



# Influence of ERP systems on business process agility

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## KEYWORDS

ERP;  
Business process agility

**Abstract** Past research on the effect of ERP systems on agility is contradictory, and research on the post implementation effects of ERP systems on agility is limited. Employing a cross sectional field study, this exploratory study analyses how key defining features of enterprise systems environment—integration, process optimisation, and best practices—affect agility. Standardisation of processes has mixed effect on agility and depends on the extent of standardisation implemented and whether it included prior simplification. Rather than the ERP-system enabled environment, the inadequacies in implementation and poor process optimisation prior to ERP implementation are restricting process agility.

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## Introduction

Ever-changing customer requirements, unrelenting financial reporting requirements, and competitive cost pressures require firms to rapidly adjust, redesign, and adapt their processes and capabilities. In today's volatile business environment, ability to sense, shape, and respond to dynamic customer needs, emerging business opportunities, and unprecedented threats are considered a critical business capability (Pralhad, 2009). In addition, dealing with challenges associated with the exponential growth of data volumes, organisational realignments that include mergers,

acquisitions, spin-offs, and outsourcing decisions require continuous unbundling and re-bundling of business processes. Thus, agility defined as the ease and speed with which firms can reconfigure, redesign, and realign their processes to respond to these needs, threats, and opportunities (Raschke & David, 2005; Sambamurthy, Bharadwaj, & Grover, 2003), has become an essential capability for business organisations today.

Though the relationship between a firm's agility and information technologies has been studied in the past, the underlying contradictions between information technology (IT) and agility have not been satisfactorily researched (Lu & Rammurthy, 2011). Some studies argue that IT enables agility by improving decision making, facilitating communication (Davenport, Harris, & Cantrell, 2004), delivering electronic integration (Nazir & Pinsonneault, 2012), and providing digital options (Sambamurthy et al., 2003). Others contend that IT impedes agility (Overby, Bharadwaj, & Sambamurthy, 2006; Weil, Subramani & Broadbent, 2002) partly due to rigidity of information systems and technology artifacts (Galliers, 2007; Wensley & Stijn, 2007). Even though several IT vendors and consultants have made it

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their key strategy to help organisations achieve agility, an understanding of the relationship between firm agility and information technologies is limited (Lu & Rammurthy, 2011; Nazir & Pinsonneault, 2012). While leading vendors offer a variety of technical and organisational solutions to achieve agility, and software vendors promise this agility through their enterprise systems and their suite of applications, their capacity to deliver the required capability has not been empirically studied (Tallon, 2008).

With enterprise resource planning (ERP) systems firmly entrenched in most firms today and considered the backbone to managing business processes, understanding the influence of these systems on process agility is important. Despite the accumulated knowledge about ERP projects, research on post-implementation effects of ERP systems in general and on agility and innovation in particular is still limited (Nazir & Pinsonneault, 2012; Peng & Nunes, 2009; Schlichter & Kraemmergaard, 2010). With ERP systems associated with agility (Goodhue, Chen, Boudreau, Davis, & Cochran, 2009) as well as rigidity (Galliers, 2007), the underlying contradictions are largely unknown and under researched. This research extends prior research on the post-implementation effects of ERP systems in firms and analyses the specific role played by ERP systems on process agility. Set against a resource-based view, the research analyses the link between ERP systems and business process agility from the perspective of the benefits of ERP systems. By analysing the impact of capabilities such as integration, process optimisation, and best practices enabled by the implementation of ERP systems on process agility, this study contributes to the literature by demonstrating how process agility, an intermediate outcome, is likely to affect organisational outcomes such as cost, efficiency, and profit (Tallon & Pinsonneault, 2011). This paper will first review the literature on ERP systems and agility and discuss the research model emerging from the literature review. It will then describe the research method employed in this study, and finally, present its findings and conclusions.

## Literature review

Business processes are central to the way organisations and individuals interact with one another (Malone, Crowston, & Herman, 2003). Dealing with the effects of globalisation, the pressure to bring out new products and services rapidly, and improving operations are the top three priorities of business organisations in the future (Gartner Research, 2012) and business processes are the key enablers in dealing with these challenges. The current requirements for enterprises to be cost-effective and responsive make it difficult for enterprises to stick to well-defined, static processes. It is considered necessary for a firm to rapidly reconfigure, modify, and shape a process in order to respond to internal and external changes (Ray, Barney, & Muhanna, 2004).

Agility, a complex concept, has been analysed in a range of disciplines. Built from the literature on flexibility in economics, the concept of agility was further developed in agile manufacturing and in strategic management and information systems literature. Agility merges the four competitive dimensions of cost, quality, dependability, and flexibility and moves beyond them to encompass an ability

to respond rapidly to any unexpected changes in the market and business environment. Flexibility refers to the capability of an organisation to move from one task to another, adapt to expected changes and respond to change requests economically (Becker, 2001), while agility is about the speed to detect and respond to changes in the business environment (Li, Chung, Goldsby, & Holsapple, 2008).

Though different facets of agility have been defined and discussed across the literature, operationalisation of the process agility construct has only been recently discussed (Raschke & David, 2005; Tallon, 2008). Some researchers consider agility as a broad concept with two dimensions – “sense” and “respond” capabilities. Agility is defined as “the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise (Sambamurthy et al., 2003: p.245). Li et al. (2008) used two dimensions – speed and capabilities of the firm to use resources and to respond to changes – to define agility. Sambamurthy et al. (2003) defined business agility as the capability of firms in managing their internal operations and interactions with their eco-systems and identified three types of agility – customer agility, partnership agility, and operational agility.

While the first two deal with managing relationships with customers and partners, operational agility refers to the ability to rapidly redesign existing processes. Similarly, Li et al. (2008) identified two dimensions of agility – alertness and responsiveness. Thus, the key dimensions of agility are the ability to sense or detect changes in the environment with speed and the ability to respond to those changes with speed.

