions, however, the co-introduction of IT and complementary organizational changes may not result in immediate success, due to adjustment costs (Chew 1991), learning, and other factors. In a study of the introduction of computer integrated manufacturing at a medical products manufacturer, Brynjolfsson et al. (1997) find that despite management's introduction of an extensive set of organizational change initiatives, managerial goals of improved flexibility and responsiveness are not immediately attained. At the core of the problem lies difficulty in changing employees' behaviors when their tacit knowledge about what works accumulated over many years appears to contradict new managerial edicts intended to complement new information systems.

Synthesizing the findings of quantitative and qualitative empirical research, it is clear that complementary organizational resources such as workplace practices, change initiatives, and culture all interact with IT in the process of value generation. It is unclear, however, which organizational practices are most synergistic with which types of information systems in specific organizational contexts. We synthesize this finding in the following general proposition.

> *Proposition 2A: Certain organizational resources are complementary to the IT resource in the generation of IT business value for the focal firm; the existence and magnitude of the complementarity between any two specific instantiations of these resources varies depending upon the organizational and technological contexts.*

Proposition 2A is broadly understood. What is not understood is the specific nature of complementarities, i.e., what specific resources are complementary to one another, under what conditions, and how are the attributes of complementary resources related to business process and organizational performance impacts? We take a step toward addressing this knowledge gap by specializing Proposition 2A. Examining the nature of IT and non-IT resources according to the RBV sheds light on which types of organizational practices and structural characteristics are more likely, when complementary, to provide a competitive advantage.

Certain organizational characteristics that may be complementary to IT, such as firm size and culture, are fixed in the short run, or quasi-fixed. For example, changes in culture and thinking complementary to the data warehouse implementation at First American Corporation took several years to implement (Cooper et al. 2000). Select manufacturing practices are also difficult to change and require many stops and starts to evolve toward a successful system (Brynjolfsson et al. 1997). Moreover, complex business processes enabled by IT such as build-to-order at Dell also take years to develop (Kraemer et al. 2000) and hence years to successfully imitate, if imitation is indeed possible. In contrast, other change initiatives are easier to implement, and hence to imitate.

Barney (1991) proposes three potential sources of imperfect imitability: (1) firm-specific historical conditions, i.e., a unique path through time; (2) causal ambiguity pertaining to the association between a firm's resource bundle and its sustained competitive advantage; and (3) socially complex resources such as interfirm relationships. In the case of IT, these factors may either hamper imitability, as is the case with quasi-fixed complementary assets, or in the more extreme situa-

tion, may prevent it entirely. For example, examining how Dell has been able to maintain competitive advantage over time suggests the presence of both historical path dependencies as well as causal ambiguity in its application of IT (Kraemer et al. 2000). In sum, analysis of the extent to which complementary organizational assets are imitable informs understanding of the degree to which the resulting synergies enable sustained competitive advantage.

Formalizing our arguments, complementary organizational assets are valuable and may be rare. When there are no strategic equivalents, i.e., no substitutes enabling the same strategies to be implemented, sustained competitive advantage rests on the extent to which such resources are imitable. As argued above, IT application is fraught with uncertainty and a lack of clarity with respect to the connection between its application and competitive advantage. We thus propose that

> *Proposition 2B: The greater the inimitability of rare organizational resources that are complementary to IT and lacking substitutes, the greater the degree to which the focal firm can obtain a sustained competitive advantage.*

Competitive Environment

Thus far we have reviewed accumulated knowledge of IT business value research emphasizing focal firm dynamics. In this section, we shift our attention to studies that include factors in the competitive environment. Following the integrative model, we review those focusing on industry characteristics as well as the impact of trading partners linked via information systems spanning firm boundaries.

Research Question 3: What is the role of industry characteristics in shaping IT business value?

Industry characteristics shape the extent to which a firm can acquire IT and apply it successfully. For example, in a design-driven industry such as apparel, it is critical for firms to rapidly shift with changing consumer preferences in styles (Ghemawat and Nueno 2003). The high-clockspeed fashion industry thus dictates the type of IT that is required, the way in which it is usefully applied, the dimensions of value that may result, as well as the extent of value generated. More broadly, technological change in product and factor markets, competitiveness, regulation, workforce composition, and minimum efficient scale have been shown in other contexts to impact the performance of firms (Clark 1984; Datta and Narayanan 1989; Edwards 1977; Primeaux 1977). We now assess what is known regarding the role of industry characteristics in impacting the ability of firms to create and capture IT business value.

Empirical studies of IT business value typically include variables to control for industry effects, whether an industry dummy variable (Lichtenberg 1995) or measures of industry structure such as competitiveness and regulation (Bharadwaj 2000). By including such controls, researchers are able to more accurately identify those impacts associated with IT versus those being driven by industry factors. However, the use of industry controls does not address the issue of how industry characteristics constrain or promote the ability of competing firms to apply IT for organizational improvement.

Few studies directly examine differential IT business value across industries. Fewer still attempt to provide a theoretically derived argument for why such differences may exist. One strand of such studies uses growth accounting at the industry level to examine differential multifactor productivity (MFP) growth. Stiroh (1998) finds differences in MFP growth between computer-producing and computer-using sectors; recent results indicate that producers as well as high-IT use industries have larger productivity acceleration relative to other industries (Stiroh 2001). In a direct examination of the net marginal benefits of IT investment, Morrison (1997) finds that the IT benefit-cost ratio has generally increased with time but is not uniformly distributed across industries. Indeed, according to the structure-conduct-performance

Table 6. Competitive Environment Propositions	
3A	Industry characteristics moderate the ability of firms to apply IT for improved organizational performance and to capture the resulting benefits.
3B	The greater the degree of competition in an industry, the greater the extent to which firms achieve efficiency gains via IT.
3C	The greater the degree of competition in an industry, the lower the extent to which firms are able to capture the benefits of efficiency gains and achieve profitability gains via IT.
4A	The IT and non-IT resources and the business processes of electronically connected trading partners shape the focal firm's ability to generate and capture organizational performance impacts via IT.
4B	The greater the degree of focal firm power relative to its trading partners connected via inter-organizational information systems, the greater its share of net value from deployment of the systems.

paradigm from the industrial organization literature, an industry's structure directly impacts the performance of firms within that industry (Bain 1951; Mason 1939; Porter 1985).

Another strand of research explores how industry competitiveness shapes IT value generation and capture, specifically, the degree to which the gains due to IT application may be competed away and passed on to business and end customers. Bresnahan (1986) finds spillovers in the capture of value by downstream industrial users of information technology produced in upstream sectors. Estimation of consumer welfare gains arising from the use of IT suggests that a substantial portion of generated IT business value accrues to end consumers via improved quality, product variety, etc. (Brynjolfsson 1996). Moreover, the extent of such appropriation by consumers may be large enough to significantly dampen performance impacts, although operational efficiencies are large (Barua et al. 1995; Hitt and Brynjolfsson 1996). These studies suggest that the competitiveness of product markets may affect the degree to which a firm may capture the benefits that it generates via application of information technology.

In sum, there is evidence for structural differences across industries regarding the ability of competitors to apply IT for improved performance. In addition, there is some evidence that a firm's ability to capture such value is moderated by competitive product markets. We synthesize these basic findings in the following:

> *Proposition 3A: Industry characteristics moderate the ability of firms to apply IT for improved organizational performance and to capture the resulting benefits.*

Moving from the general to the specific, we know very little about particular industry characteristics and their association with IT business value. Moreover, our theoretical and conceptual understanding of why such differences exist is limited. We address this theoretical gap by deriving a proposition relating industry competitiveness to IT business value.

In the presence of high industry concentration, the sophisticated pricing mechanism enabling efficient allocation of resources is weakened (Hayek 1945). According to the X-inefficiency hypothesis, the absence of competition allows for slack and other inefficiencies that raise costs (Leibenstein 1966). In the case of electric power, Primeaux (1977) finds 11 percent lower costs on average in firms facing competition. In banking, higher concentration is associated with larger staffs and higher labor expense, controlling for urban size, demand, and branch characteristics (Edwards 1977).

