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One Size Fits All? How Does Firm Heterogeneity Affect ERP Adaptation and Firm Performance?

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Abstract

A cause of high ERP failure rate is the misfit between organization processes and ERP systems. To solve the misfit problem, literature suggests two adaptation approaches: conducting business process reengineering (BPR) to fit organization processes into ERP systems, or customizing ERP systems to fit organizational processes. However, extant studies seldom explore how firms should choose between the two adaptation approaches and adjustment level based on their heterogeneous firm characteristics. Through the lens of contingency based task-technology-fit (TTF) theory, this study collects data from 150 U.S. manufacturing firms that use ERP systems, and empirically investigates how firms could choose a suitable adaptation approach between BPR and system customization while considering their heterogeneous characteristics, such as firm size, industry, top management involvement, big-bang or phase-in implementation speed. Consequently, this study further examines how such choice of different adaptation strategies and adaptation level affect firms' final firm performance. Our results show that industry, top management involvement, and implementation speed significantly affect firms' choice of adaptation approaches and adaptation level, while their choices also significantly affect final firm performance.

Keywords

Enterprise Resource Planning, ERP, Business Process Reengineering, BPR, Customization, Firm Performance

1. Introduction

Enterprise resource planning (ERP) is an enterprise system that helps integrate business information and reengineer business processes (Tian & Xu 2015; Strong & Volkoff, 2010). ERP's ability to collect complete, real-time, and integrated business information enables firms to efficiently and effectively respond to a ra-

pidly changing environment and fulfill customers' needs. However, when implementing ERP systems, many enterprises encounter a *misfit* problem between existing business processes and ERP systems that, consequently, involves huge costs to either adapt their ERP systems or organization processes (Strong & Volkoff, 2010). A recent survey found that 66% of organizations experienced operational disruption while implementing a new ERP system, while 81% failed to realize their expected benefits after implementation due to such a misfit problem (Panorama Consulting Group, 2019).

The misfit between business processes and ERP systems is a critical challenge for firms (Hong & Kim, 2002). ERP vendors design systems to comply with the general mass market, rather than specific needs of individual companies (Strong & Volkoff, 2010). That type of design leads to a problem in that ERP systems cannot fully comply with firms' specific and unique requirements (Seddon et al., 2003; Strong & Volkoff, 2010). As Rajagopal (2002) points out, the high failure rate of ERP implementation results from a gap between ERP-using firms and ERP vendors: firms desire a customized ERP system, while ERP vendors develop systems for generic mass markets to achieve economies of scale. It has been estimated that, on average, off-the-shelf ERP systems can only address about 70% of the business needs of ordinary firms (Markus et al., 2000). The misalignment is considered to be a gap between the "best practices" embedded in ERP systems and organizations' original business processes (Van Beijsterveld & Van Groenendaal, 2016). In order to solve the misalignment problem, previous studies propose two adaptation approaches: 1) Business Process Reengineering (BPR), and 2) customizing ERP systems (Soh et al., 2003).

Business process reengineering (BPR) refers to adjusting a company's internal processes to fit its ERP system. In other words, organizations change their original business processes to follow the best practices embedded in ERP systems in order to improve operational efficiency, thereby enhancing their competitiveness in the market. IS scholars and practitioners suggest this approach involves lower costs, smaller technical risks, and can incorporate learned experiences from leading enterprises (Liang & Xue, 2004). Therefore, many firms, in particularly small and medium-sized firms (SMEs), often use or are strongly recommended to use such an adaptation approach when implementing ERP systems. However, previous studies also show that while BPR can mitigate the misfit problem, it does not guarantee successful ERP implementation (Liang & Xue, 2004). Business process reengineering often fails due to difficulties in changing employees' habits (Yen et al., 2015), huge hidden costs in long transformation processes, and risks of losing firms' original competiveness and unique business processes (Liang & Xue, 2004).

Customizing ERP systems to address existing organizational processes is another approach to solve the misfit problem. Some firms choose this approach due to their large size, complex business processes, and/or intention to maintain their core and specific business processes (Mabert et al., 2003a, 2003b). The cus-

tomized ERP system approach could better retain firms' key processes, maintain original workflow, reduce employee resistance to change and, thereby, enhance the likelihood of implementation success. Nevertheless, this approach also brings concerns, such as the complex technical skills needed for customizing, upgrading, and maintaining ERP systems. The high technical risks increase the difficulty of putting ERP customization into practice.