Digitised platforms of business processes that include ERP, customer relationship management (CRM), and supply chain management (SCM) systems, help firms build and deliver this critical capability, i.e. agility (van Oosterhout, Waarts, & van Hillegerberg, 2006; Sambamurthy et al., 2003). This capability not only helps firms in developing new information-based products and services but also in building organisational and inter-organisational relationships through streamlining and reconfiguring their processes (Agarwal & Sambamurthy, 2001). Enterprise resource planning systems are large scale, real time integrated application packaged software that support business processes, information flows, reporting, and business analytics (Seddon, Calvert, & Yang, 2010). These systems impound deep knowledge of designing and executing business processes and since they are complex systems they may cause assimilation difficulties and challenges (Robey, Ross, & Boudreau, 2002). Despite huge investments in the software, in implementation, maintenance, user training, and continuous updates, many implementation failures and less than satisfactory benefits have been reported in the literature (Davenport, 2000; Nah, Tan, & Teh, 2004; Seddon et al., 2010).

Impact of investments in information technologies on a firm’s performance has been an important issue for practitioners and academics (Wade & Hulland, 2004). Most of the literature on IT impact has focused on the standard firm performance metrics (Oh & Pinsonneault, 2007) and largely overlooked agility. Literature on agility has tended to focus on conceptual concerns such as benefits of agility (Galliers,

2007; Overby et al., 2006). Sambamurthy et al. (2003) and Tallon and Pinsonneault (2011) have suggested positive relationship between IT and firm's agility. Sambamurthy et al. (2003) offered a theoretical foundation for understanding the interacting influences among organisational IT, agility, and performance outcomes. Though literature provides a strong foundation for understanding the relationship between IT and agility, how and why specific IT investments can enable agility is still under researched (Lee, Sambamurthy, Lim, & Wei, 2007).

With a majority of business transactions, organisational structure, automation, workflow, and reporting well supported by enterprise resource planning systems today, they are considered the backbone of the current IT infrastructure (Davenport et al., 2004). By collecting greater amounts and types of internal data, enforcing business processes and controls, restricting and monitoring employee tasks, and supporting internal controls to a greater extent than ever before, ERP systems are changing the very nature of business (Grabski, Leech, & Schmidt, 2011). Past research on ERP systems predominantly focused on how these systems add value (Ross & Vitale, 2000), on implementation issues (Barker & Frolick, 2003; Scott & Vessey, 2002; Sheu, Chae, & Yang, 2004), benefits (Shang & Seddon, 2002), end user acceptance and participation (Kawalek & Wood-Harper, 2002; Nah et al., 2004), measurement of enterprise system success (Sedara & Gable, 2004) and impact on operational performance (Uwizeyemungu & Raymond, 2009).

The body of knowledge available in the literature about ERP systems is mature and several disciplines using different methods have contributed to it (Schlichter & Kraemmergaard, 2010). Thus, while there is a rich body of literature on ERP adoption and implementation, there is limited research on post-implementation effects and benefits such as flexibility, agility, process innovation, and competitive advantage (Liang, Saraf, Hu, & Xue, 2007; Seddon et al., 2010). Given the investments in ERP systems and the significant risk of failure, it is important for firms to understand the impact of enterprise systems on agility – a firm level performance challenge in the current dynamic business environment.

## Theoretical background

According to the resource-based view (RBV) firms can derive capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991) from their internal resources. Considering information technologies as key internal resources, Bharadwaj (2000) classified them into IT infrastructure, intangible IT-enabled resources, and human IT resources. Enterprise resource planning systems are a key IT resource today in most firms. The IT infrastructure is the hardware and software needed to operate the ERP system; the intangible IT-enabled resources are the integrated, standardised, and best practice processes, practices, and controls embedded in the software. In the ERP systems context, the users with their knowledge of business processes and their interdependencies, their ability to make better decisions because of the improved access to and visibility of information and processes across the

enterprise as they assimilate and use the system, constitute the human IT resources. Even though ERP software is commercially available to any organisation, the process of configuring and customising the system to meet the needs of the firm is unique and therefore becomes an inimitable, valuable capability to the adopting firm (Ketokivi, 2006). The capability derived from implementing an ERP system, however, is influenced by the degree of functional fit and the level of integration and process optimisation achieved by the firm, and the ability of the organisation to overcome inertia for change (Seddon et al., 2010). Enterprise resource planning systems, through optimisation, integration, and automation of business processes, have contributed to cost efficiencies (Davenport et al., 2004).

Even though the original vision of ERP systems was to create an environment of seamlessly integrated data, processes, technology, and people, it often plays out differently at ground-level. Several factors such as implementing the enterprise systems in phases (one module after another), continued usage of legacy systems, prohibitive cost of change in the configuration after embedding the system, and complex nests of links between various applications supported by silos of technology from different vendors have impeded the realising of a truly seamless and integrated environment (Nazir & Pinsonneault, 2012; van Oosterhout et al., 2006). Current monolithic IT infrastructure with ERP systems as its backbone has resulted in tight coupling of business processes with several proprietary technologies of software vendors, business rules, and organisational structure. Further, the inherent nature of ERP infrastructure has resulted in tight coupling of structures, processes, business rules, and roles along with its associated interdependencies. Changing them is considered expensive and complex, even if the environment demands flexibility and agility (Newell, Wagner, & David, 2007).

Integration of processes, embedded best practice processes and business rules, and better access to information enabled by ERP systems will improve visibility and control at multiple levels (Davenport, 2000) and information quality (Seddon et al., 2010; Staehr, 2007). Such enhanced visibility and quality with controlled access may improve understanding of the process context within which individual managers and staff members work and of the impact their work may have on other aspects of business. This could improve information management discipline and empower employees at all levels while simultaneously ensuring transactional efficiency and consistency (Huang & Newell, 2003).

