IDEA GROUP PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
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ITJ3213

This paper appears in the publication, *Journal of Database Management, vol. 17, issue 3*
edited by Keng Siau

Designing Information Systems Capabilities to Create Business Value:

A Theoretical Conceptualization of the Role of Flexibility and Integration

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ABSTRACT

Despite Internet success and the fact that software has become the factory in many businesses, questions remain concerning information technology (IT) business value, the IT payoff paradox, and why IT even matters. While numerous econometric studies have established that there is significant business value from IT investments at an aggregate level, it is often unclear how this value accrues specifically and how a particular IS design and specific IS capabilities contribute. Therefore, this article focuses on IT business value (ITBV) antecedents. It analyzes the role of two distinct key IS capabilities: integration and flexibility, which are widely considered central to IS analysis and design. This article is a necessary first step toward decomposing and measuring ITBV antecedents. Subsequent efforts can build on it by developing scales and survey instruments for quantitative-empirical evaluation. This article follows a tradition of theory development adapted and condensed into a four-step approach for IS literature by Zmud (1998), defines and clearly delineates the constructs, and evolves a model that links them with IT business value.

Keywords: customer involvement; IS architecture; IS flexibility; IS integration; operational linkages

INTRODUCTION

With a more uncertain and disruptive business environment today on the one hand and, as a result, sharply increased information systems (IS) requirements and more distributed information technology (IT) choices such as Web services on the other hand, companies are struggling to design and build appropriate IS capabilities.

In the past, many companies have invested in information systems and software with the particular goal of facilitating business process reengineering (Davenport, 1990; Hammer, 1990; Hammer & Champy, 1993). The adoption of this strategy has been so widespread that it has created entirely new IT markets and businesses, such as systems integration consulting, enterprise resource planning (ERP), and customer relationship management (CRM) software markets. Akin to Henry Ford's introduction of the moving assembly line using the conveyor belt (Womack, Jones, & Roos, 1990), tight integration of business operations using software applications has resulted in efficiency gains (Turban, McLean, & Wetherbe, 2001). However, anecdotal evidence suggests that tight integration also has reduced companies' flexibilities (e.g., the ability to respond quickly to new sales opportunities, to add new product features, or to link quickly with new business partners) (*The Economist*, 2002). Early research has pointed to the importance of flexibility as a key characteristic of information systems architectures. Allen and Boynton (1991) stated, "Traditional [information] systems don't bend; they won't change, and they can't adapt. … The change must come through a revamped IS architecture" (p. 435). In order to address this issue, the IT industry has responded with innovation in distributed systems architectures. Examples include the common object request broker architecture (CORBA) (www.omg.org) and J2EE (http://java.sun.com/j2ee/). The latest IT innovation is Web services technology, the use of which is expected to facilitate loosely coupled intersystem interaction, or machine-to-machine communications (Hagel & Brown, 2001; Hars & Schlueter Langdon, 2002; Patil & Saigal, 2001; Schlueter Langdon, 2003a). While Internet technology has made interconnectivity easier, Web services technology could improve greatly the interoperability of distributed systems.

Despite the importance of various IS capabilities, there is little scientific guidance on the subject. Early attempts at conceptualizing and measuring IS capabilities have been promising (Byrd & Turner, 2000; Nelson & Ghods, 1998). However, inconsistencies in construct definitions remain. For example, the meaning and subject of the capability of flexibility often remain unclear. There is infrastructure flexibility, IT flexibility, system flexibility, and even adaptability and dynamic capabilities, all of which sound very similar. Furthermore, antecedents, dimensions, and consequences of flexibility are not delineated clearly. Such weak theoretical support hinders empirical confirmatory analysis. To the author's best knowledge, there is no empirical analysis of IS architecture capabilities and their business values. Weak theory and empirical confirmation, in turn, contribute to uncertainty about IT investments and to misunderstandings and faulty expectations of IS design. Therefore, it appears to be appropriate to propose to develop a theoretic paper "to develop and present a rich conceptual understanding of this issue to serve as a basis for future empirical as well as theoretical work" (Zmud, 1998). This exploratory, theoretic stage is crucial "since validation of causal assumptions which go undetected at this stage are unlikely to be detected at the confirmatory phase either" (Lee, Barua, & Whinston, 1997, pp. 117, 121). This article is a first step only but a necessary one toward decomposing and measuring IT business value (ITBV) antecedents. Subsequent efforts can build on it by developing scales and survey instruments for quantitative-empirical evaluation.

