

December 2006

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Recommended Citation

Lee, Fei and Gebauer, Judith, "The Role of IS-Flexibility for the Management of an E-Procurement System: A Case Study" (2006).
AMCIS 2006 Proceedings. 238.

<http://aisel.aisnet.org/amcis2006/238>

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The Role of IS-Flexibility for the Management of an E-Procurement System: A Case Study

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ABSTRACT

A number of benefits of e-procurement systems have been identified by researchers and by practitioners. However, the selection of an appropriate solution from a large number of available solutions is still considered difficult in practice. Traditional cost-benefit and business strategy approaches fall short to provide guidelines regarding an appropriate, let alone optimal level of information system (IS) flexibility to support procurement processes, yet there is empirical evidence that insufficient as well as overly extensive IS flexibility can lead to sub-optimal results. In this paper, we present a case study of an e-procurement system at a Fortune 100 firm that confirms the importance of actively managing IS flexibility. We identify the expected time-frame of an e-procurement system as an important variable for the selection and the management of IS flexibility, in addition to business process characteristics that have been identified earlier as having an impact on flexibility requirements.

Keywords

E-procurement, flexibility, procurement process, uncertainty, time-frame

MOTIVATION

Enterprises face many challenges in today's fast-changing world. New technologies and globalization have created a highly competitive environment, where productivity increases and cost reductions have become major concerns. One approach to improve effectiveness and efficiency is the improvement of procurement processes, given that the purchase of goods and services is one of the largest cost factors for many businesses (e.g., Kalakota and Robinson, 2001, Turban, King, Lee, and Viehland, 2004). Many enterprises have started to replace traditional paper-based purchasing models with more effective and efficient electronic procurement (e-procurement) systems. Typical goals for the implementation of e-procurement systems include the automation and streamlining of purchasing processes, reduction of processing time, reduction of operational cost, improvement of process discipline, and enhanced visibility across supply chains (e.g., Atkinson, 2000; Kalakota and Robinson, 2001; Kheng and Al-Hawamdeh, 2002; Roche, 2001).

Despite the benefits, however, many enterprises find it difficult to select the best e-procurement solution from a large number of solutions available in the market (Atkinson, 2000, 2001). Previous research has suggested that a cost-benefit analysis approach should be used when selecting an e-procurement system, and has identified a number of tangible and intangible costs and benefits that firms should consider during the selection process (e.g., Narasimhan, Talluri, and Ross, 2003; Rajkumar, 2001). Other researchers have identified a number of key success factors for e-procurement deployment, such as support and intensive participation from top management within a firm and from the firm's suppliers (e.g., Aberly, 2002; Atkinson, 2001, 2005; Turban et al., 2004). However, some issues concerning the selection and management of an e-procurement system have not been thoroughly investigated from an IS perspective, such as the flexibility of an e-procurement system.

In general, to be effective, a system needs to be flexible and be able to accommodate a certain amount of variation regarding the requirements of a business process over time (Allen and Boynton, 1991; Boynton, 1993). Insufficient flexibility of an e-procurement system can prevent system use in certain circumstances and make exception handling necessary, and as a result jeopardize the expected benefits. In contrast, excessive flexibility of an e-procurement system can introduce complexity and usability problems, which can cause resistance from both, suppliers and a firms' own employees, as well as lead to extra cost (Koste and Malhotra, 1999; Silver, 1999; Soh, Sia, Boh, and Tang, 2003). In addition, there is empirical evidence for the failure of e-procurement implementations, where firms implemented large-scope systems when smaller systems might have been sufficient to address the business needs, in other words the firms "over-bought" (Atkinson, 2000, 2001). Since traditional cost-benefit analysis does not address the issue of IS-flexibility, it cannot provide good guidelines to answer questions such as: How should a firm choose between a comprehensive system with many pre-built functionalities and low

flexibility for changes and extensions after the initial implementation, and a more targeted system with few pre-built functionalities, but many options and high flexibility for future changes, assuming that the costs of both systems are within the IS budget? In the long run, how does the performance of systems with different levels and types of flexibility compare?

In this paper, we present the case of an e-procurement system that was implemented at a Fortune 100 firm to investigate the applicability of a theory of IS flexibility developed by Gebauer and Schober (2006). The theory proposes that the impact of IS flexibility on the cost efficiency of business processes depends on a number of business process characteristics, such as uncertainty, variability and time-criticality. In this paper, we contribute to the management of IS flexibility by identifying the need to include the expected time-frame (i.e., lifetime) of the e-procurement system as an additional factor into the analysis. In the following, we first provide a brief review of the literature on e-procurement and of the theory of IS flexibility developed by Gebauer and Schober (2006). We then present the e-procurement case study of a Fortune 100 firm as a basis to discuss the applicability of the theory IS flexibility, before we draw a number of conclusions.

