

# **Implementing Web-based E-commerce System at a Multinational Enterprise – A Field Study on IT Adoption**

*Stella Ying Shen, Michael J. Shaw and Chandrasekar Subramaniam*

Department of Business Administration, University of Illinois at Urbana-Champaign,  
Urbana, IL, USA  
[yingshen@uiuc.edu](mailto:yingshen@uiuc.edu)

Department of Business Administration, and Beckman Institute for Advanced Science  
and Technology, University of Illinois at Urbana-Champaign,  
Urbana, IL, USA  
[m-shaw2@uiuc.edu](mailto:m-shaw2@uiuc.edu)

Department of Business Administration, University of Illinois at Urbana-Champaign,  
Urbana, IL, USA  
[csubrama@uiuc.edu](mailto:csubrama@uiuc.edu)

## **Abstract**

As one type of inter-organizational information system, Web-based business-to-business (B2B) e-commerce systems holds the potential of achieving significant procurement cost savings, identifying new business opportunities, and supporting collaboration and cooperation among all supply chain partners. Regardless of the promising benefits, the implementation and adoption of the system is still an issue. Existing IT adoption literatures are usually done at the individual level, within the scope of a particular entity, and seek to explain users' adoption intention through perceived usefulness resulting from personal beliefs and attitudes. We argue that this type of analysis is not sufficient for studies of B2B e-commerce adoption. Our field study at a multinational manufacturing company shows that the different user expectations and the specific characteristics of the purchase process, business unit, and the supplier are the causes of variations in perceived usefulness and effectiveness of the system. Therefore, those expectations and characteristics need to be identified and considered in designing and adopting a B2B e-commerce system.

## **1. Introduction**

As one type of inter-organizational information system (IOS), Web-based business-to-business (B2B) e-commerce systems enable one organization to link to two or more organizations via the Web. Using the Web technology, system designers diligently build various features in order to help the buyer organization achieve transaction cost savings, enhance supply chain relationship, and result competitive sourcing opportunities.

Despite the state-of-the-art information technology (IT), potential users are willing to use them only when they believe such systems have the expected capabilities to fulfill their needs or solve their problems. To this end, whether the system can help them finish work faster, improve quality of work, enhance job effectiveness, or make job easier are much more important than the IT itself. Therefore, adding more advanced features into the systems does not guarantee users' adoption.

However, the potential users of Web-based e-commerce systems is a complex group, ranging from end material users and procurement managers within the buyer organization to multiple tiers of suppliers. Their particular organizational goals and functional requirements determine that their expectations of the system's capability are most probably different, or even contradictory. While designers are usually successful in developing features to meet the common needs of users, such as functions to facilitate transactions, they are also likely to ignore the differences. Failure to recognize those conflicting expectations and incorporate them in the system design will result difficulty in promoting the systems, and consequently, the potential value of the systems can not be realized. Therefore, studying the expectations of various users should be a good start of IT adoption research. Specifically, we attempt to answer the following three questions in this study:

1. What are the impacts of a Web-based e-commerce system?
2. What do users expect a Web-based e-commerce system to achieve?
3. What are the critical considerations that determine users' adoption decisions?

Our study site is a multinational manufacturing enterprise in the mid-west. As a pioneer in its industry, the company developed a Web-based Procurement System (WPS) for its indirect purchases several years ago. So far very few people in the company uses WPS although a pilot trial has been conducted a few years ago. The study consists of multiple visits to the different facilities of the company. We conducted nine private interviews with potential users, including procurement analysts, purchasing managers at the individual business units and at the corporate office. In addition, we had a general conference with the management team who are in charge of developing and implementing the system. All the meeting and interviews were documented to serve as our primary source of data.

## **2. Overview of B2B E-Commerce**

### ***2.1 Current Status and Predictions about its Future***

Despite the disappointment in business-to-consumer (B2C) e-commerce, industry predictors still hold great expectations for B2B. According to Jupiter Research, U.S. B2B e-commerce will grow rapidly from \$336 billion in 2000 to \$6.3 trillion in 2005. On-line B2B activity will increase from its current 3% to 42% of the B2B market by 2005. Among them, supply chain trade will dominate B2B e-commerce during the period. The leading industries on-line will be computer and telecommunications equipment, food and beverage, motor vehicles and parts, industrial equipment and supplies, and construction and real estate, constituting more than half of the overall on-line buying and selling.

A survey conducted by Boston Consulting Group further indicates that 69% of the U.S. buyers and 75% of the U.S. sellers are already engaged in or plan to undertake on-line collaboration. Collaborative activities include on-line product design and project management, real-time information product sharing, and coordination of supply schedules in build-to-order initiatives.

There are now over 1,000 e-markets facilitating B2B on-line transactions, however, B2B procurement is not only about e-market, organizations now have a choice of different Web-based B2B procurement models. The four major models that have emerged on the Internet for B2B e-commerce are shown in figure 1.

