Web-based catalogs provide the main entry point for B2B e-commerce and will fundamentally transform supply-chain relationships.

Electronic commerce (EC) has many possible definitions [1, 4, 6]; we define it as the use of electronic systems in the exchange of goods/services/information. There are two major divisions of EC on the Internet: consumer-oriented electronic commerce (CEC) and business-to-business oriented electronic commerce (BEC). Of the two, BEC is expected to grow more rapidly—from $114 billion in 1999 to $1.5 trillion in 2004 [5]. Electronic catalogs have become the entry point for both CEC and BEC and as such represent much of what is expected of EC. The benefits of e-catalogs for both
suppliers and retailers include drastically reduced production costs, expanded markets, and reduced processing costs. From the supplier standpoint, the case for e-catalog use in BEC is more focused than that for CEC because the number of business buyers is much smaller than the number of consumer buyers. Thus, there is less diffusion in the number and types of channels utilized in business-to-business purchasing compared to that in consumer sales. However, from the purchasing business standpoint the benefits of e-catalogs and their use in Web-based business-to-business procurement/purchasing systems (WBPS) are not so well understood. We developed an evaluation model and applied it in our work for a large midwestern manufacturer. We found that while there are large potential benefits, there are also crucial managerial issues that need to be addressed.

**E-catalogs.** We look at e-catalogs in the broadest sense, defining them as electronic representations of information about the products and/or services of an organization [11]. Thus a company’s Web page that provides even a short list of its products is an e-catalog. However, this type of e-catalog is static, passive, and dumb. Static requires constant and specific effort to assure currency—the catalog must be updated on the Web regularly just as in a physical catalog. The Web page is passive since it does not react to user needs other than in some very limited predefined ways. Dumb refers to the inability to learn from experience.

At the opposite end of the scale are intelligent catalogs. Intelligent catalogs are dynamic, active, and capable of learning. Arthur M. Keller describes this type of e-catalog as those that are “…searchable, annotated combinations of machine readable (minimally processable) and machine sensible (actually understood by the computer) product data.” He defines virtual catalogs as those that “…dynamically retrieve information from multiple smart catalogs and present these data in a unified manner with their own look and feel, not that of the source smart catalogs” [7]. The virtual catalog would be ideal for BEC use. However, virtual catalogs require smart catalogs as a source. Unfortunately, the vast majority of supplier catalogs do not fit the definition of smart catalogs. They contain material that is difficult for the computer to read and even more difficult for the computer to understand. Thus, at this time, we have to accept something less than an intelligent catalog in developing e-catalog systems.

The general absence of smart catalogs means we have to rely on business relationships and agreed standards (we must rely, in part, on the cooperation of the suppliers). Figure 1 illustrates an example of this type of cooperation viewed from the buyer’s perspective. An internal buyer, who has a need for an item, utilizes a Web browser on a computer to link to the procurement site. At that site, which is internal to their organization, the buyer indicates the item he needs by description, number, or search. This information is used to build a dynamic Web page that contains information on the matching items of approved suppliers from an internal database of product information [10]. If the buyer is satisfied, the system handles the order and the user is done without any assistance from the procurement unit. If, however, the items presented do not satisfy the buyer, then the system will search the Web for suppliers with items that better match the buyer’s requirements. Once suppliers have been found, the buyer can access the information from each supplier to make his choice. As long as the conditions of the purchasing process are satisfied the order will be placed. In both of these cases the decisions will have been made at the point closest to the action. Further, the information developed about the
Procurement: Direct vs. indirect purchases. Procurement is the process utilized in supplying each link in the supply chain. Historically it has had an internal focus and has to varying degrees become an automated business process in many firms. Procurement is driven by a recognition of need that originates, with a high degree of predictability, through planned production, or is ad hoc with little predictability. Items required in the production of an organization's products—direct items—are typically planned and predictable. Items used in processes that support production—indirect items—are often less well planned and thus, less predictable (maintenance, repair, and operations, known as MRO). The value of MRO orders is generally much smaller than that of direct items. However, the cost to process each is roughly the same [2, 8] and this can result in the classic case of an item that costs more to order than it does to pay for. While the direct procurement processes in major companies have gone through major reengineering efforts in the past decade, the procurement of indirect items has had little attention paid to it. Thus MRO procurement is the area where WBPSs can have the greatest impact.