ELECTRONIC PROCUREMENT

Procurement and e-procurement technologies, in general, can be classified into three general categories: (1) indirect procurement –non-production goods and services such as, office and computer supplies, maintenance, repair and operating (MRO) supplies; (2) direct procurement –production goods and services such as, raw materials, components, and assemblies; and (3) sourcing – such as the identification of potential suppliers and the evaluation and negotiation of goods and services for both direct and indirect materials supply chains (e.g., Chang, Markatsoris, and Richards, 2004; Hawking and Stein, 2004; Rajkumar, 2001). According to Atkinson (2000), the most widely used procurement-related technology tools are purchasing software, manufacturing resource planning (MRP) and MRP II software, web-based e-procurement systems, electronic data interchange (EDI), enterprise resource planning (ERP) software, and supply chain management software. Despite the expected benefits, procurement professionals often find it difficult to select and implement e-procurement systems, be the systems developed internally or obtained from external vendors (Atkinson, 2000, 2001, 2005). Failures of e-procurement system implementations have been attributed to vendors over-promising on returns on investment (ROIs), lack of supplier participation, in particular in the case of small and medium-sized suppliers, and lack of sufficient technical support. From the viewpoint of the implementing firm, e-procurement solutions vendors often promise too much but deliver too little or too late (e.g., Abery, 2002; Atkinson, 2001; Turban et al., 2004).

Previous research has identified a number of success factors for e-procurement deployment, such as support from top-level management, training, and incentives to enhance adoption by both suppliers and employees within the firm (Abery, 2002; Atkinson, 2005; Rajkumar, 2001; Turban et al., 2004). From an IS budget perspective, Narasimhan et al. (2003) propose a two-phase approach for evaluating alternative e-procurement solutions by considering a variety of strategic, tactical and operational factors. Phase I involves an initial screening of potential e-procurement vendors and Phase II involves an in-depth cost-benefit analysis by utilizing a value metric. Narasimhan et al. (2003) suggest that it is important for enterprises to recognize both tangible and intangible costs and benefits of e-procurement deployment. They further conclude that the selection of an e-procurement solution would be sub-optimal if “intangible” costs and benefits were not included in the evaluation process. Others have point out the shortcomings of focusing on software and licensing cost of an e-procurement system, while omitting the assessment of hidden and less visible costs, such as user training, integration with legacy system, and transaction and consulting costs (Chang et al., 2004; Rajkumar, 2001).

Compared to a fair amount of research studies on the selection, deployment, and management of e-procurement systems from both a business strategy perspective and from an IS budget perspective, research studies at the system level are relatively rare. At the same time, however, there is empirical evidence that the complexity resulting from excessive functionality of an e-procurement system can lead to usability problems. For example, Atkinson (2000, 2001) found that while some purchasing professionals complained about the fact that the powerful systems increased the time to process invoice information, others reported failure to train the employees in how to fully utilize their systems. In addition, a high level of customization (= flexibility) can lead to problems related to system maintenance and upgrading. As one purchasing manager put it, “it seems that when you find a flaw in a program, no one wants to fix the version you have. They tell you the problem will be fixed in the next version. But then, if you want the next version, it requires additional costs, and none of the customization you’ve done on your version will work with the next version” (Atkinson, 2000. p.61). Even after a cost-benefit analysis has been conducted, a number of important questions may remain open, such as (1) What level and kind of functionality should be to be included in the system (i.e., extensive pre-built functionality yet little flexibility to change vs. limited pre-built functionality yet high flexibility to change)?; and (2) How much additional flexibility is required to change and extend the system after its initial implementation?

IS FLEXIBILITY

Economists have long conceptualized and modeled the value of flexibility on an abstract level (Black and Scholes, 1973; Stigler, 1939). Previous research has viewed flexibility as a concept that is multi-dimensional and polymorphous (Evans, 1991; Upton, 1994), and has focused frequently on the concept of flexibility as such, and on its effects on organizations (Aaker and Mascarenhas, 1984; Volberda, 1997) and on business processes, in particular manufacturing processes (e.g., Sethi and Sethi, 1990; Upton, 1994). In the research discipline of IS, flexibility has been linked to operational efficiency and to organizational flexibility (Boynton, 1993). Palanisamy and Sushil (2003) define IS flexibility as the capacity of the information system to change or to adapt and adjust in response to new conditions, demands, and circumstances within a firm.