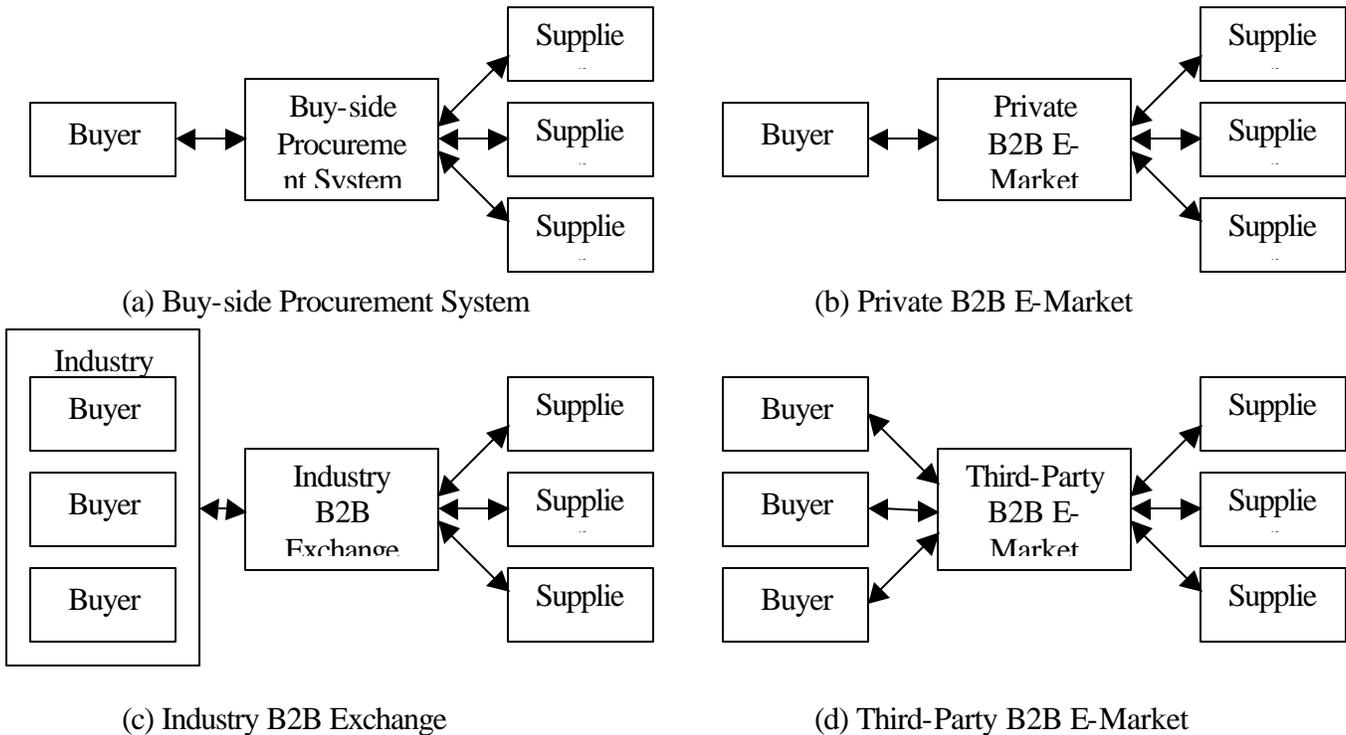


Figure 1. Web-based Procurement System Models

Each procurement model creates value for the enterprise in a different way. Buy-side procurement system is usually developed and implemented by a large buyer organization, Web-enabling and integrating procurement systems between the buyer and its selected suppliers to achieve greater transaction efficiency and process control. Like the electronic data interchange (EDI) system, this system creates a virtually integrated inter-organizational information system (IOS), but with greater scope and capability.

Market based system, no matter it is owned by a private enterprise, an industry consortium, or a third-party market-maker, always emphasizes on reducing search cost, forcing competition among suppliers, and resulting lower prices for buyers. However, the scope of the system could be very different because of the different type of ownership. Private B2B e-market is usually highly customized to serve the needs and preferences of that particular buyer who owns the system, containing proprietary knowledge of that enterprise. Industry B2B exchange aggregates buyers and sellers in a specific industry, increases process transparency and efficiency for the industry. Third-party marketplaces could aggregate buyers and sellers either across a particular function (horizontal) or across a particular industry (vertical), making them especially suitable in fragmented markets.

Our study will focus on Web-based buy-side procurement system in the enterprise. Built in-house, this system carries the capability to fit the customized needs of the internal customers, integrate the organization's internal operations, and at the same time, improve its sourcing opportunities.

## ***2.2 B2B E-Procurement Cycle***

The B2B e-procurement activities start from and end at internal customers within the enterprise (see Figure 2). Those internal customers include direct goods and service users, purchasing personnel, and design engineers who need specific parts for new product development. Although the flow of information and physical goods follows the same direction as traditional procurement, the searching and transformation of information is changed dramatically by the use of the Internet.

First of all, there is no more phone, fax, or other paper-based ordering processes, all the requisitions and purchase orders are generated and transferred in real time online. This reduces procurement errors resulting from traditional manual order entry and re-entry, speeds up the ordering process, and eventually shorten the whole procurement cycle.

Second, the way that buyers search for the right product and service is changed. Now customers can access to a vast amount of information that they were impossible to get before. Through company's internal catalogs and suppliers-managed catalogs, they can possibly locate any product or supplier around the world. In addition to the quantity, the quality of such information retrieved is also improved. The Web-based procurement systems usually allow suppliers to easily upload and maintain their catalogs online, thus keeping the information the most up-to-date.

The most important differentiating characteristics of B2B e-procurement process is the real time order status checking and feedbacks that customers can get throughout the process. Suppliers, logistics partners, and the receiving dock send notices to the customers automatically once the orders are received, and the goods is shipped or arrived.

