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Critical Success Factors for the Implementation of Business-To-Business Electronic Procurement

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ABSTRACT

This article investigates the critical success factors of e-procurement--the purchase of goods and services for organizations, which usually represents one of the largest expense items in a firm's cost structure. Data was gathered using the survey method and a random sample drawn from the membership of the Institute for Supply Management and the Council of Logistics Management. Data was analyzed from 74 firms that implemented e-procurement. Factor analysis resulted in a four-factor solution: (1) factor one suggests the rationalization of the firm's management of its suppliers; (2) factor two calls for redesigning affected business processes and influencing end-user/employee procurement-related behaviors; (3) factor three refers to carefully orchestrating an e-procurement technology planning process with one's suppliers and using intelligence in designing the software and mining the data it produces; and (4) factor four relates to selecting an e-procurement solution and/or simultaneously participating in a number of electronic environments supporting e-procurement.

Key words: Business-to-business commerce, e-procurement, supply chain management, interorganizational systems.

INTRODUCTION

This study investigates the critical success factors (CSFs) in the implementation of e-procurement, an initiative that refers to the purchase of goods and services for organizations (Turban, King, Lee & Viehland, 2004). Procurement usually represents one of the largest expense items in a firm's cost structure (Attaran & Attaran, 2002; Lennon, 2002). The Aberdeen Group 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 & Traver, 2004) usually constitutes 30 to 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., 2004). Overall, it appears that e-procurement is still in its early stages of adoption in the corporate world. A recent Aberdeen Group 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).

This study intends to investigate the CSFs for e-procurement from the point-of-view of firms that have actually used electronic purchasing solutions. The CSFs that emerged were also used to predict a number of e-procurement success measures used in the study.

LITERATURE REVIEW

Use of extensive literature review and interviews with procurement/purchasing executives were employed to narrow the selection of items considered relevant in the identifying the critical success factors for e-procurement implementation.

Reduce the number of suppliers

Studies show that firms that rationalize their procurement processes have also reduced the number of vendors or

suppliers they are dealing with. The Hackett studies have shown that firms that were most successful with their procurement practices also cut back on the number of vendors they had contracts with per billion dollars in spending (Roth, 2001).

Consolidate suppliers and contracts

Rationalizing procurement practice also requires identifying which products or services should be sourced from specific suppliers and thus, consolidate suppliers and contracts (Hope-Ross, December 6, 2001). Lion Nathan, an Australian-based beverage firm, discovered that with operations in New Zealand, China, and Australia, it was a major user of international sea freight service in these geographic regions (Bushell, 2004). The firm consolidated its sea freight spending and contracts with a single service provider and consequently, gained significant savings.

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 (also referred to as maintenance, repair, and operations goods/services or MRO) first (Orr, 2002; Kyte, September 26, 2000). Another recommended practice is for a firm to centralize the control of its contracts, product data, catalogs, and price updates for indirect procurement (Hope-Ross & Reilly, February 23, 2000; Hope-Ross, Luebbers, Purchase, & Reilly, 2000).

Studies have shown that Web-enabled procurement enables the firm to centralize purchasing business processes and enable it to: (1) spread its administrative costs over a larger volume of purchases; (2) negotiate more favorable prices and terms for goods/services purchased; and (3) motivate end users to use the new system to eliminate off-contract buying (Subramaniam & Shaw, 2002). Croom's study of procurement practices in the U.K., continental Europe, and the U.S. reveals that centralization allows firms to gain greater control over sources of supply, purchase price, and inventory policies (Croom, 2000).

Give individual and unit spending a lot of visibility

Providing visibility into individual and unit spending within the firm is one of the suggested strategies for rationalizing a firm's procurement process (Hope-Ross & Reilly, February 23, 2000; Hope-Ross, et al., 2000). "Visibility" here 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). Having visibility also means assigning ownership of and responsibility over spending on specific goods to the individual or unit that knows most about it (Kanakamedala, Ramsdell, & Roche, 2003). Allowing visibility in macro and micro procurement transactions enables the firm to: create audit trails in the system; understand spending patterns; maximize buying leverage; undertake informed sourcing and supply management decisions; pursue contract compliance and raise supplier performance; and optimize budgeting and planning (Bushell, 2004; Croom, 2000). Thus, firms that are serious with their purchasing initiatives are decomposing their spending into more granular categories, specific end-user constituencies, and particular geographies to more effectively determine appropriate areas for e-procurement (Hope-Ross, December 6, 2001).