Two Types of IS Flexibility

Gebauer and Schober (2006) studied the impact of IS flexibility on the cost efficiency of a given business process, and identify two types of IS flexibility: (1) flexibility-to-use, defined as the range of process requirements that is built into the IS and supported without requiring a major change, and that is enabled by four main components: system functionality, scope of the underlying database, user interface, and processing capacity; and (2) flexibility-to-change, defined as the effort required to change a given IS after its initial implementation, and enabled by knowledgeable IS staff, integration of data and functionality, and modularity of system components. In the case of an e-procurement system, firms often require integration with existing backend ERP and database systems. Insufficient technical support from IS staff within the firm and outside (vendor) can slow down and delay the implementation and integration process. In other words, limited IS flexibility-to-change can result from a lack of access to knowledgeable IS staff (Atkinson, 2001, 2005; Chang et al., 2004; Narasimhan et al., 2003; Rajkumar, 2001).

In their theoretical model of IS flexibility, Gebauer and Schober (2006) focused on three business process characteristics that were proposed to have an impact on the requirements for IS flexibility: uncertainty, variability, and time-criticality. Uncertainty refers to the difficulty to predict the tasks and resources required to perform the business process in a particular instance. Variability of a business process is determined by the number of *actual* process occurrences in relation with the number of all *possible* process occurrences (depicted by a Lorenz curve). Time-criticality refers to the questions of how urgent it is to perform a procurement operation promptly, and how urgent it is for a firm to adopt an information system. Gebauer and Schober (2006) presented an economic model to assess the impact of IS flexibility on process cost efficiency. In the model the authors suggested that flexibility-to-use is cost efficiently deployed to support a business process characterized by a low level of uncertainty, whereas a high level of process uncertainty corresponds efficiently with flexibility-to-change given the higher pay out of the extra investment. Gebauer and Schober's (2006) model further indicates that high process variability tends to limit the value of an IS over manual operations, whereas a high level of time-criticality of process requirements tends to increase the value of an IS over manual operations.

THE SUCCESS STORY OF AN E-PROCUREMENT SYSTEM

In this paper, we use the e-procurement implementation at a Fortune 100 manufacturer of electronic products to examine the applicability of Gebauer and Schober's (2006) theoretical framework to a practical case. Information was collected during several on-site visits, in-person and phone interviews with e-procurement professionals at managerial and at operational levels. Overall, the case represents an e-procurement implementation that is fairly typical and that resembles many examples reported elsewhere, in terms of motivation, pre-adoption business challenges, and post-adoption performance (e.g., Atkinson, 2001, 2005; Avery, 2004; Minahan and Degnan, 2001). Similar to the situations at other firms, the procurement process at the Fortune 100 firm was traditionally paper-based and labor-intensive, as well as highly decentralized. The procurement structure resulted in low visibility not only within the firm but also across the supply chain. For example, no single group was responsible for the indirect procurement process (i.e. non-production goods and services) and thus, related purchasing requests were often processed separately at different sites and functional domains (e.g., materials and manufacturing). Reported problems included poor control, low visibility, high administration costs, high fragmentation, and a significant level of maverick purchases.

In the mid 1990s, and prior to implementing its e-procurement solution, the firm conducted both a quantitative and a qualitative analysis on its indirect procurement patterns in order to enhance the understanding of the procurement function and in order to help prioritize the e-procurement focus areas. In other words, the firm thoroughly evaluated how much it spent (transaction value), on what items, from which suppliers, and how frequently it purchased (transaction volume). The spend analyses provided the basis to identify opportunities for improvements of the procurement process in terms of process re-engineering and automation, and for improvements of sourcing strategies and commodity management. Typically, high value

categories, called for improvement at the sourcing side, whereas high frequency (volume) categories were considered good candidates for process improvement. The sweet spot for an automated procurement solution was seen in the category of high value/high frequency categories, including computers, office equipment, furniture and services, where the project team expected benefits from a combined effort of sourcing improvement (e.g., renegotiations of supplier contracts) and process redesign supported by information technology. For the category of low value/high frequency categories, such as office supplies, industrial supplies, software and communication services, a focus on process improvement was considered most promising, consisting of measures to eliminate manual steps to perform procurement activities and to improve the level of process standardization.

