Research paper

Business-to-business e-procurement: success factors and challenges to implementation

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Abstract

Purpose – The paper seeks to pursue the understanding of current business-to-business e-procurement practices by describing the success factors and challenges to its implementation in the corporate setting.

Design/methodology/approach – Members of the Institute for Supply Management and the Council of Logistics Management were asked to respond to a survey questionnaire. Factor analysis was used to analyze data from valid responses received from 185 firms.

Findings – Factor analysis resulted in three e-procurement success factors (SF):supplier and contract management; end-user behavior and e-procurement business processes; and information and e-procurement infrastructure. Three challenge-to-implementation factors (CIF) also emerged: lack of system integration and standardization issues; immaturity of e-procurement-based market services and end-user resistance; and maverick buying and difficulty in integrating e-commerce with other systems.

Research limitations/implications – A representative sampling design should be used in the future to be able to make claims for generalizable results.

Practical implications – E-procurement is a very important initiative with significant cost savings potential for firms. This study's findings can guide various stages of corporate implementation efforts.

Originality/value – This study fulfills the need for solid empirical findings on this very important topic that has a direct impact on a firm's bottom line. E-procurement is still in the early stages of marketplace deployment and guidance is still needed on how to do it right.

Keywords Business-to-business marketing, Procurement, Electronic commerce, Supply chain management

Paper type Research paper

Introduction

This study investigates the success factors and challenges to the implementation of e-procurement, one initiative that promises to deliver significant savings to the firm. E-procurement refers to the purchase of goods and services for organizations (Turban *et al.*, 2006). Procurement usually represents one of the largest expense items in a firm's cost structure (Lennon, 2002; Attaran and Attaran, 2002). The Aberdeen Group (2001) found that the indirect procurement or the purchase of maintenance, repair, and operations (MRO) goods not directly involved in the production process such as office supplies, personal computers, non-manufacturing items, etc. (Laudon and Traver, 2004) usually constitutes 30-60 percent of a firm's total expenditures (Orr, 2002). Moreover, corporate buyers tend to waste time on non-value adding activities such as data entry, correcting errors in paperwork, expediting delivery, or solving quality problems (Turban *et al.*, 2006). A number of recent drivers have spurred interest in finding ways of cutting costs in the corporate environment. Among them are the recessionary trend that saddled the US economy after 2001 (Attaran and Attaran, 2002), the resolve of firms to use internet-enabled technologies to achieve supply chain management efficiencies for competitive advantage with a specific focus on procurement (Presutti, 2003), and the passage of the US Sarbanes-Oxley Act in 2002, which requires organizations to improve their ability to report on revenues and expenses in order to provide greater transparency into the financial activities of public companies (Bushell, 2004).

Although the implementation of e-procurement initiatives is not all that new, there is current interest in understanding issues involved in its implementation, especially in a web-enabled environment. Overall, it appears that e-procurement is still in its early stages of adoption in the corporate world. A recent Aberdeen Group (2001) study of spending analysis practices of 157 firms revealed that only a few firms truly know and understand how much they spend, on which products, and with which suppliers (Bushell, 2004). About 80 percent of the study participants recognized that spending analysis is "very important" or "critical" to their success, yet

only about half of those specific respondents had any formal spending analysis tool in place. And the few that had these tools analyzed only half of their total spending. A recent McKinsey Company research study found that the majority of the respondents considered spending analysis and demand management (i.e. questioning the necessity of purchases) as the two areas that were resistant to improvement in their firms (Kanakamedala *et al.*, 2003). Recent McKinsey Company research into auto suppliers reveals that 85 percent of the study participants intended to invest at their current or higher levels in new software to automate procurement processes (Hensley *et al.*, 2003). An earlier industry study indicated that only 8-10 percent of the largest 5,000 firms had an e-procurement system in place (Attaran and Attaran, 2002).

Recent research studies, though, show indicative trends on how the leading-edge firms are proceeding with their e-procurement initiatives. The study of Davila *et al.* (2003) demonstrates that there are two types of e-procurement adopters: one group of firms experiments with multiple solutions, whereas the second group commits only to one type of technology. The study also indicates that "follower" firms value the lessons they learn from their more venturesome counterparts who innovate with newer e-procurement technologies. The findings also show encouraging signs of wider adoption of e-procurement as more firms come forward with their pioneering implementation experiences and as more and more firms take internet-enabled supply chain management initiatives more seriously. Meanwhile, in a field study of an industrial supplier and its customer, Mukhopadhyay and Kekre (2002) found that a supplier could derive strategic benefits when the hub customer firm initiates the e-procurement system and the supplier trading partner, in turn, enhances the system's capabilities. It was also found that supplier trading partners with advanced technological capabilities can significantly increase the benefits of an order processing system both to themselves and their customers.

Other recent studies are also emphasizing the importance of organizational redesign, the organization of business units, the "extended enterprise" attributes (Subramaniam and Shaw, 2002), and the rethinking the e-procurement business processes (Hayward, 2001), which are really key to the success of the initiative.

A number of recent studies have also looked into difficulties faced by firms in launching e-procurement. In a recent survey of 102 international active e-marketplaces and procurement service providers, Huber *et al.* (2004) found the following perceived barriers to electronic procurement:

- a "wait-and-see" attitude among firms in selecting e-marketplaces and procurement service providers;
- concerns over security and confidentiality of the data needed to be exchanged in electronic environments;
- reluctance to share data with trading partners;
- the "non-feasibility of custom-made products" for pooling initiatives;
- lack of standardization; and
- uncertainty over trust and commitment among trading partners.