The benefits of implementing an ERP system could be influenced by the level of integration (Mooney & Ganley, 2007) and process optimisation (Davenport et al., 2004) achieved by a firm consequent to the implementation and assimilation of the ERP system and is dependent upon the level of functional fit and ability to overcome organisational inertia (Seddon et al., 2010). Even though ERP systems facilitate improved access to information for better decision making and best practices, this may potentially reduce the richness of information available to managerial decision making (Wensley & Stijn, 2007).

Even though process re-design and optimisation at the time of implementing ERP systems was advocated by software vendors, consultants, and researchers, many business

organisations could not effect these changes because of several organisational, cultural and/or technology-related reasons (Davenport et al., 2004; Liang et al., 2007; Seethamraju, 2009). This could potentially reduce the ability of enterprise processes to respond to changes (Newell et al., 2007). Enterprise resource planning software vendors, however, claim that updates, new versions, and patches released regularly would deliver continuous improvements in processes, controls, and practices. Even though good IT infrastructure capability, including capabilities delivered by a well-established ERP system, could have a positive effect on process agility (Tallon, 2008), centralisation of controls and the consequent requirements of new skills to manage improved and new processes could potentially limit agility.

Depending upon the varying contexts within which ERP implementations are situated and the changes they enable (Schubert & Williams, 2009), the organisational ability to facilitate agility of its processes could be different for different organisations. Understanding the organisational environment that may follow the implementation of ERP systems could help in understanding their impact on process agility. In addition, the volatility of the external environment also plays an important role where more effective managerial capabilities are required in a turbulent setting (Tallon, 2008).

Integration is the most frequently identified capability of the ERP system and one of the key reasons why organisations implement an ERP system (Markus, 2001). In the information systems context, a technical perspective of integration looks at the extent to which different systems are interconnected (Chiang, Lim, & Storey, 2000). From an organisational perspective, integration refers to interconnection between various functions within a firm (Uwizeyemungu & Raymond, 2004).

Process optimisation, a key benefit of implementing an ERP system, refers to standardising and improving the processes. Standardisation of processes, information, formats, and systems and common user interface may reduce the variability and variety in the terminology, definitions, and information/data formats in organisations and help achieve efficiencies and consistency in execution across various business units (Davenport et al., 2004).

Best practices or methods, procedures, interfaces, and controls, proven over time for a large number of organisations, are considered to be embedded in ERP software solutions. Leading ERP software vendors work with their clients and build the software by optimising and standardising their processes, procedures, and controls, thereby delivering capability to adopting organisations. Further, these vendors also claim that the continuous updates of software, released as versions, typically incorporate improvements in the processes, technology, and user requirements, and therefore deliver continuous improvement of processes and updating of technologies. These best practices, however, could be influenced by organisational politics, dominating role of particular user organisations, early adopters of software, and standards development efforts (Wagner, Scott, & Galliers, 2006).

Thus, while some capabilities delivered by the ERP systems have resulted in increased access to information, improved quality of information for decision making, and

consistent and effective execution of business processes (Davenport et al., 2004; Seddon et al., 2010), the goals of process agility and innovation as envisaged by the ERP software vendors have not necessarily been realised (Galliers, 2007; Nazir & Pinsonneault, 2012). Given the limited number of studies on the post-implementation effects of enterprise systems (Peng & Nunes, 2009) and limited understanding of the relationship between agility of the firm and ERP systems – the key IT infrastructure in firms today (Nazir & Pinsonneault, 2012), this study aims to fill this research gap. The objective of this study is to analyse the influence of the ERP systems environment on firm agility in general and on business process agility in particular. Based on the experience of the managers and key members in participating organisations, it aims to understand how these ERP systems enable and/or restrict the firms' process agility. In this context, the study will consider integration, process optimisation, information visibility, and best practices, the four major capabilities enabled by the ERP system, as a framework.

## Research methodology

### Research objectives and methods

In investigating the influence of ERP systems environment on business process agility, this exploratory study employs a cross-sectional field study. Cross-sectional field studies involve limited depth studies conducted at sites non-randomly selected and lie between in-depth case studies and broad-based surveys (Lillis & Mundy, 2005). When there is insufficient knowledge about the relationships between well-defined constructs and their empirical interpretation, cross-sectional field studies help to refine and re-specify those relationships. By validating well-defined constructs and relations these cross-sectional field studies enhance the credibility and generalisability of field-based theory refinement.

Collecting data from multiple respondents from multiple organisations helps increase the validity of the data (Arnold, 2006) while using individual perceptions of managers and/or consultants in the field helps in the understanding of the phenomenon (Lillis & Mundy, 2005). The cross-sectional field studies method is suitable for understanding and explaining the influence of a dynamic enterprise systems environment on process agility with both the dimensions continuously evolving with the organisational assimilation of ERP systems environment and demand for process agility.

A cross-sectional field study requires the main constructs to be well defined and researched in the literature (Lillis & Mundy, 2005), a requirement that is met by the two main constructs in this study – ERP systems environment and process agility. Such cross-sectional field studies provide an opportunity to explore new phenomenon (Klein and Myers, 1999) and facilitate understanding of the multiple interpretations of the impact of ERP systems environment on process agility from different perspectives (Yin, 2003). This exploratory study allows focus on context, process, and interpretations of key players in various organisations. Given the exploratory nature of the research, and the aim



of the study, the study proceeds through interviews based on individual perceptions and perspectives of the key individuals, interpretations of key players' views and perceptions from multiple organisations. The aim is to ask critical "how" and "why" questions of respondents that might inform and develop existing theory.