In summary, both BPR and customization have pros and cons (Law & Ngai, 2007). Most ERP scholars, vendors, and consultants, however, advocate that enterprises should adopt BPR to improve their business processes in order to benchmark with the embedded ERP best practices (Tsai et al., 2010; Finney & Corbett, 2007), implying that the full benefits of ERP systems can only be realized with a great deal of BPR. In contrast, other scholars, such as Rothenberger and Srite (2009), argue that all ERP implementation projects inevitably need some degree of customization, which is one of the important steps in ERP implementation that cannot be avoided. Thus, existing studies propose two competing opinions (i.e., "adjust systems" or "adjust organization processes") and have not reached a clear conclusion regarding how to solve the misfit problem. More importantly, prior studies rarely investigated how firms with different characteristics (e.g., firm size, industry, ERP implementation speed, and level of top management involvement) should choose between the two adaptation strategies. It is also not well understood what adaptation level of the two adaptation strategies may affect final firm performance. Thus, the lack of a clear conclusion motivates us to conduct a large-scale empirical study to further address the following research questions:

1) How does firms' heterogeneity (e.g., firm size, industry, ERP implementation speed, level of top management involvement) affect their choices of adaptation strategy (BPR or customization) and their adaptation levels to solve the misfit problem?

2) What is the subsequent ERP performance after firms adopt different adaptation strategies (BPR or customization) and different adaptation levels?

2. Literature Review

Firms' choice between BPR and customization is considered a critical factor for ERP success (Plant & Willcocks, 2007). In the following, we review literature to understand the details of the two types of adaptation.

2.1. Business Process Reengineering (BPR)

BPR is defined as an organization redesigning its business processes in order to improve competitiveness in the market (Hammer, 1990). More specifically, improving customer services, shortening delivery time, lowering production costs, and improving quality are considered important BPR benefits (Huq & Martin, 2006). BPR is also proposed as a critical success factor in many IT implementation projects. Since BPR aims to simplify and reengineer business processes, in

theory, it should smoothly link the newly implemented IT systems with business processes, and effectively complement the new IT system with business functions (Law & Ngai, 2007; Tsai et al., 2010).

Most ERP vendors and consultants recommend companies carry out business process reengineering (BPR) while implementing ERP systems (Kang et al., 2008). In other words, adjusting internal workflows to fit the best practices embedded in ERP systems (Esteves et al., 2002). Best practices aim to guide ordinary companies toward following the processes and management practices of industry leaders so they can improve their organizations and enhance firm competitiveness. By conducting BPR to fit the best practices embedded in ERP systems, companies could break boundaries of traditional departments and functions, enable them to be more flexible, respond rapidly to market changes, shorten transaction times, reduce human errors, and improve data accuracy, thereby enhancing firm efficiency (Tsai et al., 2010).

When implementing ERP systems, organizations have to select an appropriate BPR adaptation level, thus enabling ERP systems to connect smoothly with organizations so that firms can receive the full benefits of ERP. The magnitude of the adaptation level can be as low as merely streamlining, to a very high reinvention level (**Figure 1**). Streamlining refers to incremental changes in existing organization processes in order to enhance product quality, shorten cycle times, and reduce costs. Reinvention refers to discarding existing processes and creating new processes that the organization really needs (Bancroft et al., 1997). Since streamlining adopts a periodic approach to improving partial processes first and then slowly extends to other processes, it is considered a low magnitude BPR change. On the other hand, reinvention removes outdated processes and creates new ones to improve the organization, and is viewed as high magnitude BPR. Following the definition of (Bancroft et al., 1997), this study categorizes BPR level into two groups: 1) high magnitude change and 2) low magnitude change.

However, a recent study shows that 53% of organizations consider BPR difficult (Panorama Consulting Group, 2019), which implies the dilemma of BPR implementation in practice. Hong and Kim (2002) and Wei et al. (2005) further indicate that when organizations adjust their processes to fit ERP, it affects not only existing internal processes but also involves other organization difficulties, in particular, personnel problems. Several prior studies identify these BPR-related personnel problems, including:

1) Employee resistance: employees are not willing to change from their habits of conducting work to the new ERP or BPR way of completing tasks (Yen et al., 2015).

2) Barriers in cross-departmental communication: Due to business process reengineering, firms have to abandon traditional department perspectives and change to a process-oriented perspective, which may cause conflicts among departments (Hodge, 2002).

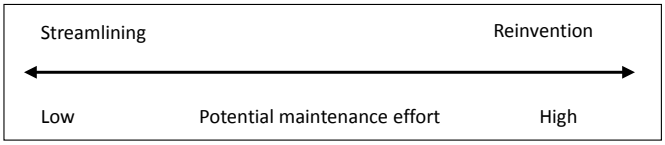

Figure 1. BPR level (adapted from Bancroft et al., 1997).

3) Unmotivated organizations: it usually takes a long time for firms to complete BPR, which may result in demoralized organizations, and it also prolongs ERP implementation. If organizations happen to lack strong leaders, the long implementation usually leads to decreased firm performance (Subramoniam et al., 2009).

4) Increased costs rather than cost savings: hidden costs happen in implementing business process reengineering and redesign, so firms have to put in more manpower, financing, and time (Subramoniam et al., 2009).

