Chapter 20

A Study on the Value of B2B E-Commerce: The Case of Web-based Procurement

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Abstract: Web-enabled business-to-business (B2B) e-commerce enhances inter-organizational coordination and results in transaction cost savings and competitive sourcing opportunities for the buyer organization. However, organizations are unsure if this is an improvement over existing information technology such as EDI. In particular, what is the value of B2B e-commerce to a buyer organization and how to measure this value? What factors most affect the realization of the value of B2B e-commerce? Using the case of Web-based B2B procurement system, we propose a framework to quantify and measure the value of B2B e-commerce system and identify the factors that determine this value. Our analysis indicates that, even though all stages of B2B procurement is affected by the Web, the value of Web-based procurement is most determined by the process characteristics, organization of business units and the "extended enterprise".

Key words: Inter-organizational Information Systems, Value of B2B E-commerce, Web-based Procurement, Measurement of Value, Extended Enterprise

1. INTRODUCTION

Business-to-business (B2B) e-Commerce technologies and electronic markets are emerging as the critical infrastructure of modern Web-enabled organizations. The Internet and the Web provide a cost-effective mechanism for organizations to engage in search, negotiation and coordination with their suppliers anywhere in the world (Buxmann and Gebauer, 1999; Kalakota and Robinson, 1999). At the same time, the Web is also being used to integrate and manage business processes across traditional firm boundaries to create an "extended enterprise" of the firm and its business partners (Shaw, 2001). However, even in the face of these opportunities and seemingly easier to implement Web-based technologies, many organizations

have been surprised at the range of responses shown by both their business units and business partners. On the one end of this range, there are users who strongly feel the need for a Web-based system and are enthusiastic about it. On the other end, there are users who are certain that a Web-based system can offer no improvement over their existing systems and procedures. In between, there are users with different expectations regarding the usefulness and preferred features of a B2B system.

Central to the concerns expressed by potential users of B2B e-Commerce systems is the lack of any sound *framework to precisely determine the value of a B2B system* from the perspective of user as well as the enterprise. In this context, managers responsible for implementing B2B systems are faced with the challenge of convincing all potential users, internal and external to the organization, of the real value of these systems. Medium and large manufacturing firms, with their decentralized and focused facilities, face more challenges in implementing B2B e-Commerce systems because of greater variation in the nature of their business operations and, often conflicting, objectives of their internal units.

Our research objective is to develop and validate a framework to better understand the value of B2B e-commerce and the factors that affect this value. More specifically, we propose that process and organizational attributes play a significant role in determining the value of B2B e-commerce. Using Web-based B2B procurement, also called e-procurement, as a case of B2B e-commerce, we develop a framework to theoretically and empirically determine the value of B2B systems and to verify the role of process and organizational attributes. B2B procurement in most organizations involves very unstructured processes and a broad range of products and services, providing wide variations in the parameters that determine the benefits from a Web-based system. Opportunities to improve procurement activities have significant economic implications for the enterprise. Our paper is organized as follows. The next section presents a general model of an e-procurement system and introduces the major research questions. We then review related research on the impact and value of IOS. Extending this research to B2B e-commerce, we develop a framework to determine the value of e-procurement. We use an economic model to analytically evaluate the value of e-procurement and present some initial findings from a study at a large manufacturing organization. We conclude by discussing the implications of our findings for design and implementation strategies.

2. B2B E-PROCUREMENT SYSTEM

The procurement of goods and services by organizations, called business-to-business (B2B) procurement, constitutes an important business activity. Large organizations spend more than 15 to 30 percent of their revenue on procurement of non-production goods, such as office equipment, supplies, computers, and peripherals[1]. However, traditional B2B procurement practices, particularly those related to non-production goods, have been plagued by problems, such as inefficient buying, redundant and disconnected processes, non-strategic sourcing and maverick purchases. Use of Web-based procurement solutions, also called e-procurement solutions, is expected to address several of these problems (Buxmann and Gebauer, 1999; Kalakota and Robinson, 1999).