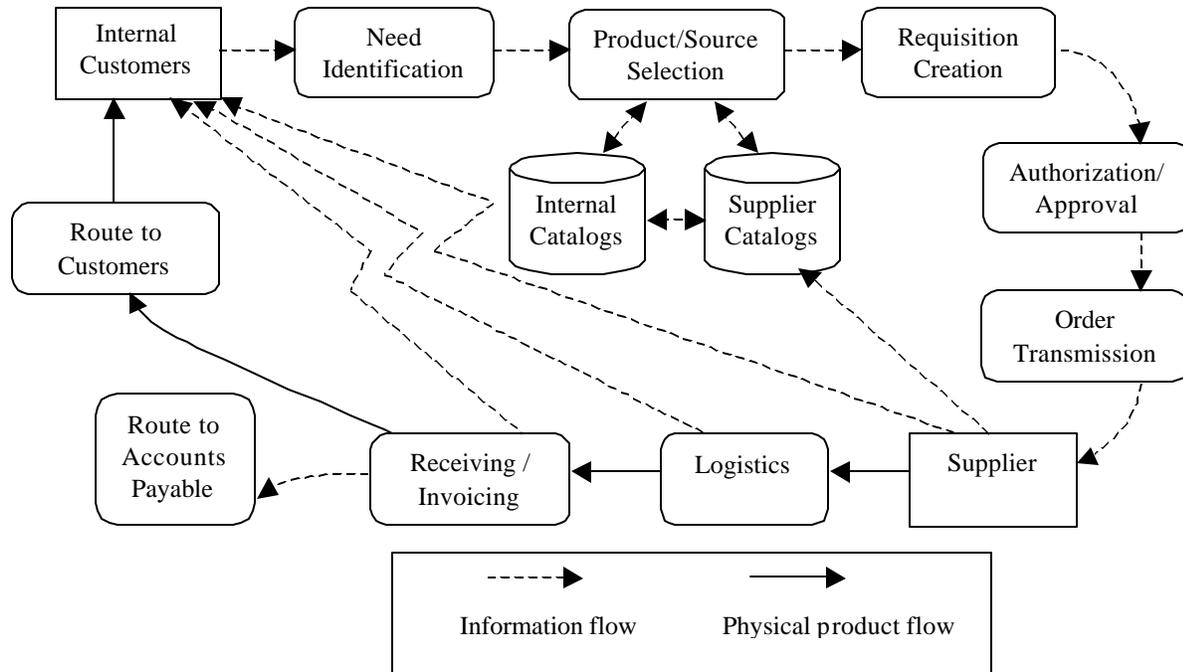


Figure 2. B2B E-Procurement Cycle

### 2.3 A Value-Chain View of B2B E-Procurement Systems

In any organization, value is created through the process of producing and selling goods and services. Traditional value chain activities consist of the movements of physical objects, from inbound logistics, production, outbound logistics, and marketing of the final products to customers. From this perspective, procurement does not bring value to organizations directly and thus the corporate procurement function is considered a pure cost center.

Rethinking the organizational value chain in the digital economy, however, we can see that the new value-added activities are now organized around the flow of information rather than physical goods. Thus by linking to suppliers' information systems, company's internal Enterprise Resource Planning (ERP) and Materials Resource Planning (MRP) systems, and other e-commerce systems serving the customers, the effect of Web-enabled B2B e-procurement systems spans from upstream multiple tiers of suppliers to downstream dealers and distributors, creating values for the organization along the whole spectrum of value-added business activities (Figure 3). Therefore, the corporate procurement function is then expected to help organizations achieve cost

savings and create new value opportunities. Specifically, the value creation can be viewed from the following three areas.

First, value is created when B2B e-procurement systems are linked to major suppliers at the beginning stage of new product introduction. The real time information sharing enables suppliers to design and customize the particular parts parallel to the company's new product development process. This allows them to greatly reduce their casting time, resulting faster delivery and lower production cost. At the buyer's side, the effect of suppliers' participation is reflected in reduced new product development cost and shorter time-to-market. Both of them are critical benefits for manufacturers. Since research and development can constitute up to 70% of the total cost of a typical manufacturing product, a small percentage of saving in this category means much lower production cost. As continuous product innovation is essential for competing manufacturers, timely new product introduction can bring some strategic benefits, such as price and market advantage, and preempt rivals from serving the same product or market.

Second, value is created when B2B e-procurement systems are integrated with enterprise operations and production systems. The major effect of this integration is the synchronized production and procurement processes, resulting greatly reduced inventory in the organization. Companies can even eliminate some internal warehousing functions or leased storage spaces, thus further reduce their inventory holding costs.

Furthermore, value is created when B2B e-procurement systems are integrated with enterprise sales and order fulfillment systems. Efficient procuring of parts and materials enables shorter production cycle time, thus allows the manufacturers to deliver the final products faster to their business customers.

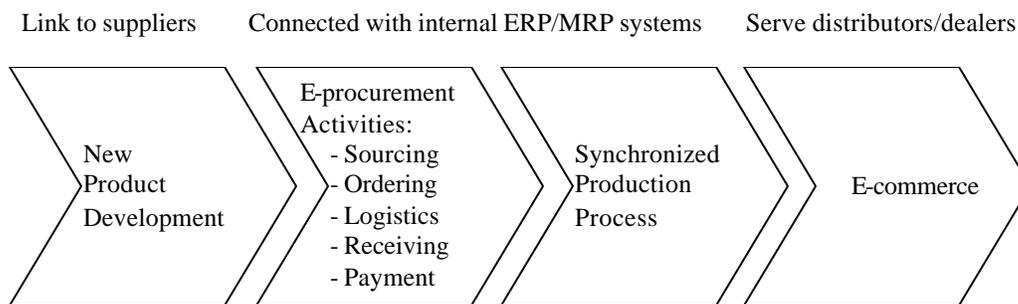


Figure 3. Value-Chain View of B2B E-Procurement Systems

### 3. Impact of Web-based E-Commerce Systems

As noted earlier, the advanced search features and the manufacturing expertise that has been built into WPS are considered its major strengths. At present, WPS has the following capabilities:

- *Global searching with various search options.* It results significant time saving in searching for information about parts and machinery.
- *Duplicate parts identification.* Thus it helps reduce the overall inventory level.
- *Online ordering, status checking and feedback.* The ordering capability reduces people needed for order entry. Moreover, users can check the status of their requisitions and purchase orders, and receive notifications of shipping and receiving.
- *Flexible display option.* It allows users to view the product as a graphical image or an e-engineering drawing. This function is unique and particularly useful for engineers to exchange technical notes among each other and with the suppliers to achieve collaborative new product development.
- *Real-time inventory status.* Users can find the most updated information on the location and quantity of inventory items.
- *Multiple Payment options.* By allowing credit card buying, it gives users more freedom and convenience to get what they need in the fastest way.

Looking from a higher level, the Web-based B2B e-commerce system has the following impacts.

### ***3.1 Process Level – Streamlining Purchasing and Supporting Product Design***

From a process level perspective, WPS is expected to reform the buying and selling processes. The system enables automatic ordering, fulfillment and invoicing, thus reduce the manual re-keying of purchasing information at both the buyer and the supplier side, resulting faster completion of the purchasing cycle and less procurement errors.

The global searching and built-in coordination capabilities greatly reduce the associated transaction costs. With the decision support component, the system can analyze the purchasing history and past usage pattern of some regular items, then make re-order decisions spontaneously, thus reduce the chance of product shortage or overstock. The system can further reduce the inventory holdings along the supply chain by sharing inventory information with suppliers. An extension of the system is to build some market making mechanisms, such as RFP/RFQ, auction, exchange, and bidding, to allow competitive sourcing of unplanned purchases.