The greatest challenge of BPR is to solve problems related to resistance from employees, role changes, training, and other personnel issues (Panorama Consulting Group, 2019). However, many previous studies show that implementing ERP alone without BPR does not improve organization efficiency. Nevertheless, very few existing studies explore what magnitude of BPR adjustment (i.e., streamlining vs. reinvention) is appropriate for obtaining desired beneficial results from ERP implementation. Nah et al. (2001) claim that while implementing BPR, a great deal of process reengineering should be adopted repeatedly in order to get the benefits of ERP, but this strategy is criticized by increasing risks, complexity, and costs (Davenport, 1998). Wei et al. (2005) report that BPR affects employees' work content, responsibilities, and performance. It can be seen that while BPR may improve organization processes, it also has extensive impacts, and sometimes negative impacts, on the whole organizations. Therefore, some firms choose another adaptation strategy—customized ERP system—due to their large number of employees and complexity of organization processes.

2.2. ERP System Customization

Customization refers to meeting organizations' needs by adjusting ERP systems (Chou & Chang, 2008; Rajagopal, 2002). Rothenberger and Srite (2009) define low level ERP customization as enterprises choosing a suitable ERP system and setting parameters in the system, then they can have ERP functions needed under an established scope of work. The drawback of conducting this kind of basic adjustment is that it only meets organizations' partial needs in many cases, and cannot fully fit firms' existing processes. On the other hand, extensive ERP customization refers to that organizations adopt third-party packages to supplement existing ERP functions or, if firms need a very unique modification, they may further construct their own ERP platforms (i.e., core customization). Light (2001) categorizes the degree of customization into five levels (**Figure 2**), including new report, amend existing reports/displays, process automation, add functionality, and change functionality. The higher the degree of customization, the greater the maintenance efforts needed.

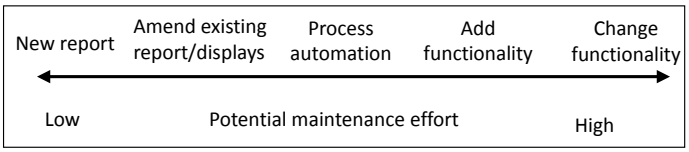

Figure 2. ERP system customization level (adapted from Light, 2001).

Customization usually requires high-level technical skills since organizations may encounter many technical difficulties during the customization process. Thus, prior studies suggest that customization is preferred only in the following scenarios (Mabert et al., 2003b):

1) Industry: if an organization is in a distinctive industry with specific needs, such as complex order management and short-term orders, and off-the-shelf ERP solutions are not able to meet its needs, then customized ERP systems are needed.

2) Core competence: when firms want to keep their core business processes, they then need to significantly customize ERP systems to maintain their core competency.

3) Multinational corporations and large companies: multi-plant and multi-national enterprises mostly choose customized ERP systems to meet their complex processes.

Customization reduces incompatibility between ERP systems and organization processes, lowers employees' resistance, and reduces the need for training and organizational adjustment (Hong & Kim, 2002). Mabert et al. (2003b) indicate that most organizations more or less adopt some degree of customization. While customization has many advantages, it also involves risk. First, customization requires a great amount of IT manpower, resources, and time, followed by difficult system maintenance and upgrades (Rothenberger & Srite, 2009). The greatest challenge of customization is to understand the customized ERP system. Mabert et al. (2003b) indicate that if a customized ERP system is too complicated, then even an experienced ERP developer may find it difficult to maintain and upgrade. Additionally, since the core value of an ERP system emphasizes integration, IT staff in ERP-using firms may feel it is difficult to decide which ERP functions are to be kept, and which can be modified or removed in the customization process.

Customizing an ERP system has its pros and cons; it keeps firms' core processes, but it also suffers from many drawbacks. Panorama Consulting Group (2018) show that 89% of their surveyed enterprises customized some degree of their ERP systems to fit existing processes. Among them, 10% adopted minor customization (1% - 10% of code modified), 70% chose some customization (11% - 25% of code modified), and 5% adopted extreme customization. While organizations indeed adopt different levels of customization, it is still unclear what extent of customization enables firms to reach satisfactory performance. Brehm et al. (2001) propose that the success of ERP implementation is highly related to

the degree of customization. Somers and Nelson (2001) propose that a low degree of customization is more likely to result in successful ERP implementation because heavy customization involves increased costs, prolonged implementation time, and difficult upgrade/maintenance problems. Organizations are not recommended to adopt customization unless it is necessary or the organization's competitive advantage is derived from a non-standardized process (Hong & Kim, 2002). However, high degrees of customization still exist in reality; Subramoniam et al. (2009) indicate that most large organizations with abundant resources and unique processes choose a high degree of customization because these vast firms think it is easier to change ERP systems than to change a large group of employees. Since prior studies show no conclusions on how firms should choose between high and low degrees of customization (Rothenberger & Srite, 2009), and diversified levels of customization do exist in industry, this study aims to further investigate this issue.