Although in highly competitive markets firms may apply IT more efficiently, profitability may suffer as gains to IT application are competed away. Conversely, under less competitive regimes the firm may achieve profitability without productivity, the former accruing due to monopoly rents. Our argument refines existing empirical evidence suggesting that, in general, there may be productivity without profitability (Hitt and Brynjolfsson 1996). To emphasize, increased competitive pressure has two effects: (1) it drives IT use for increased efficiency and (2) it lowers the ability of firms to capture rents due to competitive pressure. We thus propose that

Proposition 3B: The greater the degree of competition in an industry, the greater the extent to which firms achieve efficiency gains via IT.

Proposition 3C: The greater the degree of competition in an industry, the lower the extent to which firms are able to capture the benefits of efficiency gains and achieve profitability gains via IT.

Research Question 4: What is the role of the resources and business processes of electronically linked trading partners in impacting the value generated and captured by the focal firm?

In this section we analyze the value implications of interorganizational information systems (IOS) connecting the focal firm with its trading partners, including electronic data interchange (EDI), collaborative design systems, extranets, etc. We examine the role of trading partners' technological and human IT resources, complementary organizational resources, and business processes in shaping focal firm IT business value generation.

Electronic integration of business processes across organizations requires the development of IT resources by both the focal firm and its trading partners. Although standardization on Internet protocols is growing, electronic data interchange (EDI) is still a mainstay, requiring investment in translation and mapping software and service arrangements with value-added networks (VANs). Even in basic implementations, electronic integration requires some investment by trading partners (Unitt and Jones 1999; Williams and Frolick 2001).

In the context of electronic marketplaces linking many buyers and sellers, traditional microeconomics stresses the reduction of search costs and enhancement of economies of scope and scale (Bakos 1991). Transaction-cost economics (TCE) informs understanding of how IT affects the firm-market boundaries by (1) reducing market coordination costs, including searching, contracting, scheduling, budgeting, etc.; (2) facilitating the processing and communicating of complex product descriptions, thereby making them less complex; and (3) making some asset-specific components less specific (Gurbaxani and Whang 1991; Malone et al. 1987).

Regarding basic efficiencies accruing to the focal firm by connecting to a trading partner, cost reduction is well documented in the literature. FedEx uses EDI for billing and invoices to lower costs associated with specialized printing and mailing as well as for rapid matching of purchase orders, receipts, and invoices (Williams and Frolick 2001). Cost reduction results from the elimination of errors, reduction of inventory, and billing cycle efficiencies which may reduce float times and improve cash flow (Mukhopadhyay et al. 1995, Teo et al 1997).

These and other studies indicate that technological IT resources dedicated to integrating business processes enable firms to gain efficiencies in supply chain operations. However, they do not account for the complexities of interorganizational relationships and the potential for competitive advantage in the strategic implementation of shared resources that may be valuable, scarce, and difficult to implement.

Dyer and Singh (1998) argue that interorganizational relationships, whether electronically mediated or not, can be a source of competitive advantage. The authors propose four sources of potential competitive advantage: (1) relation-

specific assets; (2) knowledge sharing routines; (3) complementary resources; and (4) effective governance. Although the resource-based view is conventionally limited to analyzing the attributes of assets owned and controlled by a single firm, it has been extended to the multi-organizational context to incorporate the shared resources of multiple trading partners. Dovev (2002) develops a model assuming that the competitive advantage of the focal firm is a function of the value and rarity of resources of both the focal firm and its trading partners. Building upon Dyer and Singh's notion of relational rents, Dovev identifies three mechanisms by which the focal firm's competitive advantage is impacted by shared resources: (1) complementarities across organizational resources may create synergies or dissonance; (2) relational rents generated are not appropriated proportionally between the focal firm and its trading partners; (3) the benefits captured by the focal firm may not outweigh the costs of opportunistic trading partners in their use of shared information.

Few quantitative empirical studies have directly examined the impact of trading partners on focal firm IT business value generation and capture. However, emerging research indicates several sources of operational efficiencies and competitive advantage. One study adapts the notion of embeddedness from social network theory as a lens through which to examine strategic payoffs of EDI (Chatfield and Yetton 2000). Embeddedness is defined as how central an EDI network is to managing interfirm interdependence, as indicated by people links, mutual exchange of information, and joint problem solving. Firms with deeply embedded EDI are found to be more likely able to gain strategic benefits versus those with lower embeddedness. Mukhopadhyay and Kekre (2002) examine the EDI-based order processing system of a large industrial supplier of tools, tooling systems, and services. The authors examine the benefits to both the supplier as well as its network of trading partner customers. Results indicate that both parties derive value but that the capture of such value depends on who initiates the system and whether it has basic or enhanced functionality. In a study of the IT business value accruing to smaller firms within a network led by a large retailer, Subramani (1999) finds that IT may provide operational and strategic benefits in the presence of investment in relationship-specific investments.

Such studies suggest how operational and strategic benefits might result in the context of IOS, but they say less about the appropriation of such benefits. Another strand of research, primarily using analytic methods, focuses on how benefits are distributed. Using an economic model of cooperative investment in IT among multiple firms, Clemons and Kleindorfer (1992) deduce that the generated economic surplus is shared by participants in proportion to their bargaining power, which is related to alternative investment opportunities and asset specificity. Bakos and Nault (1997) model ownership and investment of electronic networks and find that the indispensability of stakeholders—the degree to which trading partners possess unique, specific skills—is critical to network ownership.

Synthesizing the diverse strands of research examining IT business value in the trading partner context, we conclude that trading partner resources, including IT and non-IT resources, and business processes are an important driver of the focal firm's ability to implement IOS successfully (Riggins and Mukhopadhyay 1994). In particular, relationships among organizations may be a key interorganizational resource complement to interorganizational IT, and may help to explain differences in benefits among trading partners. Other salient dimensions include knowledge and information sharing as well as the degree to which the interconnections are valuable and idiosyncratic to the relationship. We summarize this finding in the following:

> *Proposition 4A: The IT and non-IT resources and the business processes of electronically connected trading partners shape the focal firm's ability to generate and capture organizational performance impacts via IT.*

Beyond generalities, many complex questions remain. It is not clear how differences in the

human IT resource across organizations may shape the degree of value generated and captured by the focal firm. Moreover, we do not understand the extent to which complementary resources of trading partners, for example, workplace practices and organizational structure, impact focal firm benefits. Finally, value is not distributed equally, and may depend on a variety of factors including the role of the system initiator, the features of the system, and power.

We build on existing literature to examine the impact of a single trading partner resource—power—on the ability of the focal firm to generate and capture benefits from an interorganizational information system. Although power has many conceptualizations, in the context of trading partner relationships, we interpret power as equivalent to market power based on the control of resources and information. As argued by Horton (2003), power is critical to strategy and information systems.

In a review of power and IT research, Jasperson et al. (2002) identify three conceptualizations of power: technological imperative, organizational imperative, and emergent perspective. Viewing power through these alternative lenses, the authors develop metaconjectures relating power and IT impacts. Jasperson et al. posit that "IT can moderate the relationship between external power (power that derives from social structures outside the immediate context of formal authority) and the internal exercise of power" (p. 417). We build on this concept in the context of multiple organizations.

According to the reinforcement politics argument (Kraemer and Dutton 1979), computerization reflects existing structures. IT is a malleable technology controlled by those in power to enhance their level of control. The initiators of interorganizational information systems are often large incumbents who are industry leaders, i.e., they hold a great deal of power over their suppliers (Unitt and Jones 1999; Williams and Frolick 2001). As power may involve "manipulation of information that protagonists employ in the power game" (Fincham 1992, p. 743), those with relatively greater power can utilize it to appropriate a greater portion of the benefits, and hence reinforce their power.