The focus of this study is on the post-ERP implementation effects on agility. Therefore, we decided to select organisations that had an ERP systems environment for at least six years. Given that a newer version is made available by the large ERP software vendors every three years, six years was considered sufficient for an organisation to assimilate the enterprise systems environment and experience its benefits and challenges. Organisations from the membership list of SAP user group ([www.SAUG.com.au](http://www.SAUG.com.au)) and Supply Chain Council ([www.Supply-chain.org](http://www.Supply-chain.org), a non-profit organisation that has Fortune 500 members) were approached for this study. Six organisations including two consulting organisations were selected for study, based on their willingness to participate in the research process, accessibility, and personal contacts of researchers.

### Data collection and analysis

Primary data was collected from one or two key respondents from each of the six organisations that agreed to participate in the study. The key respondents selected were senior managers actively involved in managing the ERP environment. Participants included senior IT managers and managers responsible for certain business processes, and leading consultants in the field. Primary data was collected using semi-structured interviews from 11 respondents. A brief summary of the characteristics of the organisations and respondents who participated in the study is given in [Table 1](#).

Each interview was of 60–90 min duration and was recorded with prior permission from the organisation and the key respondents. These recorded interviews were transcribed for further analysis. Interview questions were loosely structured, allowing managers flexibility in responding. Starting with the background of the respondents to understand the context and their perspective, two main questions were asked. The first question was meant to elicit respondents' perception of the key characteristics of the enterprise system (ES)-enabled work environment in their organisation and the second question related to the impact of each of those factors on the agility of their business processes and on the ability of the organisation to build agility into processes in the post-ES environment. A protocol was prepared for the collection of data and two pilot interviews were first conducted in order to test the process of questioning and its structure (Yin, 2003). The use of semi-structured interview protocols, and recording the data mechanically using a digital recorder, were steps to improve reliability.

Data validation took place in three ways. Firstly, interviews were recorded using a digital recorder and verbatim transcripts were prepared. Secondly, a chain of evidence was established using verbatim transcripts and notes of observations made during the interview. Thirdly, these transcripts were sent to individual respondents for

validation and their corrections were incorporated. The texts of these interviews were extensive and ran into more than 120 single-spaced pages. (In view of the volume of the text, some examples of managerial quotes have been paraphrased and included in the analysis and discussion section in italicised form.)

In the data analysis stage, an objective researcher and a colleague, not involved in the data collection, reviewed the data analysis. Two study participants also reviewed the data analysis, initial observations, and findings. Findings were compared with relevant extant literature. Further, an academic with research and teaching experience in the enterprise systems field was asked to review the interpretation of the impacts of ERP systems on business process agility. Thus the data was validated and its reliability improved at the data collection, analysis, and interpretation stages.

This study, similar to any other qualitative research, may project the subjective bias of the researcher and the respondents, and could lack generalisability (Yin, 2003). The extent of cooperation from different respondents was not uniform and it is possible that the respondents may have either overrated or underrated the issues in their respective organisations. These limitations, however, are unlikely to have affected the validity and reliability of the outcomes significantly because the objective of the study was not to generalise, but to provide anecdotal evidence. The following section provides detailed discussion of the issues analysed and findings from the study. It is structured around the three key themes discussed in the literature review section.

### Results, discussions, and findings

This study posed one question: How do the capabilities enabled by the implementation of ERP environment enhance or impede a firm's business process agility. The study observed varying effects of the capabilities (integration, process optimisation, visibility, and best practices) on process agility. A discussion of the study findings categorised under various sub-themes with reference to the research framework that emerged from the analysis of data is presented below.

### Integration and agility

Integration is one of the key capabilities delivered by ERP systems. Firms commonly configure and customise packaged ERP software according to their organisational needs, conditions, and structures. In the firms that were part of our study, it appears that full integration was not realised, with a few legacy systems still supporting certain specific applications such as plant maintenance, retail sales, and quality management processes. Even for the processes for which the ERP system was configured the system was observed to be tightly linked with organisational structures, processes, technology, and roles. Changing them was perceived to be "*hard, uneconomical, and costly*" (respondent 5). Even though a majority of the main application modules were implemented in four of the six organisations, certain legacy systems continued to be used for

**Table 1** Case study organisations and respondents who participated in the study.

Details about case study organisations	Details about respondents
Glass manufacturing – global company, manufactures glass containers; unit of a multinational company with 500 employees in Australia; has had an ERP system for more than 7 years; vanilla implementation with minimum customisation; Financials & Controlling (FI/CO), Sales & Distribution (SD), Production Planning (PP), Materials Management (MM) modules implemented	Respondent 1: IT manager; implemented ERP system in this company; 20 years of experience Respondent 2: Operations manager; champion in ERP implementation; actively involved in managing operations and managing IT-business interface and upgrades
Retail organisation – one of the largest grocery retail organisations; 10,000 employees; working with ERP system for 6 years; uses ERP for finance, procurement, controlling and HR; has several other IT applications specific to retail industry needs	Respondent 3: Chief Information Officer (CIO) and enterprise architect; worked in the ERP implementation team; managed customisation; 10 years of experience in the firm Respondent 4: Finance manager; manages various accounting functions; worked in ERP implementation
Packaging materials manufacturing; employs 6000 people in Australia; implemented ERP 7 years ago; has financials, procurement, production planning, and SD modules; some customisation of S&D module;	Respondent 5: CIO with business general management experience; led the implementation of ERP system in this company; 20 years of experience. Respondent 6: IT manager; manages upgrades, ERP extensions and provides support; 6 years of experience in the firm; 4 years IT experience earlier
Milk products manufacturing – 20 year old company; employs 2200 people all over Australia; has had an ERP system for more than 8 years; implemented finance, S&D, production, and MM modules	Respondent 7: IT manager/CIO; 18 years of experience in the same company; involved as champion in the stage/module-wise ERP implementation in the company; looks after upgrades, maintenance and support to ERP system, and other IT infrastructure
Consulting organisation ERP implementation and upgrades consulting company; preferred partner to SAP; has large implementation projects; employs 20 consultants	Respondents 8 & 9: two senior consultants; each worked on 4 ERP implementation projects in consumer goods, packaging and/or retail organisations; more than 12 years of functional and general management experience in ERP environments; 6–8 years of consulting experience Respondent 10: Consultant who has implemented ERP system in a packaging materials manufacturing company; has 8 years of business and IT experience
Consulting and business process management (BPM) software vendor; ERP implementation consulting and BPM software development company	Respondent 11: Vice President; senior executive who manages ERP support and upgrades, ERP extensions; 6 years of experience

