

Influence of Enterprise Systems on Business Process Agility

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Abstract — Business process agility (a combination of speed and flexibility) is increasingly becoming an important weapon for achieving a competitive advantage in today's growing competition and dynamic business environment. Based on literature review and past research by the author, this paper will present the development of a research framework to investigate the influence of enterprise systems on business process agility. Using exploratory qualitative case studies, this study will identify the major drivers and inhibitors for enhancing the process agility in business organizations that have implemented enterprise systems and investigate the possibility of attaining both process efficiency and agility simultaneously while automating and/or integrating business processes.

Keywords—Business process, process agility, enterprise systems, process change

I. INTRODUCTION

In the past quality, cost efficiency and speed, the traditional measures of performance, were sufficient to achieve profitability and maintain a competitive edge. In today's market place, firms must be able to change business processes rapidly and efficiently in line with the changing business conditions and customer needs. Thus, agility, a combination of speed and flexibility, is becoming a vital tool for innovation and competitive performance in contemporary business environments. Enterprise Resource Planning (ERP) systems have enabled cost-effective business processes and contributed to the improvement in process efficiencies. The pervasive influence of ERP systems on the ability of processes to adapt to changing business conditions is not known.

Using an exploratory case study approach, this study investigates the influence of implementing ERP systems on business process agility. The paper first reviews the literature on the concept of 'agility' in general and in operations management and information systems context in particular and discusses the significance of process agility for modern business organizations. It then briefly discusses the research framework and methodology and presents the propositions developed.

II. BACKGROUND AND LITERATURE REVIEW

A. Agility – a complex concept

Agility is a complex concept and has been analyzed across economics, strategic management, operations management and information technology/information systems disciplines. The concept of agility builds from the literature on flexibility in economics [1], and was further developed in the context of agile manufacturing. According to Yusuf and others, the concept of agility was first coined in 1991 by a group of senior executives and researchers at Iacocca Institute, Lehigh University, to describe the practices observed and considered as important aspects of manufacturing [2]. This group argued that organizations must adapt to the changing business environment and needs such as speed, flexibility, responsiveness, infrastructure with a manufacturing system that is capable of quickly shifting among product models and/or between product lines.

Taking a strategic management perspective, Sambamurthy and others defined business agility as the capability of firms in managing their internal operations and interactions with their ecosystems of external partners and networks, and identified three types of agility – customer agility, partnership agility and operational agility [3]. While customer agility and partnership agility deal with the agility of the firm in managing relationships with customers and partners, operational agility is defined as the ability of the firm to redesign existing processes rapidly and to create new processes in a timely fashion in order to be able to take advantage of dynamic market conditions [3].

Mathiyalakan and others considered agility as a broader concept and defined it as the ability of an organization to detect changes, opportunities and threats in its business environment and to provide speedy and focused responses to customers as well as stakeholders by reconfiguring resources and processes, and through strategic partnerships and alliances [4]. This definition incorporates a strategic as well as an operations perspective of the term and explains how firms can be made agile in terms of managing capabilities, resources, partnerships, alliances and business processes.

B. Agility in operations management context

In operations management literature agility was studied in the context of agile manufacturing [5], [6] and in supply chain management [7]. Achieving flexibility and

responsiveness to the changing market needs [8] was the aim in both manufacturing and supply chain contexts. Manufacturing agility involves shifting rapidly among product models and/or between product lines in real-time response to customer demands [9, 10, 11]. Incorporating agility in the manufacturing process is expected to make the firm capable of surviving and prospering in the competitive environment of continuous and unpredictable change [12].

Implementation of manufacturing philosophy reportedly resulted in the reduction of the time required to get products to market [13]. Combining all the 'world class practices' such as total quality management, concurrent engineering, employee empowerment, lean production and learning organization in manufacturing organizations in the late 20th century, with the flexibility and speed of business processes, agility in a manufacturing context is described as an umbrella term [6].

Though operations performance objectives such as cost, quality and dependability are implicit in the term 'agile' enterprise, the two concepts of flexibility and speed are particularly important and inherent to the definition of agility in operations management literature [14], [15], [16], [17], [11].

Contrary to the traditional view of operations management in which these performance objectives were considered at times conflicting [18], the modern definitions of operational agility incorporate a combination of all these capabilities and postulate the possibility of simultaneously excelling in all of them. Thus, agility from modern operations management's view is a combination of all the five performance objectives – cost, quality, dependability, flexibility and speed, and particularly the combination of speed and flexibility [19].