Day *et al.* (2003) noted users' reluctance to be subjected to significant changes in business processes as a major barrier to the implementation of e-procurement systems. Saeed and

Leith (2003) examined buyers' perceptions of e-procurement risks and arrived at three dimensions:

1 transaction risks resulting from wrong products purchased due to incomplete or misleading information;
2 security risks resulting from unauthorized penetration of trading platforms and failure to protect transaction-related data while being transmitted or stored; and
3 privacy risks arising from inappropriate information collection and information transparency.

Yen and Ng (2002) found that both buyer and seller firms in their sample considered the following prohibitive and discouraging:

- the costs and development time required to set up online procurement systems, enabling these systems, and meeting workforce requirements of such systems;
- the lack of adequate security measures to protect data; and
- trust issues between buyers and sellers.

In the same study, managers of the seller firms also cited attitudinal resistance to change stemming from a number of concerns:

- the uncertainty over its ability to gain the expected return on investment to cover development costs;
- the work required to enforce business process changes called for by these systems; and
- worker apprehensions about being replaced by automated procurement systems.

Dai and Kauffman (2002) uncovered a number of issues ventilated by a panel of noted academics who were asked to indicate key business-to-business commerce issues. They had expressed concern about a number of what appeared to be difficulties facing business-to-business (B2B) commerce at that time:

- the marketplace seemed to not be ready to take on B2B services, particularly those of e-procurement exchanges;
- inequities in power valence between and among trading partners participating in electronic environments like B2B exchanges, with most of the power held by channel masters or hub firms and B2B exchange founders;
- challenges accompanying building a single point-of-contact between a large multi-unit business firm that wants to offer a single B2B interface to its corporate customers as this will require changes in the way the firm manages its customers and the way its customer relationship management functions work;
- cross-enterprise systems integration issues;
- lack of trust among trading partners and therefore, reluctance to share data and information; and
- issues peculiar to small firms – lack of capital to participate in B2B procurement environments and small transaction volumes associated with these firms' scale of business.

Kheng and Al-Hawandeh (2002) investigated the adoption of e-procurement in Singapore and presented stumbling blocks to this initiative from the point of view of Singaporean firms. First, there was concern about security and privacy of procurement transaction data. Second, required significant investments in hardware, software, and personnel training to participate in e-procurement are prohibitive. Third, the laws governing B2B commerce, crossing over to e-procurement, are still undeveloped. For instance, questions concerning the legality and force of e-mail contracts, role of electronic

signatures, and application of copyright laws to electronically copied documents are still unresolved. Fourth, technical difficulties related to information and data exchange and conversion such as inefficiencies in locating information over the internet using search engines and the lack of common standards that get in the way of the easy integration of electronic catalogs from multiple suppliers. In Zhu's (2002) interview of 20 suppliers, he found that their major concerns centered on how participating in electronic e-procurement environments threatened their profit-making abilities through data exposure, pricing pressure from customers, and the resulting margin erosion.

Lee and Clark (1997) invoked transaction cost economics in pointing out a number of risks associated with setting up electronic market mechanisms such as opportunism by unscrupulous market participants and asset specificity. The latter has to do with the need for a firm to commit certain resources to deploy IT applications and infrastructures needed to link its internal business processes with those of the e-marketplace trading platform. The more complex and idiosyncratic these integration links are, the more difficult it is to transfer use of such connections with other trading platforms or trading partner networks.

This study intends to investigate the success factors and the challenges to implementation for e-procurement in B2B commerce.

Methodology

Data for this research study was gathered using a questionnaire study. A two-stage approach was used to generate two sets of questionnaire items – one set of items that captured e-procurement success factors and the other set to determine the challenges to successful e-procurement implementation. In the first stage, for each set, an initial list of items was generated based upon an extensive literature review (Tables I and II). In the second stage, four e-procurement executives were asked to examine the initial draft of the items for completeness, clarity, and readability. This feedback resulted in several modifications to each list. This two-step process resulted in 12 items germane to a successful e-procurement implementation. Each item was worded so that it could be answered using a seve-point Likert scale (1 = not critical at all; 7 = extremely critical). To determine the challenges to implementation, 13 items were developed. Once again, each item was worded such that it could be answered using a seven-point Likert scale (1 = strongly agree; 7 = strongly disagree). A list of these items is shown in Table III.

A cover letter, a copy of the questionnaire, and a postage-paid return envelope were mailed to a random sample of procurement managers and professionals listed in the roster of the Institute for Supply Management and the Council of Logistics Management. From the combined list of potential respondents, a random sample of 7,000 was generated. A total of 225 completed questionnaires were received. However, only 185 questionnaires were useable as the rest contained significant missing data. The resulting sample is considered a convenience sample considering the challenges of data gathering for a study of this nature.

Results

Table IV shows the profiles of the responding firms. Note that nearly half of the firms have less than 1,000 employees and only about 15 percent are larger than 10,000 employees. Also, in the sample, 45 percent of the firms belong to the manufacturing sector and 55 percent of the firms belong to the services sector.