Many interviewees feel that WPS can be very helpful in managing the electronic images of engineering drawings and supporting new product development. Through WPS, an engineer at location A can access the e-engineering database for display of engineering drawings, making annotations and sending the drawings electronically to engineers or suppliers in various other locations. The whole process is much faster and cheaper than the traditional one, which typically requires the engineer to manually print out multiple copies of the drawings, then address and mail them to others.

Furthermore, as a great information repository, WPS can also directly affect the new product features to be designed and the cost of the new product. The product cost can be driven down if the design engineers have information support of the various design

options and their implications. For example, when designing a particular new product, if the design engineer knows a list of standard components that can be used, their costs and their performance characteristics, then he can make the design decisions that utilize the existing components while at the same time ensure the performance of the final product. This results in a cost-effective design, which can have long-term implications for the service of the product.

In addition, WPS can provide the communication and collaboration tools needed to support joint product development efforts. Through those collaboration tools, all the players, such as designers, suppliers, dealers, and even end-customers can contribute in the new product design process. This eventually drives down the long-term product cost, and allows innovative features to be added at the design stage.

### ***3.2 Organization Level – Facilitating Both Centralized Sourcing and Decentralized Purchasing***

One of the advantages of WPS is that it provides a graphical user interface, allowing all users to be able to locate items fast and easily, completing purchases for unexpected (non-inventory) items from their desktops. At the individual level, it enables end users to bypass unnecessary administrative layers and make quick purchase decisions that are directly related to their work. At the business unit level, it allows local indirect purchase managers to customize the purchase of some irregular items to fit its unique situation, such as the local ordering done at the individual plant. This type of decentralized purchasing gives local managers the flexibility to negotiate the terms and conditions, particularly the delivery and after-sales services from suppliers.

However, sourcing and procurement analysts also view WPS as a great supporter of centralized sourcing. Sourcing is a process of identifying the proper suppliers for certain items, negotiating price, quality and delivery conditions, and reaching an agreement on those terms for future purchases. For a multinational enterprise, aggregating indirect purchase needs from different facilities and units means tremendous volume discounts. Most of the frequently used items, particularly automatically re-ordered crib items, are sourced at the company's central purchasing, where purchasing analysts identify the suppliers and negotiate prices with them based on the consolidated company volume. For some high value items such as fuel, the central purchasing even teams up with the company's dealers to make bulk purchasing. This helps the company to leverage even higher volume buying and reduce the price significantly. In fact, procurement analysts indicate that they are seeing less number of suppliers now, mainly because of centralized sourcing.

### ***3.3 Extended Enterprise Level – A Total E-Procurement Solution***

It appears that WPS can potentially affect the entire purchasing process – from sourcing, ordering, delivering, to payment, enhancing job efficiency and effectiveness of all types of users. However, it also appears that most potential users are near-sighted in seeing its capabilities. It has been the norm among purchasing professionals to view WPS as an

excellent information search tool and the legacy systems as ordering systems. One of the reasons is that a lot of mission-critical technologies, such as engineering drawings, electronic document routing, and employee accounting information, are already embedded in the existing legacy systems. Therefore, interfacing and integrating with the legacy systems and established EDI is a must in developing the full capability of WPS.

WPS architecture should be such that it provides a single comprehensive interface for users to perform any functions in the organization, from new product introduction, sourcing, supplier communication, logistics, receiving and invoicing, to accounts payable (see Figure 4).

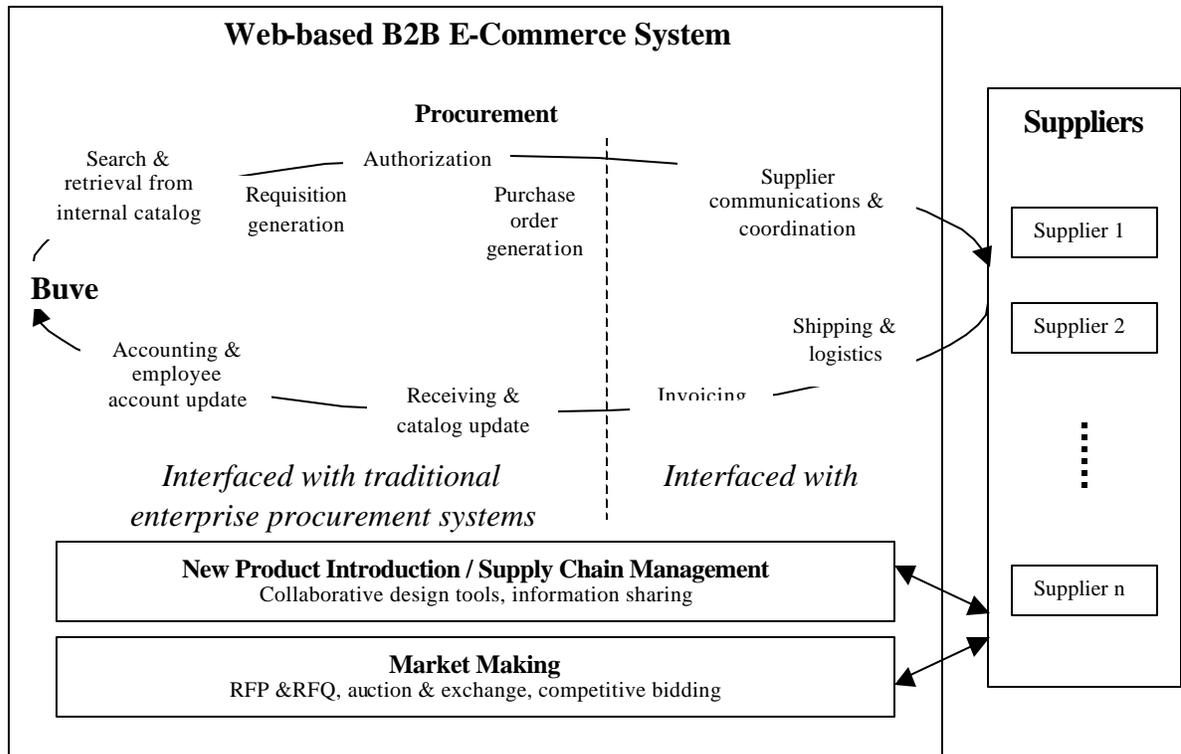


Figure 4. Web-Based B2B E-Commerce System

#### 4. Conflicting User Expectations

As a great information tool, Web allows people to search product and price information in real time and beyond their geographic limitations— a very favorable feature to all internal users. The corporate procurement function further demands the system to incorporate analytical capabilities, such as side-by-side comparisons of product, price, and supplier performance, to assist efficient sourcing and decision-making. On the contrary, suppliers wish to limit buyers’ access to others vendors’ product related information. Side-by-side comparisons are particularly threatening to them.