RESEARCH OBJECTIVES AND METHOD

Deeper research into IS capabilities is crucial in order to design systems that help to create business value. Lee et al. (1997) have pointed to the "reengineering paradox" in the IS literature in order to illustrate this point (p. 110). While the popular reengineering doctrine of radical change (Davenport, 1990; Hammer, 1990; Hammer & Champy, 1993) "is intuitively appealing, … literature shows a paucity of systematic evidence regarding the relationship between radical change and reengineering success. In the absence of explicit modeling and theoretical justification of why and when radical change leads to success, a simplistic model of reengineering payoff through radical change can provide misleading results" (Lee et al., 1997, p. 110). Therefore, the focus is on variables and their causal relationships in order to link IS capabilities with IT business value.

This study is focused explicitly very narrowly on only two, albeit important, IS capability constructs: integration and flexibility. The aim of this article is to clarify and delineate both. The article defines flexibility and integration, explores the relationship between the IS capabilities constructs and IT business value based on prior literature, and investigates how integration and flexibility interact in order to create IT business value. Toward the end of this article, formal statements of these relationships in the form of research propositions are provided.

The investigation is organized according to the widely acknowledged concept of a pure theory manuscript that has been adapted for the IS literature by Zmud (1998) from the *Academy of Management Review*, the sole editorial mission of which is to publish theoretical contributions.

Zmud (1998) argues that it is imperative for any pure theory manuscript to remain focused on constructs and their relationships and states, "Both of these elements [review of the literature and frameworks] should be secondary, and may in fact be quite invisible, relative to the focus on constructs and their relationships."

Following Zmud (1998), this article continues with the main section on Research Model Development, which begins with a provisional research model that evolved step-by-step into a refined research model that reflects the propositions. This section is similar to the exploratory first phase of construct development in Chin, Gopal, and Salisbury's (1997) three-phase approach to construct design, an often-citied approach to construct and scale development. As a result, the article posits a baseline model (Lee et al., 1997) complete with research propositions and implications for research and practice.

RESEARCH MODEL DEVELOPMENT

IS Capabilities

IS capabilities are an important concept in IS literature and central to IS analysis and design (Hars, 1998; Kendall & Kendall, 2002; Scheer, 1998; Turban et al., 2001). They are understood as the fundamental competencies, skills, and tacit knowledge that an organization develops in order to effectively acquire, deploy, and leverage its IT infrastructure in pursuit of its business strategy (Bharadwaj, Sambamurthy, & Zmud, 2001). This concept also is referred to as IT capabilities or IT infrastructure and architecture capabilities. A review of IS and computer science literature reveals a distinction between IS and IT as well as between infrastructure and architecture (Schlueter Langdon, 2003b). A system typically is understood as an assemblage of components serving a common purpose. Thus, IS is defined as a group of IT components serving a common business automation purpose (Bakopoulos, 1985; Dewett & Jones, 2001; IEEE, 1990; Turban et al., 2001). IT components include computer hardware, application software and databases, and telecommunication networks (IEEE, 1990). This assortment of physical IT artifacts is often referred to as the base of IT infrastructure (Broadbent & Weill, 1997; Earl, 1989). Other IT infrastructure elements that compose the human dimension of IT infrastructure include intellectual assets such as knowledge, skills, and experience that complement physical IT components (Weiss & Birnbaum, 1989).

An IS architecture refers to the manner in which the components of an information system are organized and integrated (IEEE, 1990; Lloyd & Galambos, 1999). More specifically, computer science literature architecture is concerned with the assignment of responsibilities to components and the methods of interaction among components within a system (Dewayne & Wolf, 1992). In terms of IS architecture, some parts of IS literature have further broken out the notion of an information architecture. For example, Turban, et al. (2001) suggested considering information architecture as the "high-level, logical plan of the information requirements and the structures or integration of information resources needed to meet those requirements" (pp. 533-534).

In order to avoid ambiguity of results, human IT elements explicitly are excluded, and the article is focused on physical IT infrastructure elements only. This separation is also useful for practice, because the two aspects represent different types of managerial challenges. Equipment is purchased, updated, and maintained. Talent is recruited, trained, and mentored. With physical IS capabilities, decision making is concerned, for example, with choices made relative to applications, data, and technology configurations—the architecture (Broadbent & Weill, 1997; Henderson & Venkatraman, 1993). In the case of human IS capabilities, decision making is concerned with the choices made relative to the knowledge and capabilities required to effectively manage the IT resources within the organization (Broadbent & Weill, 1997; Henderson & Venkatraman, 1993). Consequently, our results are limited to aiding decision making related to physical IT infrastructure and are not designed to have an impact in areas such as human resources management.