2.3. Firm Performance

While most prior research evaluates ERP performance by measuring financial indexes such as cost decreases, productivity improvement, and profit increases (e.g., Hitt et al., 2002), many scholars suggest that intangible organizational improvements should also be considered when evaluating whether or not an implementation of ERP is successful. For example, Mabert et al. (2003a, 2003b) report that most improvements after using ERP are in intangible areas, such as increased interaction across the enterprise, quicker response times for information, integration of business processes, and availability and quality of information. Gattiker and Goodhue (2005) show that ERP can deliver intangible benefits to firms, including better information, more efficient internal business processes, and better coordination between different units of a firm. Banker et al. (2006) found that ERP systems have positive impacts on product quality, product time to market, and plant efficiency, while Mabert et al. (2003a, 2003b) indicate there are also operational improvements in order management, on-time deliveries, and customer interactions. Cotteleer and Bendoly (2006) show that order fulfillment lead-time is significantly improved after ERP system deployment. Karimi et al. (2007a, 2007b) found that ERP implementation is associated with process efficiency, effectiveness, and flexibility. Ranganathan and Brown (2006) report that ERP projects with greater functional scope or greater physical scope result in higher shareholder returns. Following these previous studies, we categorize ERP-related firm performance improvement into three categories: *cost decrease*, *productivity & efficiency*, and *higher level of organizational benefits*. More importantly, our study aims to investigate how different ERP adaptation approaches (BPR and customization) and adaptation level would result in different types of firm performance. The details of how we operationalize these variables are in Section 4 and in Appendix A.

2.4. Research Gaps

Conducting a literature review (**Table 1**) by using keywords including ERP and misfit to search recent studies, we found existing efforts are greatly dominated by conceptual or qualitative studies, while empirical investigation is relatively limited. For instance, Seddon et al. (2010) use content analysis to qualitatively show good fit leads to better firm performance, but without illuminating how to choose adaptation approaches to achieve such good fit. Alsulami et al. (2014) conduct a conceptual analysis to categorize different types of ERP implementation misfits, while Strong and Volkoff (2010), Peng and Nunes (2017), Hustad et al. (2016), Van Beijsterveld and Van Groenendaal (2016), and Kouki et al. (2010) use case studies in the United States, China, Norway, Netherlands, Canada and Tunisia, respectively, to explore the ERP misfit phenomenon. A handful of studies examine the misfit issue empirically. Among them, Wang et al. (2006) examine how consultant quality, top management support, and country of origin of ERP package may affect misfit through 85 ERP using firms in Taiwan. It is noted that more than half of their surveyed firms use local ERP packages rather than international brands; thus, their study can be further improved by expanding the ERP surveyed packages to include more international brands. Hong and Kim (2002) and Sun et al. (2016) survey ERP using firms and show that good fit leads to ERP implementation success, while Shiang-Yen et al. (2013) using survey method to empirically examine how different adaptation approaches may be used to different misfit scenarios by investigating 305 ERP users in Malaysia. These existing studies can be strengthened by further investigating how firm could choose different adaptation strategies and level, according to firm heterogeneity to achieve good fit and final firm performance.

In summary, the review indicates a research gap that much more empirical studies are needed to validate the qualitative and conception findings on ERP misfit problem, and our study aims to bridge this gap by conducting a large scale empirical investigation in ERP using firms. In particular, our study empirically examines firms in manufacturing industry in the United States, which is the most mature industry on ERP using (Mabert et al., 2003a, 2003b), with a verity of local and international ERP brands being used. More importantly, our study is different from extant works by taking a deeper examination on how firms can choose appropriate adaptation approaches and levels based on their different heterogeneity.

3. Task-Technology Fit Theory and Research Model

Task-technology fit (TTF) theory is a compelling basis for a depiction of IS system performance (Goodhue & Thompson, 1995). TTF theory defines "fit" as the extent to which the technology functionalities match with organizations' task requirements. TTF theory proposes that information systems will have positive impact on firm performance only when there is a good fit between the system

Table 1. Representative studies on ERP Misfit (Qualitative vs. Quantitative).

Author(s)	Theoretical Foundation	Methodology	Main Findings
Qualitative studies			
Seddon et al. (2010)	Organizational benefits from enterprise systems model	Content analysis	Good fit leads to better firm performance.
Alsulami et al. (2014)	Dialectic model of organizational change process	Conceptual analysis	Categorizing ERP implementation conflicts (misfits).
Strong and Volkoff (2010)	Critical realism. Grounded theory.	Case study	Six misfit domains (functionality, data, usability, role, control and organizational culture)
Peng and Nunes (2017)	Updated IS success model	Case study	A 9D (nine dimensions) ERP evaluation framework is proposed to explore ERP misfit.
Hustad et al. (2016)	Conceptual framework for ERP customization	Case study	Connecting different types of customization and different categories of misfits.
Van Beijsterveld and Van Groenendaal (2016)	Misfit analytical framework.	Case study	The proposed framework can distinguish actual from perceived misfits.
Kouki et al. (2010)	Diffusion of innovation theory	Case study	Alignment gap between ERP systems and business is a key factor to receive ERP benefits.
Robey et al. (2002)	Dialectic motor of change	Case study	Core teams and consulting relationships address configuration knowledge barriers. User training and phased implementation overcome assimilation knowledge barriers.
Luo and Strong (2004)	Conceptual framework	Conceptual analysis	Proposing a framework for choosing BPR or customization.
Wei et al. (2005)	A stage view of ERP implementation	Case study	Different types of misfits are categorized into different stage of ERP implementation.
Rothenberger and Srite (2009)	N.A.	Case study	Exploring the reasons of high customization
Quantitative studies			
Wang et al. (2006)	Social Shaping of Technology Perspective	Survey of 85 ERP using firms in Taiwan	Country of origin of ERP package, consultant quality, and top management support could alleviate misfit problems.
Hong and Kim (2002)	Literature related to fit	Survey of 34 ERP using firms	Good fit may lead to ERP implementation success.
Sun et al. (2016)	ERP implementation lifecycle models	Survey of 144 ERP users	Fit between ERP (packages vendors, implementation partners) and organization needs affects time and budget of ERP implementation.
Shiang-Yen et al. (2013)	Task-Technology Fit theory	Survey of 305 ERP users in Malaysia	System modification could more effectively solve deeper layer of ERP misfits. Surface layer misfits are more appropriate to be resolved through changes in business practices.