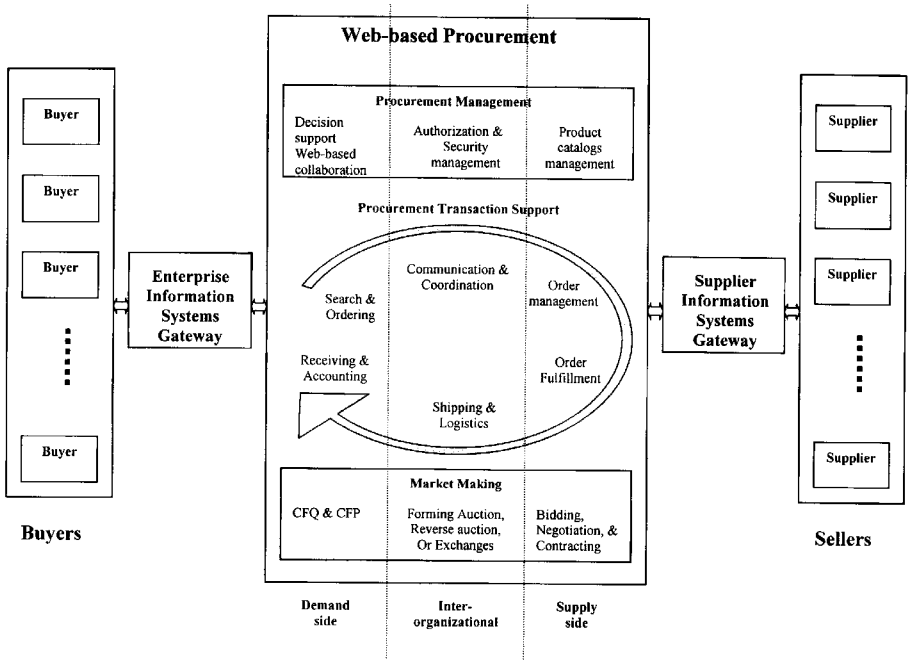

Figure 1. Functionalities of a Web-based procurement system

An e-procurement system, shown in figure 1, is a Web-based client/server application used to replace the manual procurement process. The system is usually connected to other business critical information systems in the enterprise, such as the enterprise resource planning systems (ERP) or the electronic data interchange (EDI) systems. This is done to leverage the critical enterprise data present on these systems, so that they need not be duplicated on the e-procurement system. On the supplier side,

the e-procurement system can be integrated with the suppliers' order fulfillment system or may just link to product catalog on the website of the supplier.

The Web-based capabilities built into e-procurement systems help organizations create an efficient and responsive procurement process. More specifically, use of e-procurement impacts four major B2B procurement activities - search, negotiation and contracting, coordination, and monitoring and control.

Search: Users and procurement personnel spend a considerable amount of time in just identifying the right product and supplier to match their business needs. A Web-based IOS, such as e-procurement system, is used to quickly locate a required product or supplier. Using electronic catalogs and intelligent search engines, users can search across product categories and specifications to identify the right product to order in considerably less time. Also, by linking to enterprise systems, such as ERP, and automatically filling in the details necessary for the order, the Web-enabled user interface minimizes the data to be input, thus avoiding a major source of errors and mismatches.

Negotiation and contracting: Web-based negotiation and contracting has had a significant impact on the costs to the enterprise. Use of Web reduces the time and resources spent by various parties in exchanging information and processing the bids. As organizations consolidate their suppliers using a more centralized Web-base system, the number of contracts to be negotiated also reduces. Even though contracts form an important concept in transaction costs, there has been surprisingly little discussion in the IT literature of the effect of the Web on contracting.

Coordination: In addition to electronic processing at much lower costs than manual processing, We-based systems can support increased and more complex coordination. Coordination involves the sharing and exchange of relevant information among the enterprise and its business partners. Several times, during the fulfillment of an order, procurement personnel need to communicate and exchange information with the suppliers and users. Procurement systems based on paper documents and telephone involves more time of the procurement staff and higher communication costs. Using a Web-based procurement system provides real-time information flow and is less costly to coordinate with suppliers and users. This leads to faster resolution of any problems and results in lower order cycle time. The low

communication costs of the Web and the lesser time spent by the procurement staff in coordination results in lower transaction costs.

Monitoring and control: Using a Web-based procurement system, organizations can achieve their twin objectives of responding effectively to the user needs as well as leveraging their combined buying power. Users can search the catalog to identify the most cost-effective supplier and place their orders. Corporate B2B managers can aggregate the demand for the whole enterprise and use this to negotiate competitive prices for the products, which they can then make available to any business unit, irrespective of the size or location of the unit. *Centralized control*, combined with the availability of an increased range of items on the electronic catalog, motivates more users to order through the e-procurement system, reducing the extent of "premium buys".

The use of Web-based systems is expected to provide better value than traditional IOS, because of the use of a public network and the much wider scope of application within the enterprise (Gebauer, et.al., 1998). However, the method used currently by most organizations to compute the value and justify their e-procurement investment relies upon the average estimated savings for a procurement transaction and the transaction volume. The individual share, in the investment, of the internal business units is also based on this simple estimation. This simple estimation ignores the differences in the procurement needs and current processes within the firm. For example, using the current value estimation procedures, large business units with higher transaction volume will share a higher proportion of the investment, as they are deemed to benefit more. But, if they have established efficient procedures in a non-Web environment, the benefits from a Web-based system will be minimal. From the point of view of the business unit, there is no justification for their investment in e-procurement. Thus, we see that there is a need to understand how e-procurement value differs within the firm and what attributes contribute to these differences. At the same time, such an understanding should be based on theoretical support and should be empirically verifiable. Thus, in our research on e-procurement, the major research questions are:

1. What is the value of B2B e-procurement to an enterprise? How to measure this value?
2. What factors affect the value of B2B e-procurement?
3. What implications do the differences in value within a firm have for the design and implementation strategies of e-procurement solutions?