Reengineer all affected business applications effectively

Changes in a firm's purchasing business processes in its relationships with suppliers bring significant benefits (Attaran & Attaran, 2002; Anonymous, 2001; Rajkumar, 2001; Hope-Ross & Reilly, February 16, 2000).

Fedex Corp. spends about \$7 billion yearly on various indirect goods and services (Aberdeen Group, 2001). Prior to reengineering its purchasing business processes, Fedex employees hand wrote purchase order requests, which were mailed to the firm's central logging facility where data entry clerks keypunched the information to a tracking system that forwarded the requisitions to the appropriate supplier. The old procedure was paper intensive and inefficient. It took four to five days for a purchase order requisition to get processed through the old system, and it took weeks before the requisitioned items were delivered to Fedex employees from suppliers. After the deployment of Ariba's B-to-B platform, it took only about a day to approve purchase order requisitions and ordered goods arrived within days rather than weeks.

Enforce on-contract buying with preferred suppliers

PricewaterhouseCoopers calculated that a firm stands to gain savings of 30 to 40 percent of nondirect spending if it

enforces on-contract buying. The firm also calculated the benefit from on-contract buying as the difference between the average level of discount for on-contract and off-contract goods multiplied by a reasonable estimate of the likely compliance that can be achieved (Hope-Ross, February 16, 2000). Some procurement software products have been designed so that a firm's purchasing processes and policies can be automated; thus, order requests for specific goods could be directed to preferred suppliers (Kanakamedala, Ramsdell, & Roche, 2003).

Analyze purchasing behavior of end users

Analyzing a firm's spend patterns calls for aggregating, cleansing, and analyzing corporate spending data to reduce costs and improve operational performance (Aberdeen Group, 2001). As of late, e-procurement software vendors have incorporated analytical tools to track how much firms spend on certain product categories, how much they have purchased from vendors, and how efficient the procurement process has been across the entire enterprise (Foster, 2002). With these software tools, a firm could identify areas of spending with the highest product and administrative costs, all of which promise high savings levels (Hope-Ross & Reilly, February 16, 2000). Firms specifically need to know how much is spent annually on goods and services, cost savings patterns in the immediate past, cost savings goals for the future, and the budget commitment to these goals (Chapman & Dempsey, 1997).

Understand preferred supplier technology plans and their ability to support e-procurement initiatives

Buyers will increasingly rely significantly on their suppliers' ability to connect with them electronically and support the catalog creation and maintenance issues involved in e-procurement. Thus, buyers will need to review their suppliers and choose those who are in the best position to respond to their e-procurement deployment plans (Hope-Ross, December 6, 2001; Rajkumar, 2001). Supplier readiness to respond to such buyer initiatives differ by firm and by industry (Hannon, 2001).

Buyers, therefore, should have a clear understanding of their suppliers' technology plans and their subsequent ability to support e-procurement initiatives. Suppliers may prefer one e-procurement system over another on account of transaction fees being charged by e-marketplaces or catalog managers. Also, there will be situations where suppliers will not be able to keep up with the technology requirements of the buyers' e-procurement initiatives, much less with the requirements to continually update their catalogs designed to serve different buyers (Hope-Ross, et al., 2000). Where the buyers are the hub firms or channel masters, it behooves them to initially cover the costs of enabling supplier involvement in managing catalog data.

Implement and maintain computerized rules governing procurement

Implementors of the e-procurement system need to set up the technical architecture of the system which includes the workflow rules embedded in the programs that govern the tasks involved in the procurement process (Rajkumar, 2001; Hope-Ross, et al., 2000; Hope-Ross & Reilly, February 23, 2000). Specific examples of such rules follow (Doyon, 2001). The information presented to authorized users need to be determined by information access and privilege rules. Customer-specific information may include pricing and detailed product item specifications, for instance. Context-sensitive roles are also defined in the workflows --- for instance, a buyer's purchase order on one side is the distributor's sales order on the other side of the transaction. Nonrepudiation rules not only allow suppliers to ensure that the electronic message has been received, but also enable the buyer firm it is dealing with to authenticate the origin of the message. Pricing rules are those designed by buyers to alert them when certain suppliers increase the prices of certain goods purchased beyond preset thresholds. Purchase order rules are still another example. For instance, Eastman Chemical Company has designed purchasing computerized 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, 2001).

