Enterprise System Flexibility and Implementation Strategies−Aligning Theory with Evidence from a Case Study

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Abstract

Flexibility can have important consequences for the operational efficiency and long−term effectiveness of an enterprise system, yet is often not considered explicitly as a decision factor during system design and implementation. In this article, we join managerial advice for implementation strategies with insights from a theory that determines the flexibility requirements of an enterprise system in relation with characteristics of the business process that the system is intended to support. We align our theoretical considerations with practical evidence from the case of an electronic procurement system that was implemented at a Fortune 100 firm. Based on our findings, we present a roadmap that can guide flexibility and implementation strategies based on both project and process characteristics.

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ENTERPRISE SYSTEM FLEXIBILITY AND IMPLEMENTATION STRATEGIES – ALIGNING THEORY WITH EVIDENCE FROM A CASE STUDY

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ABSTRACT

Flexibility can have important consequences for the operational efficiency and long-term effectiveness of an enterprise system, yet is often not considered explicitly as a decision factor during system design and implementation. In this article, we join managerial advice for implementation strategies with insights from a theory that determines the flexibility requirements of an enterprise system in relation with characteristics of the business process that the system is intended to support. We align our theoretical considerations with practical evidence from the case of an electronic procurement system that was implemented at a Fortune 100 firm. Based on our findings, we present a roadmap that can guide flexibility and implementation strategies based on both project and process characteristics.

Keywords: Enterprise system, flexibility, implementation, project management, electronic procurement system, case study, business process characteristics

Companies implement enterprise information systems to support business processes, such as supply chain management, customer relationship management, and procurement, and to "restructure interactions among groups of employees or with business partners" (McAfee, 2006, p. 145). Empirical evidence suggests a positive net impact of enterprise systems on financial performance (Hitt, Wu & Zhou, 2002), and on the market value of a firm, in particular in cases where a firm announces large-scale projects (Ranganathan & Brown, 2006). At the same time, however, the size and complexity of enterprise systems is associated with many risks, and enterprise systems are consequently notorious for the difficulty associated with their implementation and project management (Davenport, 1998). To ensure implementation success, experts in research and practice emphasize the need to account for various system-related technical, organizational and legal factors, as well as for the interrelations between these critical factors (Brown & Vessey, 2003; Grossman & Walsh 2006; King, 2005; McAfee, 2006; Robey, Ross & Boudreau, 2002). Recommended implementation strategies range from the complete implementation of a system within a short period of time ("big bang") to incremental implementation based on a phased approach over an extended period of time (Brown & Vessey, 2003). Factors that impact the recommended implementation strategy include technology maturity and availability of project knowledge; project size and complexity; and project-external risk, resulting for example from personnel turnover and unanticipated events that occur after a project has gone underway. Selecting an implementation strategy is challenging because of a number of uncertainties and trade-off effects that need to be taken into consideration: For example, a situation of limited knowledge about an immature technology might suggest a phased roll-out to facilitate a learning process, whereas a high risk for personnel turnover might at the same time point to the need for a swift and complete implementation with quick results. Decision makers can benefit from support with identifying the factors that are relevant to implementation, and with determining expected interactions and resulting impacts on the project results.

The implementation process is logically preceded by system development where decisions are made regarding the scope and inherent flexibility of a system that will support a given business process over time. To be effective and efficient, an enterprise system needs to be flexible, that is, cover a certain range of functions and features and allow for variation over time (Allen & Boynton, 1991; Boynton, 1993; Prager, 1996). Similar to implementation-related decisions, the decisions related to flexibility are typically not straightforward. On the one hand, insufficient flexibility limits system usage and may require manual operations, thereby jeopardizing the anticipated benefits (Koste & Malhotra, 1999; Soh, Sia, Boh & Tang, 2003). On the other hand, excessive flexibility unnecessarily increases system complexity, and can lead to extra costs and usability problems, followed by adoption resistance from users (Silver, 1999).[1]

Despite the potentially significant impact of flexibility on the long-term success of an enterprise system, the economic value of flexibility is only rarely acknowledged (Kumar, 2004). Thus, system project managers find little guidance of how to determine an appropriate, let alone optimal extent of system flexibility (Gebauer & Schober, 2006). Few practical guidelines are given of how to choose between systems that differ with respect to initial scope and expandability (McAfee, 2006), and there are no clear answers to questions, such as: How should a firm choose between a comprehensive system that provides extensive pre-built functionality but comparatively less flexibility for future change, and a more targeted system that provides limited pre-built functionality but comparatively more flexibility for future change?; How much functionality should be included in an enterprise system initially?; and In the long run, how does the performance of a comprehensive yet less flexible system compare to that of a targeted yet more flexible system?

To address the stated questions and to provide managerial guidance for enterprise system implementation projects, this article joins results from (1) implementation research with (2) a theory that determines the flexibility requirements of an enterprise system based on the characteristics of the supported business process. After outlining the theoretical background, we illustrate the combined theories with the case of an electronic procurement system that was implemented at a Fortune 100 firm. Based on our findings, we present a roadmap that can guide flexibility and implementation strategies taking into consideration both project and process characteristics.

THEORETICAL BACKGROUND

We build our theoretical concept on research work in two areas: enterprise system flexibility, and implementation strategies. Our goal is to provide guidelines for the development and implementation of an enterprise system to support a given business process cost-efficiently over the lifetime of the system.