Table III shows the mean and standard deviation for both the e-procurement success and the implementation challenge items. Next, in order to derive underlying constructs for each set of items, principal components analysis was used to obtain estimates of the initial factors that account for the largest variance in the sample (Norusis, 1990). Factor analysis was applied to 12 items for exploring the e-procurement success factors and to 13 items for uncovering the challenges to e-procurement implementation. For factor analysis, Stevens (1986) recommends a cases-to-variables ratio of 5:1 to guarantee a reliable factor analysis procedure. In this research, these ratios far exceeded the minimum threshold (for 12 success items, this ratio was 14:1 and for the 13 "barrier" items, it was 13:1). The rule used to determine the number of factors to keep was the "eigenvalue greater than one" criterion (Kaiser, 1974). For the e-procurement success factors it resulted in a three-factor solution that explained about 57 percent of the variation, and for the challenges to implementation it also yielded a three-factor structure explaining 54 percent of the variation. Subsequently, Varimax rotation was chosen as a method of transforming the initial factors into a more meaningful configuration of factors. In both analyses, an item was assigned to a factor if the factor loading was at least 0.35 as recommended by Churchill (1979).

The Kaiser-Meyer-Olkin (KMO) measure is also greater than 0.70: for the e-procurement success factors, the KMO value is 0.846 and for the challenges to implementation, the KMO is 0.808. Each of the factors, therefore, predicts an adequate number of items which are bonded to them. Bartlett's test of sphericity is significant ($p < 0.000$) for both the e-procurement success factors and barrier factors, which means that the variables under each factor are correlated highly enough to provide a reasonable basis for conducting the factor analysis procedure. The approximate chi-square for the Bartlett's test of sphericity for the success factors was 606.995 with 66 degrees of freedom (d.f.) and 697.540 for the challenge factors with 78 d.f. The Bartlett test indicated that non-zero correlations existed at the significance level of 0.000 for both sets of factors, thus establishing their statistical validity.

E-procurement success factors

A careful examination of the six items (S3, S4, S6, S7, S8, and S12) that bond with the first factor reveals that these items, in general, deal with managing the number of strategic suppliers and the associated contracts. This factor is named "Supplier and contract management". The second factor is termed "End-user behavior and e-procurement business processes", as items S2, S9, S10, and S11 are related to analyzing end-user behavior and examining business processes germane to e-procurement. The final factor is called "Information and e-procurement infrastructure" since the two items that bond with this factor (S1 and S5) have to do with aligning e-procurement solution with business needs

Table I Literature review on e-procurement success factors

E-procurement success factor	Literature review content
Deploy a balanced catalog selection strategy (i.e. choosing from buyer-managed, seller-managed, and electronic marketplace-managed catalogs)	Firms need to craft a portfolio approach to managing their relationships with trading partners (Hope-Ross et al., 2000) No single e-procurement solution can adequately address the need for a firm to purchase different types of goods or services (Hope-Ross et al., 2000; Rajkumar, 2001) Firms will need to consider three major types of electronic environments for e-procurement: (1) buy-side applications; (2) sell-side applications; and (3) marketplace services (Davila et al., 2003; Kyte, 2000a, b)
Analyze purchasing behavior of end users	"Spending analysis is the process of aggregating, cleansing, and analyzing corporate spending data for the purposes of reducing costs and improving operational performance" (Mitchell, 2004) Functional silos, ad hoc management practices, weak technology support, and poor source data quality have worked against firms' ability to conduct spend analysis (Mitchell, 2004) Without spend analysis, a firm could not maximize its buying leverage, arrive at intelligent sourcing decisions, ensure compliance with supplier contracts, raise supplier performance, optimize budgeting and planning, and anticipate the impact of changes in cost, inflation, and other factors (Mitchell, 2004)
Consolidate suppliers and contracts	Good procurement practice requires identifying which products or services should be sourced from specific suppliers and thus, consolidate suppliers and contracts (Hope-Ross, 2001c) Lion Nathan, an Australian-based beverage firm, consolidated its sea freight spending and contracts with a single provider and achieved significant savings. Its operations in New Zealand, China, and Australia all used international sea freight service (Bushell, 2004)
Involve preferred and strategic suppliers in planning for e-procurement	Strategic suppliers of buyer firms usually constitute 20-40 percent of their supply base. These suppliers offer the buyer firm the greatest chances of e-procurement success. Buyer firms should further narrow down the list of candidate suppliers for e-procurement initiatives by considering only those with previous e-procurement engagements with other customers, those interested in emerging innovations, and those that have the local decision-making authority to approve the investments and business process changes the buyer might require (Kyte, 2001a, b, c)
Select e-procurement software and services following the development of a solid business case	Firms need to develop a solid business case for subscribing to e-procurement software and services through cost-benefit analyses (Hope-Ross et al., 2000). There is a wide variability in the price of e-procurement applications from about $10,000 (Trilogy software) at the low end and from $500,000 to $2 million (CommerceOne solutions) at the high end (Hope-Ross and Reilly, 2000a) Firms may have to deal with multiple vendors, each specializing in different e-procurement functionalities (Rajkumar, 2001)
Reduce the number of suppliers	Hackett studies show that firms that were most successful with their e-procurement practices also cut back on the number of vendors they had contracts with per billion dollars in spending (Roth, 2001)
Understand preferred supplier technology plans and their ability to support e-procurement initiatives	Buyers will increasingly rely on their suppliers' ability to connect with them electronically and support the catalog creation and maintenance issues involved in e-procurement. Thus, buyers need to carefully select suppliers who are in the best position to respond to their e-procurement deployment plans (Hope-Ross, 2001b; Rajkumar, 2001) Suppliers may prefer one e-procurement system over another on account of transaction fees being charged by e-marketplaces or catalog managers (Hope-Ross, 2001a). Thus, buyers need to know if transaction fees are an issue for suppliers because, if this is so, these additional costs will very likely be passed on to the buyers Certain suppliers will not be able to keep up with buyers' technology requirements (Hope-Ross et al., 2000). Buyer channel masters need to be prepared to underwrite the costs of getting valued but under-equipped suppliers to get on board major e-procurement initiatives
Enforce on-contract buying with preferred suppliers	PricewaterhouseCoopers calculated that a firm could gain savings of 30-40 percent of non-direct spending if they buy only from preferred suppliers (Hope-Ross and Reilly, 2000a) Certain procurement software products are designed to automate a firm's purchasing processes and policies and thus, direct order requests for specific goods to preferred suppliers (Kanakamedala et al., 2003)
Re-engineer all affected business applications effectively	Significant benefits from e-procurement come from reengineering procurement business processes and subsequent modifications in employee behavior and relationships with suppliers (Attaran and Attaran, 2002; Supplier Selection & Management Report, 2001; Rajkumar, 2001; Hope-Ross and Reilly, 2000a; Lin and Hsieh, 2000). Use of an e-procurement application is secondary only to meeting change management requirements in affected procurement business processes