Our argument that power is reinforced within electronically mediated networks and used by the powerful partner to extract a disproportionate level of benefits is related to the literature on modular production networks. Sturgeon (2002) defines captive production networks as hierarchical, relying on powerful firms to organize multiple tiers of smaller, less powerful suppliers. The power of lead firms in captive networks forces suppliers to cut costs, change output, or make new investments.

As a logical extension, the power of lead firms in captive networks is also likely to lead to their orchestration of benefits resulting from the system to be skewed to their own interests. The root of this ability lies in the bargaining power of the powerful over the powerless. Bowman and Ambrosini (2000) argue that value capture is a function of the perceived bargaining power of trading partners. The bargaining power of the focal firm customer is enhanced by its financial position as well as the availability of substitutes and low switching costs (Porter 1980, 1985). According to Jasperson et al. (p. 427), "the creation and introduction of IT can be seen as a process that involves interested parties intentionally using their power to affect the nature of the systems that are put in place." IT may not only reinforce but strengthen power differentials. In a study of IT-based interorganizational relationships in the consumer packaged goods industry, Clemons and Row (1993) find that retailers resist new IT and processes due to their expectation of lower bargaining power and less sharing of economic benefits. We thus propose that

> *Proposition 4B: The greater the degree of focal firm power relative to its trading partners connected via interorganizational information systems, the greater its share of net value from deployment of the systems.*

Table 7. Macro Environment Propositions	
5A	The macro environment shapes the degree to which firms can apply IT for organizational improvement.
5B	Telecommunications infrastructure—a complementary and potentially co-specialized asset with the IT resource—moderates the economic value of an interorganizational information system to the focal firm and its trading partners; the extent of moderation varies depending on the organizational and technological context.

Macro Environment

Research Question 5: What is the role of country characteristics in shaping IT business value?

The structure and institutions of economies and the increasingly interconnected global business environment affect firms' IT choices and resulting organizational performance outcomes (Van Den Ende et al. 2001). Certain macro factors may constrain firms' choices; for example, a poor telecommunications infrastructure inhibits Web-based supply chain integration. In contrast, trade liberalization, financial safeguards for online transactions, and tax subsidies may support and promote the application of IT for operational efficiencies and competitive advantage. However, beyond casual observation we know very little about the association between macro characteristics and IT business value.

Two factors have inhibited knowledge accumulation concerning macro characteristics and IT business value: (1) emphasis on U.S. firms and (2) lack of cross-country studies. IT business value researchers have focused on U.S. firms. As such, results are conditional on the characteristics of the U.S. business environment, including relatively liberal trade policies, an advanced information infrastructure, a relatively well-educated workforce, and relatively competitive markets. The second reason for a paucity of knowledge related to the international perspective of IT business value is that very few studies have explored IT business value using cross-country samples. Thus, although several studies have examined firms outside the U.S., including Brazil (Tigre and Botelho 2001), France (Jelassi and Figon 1994), Mexico (Jarvenpaa and Leidner 1998), and the United Kingdom (Stoneman and Kwon 1996), it is difficult to draw conclusions regarding the impact of macro factors as research designs do not enable incorporation of appropriate control variables. We use resource-based theory and results from other management literatures to inform the macro context.

The RBV informs understanding of IT business value in the macro context by providing a framework to examine performance implications concerning the variation of human and technological components of the IT resource across nations. Researchers have applied the resource-based view to assess why some firms "possess unique resources and competencies—relative to their competitors of other nationalities" (Dunning 1995, p. 466). In the IT context, the extent to which IT skills are widely available in a given country is a determinant of their rareness and heterogeneity, two attributes required for a sustained competitive advantage (Barney 1991). This point is underscored in the study by Jarvenpaa and Leidner (1998), which emphasizes the salience of investing in technology skills, hiring top IT talent often educated abroad, and forming exclusive arrangements with partners possessing complementary IT skills in gaining a competitive advantage via IT in a developing country. Moreover, if complementary organizational innovations are more widely available in one nation relative to another, the former economy may benefit from productivity gains, while the latter may not.

In addition to variation in the IT resource across countries, exogenous factors may also affect the

degree to which IT can be used to improve organizational performance. Path dependencies may play a role in determining the types of IT that are demanded, how they are used, and their economic impact (Tigre and Botelho 2001). For example, Brousseau (2003) finds that the pre-existing organization of distribution channels and interfirm relationships is salient to adoption and assimilation of e-commerce in France. Differences in the extent to which technological improvements diffuse in the U.S. versus other developed nations are suggested to play a role in observed differences in productivity growth (Gust and Marquez 2001). The confluence of EDI, organizational transformation, and public policy are illustrated in a study of Singapore's TradeNet (Teo et al. 1997). EDI at TradeNet resulted in substantial gains in efficiency and effectiveness, illustrating the degree to which promotion of IT can provide benefits to both the private and public sector.

In summary, the role of the macro environment in affecting the degree to which firms apply IT for organizational improvement is complex and not systematically understood. However, research and theory suggest that macro characteristics vary by country, create country-specific sets of IT attributes, and thereby impact firms' IT choices and resultant organizational performance impacts. Additionally, other macro factors such as culture and education also impact the ability of organizations to apply IT successfully. We summarize this finding in the following:

> *Proposition 5A: The macro environment shapes the degree to which firms can apply IT for organizational improvement.*

The macro environment is dynamic and complex, and there is a paucity of IT business value research in this area. However, examining the range of macro factors that potentially shape IT business value generation, telecommunications infrastructure, and, in particular, Internet diffusion would appear to be an important factor enabling firms to apply IT for improved performance.

Telecommunications infrastructure varies widely across countries (OECD 2003). As an example, according to the Hemisphere Wide Inter-University Scientific and Technological Information Network (2003), Internet host density (number of hosts per 100 inhabitants) in Latin America as of January 2003 varies from a low of .002 in Honduras to a high of 2.3 in Uruguay—a difference of three orders of magnitude. Given such variation, researchers have explored how heterogeneity in telecommunications infrastructure may be associated with macro performance. Roller and Waverman (2001) find empirically that the extent of telecommunications infrastructure is associated with economic growth. Other researchers have analyzed the potential impact of Internet diffusion on growth and productivity across countries (Varian 2002).

According to Straub and Watson (2001, p. 338), "The net-enabled organization (NEO) coordinates its activities and interacts with its stakeholders through the exchange of messages over electronic networks." Having squeezed most of the efficiencies out of internal connectivity, organizations are looking to their external environment to coordinate the production and delivery of goods and services, with the potential for orders of magnitude increases in efficiency (Hammer 2001). However, without a sufficient telecommunications infrastructure, i.e., broad diffusion of high-speed Internet connections throughout the economy, the resulting network externalities and net-enabled efficiencies are limited. Emerging empirical evidence of differences in IT business value across developed and developing countries may be a manifestation of differences in Internet diffusion (Dewan and Kraemer 2000; Tam 1998).

From the perspective of resource-based theory, telecommunications infrastructure is not a resource in the conventional sense as it is not owned and operated by the focal firm. Rather, it can be conceptualized as a country-specific asset available to all firms. As firms and their trading partners adopt and co-specialize their own IT to the telecom infrastructure, the extent of generated IT business value is likely to increase. However, the circumstances under which this occurs are unclear due to a lack of prior research. Thus, although differences in telecommunications infra-

structure across countries enable varying opportunities of co-specialization with focal firm IT resources, the nature of resulting benefits in specific contexts is uncertain. Due to a lack of empirical evidence, therefore, we cannot say whether the role of telecommunications infrastructure in shaping IT business value is of an efficiency or competitive nature. We thus propose that

> *Proposition 5B: Telecommunications infrastructure—a complementary and potentially co-specialized asset with the IT resource—moderates the economic value of an interorganizational information system to the focal firm and its trading partners; the extent of moderation varies depending on the organizational and technological context.*

Discussion

Several streams of research are concerned with assessing the organizational performance implications of information technology, each bringing its own theoretical and empirical toolkit to bear upon similar research questions. Unfortunately, these approaches are divergent and the result has been analogous to multiple but separate communication channels traversing a single pipe of inquiry into the organizational performance impacts of IT. The lack of integration has led to ambiguity and debate over basic principles, extending beyond the IS research community. The topic is vital to public policy makers, the IT industry, and IS practitioners, as exemplified by the recent debate over whether IT matters initiated in *Harvard Business Review* by Nicholas Carr (2003) arguing that firms have overestimated the strategic value of IT and overspent on the commodity that is IT. Our analysis has illuminated these issues through the lens of a robust theoretical framework.