For an end user, it does not matter from which supplier the pencil is bought as long as he/she can get it immediately when needed. But, as a part of their job function, the

procurement personnel at individual business units expect the flexibility to select local suppliers for better terms and services while corporate procurement wish to centralize all product and supplier sourcing across the entire organization. Through centralized supplier decisions and the combed purchasing needs, corporate procurement can ensure the quality and consistency of products and negotiate better deals with suppliers. However, from the external side, the major objective of suppliers is to establish long-term, preferably exclusive, contractual relationship with the buyer, no matter it is the central corporate procurement or individual business unit.

Finally, there is a direct conflict between the procurement functions at the business unit and corporate level in terms of desired degree of control. Corporate procurement wants to control the overall procurement processes and costs by enforcing consistent purchasing policies and standards throughout the enterprise, however, as individual profit centers, business units wish to control their own procurement processes and costs by allowing flexibility to make local decisions.

## **5. Observations of Conflict**

As we go through our interview with various potential system users in the organization, we found that in addition to the general conflicting expectations across different functions and units, even within the same function or business unit, what people expect the system to achieve is widely different. This difference occurs mainly because of the respective tasks they perform, the type of products they procure, and the business processes they handle. Below are some examples of conflict from our interviews.

### ***5.1 Difference between the Sourcing Analysts (SA)***

Both of the sourcing analysts interviewed admitted the superior search capability of WPS compared to the two existing legacy procurement systems. They found this particularly useful since a majority portion of their job is to locate the items within the organization or from outside. However, they didn't find WPS equally helpful to their jobs.

SA A deals with planned ordering process – re-ordering for inventory items. As one of the earliest users of WPS, he uses WPS to identify duplicate inventory parts scattering in different facilities – a function that cannot be done with the legacy systems. Other stored information such as past purchase pattern and purchase history is also useful for him to make re-order decisions. As a result, he successfully helped the company to cut its inventory from \$17 million to \$15 million.

SA B is responsible for unplanned purchasing – procuring non-inventory items. Identifying the source and getting the item delivered fast to the needed location are key performance measures for him. As neither of the legacy systems support browsing or ordering from external supplier catalogs, he has to search the Internet based on his best knowledge. Therefore, the potential global search and on-line payment capabilities of WPS are extremely attractive to him to fulfill his job. Nevertheless, he is not using WPS at this time because those functions are not fully developed yet.

## ***5.2 Difference among Procurement Analysts (PA)***

At the company's central purchasing office, there is a group of PAs that handle the purchasing of indirect materials. However, our interviews reveal that, currently, they are spending most of their time on resolving mismatches between purchase orders and suppliers' invoices. Common mismatches include price mismatch, freight non-compliance, item number mismatch, date mismatch, and mixed-up line items. Most of the problems happen because of manual transmission and processing of information – purchase orders are printed and faxed to the suppliers, then the suppliers re-key in the order information to generate invoices. The problem is more severe with smaller suppliers that do not have EDI connections. Although they supply only 20% of the total parts by value, they are great in number, constituting 80% of the supplier population. Hence, most of the mismatches occur from them, resulting inefficient use of PA's time. None of those PAs uses WPS in their work at the time of the interview, however, future WPS will extend the current EDI connection to build a Web-based common platform for all suppliers, allowing the buyer and the suppliers to exchange and check order and invoice information electronically. Moreover, with the built-in functionality such as unit of measure conversion and tax calculation tool, it is expected to reduce the amount of mismatches significantly, allowing PAs to spend more time on strategic sourcing, resulting more purchasing cost savings.

PA A spends 80% of her time on mismatch resolution for purchases of non-inventory items. She covers all five categories of mismatches. Therefore, the reduction of mismatches will significantly affect her current workload.

PA B is a hazardous materials specialist. Procuring hazardous materials is a complex process. Any hazardous materials cannot be ordered for the first time without approval from the company's internal Hazardous Material Coordinator. Such materials have to be checked in terms of corporate safety regulations (to make sure they are safe to the employees) and government reporting procedure. The receiving procedure is usually specified and documented as well. Therefore, WPS-enabled coordination tools can facilitate effective communication and coordination among the Coordinator, the PA, the receiving dock and the end user.

PA C is a lead PA. She spends 20% of her time on mismatch resolution while save the rest on analyzing and improving the purchasing process. Therefore, the reporting and analytical tools embedded in WPS can be useful to enhance her job. In addition, she feels that WPS can be particularly helpful in managing and electronically transmitting Rastar® engineering images. The existing manual process of engineering drawings is very inefficient. The Rastar® machine is old. Through WPS, a design engineer can access the Rastar® database for display of engineering drawings, making annotations and sending the drawings electronically to suppliers for procuring necessary parts.

## ***5.3 Difference between Individual Plants***

The plant we visited manages the purchase, storage, and distribution of indirect materials inventory through its own local indirect purchase department.

Particularly, there are three types of purchases done at the plant: automatic ordering, manual ordering, and local ordering.