functionality and the task requirements of firms (Goodhue & Thompson, 1995). In contrast, poor fit between task requirements and system functionalities is expected to have negative impact on firm performance. TTF theory provides a solid theoretical foundation and logical lens to investigate how ERP fit (or misfit) affects firm performance. Recently, some scholars further propose that the relationship between task-technology fit and firm performance is not static, but is

influenced by contingencies (Morton & Hu, 2008; Ifinedo, 2011). Such contingencies may include firm heterogeneity and other surrounding environmental factors. This contingency perspective claims that there is no single best way (best practices) to design organizational structures (Morton & Hu, 2008). Instead, the best way is contingent upon the internal and external situations of the company.

Therefore, the *contingency based task-technology-fit* (TTF) perspective provides a solid rationale to our study, which proposes to examine how firm heterogeneities may serve as *contingency factors* affect ERP adaptation choices and final firm performance. In line with the contingency based TTF theory, firms have to conduct adaptation by choosing either BPR or customizing ERP systems based on their heterogeneity to solve the misfit problem. Thus, we propose a research model (**Figure 3**) to understand how firms should choose a suitable adaptation approach considering their heterogeneity (firm size, industry, top management involvement, and implementation speed). Consequently, we examine how these adaptation choices affect firms' final performance.

3.1. Firm Size

Prior IT studies investigate how firm size may affect IT adoption, implementation, and performance, while firm size is usually measured by employee numbers or revenue (Mabert et al., 2003a, 2003b). In the past, ERP systems were usually adopted by large firms due to huge investments in capital and IT capability. Recently, ERP is adapted by small and medium-sized enterprises (SMEs) to improve business processes and gain firm competitiveness (Mabert et al., 2003a). However, compared to large firms, SMEs usually have limited resources and capabilities, which could lead them to choose different IT adoption and adaptation approaches than large firms, and may result in different benefits (Achanga et al., 2006). For example, with limited budgets and resources, small firms are more likely to choose a BPR approach (Laukkanen et al., 2007). Small firms have few IT employees and limited IT capability to customize ERP systems, so they would prefer to change their business processes and train their employees to fit with the ERP systems (Deep et al., 2008). On the other hand, Mabert et al. (2003a, 2003b) found that more than 50% of large firms conducted significant amounts customization while small firms usually adopted minor customization; thus, large firms usually customize ERP systems more than small firms, because the former usually run their businesses all over the world with complicated business processes and structure, while resources and IT manpower are more sufficient. The degree of customization varies significantly across firm size, with larger companies typically customizing more to preserve their competitive advantages, while smaller companies tend to leverage best practices. Accordingly, we hypothesize that:

H1a: Small firms are more likely to conduct high level BPR.

H1b: Large firms are more likely to conduct high level customization.

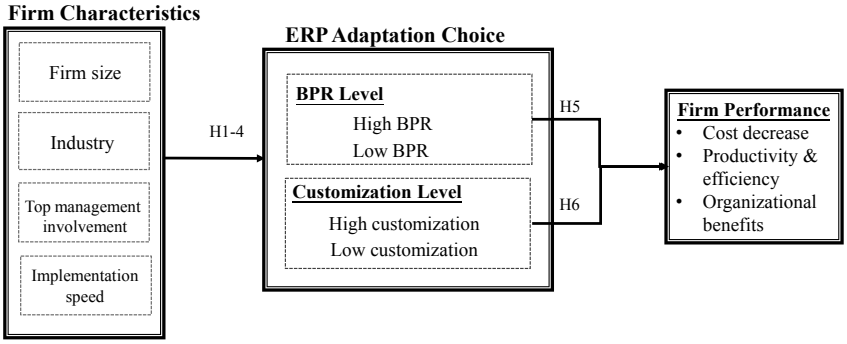

Figure 3. Research Model.