maintenance, laboratory information management systems, and retail sales. Though these firms were gradually moving with upgrades to more application-oriented modules and better integration, the limited level of integration appears to have restricted the firms' ability to change and reconfigure business processes.

Once the system has been configured and embedded, integrating the information and processes across the enterprise, the flexibility it offers may be limited and may depend upon the scope of ES implementation and other factors. In our study, with the implementation of most of the application modules in packaging, milk products, and gas manufacturing enterprises, full integration of routine transactional processes across functional boundaries had been achieved. This had delivered speed and consistency in

process execution to the firms. *"Integration will certainly enhance the speed at which a process is carried out; it has enhanced their speed of execution (respondent 1) and consistency of execution"* (respondent 5). According to respondent 7, the company's *"slowest processes are the ones that don't use integration feature"* of the enterprise system. In the retail organisation, however, full integration of basic transactional processes had not been achieved given the complexity of the organisation and a multitude of applications from *"disparate vendors used"* (respondent 3) by the organisation. This organisation, however, over time, has standardised applications across the enterprise by concentrating on one vendor and has used certain easy to add-on software for specific applications relevant to its industry. However, integration of processes has made

organisations less flexible, though that is changing. Ten years ago, as pointed out by one respondent, the organisation was inflexible in its processes, till the demands of flexibility *"forced us to go down the customization path"* (respondent 6). Because of the embedded interdependencies and costly change management efforts, integration has *"discouraged"* firms from changing their processes. Thus, while the speed of process execution has improved, the agility has been compromised as a result of process integration in many firms (respondents 9 and 11). But this appears to be changing. As noted by one respondent, *"using ABAP and others, you can alter the process without true customization; through portal applications, you can now provide that flexibility as part of core functionality. Though there are different ways of doing it, it is nowhere near the time and effort required in the past."* (respondent 5). Thus, with every upgrade, there were discernible improvements.

As noted by respondent 7, *"management believes they are making continuous changes and improvements to their processes for every upgrade"* (respondent 7) negating the need for separate attempts to change processes. Further, as pointed out by respondent 1, *"to minimise disruption and significant change management costs, we plan improvements during the upgrades.... we won't allow any changes once it is implemented... luckily, we are one of the key partners to our software vendor...we are in a good position to drive the improvements in the software itself... they (software vendor) are good so far... incorporating the problems we have experienced in our use ... in the software and processes ... they are improving them"*.

All six organisations studied have been gradually reducing the level of customisation as they move from one version to another over the years. Though the degree of customisation over time varied from firm to firm, there seemed to be a general belief among the managements not to make changes to the processes on their own if the changes required software customisation (respondents 1, 3, 9, 10, and 11). Though the process itself could not be termed *"agile"* in its current form, the organisations had been achieving necessary incremental improvements in the process with every software upgrade. Separate attempts to change and reconfigure processes in between upgrades were considered unnecessary by many respondents (respondents 11, 7, and 1).

The study found that the nature of the business process influenced the impact significantly. For example, in areas such as plant maintenance where there were a lot of manual, non-standardised processes and data, there was little potential for agility. On the other hand, in procurement, where information and processes were fully integrated, the process was very agile, especially because of the *"enhanced understanding and visibility of information and process"* (respondent 4). The richness of the information that was available and accessible had not been affected and was not considered to be a limiting factor for agility. In fact, respondents believed this to be the strength in building agility into the processes. As pointed out by respondent 2, *"better understanding of the process... its criticality, its complexity... by the managers will improve organisational capability to change the process if and when required in response to internal and/or external business*

*requirements"*. Therefore, better integration of processes would enable improved understanding of the process characteristics and contribute to improved organisational capability to change the processes efficiently and effectively.

Integration of information and processes between various hierarchical levels, as expected, had improved visibility and control in all the case organisations. Importantly, it had *"improved decision making"* (respondent 5), and helped the top management to better comprehend the critical need for process change and positioned them to build agility in their processes. As noted by one respondent, *"single truth of information both in aggregated and disaggregated form at different levels of the organisation and the improved visibility of information is helping us in the better assessment and management of process changes"* (respondent 3). Horizontal integration, on the other hand, contributed to the increase in the speed of process execution. *"Integration of our major processes has helped us understand the business rules and policies, better appreciate the roles played by each other, and ... (is) contributing to improved focus on the consistent execution, control, and performance of the end-to-end processes"* (respondent 4). Thus, both vertical and horizontal integration have contributed to an improved understanding of the process and have resulted in an improved ability to reconfigure and redeploy the process components better and faster in this organisation.

The integrated nature and higher visibility of information enabled by the ERP system may actually increase the dependence of managers on these tangible information sources and may indirectly reduce the importance of managerial judgement and external sources of information. This may result in *"information overload"* and *"reduce the richness of information available to managerial decision making, restricting the organisation's ability to respond"* (respondent 1) and may therefore restrict organisational ability to sense and respond to change through process reconfigurations. Therefore while process integration improves visibility and understanding, and thereby ensures efficient process changes, managers must be careful of becoming over dependent on the information produced by these systems, thereby sacrificing the effectiveness of process changes.

