

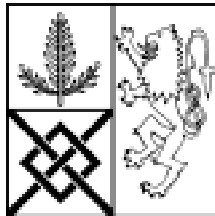
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**Moving Procurement Systems to the Internet:
The Adoption and Use of E-Procurement
Technology Models**

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Moving Procurement Systems to the Internet:
The Adoption and Use of E-Procurement Technology Models

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Abstract

This paper reports the results of a research project addressing the current state of e-procurement technologies. It analyzes which companies are moving fast into these technologies, how experimentation is taking place to learn about the business opportunities that may emerge through these technologies, the risks and benefits associated with them, and the expected evolution of e-procurement technologies in the near future. Predictions few years back indicated that e-procurement technologies would grow exponentially over the first half of the decade. However, these expectations have not been met. Current e-procurement technologies are in their developmental infancy and a dominant design is still unavailable. The results of our survey indicates that the final equilibrium may include several technologies, each one serving a different segment of the market. This multiplicity of solutions is likely to further delay the transition of the industry to its growth stage. Companies are approaching e-procurement technologies with very different strategies based upon the perceived risks and benefits associated with the technology and their competitive position and environment. We identify two main types of companies. The first type is moving aggressively to adopt e-procurement technologies, frequently experimenting with various solutions. The second type adopts a more conservative strategy by selectively experimenting, typically with one technology. This latter group relies on these limited experiences to provide the capabilities to move quickly into the technology as a dominant design emerges. The survey results suggest that e-procurement technologies will become an important part of supply chain management and that the rate of adoption will accelerate as aggressive adopters share their experiences and perceptions of low risk.

Moving Procurement Systems to the Internet:

The Adoption and Use of E-Procurement Technology Models

Online procurement (e-procurement) has been identified as the “... most important element of e-business operational excellence for large corporations.”¹ An e-procurement technology is defined as any technology designed to facilitate the acquisition of goods by a commercial or a government organization over the Internet. E-procurement technologies—including e-procurement software, B2B (business-to-business) auctions, B2B market exchanges, and purchasing consortia—are focused on automating workflows, consolidating and leveraging organizational spending power, and identifying new sourcing opportunities through the Internet. Future developments are expected to extend these technology models to create collaborative supply chain management tools.² Not surprisingly, e-procurement technologies have been credited with providing significant benefits to companies who adventure into them. These advantages include reducing administrative costs, shortening the order fulfillment cycle time, lowering inventory levels and the price paid for goods, and preparing organizations for increased technological collaboration and planning with business partners.³ The relevance of these advantages suggested a rapid migration from traditional to e-based procurement models. Accordingly, just a few years back market analysts predicted that Internet B2B transactions—a subset of e-procurement technologies—would increase from approximately \$600 billion in 2000 to over \$6.3 trillion by 2004.⁴

Unfortunately, this tremendous expected growth rate has been revised downwards. Recent market observations indicate that the adoption and integration of e-procurement technologies into the business mainstream is occurring at a much slower than expected pace. One reason is the implicit association that investors have made between e-procurement

technologies and the business-to-consumer (B2C) models responsible for the Internet bubble. More often, the slow down has been associated with technology-related issues. A 2001 study by the Conference Board points to problems in the implementation side and concludes that “organizations are ...finding (e-procurement) implementation more complex, more expensive, and more time consuming than they originally envisioned” and that consultants have been “widely criticized for overstating the business case for e-procurement.”⁵ Companies were jumping onto the e-procurement bandwagon without fully understanding the inter-organizational collaboration and network effects underlying these technology models, the investment required to move the right information from suppliers to employees, and the complexities of integrating these technologies with existing Enterprise Resource Planning systems.⁶

In this paper we present the results of a research project undertaken to map current practices of e-procurement technologies, understand the drivers—benefits and risks—of their adoption, and project the expected evolution of these technologies in the near future. The findings are based on a survey administered to North American companies supplemented by extensive discussions with industry experts and purchasing managers who are using e-procurement technologies.

The analysis indicates that the slower-than-predicted growth is not the consequence of a single problem. Rather, e-procurement technologies are still in their early stages of the traditional technology S-curve, in which alternative technology models are rapidly evolving and users are still sorting out the winning model. This process is particularly complex because the final outcome may well be that different market segments will adopt different technology solutions. Because a well-defined business process is still unavailable, companies are using

different strategies to approach these technologies. Some companies—aggressive adopters—are investing significant resources to experiment with alternative solutions with the expectation of identifying the technological winner and translating this leadership position into competitive advantage. Other companies—conservative adopters—are taking a “wait and see” approach. These companies are investing selectively in a reduced set of technology alternatives with the expectation of learning enough to be ready to move as soon as a winner emerges. Regardless of the current strategy of a company, the overall consensus is that e-procurement technologies will become an important management tool to enhance the performance of supply chains. The current focus on indirect goods as a way of experimenting with the technology is expected to evolve into procurement processes that facilitate inventory management and the purchase of capital goods.

The actual benefits and risks of e-procurement technologies and managers’ evolving perceptions about these benefits and risks will determine the speed at which the technology moves from its developmental infancy to the adoption and maturity stages. However, the perceived risks that are holding back companies from investing in e-procurement technologies are numerous. In addition to technology-related risks, there are risks associated with the integration of these technologies with existing information systems, with the business model that these technologies impose on supplier-customer relations, and with the security and control mechanisms required to insure their appropriate use.

The evidence presented in this paper should enable finance, accounting, information technology, purchasing, and top managers to better prepare and plan for the future of e-procurement technologies in their organizations. After briefly outlining the research process in section 2, the paper maps the current state of e-procurement technologies in section 3 by

describing the positioning of the various technologies in the different market segments and by developing a typology of e-procurement technology adoption strategies. Next, it describes in section 4 how companies are experimenting and learning about these technologies. Section 5 quantifies the economics of e-procurement technology through expected investments and savings, and elaborates qualitatively on the benefits and risks associated with them. The conclusion provides a summary of the current state of e-procurement technologies and expectations for future adoption.

The four specific models of e-procurement technologies examined in this paper (defined in Table 1) are e-procurement software, market exchanges, B2B auctions, and purchasing consortia.

Insert Table 1 around here

2. Research method

The data for this research project comes from 168 responses to a questionnaire designed to map the current state of e-procurement technologies. To design the questionnaire we conducted a careful literature review of e-procurement technologies, with special attention to previous surveys on the topic.⁷ We then talked to numerous managers, both users and suppliers, involved in e-procurement. These interviews were used to make sure that the questionnaire addressed the most relevant issues in e-procurement technology; they also allowed us to pre-test the questionnaire design. A panel of industry experts revised the final version of the questionnaire before it was sent out. The final questionnaire design is, to our knowledge, the most comprehensive data collection instrument developed on e-procurement

technologies to date. Given our objective of developing a comprehensive database, we traded off brevity in favor of thoroughness.