Although we could not have anticipated the emergence of this new debate at the outset of our research effort, our analysis of accumulated IT business value knowledge speaks directly to it. Examining prior reviews of the literature convinced us that the integration of ideas across the various strands of research via a common theoretical lens was not only a unique approach, but also one that would likely yield the greatest contribution to knowledge. Our approach was thus to integrate quantitative empirical research addressing the productivity paradox, conceptual and empirical studies assessing the competitive advantage implications of IT, and qualitative empirical research assessing general performance impacts of IT within a single conceptual framework of IT business value. Comparing and contrasting articles across research strands led to the insight that although the focal firm bounds the locus of direct performance impacts, the external environment shapes them. Synthesizing the internal and external perspectives using resource-based theory enabled us to identify what we know and what we don't know and suggest illustrative propositions, the future assessment of which will, we hope, expedite knowledge advancement.

We have learned that IT is valuable, offering an extensive menu of potential benefits ranging from flexibility and quality improvement to cost reduction and productivity enhancement. Our analysis also suggests that the synergies resulting from technical and human IT resources likely result in short-lived competitive advantages. Regarding the mechanisms by which value is achieved, we learned that the high degree of complexity leads to a context-contingent set of synergistic combinations of IT and other organizational resources, including workplace practices, change initiatives, organizational structure, and financial condition. Further examination of the attributes of such complementary resources led to the proposition that under conditions of sufficient rarity and non-substitutability, the more difficult they are to imitate, the more likely is the attainment of a sustained competitive advantage.

Moving to the external environment, examination of differential impacts across industries suggested that industry characteristics such as regulation may constrain IT business value. In contrast, other facets of industry structure such as rapid technological change may enable leaders to

constantly innovate and maintain their IT-based competitive advantages. Refinement of this argument led to the proposition that the relationship of IT-enabled profitability and productivity enhancement (Hitt and Brynjolfsson 1996) may be moderated by the level of industry competitiveness. We also found that trading partners play a critical role in shaping the generation and determining the capture of focal firm IT business value when they are electronically linked. In particular, we posited that power is reinforced within IOS, i.e., IT reinforces preexisting power imbalances, enabling lead firms to capture a disproportionate amount of value. Moving to the final layer in our IT business value model, we found that a variety of public policy mechanisms as well as cultural and structural factors shape organizational adoption of IT and the resulting organizational performance impacts. In particular, telecommunications infrastructure is a complementary country-specific asset whose quality shapes the extent to which firms can apply IT to improve organizational performance.

Limitations and Future Research

Although we have endeavored to achieve the highest levels of objectivity, accuracy, and validity, our analysis is not without limitations. The resource-based view of the firm has emerged as the leading theory within strategy research (Barney 2001) and is used in various management literatures including marketing (Fahy and Smithee 1999) and international business (Peng 2001). However, although there is growing consensus that the RBV provides a robust framework for viewing the sources of competitive advantages within firms (Barney 2001; Peteraf and Barney 2003), it is not without criticism (Priem and Butler 2001). Despite its synthesis of economics rationale with a managerial perspective, RBV is sometimes criticized as drawing too heavily from economics. The selection of articles followed a carefully prescribed set of procedures and we endeavored to achieve complete objectivity and comprehensiveness. However, selection may have been implicitly influenced by existing biases. Attention to the included articles in prior reviews potentially mitigated this threat, as did the suggestions of outside reviewers. In summary, despite its limitations, we are hopeful that our analysis not only sheds light on a difficult and complex subject, but also shines a ray, albeit modest, on the future.

The research agenda resulting from our analysis relates to each of the five research questions identified herein. Although a great deal of research has examined the value of the technological IT resource, several aspects of the first research question remain relatively understudied. For example, case and field studies of specific organizational contexts might shed light on the different dimensions of organizational performance resulting from different types of IT deployment, e.g., infrastructure versus business applications. In addition, quantitative empirical studies of emergent forms of IT, including e-business and Web services, might benefit from a growing range of statistics collected by national governments, as documented for the U.S. by Tehan (2003). Moreover, quantitative and qualitative research examining the synergies between human IT expertise (HIR) and technological IT resources (TIR) would improve understanding of how they interact and inform implications for competitive advantage, as suggested by Proposition 1B.

Moving to the second research question, much work remains to uncover which resources are synergistic with which types of IT and in what contexts. In particular, empirical studies assessing the degree of imitability—perhaps using primary survey data as in Powell and Dent-Micallef (1997) and Tallon et al. (2000)—would improve our understanding of the sustainability of competitive advantage resulting from synergies between IT and complementary resources. Combining multiple levels from the integrative model within a single analysis may also inform the question of complementarities. For example, is the use of decentralized decision making combined with greater information sharing dependent upon business processes or industry characteristics? Case studies controlling for IT and non-IT resources

would inform understanding. Future research examining the ability of firms to apply IT successfully may build upon the capabilities perspective of the resource-based view (Grant 1991).

Our analysis also identifies several research streams concerning the external environment. We know very little about how industry characteristics moderate the degree of IT business value. As data on such characteristics as unionization and competitiveness are often collected by national governments, this represents a potentially fruitful area of future research. In addition, the dynamic capabilities extension to the RBV may be useful in understanding dynamic markets characterized by rapid change (Eisenhardt and Martin 2000; Teece et al. 1997). For example, are the practices of Dell in the PC industry adaptable to slower clockspeed industries such as wood products? Case and field studies are required to build a foundation for understanding the role of trading partner resources on the focal firm's ability to generate IT business value. Building from initial studies of the role of trading partners (Chatfield and Yetton 2000; Mukhopadhyay and Kekre 2002), further research might draw from conceptual work on value creation and capture (Bowman and Ambrosini 2000). The literature on interorganizational relationships (Barringer and Harrison 2000), transaction cost economics, and agency theory might also be useful. Finally, studies that incorporate macro characteristics, whether in multiple case studies or in empirical research, are needed to examine which macro characteristics are salient and how they may interact with one another in shaping the ability of firms to apply IT for organizational improvement. The examination of similar firms in a single industry across multiple countries might enable the isolation of macro factors that are the source of differential IT business value.

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References

Alpar, P., and Kim, M. "A Microeconomic Approach to the Measurement of Information Technology Value," *Journal of Management Information Systems* (7:2), 1990, pp. 55-69.

Amit, R., and Schoemaker, P. J. H. "Strategic Assets and Organizational Rent," *Strategic Management Journal* (14), 1993, pp. 33-46.

Bain, J. "Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940," *Quarterly Journal of Economics* (65:3), 1951, pp. 293-324.

Bakos, J. Y. "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly* (15:3), 1991, pp. 295-310.

Bakos, J. Y., and Nault, B. R. "Ownership and Investment in Electronic Networks," *Information Systems Research* (8:4), 1997, pp. 321-341.

Banker, R. D., and Johnston, H. H. "An Empirical Study of the Business Value of the U.S. Airlines' Computerized Reservation Systems," *Journal of Organizational Computing* (5:3), 1995, pp. 255-275.

Banker, R. D., and Kauffman, R. J. "Strategic Contributions of Information Technology: An Empirical Study of ATM Networks," in *Proceedings of the 9th International Conference on Information Systems*, M. H. Olson and J. I. DeGross (eds.), Minneapolis, MN, 1988, pp. 141-150.