C. Business processes and agility

To be agile, a firm must have the ability to redesign and reconfigure individual business process components, combining individual tasks and capabilities in response to the environment [20]. Business process agility is thus defined as the ability to dynamically modify and/or reconfigure a business process to accommodate required and potential needs of the firm [20].

Indeed, throughout the literature on agility, various authors have emphasized different facets of agility and this has led to varied views reflected in the literature. These definitions are considered simultaneously in order to gain a better understanding of what constitutes agility. In this study, therefore, business process agility is defined as the ability of the firm to dynamically modify and/or reconfigure individual business process components rapidly to be able to meet the changing requirements of the firm and its business environment, without compromising other performance objectives such as cost and quality.

The present day requirements of a cost-effective and responsive enterprise make it difficult for enterprises to stick to well-defined static business processes. Further, collaboration with key stakeholders like suppliers, vendors and the partners has become a common need for many firms. In order to respond to the changes in markets,

suppliers and customer requirements, different stakeholders of a firm may be required to join or leave a business process and do it fast [21].

Adopting business process orientation and agile business processes has thus become an imperative for modern organizations [11], [3]. If business processes are well-designed to be agile, an enterprise is therefore more likely to experience success. Full management commitment and ongoing process changes are necessary to commit an organization to process-oriented thinking and make the processes agile [21]. Implementation of these initiatives requires redesigning of internal as well as external business processes and their interfaces, integration of associated information systems/technologies and processes, automation of some processes and realignment of processes, systems and structures [21].

Though some new technologies often lead to new business processes, fast paced changes to the existing processes are necessary to support new and evolving business models in response to the implementation of IT-enabled innovations and software solutions such as Radio Frequency Identification Tags (RFID), business intelligence, electronic commerce, supply chain management and product life cycle management. The literature recognizes the role of information systems/technologies as a 'platform for agility' and its ability to provide 'strategic value' to the enterprise [3].

A study on manufacturing agility revealed that the information systems themselves are not sufficient to achieve agility in business processes [22], and that manufacturing firms rely more upon non-IT attributes to improve the agility of their manufacturing operations than information systems. Software development methodologies are also evolving due to changing technologies and new demands from users. Emergent organizations in today's business environment are required to continuously adapt their structures, strategies and policies to suit the new environment.

Such organizations need information systems that constantly evolve to meet their changing requirements and traditional, plan-driven software development methodologies lack the flexibility to adapt [23]. Recent advances in information technology/systems such as grid computing, web services, service-oriented architecture and business process management tools and solutions are centered on the goal of providing the requisite agility for enterprises [24]-[25] and are expected to complement each other in making the processes more agile.

The level of business process agility is influenced by 'IT capabilities' and 'process agility drivers' [3]. Some process agility drivers include process management capability, process-modeling tools, process complexity and skills sets present in the organization for reconfiguring the processes. Nascent research on agile business processes suggests that they are difficult to develop and implement and are dependent upon organisational (size, process complexity, integrated processes, skills, information systems integration, data integration), environmental (external

competition, industry type/nature), technological (IT capabilities) and process (process management capability) factors [26] [21]. In addition to the above factors, organisational change, business process redesign, application transformation and infrastructure adaptability are some of the issues that need to be addressed to increase the agility of an enterprise [27].

Agile business processes, however, are expected to help organizations not only to achieve cost economies, but also to improve speed and accuracy with which the firm can exploit opportunities for innovation and competitive action [3]. Thus, agile business processes will contribute to the business agility wherein business processes are rapidly designing and/or redesigning in order to be able to respond effectively to unanticipated changes [28]. Importantly, it is necessary to study the enterprise as a system of processes. This system-level view potentially will reveal unanticipated synergies that can be created by exploiting interrelationships among its elements that exist in the new system, but did not exist in the old [29].

D. Process agility - significance

In the past, quality and cost efficiency, the traditional measures of process performance, were sufficient to achieve profitability and maintain a competitive edge. The time-based competition in the 1990s forced companies to analyze and speed up their crucial business processes [30] such as product development, sales and distribution and procurement, and enabled significant increases in productivity. In today's marketplace, speed alone does not enhance better performance in terms of cost effectiveness and time to market [31]. In order to position themselves better to respond to market dynamics, firms must be able to change business direction and business processes nimbly [32] and adapt quickly to rapidly changing business conditions. Business processes are the central building blocks of how individuals, organizations/functions and industries participate with one another [33].