(continued)

Table I

E-procurement success factor	Literature review content
Centralize control of contracts, product data, catalogs, and price updates for indirect procurement	Firms usually begin their e-procurement efforts by sourcing indirect goods and/or services first (Davila *et al.*, 2003; Orr, 2002; Kyte, 2000a, b)
	The Aberdeen Group (2001) found that about 30-60 percent of a firm's total expenditures are due to purchases of indirect goods/services. It is recommended that the firm centralize the control of its contracts, product data, catalogs, and price updates for indirect procurement (Bartels, 2004a, b; Hope-Ross and Reilly, 2000b; Hope-Ross *et al.*, 2000)
	Web-enabled procurement enables the firm to centralize purchasing business processes and gain three benefits: (1) spreading administrative costs over a larger volume of purchases; (2) negotiating more favorable prices and terms for goods/services purchased; and (3) motivating end users to use the software and thus, eliminate off-contract buying (Subramaniam and Shaw, 2002)
	Croom's study of procurement practices in the UK, continental Europe, and the USA reveals that centralization allows firms to gain greater control over sources of supply, purchase price, and inventory policies (Croom, 2000)
Implement and maintain computerized rules governing procurement	Workflow rules embedded in the software govern the e-procurement tasks
	(1) *Access and privilege rules* – the information presented to authorized users need to be determined by information access and privilege rules covering such things as customer-specific information that may include pricing and detailed product item specifications
	(2) *Non-repudiation rules*: allow suppliers to ensure that the electronic message has been received by buyers and also authenticate the origin of the message
	(3) *Pricing rules*: alert buyers that certain suppliers have increased the prices of certain goods beyond preset thresholds (Rajkumar, 2001; Hope-Ross and Reilly, 2000b; Hope-Ross *et al.*, 2000)
	Eastman Chemical Company designed purchase order rules so that purchase requests below $2,000 translates into a formal purchase order generated by CommerceOne EnterpriseBuyer, which then transmits the document to CommerceOne MarketSite, which directs the purchase order to the right supplier. Purchase requests above $2,000 are forwarded to the firm's SAP R/3 system (Aberdeen Group, December 2001)
Give individual and unit spending a lot of visibility	Providing visibility into individual and unit spending within the firm is a precursor step to conducting spend analysis (Hope-Ross and Reilly, 2000b; Hope-Ross *et al.*, 2000)
	"Visibility" means making transparent who is doing the spending, how much they are spending, on what they are spending, and with whom they are spending (Bushell, 2004)
	"Visibility" also means assigning ownership of spending to the individual or unit that knows most about the purchase and sharing the responsibility over purchases with all other corporate units using those same goods. Managers should also track savings targets for each spend category, link these targets to departmental budgets, track actual savings achieved and, finally, tie the bottom line to individual or unit performance evaluations linked to the savings targets (Kanakamedala *et al.*, 2003)

and catalog information selection options. Table V shows these three success factors, the associated items and their factor loadings.

Challenges to e-procurement implementation

Table VI shows the three factors that underlie challenges to e-procurement implementation. Table VI also reports the associated items and their factor loadings. Note that the first factor relates to the systems integration and standardization challenges faced by firms in deploying the e-procurement application. Items that compose this factor include:

- lack of "benchmarkable" reference implementations (B2);
- difficulty of keeping controls and data management standards when adding other e-procurement systems (B13);
- lack of a "base infrastructure" to collect transaction data from more than one e-commerce application (B10);
- immaturity of e-procurement software (B4);
- lack of standard interchange formats for e-procurement (B2); and

- project cost overruns in catalog rationalization/ implementation, training, indirect costs, etc. (B3).

Thus, this factor is named "Lack of system integration and standardization".

The items in the second factor deal with the immaturity of providers of e-procurement services in the marketplace (i.e. consulting services (B6), marketplace services (B7), and pricing models used by service providers (B9)) and the nature of certain suppliers that buyer firms have to deal with (B8), and the resistance of internal end-users to learning how to use multiple e-procurement systems (B5). In light of these, this factor is termed "Immaturity of e-procurement-based market services and end-user resistance".

Finally, the third factor concerns the difficulties of eliminating "maverick" buying on the part of the firm's staff (B1) and the challenges of taking spend data from e-commerce-driven transactions and connecting the data collected from these systems to the rest of the purchase transaction data gathered through other systems (B11).