3.2. Industry

Prior studies indicate that a firm's industry environment also affects how it chooses its ERP adaptation approaches (Mabert et al., 2003b). The manufacturing industry is the most matured ERP-using industry. However, even within the manufacturing sector, traditional manufacturing and high-tech manufacturing firms choose different ERP adaptation strategies. For example, many traditional textile and clothing firms indicate their industry has unique characteristics (e.g., seasonal issues) that should be carefully considered when adopting ERP systems. The seasonal issues require firms in this industry to quickly adjust inventory, efficiently monitor supply chains to swiftly locate production-to-sales in different countries, and rapidly notice changes in fashion trends, etc. Due to these industry-specific characteristics, off-the-shelf ERP systems usually cannot fully fulfill their business needs, and many firms in this industry customize their ERP systems.

On the other hand, high-tech industries, such as electronics and computers, are in a high-speed and constantly-changing environment. The characteristics of this industry result in short product lifecycles, and potential backlogs of outdated products force the industry to maintain low inventories. Firms in this industry may have greater requirements of their ERP system functions customized to support optimal transaction efficiency. ERP vendors sometimes label a manufacturer as a "dumbbell" type or an "olive" type according to where the company's competency is located in its operation (Liang & Xue, 2004). Dumbbell type companies, such as pharmaceutical and high-tech industries, compete on R&D and marketing, whereas olive type companies, such as textile and furniture industries, compete on manufacturing efficiency (Liang & Xue, 2004). Choosing a flexible, industry-specific ERP system to meet firms' needs and processes is a critical decision. In response, this study analyzes 11 sub-industries in manufacturing, and divides them into traditional manufacturing industries and high-tech manufacturing industries to understand their ERP adaptation approaches.

H2a: Industry type is associated with firms' BPR adaptation strategies and BPR level.

H2b: Industry type is associated with firms' customization strategies and customization level.

3.3. Top Management Involvement

Top management involvement refers to top management's willingness to champion ERP within the organization and allocate the resources required for successful ERP infusion (Stratman & Roth, 2002). Top management commitment is a recurring factor in studies examining large-scale implementation of new business processes and information systems. For example, Chou and Chang (2008) and Gattiker and Goodhue (2005) indicate that top management involvement improves ERP performance, and is a critical factor for ERP success. Higher levels of top management involvement can increase firms' acceptance of and commitment to ERP systems, and can facilitate ERP implementation (Kamhawi & Gunasekaran, 2009; Reimers, 2003). Top management announces the new goals and objectives, communicates with employees, establishes a shared vision and a new organizational structure, defines staff roles and responsibilities, and establishes policies for the new ERP system (Jafari et al., 2009). The higher the level of top management involvement in the ERP implementation, the more ERP is regarded as a high-level, strategic project rather than an IT project (Savage et al., 2010). On the other hand, case studies from Robey et al. (2002) and Rothenberger and Strite (2009) found that when top management involvement is low, ERP projects are treated as an IT project and, consequently, customization level is usually high in such cases. These companies usually aim to replace their legacy IT systems with ERP systems, they prefer keeping their original business processes, and tend to extensively customize their systems. Accordingly, we hypothesize:

H3a: High level top management involvement in an ERP project is associated with high BPR level.

H3b: Low level top management involvement in an ERP project is associated with high customization level.

3.4. Implementation Speed (Big-Bang versus Phase-In)

Existing studies indicate that implementation speed could affect BPR and system customization level, and eventually, ERP system performance (Tsai et al., 2010). However, how different IT implementation speeds (big bang vs. phase-in) result in different levels of effectiveness for firms that have different organizational needs and operate in different environments is not clearly understood. A big bang approach refers to implementing all ERP modules and functions at once and the implementation time is usually short. In contrast, a phase-in approach means implementing ERP modules gradually (phase-in by module) or implementing ERP functions in some sites only (phase-in by site), which usually takes a longer time to implement. While some firms focus more on receiving the first-mover advantage from a big bang IT implementation, others consider this approach as dangerous and risky. On the other hand, phase-in strategies entail lower risks, but might require more resources and longer implementation time, which might prevent a firm from developing specific competencies (O'Leary, 2000).

ERP implementation speed seems to be associated with degree of BPR, but mixed results are reported. For instance, Tsai et al. (2010) found that fast-speed implementation has a positive relationship with a high degree of BPR, but a phase-in approach shows an insignificant relationship. Some scholars propose that, since a big-bang approach involves implementing multiple modules at one time, implying firms' intentions to transform organizations on a large scale at a fast speed, limited customization and BPR levels are usually preferred in order to increase the success rate of the new ERP implementation (Mabert et al., 2003a, 2003b). Big-bang adopted firms seem less likely to accept the idea of extensively reorganizing business processes, redesigning workflow, or extensively customizing ERP systems that might delay their implementation project, and prefer to quickly implement the new systems so all firm data can be transferred to the new system during the cutover, and the new ERP system can function cohesively. Therefore, we hypothesize:

H4a: A big-bang implementation approach is associated with a lower level of BPR and customization.