3. A REVIEW OF RELATED RESEARCH

The impact of IT on firm performance has long been a subject of intense research, with issues studied ranging from measurement of the impact, to the conditions that are necessary to realize these impacts. The realized impact in the form of actual improvement in firm performance represents the value of the IT system to the organization. However, researchers have pointed out the conflicting results yielded by these studies (Davern and Kauffman, 2000; Hitt and Brynjolfson, 1996; Mukhopadhyay, et.al., 1995; Sircar, et.al., 2000). Some of these issues relate to measurement, while others relate to the complexity of isolating the effect of IT on firm performance (Mukhopadhyay, et.al., 1995). Part of the problems of relating IT investments to firm performance is the effect of confounding factors, such as other internal performance improvement measures and external economic influences. Another issue is that some IT investments may provide benefits after a certain period of time, but may actually increase operating costs in the short run (Kauffman and Kriebel, 1988). Researchers suggest a process oriented approach to overcome these confounding problems. Kauffman and Weill (1989) suggest that the locus of impact, i.e. the business process, be the primary level of value analysis for the benefits to become discernible for the investing firm. Barua, et.al. (1995) suggest a multi-stage, process oriented study to measure the first-order and higher-order impact of IT. Mukhopadhyay (1998) uses such an approach to understand how EDI benefits an organization.

Research on IOS impact and value, particularly use of EDI, has shown that it is largely positive in improving the efficiency of business processes and overall performance of organizations (Mukhopadhyay, 1998; Srinivasan, et.al., 1994). The electronic processing and communication of inter organizational data improves the timeliness and accuracy of the information, allowing the trading organizations to better plan and manage their assets, such as inventory (Barret and Konsynski, 1982). The use of IT improves the process quality, which in turn improves the level of output (Mukhopadhyay, et.al., 1997). This type of impact is mainly on the operational level and results in cost reduction, higher productivity and improved quality (Mukhopadhyay, 1998). IOS also increases the bargaining power of the buying organization, which now has a better information visibility of its business processes (Porter, 1985; Porter and Millar, 1985). At the same time, however, by having access to more information about the buyer, a supplier can better match the preferences of the buyer and extract a premium price. The close relationship built between the buyer and the supplier may also

enable the supplier to gradually increase the level of business with the buyers.

These impacts, however, are neither guaranteed upon implementation of the system nor are they uniform across the organization (Barua, et.al., 1995; Davern and Kauffman, 2000; Mukhopadhyay, 1998; Weill and Olson, 1989). Realization of the value of the system is conditional upon internal and external factors, some of which are controllable by the organization (Weill and Olson, 1989). These are called conversion contingencies, i..e "a spectrum of things that are likely to influence realized value from a system" (Davern and Kauffman, 2000). For example, the contribution of IT system depends on other resources, such as people and investments in associated processes (Kauffman and Kriebel, 1988). In a study of EDI impact, Mukhopadhyay (1998) found that the level of operational benefits of EDI increased with increased integration of IOS with internal systems, but decreased with more parts variety and number of trading partners. Suppliers handling a higher proportion of their business electronically saw higher performance than other suppliers. With respect to strategic impact, the size of the supplier determined what incentives are needed to join the system. The strategic benefits were found to be higher if the buyer initiated the system or if the system had been used for a longer period of time.

Even while some of the issues and critical variables of previous research are relevant for Web-based systems, some issues and variables assume increased importance. The capability of EDI to reduce the communication and processing costs and errors are also found in Web-based systems. But, in Web-based systems, the potential to reduce search costs is great and affects each B2B transaction. Thus, in our research, for example, savings in search cost emerges as an important economic benefit. Coordination costs are reduced significantly by using the Web and our research quantifies the extent of economic impact of this reduction. The Web allows organizations to choose from different procurement models, an issue that did not arise with EDI systems.

Many studies have looked at different pieces of the B2B puzzle, such as supplier selection (Bakos and Brynjolfsson, 1993; Barua, et.al., 1997) and impact of electronic markets (Bakos, 1998; Gurbaxani and Whang, 1991). B2B e-commerce is rapidly transforming how organizations structure and coordinate their business relationships, but there are very few systematic studies in this area that tries to understand the impacts comprehensively from an organizational perspective. In the following sections, we develop our

B2B value framework and evaluate the role of business factors in determining the level of the impact.

4. VALUE OF WEB-BASED PROCUREMENT

Our framework is based on a multi-stage impact model of information technology on enterprise processes (Barua, et.al., 1995; Kauffman and Kriebel, 1988; Hitt and Brynjolfson, 1994; Mukhopadhyay, 1998). The principle is that certain features or capabilities of the Web are used to enable B2B operations, which have impact on a set of intermediate variables. These intermediate variables lead to improvement in the performance variables. Any improvement in each of the performance variables contributes to the improvement of the effectiveness of the procurement process, which is the B2B goal of the enterprise. The framework is shown in figure 2.