## Process optimisation and agility

Process optimisation is achieved primarily through standardisation of business processes, business rules, information formats, and technology platforms across the enterprise and by improving business processes. Process optimisation enables understanding of inputs and outputs of a process, exceptions to the process, identification of non-value added activities and variants across the enterprise and process performance, and adoption of standard processes embedded in the software solution.

Standardisation of processes improves communications about how the business operates, and enhances understanding among employees, and facilitates efficient hand-offs across process boundaries. Standardisation of the processes, information, business rules, and technology

platforms across the enterprise is expected to result in consistent execution of the processes and improved efficiencies. This is particularly so in a global enterprise with multiple units and global process owners. The benefits, however, depend on the scope and depth achieved in a typical enterprise system implementation and by the standardisation of input data. When the implementation is close to 'vanilla' implementation, i.e. the application modules have the least amount of customisation, the organisation will achieve standardisation of information, user interface, and major processes across the major enterprise functions. As noted by one respondent, *"if you don't standardise the process, you can't see information at different levels of aggregation quickly and in a meaningful way"* (respondent 2). *"If all the processes are different and all of the definitions of these pieces of data are different, even if it is in a minor way, you can't make much sense out of the reports that you are getting from the system"* (respondent 3). Therefore, *"standardisation and common practices"* are necessary to build agility in processes (respondent 1).

In instances where the data and process are not standardised, the company has not been able to *"effectively analyse plant maintenance expenditure and produce meaningful reports,"* (respondent 6). In one organisation, for example, many things were done off-the-system in plant maintenance and there were a lot of manual processes. Some of the reasons for non-standardisation of maintenance processes were historical. This organisation in the past, introduced self-directed teams, removed all layers of middle management overseeing maintenance, up-skilled staff and made them responsible for their own work. Even though *"this has led to more efficiency and improved quality of maintenance, there is a much more laissez-faire way of doing things, and (it) is a bit of a trade-off between a command and control or mechanistic sort of environment and the self-directed team environment"* (respondent 5). This self-directed work teams regime came into force at the cost of standardisation and had historically no structured scheduling and control for maintenance activities. With a majority of those maintenance activities outsourced, there is *"now a need for a detailed and standard scheduling process"* (respondent 6). In the materials management area, where the standardisation of data as well as processes is very high in procurement, materials requirements planning (MRP) and accounts payable areas, the benefits are immense. Therefore, where standardisation is not achieved, process has become not only rigid and inefficient, but also less agile and less amenable to rapid changes.

But standardisation of the data and process are two different things. While a near vanilla ERP system implementation may help in achieving standardisation of processes across functions, say in case of procure to pay and/or order to cash process, it does not deliver standardisation of data in an organisation. As pointed out by one respondent, *"a coffee mug if not carefully standardised, may be called by three different names and therefore may have three different material numbers in the system"* (respondent 6). Therefore, standardisation of data is an important managerial initiative and has to be done before standardising processes through ERP implementations. While

some companies have done this before implementing ERP systems, there are several others who have standardised data along with using and assimilating ERP systems (respondents 11 and 9). While the ERP systems environment has contributed to standardisation of the routine low level transactional processes such as procure to pay, plan to produce, and order to cash in many organisations, there is still inadequate standardisation of data formats and decision making processes (respondent 11).

The extent of standardisation achieved may therefore be dependent upon the characteristics of an organisation including its culture and control structures. One organisation has reviewed its repetitive processes and the data before implementation, and therefore has been able to simplify and standardise its repetitive processes such as procure to pay and that has helped it deliver consistency and control. Even though it is considered critical to get the business process and data right the first time, not many employees are keen to embrace this and this information discipline is a "culture thing" in this organisation. With *"average age of employees around 47, there is a change fatigue and 'she'll be right mate' attitude"* in this organisation and this appears to be colouring people's views (respondent 5). Thus the standardisation of data well before implementing the ERP system has helped one organisation, which positioned itself to change processes rapidly when necessary. In general, organisational culture characterised by low computer skills, high average age, and inertia to change is restricting firms' ability to make process changes effective and efficient and thus negatively affecting process agility (respondent 10).

Do we require all processes to be agile? The study found that agility in repetitive end-to-end processes that are of a transactional nature is neither a requirement nor relevant. *"We don't want these repetitive processes to be agile at all. Who wants to change 'procure to pay' process, what potential benefits can come out of this?"* (respondent 1). Management believes that the *"procure to pay process is a standard process in any organisation and we don't expect to derive any competitive advantage or benefit by making it agile and flexible"* (respondents 2 & 4). Process agility, therefore is not a requirement for every process and organisations may prefer certain processes to be stable and want them to deliver consistent execution. Any generic improvements in the process can be delivered through software upgrades and new versions. But the firm must have the capability to change its high-level decision making processes that are supported and facilitated by the ERP systems environment. As pointed out by one respondent, the place where you have to be agile is where you support your customer. An organisation must be ready to *"make changes and respond where it is facing the customer"* (respondent 11). From an *"IT point of view in retail sector, for example, there is a very clear trend in the marketplace. While one large point of sale software vendor is dying, another vendor that has the capability to support agility is expanding"* (respondent 3). Thus, agility is a requirement for processes that are customer-facing, while for transactional routine processes, agility may not be an essential requirement. Thus, if the process environment is stable, the need for its agility is less.



Standardisation of the processes and information has helped this organisation to achieve "single truth" of information and "consistent and accurate" execution of processes across the enterprise. As observed by one respondent, this factor has *"helped us to understand the process and speak one process language....use one metric of process performance... and confidence to deal with and implement required changes to processes across the organisation"* (respondent 1).