Involve preferred and strategic suppliers in planning for e-procurement

Buyers need to understand their supply base and select tier-one suppliers whom they will include in their e-procurement planning exercises. A suggested question for buyers to answer is: "How many suppliers do we have with which we place more than 'x' orders per year to an annual value of '\$y' or more?" (Kyte, January 17, 2001). After coming up with an initial short list, the buyer firm should further narrow it down and focus on suppliers who have had previous e-procurement engagements with their other customers. Then, suppliers that will move up much higher in the final list are those that are interested in innovation and have the local decision making authority to approve the investments and business process changes the buyer might require.

Select e-procurement software and services following the development of a solid business case

Developing a solid business case for subscribing to e-procurement software and services involves conducting a cost-benefit analysis process (Hope-Ross, et al., 2000). Pinpointing costs will prove to be challenging because of the wide variability in the price of e-procurement applications (Hope-Ross & Reilly, February 16, 2000).

In evaluating potential e-procurement software vendors, the firm must consider the following important issues: functionality of software; technical architecture; costs; service and support; viability; and vision (Hope-Ross & Reilly, March 1, 2000). The following software capabilities should allow a firm to consolidate different sources of supplier information into one buyer-managed view that facilitates the review, evaluation, and purchase of goods and services: catalogs, shopping baskets, product database, data translation, shipping and handling, spend analysis capabilities, supplier management, inventory management and payments, among others.

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 its 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 --primarily indirect or direct goods or services (Rajkumar, 2001; Hope-Ross, et al., 2000). Firms will need to consider three different electronic environments within which to conduct e-procurement activities: buy-side applications, sell-side applications, and marketplace services (Kyte, September 14, 2000).

Buyer firms evaluating marketplaces need to consider the following: marketplace's transaction volume and revenue; the type, depth, and geographic reach of services offered; marketplace technology partner and alliance relationships; long-term financial viability; provisions for buyer and seller anonymity; possession of a critical mass of sellers to guarantee steady flow of goods and services; notification procedure for buyers; nature of the information disclosed in an auction; future plans and prospects; and regulatory and compliance environment; and other additional services such as credit and logistics services (Furlonger & Landry, 2001; Andren & Knight, 2000).

METHODOLOGY

Data for this research study was gathered using mailed-in and online questionnaires. 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. Of these 74 firms reported actually having experience with e-procurement. Responses of the participants from these 74 firms were evaluated for this study.

Interviews with four e-procurement executives were also conducted to verify the importance of the questionnaire items in their initial drafts. Contributions from them were also sought to improve and refine the questionnaire.

Study participants were asked to respond to the item, "How critical are the following items for a successful e-procurement implementation?" They were, then, to respond to a seven-point Likert scale for each item with the value "1" anchoring on "Strongly Disagree" and "7" on "Strongly Agree." The success of the e-procurement system was captured using a number of measures: (1) the firm's satisfaction with specific supplier attributes was measured using a scale anchoring on "7" (superior performance) and "1" (needs improvement): product quality; delivery performance; sales, service, and/or technical support; and total value received from this supplier; (2) the firm's response to the item: "If we had to do this all over again, we would still choose to use this supplier." using a scale anchoring on "7" (Strongly Agree) and "1" (Strongly Disagree); and (3) the firm's response to the item: "Overall, how satisfied are you with your e-procurement approaches?" using a scale anchoring on "7" (Highly successful) and "1" (Complete failure).

FIRM PROFILES

Table 1 shows the profiles of firms. Firms using e-procurement were significantly larger as indicated by the average

number of employees (9,474 versus 3,720). Also, the sample contained a higher proportion of service firms as compared to manufacturing firms in both groups. For firms with e-procurement experience, service firms constituted nearly 58 percent of the sample; whereas for firms with no e-procurement experience, this percentage was about 54 percent.

Firm Size by Number of Employees	
Less than 200	36 (20.57%)
200-1000	51 (29.14%)
1001-5000	49 (28.0%)
5001-10000	13 (7.43%)
Over 10000	26 (14.86%)
Total	175 (100.0%)
Type of Firm by Sector	
Manufacturing	81 (44.51%)
Services	101 (55.49%)
Total	182(100.0%)

Table 1: Respondent Firm Descriptive Data.