The database includes 168 organizations in North America, mostly for-profit corporations representing a variety of industries, including mining, traditional and high technology manufacturing, food processing, transportation, and telecommunications. The sample also captures nonprofit organizations, including universities, federal government agencies, and state agencies. The organizations range from large multinational companies with annual sales of \$55 billion to smaller regional organizations with revenues of \$10 million. Sample companies had a median (mean) of 2,500 (8,088) employees.⁸ The organizations that participated in the study were clients of 14 major financial institutions that cooperated in selecting participants.⁹ The data was collected using mail survey research procedures during the last quarter of 2000 and first quarter of 2001.¹⁰ The questionnaire was 35 pages long and took over 120 minutes to complete, longer than the typical questionnaire. We took this atypical research design decision to obtain maximum detail from the respondents even at the expense of lowering the response rate. The response rate was 7%. The length of the questionnaire and the difficulty of identifying the appropriate manager in each firm¹¹ account for this response rate. Follow up investigation revealed that a large percentage of non-respondents did not use e-procurement technologies, thus the bias in the respondents is towards companies that are using e-procurement technologies.

Out of the total 168 respondents, 86 (51%) report having purchased some kind of e-procurement technology. Most of these organizations are for-profit companies. The average number of employees for the organizations that have already incorporated some kind of e-procurement technology to their procurement processes is 12,627, suggesting that larger

organizations—probably the ones that expect larger payoffs from e-procurement technology—are earlier adopters of these technologies. The approximate annual spending on goods and services purchased is \$2.5 billion and \$1.6 billion for for-profit and nonprofit organizations, respectively.

3. Adoption of e-procurement technologies: a map

The results from the survey indicate that e-procurement technologies are still in their early stages of development—the almost flat, first stage of the technology S-curve, in which different technological solutions compete to solve different business needs before a dominant design(s) emerges.¹² Once a technology becomes the dominant design, the industry moves to the rapid growth stage until it reaches the maturity stage, when most organizations have adopted the technology and the slope of the technology penetration flattens out.^{13, 14}

Most respondents using e-procurement technologies are relatively new to e-procurement; only 34% have been involved in any e-procurement technology-related initiative for a year or more. The low adoption rate has also constrained e-procurement technologies users from leveraging the associated capabilities with their suppliers. Users of e-procurement technologies report that they can acquire goods over the Internet from only 15% of their supply base. E-procurement software—designed to simplify the buying process for company employees through approved supplier electronic catalogs—has gained the most acceptance (25%) and is expected to maintain this dominance in the near future. Internet purchasing consortia, a more recent technology, though showing modest adoption at this time (3%), is expected to increase its market share nearly four-fold in the near future.

Over 61% of organizations that had purchased e-procurement software are corporations; of those, 71% are Fortune 500 size. Corporations also dominated B2B e-auction activity: three quarters of users are corporations with average annual sales above \$11 billion. In contrast, nonprofit organizations are primary users of market exchanges and purchasing consortia—62% of market exchange and 61% of purchasing consortia users are nonprofit organizations. The initiatives to reduce federal government spending by streamlining its administrative operations, which began under the Clinton administration and which had a significant emphasis on procurement practices,¹⁵ may explain the relatively high involvement of nonprofit organizations in market exchanges and purchasing consortia.

These observations indicate a probable evolution towards a segmented market, in which e-procurement software and B2B auctions are better suited to the needs of large corporations, while market exchanges and purchasing consortia better serve the needs of smaller companies and nonprofits. The likelihood that various dominant designs will emerge to satisfy the needs of different market segments may also add to the complexity of transitioning to the growth stage. The question would then be what e-procurement technologies are better suited to the needs of a particular segment. The relevant question for organizations would thus be: which market segment is it in, rather than which e-procurement technologies will dominate the industry.

Current adoption strategies

Table 2 describes the various strategies that companies are adopting towards e-procurement technologies. The majority (70%) are taking a “wait and see” approach. These companies are either aware of the developments, but are not committing resources (37%), or

investing selectively until the best e-procurement model can be identified (33%). These companies do not perceive that the current state of development merits shifting their established procurement processes to the e-world. Nevertheless, they are closely following the developments of these technologies, acknowledging the perceived relevance of these technologies to their future and investing enough to understand them and gauge their maturity until the industry moves to the growth stage. These companies are conducting some level of business transactions with suppliers through the Internet or plan to do so over the next twelve months. These “experiments” may be small in dollar value, but they are widespread. The strategy reflects active experimentation but no sizeable investments until the best e-procurement model is defined.

Insert Table 2 around here

A smaller set of companies (4%) is adopting a more passive strategy of observation without experimentation. The adequacy (and risk) of this strategy will depend on how quickly organizational learning can absorb these e-procurement technologies without creating the “absorptive capacities” that the wait-and-see companies seem to be developing.¹⁶

Still, a moderate number of organizations (27%) are taking an aggressive strategy towards e-procurement technology adoption—declaring that they are “investing significantly to gain a competitive lead” (3%) or moving “fast into e-procurement” solutions (24%). While this strategy may be interpreted as riskier—in that a well-defined solution does not exist and these companies may end up betting on the wrong technology—they expect to obtain significant returns from being first movers. The relevance of e-procurement to these organizations is further reflected in the fact that 41% of them use more than one e-procurement technology (only 7% of others do the same) and over two-thirds indicate that their company

“wants to be the leading company in its industry implementing e-procurement even if the effort may not translate into profits quickly” and that “the company is responding rapidly to changes and early signals in e-procurement.”¹⁷

A further result highlights the competitive dynamics of responding organizations. One-third of all respondents believe that at least 40% of their competitors are implementing or have plans to implement an e-procurement strategy. Among organizations pursuing an aggressive strategy, over 50% believe that their competitors are doing the same. Thus, it appears that organizational belief that competitors are moving on e-procurement is an important motivator to organizational response.

Who are the aggressive adopters?

To contrast companies with an aggressive adoption strategy with their more conservative counterparts, we analyzed their relative competitive position in terms of customer service, product features, brand image, product quality, new product development, and product selling price. Conservative organizations had an aggressiveness score of less than 4 on Table 2. Table 3 reveals that organizations with an aggressive strategy identify themselves as being in better competitive position on all factors, and significantly better in terms of customer service, brand image, product development, product quality, and product features.