- About 90% of the inventory is designed for automatic re-ordering. The re-order point and re-order quantity are set up in the legacy procurement system. Once the stock falls to the re-order point, the system triggers a purchase order for the re-order quantity to the supplier. When the items are delivered, they are verified, taken into stock, and the system's stock information is updated. In fact, about 90% to 95% of those inventory items are sourced by the company's central purchasing department.
- For some items used in limited quantities, a manual requisition is generated every time the item is needed and the central purchasing department issues the purchase order and makes the purchase. Sometimes, a purchase order may be sent directly to the supplier from the plant for these items. In both cases, the sourcing is done by the central purchasing.
- For a limited number of items, such as packaging, paper supplies, and welding supplies, the PM at the plant can identify the suppliers, and send the purchase orders directly to them when items are needed. This gives local manager the flexibility to negotiate the terms and conditions, particularly the delivery and after-sales service from the suppliers.

The existing legacy system is sufficient in managing the plant inventory. It stores 42,500 locations of items in the local warehouse. When a customer at the plant needs an item, he fills in an electronic requisition in the system, which triggers a 2-copy pick ticket. The pick ticket has all the necessary information for picking and delivering the item and the appropriate accounting settlement. Some of the information is the item ID#, location ID in the crib, unit of measure, quantity, cost, and account number to be charged. When the item is picked and the details entered, the system updates the stock. The items are delivered to the customer location by indirect purchasing and charged to the customer's account.

WPS has just been installed in his location, but the PM at the plant has not yet seen the necessity to switch to WPS for indirect purchase needs.

## **6. E-Business Adoption Issues**

The case of WPS implementation brings up an important issue in information systems management – IT adoption. As a widely studied topic, a lot of IS researchers have tried to answer the question, “Why people use the technology / system?”

### ***6.1 Issues from IT Adoption Literatures***

Rooted in social psychology, Fishbein and Ajzen's (1975) theory of reasoned action (TRA) is an intention model that has proven power to explain or predict general behaviors across a wide variety of domains, and has been the theoretical foundation of a lot of IT research on the determinants of user behavior.

Adapted from TRA, Davis (1986) introduced the technology acceptance model (TAM) to apply only to one specific behavior – computer usage. Same as TRA, TAM postulates that an individual's behavioral intention (BI) of using a specific system determines his or her actual usage of the technology. But unlike TRA, TAM attempts to explain and predict end users' BI and attitude (A) towards an information technology through two fundamental and distinct constructs: perceived usefulness (U) and perceived ease of use (EOU). TAM further posits that these two constructs can be influenced through controllable external variables. For example, EOU can be positively influenced by the use of GUI (graphical user interface) technology. Similarly, U can be positively affected by demonstrating cost savings through improved accuracy or timeliness. TAM was tested in a longitudinal study of 107 users and produced promising results on understanding the determinants of user acceptance (Davis et al., 1989).

Until now, a considerable amount of previous IS research has contained empirical evidence of the causal relationships between BI and actual usage of information technology or system, U-BI, A-BI, U-A, and EOU-U (Davis et al., 1989; Barrett et al., 1968; Schultz et al., 1975). However, studies on how those controllable external variables affect users' beliefs and attitudes, and consequently result different BI, have been unsystematic. Those external factors range from features of the system (Bewley et al., 1983; Benbasat et al., 1986; Dickson et al., 1986; Miller, 1977), the type of system development process used (Alavi, 1984; King et al., 1981), the nature of the implementation process (Ginzberg, 1978; Vertinsky et al., 1975; Zand et al., 1975), cognitive style (Huber, 1983), to training, documentation, and user support consultancy (Davis et al., 1989).

## ***6.2 An Adoption Framework***

By using the intention models, no matter it is TRA or TAM, existing IT adoption literatures usually tend to predict and explain individuals' behavior on three major constructs: intention, perceived usefulness, and perceived ease of use, and perceived usefulness and perceived ease of use are the determinants of behavior intention. Expanded from the intention models and be in consistent with our interview results, we came up with a framework that can be used to assess the users' adoption of a particular system.

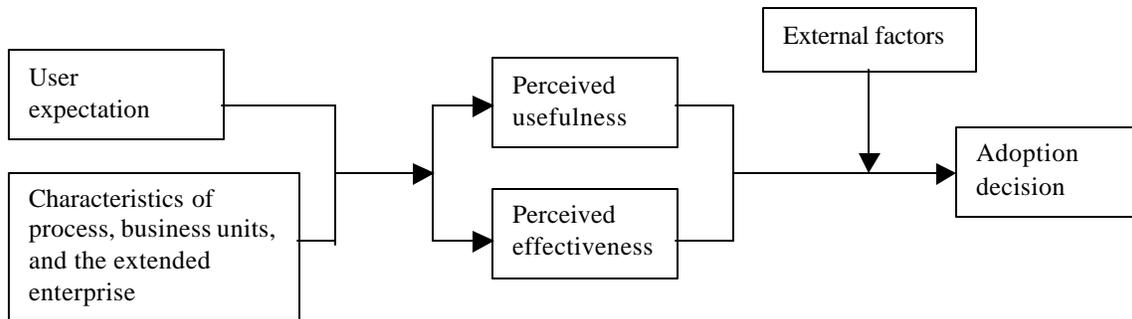


Figure 5. Adoption Framework

### Perceived Usefulness, and Perceived Effectiveness

As indicated by most users, they will use the system because it is beneficial, not because it is a new information system per se. Hence, perceived usefulness of the system is probably the most important consideration in making the adoption decision. Potential users usually make this judgment based on the perceived system capability in achieving their objectives such as:

- 1) Finish work faster
- 2) Improve quality of work
- 3) Enhance job effectiveness, and
- 4) Make job easier

Besides, the system has to be proved to work more effectively than the existing ones in order for people to be willing to use it. An effective system should offer features that are easy to use, and help users solve their procurement needs in a direct and innovative way without disrupting their regular functional requirements. It should bring users time and money savings on their jobs, and allow them to achieve what they were not able to do before.

As we look back, we found there are primarily two sources of variations that shape users' perceptions of the system's usefulness and effectiveness: their expectations and the characteristics of processes, business units and the extended enterprise.