Barney, J. B. "Firm Resources and Sustained Competitive Advantage," *Journal of Management* (17:1), 1991, pp. 99-120.

Barney, J. B. "Is the Resource-based 'View' a Useful Perspective for Strategic Management Research? Yes," *Academy of Management Review* (26:1), 2001, pp. 41-56.

Barney, J. B. "Organizational Culture: Can it Be a Source of Sustained Competitive Advantage?," *Academy of Management Review* (11:3), 1986a, pp. 656-665.

Barney, J. B. "Strategic Factor Markets: Expectations, Luck, and Business Strategy," *Management Science* (32:10), 1986b, pp. 1231-1241.

Barringer, B. R., and Harrison, J. S. "Walking a Tightrope: Creating Value Through Interorganizational Relationships," *Journal of Management* (26:3), 2000, pp. 367-403.

Barua, A., Kriebel, C. H., and Mukhopadhyay, T. "Information Technologies and Business Value: An Analytic and Empirical Investigation," *Information Systems Research* (6:1), 1995, pp. 3-23.

Barua, A., and Mukhopadhyay, T. "Information Technology and Business Performance: Past, Present and Future," in *Framing the Domains of IT Management: Projecting the Future Through the Past,* R. W. Zmud (ed.), Pinnaflex Educational Resources, Inc., Cincinnati, OH, 2000, pp. 65-84.

Basu, A., and Blanning, R. W. "Synthesis and Decomposition of Processes in Organizations," *Information Systems Research* (14:4), 2003, pp. 337-355.

Belleflamme, P. "Oligopolistic Competition, IT Use for Product Differentiation and the Productivity Paradox," *International Journal of Industrial Organization* (19:1-2), 2001, pp. 227-248.

Benaroch, M., and Kauffman, R. "A Case for Using Real Options Pricing Analysis to Evaluate Information Technology Project Investments," *Information Systems Research* (10:1), 1999, pp. 70-86.

Bharadwaj, A. S. "A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation," *MIS Quarterly* (24:1), 2000, pp. 169-196.

Bharadwaj, A. S., Bharadwaj, S. G., and Konsynski, B. "Information Technology Effects on Firm Performance as Measured by Tobin's q," *Management Science* (45:7), 1999, pp. 1008-1024.

Black, S. E., and Lynch, L. M. "How To Compete: The Impact of Workplace Practices and Information Technology on Productivity," *Review of Economics and Statistics* (83:3), 2001, pp. 434-445.

Bowman, C., and Ambrosini, V. "Value Creation Versus Value Capture: Towards a Coherent Definition of Value in Strategy," *British Journal of Management* (11:1), 2000, pp. 1-15.

Bresnahan, T. F. "Measuring the Spillovers from Technical Advance: Mainframe Computers in Financial Services," *American Economic Review* (76:4), 1986, pp. 742-755.

Bresnahan, T., Brynjolfsson, E., and Hitt, L. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-level Evidence," *Quarterly Journal of Economics* (117:1), 2002, pp. 339-376.

Broadbent, M., and Weill, P. "Management by Maxim: How Business and IT Managers Can Create IT Infrastructures," *Sloan Management Review* (38:3), 1997, pp. 77-92.

Brousseau, E. "E-Commerce in France: Did Early Adoption Prevent Its Development?," *The Information Society* (19:1), 2003, pp. 45-57.

Brown, R. M., Gatian, A. W., and Hicks, J. O. "Strategic Information Systems and Financial Performance," *Journal of Management Information Systems* (11:4), 1995, pp. 215-248.

Brynjolfsson, E. "The Contribution of Information Technology to Consumer Welfare," *Information Systems Research* (7:3), 1996, pp. 281-300.

Brynjolfsson, E. "The Productivity Paradox of Information Technology," *Communications of the ACM* (36:12), 1993, pp. 66-77.

Brynjolfsson, E., and Hitt, L. "Beyond Computation: Information Technology, Organizational Transformation and Business Performance," *Journal of Economic Perspectives* (14:4), 2000, pp. 23-48.

Brynjolfsson, E., and Hitt, L. "Computing Productivity: Firm-Level Evidence," *Review of Economics and Statistics* (85:4), 2003, pp. 793-808.

Brynjolfsson, E., and Hitt, L. "Information Technology as a Factor of Production: The Role of Differences Among Firms," *Economics of Innovation and New Technology* (3:4), 1995, pp. 183-200.

Brynjolfsson, E., and Hitt, L. "Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending," *Management Science* (42:4), 1996, pp. 541-558.

Brynjolfsson, E., Hitt, L., and Yang, S. "Intangible Assets: Computers and Organizational Capital," *Brookings Papers on Economic Activity* (1), 2002, pp. 137-181.

Brynjolfsson, E., Renshaw, A. A., and van Alstyne, M. "The Matrix of Change," *Sloan Management Review* (38:2), 1997, pp. 37-54.

Brynjolfsson, E., and Yang, S. "Information Technology and Productivity: A Review of the Literature," *Advances in Computers* (43), 1996, pp. 179-214.

Brynjolfsson, E., and Yang, S. "The Intangible Benefits and Costs of Investments: Evidence from Financial Markets," in *Proceedings of the Eighteenth International Conference on Information Systems*, K. Kumar and J. I. DeGross (eds.), Atlanta, GA, 1997, pp. 147-166.

Caldeira, M. M., and Ward, J. M. "Using Resource-based Theory to Interpret the Successful Adoption and Use of Information Systems and Technology in Manufacturing Small and Medium-sized Enterprises," *European Journal of Information Systems* (12:2), 2003, pp. 125-139.

Carr, N. G. "IT Doesn't Matter," *Harvard Business Review* (81:5), May 2003, pp. 41-49.

Chamberlin, E. H. "Monopolistic or Imperfect Competition," *Quarterly Journal of Economics* (51:4), 1937, pp. 557-580.

Chamberlin, E. H. *The Theory of Monopolistic Competition*, Harvard University Press, Cambridge, MA, 1933.

Chan, Y. E. "IT Value: The Great Divide Between Qualitative and Quantitative and Individual and Organizational Measures," *Journal of Management Information Systems* (16:4), 2000, pp. 225-261.

Chatfield, A. T., and Yetton, P. "Strategic Payoff from EDI as a Function of EDI Embeddedness," *Journal of Management Information Systems* (16:4), 2000, pp. 195-224.

Chew, W. B. "Beating Murphy's Law," *Sloan Management Review* (32:3), 1991, pp. 5-16.

Clark, K. "Unionization and Firm Performance: The Impact on Profits, Growth, and Productivity," *American Economic Review* (74:5), 1984, pp. 893-919.

Clemons, E K.. "Corporate Strategies for Information Technology: A Resource-Based Approach," *Computer* (24:11), 1991, pp. 23-32.

Clemons, E. K., and Kleindorfer, P. R. "An Economic Analysis of Interorganizational Information Technology," *Decision Support Systems* (8:5), 1992, pp. 431-446.

Clemons, E. K., and Row, M. C. "Information Technology at Rosenbluth Travel: Competitive Advantage in a Rapidly Growing Global Service Company," *Journal of Management Information Systems* (8:2), 1991a, pp. 53-79.

Clemons, E. K., and Row, M. C. "Limits to Interfirm Coordination through Information Technology: Results of a Field Study in Consumer Packaged Goods Distribution," *Journal of Management Information Systems* (10:1), 1993, pp. 73-95.

Clemons, E. K., and Row, M. C. "McKesson Drug Company: A Case Study of Economost–A Strategic Information System," *Journal of Management Information Systems* (5:1), 1988, pp. 36-50.

Clemons, E. K., and Row, M. C. "Sustaining IT Advantage: The Role of Structural Differences," *MIS Quarterly* (15:3), 1991b, pp. 275-292.