Insert Table 3 around here

We also contrasted organizations with aggressive and conservative adoption strategies in terms of environmental predictability—including legal and political developments, behaviors and strategies of suppliers, economics of the business, requirements of customers, actions and strategies of competitors, product design and features, and technology

developments. Organizations with aggressive adoption strategies perceive most market factors as more predictable than their conservative counterparts. In particular, organizations with aggressive strategies identify significantly greater predictability about the “actions and strategies of competitors” and “product design and features.”

Overall, organizations with aggressive strategies seem better positioned in the market and in more predictable market environments. While the cross-sectional nature of the study does not allow us to determine whether a more attractive competitive position leads to more experimentation or, alternatively, whether more experimentation enhances the competitive position, the results indicate that an association between competitive position and experimentation exists.

To summarize the current state of e-procurement technologies adoption, the findings describe a technology in its early stages of development in which a dominant design is still not defined and positioned prior to the steep growth rate that comes with the emergence of a dominant design. Companies are mostly experimenting on a small scale, adopting a “wait and see” strategy, but ready to move fast as technology and business uncertainties are resolved.

4. Current experiences and future implementation of e-procurement technologies

E-procurement technologies are expected to offer the greatest long-run benefit to organizations through their application to the supply chain. However, moving these technologies to core business processes—such as inventory and capital goods acquisition—is a challenging proposition. Existing legacy systems are built around these processes and e-procurement technologies would need to be integrated with production-related systems such as Materials Requirement Systems (MRP), bills of materials, scheduling, inventory, costing systems, and performance reporting systems. E-procurement technologies would also need to

“talk” to suppliers’ systems to automate the ordering process, and to customers’ systems to ease the functioning of the supply chain. Such an endeavor is costly not only in terms of money invested, but also in terms of time to implement the e-procurement technologies; most important, it is costly in terms of the risks involved in applying an uncertain technology to core business processes. Adopting a losing technology may mean not only losing the resources invested in implementing it, but also higher operating costs (rather than the promised savings) and, at some point in the future, a further transition to the appropriate e-procurement technologies.

As a consequence, companies are experimenting with e-procurement technologies in peripheral business processes. In particular, the survey results indicate that this experimentation is taking place with non-production goods and services as a way to learn without risking the integrity of the main supply chain. However, until e-procurement technologies are integrated into the main enterprise software systems of companies, they are in danger of being considered an expensive solution for controlling purchasing activities that relate to a small percentage of organizational spending. The benefits that they are expected to bring to the procurement process are only maximized if these technologies move to the main business processes where the big saving are expected to accrue. Additionally, if e-procurement technologies remain confined to indirect purchases, they become a sideways competitor to tools and solutions such as purchasing cards, which have a ten-year history of facilitating low value purchases and providing organizations with essential data about those purchases.¹⁸

Table 4 identifies the types of goods and services currently acquired through e-procurement technologies. It plots the current and projected percent of organizations using these technologies to purchase the various types of goods.

Insert Table 4 around here

Table 4 reveals that organizations are primarily using e-procurement technologies to acquire non-core supplies, including (1) office products, (2) computer and related equipment, and (3) MRO (maintenance, repair, and operating expenses). Inventory, services, and capital goods—the categories through which e-procurement technology is expected to deliver significant savings¹⁹—have a rate of adoption below 15%. However, large increases in adoption are expected in these three categories. Two years out, the percentage of organizations that expect to use e-procurement technology to acquire capital goods will go from 6% (today) to 23%, from 9% to 24% for inventory, and from 15% to 40% for services. In contrast, smaller increases are expected in the percent of organizations acquiring non-core products (MRO, office products, and computer-related equipment), although these percentages also enjoy significant growth. The outlook two years out suggests that most companies will adopt a learning mode and will primarily use the technologies to purchase non-critical secondary goods. However, the respondents indicate a likely trend towards integrating these technologies into core business processes as more companies use them to purchase inventory and capital goods.

The current application of e-procurement technologies reinforces the idea that these technologies are still in the experimentation mode. Growth is expected over the next two years, but the uncertainty surrounding e-procurement technologies indicates that organizations are being cautious about how much business processes and what types of purchases will move to these technologies. Companies are learning about them through low-risk supply processes and are managing the larger, more complex supply chains using more traditional management systems. To reinforce the analysis, we also examined e-procurement enabled spending in

dollar terms today as well as two years out. Four important patterns fully consistent with the previous conclusions emerge.

- Current e-procurement technologies have only modestly penetrated organizational spending activities—about 2% of total monthly spending has been shifted to new purchasing technologies.
- Two years out, e-procurement technologies are expected to significantly increase their importance in facilitating the procurement process. E-procurement enabled spending is expected to increase by 433%, and to grow, as a percent of organizational spending, from 2% to 11% of total purchases.
- E-procurement software enjoys the largest penetration, followed by market exchanges, B2B auctions, and purchasing consortia.
- The projected growth rate differs across technologies with purchasing consortia having the largest expected growth, followed by auctions, e-procurement software, and market exchanges. However, in dollar terms, purchasing consortia is the smallest e-procurement technologies category. E-procurement spending is predominately routed through e-procurement software.

To further sketch in the map of current experiences of e-procurement technology users, we asked respondents to describe the type of interactions with buyers and suppliers that happened through these technologies. The primary use was to place orders and track existing shipments. Higher level trading partner integration such as providing suppliers with Internet or Intranet access to company internal data, or integrating suppliers' applications with company information systems, is still uncommon.²⁰ This observation reinforces the prudence that

companies exhibit by integrating e-procurement technologies into existing systems and relationships before uncertainties are reduced.

5. Economics of e-procurement technologies, benefits and risks

Investment and expected payback from e-procurement technologies

Another important aspect of e-procurement technologies is the economics of implementing them. In this section, we quantify the economics of e-procurement technologies through expected investment and savings. Our survey results indicate that the upfront investment required varies significantly by type of technology employed. Users of the most popular technology—e-procurement software—reported a mean initial investment (including software price, consulting charges, implementation fees, etc.) of \$5.4 million and a median of \$1 million. The initial investment required of B2B auctions, market exchanges, and purchasing consortia are relatively minimal (less than \$125,000) if the company simply uses an existing network; however, some industries (e. g., energy industry consortia) require unique features to support these technologies and the investments become substantially higher (\$1 to \$6 million).