Recognizing that process agility is vital for innovation and competitive performance in contemporary business environments, business organizations are increasingly relying on information technologies including process, knowledge and communication technologies to enhance their process agility [27]. Agile business processes are thus considered a critical requirement for organizations to sustain and improve their competitive positioning in the marketplace and for profitability [34], [3], [21].

E. Business process change and enterprise systems

IT-enabled innovations, whether simple innovations such as word processing or complex enterprise integrated information systems such as enterprise resource planning (ERP) systems, always have a significant impact on the way organisational activities are carried out. Information innovations such as transactional processing systems, decision support systems and executive information systems have traditionally enabled cost effective business processes [35].

Enterprise systems or enterprise resource planning (ERP) systems have long been associated with process change. The traditional view of process improvement and redesign generally associated with the implementation of enterprise systems and other IT-enabled innovations is that it would generally lower costs and improve quality [36]. The ability to standardize and automate basic transactional processes and thereby contribute to cost effectiveness and flexibility are some of the key benefits espoused by ERP software vendors such as SAP [37].

With the focus on increasing process efficiencies, business organizations, through implementation of the first wave of ERP systems, have concentrated on the simplification, standardization and automation of business processes and their consistent execution [21]. Second generation ERP systems reportedly offer better integration and flexibility through web services, service-oriented architecture and smaller components. In addition to supporting transaction automation at the enterprise as well as the supply chain level, they will be able to support process management and contribute to the development of flexible and agile processes [38].

Though reengineering and redesigning of business processes at the time of implementing ERP systems was advocated by software vendors, consultants and in the academic literature, many business organizations could not carry out process improvements for several organisational, cultural and resource-related reasons. Even though organizations hoped to redesign and standardize their business processes, a majority of them reportedly deferred the process redesign until after implementation [39].

However, in some cases where such changes were made, these improved processes were not capable of adapting quickly to external events and reportedly became expensive to modify. Achieving a suitable fit between the processes embedded in the ERP software solution and the existing business processes proved to be challenging for many firms [40]. While some organizations have discarded their existing processes and adapted the best practice processes embedded in the ERP software, others have decided to significantly modify the ERP software to match their existing business processes, recognizing the potential competitive advantage their existing business processes offer. In both cases of implementation, it is neither easy nor cost effective to change the processes again after such huge change management efforts.

In addition to the issues that relate to change management, the legacy systems still maintained by many large organizations for some specific applications, along with the ERP system, are posing further challenges for firms in building agility in business processes. Leading organizations that have succeeded in capitalizing on enterprise systems are striving to continuously improve their business processes and the fit between processes and information systems, and how they support their business needs and models [21]. In fact, building some level of process agility may actually go against the espoused benefits of maintaining and executing standardized best

practice business processes embedded in ERP software solutions. Rapid process change requirements are beyond the scope of most of the companies with enterprise systems, who generally prefer to leave a well-tested configuration unchanged [34].

Even though recent process improvement initiatives and information/process integration facilitated by the implementation of enterprise systems in firms have positively influenced the firm's customer focus, it is not clear how they have contributed to the agility of the processes. Even though it is argued that they can facilitate changes in the speed and variety of product and process offerings by firms, thereby enabling flexible delivery [41], it is not clear how the rigid standardization of the processes would allow them to become agile. The formalized and possibly outdated business processes that are embedded in existing systems and the difficulties of achieving cross-functional consensus for cross-functional systems and fit between business processes and related information systems/technologies are some of the challenges organizations may face in the future [42], [21].

While there is significant research on the relationship between resources such as information systems/technologies, infrastructure and firm performance at an aggregated level [3], research on understanding why some activities and business processes are able to generate competitive advantages while others cannot is very limited, though it is likely to be more helpful [39].

This study will, therefore, analyze the role of ERP systems on process agility, and particularly investigate whether it is possible to achieve process efficiency and process agility simultaneously after implementation. In the context of second-generation ERP systems that are web-enabled with service-oriented architecture and flexible/inter-operable process and technology management interfaces, and the availability of modern business process modeling and management tools, it is important to determine their contribution or lack of in making business processes more agile.

III. RESEARCH FRAMEWORK & METHODOLOGY

Business process agility is a critical requirement for contemporary organizations that are geared to respond to changing market requirements and conditions. Considering its exploratory nature and the nascent stage of this research area, this study aims to investigate the influence of enterprise systems on business process agility. The study will particularly investigate whether enterprise systems would contribute to the development of agile business processes or restrict them.