### User Expectations

The perceived system usefulness and effectiveness is directly caused by the gap between users' expectations and the system capabilities. As we demonstrated earlier, users in different functions and units hold conflicting expectations for the capabilities of the system. Moreover, even users within the same function or business unit perceive the system differently because of their respective job tasks, major processes and products handled, thus creating all sorts of gaps.

## Characteristics of Processes, Business Units, and the Extended Enterprise

Like other information systems, the realized value of a B2B e-commerce system will not be the same for all units or all types of purchases. The specific characteristics of a unit or a purchase can be viewed as constraints, limiting the realized value of the system, hence affecting the perceived usefulness and effectiveness. The influential characteristics are categorized in the following table.

Table 1. Characteristics of Processes, Business Units, and the Extended Enterprise

	<b>Influential Characteristics</b>
Individual purchase process	<ul style="list-style-type: none"> <li>• Type of procurement process, planned vs. unplanned</li> <li>• Complexity of process</li> <li>• Particular task in the procurement cycle that the system can help achieve</li> </ul>
Individual business unit	<ul style="list-style-type: none"> <li>• Size / financial position of the unit</li> <li>• Degree of concentration, centralized vs. decentralized purchasing</li> <li>• Dominant type of procurement process in the unit</li> </ul>
Individual member of the extended enterprise	<ul style="list-style-type: none"> <li>• Level of integration with existing enterprise systems</li> <li>• Degree of participation</li> <li>• Industry fragmentation</li> <li>• Size / financial position of the member</li> </ul>

From the process perspective, the interviews with the procurement analysts show that the Web-based e-procurement system is expected to have more impact on unplanned, more complex procurement processes, and on achieving tasks that involve more human interactions.

From the business unit's point of view, our interview with an indirect purchasing manager at a local branch indicates that WPS does not serve the unit's procurement needs better than the existing systems when most of the unit's purchases are planned, and the sourcing decisions are already centralized at the corporate headquarter.

Finally, as expected by the company's e-business management team, the impact of the system will be greater when the major partners integrate the Web-based procurement systems with their internal information systems for directly related business activities, when partners along the supply chain actively participate in using the system, and when the existing product supply chain is more fragmented.

## 7. Critical Factors in the Adoption of Web-based E-Commerce Systems

Despite those advantages and various other new features that are still being added to WPS, the system is currently used by a very limited number of people in the

organization, and mostly as an information search engine rather than a procurement tool. Learning from those interviews with various indirect purchasing participants within the company, we are able to identify some critical success factors involved in adopting a new information technology or system.

### ***7.1 Business Unit Level – Acceptance of the Business Units***

Since all of the B2B transactions occur at the individual business units, the acceptance of the system at the unit level is the first step in IT adoption. The major objective of the indirect purchasing function at the business unit level is to satisfy the needs of the local internal customers. To this end, the emphasis is more on how the customer's problems can be solved, not on whether new information technologies (IT) can be used. The most important issue in adopting WPS, or any electronic commerce solution, is to demonstrate and convince the potential users of the potential benefits of switching to the new system. The anticipated benefits should be greater than the estimated switching cost. At the same time, the switch should be made as less disruptive as possible to the day-to-day functioning of the particular unit. A typical adoption example at the individual plant visited shows exactly the above issue.

As indicated by the indirect purchasing manager at the plant, except for a very limited amount of local ordering, which is completely decentralized, about 90%-95% of the inventory items are sourced by the company's central purchasing department. Moreover, about 90% of them are designed for automatic re-ordering by the legacy procurement system. Therefore, although one of the key strengths of WPS is that it provides global search capability, whereas existing legacy systems can search only within the corporate boundary, the potential users at the plant do not see any incentive to switch to the new system because their current procurement needs are met by the existing systems. Moreover, although the existing systems do not have the coordination tools as opposed to WPS, the needs and concerns of the internal customers can usually be solved through the personal monitoring and control of the indirect purchase manager on the site. Therefore, WPS is not perceived to provide extra value to users at the plant.

At the cost side, switching to WPS does require the plant to make a substantial investment on PCs whereas the legacy systems require just a terminal. As a profit center, the plant has to consider the high switching cost, thus is hesitant to adopt.

Therefore, although WPS has been installed in this location, the indirect purchase department has not yet seen the necessity to switch to WPS.

### ***7.2 Extended Enterprise Level – Integration with Suppliers' Enterprise Systems***

As noted earlier, extending WPS to suppliers is expected to result in benefits for both parties. As a communication channel that facilitates real time inventory information sharing, the suppliers can reduce their own work-in-process and inventory holding cost through better production planning, while at the same time, the OEM can better manage its procurement cost by reducing the number of rush orders. Those inventory items are

the best candidates for initiating this new process. Instead of assigning a procurement analyst to expedite orders, the suppliers can start to monitor the inventory levels and determine the shipment date based on past consumption pattern and lead time. To accomplish this, the Web-based procurement system must be integrated with the suppliers' internal enterprise resource planning and logistics information systems. Additionally, suppliers can shorten the procurement cycle time and reduce the collectable period by integrating their order fulfillment and accounting systems to the procurement system.

Compared to the transaction cost savings, the casting and production cost savings as a result of participating in OEM's new product development is probably even greater. It is often the case that implementing a typical information system results in greater production cost savings as compared to process cost savings, although sometimes the suppliers may be skeptical of sharing sensitive cost information with the manufacturer.

In addition, quite a number of suppliers, especially the major first-tier suppliers, have already had EDI in place and are worrying about their return on EDI investment. Therefore, it is important to emphasize that WPS is a complement rather than a replacement of EDI. They will continue to use EDI for order transformation, but use the Web-based procurement system to offer valued services such as real time order status checking.