In case of other non-standard processes, some of the case organisations had implemented their old processes which had grown out of the organisation that no longer existed. As pointed out by one respondent, *"we have a terrible time trying to analyse our plant maintenance – expenditure particularly – because we have non-standard processes, we have non-standard data, we do a lot of things off the system, there are a lot of manual processes, and we haven't thought through our business process well before implementing enterprise system, I think we're actually not very agile in that area at all – we're really locked into a bit of a mess"* (respondent 1). As pointed out by another respondent, *"if we can standardise a simple and logical process, then it will help with agility and when you try and standardise something that is very specific, may be illogical, then we are stuck .... but many years ago when ERP software was implemented, it was really implemented into an organisation that had an old-fashioned mentality, which does not exist anymore"* (respondent 3). In certain accounting processes and information, according to respondent 3, the organisation had simply converted their old paper-based (inefficient) processes into an electronic system in the ERP environment. *"The problem with ERP software is that it locks in business processes, and if you've got a poor business process, ERP software will enforce it"* (respondent 4). Assuming the old processes as standard has placed this organisation into a tight corner with no discernible performance gains in certain areas. This, together with the organisational culture that has overemphasised control in the past, has made processes so complex that it would perhaps be difficult to contemplate any changes. So, rather than the ERP software restricting organisational ability to change processes, it is the inadequacies in implementation and poor process optimisations prior to ERP implementation that are restricting process agility in this organisation.

### Standardisation of technologies

Standardisation of technologies including user interfaces is considered a major benefit of implementing ERP systems though it has not been completely achieved in many firms. Many organisations have several other applications that deal with laboratory quality control, manufacturing process control, warehouse management, merchandising, transport management, contract management, project management, and pay roll system. At present, these legacy systems have point-to-point interfaces with ERP software. As pointed out by one respondent, *"ERP software vendor cannot offer everything, even with its industry solutions....therefore we*

*are happy to maintain these separate legacy systems for these critical applications and link them up with our ERP. Of course, we will review them every time there is an upgrade and hope to minimise them one day... that is if SAP can come up with a workable solution to our requirements..."*(respondent 3).

As technologies are becoming increasingly standardised and interoperable, in the view of one organisation, technology standardisation was not a restricting factor for building agility. As noted by one respondent, *"it is the software vendor's responsibility to make their system talk to others... it is in their own interest to do that if they want to improve their market share for upgrades and revisions"* (respondent 7). In general, respondents were confident that all major ERP software vendors would remove these restrictions in their future versions and make them increasingly more open and interoperable by incorporating open standard-based non-proprietary technologies. As pointed out by one respondent, *"this trend is already discernible in ERP software"*; ERP software vendors have made the *"technology interfacing a lot easier and cost effective today compared to a decade ago when we started with them"* (respondent 10).

As noted by another respondent, disparate processes and definitions of data would produce confusing information, *"So you really need standardisation and common practices to enhance your agility, because when the information is presented to you, you understand exactly what it's telling you"* (respondent 9). Therefore, standardisation of repetitive processes, which were efficient before ERP implementations were contributing to process agility in this organisation. But for other processes, linking with technology in the ERP environment made those processes very rigid and inflexible. The company therefore has been gradually discarding its old processes by adopting the processes and rules embedded in the software with every upgrade. Instead of continuing the customisation as they have done in the past for various applications, these firms are slowly moving more towards a vanilla implementation for every upgrade and minimising the customisation.

Standardisation has led to simplification of certain repetitive processes in these organisations. *"We have simply discarded some existing processes and embraced the ERP software processes and that has been good for us"* (respondent 2). But, in some situations, many firms have configured the system around the existing process without any improvements in the process. In those few instances, the ERP implementation locked the inefficient business process and restricted the organisation's ability to make efficient and cost effective changes (respondent 8).

Thus, standardisation has a mixed effect on business process agility and the effect depends on the nature of the business process (repetitive or special or exception handling), the extent of standardisation implemented across the organisation and/or whether the standardisation carried out included simplification and improvement of the processes prior to or at the time of ERP implementation. Increasing shift by ERP software vendors towards interoperability and general adoption of non-proprietary technologies in their later versions consistent with the market demands is no threat to agility. Therefore, standardisation

of technologies enabled by ERP systems implementation has a strong positive effect and will actually make it easy for organisations to build agile processes. But, as noted by a key respondent, agility is a *"cultural thing rather than something that technology really makes a whole lot of difference to"* (respondent 11). Technology may make a bit of difference to it, but *"the thing that's always going to catch you out when it comes to agility is culture in an organisation"*.

### Best practice processes and agility

Enterprise systems offer best practice processes. It is believed that the processes embedded in the software and implemented in many case study organisations are truly the best practices and implementing them and discarding the existing practices is expected to contribute to improved performance. As pointed out by one respondent, *"people don't understand that SAP has talked to many experts in the field, studied leading organisations, and put in lot of effort and time into getting the business process right, and built up the processes and options"* (respondent 5). The case organisations believe that it is safe to simply adopt what the enterprise system software suggests rather than changing/customising its processes by changing the code. It is believed that *"the core of transactional processes supported by the ERP systems remain unchanged for a long time. Other than some changes to the user interface, screens, options, and enhancements to the way it works, the way purchase requisition is processed, the way maintenance order is created, has not changed much"* (respondent 7). These improvements to the system, over time, are consistent with the changes in the way organisations evolve. So, any variability in the process that is required for business reasons can wait for the next upgrade; alternatively, it can be handled as an exception. As pointed out by a respondent, *"as people learn how things work and as the workforce becomes more educated and skilled over time, the business processes and practices also will evolve and improve; I guess SAP is doing that with every upgrade or every enhancement"* (respondent 1).