Flexibility

Economists have long conceptualized and modeled the value of flexibility on an abstract level (Black & Scholes, 1973; Stigler, 1939). Scholars of strategy and management have viewed flexibility as a concept that is multi-dimensional and polymorphous (Bahrami & Evans, 2005; Evans, 1991), and have focused on the effect of flexibility on organizations (Aaker & Mascarenhas, 1984; Leeuw & Volberda, 1996; Volberda, 1997) and on business processes, in particular manufacturing processes (Gerwin, 1993; Sethi & Sethi, 1990; Upton, 1994; Upton, 1997).

In the research discipline of information systems, flexibility has been described as the capacity of an information system to adapt and to support and enable organizational change, and has been linked to operational efficiency and to organizational nimbleness (Allen & Boynton, 1991; Palanisamy & Sushil, 2003; Prager, 1996). It has also been demonstrated that knowledge management applications can provide an organization with greater flexibility that is manifested, for example, in the capability for innovation (Newell, Huang, Galliers & Pan, 2002).

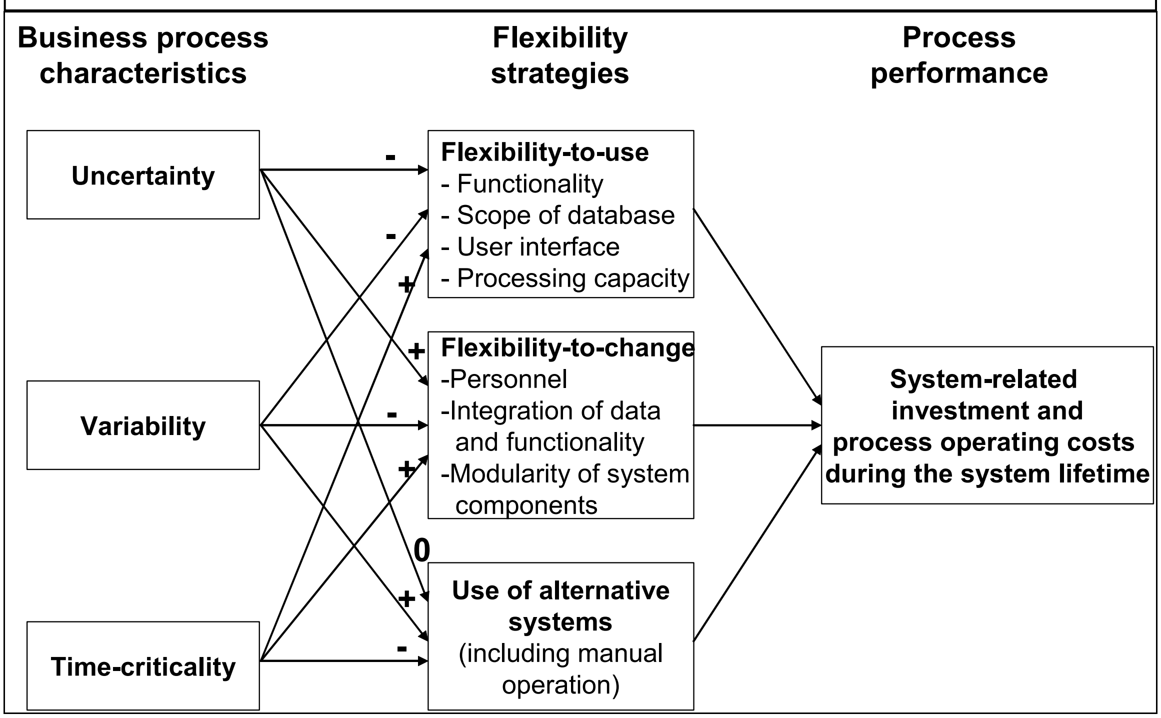
Infrastructure Flexibility

Researchers refer to the basic elements of corporate information technology architectures as information infrastructure, and emphasize the important role of infrastructure as an enabler of flexibility inasmuch as it supports a wide range of applications, business processes, and strategies (Broadbent & Weill, 1999; Strnadl, 2006; Weill, 1993). Related are research studies that viewed information technology infrastructure as a real option that creates the possibility, but not the obligation, of future changes to the use of information technology in an enterprise (Amram & Kulatilaka, 1999; Fichman, 2004; Tallon, Kauffman, Lucas, Whinston & Zhu 2002). The flexibility of information technology infrastructure has been associated with a number of dimensions, for example "platform technology" that enables connectivity, systems integration, and data storage; knowledgeable staff and available skills; and basic processes (Byrd & Turner, 2000; Duncan, 1995; Kumar, 2004). Researchers have assessed the value of information technology infrastructure similar to financial assets (Kumar, 2004), established the impact of information technology infrastructure on competitive advantage (Byrd & Turner, 2000), and emphasized the need to form synergies between business strategy and information technology architecture, such as with the development of corresponding organizational competencies (Ross, 2003).