It will investigate the influence of typical characteristics of ERP systems such as standardization of processes, integration of internal processes and information integration, real-time visibility of information, best practices embedded in the software processes and automated transactions on process agility. Particularly, it will investigate whether it is possible to achieve both

process efficiencies and process agility in an ERP environment. The following section discusses the research framework and explains the propositions developed for further investigation.

A. *Standardized & best practice business processes*

Standardization of business processes, the key benefit of implementing ERP system, may actually restrict the agility of processes. The very purpose of standardization of business processes is to rein-in the variability and lack of standardization of the processes across the organizational business units and achieve the efficiencies and consistency in execution [21]. Similarly, the processes embedded in the ERP software solutions are typically considered best practices by the vendors as it is the outcome of a thorough study and modeling of the best practice business processes in the industry. In order to make them relevant to particular industry, several software vendors have actually developed industry specific software solutions for industries such as automobile, electronics, chemicals, higher education, research and development etc.

With these best practice processes standardized and embedded in the software, any variability in the process that is required for business reasons may have to be handled as an exception expending considerable resources. While arriving at an adequate fit between the software and existing business processes, organizations either decide to modify the software at a significant expense considering the competitive advantage their existing process could offer them.

Alternatively, the organization may decide to discard a wide variety of processes used in several parts of their organizations and implement the best practice processes embedded in the ERP software solution in order to achieve standardization and consistent execution of a particular business process. The objective therefore is to eliminate this variability in order to achieve process efficiency. When there is a genuine need for a change in the process, the organization will have to again revisit the process and ERP software fit, and goes through the change management processes if the business benefits of changing the process are compelling. Alternatively, organizations may actually leave this change until the next upgrade of the ERP software version, and then make a decision as to the changes in the process or software (and its fit). Thus the standardization and automation of transactions resulting from the ERP implementations are expected to limit the ability of processes to change.

Flexibility is an important feature of any information system. Once implemented, ERP systems are tightly linked with organizational structures and processes [37]. Therefore, it is very difficult to change the system without changing the organization and vice versa. The integrative nature of ERP system makes it difficult to change one aspect or area without affecting the other. However, by editing the key configuration and relationships stored in tables and

structures, it is relatively easy to make some organizational changes in an ERP environment. The meticulous segmentation of organizational operations and huge number of standardized procedural steps that define the system in an ERP environment may actually constrain the company's ability to respond to changes in external environment [43].

ERP software vendors argue that the business processes embedded in their software solutions are typically best practices. These large ERP software vendors reportedly investigated business processes across a wide variety of organizations and industries and then modeled the best of them into their software solutions [44]. Adapting those best practice business processes embedded in the software and discarding the existing processes is expected to improve the performance. This argument implicitly assumes that the best practice processes need not be changed as they are best practices and standardized. Therefore, this rigid standardization of these so called best practice processes is antithesis to the flexibility and agility of business processes. Thus, the following propositions can be hypothesized.

H1: Standardization business processes and their procedural steps resulting from the implementation of ERP systems decrease the agility of processes.

H2: Implementation of best practice business processes embedded in the ERP system software solutions do not contribute to the agility of processes.

H3: Automation of business transactions consequent to ERP implementation restrict the agility of business processes.

H4: It is possible to achieve process efficiencies and agility simultaneously consequent to the implementation of ERP systems

B. Integration of information and processes

Integration of the information and the consequent visibility and accessibility of information across the enterprise in real time is one of the key benefits of ERP implementations. ERP systems with its integrative capability facilitate centralisation of information and services such as purchasing, accounting, finance, or human resources [45], [46] and may facilitate improved flexibility in business processes. In a centralised information management environment, it is relatively easy to modify the processes in line with the business needs and roll them out across various business units. In a decentralised and unintegrated environment, however, this is considered very difficult. The following propositions can thus be hypothesized.

H5: Integration of processes across the enterprise consequent to ERP implementation improves process agility

H6: Integration of information consequent to ERP implementation improves process agility.

H7: Real-time visibility of information across the enterprise consequent to ERP implementation improves process agility

C. Decentralization of control

Since the information in an ERP environment is instantaneously visible to all employees and managers at multiple levels, it will empower them on information analysis issues. It is expected to bring in discipline in performing basic information transactions for efficiency and standardization across the enterprise and provide flexibility [45]. In an ERP environment, it becomes necessary for everyone in the organization to understand not only the process in which they work, but also their own specific task, along with the impact their work have on other aspects of business.