IS Capabilities and IT Business Value

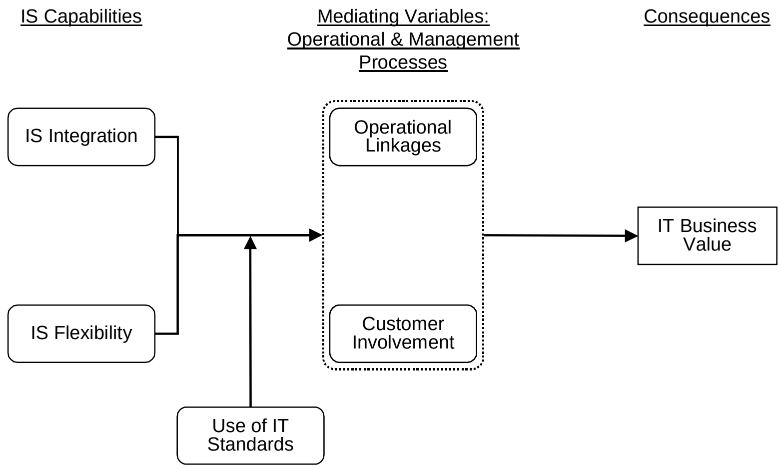
The business value from IT investments or IT business value (ITBV) has remained a broadly defined variable according to two recent reviews of the literature. Melville, Kraemer, and Gurbaxami (2004) have synthesized the literature to define "IT business value as the organizational performance impacts of information technology at both the intermediate process level and the organization-wide level, and comprising both efficiency impacts and competitive impacts" (p. 8). In this context, ITBV is different from value perceived by consumers (Wheeler, 2002). Tallon and Kraemer (2003) review the literature on ITBV in their investigation of the relationship between ITBV and strategic alignment. Both reviews conclude that any conceptualization of ITBV appears to be situational (Melville et al., 2004). For example, Intel's (2003) business metrics program defines ITBV as the "impact of [an IS] project on business strategy and priorities" (p. 2). It is measured using their so-called Business Value Index (BVI) methodology: "BVI is a composite index of factors that impact the value of an IT investment. It evaluates IT investments along three vectors: IT business value (that is, impact to Intel's business), impact of IT efficiency, and the financial attractiveness of an investment" (p. 3).

At a high aggregate level, there is no doubt about the business value of IT. Numerous econometric studies have established that there is significant business value from IT investments. The U.S. Federal Reserve Bank, for example, has credited the long phase of economic growth throughout the 1990s to technology-induced productivity increases (Stiroh, 2001). However, at a less aggregated level (i.e., at the firm, business unit, or process level), relationships and causalities become less clear. Despite many studies of IT business value at the firm level (Bharadwaj, Bharadwaj, & Konsynski, 1999; Brynjolfsson, 1993; Brynjolfsson & Hitt, 1996; Brynjolfsson, Malone, Gurbaxani, & Kambil, 1994; Dewan, Michael, & Min, 1998; Dewan & Min, 1997; Hitt, 1999; Hitt & Brynjolfsson, 1996; McKenney, Mason, & Copeland, 1997; Pinsonneault & Rivard, 1998; Tam, 1998) and the process level (Barua, Kriebel, & Mukhopadhyay, 1995; Barua & Lee, 1997; Mukhopadhyay, Rajiv, & Srinivasan, 1997; Srinivasan, Krekre, & Mukhopadhyay, 1994), to the best of the author's knowledge, there is no confirmatory, quantitative empirical study yet that analyzes the role of specific IS capabilities in value creation. Often, studies have been limited to IT investments as an independent variable. In terms of causality between specifically IS flexibility and IS integration on one side and IT business value on the other, there is very little literature on which to rely.

In terms of theoretical underpinnings used to support such causality, a synthesis of information processing theory (Galbraith, 1973), transaction cost economics (Coase, 1937; Malone, Yates, & Benjamin, 1987; Williamson, 1975, 1985), and the resource-based view of the firm (Barney, 1986; Rumelt, 1984; Wernerfeld, 1984) often is used.

Galbraith (1973) has posited that organizations are information-processing entities that try either to reduce their information-process-

Figure 1. Refined research model



ing load or to increase their information-processing capabilities.

Drawing on the transaction cost analysis of Coase (1937) and Williamson (1975, 1985), Malone et al. (1987) showed that IT investments can reduce external coordination costs more than internal. Together with microeconomic cost theory, which suggests that specialized enterprises enjoy lower production costs than vertically integrated ones (Tirole, 1988), this creates (ceteris paribus) an incentive for specialization strategies. Dewan et al. (1998) and Hitt (1999) have empirically confirmed these IT-enabled specialization effects. This transaction cost-based analysis has been expanded to include the notion of virtual integration. Clemons and Row (1991) revealed that IS can facilitate the exploitation of efficiencies through increased and tighter operational linkages across adjacent business activities while also reducing transaction costs. Hence, the vertical application of IT can achieve some of the benefits of vertical integration without vertical ownerships while at the same time realizing the production cost advantages of separate, specialized operations.