Table II Literature review on e-procurement challenges

E-procurement challenges	Literature review content
Immaturity of marketplaces services	Less developed marketplaces may not be able to offer a complete line of services such as electronic requests for quotes, reverse or forward auctions, dynamic bidding, and e-catalog creation and maintenance to subscriber firms. In order to gain a critical mass in membership, these marketplaces are reluctant to charge members high enough fees to cover the costs of delivering basic and other value-added services such as hosting services, logistics, payments, systems integration, outsourcing, and information technology consulting (Kyte, 2000b)
	Immature marketplaces also do not understand the use of effective business models and may lack sophistication in the ways they approach potential member firms (Furlonger and Landry, 2001)
Immaturity of suppliers	Buyer/channel master firms will need to deal with the technological immaturity of a number of suppliers and the latter's unpreparedness to respond to electronic purchasing initiatives (Hannon, 2001; Kyte and Miklovic, 2001; Min and Galle, 2001; Kyte, 2000b)
	Firm size appears to be a factor here. The Min and Galle study (2001) indicates that small firms are averse to innovation and tend to lack the technical knowledge/expertise, personnel, and IT infrastructure needed to respond to channel master requests to connect with them using certain electronic procurement arrangements
Immaturity of consulting services	Consultant expertise on more advanced procurement initiatives is still spotty and peculiar differences among industries complicate the matter even more. Larger and leading-edge firms are used to educating their "consultants", but smaller firms will expect more current and directive guidance from so-called consultants than is usually available in the marketplace (Kyte, 2000b)
Pricing model immaturity	Earlier e-procurement vendors found that they have locked themselves into ineffective pricing models for both client licenses for buy-side applications and transaction charges for marketplace services (Kyte, 2000b)
E-procurement software immaturity	E-procurement software is still limited in many ways. An IDC report revealed end user dissatisfaction with procurement applications because of lack of analytical capabilities (Vesset, 2003)
	Some e-procurement systems are unable to handle multiple data formats from major vendors such as Ariba, i2, CommerceOne, among others, and enable painless backend integration with the firm's existing business applications (Attaran and Attaran, 2002)
	A number of e-procurement software packages could not manage the complexities of different jurisdictions, currencies, tax structures, etc.; lack comprehensive payment and settlement features like sophisticated invoicing, payment, reconciliation, authentication, and security; and lack higher-end features like demand management and spending analysis capabilities and the ability to consolidate general ledger and invoicing systems (Kanakamedala *et al.*, 2003; Roth, 2001)
	Lately, software vendors have added functionalities to e-procurement software and automated spend analysis to help firms identify sourcing opportunities, track employee purchasing transactions with various vendors, and assess compliance with corporate sourcing policies (Bartels, 2004a, b)
Hard to keep controls and data management standards when adding other procurement systems; hard to take spend data from e-commerce-driven transactions and connecting it to the rest of the purchase transaction data collected through other systems; lack of base "infrastructure" to collect transaction data from more than one e-commerce application	There are specific integration problems related to managing data coming from multiple systems interacting with the e-procurement package and from using different e-procurement packages as well. Interviews with procurement executives revealed the following concerns: difficulty of keeping controls and data management standards when adding other e-procurement systems; difficulty of taking spend data from e-commerce-driven transactions and connecting them to the rest of the purchase transaction data collected through other systems (Aberdeen Group, 2001); and lack of base "infrastructure" to collect transaction data from more than one e-commerce application
Lack of benchmarkable reference implementations	Some firms struggle with the hazards of e-procurement experimentation. Komatsu Mining Systems (KMS), a $500 million international manufacturer of construction and mining equipment, created a private web-based network that integrates its existing Baan ERP system with the procurement systems it has with its suppliers through a portal. At the time KMS was planning the portal, it did not have a reference project from which to learn or benchmark its concept and plan. Also, Baan was still developing its web-based iBaan products in conjunction with vendors that did not support the suitable level of integration with KMS's backend systems. KMS compensated for this by working with SysComSoft, and mapped out the business processes for its direct procurement activities. Through automation programming, SysComSoft created workflows between KMS's Baan ERP system and the iBaan-driven supplier portal. Through the use of a web browser, KMS's suppliers could access the supplier portal, have real-time access to the firm's ERP systems, and download information for integration with their own business application systems (Aberdeen Group, 2001)

(continued)

Table II

E-procurement challenges	Literature review content
Lack of standard interchange formats for e-procurement	Standardization of codes used for product-related data (Ranganathan, 2003) and meeting different catalog content format requirements, for instance, will be specific challenges for e-procurement (Rajkumar, 2001)
	Extensible markup language (XML) has emerged as a promising possibility for standardizing data exchange formats and is intended to be used for developing data descriptions and protocols to describe different aspects of business transactions such as product features, prices, credit terms, and delivery options/transportation (Lucking-Reiley, 2001)
Internal end-user resistance to learn multiple procurement systems	Employees resist learning new procurement systems especially if they have alternative means of accomplishing procurement such as through the use of procurement cards and expense submissions. The firm usually cannot stop using these older instruments which it needs to interact with suppliers on the low end of the technological spectrum (Hope-Ross et al., 2000)
	Employees are averse to learn software products that are in their nascent stage of development, knowing fully well that significant changes are still forthcoming (Rajkumar, 2001)
Project cost overruns in catalog rationalization/ implementation, training, indirect costs, etc.	Firms should be cautious about calculating the costs of e-procurement initiatives and should anticipate the less visible items that may encumber the firm (Rajkumar, 2001)
	Hidden costs, which consist of any of the following items, could easily exceed licensing and maintenance costs by five or ten times (Hope-Ross and Reilly, 2000a; Hope-Ross et al., 2000): implementation (e.g. consulting fees); integration (e.g., human resource management systems, equipment asset management, IT asset management and financials); content aggregation and rationalization; catalog and search engine; transactions; supplier enablement; user training; business process reengineering; associated licensing costs (e.g. additional database management system fees and integration-ware licensing); and administration (e.g. requisitioning, ordering, matching, and payment processing) (Hope-Ross and Reilly, 2000a; Hope-Ross et al., 2000)
	E-catalogs deserve special mention because they constitute a sizable portion of costs (Doyon et al., 2001)
Difficulty of eliminating "maverick" buying	"Maverick" buying refers to the purchase of goods or services without using the firm's formally defined processes and authorized vendors (Kyte, 2001c)
	Maverick buying has a number of deleterious effects: it deprives the firm of the ability to collect data on its employees' spend patterns and therefore loses visibility and control over its expenditures; and it raises procurement costs for the firm by as much as 20 percent compared to purchases negotiated by the firm's purchasing professionals (Orr, 2002)
	Maverick buying could be eliminated by presenting end users with a highly efficient and easy-to-use e-procurement system that will lure them away from old purchasing habits (Kyte, 2001c)