Cooper, B. L., Watson, H. J., Wixom, B. H., and Goodhue, D. L. "Data Warehousing Supports Corporate Strategy at First American Corporation," *MIS Quarterly* (24:4), 2000, pp. 547-567.

Cron, W. L., and Sobol, M. G. "The Relationship between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," *Information and Management* (6), 1983, pp. 171-181.

Cronk, M. C., and Fitzgerald, E. P. "Constructing a Theory of 'IS Business Value' from the Literature," *Electronic Journal of Business Research Methods* (1:1), 2002, pp. 11-17.

Cronk, M. C., and Fitzgerald, E. P. "Understanding 'IS Business Value': Derivation of Dimensions," *Logistics Information Management* (12:1/2), 1999, pp. 40-49.

Datta, D. K., and Narayanan, V. K. "A Meta-Analytic Review of the Concentration-Per-

formance Relationship: Aggregating Findings in Strategic Management," *Journal of Management* (15:3), 1989, pp. 469-483.

Davenport, T. H. *Process Innovation: Reengineering Work through Information Technology*, Harvard Business School Press, Cambridge, MA, 1993.

Dedrick, J., Gurbaxani, V., and Kraemer, K. L. "Information Technology and Economic Performance: A Critical Review of the Empirical Evidence," *ACM Computing Surveys* (35:1), 2003, pp. 1-28.

Dehning, B., and Richardson, V. J. "Returns on Investments in Information Technology: A Research Synthesis," *Journal of Information Systems Management* (16:1), 2002, pp. 7-30.

Devaraj, S., and Kohli, R. "Information Technology Payoff in the Health-Care Industry: A Longitudinal Study," *Journal of Management Information Systems* (16:4), 2000, pp. 41-67.

Devaraj, S., and Kohli, R. "Performance Impacts of Information Technology: Is Actual Usage the Missing Link," *Management Science* (49:3), March 2003, pp. 273-289.

Dewan, S., and Kraemer, K. L. "Information Technology and Productivity: Evidence from Country-Level Data," *Management Science* (46:4), 2000, pp. 548-562.

Dewan, S., and Min, C. "The Substitution of Information Technology for Other Factors of Production: A Firm Level Analysis," *Management Science* (43:12), 1997, pp. 1660-1675.

Dierickx, I., and Cool, K. "Asset Stock Accumulation and Sustainability of Competitive Advantage," *Management Science* (35:12), 1989, pp. 1504-1511.

Dos Santos, B. L., Peffers, K. G., and Mauer, D. C. "The Impact of Information Technology Investment Announcements on the Market Value of the Firm," *Information Systems Research* (4:1), 1993, pp. 1-23.

Dovev, L. "The Competitive Advantage of Interconnected Firms: An Extension of the Resource-Based View," *Academy of Management Proceedings*, 2002, pp. C1-C6.

Drucker, P. F. *The Effective Executive*, Harper and Row, New York, 1966.

Dunning, J. H. "Reappraising the Eclectic Paradigm in an Age of Alliance Capitalism," *Journal of International Business Studies* (26:3), 1995, pp. 461-491.

Dyer, J. H., and Singh, H. "The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage," *Academy of Management Review* (23:4), 1998, pp. 660-679.

Edwards, F. R. "Managerial Objectives in Regulated Industries: Expense-Preference Behavior in Banking," *Journal of Political Economy* (85:1), 1977, pp. 147-162.

Eisenhardt, K. M., and Martin, J. A. "Dynamic Capabilities: What Are They?," *Strategic Management Journal* (21:10-11), 2000, pp. 1105-1121.

Fahy, J., and Smithee, A. "Strategic Marketing and the Resource Based View of the Firm," *Academy of Marketing Science Review* (10), 1999, pp. 1-20.

Fincham, R. "Perspectives on Power: Processual, Institutional and 'Internal' Forms of Organizational Power," *Journal of Management Studies* (29:6), 1992, pp. 741-759.

Francalanci, C., and Galal, H. "Information Technology and Worker Composition: Determinants of Productivity in the Life Insurance industry," *MIS Quarterly* (22:2), 1998, pp. 227-241.

Ghemawat, P., and Nueno, J. L. "Zara: Fast Fashion," *Harvard Business School Case* (9-703-497), 2003, pp. 1-35.

Granovetter, M. "Economic Action and Social Structure: The Problem of Embeddedness," *American Journal of Sociology* (91:3), 1985, pp. 481-510.

Grant, R. M. "The Resource-based Theory of Competitive Advantage," *California Management Review* (33:3), 1991, pp. 114-135.

Gurbaxani, V., and Whang, S. "The Impact of Information Systems on Organizations and Markets," *Communications of the ACM* (34:1), 1991, pp. 59-73.

Gust, C., and Marquez, J. "International Comparisons of Productivity Growth: Recent Developments," *Business Economics* (36:3), 2001, pp. 55-62.

Hammer, M. "The Superefficient Company," *Harvard Business Review* (79:8), 2001, pp. 82-91.

Hayek, F. A. "The Use of Knowledge In Society," *American Economic Review* (35:4), 1945, pp. 519-530.

Hemisphere Wide Inter-University Scientific and Technological Information Network. *Internet Host Density in Latin America and the Carribbean*, Organization of American States, Washington, DC, January 2003 (www.oas.org).

Hill, C. A., and Scudder, G. D. "The Use of Electronic Data Interchange for Supply Chain Coordination in the Food Industry," *Journal of Operations Management* (20:4), 2002, pp. 375-387.

Hitt, L., and Brynjolfsson, E. "Information Technology and Internal Firm Organization: An Exploratory Analysis," *Journal of Management Information Systems* (14:2), 1997, pp. 81-101.

Hitt, L., and Brynjolfsson, E. "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value," *MIS Quarterly* (20:2), 1996, pp. 121-142.

Hitt, L., Wu, D. J., and Zhou, X. "Investment in Enterprise Resource Planning: Business Impact and Productivity Measures," *Journal of Management Information Systems* (19:1), 2002, pp. 71-98.

Hoogeveen, D., and Oppelland, H. J. "A Socio Political Model of the Relationship between IT Investments and Business Performance," in *Proceedings of the 35th Hawaii International Conference on System Sciences*, IEEE Computer Society Press, Los Alamitos, CA, 2002, pp. 259b.

Hopper, M. D. "Rattling SABRE—New Ways to Compete on Information," *Harvard Business Review* (68:3), 1990, pp. 118-125.

Horton, K. S. "Strategy, Practice, and the Dynamics of Power," *Journal of Business Research* (56:2), 2003, pp. 121-126.

Im, K. S., Dow, K. E., and Grover, V. "A Reexamination of IT Investment and The Market Value of the Firm—An Event Study Methodology," *Information Systems Research* (12:1), 2001, pp. 103-117.

Itami, H. *Mobilizing Invisible Assets*, Harvard University Press, Cambridge, MA, 1987.

Jarvenpaa, S. L., and Leidner, D. E. "An Information Company in Mexico: Extending the Resource-Based View of the Firm to a Developing Country Context," *Information Systems Research* (9:4), 1998, pp. 342-361.

Jasperson, J., Carte, T. A., Saunders, C. S., Butler, B. S., Croes, H. J. P., and Zheng, W. "Power and Information Technology Research: A Metatriangulation Review," *MIS Quarterly* (26:4), 2002, pp. 397-459.

Jelassi, T., and Figon, O. "Competing through EDI at Brun Passot: Achievements in France and Ambitions for the Single European Market," *MIS Quarterly* (18:4), 1994, pp. 337-352.

Jorgenson, D. W., Ho, M. S., and Stiroh, K. J. "Growth of US Industries and Investments in Information Technology and Higher Education," *Economic Systems Research* (15:3), 2003, pp. 279-325.

Jorgenson, D. W., and Stiroh, K. J. "Information Technology and Growth," *American Economic Review* (89:2), 1999, pp. 109-115.

