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Towards a Unified Model of Information Technology Business Value

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ABSTRACT

Research on information technology (IT) business value posit complex relationships from either a resource based view (RBV) or transaction cost economics (TCE) viewpoint. In contrast with the rich theoretical work, empirical studies have taken a ‘black box’ approach, testing relatively simple models. In this study, we integrate the theoretical and empirical work into a unified model of IT value.

Keywords

Information technology, transaction costs economics, resource-based view, firm performance, business value.

INTRODUCTION

While the impact of Information Technology (IT) is a well-researched area in the field on information systems, this paper posits that several important concerns remain unaddressed. First, although theoretical work has developed complex models of IT impacts with interacting effects and intermediate processes, most empirical studies tends to take a ‘black box’ approach, examining simple cause-effect relationships, for example, IT investment to financial performance. It is necessary to study the theorized intermediate effects and moderating factors to gain a deeper understanding of the phenomena. Second, most of the theoretical literature takes either a resource-based view or transaction cost economics perspective. While studying a phenomenon from varied theoretical viewpoints increase our understanding of the phenomena, we need an integrated perspective to compare and contrast previous work, build upon existing findings and gain a deeper understanding of the complexities involved. Third, most of the empirical studies, even the more recent ones, focus on a narrow time period between 1987 through 1994, probably due to data availability. This raises the very serious concern that the findings may be limited to the particular economic situations of that time period. Fourth, even though these studies use data over several years, most studies do not consider a time lag between IT investment and the firm-level outcome. This methodology may confound the findings, as it is likely that the firm takes several years after implementation of IT to realize benefits from it.

This study attempts to address these issues. Our first research question is ‘what are the intermediating and moderating factors in the impact of IT on firm performance?’ We approach this question from a top-down, theory-driven approach as well as a bottom-up, empirically driven approach. First, we review the theory and the empirical literature on IT business value. Then, we integrate the various theoretical and empirical findings into a single model.

We group the variables in previous empirical studies into antecedent variables, intermediate variables, and outcome variables. Antecedent variables include complementary assets and IT assets. Intermediate variables include process efficiency and firm structure. Outcome variables include financial performance and strategic advantage. Through this, we see that we need to look beyond simple information technology to firm performance relationships, and look at intermediate impacts of information technology, including business processes and complementary assets.

We then compare and contrast the findings on various streams. These streams include IT spending to firm performance, IT spending to process efficiency, IT spending to firm structure, and complementary assets that moderate the IT spending to firm performance relationship. We integrate the theoretical and empirical work in an attempt to open the ‘black box’ and analyze the complexity of IT impact. To address these research questions, we gather data from a variety of secondary sources, including databases of IT spending, and firm financial and structural variables from the Compustat database.

REVIEW OF THEORETICAL LITERATURE

Most studies on IT value have taken one of two theoretical approaches – either transaction cost economics (Williamson, 1979) or resource based view (Wernerfelt, 1984). While transaction costs economics has garnered more attention the resource-based view has been the focus of more recent theoretical work on IT business value.

Transaction cost economics

Transaction cost economics (TCE), developed by Williamson (1979), posits that firms exist to avoid market costs. This perspective explains firm boundaries by comparing the costs of a given transaction within the firm vis-à-vis the same transaction done in the open market. If markets are perfectly competitive, transaction costs are likely to be lower in the market than inside a firm. TCE assumes bounded rationality, that humans are "intendedly rational, but only limitedly so" (Williamson, 1981), and opportunism, that agents are self-serving with guile. All transactions in a market are associated with production costs and additional costs caused by bounded rationality and opportunism. These transactions costs depend on asset specificity, small numbers bargaining and imperfect information. Asset specificity refers to the amount of dependence an asset has on a specific input or producer. High asset specificity may put the producer at a higher risk as the assets cannot be easily sold elsewhere. High asset specificity can lead to a lesser number of suppliers, and a potential for noncompetitive opportunistic behavior by the suppliers. This condition creates small numbers bargaining, as a replacement for the asset cannot be found without cost. Imperfect information is the condition that it is difficult for the buyer to assess the performance of the vendor, and a complete contingent contract is not possible, leaving open risk of opportunistic behavior by the latter. Transaction cost economics assumes that there is no danger of opportunism within the firm, and a firm therefore exists to decrease opportunistic potential. It predicts that when the conditions of asset specificity, small numbers of transactions, and imperfect information exist simultaneously, a firm would internalize the production of this asset. When these three conditions do not exist simultaneously, market transactions will dominate instead (Conner, 1991). Under the conditions of low asset specificity, frequent transactions, and more complete information, the vendor may achieve economies of scale by selling the same asset or resource to several firms. This would result in a decrease in production cost for the buyer.