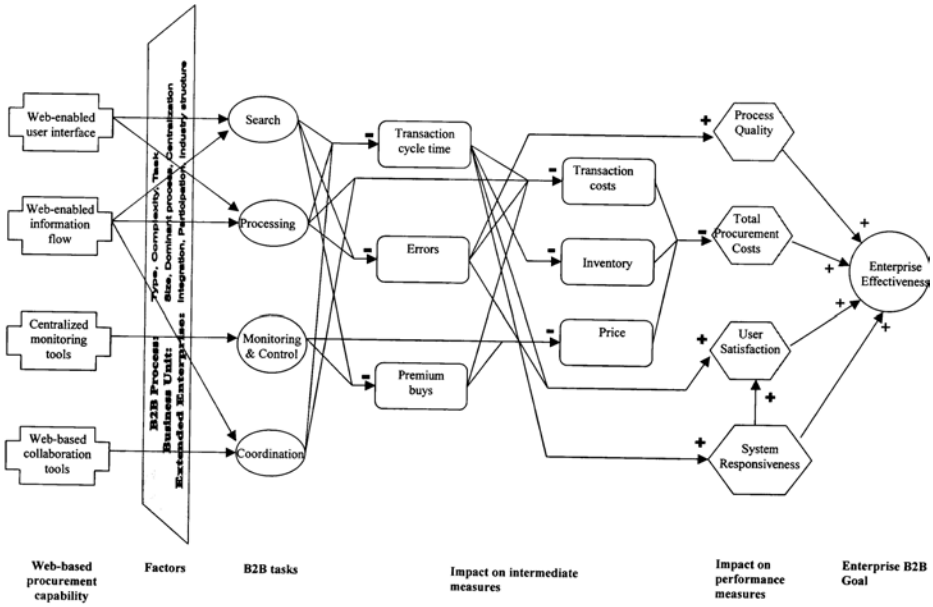

Figure 2. Framework for the value of Web-based procurement

Our level of analysis is "product category", which is a collection of procurement transactions of products with similar procurement characteristics, such as demand, search, coordination, and control. From a practical stand point, organizations groups purchases of products into similar categories, as it helps them to establish uniform procedures and business

rules for a category, instead of for each product or transaction. Hence, for example, all office stationery, including paper clips, printing paper, and other stationery items, are grouped in a category called "office-supplies". We expect the impact of e-procurement to be similar on transactions within each category and different across categories. For each "procurement category", we identify the benefits and costs of e-procurement to arrive at the value for this "procurement category".

4.1 Impact on B2B tasks

A Web-based procurement system provides enhanced search capabilities, faster and accurate processing, real-time and rich-media information support, and low communication and coordination costs (Buxmann and Gebauer, 1999; Luckling-Reiley and Spulber, 2000). From the buying enterprise point of view, use of a Web-based system affects four major categories of B2B operations - search, order processing, monitoring and control, and coordination.

Search: Search costs are costs incurred by the buyer to locate an appropriate seller and purchase a product (Bakos, 1997). Search costs in procurement are incurred at two places – when the professional buyer looks for a supplier for contracting purchases and when the individual user in the organization looks for the appropriate product to order. In both cases, the Web and associated search engines considerably lower the search costs, which can be quite significant in large organizations. Web-enabled search engines help users to easily search using multiple methods to ensure that she can find the right product even with limited available information. This "user-friendliness" of the system reduces the "premium buys", where the user goes around the procurement system and incurs higher processing and product costs (Kalakota and Robinson, 1999).

Processing: Web-based procurement system involves electronic document routing and information flow, thus reducing labor costs involved with manual processing. Web-based system can automatically route the product request for the necessary approvals and order placement with suppliers. This reduces the transaction cycle time and gets the materials to the user faster. As the system requires minimum data inputs during the information processing cycle, much of the sources of errors are eliminated. Thus, we find that Web-based procurement processing lowers the cycle time, errors and the processing costs.

Monitoring and control: Using a Web-based procurement system, organizations can achieve their twin objectives of responding effectively to the user needs as well as leveraging their combined buying power. Users can search the catalog to identify the most cost-effective supplier and place their orders. Corporate B2B managers can aggregate the demand for the whole enterprise and use this to negotiate competitive prices for the products, which they can then make available to any business unit, irrespective of the size or location of the unit. Centralized control, combined with the availability of an increased range of items on the electronic catalog, motivates more users to order through the e-procurement system, reducing the extent of "premium buys". Thus, the major benefits of Web-based monitoring and control are reduction in average product price and reduction in "premium buys".