Kauffman, R. J., and Weill, P. "An Evaluative Framework for Research on the Performance Effects of Information Technology Investment," in *Proceedings of the Tenth International Conference on Information Systems*, J. I. DeGross, J. C. Henderson, and B. R. Konsynski (eds.), Boston, Massachusetts, 1989, pp. 377-388.

Kettinger, W. J., Grover, V., Guha, S., and Segars, A. "Strategic Information Systems Revisited: A Study in Sustainability and Performance," *MIS Quarterly* (18:1), 1994, pp. 31-58.

Kling, R. "Social Analysis of Computing: Theoretical Perspectives in Recent Empirical Research," *Computing Surveys* (12:1), 1980, pp. 61-110.

Kohli, R. "In Search of Information Technology Business Value: Do Measurement Levels Make a Difference?," in *Proceedings of the 9th Americas Conference on Information Systems*, J. Ross and D. Galletta (eds.), Tampa, FL, 2003, pp. 1465-1468.

Kohli, R., and Devaraj, S. "Measuring Information Technology Payoff: A Meta-Analysis of Structural Variables in Firm-Level Empirical Research," *Information Systems Research* (14:2), 2003, pp. 127-145.

Kraemer, K. L., Dedrick, J., and Yamashiro, S. "Refining and Extending the Business Model with Information Technology: Dell Computer Corporation," *The Information Society* (16:1), 2000, pp. 5-21.

Kraemer, K. L., and Dutton, W. H. "The Interests Served by Technological Reform: The Case of Computing," *Administration and Society* (11:1), 1979, pp. 80-106.

Kriebel, C. H., and Kauffman, R. "Modeling and Measuring the Business Value of Information Technology," in *Measuring Business Value of Information Technologies*, P. Berger, J. G. Kobielus, and D. E. Sutherland (Eds.), ICIT Press, Washington, DC, 1988.

Kumar, K., van Dissel, H. G., and Bielli, P. "The Merchant of Prato—Revisited: Toward a Third Rationality of Information Systems," *MIS Quarterly* (22:2), 1998, pp. 199-226.

Lee, B., and Barua, A. "An Integrated Assessment of Productivity and Efficiency Impacts of Information Technology Investments: Old Data, New Analysis and Evidence.," *Journal of Productivity Analysis* (12), 1999, pp. 21-43.

Lee, S.-G., Swenseth, S. R., and Rho, B. H. "The Impact of Information Management on the Supply Chain: Differences of Linkages between U.S. and Japanese Manufacturers," *Proceedings of the 31st Annual Meeting of the Decision Sciences Institute*, Orlando, FL, 2000, pp. 1246-1248.

Lehr, B., and Lichtenberg, F. "Information Technology and its Impact on Productivity: Firm-Level Evidence from Government and Private Data Sources, 1977-1993," *Canadian Journal of Economics* (32:2), 1999, pp. 335-362.

Leibenstein, H. "Allocative Efficiency Vs. 'X-Efficiency,'" *American Economic Review* (56:3), 1966, pp. 392-415.

Lewis, W. W., Palmade, V., Regout, B., and Webb, A. "What's Right with the U.S. Economy," *McKinsey Quarterly* (1), 2002, pp. 30-40.

Lichtenberg, F. R. "The Output Contributions of Computer Equipment and Personnel: A Firm-Level Analysis," *Economics of Innovation and New Technology* (3:4), 1995, pp. 201-217.

Lindsey, D., Cheney, P. H., Kasper, G. M., and Ives, B. "TELCOT: An Application of Information Technology for Competitive Advantage in the Cotton Industry," *MIS Quarterly* (14:4), 1990, pp. 347-357.

Malone, T. W., Yates, J., and Benjamin, R. I. "Electronic Markets and Electronic Hierarchies," *Communications of the ACM* (30:6), 1987, pp. 484-497.

Markus, M. L., and Robey, D. "Information Technology and Organizational Change: Causal Structure in Theory and Research," *Management Science* (34:5), 1988, pp. 583-598.

Markus, M. L., and Robey, D. "Why Stuff Happens: Explaining the Unintended Consequences of Using Information Technology," in *The Past and Future of Information Systems,* K. V. Andersen (ed.), Butterworth-Heinemann, 2004 (forthcoming).

Mason, E. S. "Price and Production Policies of Large-Scale Enterprise," *American Economic Review* (29:1), 1939, pp. 61-74.

Mata, F. J., Fuerst, W. L., and Barney, J. B. "Information Technology and Sustained Competitive Advantage: A Resource-based Analysis," *MIS Quarterly* (19:4), 1995, pp. 487-505.

McAfee, A. "The Impact of Enterprise Information Technology Adoption on Operational Performance: An Empirical Investigation," *Production and Operations Management* (11:1), 2002, pp. 33-53.

Morrison, C. J. "Assessing the Productivity of Information Technology Equipment in US Manufacturing Industries," *Review of Economics & Statistics* (79:3), 1997, pp. 471-481.

Mukhopadhyay, T., and Kekre, S. "Strategic and Operational Benefits of Electronic Integration in B2B Procurement Processes," *Management Science* (48:10), 2002, pp. 1301-1313.

Mukhopadhyay, T., Kekre, S., and Kalathur, S. "Business Value of Information Technology: A Study of Electronic Data Interchange," *MIS Quarterly* (19:2), 1995, pp. 137-156.

Nelson, R. R., and Winter, S. G. *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, MA, 1982.

Newman, J., and Kozar, K. A. "A Multimedia Solution to Productivity Gridlock: A Re-Engineered Jewelry Appraisal System at Zale Corporation," *MIS Quarterly* (18:1), 1994, pp. 21-30.

OECD. *ICT and Economic Growth—Evidence from OECD Countries, Industries, and Firms*, Organisation for Economic Co-operation and Development, Paris, 2003.

Oh, W., and Kim, J. W. "The Effects of Firm Characteristics on Investor Reaction to IT

Investment Announcements," in *Proceedings of the Twenty-Second International Conference on Information Systems*, V. Storey, S. Sarkar, and J. I. DeGross (eds.), New Orleans, LA, 2001, pp. 145-155.

Orlikowski, W. J., and Iacono, C. S. "Desperately Seeking the 'IT' in IT Research—A Call to Theorizing the IT Artifact," *Information Systems Research* (12:2), 2001, pp. 121-134.

Peng, M. W. "The Resource-Based View and International Business.," *Journal of Management* (27:6), 2001, pp. 803-829.

Penrose, E. *The Theory of the Growth of the Firm*, Basil Blackwell, London, 1959.

Peteraf, M. "The Cornerstones of Competitive Advantage: A Resource-based View," *Strategic Management Journal* (14), 1993, pp. 179-191.

Peteraf, M. A., and Barney, J. B. "Unraveling the Resource-Based Tangle," *Managerial & Decision Economics* (24:4), 2003, pp. 309-323.

Porter, M. E. *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, 1985.

Porter, M. E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, 1980.

Porter, M. E. "Strategy and the Internet," *Harvard Business Review* (79:3), 2001, pp. 63-78.

Porter, M. E., and Millar, V. E. "How Information Gives You Competitive Advantage," *Harvard Business Review* (63:4), 1985, pp. 149-160.

Powell, T. C., and Dent-Micallef, A. "Information Technology as Competitive Advantage: The Role of Human, Business, and Technology Resources," *Strategic Management Journal* (18:5), 1997, pp. 375-405.

Priem, R. L., and Butler, J. E. "Is the Resource-Based 'View' a Useful Perspective for Strategic Management Research?," *Academy of Management Review* (26:1), 2001, pp. 22-40.

Primeaux, W. J. "An Assessment of X-Efficiency Gained Through Competition," *Review of Economics and Statistics* (59:1), 1977, pp. 105-108.

Riggins, F. J., and Mukhopadhyay, T. "Interdependent Benefits from Interorganizational Systems: Opportunities for Business Partner Reengineering," *Journal of Management Information Systems* (11:2), 1994, pp. 37-57.