The resource-based view of the firm as developed in strategic management theory links resource heterogeneity and resource immobility with a firm's ability to sustain competitive advantage. IS researchers have argued that IT investments and the ability to use them to leverage a firm's resource advantage allow IT to be considered a source of strategic advantage (Barney, 1991; Clemons & Row, 1991; Mata, Fuerst, & Barney, 1995; Sethi & King, 1994).

In order to further sharpen the study, this article is focused on the two dimensions of IS architecture capabilities that have been identified as being of key importance: flexibility and integration (Allen & Boynton, 1991; Laartz, Sonderegger, & Vinckier, 2000; Richardson, Jackson, & Dickson, 1990; Schlueter Langdon, 2003b). Other characteristics and candidates for capability dimensions that should be investigated in future research include scalability of applications (Menasce & Almeida, 2000; Pearlson & Saunders, 2004); compatibility, connectivity, and portability of applications; and data integrity (Richardson et al., 1990).

See Figure 1 for an illustration of the proposed research model.

Integration

The importance of IS integration is reflected in the rapid growth of system integration services business and the emergence of several software application markets. These include the enterprise resource planning (ERP) system industry, which provides IT to automate and integrate enterprise operations, and customer relationship management (CRM), which provides IT in order to integrate customer management. Every one of these markets has generated major new firms, such as Accenture, SAP, and Siebel.

We defined IS integration as the extent to which IT components, such as computer hardware, software applications and databases, and communication networks, are blended into a functional whole or a unified information system (IS). This definition recognizes the distinction made in the IS and computer science literatures between different technical IT components and an IS (IEEE, 1990).

Please refer to the Appendix for an exemplary conceptualization of the construct.

Flexibility

In addition to integration, the development of a flexible and responsive IT infrastructure frequently is identified as a key IT management priority (Brancheau, Janz, & Wetherbe, 1996; Malone & Rockart, 1991).

The IS literature presents a multitude of definitions and conceptualizations of flexibility. Huber and McDaniel (1986), Nelson and Ghods (1998), Byrd and Turner (2000), and Duncan (1995) have made important contributions to the development of a unified perspective. Huber and McDaniel (1986) distinguish between structural flexibility and process flexibility as two dimensions of technology flexibility. Nelson and Ghods (1998) as well as Byrd and Turner (2000) focused on the notion of structural flexibility and developed definitions specifically for IT flexibility. They also recognized Duncan's (1995) review of the literature, which "offers a first step toward developing an applied definition of [IT] infrastructure flexibility" (p. 55).

In order to propose a definition, the literature has been synthesized and aligned with linguistic science. Merriam-Webster defines flexibility as "ready capability to adapt to new, different, or changing requirements" (www.webster.com). The ontological aspects of flexibility according to Webster's definition first involves the notion of ready capability and, second, adapting to some event.

Therefore, IS flexibility is defined as the ready capability of an information system to be adapted to new, different, or changing business requirements. Examples of such changes are rapid sales growth, new product offerings, and new business relationships.

This definition shares important similarities with Byrd and Turner (2000), who have defined IT infrastructure flexibility as "the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure" (p. 172). The definition in this article differs in that it excludes the human element of IT, as justified before.

The proposed definition of IS flexibility is also similar to that of Nelson and Ghods (1998), who defined it as "the ability to adapt to both incremental and revolutionary changes in the business or business process with minimal penalty to current time, effort, cost, or performance" (p. 233). The performance component in their definition has been removed in order to properly discriminate between IS flexibility as a predictor variable and its consequences, such as performance or IT business value. Subsuming flexibility and business value means combining cause and effect, which prevents structural equation modeling-based analysis.

Please refer to the Appendix for an exemplary conceptualization of the construct.

IS flexibility and IS integration both are considered important capabilities for supporting business strategy. However, their relationship appears to be complicated. Byrd and Turner (2000, 2001) have suggested considering integration as a dimension or factor of flexibility. However, anecdotal evidence and other literature suggest otherwise, pointing to an interaction effect. Particularly large firms that have integrated operations by implementing ERP and CRM systems appear to have achieved efficiency at the expense of flexibility (*The Economist*, 2002). The research literature, however, is thin, and there seems to be no confirmatory, quantitative empirical study on this subject. Most discussions are theoretical, with support being based on evidence from case study analysis. Allen and Boynton (1991) supported the notion of an interaction effect. Duncan (1995) reported "one IS executive in an insurance firm indicating that in a key large system, sixteen or seventeen business processes could be imbedded in the centralized system. Processes are so tightly integrated that a change to one process might affect sixteen others. These unique integration characteristics are now haunting current efforts to implement modern, modular integration concepts" (p. 48). In short, tight integration seems to have hampered system flexibility, particularly in larger firms that tend to me more integrated and use enterprise integration software, which leads to our first proposition, as follows.