Therefore, this factor is called "Maverick buying and difficulty in integrating e-commerce with other systems".

Summary and discussion

E-procurement success factors
This study's findings suggest a three-pronged approach to addressing e-procurement in the firm.

Success factor 1: supplier and contract management
The first factor refers to the rationalization of the firm's management of its suppliers. This study's findings reconfirm the need for the well-documented practice of reducing the number of suppliers with whom a firm intends to conduct e-procurement (Roth, 2001; Min and Galle, 2001). In the course of doing so, it also makes sense to consolidate its suppliers and contracts to achieve significant savings and better contract terms. Forrester Research reported on best practices on e-procurement and found that firms and government offices adopting such practices do, in fact, centralize corporate-wide purchasing policies, standards, technologies, and the actual execution of sourcing to the relevant departments and employees (Bartels, 2004a, b). Large customer firms appear to be in a better position to

centralize its purchasing resources; they have larger annual purchasing volumes, and thus stand to gain more financially from price discounts they could extract from major suppliers (Min and Galle, 2001; Riggins and Mukhopadhyay, 1994).

In keeping with focusing the firm's energies on a highly select group of suppliers, it is also suggested that the buyer firm tries to understand their preferred suppliers' technology plans and their future abilities to respond to future business information systems requirements and involving them in planning for e-procurement initiatives such as the "supplier councils" conducted by Harley Davidson Motor Company (Fitzgerald, 2002) and the Online Procurement Top Committee (OPTC) organized by JJM, a Taiwanese freight forwarder, as it coordinates its purchasing activities with its 500 suppliers (Lin and Hsieh, 2000). On account of their power, larger customer firms appear to be able to keep a tighter rein on their supplier network when it comes to implementing IT infrastructure requirements (Min and Galle, 2001). Otherwise, it is still a major challenge to get suppliers to participate fully in e-procurement initiatives and ensuring that they adopt the appropriate technologies to make these initiatives work (Bartels, 2004a, b).

Table III Items, their means and standard deviations (SD) for the challenges to implementation and e-procurement success

	Mean	SD
Challenges to implementation		
B1. Difficulty of eliminating "maverick" buying (i.e. buying from unauthorized vendors)	4.74	1.18
B2. Lack of standard interchange formats for e-procurement	5.42	1.38
B3. Project cost overruns in catalog rationalization/implementation, training, indirect costs, etc.	4.62	1.31
B4. E-procurement software immaturity	5.05	1.39
B5. Internal end user resistance to learn multiple procurement systems and procedures	5.19	1.44
B6. Immaturity of consulting services	4.77	1.26
B7. Immaturity of marketplace services	5.02	1.21
B8. Immaturity of suppliers	5.06	1.34
B9. Immaturity of pricing model	4.78	1.35
B10. Lack of base "infrastructure" to collect transaction data from more than one e-commerce application	5.15	1.28
B11. Hard to take spend data from e-commerce driven transactions and connecting them to the rest of purchase transaction data collected through other systems	4.97	1.53
B12. Lack of benchmarkable reference implementations	4.93	1.21
B13. Hard to keep controls and data management standards when adding other procurement systems	4.89	1.14
Success		
S1. Deploy a "balanced" catalog selection strategy (i.e. choosing from buyer-managed, seller-managed, and electronic marketplace-managed catalogs)	4.91	1.50
S2. Analyze purchasing behaviors of end users	5.06	1.30
S3. Consolidate suppliers and contracts	5.70	1.14
S4. Involve preferred and strategic suppliers planning for e-procurement	5.76	1.09
S5. Select e-procurement software and services following the development of a solid business case	5.64	1.13
S6. Reduce number of suppliers	5.33	1.30
S7. Understand preferred supplier technology plans and their ability to support e-procurement initiatives	5.53	1.15
S8. Enforce on-contract buying with preferred suppliers	5.55	1.10
S9. Re-engineer of all affected business applications effectively	5.13	1.31
S10. Centralize control of contracts, product data, catalogs, and price updates for indirect procurement	5.72	1.06
S11. Implement and maintain computerized rules governing procurement	5.47	1.04
S12. Give individual and unit spending a lot of visibility	4.92	1.34

Table IV Respondent firm descriptive data

	Number (percent)
A. Firm size by total number of employees	
Fewer than 200	36 (20.57)
200-1,000	51 (29.4)
1,001-5,000	49 (28.0)
5,001-10,000	13 (7.43)
Over 10,000	26 (14.86)
Grand total	175 (100.0)
B. Type of firm by sector	
Manufacturing	81 (44.51)
Services	101 (55.49)
Grand total	182 (100.0)

Note: The subtotals for sections A and B do not correspond due to missing values

The importance of giving individual and unit spending visibility is reconfirmed by this study as well, and reinforces the recommendations from the literature. Having macro and micro visibility in procurement transactions enables the firm to create audit trails in the system, understand spending patterns, maximize buying leverage, undertake informed sourcing decisions, pursue contract compliance, and optimize budgeting and planning (Bushell, 2004; Croom, 2000). Consequently, too, the firm could decompose its spending into more granular categories, specific end-user constituencies, and particular geographies to more effectively determine appropriate areas for e-procurement (Hope-Ross, 2001b).