On the other hand, a phase-in approach allows organizations more time to rethink and revise business processes and structures, as well as customization of ERP systems in order to achieve a better competitive position in a market through the ERP implementation project (Anderson et al., 2011). Phasing an ERP implementation by modules or by sites is beneficial as it gives firms more time to learn ERP systems to customize the functions they need, or to adjust the business processes they desire. It is often observed that firms using phase-in implementation usually have a clearer business vision of how the ERP implementation could enable their corporate strategies (Panorama Consulting Group, 2018). Therefore, we hypothesize:

H4b: A phase-in implementation approach is associated with higher level of BPR and customization.

3.5. Implementation Approaches and Performance

As discussed above, it is debatable and inconclusive whether choosing customization or BPR can result in better firm performance. Many ERP-adopting firms are reluctant to incur technical problems that may delay their ERP implementation projects and increase the risks of technical failures (Chen et al., 2009). A high degree of customization is difficult not only in the adoption stage, but also very challenging when upgrading and maintaining ERP systems (Mabert et al., 2003b). Firms must strictly control the degree of customization (Chen et al., 2009). Thus, although it is possible to customize ERP systems to better fit their business needs (Davenport, 1998), many firms prefer to follow a standard configuration scheme (e.g., no or minor customization) suggested by ERP vendors, and choose to change their existing processes (BPR) to minimize the number of interventions in changing ERP systems (Chen et al., 2009). Rothenberger and

Srite (2009) suggest that a low level of customization may have a greater chance to result in better firm performance. Therefore, we hypothesize:

H5a: A low level of customization is more likely to be associated with better firm performance than a high level of customization.

On the other hand, BPR is a typical and highly recommended implementation approach by many ERP vendors and IS scholars. However, conducting BPR to fit ERP systems also has its inherent dangers, since it may force firms to abandon some of its valuable profit-generating processes. Forced selection among a limited number of built-in alternatives in ERP systems also constrains a firm's ability to generate competitive advantages. Furthermore, since the built-in alternatives are also available to a firm's competitors, the focal firm that opts for a standard configuration provided by ERP vendors may have difficulties differentiating itself from others. Therefore, while we hypothesize that a high level of BPR may result in better performance according to the literature, we also use our data to examine whether a high level of BPR has negative impacts.

H5b: A high level of BPR is more likely to be associated with better firm performance.

4. Methodology

To test our research model, a questionnaire was designed to collect data on each of the variables in the model. Each of the measurement items on the questionnaire were adapted from previously validated measures, and the details of the prior reference support are shown in Appendix A. Additionally, these measurement items were reviewed for content validity by an expert panel comprised of faculty whose work focuses on ERP systems, as well as some practitioners and consultants from industry. The initial questionnaires were pilot tested on twenty firms randomly selected from the sampling frame and, based on their responses, some items were revised for clarity.

The sample was randomly selected from within U.S. manufacturing industries since these industries use ERP systems most frequently (Mabert et al., 2003a, 2003b). Our survey was administered only to individuals from companies that make use of ERP in conducting their business. Eligible respondents for the survey were individuals considered to be the most knowledgeable about ERP use in their companies. For large sites, respondents were CIOs or IS managers. For smaller sites, respondents were business owners or senior IS mangers. **Table 2** shows the sample characteristics. In total, we successfully collected 150 completed questionnaires, and the response rate is comparable to reports of previous large-scale ERP surveys[1]. Furthermore, we compare the profiles of the responding firms with non-responding firms on demographic variables such as firm size and revenue using Chi-square analysis. The results indicate no significant response bias. We also examine common method bias that can potentially occur in

[1]These studies include Mabert et al. (2003a, 2003b), Stratman and Roth (2002), and Gattiker and Goodhue (2005).

Table 2. Sample characteristics (N = 150).

Industry	#	%	Employee no.	#	%
Computer and Electronic Products	61	40.7%			
Transportation Equipment	5	3.3%			
Measuring & Controlling Instruments	35	13.3%			
Miscellaneous Manufacturing	15	10%	<199	58	38.6%
Food	5	3.3%	200 - 499	40	26.7%
Apparel and Fabric	3	2.0%	500 - 999	14	9.3%
Furniture and Fixtures	4	2.7%	>1000	38	25.4%
Chemicals and Allied Products	9	6.0%			
Rubber, Plastics, and Leather	9	6.0%			
Metal and Fabricate Metal	4	2.7%			
Respondents	**#**	**%**	**Years of ERP Use**	**#**	**%**
CIO	74	49.3%	<1 Year	3	2.0%
IS Manager	58	38.7%	1 - 5 Years	22	14.7%
Others (Vice President, General Manager, CFO, COO, etc.)	18	12.0%	6 - 10 Years	70	46.7%
			11 - 15 Years	28	18.7%
			>15 Years	24	16.0%

survey data with two different approaches. First, following Malhotra et al. (2006), we perform a common method factor test. We found that each indicator's variance explained by its substantive construct is much greater than that explained by the common method factor, which suggests that common method bias is unlikely to be serious. Second, a Harman's single-factor test (Podsakoff et al., 2003) is conducted. In this test, all items were entered into an un-rotated factor analysis to determine whether a single factor accounts for the majority of the variance. In our test, the factor explained 19.28 percent of the variance, and the result provides further evidence that common methods bias is not a serious issue in this study.