Coordination: One of the major advances of Web-based IOS over other traditional IOS, is its ability to support increased and more complex coordination. Several times, during the fulfillment of an order, procurement personnel need to communicate and exchange information with the suppliers and users. Using a Web-based procurement system provides real-time information flow and is less costly to coordinate with suppliers and users. This leads to faster resolution of any problems and results in lower order cycle time. The low communication costs of the Web and the lesser time spent by the procurement staff in coordination results in lower transaction costs.

4.2 Impact on performance measures

The impact of the use of Web for B2B on performance measures can be discussed based on the concept of first order and higher order impacts suggested in IT literature (Barua, et.al., 1995; Kauffman and Kriebel, 1988). The first order impact is on intermediate measures that are closer to the process, which in turn affects the performance measures. One of the most visible performance impacts of Web-based procurement is the lower ***total procurement cost***. The reduction in transaction cycle time, caused by the use of Web-based procurement, reduces the labor time used in the process and the labor cost component of the transaction costs. Costs incurred due to electronic processing and coordination is several magnitudes lower than those involved in manual processing and coordination. Lower incidence of errors in a Web-based procurement system reduces the need for labor for error resolution, reducing transaction costs. With less lead times for acquiring products, organizations can store less in inventory and increase inventory turns, leading to lower inventory costs. Lower average price

negotiated for contracted items and the lower product development costs contribute to the reduction in the total procurement costs.

Quality of the procurement process is an indicator of how well the system meets the procurement needs of the enterprise. Any error in the processing cycle decreases the chance that the product delivered to the user will fully meet her expectations. A measure of process quality is the proportion of B2B orders rejected or returned by the user. Another measure is the number of user complaints about the product. By reducing the probability of errors, a Web-based system can reduce the potential mismatch between user needs and the delivered product, thus reducing user complaints.

User satisfaction refers to the perception of the user in the system's effectiveness to meet her business demands. This is more than the receipt of a matching product. User satisfaction is affected by how well the system is perceived to meet user expectations. Higher cycle time and more errors in the process leads to lower user satisfaction. Access to required information with minimum effort, faster resolution of complaints, and ease of use of the system interface are some ways in which user satisfaction can be improved by a Web-based system.

System responsiveness is the ability of the B2B procurement system to respond to the needs of the user and the enterprise. It reflects not only the time taken to get the user what she needs, but also the ability to locate alternative sources, within a reasonable time, if necessary. For example, a user or a business unit may require a critical item to prevent the idling of expensive production machinery. Delay in locating or procuring the item may cost more, though indirectly, than even the cost of the item. In such situations, a responsive system will help search internal and external locations to find the item in the shortest time possible and the best way to get it to the business unit.

In summary, by implementing a Web-based procurement system, a firm can anticipate the following potential impact on its intermediate and performance measures.

Impact on intermediate measures
Lower transaction costs
Lower inventory holding costs
Lower price

Impact on performance measures
Higher process quality
Lower total procurement costs
Increased user satisfaction
Increased responsiveness of the system

The potential value of a Web-based procurement system to an organization is the extent to which it can derive benefits from the systems, net of its investments and other implementation costs. One way to estimate the value of a system is to quantify the improvements in the performance measures in some economic terms. However, measuring and quantifying the impact on the intermediate measures will provide more precise estimate of the value of the system (Kauffman and Kriebel, 1988; Mukhopadhyay, 1998), but require more detailed data at process level.

5. FACTORS THAT AFFECT THE VALUE OF WEB-BASED PROCUREMENT

Research on IT impact shows that implementing a system does not automatically guarantee realization of the potential value (Barua, et.al., 1995; Davern and Kauffman, 2000; Mukhopadhyay, 1998; Weill and Olson, 1989). The realized value depends on several conversion contingencies (Davern and Kauffman, 2000). These conditions could be firm level controllable conditions, such as training of users, or can be external influences, such as actions of competitors and technology (Weill and Olson, 1989). The factors that affect the benefits and costs of e-procurement, and hence its value, occur at three levels of increasing scope – procurement process, organization of business units and the "extended enterprise". For each product category, it is possible to identify the values of these factors and analyze the effect of these factors on the value of e-procurement for this category.

The *first level of factors is the process*, where the use of e-procurement is immediately felt. Research on information technology and transaction costs has identified asset specificity and product description complexity, in addition to transaction frequency, as important characteristics that affect the impact (Malone, et.al., 1987; Williamson, 1996). With respect to e-procurement, we look at asset specificity more broadly as the specificity and structuredness of the procurement process that affect the value. Also, we look at complexity of not just product description but of the entire

procurement process. With the transaction frequency, these two characteristics form the process level factors in our study.