Enterprise System Flexibility

Gebauer and Schober (2006) focused on the economic value of flexibility and presented a theory of the impact of enterprise system flexibility on the cost efficiency of a given business process throughout the lifetime of the system (Figure 1). Building on the research work of Hanseth, Monteiro, and Hatling (1996), Gebauer and Schober (2006) distinguished between two types of flexibility: *Flexibility-to-use* relates to the range of process activities that is built into an enterprise system and that is supported without requiring a major change to the system. From a user perspective, flexibility-to-use manifests itself primarily in system scope, including functionality, underlying database, user interface, and processing capacity. In contrast, *flexibility-to-change* is conceptually related with information technology infrastructure and is measured by the effort that is required to change a given enterprise system after its initial implementation. Flexibility-to-change is a result of factors, such as the use of open and modular systems (Byrd & Turner, 2000; Kumar, 2004); structured data connectivity and integration of data and functionality (Byrd & Turner, 2000; Gosain, Malhotra & ElSawy, 2005); and knowledgeable staff (Byrd &Turner, 2000).[2]

FIGURE 1 – Theory of enterprise system flexibility (Gebauer & Schober, 2006)



Gebauer and Schober (2006) suggested three characteristics of a business process to impact the requirements of system flexibility in relation with overall system efficiency, namely uncertainty, variability, and time criticality. Process uncertainty refers to the difficulty to predict the tasks and resources that are required to perform the business process in a particular instance. Uncertainty is the result of both a lack of structure of a business processes that is ambiguous and requires considerable judgment from a decision maker (e.g., "one-off" situations); and of the difficulty to predict process requirements in dynamic business environments (Kumar, 2004). With Gebauer and Schober (2006), we suggest process uncertainty to be an important determinant of the flexibility strategy, and propose:

Proposition A: *Uncertainty Effect: A business process characterized by low uncertainty can be supported cost efficiently with an enterprise system that is based primarily on flexibility-to-use, whereas a business characterized by high uncertainty can be supported cost efficiently with an enterprise system that is based primarily on flexibility-to-change.*

Process variability is determined by the number of actual process occurrences in relation with the number of all possible process occurrences, in other words, the distribution of different process activities over time. Variability is shown to be particularly helpful to help determine the proposed scope of the enterprise system, whereby activities that occur most frequently would be included in the system with highest priority (Kumar, 2004). With Gebauer and Schober (2006), we propose:

Proposition B: *Variability Effect: A business process characterized by low variability can be supported cost efficiently with an enterprise system (independent of the flexibility strategy), whereas the cost efficient performance of a business process characterized by high variability may not warrant the inclusion of all different process tasks.*

Time-criticality refers to the question of how urgent it is to perform process-related operations promptly. Assuming that the use of an enterprise system generally has a positive effect on the promptness with which an operation can be performed, time-criticality is shown to be helpful to determine the proposed scope of the enterprise system, whereby activities that are most time-critical would be included in the system with highest priority. With Gebauer and Schober (2006), we propose:

Proposition C: *Time-Criticality Effect: A business process characterized by high time-criticality can be supported cost efficiently with an enterprise system (independent of the flexibility strategy), whereas in a business process characterized by low time-criticality, the enterprise system investment may not outweigh the cost premium to be paid for tasks that are performed outside of the system.*

Based on an economic analysis of the research model, Gebauer & Schober (2006) discussed the suggested impact of enterprise system flexibility on process cost efficiency that included the investments required to implement, operate, and change the enterprise system throughout the system lifetime, as well as the costs related to process performance via alternative measures (e.g., manual operations). The authors suggested that a system relying predominantly on flexibility-to-use is cost efficiently deployed to support a business process that is characterized by a low level of process uncertainty, whereas a high level of process uncertainty is supported efficiently with a system that relies predominantly on flexibility-to-change given the higher pay out of the extra investment. The overall scope of the system is to be determined based on the extent of variability (lower variability, larger scope), and time-criticality (higher time-criticality, larger scope).

Implementation Strategies

Gebauer and Schober (2006) analyzed the decisions related to enterprise system development in two periods. During the first period the system is initially designed, and during the second period the system is used and possibly changed. The theory provides guidelines to designers of enterprise systems regarding the cost-efficient scope (flexibility-to-use) and expandability (flexibility-to-change) of a system. However, even though it pertains to two periods, Gebauer and Schober's (2006) model is static inasmuch as it does not consider the dynamics of the implementation process that occur subsequent to the initial design and decisions regarding system flexibility, and during the second period. As a result, it remains unclear how a recommended flexibility strategy should practically be established during system implementation and how the success of a given project can be ensured. Such guidelines may be obtained from previous research studies of enterprise system implementation and project management. In the following, we build on the results of a research study that was presented by Brown and Vessey (2003).