ERP systems can contribute to the downsizing and decentralisation of controls and centralisation of information management [45]. Consequent downsizing of the organization may lead to the loss of valuable tacit knowledge that goes along with the employees. This loss can reduce the ability of the organization to respond to internal and external changes and demands.

Similarly, the decentralisation of control achieved through delayering of organizational structures requires a different set of skills at both employee and management levels. It requires employees to take ownership of their work and their role within the new system and to learn to monitor and manage the processes with the help of information-based and technology-enabled controls. This will enhance the process knowledge of employees and prepares them better for required changes in environment. With improved process knowledge and skills, the processes could become more agile. The following propositions can thus be hypothesized.

H8: The decentralization of control resulting from the implementation of ERP systems limits the agility of business processes.

H9: Requirement of new skills consequent to the implementation of ERP systems limit the agility of processes.

H10: Enhancement of process knowledge consequent to the implementation of ERP systems improves the agility of processes.

D. Other variables

Impact of ERP systems on organizations is dependent upon the extent of internal process integration achieved, extent of the legacy systems and their interfaces with the ERP systems, process-based thinking of the management, organizational size and characteristics of the business processes. The characteristics of business processes measured in terms of time-criticality, variability, complexity and uncertainty may inherently limit the agility of the business processes. In addition, level of business process agility is also influenced by the 'IT capabilities' and 'process agility drivers' [3] such as IT capabilities, process management capability, process modeling tools, process complexity, skills etc.

Nascent research on agile business processes suggests

that they are difficult to develop and implement and are dependent upon organizational (size, process complexity, integrated processes, skills, info systems integration, data integration) environmental (external competition, industry type/nature), technological (IT capabilities) and process (process management capability, characteristics of processes) factors [26], [47], [48]. Keeping in mind these limitations, the following generic propositions are hypothesized.

H11: Inherent characteristics of the process (such as variability, uncertainty, time-criticality, complexity etc.) influence the level of process agility achievable in ERP environment.

The above propositions will be investigated in this exploratory study with the help of an interpretive cases study. A brief summary of the proposed approach to the research methodology is discussed below.

E. Methodology

Considering the exploratory nature of the research questions (what and how), the formative stage of the research, qualitative methodology that involves semi-structured interviews [49] will be used in the first phase of the study. Semi-structured interviews are particularly useful in exploratory research and would offer rich insights on the topic because of their ability to produce data and information. They will help to generate hypotheses and develop questions or concepts for questionnaires.

A representative sample of four organizations that have implemented one of the enterprise systems software solutions will be selected for this pilot study. About four or five managers from each of the organizations will be interviewed. Focusing on some of the major business processes in case study organizations this study will explore the major drivers of enhancing business process agility and factors that could inhibit it in an ERP systems context.

A semi-structured questionnaire will be employed as a data collection strategy in this study. Interviews will be conducted in two phases with respondents in view of the limited time senior executives can allocate to research interviews. These respondents are senior managers or process managers who have supervised and/or implemented process integration and changes in the context of implementing enterprise systems.

The interviews will be recorded using tape recorder, with prior permission sought from the respondents. Detailed

manuscripts of the interviews will be transcribed from the tapes and saved for further analysis. The data thus collected will be codified and analyzed using a qualitative analysis software tool. The coded data will be categorized according to patterns or themes which emerge using pattern matching and explanation building approaches. Findings of this exploratory study will lead to several theoretical propositions/hypotheses and identification of various variables contributing and/or hindering business process agility.

IV. CONCLUSIONS

Quality and cost efficiency were the most important measures of process performance in the past and sufficient to attain firm's profitability. Apart from these performance objectives, speed and flexibility are also now considered important for the 21st century business environment, in order to change their business processes rapidly and met the dynamic requirements of markets, customers and partners. Agility of business processes that are capable of achieving speed and flexibility without compromising on the quality and cost efficiencies is now considered important to facilitate improvement in the company's ability to exploit opportunities for innovation and competitive action. Information technology enabled innovations in general and enterprise resource planning systems in particular, have contributed to the simplification, standardization and automation of business processes in the past. Building some level of process agility may go against the espoused benefits of maintaining standardized best practice business processes embedded in the ERP software solutions.

Though the second generation ERP software solutions are reportedly better in flexibility with open standards, component-based process models, standard reference models, web services and service oriented architecture, it is not clear whether they can facilitate better business process management and building up of agility. New research in this area is essential to prepare businesses for the next stage of business revolution that is going to be dominated by business processes, their management and the way the information systems support knowledge intensive work.

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