The *next level considered is the business unit*, which is the principal unit of e-procurement investment and implementation strategies. The value of e-procurement to a business unit can be determined by aggregating the value of all its procurement categories. However, beyond the process, e-procurement creates a fundamental shift from decentralized purchasing to centralized purchasing. As the major driver of the price benefits is the increase in centralization, and the extent of decentralization in the current procurement system is different in each business unit, the value realized for a category of procurement will depend on the change in centralization achieved.

The *third level considered in out study is the extended-enterprise*. The scope of B2B operations goes beyond the buying enterprise and extends to the "extended enterprise", to include all suppliers and other business partners. However, differences in the market conditions of the underlying procurement process create differences in the ability of the organization to reduce the transaction costs and to negotiate better prices. Of these market conditions, the most critical for e-procurement is the fragmentation in the supply chain of the underlying product.

5.1 B2B process characteristics

B2B processes differ along several dimensions, such as specificity, structuredness, variation in demand, frequency of orders, value of product, extent of human intervention required and complexity of the tasks involved. In this research, we propose to group these dimensions into two factors – type and complexity. We note that in addition to the differentiation of the processes based on these factors, the distribution of transaction volume in each category plays an important role in determining the level of impact.

Process type: The procurement transaction of each product category is associated with certain procedures, business rules, people involved and systems used. On the one end, there are products with customized needs, high demand volume and potential uncertainties associated with supply, which can lead to high transaction costs for the buyer enterprise, if each transaction has to undergo the supplier search, approvals, processing and ordering. If the demand for such product is regular and the product specifications do not change with time, organizations can reduce the transaction costs by negotiating a long-term contract with a supplier and

designing an automated procurement process for reordering the items. We call this type of procurement as "***structured***" procurement. Examples of such procurement include *tooling items, welding wires, and custom replacement parts*.

On the other end, there are some products that are not suitable for any level of automated procedures. Often organizations allow the end-users to take advantage of best deals available at the time of ordering and there is very little benefit of tying such procurement to product-specific purchasing steps with a particular supplier. These procurements tend to have very broad procurement rules giving plenty of freedom to the users to choose suppliers. We call this type of procurement as "***unstructured***". Examples of this category of procurement include office equipment and furniture.

The structured ordering procedures result in very little time spent by the user and procurement staff in the current process for search, input and processing activities at the level of each transaction. The streamlined and repetitive nature of the orders reduces the scope for errors in input and processing. The use of Web is mainly to replace the paper based manual communication with electronic communication. On the other hand, it is difficult to set up meaningful automatic replenishment procedures for unstructured procurement needs and every user request must be processed individually and the order placed with suppliers. More time is spent in search, input and processing for each transaction, mostly in the form of labor. The greater variety of these requests and the higher human intervention increases the incidence of errors, and staff time is spent more in error resolution. When we Web-enable such unstructured procurement, we save more on the resources used for search, input, processing and error resolution. Thus, we expect the use of Web for unstructured processes to result in higher value than its use for more structured processes.

Proposition 1: Use of Web-based procurement for unstructured processes results in greater value than its use for structured processes

Complexity of process: The complexity of a transaction refers to the need for additional efforts to process the transaction successfully. For example, a critical component may have to undergo special inspection prior to any use, requiring investments in testing equipments or inspection personnel. As the complexity of a required item or ordering process increases, it involves more transaction costs due to more search time, increased coordination requirements, need for more data processing, and the higher probability of errors. But, even if the complexity is high, if the transaction volume is

insignificant, the organization cannot expect significant value from the use of Web. Hence, the realized value depends not just on the complexity of the procurement process, but also on the transaction volume of this procurement category.

Proposition 2: The value of Web-based procurement increases with the complexity and transaction volume of the process.

5.2 Organization of business units

The effect of the process level factors gives us a sense of its impact on the value from the transactional perspective. However, the procurement systems, which handle these transactions, serve different business units and user constituencies, and each unit perceives and realizes different values even from the same Web-based procurement system. The major factors that determine the different values are the volume of transactions, the distribution of the volume of different types of processes, and the existing degree of procurement centralization in each business unit.

Size of business unit: The use of Web results in positive operational benefits (in terms of cost savings) on each transaction, irrespective of its type, even though the level of benefits may vary. The benefits accumulate more as the volume of transactions of the business unit increases. Hence, between two business units with similar distributions of the different types of transactions, a larger business unit can be expected to derive higher transaction cost benefits than a smaller business unit. In addition, the benefits due to price reduction through centralization are higher for a business unit with larger volume of B2B purchases.

Proposition 3: Among business units with similar distributions of different types of B2B processes, larger business units realize higher values from the implementation of Web-based procurement.

Dominant type of B2B process: While we earlier proposed the effect of the types of processes in isolation, a business unit deals with a mix of structured and unstructured processes. Some units, such as manufacturing facilities, can be expected to have a dominance (higher proportion) of structured procurement processes, while other units, such as sales or administrative facilities, can be expected to have a dominance of unstructured processes. The potential value of Web-based procurement cannot be realized unless the dominant type of process is Web-enabled.