Malone, Yates and Benjamin (1987) develop Williamson's framework to analyze how information technology affects the organization of economic activity through markets and hierarchies. Both markets and hierarchies are associated with production costs and coordination costs. Production costs consist of the costs of the physical and primary processes to produce the goods and services being sold. Coordination costs consist of the costs needed to process the information needed to coordinate the activities of the humans and machines that participate in the primary processes of production. The coordination costs of the market are termed external coordination costs, and include the costs of finding suppliers, negotiating contracts, monitoring supplier behavior, and paying bills. The coordination costs of the hierarchy are termed internal coordination costs and include the costs of managerial decision making, accounting, control, and planning. In market transactions, a buyer may compare the quality and price of several suppliers before deciding on a product, which could result in low production costs. However, the costs of searching for a supplier, comparing products, and negotiating individual contracts result in higher coordination costs. Transactions inside a hierarchy are the opposite of this. Inside a hierarchy, since choice is limited to a single supplier, production costs are higher than market costs. However, since the costs of searching, comparison, and negotiation are practically eliminated, coordination costs are lower. This is shown in Figure 1.

Organizational Form	Production Costs	Coordination Costs
Markets	Low	High
Hierarchies	High	Low

Figure 1: Relative Costs for Markets and Hierarchies. From Malone, Yates, and Benjamin, 1987.

Information technology affects markets and hierarchies in three ways: the electronic communication effect, the electronic brokerage effect, and the electronic integration effect (Malone, Yates and Benjamin, 1987). The electronic communication effect means that IT increases the amount of information communicated, increases the speed of communication, and reduces the cost of communication. The electronic brokerage effect considers the effect of electronically connecting potential buyers and suppliers in a specific market. The electronic brokerage effect increases the number of alternatives considered, increases the quality of the selected alternative, and decreases the cost of the selection process. Electronic integration effect occurs when a buyer and a supplier use IT to create an interpenetration interface between the value-added stages. The benefits include integration of processes in specific situations, in addition to a reduction in time and error.

Malone, Yates and Benjamin (1987) then argue that IT should lead to an increase in use of markets over hierarchies. The first reason for this is due to the reduction in coordination cost caused by IT. The main disadvantage of the market is its higher coordination costs, and since IT reduces these, the lower production costs of the market may look favorable compared to the higher production costs of hierarchies. The second reason for the move to markets is that IT reduces information complexity and asset specificity. Information technologies like databases and broadband communication networks can communicate complex, multidimensional product descriptions much better than earlier technologies, lowering information complexity. In addition, flexible manufacturing technologies allow manufacturers to switch production lines processes rapidly, lowering asset specificity. Lowering of information complexity and asset specificity should lead to favoring the use of markets over hierarchies, in line with TCE predictions (Conner, 1991)

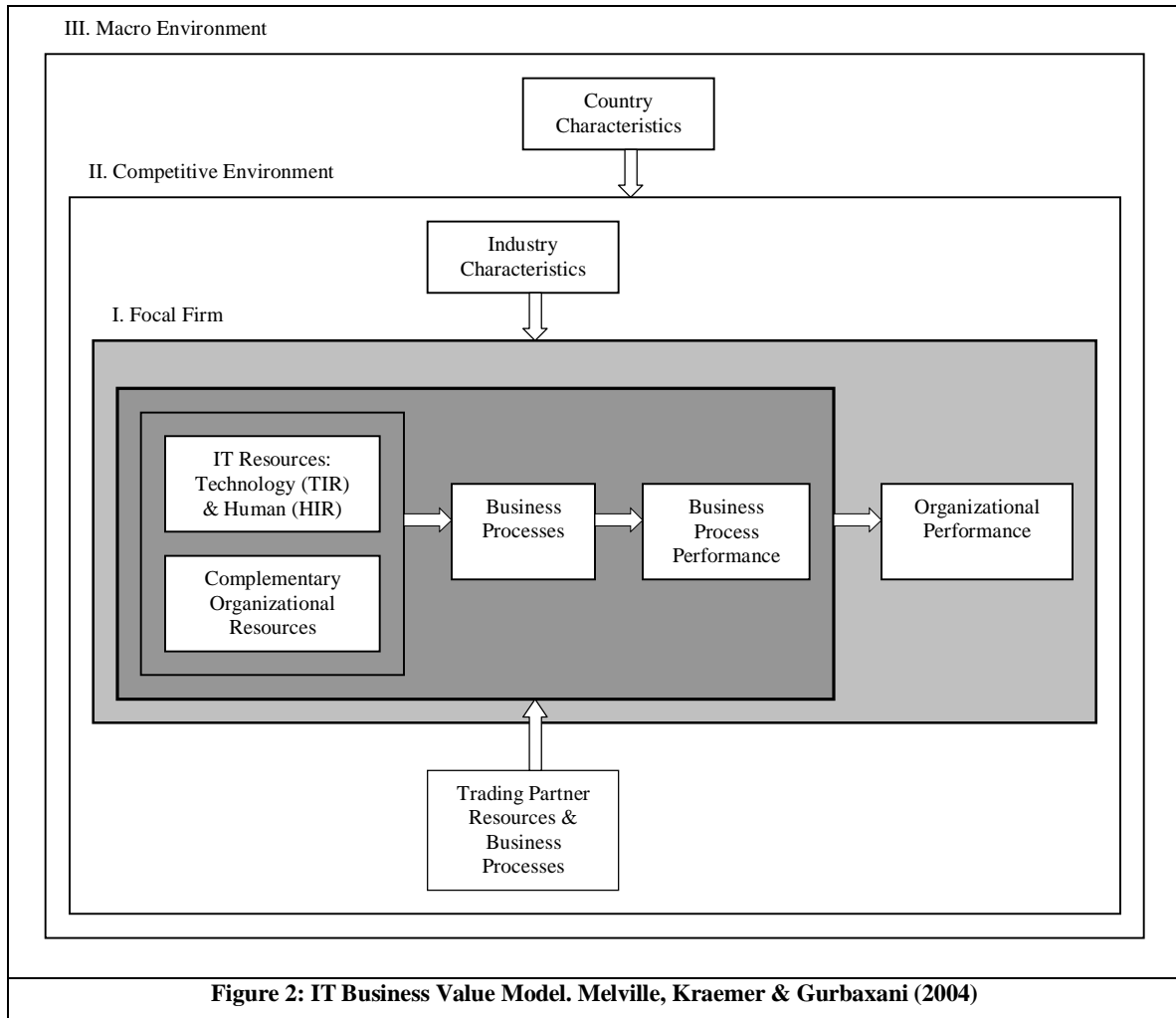
Malone and Rockart (1991) theorize that IT affects firms in three orders through the reduction in coordination costs. The first order effect is the labor substitution effect. This simply means that information technology is used in place of human labor, for example, transaction processing systems lower the number of bank clerks required, and management information systems reduce the number of middle level managers needed. The second order effect is an increase in the overall amount of coordination used. For example, airline reservation systems allow travelers greater choice; Otis' elevator service system allows it to increase the amount of maintenance on its elevators. The third order effect is the emergence of coordination intensive structures. These may establish links between employees at different levels in a single firm, for example, between route salespersons, district managers, and senior executives. They may also link different companies within a production chain as with the US textile industry. Multi-organizational structures may help reduce inventory costs and react quicker to changes in demand. There may also be structures involving competitors to provide enhanced customer service and increased flexibility. Malone and Rockart predict that the result will be an increased move to markets from hierarchies, more electronically mediated alliances, and an increased use of electronic markets to pick suppliers.