E-procurement software requires larger investments than alternative e-procurement technologies, a fact that probably explains why large corporations are the main adopters of this technology. The variation in the upfront investment may partly account for the association previously identified between various e-procurement technologies and different market segments. More expensive e-procurement technologies (like e-procurement software) may be better suited for organizations with large supply chains that expect larger savings from improving these processes, but not for smaller companies that do not have the scale to justify

such a large investment. In contrast, these companies may benefit from cheaper e-procurement technologies.

We also examined the savings that companies expected from adopting e-procurement technologies. These savings, together with the investment required in e-procurement technologies, translate into a mean and median payback period of two years in any of the four technologies contemplated, a significant time increase from earlier expectations.²¹

Benefits associated with e-procurement technologies

This section elaborates qualitatively on the benefits that accrue from adopting e-procurement technologies. These benefits are expected to accelerate the rate of adoption of these technologies once the uncertainties that remain are reduced to levels that encourage significant resource commitments.

Companies that use e-procurement technologies report savings of 42% in purchasing transaction costs. This cost reduction is associated with less paperwork, which translates into fewer mistakes and a more efficient purchasing process. The simplification of the purchasing process that e-procurement technologies are credited with also has a favorable impact on the purchasing cycle time. While not directly quantifiable into dollars, faster cycle time provides increased flexibility and more up-to-date information at the time of placing a purchasing order. E-procurement technologies users also report a reduction in the number of suppliers—with the associated cost benefits of lower managerial complexity, lower prices, and a headcount reduction in the purchasing process. Table 5 reports these results.

Insert Table 5 around here

Figure 1 provides some examples of responses to an open-ended question on the drivers of e-procurement technology adoption. It shows that cost savings is the primary rationale for investment across all technology platforms, though the manner in which these savings are delivered varies. For example, organizations expect cost reductions from e-procurement software to be derived from the additional control over maverick spending (purchases of goods from suppliers with which the organization does not have a formal relationship and negotiated prices based on volumes) and the beneficial effect associated with the additional purchase-related information inherent in that technology. By contrast, the source of savings in B2B auctions comes from accessing a broader base of suppliers bidding for the buying needs of the organization, thus obtaining better prices, better quality, or both. Purchasing consortia users said that the savings derived from joining bargaining power would translate into more aggressive discounts for members of the consortia. The logic behind cost savings for market exchange participation appears muddled, portending perhaps the collapse of many exchanges in mid 2001.²²

Insert Figure 1 around here

Risks associated with e-procurement technologies

The results of this research project show a promising set of technologies that still has not resolved how each set will address the needs of various market segments, nor which dominant design(s) will lead the technologies to their rapid adoption. In addition, respondents perceive certain risks linked to the adoption of e-procurement technologies that need to be addressed before these technologies are widely accepted. These risks include:

- *Internal business risks:* companies are uncertain about whether they have the appropriate resources to successfully implement an e-procurement solution. The experimentation of the companies following a “wait and see” strategy may help to develop the required absorptive capacities. Implementing an e-procurement solution requires not only that the system itself successfully performs the purchasing process, but most important, that it integrates with the existing information infrastructure. This internal information infrastructure includes systems such as accounting, human resources, asset management, inventory management, accounts payable, production planning, and cash management systems. Most organizations adopting or looking to adopt e-procurement software already have significant investments in these other systems; integrating these new technologies with existing platforms should happen as smoothly as possible. Failure to integrate creates duplicative work steps and jeopardizes the reliability of organizational information.
- *External business risks:* e-procurement solutions need to not only “talk” with internal information systems, but also need to cooperate with external constituencies—mainly customers and suppliers. External constituencies need to develop internal systems that facilitate the communication through electronic means—an issue that demands technology investments as well as incentives for these constituencies. For e-procurement technologies to succeed, suppliers must be accessible via the Internet and must provide sufficient catalog choices to satisfy the requirements of their customers. Ideally, suppliers will provide e-catalogs in the formats required by customers, reflecting custom pricing and/or special contractual agreements, and will send updates on a regular basis. However, suppliers, especially in low margin industries, may be

hesitant or even unable to meet such demands without guarantees of future revenue streams. Lack of a critical mass of suppliers accessible through the organization's e-procurement system would limit the network effects that underlie these technologies, further hindering the acceptance and adoption of the technology. Cooperation with external parties also requires new suppliers and customers to meet the business criteria that organizations have set to accept them in their networks. Since some of the business models associated with e-procurement technologies (e.g., auctions, consortia, and exchanges) clearly envision the use of suppliers with whom the buyer has not previously transacted business, companies need to develop mechanisms that provide the buyer with assurances that the supplier meets or exceeds recognizable and industry enforced standards relating to supplier quality, service, and delivery capabilities.

- *Technology risks*: companies also fear the lack of a widely accepted standard and a clear understanding of which e-procurement technologies best suit the needs of each company. The lack of a widely accepted solution blocks the integration of different e-procurement software across the supply chain. The significance of this risk factor seems to suggest the need for clear and open standards that would facilitate inter-organization e-procurement technologies. Without widely accepted standards for coding, technical, and process specifications, e-procurement technology adoption will be slow and will fail to deliver much of the benefits expected.
- *E-procurement process risks*: another set of risks has to do with the security and control of the e-procurement process itself. Organizations must be confident, for example, that unauthorized actions will not disrupt production or other supply chain activities when committing to e-procurement technologies.

Thus, the challenge for the e-procurement technology adoption is to provide evidence to non-users that these technologies (1) do not undermine control, security, or privacy requirements; (2) they are not so technically complex that organizations without a sufficient technology skill set cannot use them, and (3) the new business model provides the right incentives to supply chain constituencies to effectively use these technologies.

We compared the risk perceptions of companies following different adoption strategies. Our expectation was that companies following a more aggressive strategy would have better information about the significance of the various risks and, accordingly, a different perception about their importance. Table 6 summarizes the results.

Insert Table 6 around here

In most cases, conservative adopters perceive risks to be more significant than aggressive adopters. If we accept that the information prior to adopting e-procurement technologies and the risk profile of various companies is comparable, then the differences reported in Table 7 suggest that slow adopters may be too cautious about the significance of these risks.

We further analyzed open-ended statements disclosing additional risks. Figure 2 indicates that conservative adopters are more apt to believe that it is premature to make a significant investment in e-procurement technology. The reasons for their belief include concerns over the potential for escalating costs relating to support of the technology (i.e., e-procurement investment estimates could be severely underestimated, not unlike what many organizations experienced with Enterprise Resource Planning), the risk of acquiring an e-procurement solution that will not survive in the market (betting on the wrong technology), or questions about whether the organization’s use of the technology will be sufficient to generate

the benefits necessary to justify the investment. Other concerns (e.g., supplier participation, integration with existing systems) are similar to those held by organizations with an aggressive adoption strategy.