Proposition 1. In large firms, IS integration and IS flexibility have an inverse relationship to Operational and Management Processes.

The Role of Standards

The use of standards such as Internet and Web technology can reduce the trade-off between IS integration and IS flexibility. Referring to the dictionary again, a standard is something set up and established by some authority as a rule for the measurement of quantity, weight, extent, value, or quality (www.webster.com). In IS, a key application of standards is in interfaces. Interfaces are defined as "shared boundaries across which information is passed or a hardware or software component that connects two or more other components for the purpose of passing information from one to the other" (IEEE, 1990, p. 41). Please refer to the Appendix for an exemplary conceptualization of the construct.

Much of the enthusiasm about Web services technology, for example, is due to the fact that its many interfaces use open IT standards. Web service technology differs from past innovations such as Common Object Request Broker Architecture (CORBA) (www.omg.org) in its extensive use of open IT standards (Hars & Schlueter Langdon, 2002). Only some components of the technology are new, such as Web Service Definition Language (WSDL), while other components are already well established, such as the Web standards URL and XML. This is a great advantage, since these standards are very popular and already enjoy a large installed base. Furthermore, as Web services-based systems become capable of leveraging existing Internet investments, they initially may be less costly. They also may be perceived as less risky, because with a Web services-based project, a company continues to invest in open technology, thus avoiding the risk of sunken costs that can result from investments in proprietary alternatives. In short, a business could benefit from increased flexibility while achieving tighter systems integration. This leads to our second proposition.

Proposition 2. The greater the use of IT standards, the weaker the adverse relationship between IS integration and IS flexibility.

Mediating Structure

While the depreciation of IT investments increases cost immediately, the benefits from an IT investment, such as higher sales revenues or product quality improvements, also hinge upon other factors. In order to properly examine and measure the causality between IS capabilities and IT business value, the literature recommends adopting a process perspective. This can be achieved by introducing intermediate variables that capture business process or operational and managerial process characteristics as depicted in Figure 1. As a result of a mediating structure, the model explores causal relationships between IS, organizational, and economic factors in order to help managers improve business processes and competitiveness through the deployment of IT (Barua et al., 1995; Lee et al., 1997).

This research strategy has its roots in the economics literature. Marschak (1950) noted that a parsimonious model such as a single equation relationship is more easily traceable; however, such a model increases the risk of using endogenous variables as predictors of an independent variable where, in fact, the predictors themselves depend on other variables (1950).

This mediating structure of the business model corresponds well with a categorization of distinct perspectives on IS impact, which often is referred to as the common information system layer concept (Turban et al, 2001). The framework distinguishes between three layers: IT, business processes, and market and strategy. It is used frequently in the management science literature, often as the foundation for more specific concepts such as Henderson and Venkatraman's (1993) strategic alignment model.

In order to complete the theoretical discussion of causality between specific IS capabilities of integration and flexibility on the one hand and IT business value on the other, two exemplary intermediating variables are proposed. The choice of intermediate variables also corresponds to recent events in supply chains, such as virtual integration upstream in the supply chain — operational linkages — and electronic delivery in downstream channel systems — customer involvement (see Figure 1).

Dell Computer Corp. often is used as an example to illustrate such IT-enabled structural change in supply chains (Magretta, 1998). Downstream in the supply chain, which is referred to as the channels system in the marketing literature (Frazier, 1983), Dell has eliminated traditional intermediaries and channel partners such as wholesalers and retailers. Furthermore, Dell has harnessed the Internet and Web services to tighten operations of adjacent suppliers and, thus, to extend its control upstream in the supply chain without ownership of all the assets and skills required (Gershman, 2002). Dell's combination of direct selling and electronic backward integration has moved the point where market pull turns into producer push further upstream in the supply chain, which first has increased Dell's flexibility in the marketplace and then has reduced inventory. Flexibility allows for product (mass) customization, which increases product differentiation and customer satisfaction and saves the cost of writing off slow and obsolete items. Lower inventories save inventory-carrying cost.

Operational Linkages

Operational linkages have been chosen as a mediating variable in order to link IS capabilities with the creation of value in a business network, because it already is mentioned as a key relationship connector in IS, networks, and relationship marketing literatures.