Resource Based View

In the resource based view (Wernerfelt, 1984), the firm is viewed as a collection of physical and intangible resources that enable it to compete with other firms. RBV assumes resource heterogeneity and resource immobility (Barney, 1991). Resource heterogeneity posits that the resources that firms possess and the strategies they pursue are idiosyncratic to the firm. Resource immobility posits that all resources are not perfectly mobile, that is, all resources may not be bought and sold in open markets to create resource homogeneity between firms. Competitive advantage is gained through resources that are valuable, rare, imperfectly imitable, and without strategically equivalent substitutes (Barney, 1991). Value refers to the ability of a firm attribute to exploit specific opportunities and counter threats in the environment. Only when a firm attribute possesses value does it become a resource. To provide sustained competitive advantage, a resource must also have the remaining three qualities. The resource must be rare among the firm's present as well as potential competitors. As long as the number of firms possessing this resource is less than the number of firms needed to generate perfect competition, the resource is adequately rare to potentially create competitive advantage. A resource may be imperfectly imitable due to any of the following three factors: it is dependent on unique historical settings; its relation to competitive advantage is causally ambiguous; the resource is socially complex. Non-substitutability indicates that there are no strategically equivalent substitutes that are valuable but are either imitable or not rare. If potential competitors can easily acquire or imitate these substitutes for the resource, then the resource does not provide a means for sustained competitive advantage.

Bharadwaj (2000) extends the resource based view to the IT business value literature, and defines IT capability as a firm's ability to deploy IT enabled capabilities in combination with other complementary assets to achieve competitive advantage. Key IT based resources were classified into tangible IT resources comprising of the physical components of IT, human IT resources comprising of the technical and managerial skills, and intangible IT-enabled resources, including knowledge assets, customer orientation, and synergy.

An integrative model of IT business value based on the RBV was developed by Melville, Kraemer & Gurbaxani (2004). This model has three domains: the focal firm, the competitive environment, and the macro environment, as shown in Figure 2.



The focal firm is the organization that is acquiring or deploying the IT resource. The IT resource applied with complementary organizational resources affects may improve business processes or enable new ones. This affects business performance, which in turn affects organizational performance.

CONCLUSION

This study aims to make important contributions to practice. By analyzing the complexity of IS impact, we give managers a tool to assess how their investment will affect their organization. In particular, it may be a valuable guide in deciding how much to invest, and what effects to watch for in assessing the benefits of their investment.

We make valuable contributions to research as well. While complex theoretical models of IT impact were developed, empirical work tended to focus on simpler, 'black box' relationships. We make an important contribution by combining the theoretical models with the findings of empirical research to develop an integrated model of IT value. By empirically testing all these relationships in the same model, we gain a deeper understanding of the complexity of IT impact, and the various mediating and moderating effects that have been theorized to affect this impact.

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