Insert Figure 2 around here

Figure 3 adopts a different perspective on the factors that may limit the adoption of E-procurement technologies. It presents the three barriers most frequently identified as limiting the utilization of the four e-procurement technologies contemplated in the paper.

Insert Figure 3 around here

Figure 3 identifies the changes in the buyer-supplier relationship as a major barriers to e-procurement technology use. While technology is perceived as a barrier, reflected in the “lack of common standards” concerns for e-procurement software, most barriers point to the need for redesigning these relationships. If, for example, the use of e-procurement undermines amicable trading relationships, buyers are concerned about how they will obtain needed goods when supplies get tight. Buyers are also concerned that these technologies will push prices down to the point where suppliers cannot invest in new technology or product development, upgrade facilities, or add additional productive capacity. Additional price pressures can even push suppliers with a poor understanding of their cost structure out of business. Finally, integration with existing mechanisms is seen as another barrier.

7. Conclusions and recommendations

E-procurement technologies have been the subject of much discussion and great expectation. The market has been disappointed with what e-procurement models have

delivered to date. Nevertheless, in most cases, these technologies present attractive value propositions for greater organizational efficiency and reduced costs and cycle times. Nothing in our analysis indicates that the apparently inexorable shift in business communications toward the Internet is grinding to a halt. However, the report does provide evidence that organizational participation, investment, and use of e-procurement technologies is occurring at slower pace than the market expected.

E-procurement technology and its applications are still in their infancy and going through growing pains not uncommon to new technologies and changing initiatives. Aggressive adopters are moving steadily into these technologies and the future outlook indicates that their importance will grow as companies move from experimenting to fully adopting e-procurement technologies. The quantifiable savings as well as the qualitative benefits associated with these technologies indicate that the rate of adoption will accelerate as aggressive adopters share their positive experiences regarding perceived technology and business risks.

The overall respondent perception is that e-procurement technologies will become an important element in the management of supply chains. Except for a small group of companies that have chosen to sit on the side and let others experiment, organizations are actively involved in these technologies. Most organizations are participating with small investments that allow them to be aware of developments and develop the required capabilities to move into these technologies. These experiments with e-procurement technologies are run on non-core supply processes such as office supplies and computers. A selected group, however, is investing heavily in e-procurement technologies with the expectation of deriving the promised

benefits ahead of their competitors. These aggressive adopters are companies that enjoy a better competitive position.

The economically determined selection process at this early stage suggests that the outcome may not be a single dominant design but a set of technological solutions that vary across market segments. Thus, companies planning to move their core supply processes to an e-procurement solution should carefully weight the economics of the various e-procurement technologies. A scaled down version of the best solution for a large organization may not be the best technology for a smaller company.

E-procurement technologies are still perceived to involve significant risks. From a technology point of view, the lack of an overall accepted standard is holding back a sizeable number of companies from adopting technologies. These companies fear buying into a “closed” technology that cannot communicate with other technologies and thus limits access to a broader network of supply chain constituencies. But the risks are not limited to technology, they also involve the business model that will emerge to support e-procurement technologies. These technologies will redefine the supplier-customer relationship—who can be a supplier, who pays for the investment required to access the technology, what information gets shared. The success of some e-procurement technologies relies on network effects that appear only if enough players adopt these technologies. Finally, there are risks that bridge business and technology, including security and control systems that will insure the reliability of e-procurement technologies. The good news is that companies that have aggressively moved into these technologies perceive these risks to be lower than companies that have adopted a “wait and see” approach. If this lower risk perception is related to their experience with e-

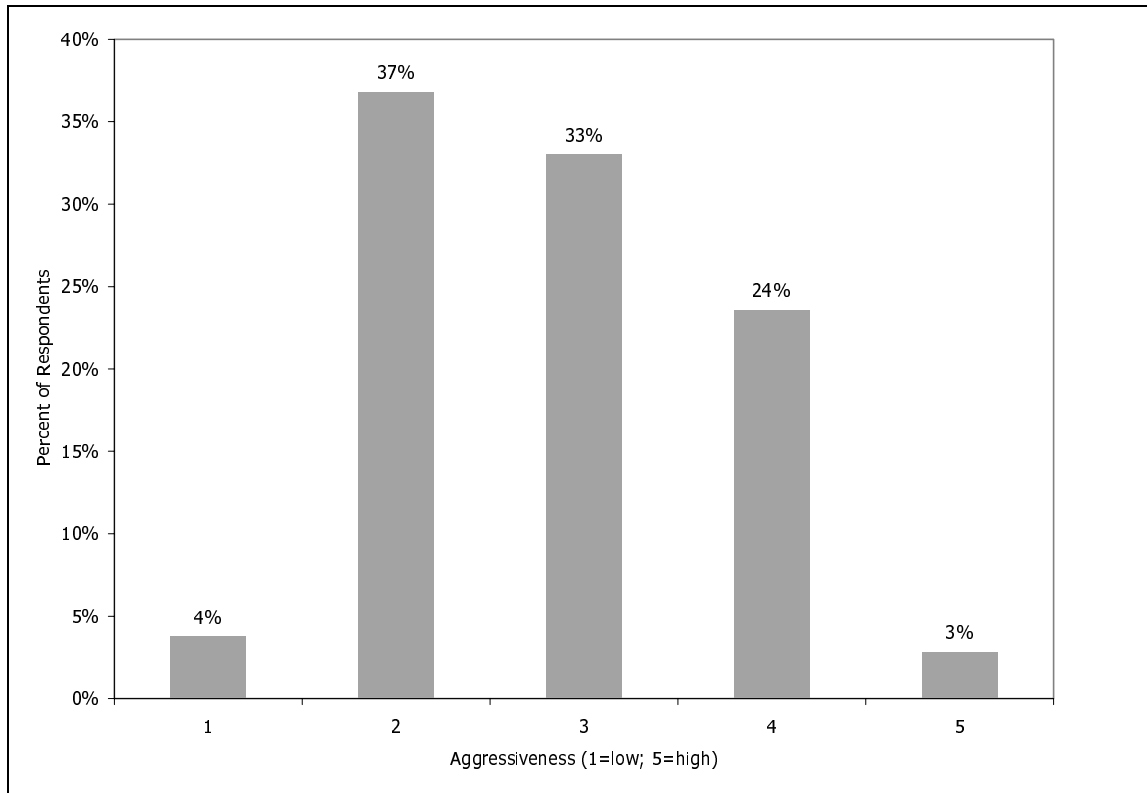
procurement technologies, the cost that slower adopters perceive may be over-estimated and will come down as aggressive adopters share their experiences.