In the late 1990s, a decision was made to adopt a web-based e-procurement system, including an electronic catalog and online ordering features, with the objectives to start automating, consolidating, and standardizing the procurement process, to save processing time and cost, to leverage and manage the supply chain, and to enhance visibility and communications. The selected vendor was a recent software startup with a focused (best-of-breed) business-to-business solution. The initial system was small and focused on the automation of purchase order processing for a limited set of products (e.g., office supplies, computer equipment), while other documents, such as receipts, were continued to be processed directly within the enterprise resource planning (ERP) system. Links between the e-procurement system and the ERP's accounts payable and human resources modules were established. As a result, the initial e-procurement system included only two catalogs and was limited to fifty end users, yet given the small size it was deployed in record time. After approximately one year of pilot testing, the system was grown to cover a total of fifteen catalogs and about 5,000 end users. By the early 2000s, more than 17,000 employees from over 250 locations in 13 countries used the system and about 6,500 suppliers had participated in the firm's e-procurement practices. The system then covered about 450 catalogs with more than 300,000 items online. After a period of altogether ten years the e-procurement system now (2006) covers the entire procurement process from requisition to purchase order and is deployed for all MRO-buying within the firm worldwide. Per year, several hundred thousand orders are processed by the e-procurement system adding up to several billion dollars in transaction value and producing several hundred millions of dollars in cost savings. Recently, the firm has added electronic sourcing and negotiation modules with features, such as sourcing, auction, ordering, and supplier collaboration. Plans for the near future include the launch of more strategic e-procurement modules such as contract management and supplier performance management.

Overall, the e-procurement system is considered a success, as it allowed the firm to achieve its initial goals, including the standardization and streamlining of the procurement process, and as it resulted in broad usage throughout the organization, and in significant cost savings. Figure 1 shows timeline of the e-procurement system development.

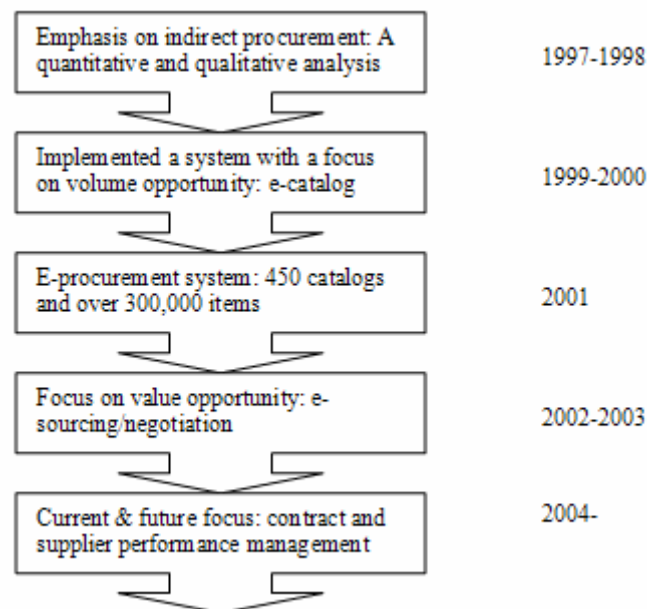


Figure 1. The E-Procurement System Development of the Fortune 100 Firm

E-Procurement System Flexibility

As one of our interview partners, an e-procurement project manager, indicated, important e-procurement success factors included usability, user-friendliness, functionality, and system modularity. The e-procurement solution now allows for the support of many different types of purchasing and provides the different teams in the firm with the flexibility to buy goods and services “in any way they want to buy”. The firm generally strives to increase the usage of the e-procurement system by its employees as well as by its suppliers. Over time, a learning process has occurred where increased usage led to improved knowledge, skills, and experience, which then became the basis for subsequent system improvement and management. Additional modules that were added to the e-procurement system most recently include contract management and improved spending analysis.

Throughout a period of approximately ten years, the firm gradually added new and well-selected modules to the initial e-procurement system. Modules that have not yet been added but may be added in the future include invoicing and sourcing. Overall, the firm deployed a policy that one interview partner summarized as follows: “First we wait out for buggy releases. And we also want to wait for a while and look for the best time to jump in (adopt more modules). There is also a negotiation involved to adopt any module since we want to eliminate any potential risk through an appropriate contract”. The interview partner further indicated that modification to the current e-procurement system tends to be complicated in nature. For example, besides the reporting tool, a web-based negotiation tool has been recently added to the system. In this process, it turned out that the modifications required by the firm’s particular implementation tend to increase the complexity related with system expansions. The modifications require a significant amount of custom code for each new module, which tends to be difficult and time-consuming. Therefore, new modules are typically added only when the current modules are considered to be mature enough. The manager indicated to exercise the options to “expand the system further, only if we are more mature in operationalizing the current tools.”