The article proposes defining operational linkages as the extent to which assets, procedures, and routines of buying, selling, and intermediating organizations are linked in order to facilitate operations. This definition is adapted from a study by Cannon and Perreault (1999) that focuses on buyer-seller relationships in business markets. It is similar to the concept of operational integration used by Robicheaux and Coleman (1994), the bundles of related relation-specific investments used by Dyer and Singh (1998), and the operational linkages and virtual integration discussed by Clemens and Row (1991).

Clemens and Row (1991) have used transaction cost economics to argue that "information systems (antecedent) can exploit efficiencies (consequence) through increased operational integration (mediating variable) among vertically related activities" (p. 285). The authors also referred to this concept as virtual integration, the IT-enabled tight coupling of adjacent but organizationally separated activities, because use of IT can allow for vertical deintegration in order to realize production economies available to specialized firms while reducing transaction costs and risks usually associated with such specialization strategy. This concept also has been referred to as electronic integration by Zaheer and Venkatraman (1994). Drawing upon transaction cost theory, the authors argued that electronic integration as "a specific form of vertical quasi-integration [can be] achieved through the deployment of dedicated information systems between relevant actors in adjacent stages of the value chain" (p. 551). This leads to the third proposition.

Proposition 3a. The greater the IS integration, the greater is the extent of operational linkages leading to higher IT business value.

Causality appears to be less clear between IS flexibility and operational linkages. It is quite plausible that a firm could achieve high operational linkages upstream with little or no IS flexibility. However, it may not be very likely. Important control variables could include the number of business partners, the trust and reputation of a business partner, and even market volatility.

Investments in IT represent considerable assets. Without flexibility, any IT investment would be specific to a particular process and relationship. Duncan (1995), for example, has noted that "the ideally flexible infrastructure would be one that was designed to evolve, itself, with emerging technologies and [that] would support the continuous redesign of business and related IS processes" (p. 44). If the system is not flexible, then any IT investment required to link tightly (i.e., efficiently) with a particular supplier upstream would be specific to this relationship. In other words, asset specificity of such an investment would be high. Asset specificity has been introduced in order to analyze dependencies in buyer-seller relationships (Williamson, 1983). It typically is defined as the extent to which investments cannot be redeployed from existing uses and users except at a significant loss of productive value. The literature shows that high asset specificity can create dependencies or hold-up situations. A seller who commits to selling something that is specific to a particular buyer can be held up by the customer. In turn, a buyer who invests in buying from a particular seller may find that such an investment makes it costly to switch to an alternative seller. This lock-in as a result of sunken costs makes the buyer vulnerable to opportunistic pricing. These grim prospects at both ends of a buyer-seller relationship as a consequence of high asset specificity can deter such investments in the first place. Therefore, flexibility, which reduces asset specificity, can be considered an antecedent to operational linkages. Hence, we cautiously state the next proposition:

Proposition 3b. The greater the IS flexibility, the greater is the extent of operational linkages leading to higher IT business value.

Customer Involvement

Many companies have decided to use information technology in order to build electronic direct sales and distribution channels. The emergence of Internet and Web technology, in particular, has triggered electronic forward integration strategies, which, in turn, have caused deep structural changes in channel systems such as the emergence of new intermediaries (Schlueter Langdon & Shaw, 2002). Some companies have decided to use this new electronic channel for more than just complementing or bypassing traditional intermediaries. They use the direct electronic channel to sell new, related services. Banks, for example, sell insurance products and vice versa. Others increase business value by using their e-channels to increase the extent to which customers are involved in business operations. In this article, this strategy is referred to as customer involvement and defined as the extent to which a customer is engaged as a participant in business operations, specifically in service production and delivery, including, for example, order processing and account management. High customer involvement may allow for mass customization of products and services. To use a real-world example, Dell can leave customization of products (e.g., choice of microprocessor and speed) and product bundles (e.g., PC with ink jet or laser printer) to individual preference, which, in turn, can increase customer satisfaction and allow for customer triggering of manufacturing and assembly activities. Another prominent example is BMW, the German maker of luxury cars. It has designed information systems so that European buyers can custom design their own cars with any change possible until five days before production. As a result, 80% of European BMW buyers custom design their vehicles (*Business Week*, 2003).

Customer integration is presented in the marketing literature as an extension of manufacturer-distributor relationships (Sheth & Parvatiyar, 1995). The theory base that underlies the marketing literature on manufacturer-distributor relationships (Andersen & Narus, 1984, 1990) and, therefore, the argument that customer involvement can enhance business value is a synthesis of exchange theory (Thibaut & Kelly, 1959; Kelly and Thibaut, 1978) and transaction cost economics (Williamson, 1975, 1985). Exchange theory states that parties transfer resources in relationships in order to enhance self-interest, while transaction cost economics reveals conditions under which certain organizational choices can maximize self-interest in the exchange relationship.