Brown and Vessey (2003) examined a number of cases of comprehensive implementations of enterprise resource planning systems (i.e., a very complex form of enterprise systems). As part of their analysis, Brown and Vessey (2003) compared the benefits and limits of two implementation strategies, namely implementation that is conducted in full with a "big-bang", and implementation that is conducted incrementally in phases over a longer period of time. According to Brown and Vessey (2003), the chosen strategy "largely determines the timeline for the project and the complexity of the project" (p. 68) and a "satisficing mindset" is required to comprehensively assess the various trade-offs, for example between project-related risk and project-external risk. Other things being equal, a phased roll-out is recommended for situations where knowledge about the technology is low, for example because of technical immaturity and unavailability of external consultants; where size and complexity of the system are high, for example because of large scope in terms of functionality and roll-out locations; and where there is comparatively low project-external risk of personnel turnover and other unanticipated events that would have warranted a swift implementation. In contrast, Brown and

Vessey (2003) showed that a full roll-out of an enterprise system in a short period of time can be the better choice in cases where technology maturity is high and expertise available; where scope and complexity of the system are limited; and where project-external risks of personnel turnover and unanticipated events are high, possibly exceeding the risk inherent in the project. We rephrase the results of Brown and Vessey's (2003) research study in the form of three propositions:

Proposition D: *Maturity Effect: An enterprise system that is based on technology that is well-understood (e.g., because of general maturity or the availability of external knowledge) may be implemented with a "big bang", whereas an enterprise system that is based on technology that is not well-understood should be implemented in phases to create a learning experience.*

Proposition E: *Complexity Effect: An enterprise system that is small (e.g., because of limited functional or physical scope) may be implemented with a "big bang", whereas an enterprise system that is large should be implemented in phases.*

Proposition F: *Risk Effect: An enterprise system that faces high project-external risk because of the possibility of personnel turnover or unanticipated events should be implemented swiftly with a "big bang", whereas an enterprise system that faces low project-external risk may be implemented in phases.*

To examine the practical applicability of the stated propositions, the next sections present and discuss the case of an electronic procurement system that was implemented at a Fortune 100 company. We begin with a description of the research methodology.

METHODOLOGY

Electronic Procurement

For many businesses procurement represents one of the largest cost factors (Kalakota & Robinson, 2001). Professionals and researchers often distinguish between the procurement of material that becomes part of the finished product (i.e., direct procurement), and the procurement of the many items and services that generally support business operations (i.e., indirect procurement). For many years, managers have recognized the strategic relevance of direct procurement, and have consequently developed advanced supply chain practices that included the early deployment of information technology, such as electronic data interchange. With the emergence of internet-based information technology, however, the benefits of electronic procurement systems to automate, streamline and increase the effectiveness of indirect procurement processes have increasingly been recognized (Gebauer, Beam & Segev, 1998; Minahan & Degnan, 2001; Rajkumar, 2001). Still, managers often find it difficult to select and implement an appropriate system from a large number of solutions available in the market, and empirical evidence suggests that the success of electronic procurement projects may be limited in cases where firms “over-buy” relative to what they really need to support the procurement process (Atkinson, 2000). In addition, a high level of customization may result in problems related to system maintenance, upgrading, and user training (Atkinson, 2001).

Data Collection

In order to assess the practical applicability of the stated propositions of flexibility and implementation strategies, we focus on an enterprise system that was implemented at a Fortune 100 firm to streamline and automate the procurement of non-production goods and services (indirect procurement). Case study data were collected through ongoing interaction with various members of the procurement project team over a period of several years. Data collection included formal and informal interviews that were conducted on site and per telephone and documented with notes and transcripts; interaction with project team members at practitioner conferences and seminar presentations; and screening of public and internal documents that were made available to us. Most recently, and in preparation for the current research study, a one-hour formal interview was conducted with a former leading project manager. The interview was transcribed and reviewed by the interview partner as well as by a senior procurement manager and members of the technical team that is currently managing the system.

CASE STUDY: AN ELECTRONIC PROCUREMENT SYSTEM

Corporate Background

As a global provider of communication technology, the Fortune 100 firm operates in a number of dynamic and highly competitive markets. Headquartered in the U.S., the firm had 60,000 employees worldwide in 2006, and reported sales in excess of 40 billion dollars. Traditionally, the organizational structure was highly decentralized with a multitude of divisions, and business units that operated quite independently, and were encouraged to "demonstrate entrepreneurship". In the mid 1990s, the need to improve performance resulted in the launch of a major corporate program with the intent to (1) improve the leverage of corporate assets, including buying power; to (2) standardize business processes across the organization; and to (3) reduce process inefficiencies with the use of information technology. In 1998, an enterprise resource planning system was implemented to support accounting and human resource functions that became an important basis for subsequent projects, including the implementation of supply chain management and non-production procurement systems.

Procurement Background

The procurement process for non-production goods and services at the firm was traditionally paper-based, labor-intensive, and highly decentralized, with the result of low visibility within and between organizational units and across the organizational boundary. In all, the firm did business with as many as 50,000 suppliers and partners. No single organizational group was responsible for the procurement of the large variety of indirect goods and services, and thus, related purchasing requests were often processed separately at different sites and business units. The situation resulted in poor control, high operational and administrative costs, and a significant level of maverick (out-of-contract) purchases.

In order to improve the understanding of its purchasing patterns the project team conducted both a quantitative and a qualitative spend analysis of the indirect procurement process. During the analysis it was assessed how much the firm spent (transaction value), on what items, from which suppliers, and how frequently it purchased (transaction volume). The analysis results helped identify opportunities for improvements based on three elements: sourcing and commodity management including the re-negotiation of supplier contracts with the intent to improve the leverage of corporate purchasing power; process redesign and standardization; and the deployment of information technology for automation and data analysis. Typically, product categories of high value called for improvement at the sourcing side, including efforts to improve access to information about purchasing activities. In comparison, product categories of high frequency (volume) were considered good candidates for process improvement, including standardization and technology-supported automation (Rajkumar, 2001).