Over time, the firm has in fact developed quite mature support operations featuring ramp-up procedures to facilitate supplier enablement, data management to manage the interfaces between data and tools, a core IT-group in charge of continuous upgrades, and call-center support for users. All of these elements ensure the firm’s ability to continuously improve the system, to continue to learn about suppliers, and to continue to lower spend in an ever more complete e-procurement environment. The system builds on a modular architecture and relies on knowledgeable IT staff to perform customization. Integration with the ERP-solution and additional flexibility are provided to the firm through the extensive customization of the system modules.

DISCUSSION AND FUTURE RESEARCH

In order to determine the applicability of Gebauer and Schober’s (2006) theory of IS flexibility to the case study just described, we need to determine (a) the nature of the underlying e-procurement business process, (b) the nature of the IS flexibility deployed, and we need (c) an indicator of system success. To start out with the third element (c), the system has been considered a success as determined by the high number of active users, ratio of spend covered, continued cost savings, and continued support from top-management. Regarding the first element (a), the underlying process of MRO-procurement can generally be characterized as well understood and stable, in other words, of low uncertainty, as pointed out in the literature (Minahan and Degnan 2001), and as confirmed by our interview partners. Regarding the second element (b), the e-procurement system implemented at the Fortune 100 firm incorporates a significant amount of flexibility-to-change, enabled by a knowledgeable IS staff, modular system architecture and integration with complementary enterprise systems. Instead of implementing the system to full extent at one point in time, an iterative approach was used to gradually cover more and more instances of the procurement process. New modules were added not in reaction to new knowledge about the environment but following the maturity of the software modules that were provided by the software vendor, and following the lessons learned from the implementation of earlier modules, a process that has been ongoing for now more than a decade.

At first glance, the findings from the case study contradict Gebauer and Schober’s (2006) propositions regarding the optimal focus strategies for IS flexibility. Gebauer and Schober (2006) proposed that a business process with low-uncertainty (i.e., stable and structured in nature) should be supported cost efficiently with an IS with a focus on flexibility-to-use. In the reported case, however, a relatively stable process (i.e., low uncertainty) was supported by a successful e-procurement system that was based on flexibility-to-change. A deeper look at the case reveals that the firm could only afford a significant amount of change throughout the prolonged implementation period because the low level of procurement process uncertainty provided the firm with the opportunity to apply a long timeframe. While the firm started out with a relatively small system, in an attempt to automate purchase order processing, over time, the system grew into one that now covers a broad range of the procurement procedures.

The contradictory findings of Gebauer and Schober (2006) and the current case study can be resolved if expected “system time-frame” (i.e., system lifetime) is included into the analysis, in addition to the three previously identified business process characteristics of uncertainty, variability, and time-criticality. We suggest that in a situation of low process uncertainty, such as in the case of MRO processing a firm is likely to opt for an IS that is characterized by high flexibility-to-change in combination with a long projected time-frame. Given that systems changes will be complicated and time-consuming, the firm can benefit from the learning curve associated with the changes. We also suggest that in a situation of high process uncertainty, a firm is likely to opt for a solution that is characterized by flexibility-to-use in combination with a short time-frame. In a situation where it is difficult to predict process needs, the firm might be better off with a solution that covers its current needs in a timely manner, followed by the swift implementation of a new system in reaction to environmental changes.

In summary, we identified a need to analyze IS flexibility as a complement to traditional cost-benefit analysis, when selecting and managing an e-procurement system. We used a typical and successful case of an e-procurement system to examine the applicability of Gebauer and Schober’s (2006) theoretical framework regarding the practical role of system flexibility for the success of e-procurement systems. We identified the projected “system time-frame” as an important aspect that should be included in the analysis and operationalization of IS flexibility, in addition to the process characteristics of uncertainty, variability and time-criticality that were proposed by Gebauer and Schober (2006). Our findings show that a more refined notion of time can enhance the applicability and validity of Gebauer and Schober’s (2006) theoretical model of IS flexibility. Further research is required to solidify and to operationalize the results reported in the current study.

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