Proposition 4: Business units can derive higher value from Web-based procurement only by Web-enabling the dominant type of procurement process.

Degree of centralization: Web-based procurement systems enable organizations to centralize their purchase processes while at the same time given enough flexibility to the local units to serve their local sourcing needs. Centralized procurement benefits a business unit in three ways. First, the administrative costs (part of the transaction costs) are spread over a larger volume of purchases, thus reducing the operational costs for each business unit. Second, the visibility of enterprise-wide procurement demand and preferences helps buyers to negotiate lower prices for goods and services. Third, centralized control and monitoring, combined with the user-friendly Web interface motivates more users to order through the e-procurement system and reduces the volume of "off-contract" purchases. Since most of these purchases cost more and are charged to the business unit, reduction in "off-contract" purchases benefits the business unit.

Proposition 5: The value of Web-based procurement system will be higher for a business unit that achieves a greater *increase* in centralization due to the use of Web.

5.3 Extended enterprise

While the characteristics of business units help us establish the value of implementing Web-based procurement system in a particular business unit, the participation of external partners, such as suppliers, is necessary to realize the value of the Web across the supply chain. A supplier, who is able to manage its production operations efficiently based on timely and accurate information received from the buyer, as well as its down-stream suppliers, benefits the entire supply chain. The factors that are important to realize the value of the Web relate to the organization of the supply chain and technology adoption, participation of the individual players, and the structure of the industry.

Integration of e-procurement with enterprise systems: E-procurement systems interact with other information systems in the enterprise and the supply chain to enable the procurement process. For example, inventory, personnel data and supplier data are accessed from the ERP system of the buyer. Design systems provide data for product development process. Supplier's manufacturing information system is accessed for fulfillment information and order tracking. The full potential of an e-procurement

system can be realized only when all the information exchange and sharing is done electronically, with minimum need for turnover of paper documents. For example, even if the buyer side of procurement process is fully automated and the purchase order is sent electronically to the supplier, if the supplier prints the purchase order and re-keys the data into his own system, the chances for errors and delays are increased, reducing the benefits of e-procurement.

Proposition 6a: Web-based procurement systems that have greater integration with existing enterprise systems yield higher value than procurement systems with lower integration.

Among the various information system applications present in organizations, some are closely related while others are disparate. For example, the functions of production planning and materials management may be closely connected, while production planning and human resource management may not have such close connection. As we integrate the existing information system applications into e-procurement, connecting to closely related systems helps leverage the synergy among those systems. An e-procurement system connected to production planning benefits more if it also connected to materials management, but benefits may be less if connected to human resource management.

Proposition 6b: Web-based procurement systems that are integrated with closely related systems result in higher value.

Participation of business partners: From the enterprise point of view, business units and suppliers are the two most important participants in e-procurement system. Business unit procurement managers are reluctant to reduce their control over procurement decisions and hence need strong incentives to motivate their users to purchase through the Web-based procurement systems. Suppliers are resistant to Web-based procurement as they anticipate fierce competition online and they need strong incentives to Web-enable their catalog and ordering process. The potential value of the system cannot be realized unless both users and suppliers participate in the system. There is also a behavioral aspect involved here. Higher participation by business units or supplier convinces the benefits of Web-based procurement and motivates them to participate. However, increased participation by business units or suppliers alone is not sufficient to realize significant benefits of e-procurement. In fact, we expect that the benefits are modest at low participation of business units, irrespective of the level of participation of the suppliers. Similarly, the benefits are expected to be

modest at low participation of suppliers, irrespective of the level of participation of business units.

Proposition 7a: The value realized from Web-based procurement system is low when a small number of business units participate in the system, irrespective of the number of suppliers participating.

Proposition 7b: The value realized from a Web-based procurement system is low when a small number of suppliers participate in the system, irrespective of the number of business units participating.

We expect a synergy effect depending on who participates in e-procurement, similar to that proposed in e-procurement integration. In the "extended enterprise" supply chain, partners who have a close business relationships may add more value if they participate together in the system, rather than the participation by two unrelated partners. Suppose an MRO supplier and its suppliers participate in e-procurement, inefficiencies are reduced to a greater extent as information flow is optimized at a greater extent in the purchase process. But, if an MRO supplier and an office products supplier participate in e-procurement, each purchase process needs to be optimized, which cannot be done without participation of the lower tiers of suppliers.

Proposition 7c: In Web-based procurement, participation by business partners, who themselves have closer business relationships in the same product supply chain, results in higher value than participation by suppliers not related in the supply chain.

Industry fragmentation: The characteristics of the industry play an important role in realizing the benefits of Web-based procurement. Industry fragmentation of the demand or supply is an important factor that can be managed by using the Web. In an industry fragmented on the demand, supply or both sides, we expect high levels of search costs and inefficiencies in the traditional procurement. Intermediaries play an important role in reducing the transaction costs, but even they are limited by technology. Such industries are greatly benefited by the Web, which allows the integration of demand and supply on a global scale. We expect that enterprises that procure from a fragmented product supply chain derive higher benefits from Web-based procurement.