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

FINDINGS

Principal components analysis was used for factor extraction to obtain estimates of the initial factors that account for the largest variance in the sample (Norusis, 1990). Table 2 (page 25) shows the initial statistics generated for the candidate critical success factors. The rule used to finally determine the number of factors to include was the “eigenvalue greater than one” criterion (Kaiser, 1974). For the critical success factors, this resulted in a four-factor solution which explains 63.44 percent of the variation and has a Kaiser-Meyer-Olkin measure of sampling adequacy of .667. Subsequently, varimax rotation was chosen as the method of transforming the initial factors into a more meaningful configuration.

In the analysis of critical success factors, a total of 12 items were subjected to exploratory factor analysis. Stevens (1986) recommended a cases-to-variables ratio of 5:1 to guarantee a reliable factor analysis procedure; however, some researchers such as Fuller and Swanson (1992) have worked with ratios as low as 2:1. There were a total of 74 cases for the 12 critical success items, thus, resulting in a cases-to-variables ratio of 6.167:1, which exceeds the suggested ratio limits.

Critical Success Factors	Eigenvalue	Percent of Variance	Cumulative Percentage
CSF1	3.475	28.956	28.956
CSF2	1.613	13.443	42.399
CSF3	1.337	11.145	53.544
CSF4	1.187	9.890	63.434

Table 2: Critical Success Factors for E-Procurement Based on Eigenvalues.

Factor loadings resulting from the varimax rotation were evaluated using the threshold of .34, which is very slightly less than the .35 level recommended by Churchill (1979). Only items with factor loadings of .34 and above were considered to be included under each of the critical success factors.

Table 3 shows the factor loadings of the final items selected for each of critical success factors. This discussion details the specific variables that are associated with each of the four critical success factors. Items under critical

success factor (CSF) 1 all have to do with managing suppliers, contracts, and e-procurement related information. Firms are advised to reduce the number of suppliers they deal with (variable 45), consolidate their suppliers and contracts (variable 42), and centralize control of contracts, product data, catalogs, and price updates for indirect procurement (variable 49).

Variable	F1	F2	F3	F4
VAR42	.861			
VAR49	.751			
VAR45	.708			
VAR51		.712		
VAR48		.707		
VAR47		.580		
VAR41			.815	
VAR46			.674	
VAR50			.505	
VAR43			.497	
VAR44				.796
VAR40				.735

Table 3: Factor Loadings of the Items for the Critical Success Factors for E-Procurement.

Items under CSF 2 relate with changing business practices and organizational behavior related to procurement. Individual and unit spending need to be given organizational visibility to better understand spending patterns and to assign accountability (variable 51). The power of e-procurement comes from reengineering the business processes that surround it (variable 48) not from the implementation of a software solution. After an e-procurement package has been adopted, management needs to enforce on-contract buying from preferred suppliers to optimize the initiative (variable 47).

Items under CSF 3 are concerned with employing deliberateness and intelligence in the planning for e-procurement, designing the ways in which the application will function, and extracting meaning out of purchasing data. Firms should understand the technology plans of their preferred suppliers and their ability to support e-procurement initiatives (variable 46). Subsequently, the firm should involve suppliers whom it has selected to conduct e-procurement with in its planning activities (variable 43). Prior to implementing the e-procurement package, the firm should determine, implement, and maintain the appropriate business rules that will govern the way the solution will function (variable 50). When the package is installed and starts gathering data, the firm should analyze purchasing behavior of its end users to ensure that its savings goals are met (variable 41).

Items under CSF 4 concern the information technology solution chosen for the e-procurement initiative. The firm needs to conduct cost-benefit analysis in building a solid business case for the e-procurement software and services it intends to use (variable 44). Eventually, also, the firm needs to determine a balanced catalog selection strategy and choose how to deploy buyer-managed, seller-managed, and electronic marketplace-managed catalogs (variable 40).

The value of the critical success factors is demonstrated by their ability to predict the e-procurement success measures used in the study: 1) the firm’s satisfaction with the specific supplier’s performance in terms of product quality; delivery performance; sales, service, and/or technical support; and total value received from this supplier; (2) the firm’s satisfaction with the specific supplier; and (3) the firm’s overall satisfaction with the e-procurement system used. Table 4 (page 27) shows all significant regression equations that resulted after using all four critical success factors as independent variables and all e-procurement success measures as dependent variables. Of the four critical success factors, CSF 1 appears to be the strongest in that it significantly predicted three dependent variables,

total value received from the specific supplier, supplier's delivery performance, and the average of all supplier performance indicators (i.e., product quality; delivery performance; sales, service, and/or technical support; and total value received from supplier). CSF3 also significantly predicted total value received from the specific supplier. Finally, the combination of all four critical success factors successfully predicted the total value received from the specific supplier. CSF4, though, has behaved rather unexpectedly in that it negatively predicts the dependent variable.