Figure 2 illustrates the flow of information and goods in a generic procurement process. It fits either the direct or the indirect processes at the conceptual level and adequately depicts either a manual or automated system. The largest number of errors occurs in translating need recognition into an item on an order. Electronic Data Interchange was introduced as a means of forging automated linkages between the buyer and supplier to facilitate transmitting orders, receipts, and payments. While EDI has had great success, its application has been limited to those relationships where the volume of use and/or specificity of need compensate for the cost. Direct items are ideally suited to this type of link-
Figure 4. External view of procurement: Integrated interaction between buyer and several suppliers and several internal customers.

The complexity and translation problems implicit in a Figure 3 exchange can be virtually eliminated by extending the internal electronic communications to the supplier’s location as an extranet. Figure 4 illustrates the linked buyer/supplier model. Communications are coordinated through a common conceptual gateway. The problem of translation can be automated and the complexity of the interactions can be controlled in the context of a common and integrated model of the procurement process. To accomplish this some standardized means of communications is necessary. EDI and its proprietary networks have proven to be too costly. Intranets and the Internet provide an ideal means of communication at a very low cost. However, conflicts between the goals and methodologies of the suppliers and buyers must still be resolved within the development process.

How e-catalogs relate to EC.

To understand the value added by electronic catalogs, we have to understand where they fit in the EC environment. The electronic catalog is the means by which the user views and interacts with the supplier’s information. While other applications can provide similar services, electronic catalogs provide a range and effectiveness of service that exceeds the capability of any competing application. Physical catalogs are cumbersome to use, require large storage areas, become dated soon after publication, and make search and comparison activities very difficult. CD catalogs also are apt to be out of date soon after publication, require physical storage, and either replication for each user or some means of remote access and control. The interactive possibilities of Web-based electronic catalogs eliminate physical storage and makes continuous updating effective and efficient. In addition a hierarchy of information, where the user accesses only the amount of catalog information required to make the procurement decision, can be made available. The added value of Web-based electronic catalogs is their ability to simplify search, maintain currency, and adapt. This makes locating and evaluating the supplier goods much easier and more effective than other methods. W.W. Grainger has a Web-based catalog that replaces its six-inch thick physical catalog. Grainger’s customers can interact with the information in the manner they choose.

The use of e-catalogs creates an Inter-organiza-
tional Information System (IOIS) allowing two or more organizations to exchange information in an automated and electronic form [3]. Malone, Yates, and Benjamin [9] identify two forms of IOISs, the market and the hierarchy. They relate coordination and production costs to organizational form. The coordination costs for a market are high in comparison to those of a hierarchical form, while the production costs for the hierarchical form are high in comparison to those for the market. E-catalogs can drastically reduce the cost of coordination, data gathering, and analysis. This capacity makes the market form applicable in a broader range of circumstances and reduces processing costs. Choudhury [3] adds a third form of IOIS and defines his three as:

- Electronic Dyads: bilateral IOISs where EDI links are common examples;
- Multilateral IOISs: such as electronic markets; and
- Electronic Monopolies: IOISs that supports a sole source relationship for a product or set of products usually by the buyer’s choice.

The structure of the multilateral IOISs, the most common form, provides some degree of trust that is otherwise difficult to establish. It also provides a first step in common connections—these are advantages to both the buyer and the supplier. However the move to WBPS involves more than simply communications and its value is a complex measure. The WBPS can incorporate any one or all of the IOIS types for varying product categories.

A WBPS as described previously is expected to improve coordination and communications between the firm and its suppliers. The exact form of organization that the WBPS takes is open to any mix of the three forms of IOISs. Determining the value of the WBPS, how to implement it, and what to implement, based upon our experience, is described here.