Proposition 8: The value of Web-based procurement is greater if the existing product supply chain is more fragmented on the demand, supply or both sides.

6. IMPLICATIONS OF THE ANALYSIS FOR THE DEVELOPMENT OF ADOPTION STRATEGIES

Buyer organizations implementing a buy-side Web-based procurement system cannot do it in one-step. There are two major strategies to choose from.

1. All the purchases can be Web-enabled, but the system is implemented one business unit at a time.

2. A specific type of purchase is Web-enabled across the enterprise, and after successful implementation, the next type of purchase is Web-enabled.

In addition, the buyer organization should also consider the participation of suppliers in order to realize the benefits from the Web.

If the organization chooses to implement by business units, then it will compare the characteristics of business units to decide where to implement first. The units with the highest decentralization of existing purchases should be chosen because of the potential for greatest change in centralization (proposition 5) and resulting higher benefits. However, if the choice is between business units with similar distributions of purchase types, the larger the unit, the greater the benefits from Web-based procurement (proposition 3). After a business unit has been chosen for implementation, the type of purchase to implement first is decided by its proportion of structured and unstructured procurement, and its inventory levels. If the business unit has a higher proportion of structured procurement that deals with highly fragmented product supply-chains, Web-enabling structured procurement yields greatest benefits (proposition 8). Otherwise, Web-enabling unstructured procurement yields greatest benefits.

If the implementation strategy involves enterprise-wide adoption of the system, the process type and complexity play a critical role in selecting which purchases to Web-enable first. Unstructured and complex purchases involve a high level of search and coordination. They also require stricter control in view of potential non-compliance hazards. This type of purchases

requires higher levels of human interaction. Thus, the firm should Web-enable the search process of unstructured and complex purchases in order to derive maximum benefits (proposition 1 and 2). However, if the proportion of unstructured and complex purchases is very low compared to other types of purchases, the greatest benefit comes from Web-enabling moderately complex purchases.

Once an implementation strategy is chosen, there are two critical factors that influence the realization of maximum benefits – integration of Web-based procurement with current systems and the participation of suppliers. The procurement system should be designed to automatically retrieve and use data that is already available in the system, instead of duplicating the input. Also, it should provide the necessary data required by other applications. The greater the level of the integration with the organization and supplier systems, the greater will be the benefits (proposition 6a). In a manufacturing organization, purchasing is closely linked with engineering design and materials management, because of the higher need for customized components. The focus in implementation should be to integrate the Web-based procurement system with the design and materials management applications, rather than with accounting or human resource applications (proposition 6b). Thus, buyer organizations should not only integrate with other applications, but integrate with applications whose functions are closely related to the procurement process.

The other critical factor is participation. In order to encourage more use of the Web-based system, more suppliers have to be included in the procurement systems by adding their products to the electronic catalog (proposition 7, 7b). However, if the suppliers who are connected to the buyer-side system are themselves connected to their suppliers, there is further reduction in the cycle time and errors and improved coordination is possible. This leads to higher benefits than if two suppliers not related in the supply chain are added to the catalog (proposition 7c). Hence, buyer organizations should not only look to add more of their suppliers to the system, they should also motivate the suppliers' suppliers to join the Web-based system.

7. CONCLUSION

Global scope and enhanced supply chain coordination capability beyond immediate business partners illustrate the big leap that Web-based IOS makes over traditional IOS. Using the Web, organizations and its several

levels of suppliers can integrate their supply chain across the "extended enterprise" in order to remove the inefficiencies and to be able to respond effectively to demand changes. While previous generations of IOS were linear links between organizations, Web-based IOS are truly "networked" business systems. The economic contribution of each participant in this network, benefits realized by each participant, optimal incentives for increased participation and the type of "network externalities" created are very interesting issues for research and practice. Also, the strategic impact of this network and its critical drivers are areas of research that will have tremendous value for organizations in the new economy.

Even as organizations are moving to Web-enable their B2B processes in the hope of improving their B2B supply chain and reaping economic benefits, there is a need to fully understand how this value is created and realized. Once we know how the value is created, it is critical to identify the factors that explain the differences in the realization of Web potential across the entire B2B supply chain. This will help B2B managers to plan their B2B adoption strategies to ensure that the migration to e-procurement results in maximum benefits to the "extended enterprise". We have provided a start to this effort by developing a framework for understanding the value of Web-based procurement and the factors that affect the value. We were able to establish the effects of process related factors, such as type and complexity, in determining the value of Web-based procurement to an enterprise, and the implications for implementation strategies. Future work on this research will use a comprehensive measurement of economic value and more empirical data to validate our framework both theoretically and empirically.

Note

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