Significant Multiple Regression Equation:

Total Value=2.066 + .228 (CSF1) + .005 (CSF2) Received from + .239 (CSF3) - .163 (CSF4)
Supplier $R^2=.146$, $p = .047$

Significant Simple Regression Equations:

Average of All Suppliers= 3.443 + .260 (CSF1) $R^2=.067$, $p = .029$

Total Value Received from Supplier=2.60 + .309 (CSF1) $R^2=.095$, $p = .009$

Delivery Performance= 3.334 + .212 (CSF1) $R^2=.045$, $p = .076$

Total Value Received from Supplier=3.263 + .206 (CSF3) $R^2=.042$, $p = .09$

Table 4: Significant Linear Regressions Using the Critical Success Factors.

DISCUSSION

This study's findings suggest a four-pronged approach to addressing critical success factors for e-procurement. The first factor refers to the rationalization of the firm's management of its suppliers. In keeping with well-documented practice, the firm should reduce the number of suppliers with whom it intends to conduct e-procurement. It also makes sense to consolidate its suppliers and contracts to achieve significant savings and better contract terms. Finally, 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.

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. Conducting spend pattern analysis prior to business process reengineering 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 reengineered 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. Once new IT-enabled business processes are in place, the next logical step is to promote on-contract buying with preferred vendors among the firm's employees or end users. Their active participation in the reengineering effort, to begin with, is an important piece of ensuring their support for the resulting new system. At the end of the day, the one effective way to enforce on-contract buying is to design easy-to-use e-procurement systems so that employees will not perceive the need to override the new, official, automated purchasing processes put in place.

The third factor is concerned with conducting a carefully orchestrated e-procurement technology planning process with one's suppliers and using intelligence in designing the software and mining the data it produces. First of all, the firm needs to design workflow business rules that should make the e-procurement software function in accordance with desired practices. Business rules among trading partners that specify information access and privileges, context-sensitive roles, nonrepudiation, purchase order, and pricing, among others, need to be clearly defined and embedded in the software. After the package is functional and starts to gather data, end users should optimize it by mining the data it produces to lend the firm more knowledge and intelligence in maximizing savings. Understanding the purchasing behavior of end users/employees involves aggregating, cleansing, and analyzing data in the effort to identify spending areas with the highest costs and consequently, the greatest savings potential. E-procurement vendors have incorporated analytical tools to help firms track how much has been spent on certain product categories, how much has been purchased from vendors, and how efficient the procurement process has been across the entire enterprise.

The second aspect of this factor has to do with the careful selection of suppliers who are technologically prepared. The hub firm or channel master needs to continually involve valued trading partners in their evolving e-procurement planning sessions such as in the use of "supplier councils" by Harley-Davidson Motor Co.

The fourth factor has to do with the firm's actual selection of the e-procurement solution itself and the portfolio of catalogs it would need to support. 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; installation costs; service and support; and other post-acquisition costs (including all hidden costs).

Though initially a firm may need to choose one of the three general options---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 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.

The practical value of the four CSFs to a firm was demonstrated by the results of running regressions between the CSFs and the e-procurement success measures used in the study. CSF 1 which refers to managing and reducing the number of the firm's suppliers, consolidating contracts, and centralizing control of contracts, product data, catalogs, and product updates for indirect procurement, appears to have the most impact in the firm's ability to gain satisfactory levels of total value received from the supplier, delivery performance, and the average of all supplier performance indicators. Deliberate and intelligent planning for the e-procurement initiative that capitalizes on coopting suppliers, designing the appropriate business rules for the software application, and mining the data gathered by the e-procurement system also appear to lead to obtaining higher levels of total value received from the supplier.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Using factor analysis, this study has reduced a total of 12 variables into four critical success factors. Possible directions for future research would be to investigate how the CSFs are able to predict the success of different types of e-procurement initiatives utilizing a variety of business models and digital environments.

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