Specifically, the literature points to several consumer and seller benefits from tight customer integration. For example, consumers benefit from products and services that suit their needs better and sellers from longer-lasting customer relationships (Sheth & Parvatiyar, 1995). Lovelock and Young (1979) discussed the customer as a source for increasing a service firm's productivity. In the aforementioned example of BMW's European build-to-order system, most last-minute order changes are reportedly upgrades to bigger engines and more luxurious interiors, which tend to be more lucrative for the firm (*Business Week*, 2003). Hence, this article posits the following proposition:

Proposition 4a. The greater the IS integration, the greater is the extent of customer involvement leading to higher IT business value.

If high customer involvement requires deep IS integration, then some IS flexibility is also required in order to mitigate the negative consequences of asset specificity of such deep IS integration, as discussed earlier. This leads to the following proposition:

Proposition 4b. The greater the IS flexibility, the greater is the extent of customer involvement leading to higher IT business value.

IMPLICATIONS AND CONCLUSION

While (physical) IS integration and flexibility have been defined in order to be aligned with the literature and linguistic science, much remains to be done. This translates into several implications for research, as discussed next.

First, the model presented here and, in particular, the ways in which flexibility and integration interact to create business value would benefit from empirical testing. This would not necessarily require using the intermediating variables of operational linkages and customer involvement. They are representative of a class of operational and management process constructs required to mediate the relationship between IS capabilities and IT business value. It also would be of interest to empirically explore the relationship between IS integration and IS flexibility.

Second, flexibility and integration are only a subset of IS capabilities, albeit the more important ones, according to the literature. Other characteristics and candidates for capability dimensions that should be investigated in the future include, but are not limited to, scalability, connectivity, and portability of applications, as well as data integrity.

Third, the role of standards is certainly more complex in business than presented in the model. Use of IT standards is limited to moderating the interaction effect between IS flexibility and IS integration, the focal constructs of this article. For example, use of IT standards could have a direct effect on IT business value. However, in the interest of focus and clarity, it has not been included in this model. Use of IT standards could have a positive effect on ITBV, if it would reduce costs. This could be the result of use of free standards or dominant standards, which are universally used and supported by a wealth of complementary products. Examples include Internet standards and Microsoft Windows, respectively.

At the same time use of IT standards could have a negative effect on ITBV. For example, switching from a proprietary technology to an open standard could erode a firm's competitive advantage. MP3 is a popular example.

Fourth, the review of the literature on IS capabilities and on systems flexibility, in particular, has revealed the need for further clarification of dimensions and antecedents. This may be done in the context of theorizing on the research subject of systems architectures, because any deeper analysis of IS capabilities certainly would require a thorough analysis of the notion of systems architecture, which either has been neglected or considered only of peripheral interest in the aforementioned papers on flexibility. Every system has a structure or architecture, which is the manner in which the components of the system are organized and integrated. Omitting architecture is like building a house without a plan.

Architecture choices have emerged as an important strategic consideration (Schlueter Langdon, 2003b). In certain markets, such as high technology and communications (but not limited to these), strategy has come to mean a systems architecture strategy. Success in these environments requires architectural control (Morris & Ferguson, 1993) or platform leadership (Cusumano & Gawer, 2002). In its Findings of Fact in the Microsoft antitrust trial, the U.S. Department of Justice (DoJ) (1999) explicitly referred to IS architecture design as a competitive weapon. One example is the design of the interface between the operating system, which orchestrates system hardware components such as input/output devices and software applications. The interface can be constructed in such a way that an application becomes incompatible with the operating system. If the maker of the operating system also sells applications, then this strategy makes it difficult for other application vendors to compete and also may deter market entry. The DoJ (1999) considered such architectural strategy as an "application barrier to entry" (p. 17). A constellation with mutual dependencies across components (in this case, the operating system and software applications) has been referred to in the strategy literature as an ecosystem (Moore, 1996). Within such systems, companies are complementing each other and competing for value added at the same time. One successful architectural strategy that has emerged allows a firm to "link, lock, and leverage" (Arthur, 1996, pp. 106-107) (Arthur, 1988). This means designing systems (1) to link components, products, or services with each other in order to make a bundle more valuable than a single component; (2) to lock users into this arrangement to prevent their switching to competing offerings; and (3) to leverage the installed base to launch yet another complementary component or upgrade.