Robinson, J. *The Economics of Imperfect Competition*, MacMillan Press, London, 1933.

Roller, L.-H., and Waverman, L. "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," *American Economic Review* (91:4), 2001, pp. 909-924.

Ross, J. W., Beath, C. M., and Goodhue, D. L. "Develop Long-Term Competitiveness through IT Assets," *Sloan Management Review* (38:1), 1996, pp. 31-42.

Rumelt, R. P. "Theory, Strategy, and Entrepreneurship," in *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, D. J. Teece (ed.), Ballinger Publishing, Cambridge, MA, 1987, pp. 137-158.

Rumelt, R. P. "Towards a Strategic Theory of the Firm," in *Competitive Strategic Management,* R. Lamb (ed.), Prentice-Hall, Englewood Cliffs, NJ, 1984, pp. 556-570.

Santhanam, R., and Hartono, E. "Issues in Linking Information Technology Capability to Firm Performance," *MIS Quarterly* (27:1), 2003, pp. 125-153.

Scott Morton, M. S. (Ed.). *The Corporation of the 1990s: Information Technology and Organizational Transformation*, Oxford University Press, New York, 1991.

Siegel, D. "The Impact of Computers on Manufacturing Productivity Growth: A Multiple-Indicators, Multiple-Causes Approach," *Review of Economics and Statistics* (79:1), 1997, pp. 68-78.

Soh, C., and Markus, M. L. "How IT Creates Business Value: A Process Theory Synthesis," in *Proceedings of the 16th International Conference on Information Systems*, J. I. DeGross, G. Ariav, C. Beath, R. Hoyer, and C. Kemerer (eds.), Amsterdam, The Netherlands, 1995, pp. 29-41.

Stiroh, K. "Computers, Productivity, and Input Substitution," *Economic Inquiry* (36:2), 1998, pp. 175-191.

Stiroh, K. J. "Investing in Information Technology: Productivity Payoffs for U.S. Industries," *Current Issues in Economics & Finance* (7:6), 2001, pp. 1-6.

Stoneman, P., and Kwon, M. J. "Technology Adoption and Firm Productivity," *Economic Journal* (106:437), 1996, pp. 952-962.

Straub, D. W., and Watson, R. T. "Transformational Issues in Researching IS and Net-Enabled Organizations," *Information Systems Research* (12:4), 2001, pp. 337-345.

Sturgeon, T. J. "Modular Production Networks: A New American Model of Industrial Organization," *Industrial and Corporate Change* (11:3), 2002, pp. 451-496.

Subramani, M. R. "Linking IT Use to Benefits in Interorganizational Networks: The Mediating Role of Relationship-Specific Intangible Investments," in *Proceedings of the 20th International Conference on Information Systems*, P. De and J. I. DeGross (Eds.), Charlotte, NC, 1999, pp. 358-363.

Tallon, P. P., Kraemer, K. L., and Gurbaxani, V. "Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach," *Journal of Management Information Systems* (16:4), 2000, pp. 145-173.

Tam, K. Y. "The Impact of Information Technology Investments on Firm Performance and Evaluation: Evidence from Newly Industrialized Economies," *Information Systems Research* (9:1), 1998, pp. 85-98.

Tatsiopoulos, I. P., Ponis, S. T., Hadzillias, E. A., and Panayiotou, N. A. "Realization of the Vertical Enterprise Paradigm in the Clothing Industry Through E-business," *Production and Operations Management* (11:4), 2002, pp. 516-530.

Teece, D. J., Pisano, G., and Shuen, A. "Dynamic Capabilities and Strategic Management," *Strategic Management Journal* (18:7), 1997, pp. 509-533.

Tehan, R. "E-Commerce Statistics: Explanation and Sources," RL31293, Congressional Research Service Documents, Information Research Division, The Library of Congress, Washington, DC, 2003, pp. 1-12.

Teo, H.-H., Tan, B. C. Y., and Wei, K. K. "Organizational Transformation Using Electronic Data Interchange: The Case of TradeNet in Singapore," *Journal of Management Information Systems* (13:4), 1997, pp. 139-165.

Tigre, P. B., and Botelho, A. J. "Brazil Meets the Global Challenge: IT Policy in a Postliberalization Environment," *The Information Society* (17:2), 2001, pp. 91-103.

Triplett, J. E. "The Solow Productivity Paradox: What Do Computers Do to Productivity?," *Canadian Journal of Economics* (32:2), 1999, pp. 309-334.

Unitt, M., and Jones, I. C. "EDI—The Grand Daddy of Electronic Commerce," *BT Technology Journal* (17:3), 1999, pp. 17-23.

Uzzi, B. "Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness," *Administrative Science Quarterly* (42:1), 1997, pp. 35-67.

Van Den Ende, J., Wijnberg, N., and Meijer, A. "Public Policy and Innovative Capabilities: The Case of Philips' IT Activities," *Technology Analysis & Strategic Management* (13:3), 2001, pp. 389-405.

Varian, H., Litan, R. E., Elder, A., and Shutter, J. "The Net Impact Study: The Projected Economic Benefits of the Internet in the United States, United Kingdom, France and Germany," 2002, pp. 1-60 (available online at http://www.netimpactstudy.com/nis_2002.html).

Webster, J., and Watson, R. T. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), 2002, pp. xiii-xxiii.

Weill, P. "The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector," *Information Systems Research* (3:4), 1992, pp. 307-331.

Weill, P., Subramani, M., and Broadbent, M. "Building IT Infrastructure for Strategic Agility," *Sloan Management Review* (44:1), 2002, pp. 57-65.

Wernerfelt, B. "A Resource-Based View of the Firm," *Strategic Management Journal* (5:2), 1984, pp. 171-180.

Williams, M. L., and Frolick, M. N. "The Evolution of EDI for Competitive Advantage: The FedEx Case," *Information Systems Management* (18:2), Spring 2001, pp. 47-53.

Wilson, D. D. "IT Investment and Its Productivity Effects: An Organizational Sociologist's Perspective on Directions for Future Research," *Economics of Innovation and New Technology* (14:3), 1995, pp. 235-251.

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Appendix A

Methodology Used to Identify Research Articles

Our methodology for identifying IT business value studies proceeded in three stages (Webster and Watson 2002). First, using key words from our definition of IT business value we queried journal databases (no time period constraint) and browsed the titles of articles in leading journals and conference proceedings (1990 through 2002). Journal databases included Business Source Premier and JSTOR. Browsed journals included *American Economic Review*, *Communications of the AIS*, *Communications of the ACM*, *Decision Support* Systems, *Economics of Innovation and New Technology*, *Information Systems Research*, *Journal of MIS*, *Management Science*, *MIS Quarterly*, *Organization Science*, and *Production and Operations Management*. Conferences included Americas Conference on Information Systems, Australasian Conference on Information Systems, European Conference on Information Systems, and the International Conference on Information Systems. Second, we used citations of identified articles as further sources. Finally, we used the Social Sciences Citation Index and the Web of Science to identify additional candidate articles. This systematic and comprehensive search resulted in 202 IT business value articles, a complete listing of which is available upon request from the authors. Note that this process excluded book chapters, working papers, and other articles not subjected to the peer-review process. In addition to identifying IT business value studies, we also identified prior reviews of the literature (Barua and Mukhopadhyay 2000; Brynjolfsson 1993; Brynjolfsson and Hitt 2000; Brynjolfsson and Yang 1996; Chan 2000; Cronk and Fitzgerald 1999; Dedrick et al. 2003; Dehning and Richardson 2002; Kauffman and Weill 1989; Soh and Markus 1995; Triplett 1999; Wilson 1995). Regarding reliability of the final list of included articles, for approximately 75 percent of the articles, there was agreement on the selection by all three reviewers. For the remainder, there was agreement by at least two reviewers. Each of these articles was then discussed until there was agreement that the article should be included or excluded from the final set.