Success factor 2: end-user behavior and e-procurement business processes

The second factor probably has the greatest impact on the success of the e-procurement initiative: redesigning affected business processes and consequently, influencing end-user/employee behaviors accordingly to conform with the new systems and enforcing new procedural guidelines through the computerized business rules programmed in the e-procurement software the firm decides to implement.

Conducting spend pattern analysis prior to business process re-engineering helps the firm understand who is doing the spending, how much they are spending, on what they are spending, and with whom they are spending. Providing such visibility precedes assigning ownership to spending business processes and final accountability in achieving savings targets in conjunction with the use of re-engineered procurement processes.

Redesigning business processes looks into rationalizing the flow of transactions and information both within the firm and outside its boundaries, particularly in relationship with its suppliers, with the enabling support of information

Table V E-procurement success factors, corresponding items, and factor loadings

Factor	Item	Factor loading
Supplier and contract management	S3: Consolidate suppliers and contracts	0.79
	S4: Involve preferred and strategic suppliers in planning for e-procurement	0.71
	S6: Reduce number of suppliers	0.80
	S7: Understand preferred supplier technology plans and their ability to support e-procurement initiatives	0.58
	S8: Enforce on-contract buying with preferred suppliers	0.52
	S12: Give individual and unit spending a lot of visibility	0.45
End-user behavior and e-procurement business processes	S2: Analyze purchasing behaviors of end-users	0.65
	S9: Reengineer all affected business applications effectively	0.70
	S10: Centralize control of contracts, product data, catalogs, and price updates for indirect procurement	0.55
	S11. Implement and maintain computerized rules governing procurement	0.74
Information and e-procurement infrastructure	S1: Deploy a balanced catalog selection strategy (i.e. choosing from buyer-managed, seller-managed, and electronic marketplace-managed catalogs)	0.83
	S5: Select e-procurement software and services following the development of a solid business case	0.64

Table VI E-Procurement implementation challenge factors, corresponding items and factor loadings

Factor	Item	Factor loading
Lack of system integration and standardization issues	B2: Lack of standard interchange formats for e-procurement	0.63
	B3: Project cost overruns in catalog rationalization/implementation, training, indirect costs, etc.	0.58
	B4: Immaturity of e-procurement software	0.63
	B10: Lack of base "infrastructure" to collect transaction data from more than one e-commerce application	0.70
	B12: Lack of benchmarkable reference implementations	0.74
	B13: Hard to keep controls and data management standards when adding other procurement systems	0.71
Immaturity of e-procurement-based market services and end-user resistance	B5: Internal end-user resistance to learn multiple procurement systems	0.37
	B6: Immaturity of consulting services	0.83
	B7: Immaturity of marketplace services	0.88
	B8: Immaturity of suppliers	0.64
	B9: Immaturity of pricing model	0.59
Maverick buying and difficulty in integrating e-commerce with other systems	B1: Difficulty of eliminating "maverick" buying	0.79
	B11: Hard to take spend data from e-commerce-driven transactions and connect them to the rest of the purchase transaction data collected through other systems	0.50

technology. Also, in the actual management of its e-procurement business process, it is recommended that the firm centralize control of the different contracts it administers, product data, catalogs, and price updates for indirect procurement to gain greater control over its sources of supply, purchase price, and inventory policies. To minimize implementation complexity, most firms usually initiate e-procurement with indirect rather than direct goods/services.

Success factor 3: information and e-procurement infrastructure
The third factor has to do with the firm's actual selection of the e-procurement solution itself and the portfolio of buy-side, sell-side, or marketplace catalogs it would need to support as a seller firm or connect to as a buyer firm. Though initially a firm may need to choose one of the three general options it has for doing e-procurement – buy-side, sell-side, and marketplace services – eventually, it has to maintain a portfolio of possibly all three since not one electronic environment could meet all purchasing needs of the firm. Due to cost constraints, small firms tend to opt for the marketplace at the outset. Medium-sized firms may stay with

marketplaces for a limited period of time and then, move into the portfolio arrangement. Large firms, however, appear to immediately use a combination of all three environments and are most motivated and prepared to create linkages with its tier-one suppliers.

Using cost-benefit analysis, the firm should be able to identify and justify the different items that constitute the total cost of ownership:

- functionalities of the software package;
- technical architecture (i.e. the overall software design that determines the means through which components of the software interact and integrate with each other and other application systems within the firm and with its trading partners);
- installation costs;
- service and support; and
- other post-acquisition costs (including all hidden costs).

Challenges to e-procurement implementation
The study findings should alert firms to the three important sources of e-procurement implementation difficulties.