Procurement System

In 1997, a decision was made to implement a corporate-wide system to support the non-production procurement process. Following a request for proposals, the offerings of about a dozen vendors were evaluated according to functional requirements in accordance with the results of the spend analysis; non-functional requirements, such as usability; fit with existing technology infrastructure to ensure modularity; and vendor capabilities. The resulting shortlist was then further evaluated based on customer references. Eventually, a recent software-startup was selected that offered a targeted, "best-of-breed" solution.

Despite the far-reaching goal to cover the entire procurement process, the implementation began in 1999 with a small system that was deployed to approximately fifty users in the U.S., and focused on the automation of purchase order processing for items from two catalogs (office supplies and computer equipment). Links were established with the accounts payable and human resource modules of the enterprise resource planning system. Because of its small size, the initial deployment was completed in the record time of six weeks, subsequently followed by continuous expansion to more users and locations, including international locations. After approximately one year, the system had grown to include 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 that now included 450 catalogs with more than 300,000 items from a total of 6,500 suppliers. More recent additions include a separate module that was added in 2003 to streamline and digitize the procurement of complex services (e.g., consulting), followed by modules for spend analysis and reporting; sourcing; and negotiation with features, such as auctions, ordering, and supplier collaboration. Plans for further extensions of the procurement system included the launch of additional strategic modules to support contract management and compliance, as well as electronic invoicing and supplier performance management.

After about eight years, the system covered the entire procurement process from requisition to purchase order and was deployed for the purchases of all maintenance, repair and operations (MRO) items within the firm worldwide. Additional expansions to the system became increasingly difficult to justify, as described by the project manager: “The problem is that, over time, the benefits of the electronic procurement system tend to become intangible and do not show up in a timely manner. One cannot put an actual dollar value on a good procurement system and the system does not always get credit for good performance. The excitement for the electronic procurement system tends to wane over time.”

System Flexibility and Implementation Strategy

The non-production electronic procurement system described in the previous sections exhibited elements of both flexibility-to-use and flexibility-to-change. Implementation was based on an iterative, phased roll-out.

Over a period of more than eight years, considerable scope of the system was built up gradually and with the objective to develop an environment that supports many different types of purchasing. As one project manager put it, “flexibility[-to-use] refers to the ability to provide different teams in the firm with the ability to buy stuff in any way they want to buy.”

The implementation of the system was gradual, whereby new modules were added after careful selection to mitigate project-risk, as explained by the project manager: “We wait out the buggy releases and look for the best time to jump in. A negotiation process is involved with the adoption of any new module since we want to eliminate any potential risk through an appropriate contract.” The manager also indicated that modifications to the system were often complicated and lengthy as a result of customizations that had been implemented in order to account for firm-individual conditions. For example, during the addition of a web-based negotiation tool, it turned out that modifications that had been made throughout the earlier implementation process resulted in the need to manually adapt a significant amount of customized code, which complicated the effort and increased the length of time required for the changes. Given the complexity related with expansions, new modules were typically added only when the project team felt "mature in operationalizing the current tools".

The multi-year evolutionary approach was enabled by several elements that are associated with flexibility-to-change. For example, the project team included into the initial selection of the system the modularity of the software architecture that pertained to both the ease to connect the procurement system to the corporate enterprise resource planning system, and the ease to possibly disconnect the procurement system partly or fully in case that a better solution became available. In addition, internal expertise was developed deliberately over time through a learning process where increased system usage contributed to knowledge, skills, and experience among users and system managers, which in turn provided a basis for further system expansion and improvement. The resulting set of fairly mature support operations featured ramp-up procedures to facilitate supplier enablement, procedures to manage the interfaces between data and tools, a core technology group in charge of continuous upgrading, and call-center support for users.

System Performance

The electronic procurement system was considered a success within the firm, as determined by reduced transaction processing time; improved accuracy and ready availability of procurement data; a good fit with business needs; a significant ratio of spend covered; a large number of active users; and an increasing level of user satisfaction over time (Gribbins, Subramaniam & Shaw, 2004, Shaw & Subramaniam, 2002). Per year, several hundred thousand orders were processed by the system adding up to several billion dollars in transaction value and resulting in several hundred million dollars in cost savings. While employees were provided with the opportunity to purchase and receive goods and services in many different ways, the system also enabled the firm to standardize and streamline the procurement process in line with the initial project goals.

DISCUSSION

We now discuss the electronic procurement case study with respect to the six stated propositions related to both process and project characteristics. We then align our theoretical considerations with the practical findings, and present a roadmap to support decisions regarding system flexibility and implementation strategies.

Propositions

A – Uncertainty: Reflecting its role to support the operations of a firm, non-production procurement is generally perceived to be well understood and stable, and typically based on highly structured procedures (Minahan & Degnan 2001). The perception was confirmed by our interview partners who asserted that procedural and environmental process uncertainties have not been a dominant decision factor during the design or implementation of the electronic procurement system. Uncertainty was of initial concern, however, as a result of deep process fragmentation, and limited availability of detailed historical purchasing data. As outlined earlier, the early analysis of purchasing patterns in the form of transaction values and volumes served the objective to address this type of process uncertainty and resulted in a better understanding of the process requirements. Overall, the level of process uncertainty associated with non-production procurement at the firm is considered to be low to moderate.