**Analyzing Moving to a WBPS**

The analysis we performed was based upon the interaction of four groups of internal and external factors: economic, social, legal/control, and technological. Figure 5 shows these factors. The factors are not independent and cannot be addressed independently since each affects the actions of the organization and each reacts to the organization’s actions. The conceptual factors categorize factors based upon their orientation and serve to align both the internal and the external groups of factors. The external factors categorize items based on their use and as such items may appear in multiple factor categories, for example, regulation is used in legal/control and in the social categories. The internal factors are those present within the organization that affects its actions. While it would be ideal to evaluate a situation utilizing all of the factors it is not practical.

Our efforts focused on four types of factors—tangible, intangible, critical success, and managerial issues—that we feel capture the essence of the concept in Figure 5. The first two factors were evaluated separately and the second two then served to evaluate the relation of factors and actions. Tangible factors are those where we can attach quantitative measures of costs and benefits. Those factors that have costs and/or benefits for which we cannot derive quantitative values are considered intangible factors and scored dichotomously as positive or negative. We categorized critical success factors (CSF) as those that needed positive resolution for the project to be able to succeed and highlighted those most likely to be problems. Managerial issues are items external to the project that require attention if they are not to impede the effort. We provide suggested courses of action in handling managerial issues here.

**Tangible factors.** We identified five tangible factors that associated with benefits in a WBPS: cycle time, transaction cost, error rate, inventory, and the item prices. We estimated the values in each of these factors. In some cases estimates are based upon expert judgement because the hard information available on the factor was insufficient to make precise measurement possible. In addition we divided these items into a number of subcategories to reduce unintentional biases. Where there were aggregate values available, we were then able to compare them to the sum of the subcategories of the estimated values as an accuracy croscheck.

The tangible factors, in our analysis, indicate significant value in utilizing e-catalogs in the MRO procurement process. Specifically it was estimated that the transaction cost could be reduced by 25% and the cycle time by 33%. Both the cycle time and the trans-
THE INTEGRITY of an organization’s data is at least as important as safeguarding traditional assets like cash.

action cost include all components of the transaction process from the initial need recognition to buyer satisfaction. We worked from data on existing costs, times, and inventories and from this estimated the potential effects based upon the expectation that WBPS would reduce errors, search, and input associated time and costs.

**Intangible factors.** We identified four categories of intangible factors: integrating with existing business processes, security, technology, and operations. Each of these areas can be judgmentally evaluated to assess benefits and costs, as a component of the intangible portion of the overall value (is it strongly supportive, strongly disruptive, neutral, or somewhere in between).

Most organizations have a significant investment in their existing (legacy) systems. Abandoning such systems is often simply not economically feasible. Therefore, any new system must make use of the major existing systems at least until they have hit the replacement point in their life cycle. The integration of the new systems with the legacy systems can entail various costs. Depending on the nature of the existing systems and the WBPS this cost may be significant or minimal. Also dependent upon the nature of the legacy systems is the degree to which the new environment must be adjusted to allow for the integration. Where the value of the existing system is high and the changes to the WBPS have little effect, there is no problem. It must be remembered that the legacy systems should not determine the capabilities of the new system or else you will be building a new system based on old standards.

The integrity of an organization’s data is at least as important as safeguarding traditional assets like cash. An electronic system that allows any user access to either data or other asset equivalents must be designed to reduce the chance of access misuse. WBPSs by their nature result in an increased security problems simply because they are open systems. Increased awareness of this factor is necessary and additional hardware/software is sure to be required to secure the firm’s data.

In our analysis we found that the existing infrastructure would provide a well-developed platform for the implementation of the application with a minimal amount of additional cost and organizational disruption. This will not be the case in all organizations.

Operational costs and benefits, aside from those tangible items previously discussed, involve the integration of the new processes and technology into the existing operation. This required examining the interaction of the procurement system with other processes and an assessment of the effects of any changes. We found little if any negative effect on other processes in our analysis and those most noticeable effects were positive. However this need not always be the case.