Challenge factor 1: lack of system integration and standardization issues

This factor refers to a host of e-procurement systems development challenges that may potentially confront the firm. In general, e-procurement systems are a relatively recent development in the business application area and it is not unusual to find a lack of benchmarkable reference models especially in firms that are just beginning to learn of these systems' functionalities and uses in their organizations. Consequently, a back-end integration issue that results from this situation is the lack of a "base infrastructure" to collect transaction data from more than one e-commerce application, if, in fact, the firm had to run such multiple systems simultaneously. And even if this base infrastructure existed, it would still be difficult to observe data management standards and controls when a number of e-procurement systems need to be running and maintained.

Another challenge is software immaturity, which is probably true more of the lesser known vendors in the marketplace and to a limited extent, of the major players such as Ariba, Oracle, SAP, CommerceOne, etc., who are the trailblazers in product definition. Unlike its more mature counterpart which is enterprise resource planning (ERP), certain e-procurement packages may lack key features like invoicing, payment, reconciliation, authentication, security, and consolidation of general ledger and invoicing systems. Non-global stand-alone solutions may not be able to manage the complexities of different geographical jurisdictions, currencies, tax structures, etc.

One other implementation issue is the lack of data interchange standards for e-procurement systems. Business managers need to be aware of developments surrounding the standards making organizations and support their efforts towards evolving universal data exchange standards, especially those based on extensible markup language (XML) (Olivia, 2001).

Finally, the last item in this factor is the financial penalty of not paying attention to hidden costs of implementation that can creep up on the firm and derail its well-intentioned efforts. Hidden costs covering such things as implementation, systems integration, content aggregation and rationalization, catalog and search engine maintenance, transaction management, supplier enablement, end user training, business process re-engineering, and administration, could very easily exceed software licensing and maintenance costs by five to ten times. Firms should demand more cost transparency in dealing with software vendors and service providers and be vigilant in querying reference firms that have previously launched similar e-procurement projects.

Challenge factor 2: immaturity of e-procurement-based market services and end user resistance

This factor encompasses the immaturity of providers of e-procurement services, lack of preparation of certain suppliers a buyer firm may be dealing with, and resistance of a firm's end users to learning multiple e-procurement systems. Immature marketplace service providers, for instance, may not have the capitalization required to provide a complete suite of services to its members. Consulting services for more complex or advanced e-procurement implementations may fall short of expectations. Leading-edge firms are more accustomed to educating their "consultants", whereas smaller firms may need more directive guidance. Also, some software vendors and marketplace service providers are saddled by immature service

pricing models that discourage the growth of their clientele. Then, there's the immaturity of certain suppliers that a buyer firm deals with. Although most tier-one suppliers are probably technologically sophisticated, the hub firm or channel master may still have to be prepared to underwrite the costs of bringing its preferred suppliers up to par when it comes to very specific e-procurement implementation requirements (Kyte, 2000b). Suppliers need to learn how to generate catalog content, process electronic purchase orders, use invoicing mechanisms, among other tasks.

The last item here is the resistance of internal end-users to learning how to use multiple e-procurement systems, especially when other older and competing means of purchasing are still being supported by the firm such as the use of procurement cards and expense submissions. Firms should encourage the learning of new e-procurement systems through intensive training and educational sessions with end users/employees and reward them by deploying easy-to-use and seductive desktop purchasing systems. The purchasing experience should be practically "effortless" so that workers in the firm are able to focus on more substantial and value-adding tasks that are more critical to their job descriptions.

Challenge factor 3: maverick buying and difficulty in integrating e-commerce with other systems

This factor entails the challenges in changing purchasing-related behaviors of employees and integrating e-commerce transactions with those of other e-procurement systems. "Maverick" buying or purchasing without the use of formally defined processes on the part of end users/employees even after the e-procurement solution has been fully implemented, has proven to be difficult to eliminate. Thus far, selling the benefits of new e-procurement systems to end-users, making them accountable for savings they purport to achieve in alignment with corporate cost savings targets, and demonstrating how e-procurement systems will help them reach such targets through intensive end user training and educational programs appear to be the best solutions to this problem.

The firm also needs to anticipate potential problems when spend data from e-commerce-driven transactions need to be siphoned off and combined with other purchasing-related transaction data collected from other systems. This is expected to be less of an issue as the firm builds its e-procurement initiatives upon a sound and robust "base infrastructure" that can serve as a convergence point for procurement data originating from diverse sources.

Conclusion and directions for future research

Using factor analysis, this study has reduced a total of 12 variables into three success factors and 13 variables into three challenges to implementation factors for e-procurement from the buyer firms' perspective. Directions for future research include a number of possibilities. First, the supplier firms' perspective could be explored instead. Second, one could investigate how the three success factors found in this study actually correlate with the firms' successful procurement performance using larger sample sizes and spanning various industries. Third, it is possible that the items constituting the success factors may change if firm size were used as a control variable; e-procurement concerns may be different between large and small firms or for that matter, between supply chain hub firms and value chain members. Fourth, another control variable may be the type of goods purchased. This study

articulated that most firms start their e-procurement initiatives by purchasing indirect goods. It is possible that the implementation issues may differ significantly once they start procuring strategic or direct goods.

It is also important to understand what might get in the way of the successful engagement of all firms in a value chain, since an entire value chain's performance is only as good as that of its weakest link. Keeping informed of these challenges to e-procurement implementation should help all executives participating in purchasing intelligently plan for and implement their firm's procurement initiatives. Again, the challenges to implementation may differ depending on whether or not the firm is the hub or participating trading partner in the network. Being sensitive to these "pain points" can alert both planners and implementers to devote more preparation, attention, and resources to potential areas of difficulty.

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