In summary, the results of the survey provide a comprehensive picture of the current state of e-procurement technologies. The results should be assessed in light of the fast-paced technological changes in the marketplace and the volatile history and hype that have recently accompanied emerging Internet-based business applications such as e-procurement.

Table 1. E-Procurement Model Definitions

E-Procurement Model	Description
<i>E-procurement software</i>	Any Internet-based software application that enables employees to purchase goods from approved electronic catalogs in accordance with company buying rules, while capturing necessary purchasing data in the process. The employee's selection of a good for purchase from a supplier catalog is automatically routed through the necessary approval processes and protocols. E-procurement software investment may take several forms, including purchase of a software package from a third party technology provider (e.g., Ariba, CommerceOne), use of an e-procurement system embedded in an Internet market exchange, subscription to e-procurement software hosted and supported by an application service provider (ASP), or development of a proprietary in-house system.
<i>Internet market exchanges</i>	Web sites that bring multiple buyers and sellers together in one central virtual market space and enable them to buy and sell from each other at a dynamic price that is determined in accordance with the rules of the exchanges.
<i>Internet B2B auctions</i>	Internet B2B auctions are events in which multiple buyers place bids to acquire goods or services at an Internet site. There are a variety of e-auction formats. The two most popular auction formats are the Dutch auction (where the sellers control the minimum bid and prices move upward from the minimum bid) and the reverse auction (where buyers post "requests for quotations" and sellers bid the price down). A major benefit of auctions is that they enable organizational buyers to identify the best offer from an expanded base of potential suppliers from around the world. Sellers benefit by obtaining access to bid for business on a level playing field rather than attempting to obtain business based on networks of personal relationships. Auctions also provide sellers a ready market for the anonymous sale of excess inventory. Web sites such as freemarkets.com, purchasepro.com, fastparts.com, and sorcity.com, among others, can enable the e-auction process.
<i>Internet purchasing consortia</i>	Internet service that gathers the purchasing power of many buyers to negotiate more aggressive discounts. Some organizations aggregate buying power for manufacturing inputs (such as FOB.com), while others perform similar functions for indirect goods (such as BizBuyer.com).

Table 2: Adoption Strategies of E-Procurement Technologies*



* Table reflects respondent strategy as follows:

- 1= Leave the learning cost to others and then invest.
- 2= Aware of developments in e-procurement, but do not commit major resources.
- 3= Invest selectively until the best e-procurement model for our company can be identified.
- 4= Move fast into e-procurement.
- 5= Invest heavily to gain a competitive lead in the field.

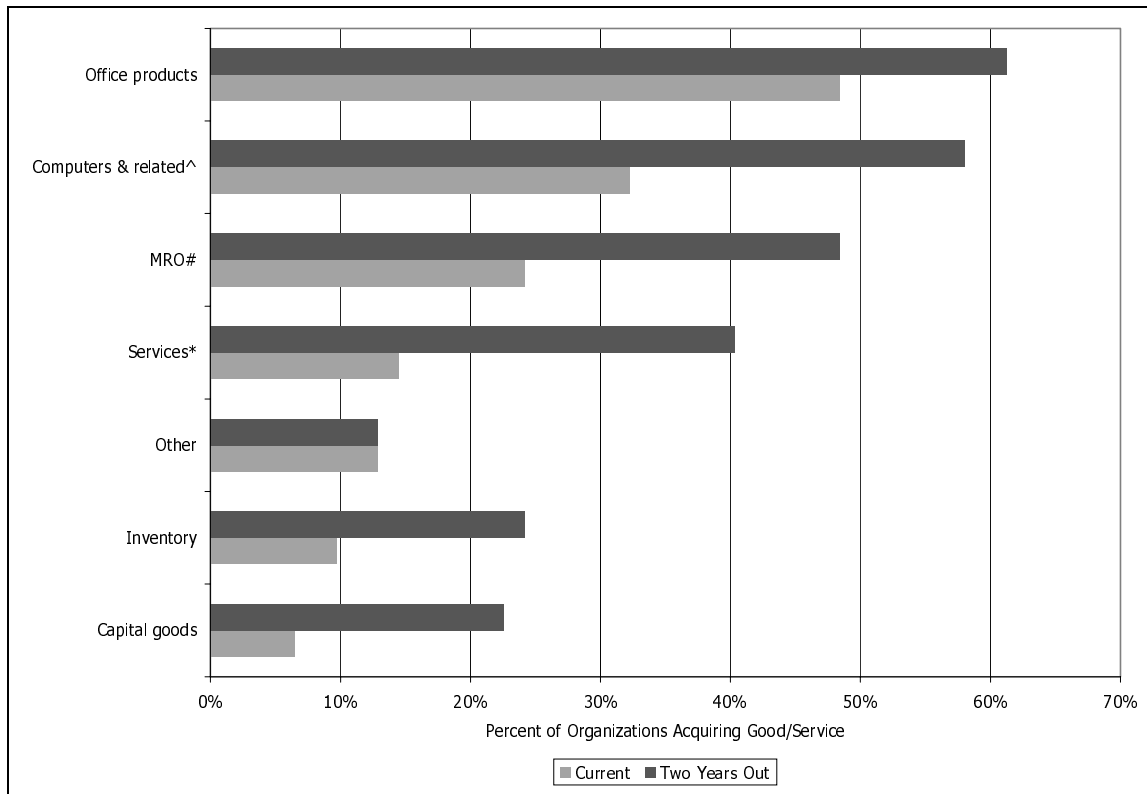
Table 3: Competitive Position by Organizational E-Procurement Adoption Strategy

Entity's Competitive Position Relative to Market [#]	Aggressive Adoption Strategy	Conservative Adoption Strategy	Difference
Product selling price	4.32	4.09	.23.
New product development	5.21	4.82	.39*
Product quality	5.89	5.28	.61**
Brand image	5.68	5.23	.45*
Product features	5.50	4.97	.53**
Customer service	5.61	5.22	.39*

Higher scores indicate better competitive position. On 1-7 scale; 1=significantly lower, 7=significantly higher.

* p < .15; ** p < .10; *** p < .05, **** p<.01.

Table 4: Current and Projected Percent of Organizations Purchasing Selected Goods/Services Through E-procurement Technologies



^ Including hardware and peripherals.