In accordance with Proposition A, we expect an enterprise system based predominantly on flexibility-to-use. However, the case study does not immediately support the proposition. Instead of implementing a fully specified system systematically from the beginning, an iterative approach was applied, whereby the initial implementation of the electronic procurement system was rather limited in scope, followed by a gradual expansion over time to include more and more instances of the procurement process in terms of users, locations, catalog database, and functionality. We note that the addition of new modules was not a reaction to new knowledge regarding the process requirements (i.e., process uncertainty), but rather a reaction to increased maturity of available software modules, and following the lessons learned from the implementation of earlier modules. The iterative approach was based on elements associated with flexibility-to-change, including modular system architecture, integration between data and functionality and the availability of knowledgeable staff.

B – Variability: Similar to the situation at many other firms, the non-production procurement process at the company was characterized by a high degree of variability with respect to the number of commodities, suppliers, and procurement practices that were utilized throughout the corporation. Even after active commodity management and consolidation of the supplier base, the number of different product categories available for procurement still amounted to several hundred thousand items and tens of thousand suppliers. In addition, despite process standardization, purchasing patterns and procurement practices continued to differ between organizational units—a result of the decentralized and global organizational structure. We consider the level of variability of the business process as high, and according to Proposition

B expect a focus of the system on high-frequency activities. The case study supports this expectation with an early focus of the system on the requesting of high-frequency products, including office supplies and computer equipment. To the extent that high frequency over time is related with low variability (i.e., high concentration), the focus on high frequency corresponds directly with Proposition B.

C – Time-Criticality: Regarding the third process characteristic, time-criticality, the level of urgency of indirect procurement requests tends to be limited, in particular when compared to the situation of direct procurement, where prompt processing and delivery of requested items is often critical for the production process, and directly impacts the overall competitive performance of the firm. Nevertheless, the ability to process procurement requests promptly can also play an important role for indirect procurement processes. For example, the ability to make a swift purchasing decision based on the availability of the electronic procurement system was once critical for the award of a million-dollar contract at the firm. As a consequence of the mixed evidence, we consider the level of time-criticality of the non-production procurement process at the firm as ”low” to “moderate”, and varied. According to Proposition C, we expect a focus of the system on highly time-critical activities.

The initial implementation of the system included catalogues for two product categories, namely computer and office equipment that were selected mainly based on frequency, in addition to value. Consequently, it appears that time-criticality was not a major factor in the initial decision process. Support for Proposition C is provided somewhat indirectly, though, by the measures that were used by the project team to assess system success. More specifically, to report and promote the success of the system, the project team emphasized the reduction of transaction processing time from weeks to days as an immediate result of the electronic procurement system. Reductions of transaction time resulted in particular from electronic document exchange and from improved visibility during the approval processes.

D – Technical Maturity: Both the level of technical maturity and the knowledge that was available in the organization regarding the technology of web-based non-production procurement systems were low, in particular at the beginning of the project. The firm was among the earliest adopters of this new type of enterprise applications (Rajkumar, 2001), and some functionality (e.g., support for computer purchases that included a third party service provider) was first developed by the vendor in direct response to the requests made by the project team. In addition, it was important to management to develop expertise in-house, rather than to rely on consultants to conduct the project. According to Proposition D, a phased roll-out strategy was recommended as long as the technical maturity and available knowledge are limited. Evidence from the case study supports Proposition D.

E – Size and Complexity: Compared to the implementation of a comprehensive enterprise resource planning system (Brown & Vessey, 2003), the non-production system at the firm can be considered to be low to moderate. The system concerned the one function of non-production procurement only and, even though it was expected to be deployed across the corporation, only one instance of the system was implemented globally. According to Proposition E, both a full roll-out and a phased roll-out should be feasible for the non-production procurement system at the Fortune 100 firm.

F – Risk: Brown and Vessey (2003) included into their analysis two project-external risk-factors, namely the risk of turnover of critical personnel (project and top-management), and the risk of unanticipated events that can impact the implementation of an enterprise system once the project has gone underway. The risk of personnel turnover at the firm was in fact considerable at the time of the implementation, in particular because of a difficult performance situation at the corporate level. Even though the risk of unanticipated events that may impact an implementation project can never be eliminated fully, it can be considered to be somewhat limited in the current case due to the significant commitment of the corporation to the larger restructuring effort and general stability of the underlying business process. For the resulting level of moderate to high overall risk, Proposition F tends to recommend a "big bang" implementation strategy, which was not confirmed, however, given the long-term and phased approach. Still, the effort of the project team to achieve tangible results quickly (e.g., through an initial deployment that was completed in six weeks) can be explained with project-external risk factors. As described earlier, subsequent expansions of the system became increasingly difficult to justify due to a reduced sense of urgency among management. Table 1 contrasts the theoretical propositions with the findings from the case study.