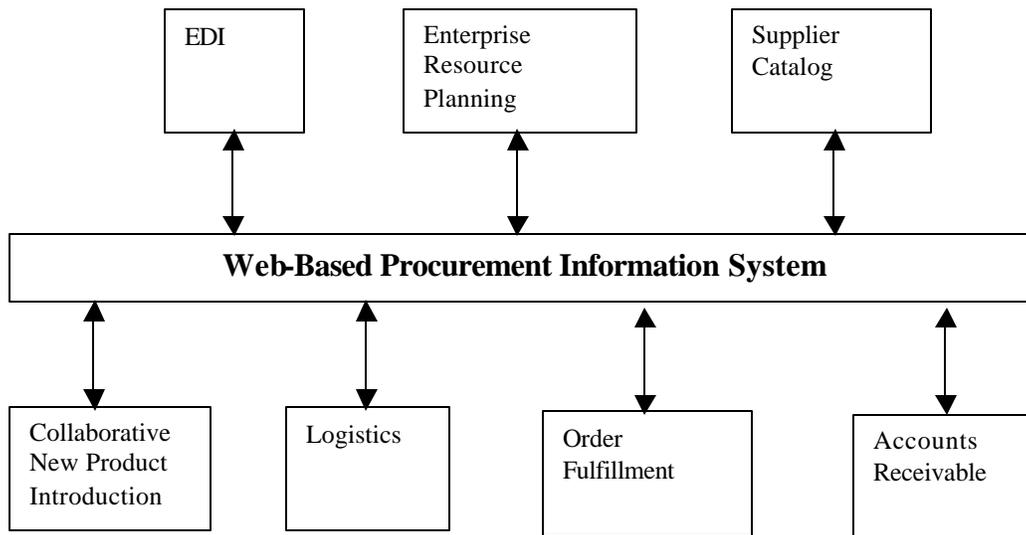


Figure 6. System Integration at the Supplier Side

## 8. Conclusion

As it is already showing in the enterprises, buyer-side procurement systems are not only changing the old enterprise procurement processes, accelerating sourcing and purchasing of products, and reducing procurement errors, more importantly, it is changing the relationships among the supply partners. The value of the system is no longer limited to procurement cost savings, rather, it is extended along the whole enterprise value chain:

from new product introduction to customer service, resulting direct impact to their bottom line of business – financial profitability. Furthermore, the boundaries among businesses become blurred. As more and more supply chain participants integrate their internal functional information systems with the Web-based procurement system, they are able to cooperate and collaborate across multiple enterprises, creating the extended enterprise.

Despite the tremendous impacts of the Web-based procurement systems, however, the adoption of the system remains a hurdle to many potential users. Like any new information systems, people are willing to use the Web-based procurement system only if it is useful and effective in accomplishing their job responsibilities. However, adding more advanced features does not guarantee higher perceived usefulness and effectiveness of the system. User expectations and the characteristics of the procurement processes, the prospective business units, and the extended enterprise determine those perceptions.

In addition, although not explicitly shown in the interviews, there could be psychological factors in making the adoption decisions. Some psychological factors can be significant in some particular situations. For example, employees' fear of losing their expertise or jobs to the system, or their sole trust in traditional human interactions can cause their resistance to the system significantly. On the other hand, the peer pressure from another business unit may stimulate the adoption of the system at this unit.

As B2B e-commerce continues to grow, more and more businesses are connected by the Internet and their operations are increasingly integrated by Web-based e-commerce information systems. Advancing from a buy-side procurement system to a private or industry B2B exchange seems to be a natural path for companies to further exploit the benefit of aggregated demand and supply from an e-market. The extended enterprise in question will then not be limited to include those selected suppliers, rather, all possible suppliers, distributors, customers, and even competitors will need to be taken into consideration. Consequently, the different incentives for distributors, customers, and competitors to adopt the same Web-based e-commerce system need to be recognized and reflected in the evaluation of adoption tendency. Future studies on the adoption of such systems should address these considerations.

## References

- Alavi, M., "An Assessment of the Prototyping Approach to Information Systems Development", *Communications of the ACM*, 27 (1984), pp 556 – 563.
- Barrett, G. V., Thornton, C. L., and Cabe, P. A., "Human Factors Evaluation of a Computer Based Storage and Retrieval System", *Human Factors*, 10 (1968), pp 232 – 238.
- Benbasat, I. and Dexter, A. S., "An Investigation of the Effectiveness of Color and Graphical Presentation under Varying Time Constraints", *MIS Quarterly*, March 1986, pp 59 – 84.
- Bewley, W. L., Roberts, T. L., Schoit D., and Verplank, W. L., "Human Factors Testing in the Design of Xerox's 8010 "Star" Office Workstation", *CHI '83 Human Factors in Computing Systems*, Boston, December 12-15, 1983, ACM, New York.
- Davis, F. D., "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results," Doctoral dissertation, Sloan School of Management, Massachusetts Institute of Technology, 1986.
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R., "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models", *Management Science*, Vol. 35, No. 8, August 1989, pp 982 – 1003.
- Dickson, G. W., DeSanctis G., and McBride D. J., "Understanding the Effectiveness of Computer Graphics for Decision Support: A Cumulative Experimental Approach", *Communications of the ACM*, 29 (1986), pp 40 – 47.
- Fishbein, M. and Ajzen, I., *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley Publishing Company, 1975.
- Ginzberg, M. J., "Steps toward More Effective Implementation of MS and MIS", *Interfaces*, 8 (1978), pp 57 – 63.
- Huber, G. P., "Cognitive Style as a Basis for MIS and DSS Design: Much Ado about Nothing?", *Management Science*, 29 (1983), pp 567 – 582.
- King, W. R., and Rodriguez J. I., "Participative Design of Strategic Decision Support Systems: An Empirical Assessment", *Management Science*, 27 (1981), pp 717 – 726.
- Miller, L. H., "A Study in Man-Machine Interaction", *National Computer Conference*, 1977, pp 409 – 421.

Schultz, R. L. and Slevin, D. P., In Schultz, R. L. & Slevin, D. P. (Eds.), *Implementing Operations Research / Management Science*, American Elsevier, New York, 1975, pp 153 – 182.

Vertinsky, I., Barth R. T., and Mitchell, V. F., “A Study of OR / MS Implementation as a Social Change Process”, In R. L. Schultz & D. P. Slevin (Eds.), *Implementing Operations Research / Management Science*, American Elsevier, New York, 1975, pp 253 – 272.

Zand, D. E., and Sorensen, R. E., “Theory of Change and Effective Use of Management Science,” *Administration Science Quarterly*, 20 (1975), pp 532 – 545.