Maintenance, repair, and operating supplies (e.g., maintenance, shop, lab supplies; electrical mechanical; and electronic components, etc.).

* Including contract or professional services, mail, delivery, travel, rental payments, etc..

Table 5: Efficiencies Generated from the Adoption of E-procurement Technologies

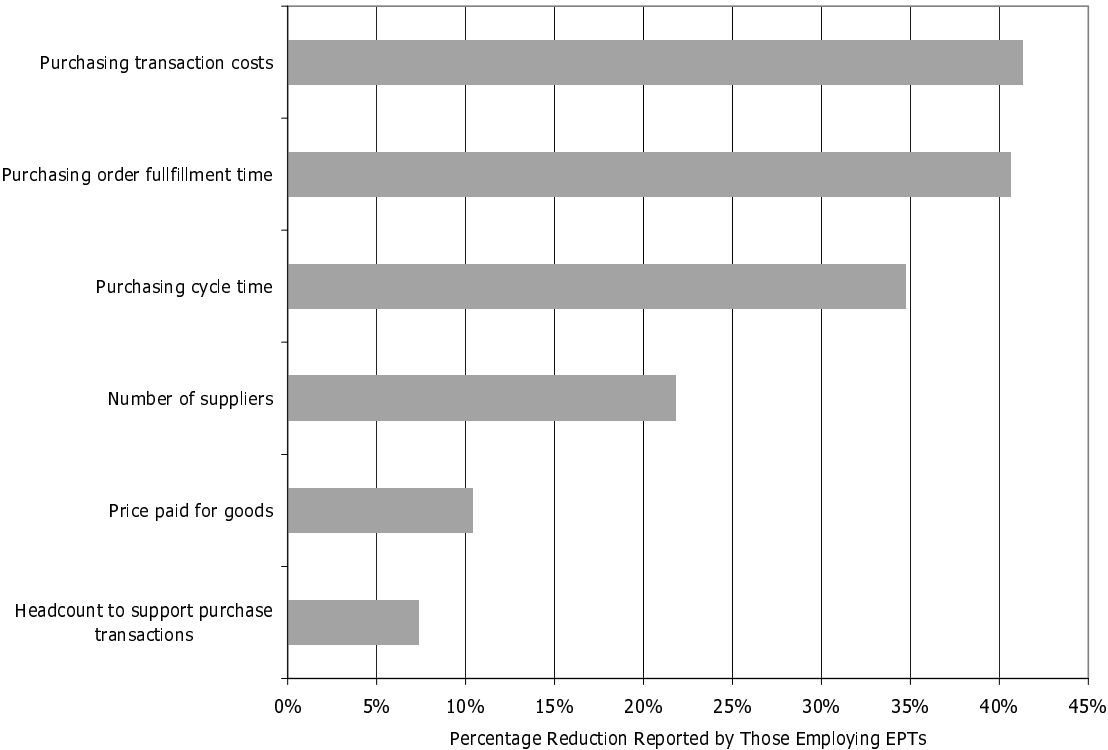


Table 6: Difference in Risk Perceptions by E-Procurement Technology Adoption Strategy

Business Risk Category/ Item Description#	Aggressive Adoption Strategy	Conservative Adoption Strategy	Diff.
Supplier Relationships			
Dealing with anonymous vendors that our company has not “vetted” against quality, service, and delivery standards.	4.05	4.87	-.82***
Downward price pressure on vendors creating quality issues.	3.82	4.33	-.51**
Downward price pressure on vendors resulting in diminished customer service.	3.77	4.35	-.58***
Technology and Control Risk			
Reluctance within our organization to allow intermediaries (e.g., Ariba, CommerceOne, FreeMarkets, etc.) to become a part of existing purchasing processes.	3.55	4.22	-.77***
E-procurement will provide opportunities for hackers to paralyze company operations.	3.14	4.02	-.89***
Potential loss of proprietary and confidential information.	3.41	4.10	-.69**
Proprietary and confidential purchasing data will end up in competitors hands.	2.91	3.49	-.58**
Lack of faith in transaction and data <i>integrity</i> .	3.45	3.94	-.49*
Lack of faith in transaction and data <i>security</i> .	3.65	4.02	-.37
Potential loss of control and segregation of duties.	3.14	3.55	-.41*
Difficulty integrating e-procurement solutions with legacy/ERP information systems.	5.41	4.93	.48*
Cost/Benefit Concern			
It would be too expensive to move to procurement to the Internet.	2.45	3.46	-1.01****
Expenses far exceed benefits of moving to Internet procurement.	2.36	3.47	-1.11****
Organizational Skill Set			
General lack of awareness as to which solution(s) best meet your company’s needs.	3.68	4.85	-1.17****
A lack of organizational readiness (supporting processes, IT capabilities, skills “gaps”).	3.73	4.75	-1.02****
Organizational Culture			
The belief that e-procurement is merely the “flavor of the month” and will soon be obsolete.	1.86	2.84	-.98****
A lack of enthusiasm for e-procurement among company officials and/or key stakeholders.	2.64	4.18	-1.55****

Higher scores indicate perception of higher risk. On 1-7 scale; 1=no risk, 7=very high risk.

* p < .15; ** p < .10; *** p < .05, ****p<.01.

Figure 1. Customer Reports on Drivers of E-procurement Technologies Investment

In the words of customers – the “most significant factor driving your company’s purchasing activities to your....

...e-procurement software.”

“Reductions in transaction costs...(and) maverick spending.” --Director of Supply Management, major building products manufacturer.

“Capture more strategic sourcing information in a consolidated fashion.”--E-Sourcing Leader, Fortune 500 manufacturer.

“Resource reductions enabled by e-procurement.”--Manager, Fortune 500 chemical manufacturing company.

“Belief that Internet procurement will enable significant supply chain efficiencies.”--Director of E-Procurement Programs, electric utility company.

...market exchanges.”

“Time and cost savings.”--Manager of Corporate Purchasing Services, major distributor of computer and electronic components.

“The ability to possibly better leverage purchases and gain administrative efficiencies in transactions.”--Director of E-Procurement, Fortune 500 building products manufacturer.

“Reduce transaction costs.”--Director of Materials Management, major county in Western state.

...B2B auction purchasing activity.”

“Price visibility and process efficiencies.”--Procurement Manager, major grocery chain.

“Unit cost savings.”--Purchasing Manager, Fortune 500 chemical manufacturer.

“Gain access to world market.”--Director of Materials Management, Fortune 500 auto parts manufacturer.

“Cost avoidance and cost savings.”--Senior Procurement Executive, federal government agency.