Table 1 – Flexibility and Implementation Strategies – Theory versus Empirical Findings

Proposition	**Situation at Fortune 100 Firm**	**Recommended Strategy**	**Actual Strategy**
A – Uncertainty	Low to moderate expected need for future change	Focus on flexibility-to-use	System built up gradually based on flexibility-to-change
B – Variability	High	Limited scope, focus on high-frequency activities	Limited scope, focus on high-frequency activities
C – Time -criticality	Low to moderate	Limited scope, focus on time-critical activities	Time savings reported prominently as a factor of system success
D – Maturity	Initially low (early adopter of non-production procurement system)	Phased roll-out as part of a learning process	Phased roll-out as part of a learning process
E – Complexity	Low to moderate: • Functional scope limited to non-production	Both full and phased roll-outs feasible	Phased roll-out

	procurement • Roll out of a single instance globally		
F – Risk	Moderate to high: • Risk of personnel turnover considerable because of organizational uncertainties • Risk of unanticipated events somewhat limited	Corporate commitment to restructuring effort, and high process stability allow for a phased roll-out, yet the considerable risk of personnel turnover could be problematic	Phased roll-out with fast results early; later extensions became more difficult to justify

In summary, while process-related characteristics suggested a strong focus on flexibility-to-use, project-related characteristics offered an additional perspective and helped to explain the chosen approach of an incremental implementation based on considerable flexibility-to-change. We note that the firm could afford a significant amount of flexibility-to-change throughout the implementation period precisely because the limited level of process uncertainty provided the opportunity to plan for both a long project timeframe and long system lifetime. The ability to add new modules and perform modifications was considered beneficial in order to cope with uncertainties related to implementation and project-management (e.g., as a result of technology immaturity), rather than process-related uncertainties, and was based on the availability of dedicated staff, system modularity, and on the integration with related enterprise applications, all of which can be considered long-term investments.

Aligning Theory and Case Study Evidence

In combination, the theoretical considerations and results of the case study analysis suggest a need to include both process- and project-related characteristics and to consider the project timeframe and expected system lifetime when developing and implementing an enterprise system. Based on our findings, we suggest a three-step roadmap to decision making:

In step 1, the efficient scope of the enterprise system is determined, according to Propositions B (Variability) and C (Time-Criticality) and based on the process characteristics of variability and time-criticality. Scope provides a first indication of the recommended implementation strategy, according to Proposition E (Complexity). In the case study, the recommended scope was rather small, based on a process determined to be highly variable and of low to moderate time-criticality. Accordingly, a big bang implementation was considered to be feasible.

In step 2, the level of technology maturity and available implementation-specific knowledge is determined, for a second indication of the recommended implementation strategy, according to Proposition D (Maturity). In the case study, technology maturity was considered to be low, resulting in the recommendation of a phased implementation approach.

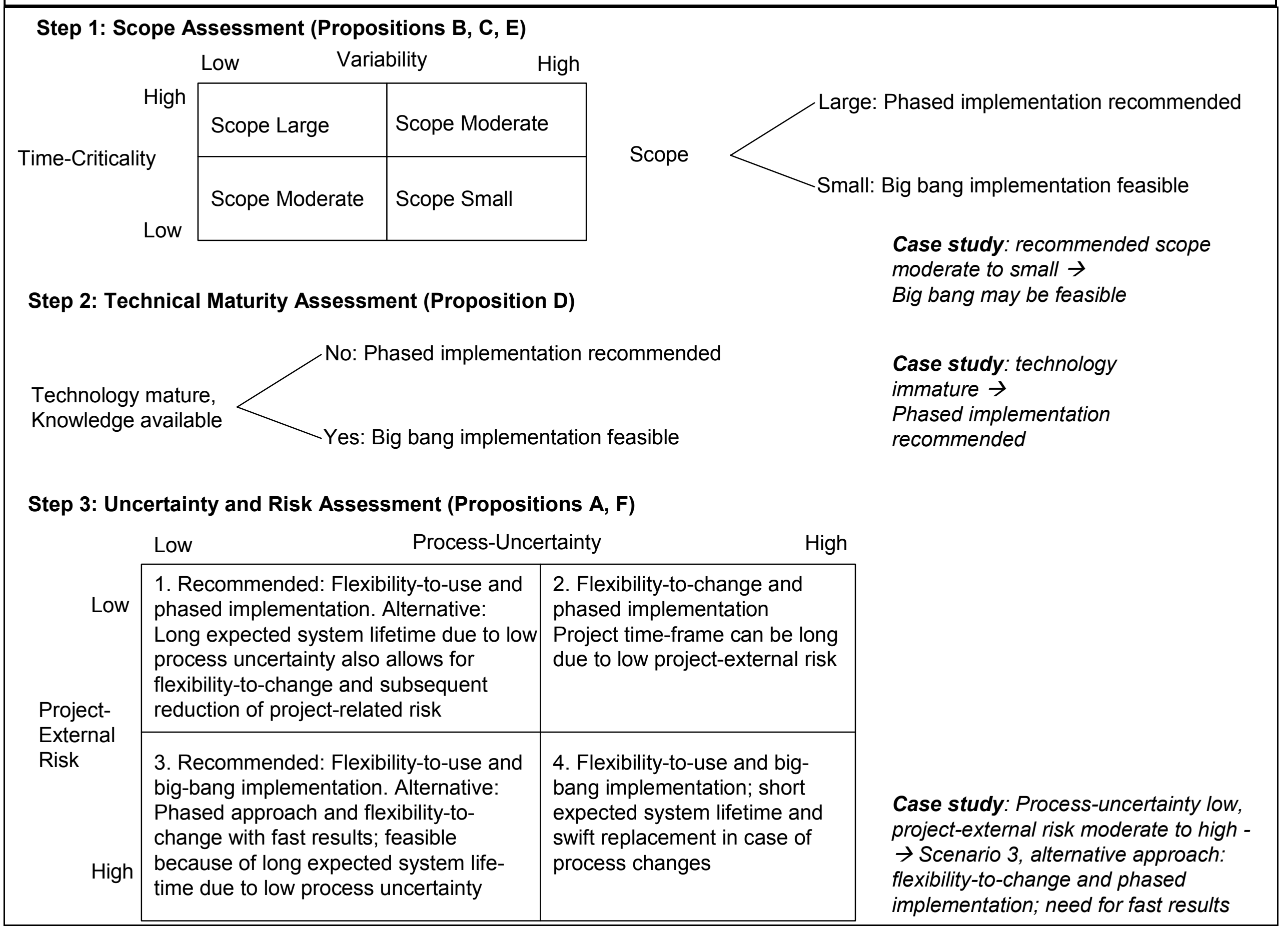
In step 3, the efficient flexibility strategy is determined according to Proposition A (Uncertainty), and combined with the recommended implementation strategy according to Proposition F (Risk). To be included into the analysis are the expected lifetime of the system and the timeframe of the project. Four scenarios result:

1. Both process-related uncertainty and project-external risk from personnel turnover and unexpected events are low: Process-related uncertainty suggests a focus on flexibility-to-use and allows for a long expected system lifetime. Low project-external risk, however, also allows for a phased implementation, which means a focus on flexibility-to-change is feasible and can help to reduce the overall project-risk.
2. Process-related uncertainty is high and project-external risk is low: High process-related uncertainty suggests a focus on flexibility-to-change, whereas low project-external risk allows for a phased approach and long project timeframe.

3. Process-related uncertainty is low, and project-external risk is high: Low process-related uncertainty suggests a focus on flexibility-to-use with a long expected system lifetime, whereas high project-external risk calls for a swift implementation strategy (big-bang). A feasible alternative—as presented in the case study—consists of a system that is based on flexibility-to-change with a long expected system lifetime. The phased implementation needs to show quick results, though, to mitigate project-external risk.
4. Both process-related uncertainty and project-external risk are high: This combination of factors calls for a system that relies on flexibility-to-use and has a *short* expected lifetime; the system should be implemented swiftly (big-bang), and subsequently be replaced quickly in case of sufficient process changes.

Following the assessments of scope, technology maturity, and process uncertainty and risk assessment, both flexibility and implementation strategies are to be determined with respect to the total estimated system-related investment, and process operating costs over the lifetime of the system. The roadmap is summarized in Figure 2.

FIGURE 2 – Roadmap to help determine enterprise system flexibility and implementation strategies, based on process- and project-characteristics



CONCLUSIONS

In the current research study, we have developed a roadmap that can support decisions regarding flexibility and implementation strategies of an enterprise system to support a given business process, taking into account characteristics of the underlying business process and implementation project. The roadmap results form the alignment of conceptual considerations regarding enterprise system flexibility and implementation management with evidence from a case study of a non-production procurement system that was implemented at a Fortune 100 firm. Our analysis and findings indicate a need to take into consideration simultaneously process- and project-related factors, as well as to include a time-dimension. Future research studies will need to further assess the validity of the suggested roadmap with additional empirical studies, and to integrate the roadmap with respect to earlier research that has emphasized the importance of additional implementation-related factors, such as technical, organizational, and legal requirements.

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[1] At an operational level, the issue of flexibility has been acknowledged in discussions of the pros and cons of standard off-the-shelf systems versus customized systems (Brown & Vessey, 2003; Grossman & Walsh, 2006, Soh & Sia, 2005): While an off-the-shelf system, in particular when implemented "vanilla style" without much process-specific customization, tends to allow for rapid deployment as well as easy upgrades, it often provides a suboptimal fit with the operational procedures of the firm and may require considerable organizational changes. In contrast, customized development can provide a better fit with the operational procedures of the firm, yet often results in a system that is more risky to implement and more complicated to maintain and upgrade. While the first option tends to be favored by consultants and project managers, the second option is typically the choice of the users (Soh & Sia, 2005).

[2] In practice, a trade-off between both types of flexibility can often be observed. For example, to the extent that an enterprise system provides flexibility-to-use, it is also likely to provide a good fit with the respective organizational processes, often as a result of considerable customization and configuration that are performed during project implementation that might again lead to greater efforts required for subsequent changes. In comparison, flexibility-to-change tends to be associated with the extent to which an enterprise system can be easily extended and upgraded. Flexibility-to-change may result from the use of a standard, off-the-shelf solution and limited customization, as well as from the implementation of an open and highly modular system, based, for example, on innovative architectures, such as service-oriented computing. Both approaches to flexibility-to-change tend to come at a cost: Standard off-the-shelf implementations often provide a limited "natural" fit with the business processes that the system supports, which may result in the need for process adjustments (McAfee, 2006, Soh & Sia, 2005), or frequent system work-arounds (e.g., manual operations). Technology innovations, such as service-oriented architectures, while possibly providing a better fit with the individual business processes, tend to be complex, risky because of technology immaturity, and require significant investments for initial implementation and ongoing operation.