On the economic front as well, this firm views this as a cost effective and efficient option. In any case, as observed by another senior manager, core business processes such as procure to pay, or order to cash do not often change in any enterprise system software. As the *processes supported by ERP systems are transaction centric*, following the best practice processes embedded in the software may not negatively affect process innovation even at the cost of ignoring some local practices (respondent 5). It is expected that the software vendors will take into consideration the changes in technologies, education, and skill levels of a typical workforce as users learn about the software, and contribute to the evolving nature of business processes. In addition, improvements if any to the business processes consequent to the evolution of technologies, skills, and practices are generally incorporated in the upgrades, enhancements and newer versions. Therefore, in this organisation, there is a strong belief that the best practices are truly best practices and there is *"no need for the core*

*transactional processes to be agile and they don't require to be changed"* (respondent 9).

It is very rare that firms would change business processes outside the enterprise system's environment, to deal with external demand, especially in the case of standard transaction based processes. Changing the business processes involves significant changes to the information technology systems, their interfaces, and organisational structures, and is generally discouraged because of the significant costs, change management efforts and particularly because it may encourage proliferation of non-standard processes, practices, technologies and systems in the enterprise (respondents 10 & 11). *"We don't want to change these standard processes..., they are working fine for us... it is important to keep these processes stable and consistent, rather than flexible and allow frequent changes"* (respondent 6). Thus, the best practices embedded in the enterprise systems do not have any specific influence on the firm's ability to build agility in their business processes. It is expected that the best practices themselves will incorporate periodic changes necessary in the processes to deal with the dynamic business requirements (both internal and external).

### Improved visibility, control, and agility

One of the key benefits of implementing an ERP system is to improve visibility of information and process across the functional boundaries and hierarchical levels. With every data element entered only once and by one person in the organisation, the potential risk of erroneous data entry is high in an ERP enabled environment. This risk is considered particularly high when the data entry activities are diffused to lower level staff within an organisation and in firms that have lower level of education and training. This is generally viewed as *"a significant control risk for day-to-day management"* by a majority of respondents. Some firms, however, do not see this as a major risk, given the confidence they have in the skill levels of their employees and the regular user training regime. Though this risk is mitigated to some extent by equipping operating staff (users) with necessary skills and process knowledge through user training and communication campaigns, its effect on process agility is considered negligible. Rigid discipline of data management enforced by the ERP system at lower levels, however, appears to have negative effect on the ability to change processes in all the manufacturing firms. In a way, this has increased organisational inertia to change of processes. Centralisation of control has enabled the managers to know what is going on at a big picture level and helped them handle frauds. *"When processes are simple, standardized, and visible, you will get higher compliance and there will be less work-around: thus, compliance to process is important for agility"* (respondent 2).

Information collected in an ERP environment is not limited to business transactions. As observed by one respondent, *"more data is collected about what's the quality of the product sold? How profitable is a particular customer? What are the customer claims? What was the productivity around the machines? All that's got nothing to do with commercial transactions leading to complexity"*

(respondent 8). Though this has increased information overload and complexity of the information collected, the focus now is on intelligence and “being smarter about how you report that information” (respondent 5).

Improved visibility of information is driving the process agility in case study organisations. As pointed out by a respondent, “though the process per se does not change, it is the timeliness of a particular triggering event that would change significantly” (respondent 6) because of the improved visibility and accuracy of information. For example, by asking the customer to go online and trigger an internal order fulfilment event and by capturing the information right at the source, whether it is internal or outside the firm, a process execution starts much earlier than normal and this gives “speed” to the execution. As noted by one respondent, “the earlier you can kick off the process, the more agile you will become. You are altering the process, but the timing starts earlier. Either by the customer or by our sales representative with the help of a laptop” (respondent 5). So, in many such instances, process agility is about how soon you can start the process, which is viewed as better service by the customer.

Improved visibility of information enabled by ERP systems has resulted in greater centralisation in case study organisations. This effect is particularly significant where the process owners are global. Thus, improved visibility has empowered people further down in the organisations.

## Conclusions

Enterprise resource planning systems in the past have contributed to simplification, standardisation, integration, and automation of processes, but their influence on the firm’s ability to build agility is ambiguous. Integration of processes and information across functional boundaries, according to this study, contributes to improvement in the speed of execution and enhances the ability to re-configure process components. Integration across hierarchical levels in the case organisations has resulted in improved visibility, centralisation of control and improved decision making, which indirectly contributed to process agility. Standardisation of repetitive processes that were efficient before ERP implementation may also have contributed to agility. Linking with technology in an ES-enabled environment without optimising the process made those processes rigid and inflexible. In general, the best practice processes embedded in the software were found to be “true” best practices and have helped the firms achieve incremental process improvements, thereby reflecting agility. With regular updates ensuring the incorporation of latest developments in practices and technologies, it is generally believed that the requisite agility is also part of the best practices. While the technical tight-coupling of the enterprise system infrastructure has limited the firms’ ability to build agile processes, both vertical and horizontal integration, and standardisation of processes and information appear to be contributing positively, this study found.

It is, however, important to note that it may not be necessary for all the major standard processes supported by enterprise systems to be agile. For example, high volume transactional processes such as procure to pay, order to

cash, and hire to retire are not likely to change rapidly and building agility into those standard processes is not found to be necessary. The focus of management in such transaction-centric and volume-based processes is to achieve consistency, control, and thereby cost efficiencies. While demanding that their IT infrastructures be tightly integrated for control and visibility, firms are seeking to deliver agility with loosely coupled systems and technologies. Though it was considered difficult to achieve both agility and control simultaneously in the past, introduction of web services technologies as well as organisational ability to optimise and manage the processes would deliver both in the long run. As rightly pointed out by one respondent, “We get agility automatically once we deal with the process efficiency first and then automate it using the available technologies” (respondent 1). Building agility into business processes and implementing them is not easy and is dependent not just on the IT infrastructure, but also on other factors such as organisational culture, business process management capability, and process characteristics specific to a particular organisation.

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