As a result of this analysis, it follows that the architecture, or choices with architectural styles, determines whether a system, for example, is easy to integrate and is flexible. This is an important insight, because it suggests that architectural choices are an antecedent of flexibility. What are these choices and how should we conceptualize them? Byrd and Turner (2000) considered modularity as dimensions of flexibility. An alternative view is to consider modularity as a dimension of architecture. If a system is organized in a modular manner, then it can be flexible. This logic also is embedded in the dictionary's understanding of modularity, which is defined as "constructed with standardized units or dimensions for flexibility" (www.webster.com). In order to identify dimensions of flexibility, the elements of its definition would have to be considered. Key elements are, first, the notion of ready capability to adapt and, second, adapting to some event. How ready is a system to respond or to adapt to which types of events? Thus, dimensions of flexibility could capture the extent of readiness and types of challenges. The latter, for example, could be categorized according to the three key IS perspectives of data distribution, data storage and management, and data processing. Turban et al. (2001) suggested numerous measures such as scalability, which is used to describe a system that can be adjusted in order to provide adequate service levels as the workload increases (Menasce & Almeida, 2000). Also, there is a rapidly emerging body of literature on elements of architectural styles — boxology — in the computer science literature (Bass, Clements & Kazman, 2003; Shaw & Clements, 1997; Shaw & Garlan, 1996), which may be useful in identifying appropriate dimensions.

Practitioners certainly would benefit from deeper insights into the relationships of important IS capabilities and their dimensions. There is a need to put forward sound variables or decision parameters so that a CIO can sort through the continuous stream of IT innovations in order to better understand choices. Often, key IS decision makers find themselves trapped in a dilemma, because in many situations, it is unclear whether it would be more beneficial to invest in highly customized, tightly integrated, best-of-breed systems or to select a more generic solution based on many open standards and common interfaces, which would provide more flexibility but at a cost in terms of efficiency. Furthermore, such uncertainty continues to fuel misunderstandings about the creation of IT business value. Many market observers and researchers who have studied the IT payoff paradox point to the need to go more deeply and to delineate relationships and causality more clearly. This article responded to that need.

ACKNOWLEDGMENTS

The author gratefully acknowledges discussions with Omar El Sawy, Gary Frazier, Gordon Guth, Ann Majchrzak, Richard Chase, Eric Clemons, and Scott Rose. This research was partially supported by a grant from Microsoft Research.

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APPENDIX

Select Descriptive Attributes for and Characteristics of Research Model Constructs

Based on the discussion and literature in respective sections.

IS Integration	IS Flexibility	Operational Linkages	Customer Involvement
• Blending information technology components, such as networks, software applications, and databases, into a functional whole • Network interconnectivity • Application interoperability • Data consistency	• Ability to accommodate changes in business requirements quickly • Ready ability of a systems to grow or expand in order to handle new and larger amounts of data, users, and transactions • Capability to adapt to change	• Coupling of business procedures and routines of related business operations (upstream in the supply chain as well as downstream in channel systems) • Linking of business procedures and routines across business partners to facilitate operations	• Customers are actively engaged as participants in a company's business processes, such as order processing • Customers perform functions that otherwise would be performed by employees • Customers actively take part in the customization of their services

IS Integration

Definition

The extent to which information technology (IT) components, such as computer hardware, software applications, databases, and communication networks, are blended into a functional whole or unified information system (IS).

We distinguish between data and application integration.
Please indicate how strongly you agree or disagree with the following statements:

	Strongly disagree						Strongly agree
We have successfully integrated most of our software applications.	1	2	3	4	5	6	7
Most of our software applications can work seamlessly.	1	2	3	4	5	6	7
Software applications on multiple machines of multiple vendors are interoperable with each other.	1	2	3	4	5	6	7
Our software applications and database management systems function as an integrated information system.	1	2	3	4	5	6	7
We have successfully integrated most of our software applications and databases.	1	2	3	4	5	6	7
We have successfully blended our information technology (IT) components into a functional whole or a unified information system (IS).	1	2	3	4	5	6	7

APPENDIX (CONT.)

IS Flexibility

Definition

The ready capability of an information system to be adapted to new, different, or changing business requirements, such as rapid growth, new product offerings, and/or business relationships.

Please indicate how strongly you agree or disagree with the following statements:

	Strongly disagree						Strongly agree
Our information systems are designed to accommodate changes in business requirements quickly.	1	2	3	4	5	6	7
The manner in which the components of our information systems are organized and integrated allows for rapid changes.	1	2	3	4	5	6	7
The ability of our systems to grow or expand in order to handle new and larger amounts of data, users, and transactions is high.	1	2	3	4	5	6	7
Our information systems are designed to support new product offerings easily.	1	2	3	4	5	6	7
Our information systems are designed to support new business relationships easily.	1	2	3	4	5	6	7
Our information systems are highly scalable.	1	2	3	4	5	6	7