....purchasing consortia activity.”

“Expected savings through aggregated spending opportunities.”-- Manager of Materials Planning, major energy corporation.

“Ability to leverage procurement volumes and spend.”--Manager of Global Procurement, Fortune 500 oil and gas producer.

“Overall less time spent locating products and services.”--Electronic Government Manager, county government.

Figure 2. Representative Comments That Distinguish Perceptions of Other E-Procurement Risks by Technology Adoption Strategy

Companies with an Aggressive E-procurement Technologies Adoption Strategy
<p>"Increased long-term costs in the supply chain through virtual distributors."</p> <p>"Implementing e-procurement globally."</p> <p>"Financial stability of [solution providers]."</p> <p>"Lack of supplier readiness."</p> <p>"Rapid changes in technology and standards results in higher operational costs."</p>
Companies with a Conservative E-procurement Technologies Adoption Strategy
<p>"Ability to budget necessary funds to keep up to date with changes in technology."</p> <p>"Having chosen a vendor and then pricing for support gets out of hand."</p> <p>"The risk of escalating costs as new requirements are discovered during implementation."</p> <p>"That it will be outdated in 3-6 months and need to replace with new technology and training. Or, that we'll implement solution and shortly after [corporate headquarters] will endorse/mandate a different solution."</p> <p>"Wasted investment (people, time, money) as e-procurement sorts itself out."</p> <p>"Minimal usage would cause investment of time to be greater than efficiencies gained."</p> <p>"Interface with existing mainframe system."</p>

Figure 3: Three Most Frequently Identified Barriers to E-procurement Technologies Utilization

E-Procurement Software
<ul style="list-style-type: none"> • Problems integrating with existing systems. • Lack of common standards for e-commerce software development. • Lack of suppliers accessible through the organization's e-procurement system and/or lack of supplier investment in catalog development.
Internet Exchanges
<ul style="list-style-type: none"> • Not enough suppliers to create a liquid marketplace. • Suppliers reticent to participate in selling environments where preeminent focus is on price. • Suppliers reticent to participate because control is lost over the presentation of brand name and product features
E-Auctions
<ul style="list-style-type: none"> • Organizational discomfort with auctions, as opposed to honoring commitments to supplier partnering and consolidation. • Downward price pressure on vendors resulting in diminished customer service or quality. • Inability to identify potential items for auction.
Purchasing Consortia
<ul style="list-style-type: none"> • Pricing that is not significantly better than available without consortia. • Getting a sufficient number of vendors into the process. • Ensuring conformance to state laws and regulations that require a bidding process.

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- ⁸ Additional information on the proprietary sample is in a report entitled, "E-Procurement Benchmark Survey Results," available from the authors.
- ⁹ Bank of America, Bank One, Canadian Imperial Bank of Commerce, Chase Manhattan, Citibank, Firststar, National City Bank, GE Capital Financial, Mellon Bank, PNC Bank, SunTrust, USBank, Wachovia, and Wells Fargo.
- ¹⁰ In the last quarter of 2000, 2,551 packets were sent to selected organizations that are purchasing card using customers of one of 14 major financial institutions. Purchasing card using organizations were targeted since they have already demonstrated an understanding of opportunities for reducing costs and improving efficiency in traditional procurement systems through the use of technology. One hundred and seventy-nine surveys were returned for response rate of 7%. A late mailing of another 500 surveys with a constricted response time yielded an additional 12 responses. Twenty-three responses were dropped from the database and were not considered in any analysis shown because the survey was substantially or totally incomplete. Many of the participants that returned incomplete surveys indicated by letter that their organization had yet to engage in an e-procurement effort of any kind. The final survey database consists of 168 usable responses received on or before January 25, 2001.
- ¹¹ The survey was sent to the contact person in each organization—typically the manager in charge of purchasing payments (the manager who kept the day-to-day relationship with the bank). This person was asked to forward the survey to the person in the organization most knowledgeable about e-procurement. Because of the difficulty of finding a database with a list of e-procurement managers, we chose this alternative as the best approach to reach this constituency.
- ¹² See R. N. *Innovation: The Attackers Advantage* (New York, NY: Summit Books, 1986) for an elaboration of the technology S-curve.
- ¹³ Further elaboration of the idea of dominant design can be found in J. M. Uterback, *Mastering the Dynamics of Innovation* (Boston, Ma: Harvard Business School Press, 1994), R. M. Henderson and K. B. Clark, "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." *Administrative Science Quarterly* (1990): 9–30.

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- ¹⁴ The development of a dominant business model is also an issue within the broader e-commerce industry, for various alternatives see G. Saloner and A.M. Spence, *Creating and Capturing Value: Perspectives and Cases on Electronic Commerce* (New York, NY: John Wiley, 2002)
- ¹⁵ See, for example, the Federal Acquisition Streamlining Act of 1994, Public Law 103-355, 103d Congress.
- ¹⁶ On absorptive capacity, see W. Cohen and D. Levinthal, "Absorptive capacity: A new perspective on learning and innovation," *Administrative Science Quarterly* (1990): 128-152. Reference to absorptive capacity.
- ¹⁷ A case study of GM's experience with e-procurement can be found in E. A. Ageshin, "E-procurement at Work: A Case Study," *Production and Inventory Management Journal* (2001): 48-53.
- ¹⁸ Corporate purchasing cards are bank charge cards that enable employees to acquire needed goods and services without going through the traditional approval process. Purchasing cards currently account for approximately \$40 billion of an estimated \$400 billion of low-value corporate purchases—though a 100% increase in purchasing card volume is expected over the next two years (see, The 2000 Corporate Purchasing Card Benchmark Survey, <http://www.napcp.org/palmersurvey>). The advantage of purchasing cards is the ease with which they can be implemented and the low initial dollar investment.
- ¹⁹ While most benefits are expected to come from inventory and capital goods, the savings in smaller items (as companies are currently doing) can be significant, for an example see A. Ovans, "E-procurement at Schlumberger," *Harvard Business Review* (2000): 20-21.
- ²⁰ For the importance of information sharing to improve the performance of the supply chain see, H. L. Lee and S. Whang, "Winning the last mile of e-commerce," *MIT Sloan Management Review* (2001): 54-62, H.L. Lee and S. Whang, "Information Sharing in Supply Chain," *International Journal of Technology Management* (2000): 373-387.
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- ²² See, for example, discussions in D. Little, "Let's Keep This Exchange to Ourselves," *Business Week* (December 4, 2000): 48, and T. Reason, "This Year's Model," *E-CFO* (Spring 2001): 44-52.