Critical success factors. In Table 1 we categorized those factors critical to the success of implementation of the WBPS and described the views of the interested parties (stakeholders), about each category. We considered the suppliers, the internal users of the systems, and the members in the purchasing unit. The table highlights those areas where a lack of agreement between user/purchasing/supplier might be detrimental to the success of the implementation of the WBPS. We evaluated eight factors and in only two cases, numbers four and five, were the goals of the parties in sufficient conflict to potentially threaten the success of the effort. In addition we found two other factors, numbers two and six, where there is the possibility of significant conflict. The problem is that in these cases the benefits associated with accomplishing the project goal may be apparent to only one party. To resolve the
problem, the benefits of achievement of the goal have to be made apparent to all players.

Table 1 documents the goal conflicts of the users for the critical success factors we identified. These are serious managerial issues to be resolved before the project can begin. For example, seeking supplier cooperation for a buyer-sited e-catalog seemed to be the most difficult issue; but in discussions with suppliers it was found that they were willing to trade information to become a member of a restricted set of suppliers. Restricting the set of suppliers in a buyer-sited e-catalog is necessary as a matter of practicality and effectiveness. The effort to maintain an e-catalog with every supplier in it would be enormous, and its effectiveness would diminish as the number of suppliers grows and as decisions become more difficult to make.

It became apparent that the internal perception of the project was the most critical of the CSFs. For the users to recognize the value of the e-catalog application to them, and hence willingly participate, the organization must make a concerted effort to measure and reflect the value for the user.

Managerial factors. The various factors—tangible, intangible, and CSF—are not independent of each other. For example, the analysis of the tangible items assumes that the majority of users move to the new environment. However, as seen in the CSFs, one of the problems is the possibility that users will not see the benefit of a move to the new environment. Thus it is important to address the transparency and incentives of the move. Accomplishing this is a managerial issue since it can be done in a number of ways and management must determine what best fits the organization. Often the managerial factors center on corporate culture issues.

Another managerial factor we found involves the users of the system. Depending on which individuals are responsible for using the system, there are differing levels of technological expertise. Requiring all employees to utilize the system could create a technology bottleneck, but limiting the use of the system to “experts” would reduce the level of experience available at the critical recognition of need phase. Management has to determine the correct level of use.

**Generalizing the Model**

In our analysis the move to a WBPS scored very well in the tangible factors and was also positive for the intangible factors. The CSFs showed several areas of concern. Related to that were several managerial factors that were also of concern. However, these problem factors were not of sufficient consequence to impede the move to a WBPS and given the forewarn-

![Figure 5. External and internal factors affecting organizations.](image)

- Search (ease of finding information);
- Data (amount of information available for exchange and the quality of it);
- Speed (how fast the transmission of the information occurs);
- Integration (how the e-catalog integrates internally, with legacy systems, and externally);
- Payment (the manner in which payment takes place); and
- Delivery (how the item is delivered, tracked, and recognized upon delivery).
There is no established formula to calculate a net value. The implementation of a WBPS need not require acting on all attribute areas at once, but it is worthwhile to remember that the benefits achieved are more than additive since the attributes are not independent. Therefore limiting one may have an adverse effect on others.

Our model, while simple, provides a methodology for evaluating the aspects of e-catalogs and many other forms of IT that are often ignored in traditional evaluations. The utilization of the model should pose no problem in most environments since it employs readily available information. Most large corporations today, and even educational institutions with a WBPS project, such as the University of Illinois, have recognized the inevitability of the move to the Internet and e-catalogs. Both the suppliers and customers are increasingly pushing for such a move. Many of these organizations have recognized that an early move on their part will allow them to have more control of the manner in which it is done and will be beneficial to the company.

We have identified a variety of problems and have shown how they can be addressed in an effective manner. Without first examining the situation, as was done in our analysis, the organization might have been surprised by the potential problems emerging, such as culture clash, supplier reluctance, system incompatibility, processing bottlenecks, security holes, hidden costs, and so forth. The sooner buyers choose to use e-catalogs, the more influence they will have on how they are used. However, the organization must first determine that their use is appropriate in their organization and market and that they have the structure and technology to make effective use of e-catalogs. 

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