Table 3 shows descriptive statistics of the key variables used in our model. Regarding *firm size*, we separate our sample into large and small firms using 500 hundred employees as a cutoff, according to the definition published by U.S. Small Business Administration. In our sample, around two thirds (65.3%) of our respondents are from small firms, while the rest belong to large firms. In terms of *industry*, our sample includes 10 industries, and we separate them into two groups: around one-third belong to traditional manufacturing (e.g., food, apparel, furniture, chemicals, rubber, etc.) and the rest belong to high-tech manufacturing (computer, electronic products, transportation equipment, etc.). Using an average as a cutoff, we separate our sample firms into two groups in terms of their *top management involvement* level in ERP implementation: high-level top management involvement, and low-level top management involvement. In terms of *Implementation speed*: 36% of our surveyed respondents indicated their firm

used a big-bang approach, while 55.3% of our sampled firms used phase in (by site or by phase).

Regarding ERP firm performance, we use twelve items which are categorized into three groups: *cost decrease*, *productivity & efficiency*, *and organizational benefits* (Table 4) following previous studies that claim ERP's main benefits are related to the three categories (Mabert et al., 2003a, 2003b; Karimi et al., 2007a, 2007b). Using seven point Likert scales, where one means a large decrease, four means no change, and seven means a large increase, we found that order management, information quality, and decision making are those areas where firms felt they improved the most (mean value 5.69, 5.89, 5.50, respectively). On the other hand, cost-related items that firms usually care about the most do not decrease significantly.

5. Data Analysis and Results

We first conduct a cross-examination and chi-square test on how each of our model's important variables are related to BPR and customization level, respectively (Table 5). In terms of firm size and BPR level, small firms are more likely to choose a low BPR level (56.7%), while fewer small firms choose a high BPR level (43.3%). For large firms, a similar pattern shows that more firms prefer a low level of BPR (57.4%), compared to high BPR (42.6%). The Chi-square result shows no significance ($p = 0.88$). As for customization, many more small firms (71.1%) choose low customization, indicating that small firms have fewer resources and IT human resources to customize their ERP systems. Additionally, contrary to conventional believe, large firms also prefer low-level customization (65.3%) versus a high level of customization (34.7%). Therefore, firm size shows no significant effect on customization ($p = 0.46$).

To further explore how firm size affects firms' choice of BPR level and customization level, we conduct a *t*-test. As shown in Table 6, small firms' average BPR level equals 3.26, while large firms' average BPR level equals 3.12, and a *t*-test shows there is no significant difference between the two groups ($p = 0.184$).

Table 3. Descriptive statistics.

Variables	Categories	Count	Percentage
Firm size	Employees < 500 (small firm)	98	65.3
	Employees ≥ 500 (large firm)	52	34.7
Industry	Traditional manufacturing	49	32.6
	High tech manufacturing	101	67.3
Top management involvement	Low involvement	24	16.0
	High involvement	126	84.0
Implementation speed	Big bang	54	36.0
	Phased in	83	55.3

Table 4. ERP firm performance.

Category	Item	Mean	Mode
Cost Decrease	Operational costs	3.38	4
	Procurement costs	3.15	4
	Inventory costs	2.82	4
Productivity and Efficiency	On time delivery	5.31	4
	Productivity	5.40	6
	Product quality	4.82	4
	Order management	5.69	7
Organizational benefits	Customer service	5.39	4
	Information quality	5.89	7
	Decision making	5.50	7
	Market share	4.69	4
	Profitability	5.18	4

Table 5. Frequency of BPR and customization.

Variables	Category	BPR (%)		Customization (%)	
		Low	High	Low	High
Firm size	Small	56.7%	43.3%	71.1%	28.9%
	Large	57.4%	42.6%	65.3%	34.7%
		Chi-square test Sig = 0.88		Chi-square test Sig = 0.46	
Industry	Traditional	58.8%	41.2%	52.9%	47.1%
	High tech	58.6%	41.4%	76.2%	23.8%
		Chi-square test Sig = 0.44		Chi-square test **Sig = 0.050****	
Top management involvement	Low	82.6%	17.3%	75.0%	25.0%
	High	52.4%	47.6%	68.0%	32.0%
		Chi-square test **Sig = 0.001*****		Chi-square test sig = 0.49	
Implementation speed	Big bang	61.1%	39.9%	77.4%	24.6%
	Phased in	52.4%	47.6%	60.2%	39.8%
		Chi-square test **Sig = 0.078***		Chi-square test **Sig = 0.039****	

Note: ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

Table 6. Firm size vs. BPR and customization level.

		BPR level			Customization level		
Firm size	Count	Mean	SD	p-value	Mean	SD	p-value
Small	97	3.26	1.063	0.184	2.64	1.348	0.235
Large	52	3.12	1.043		2.65	1.399	

Similarly, we found that the customization level between the two groups shows no significant difference (mean 2.64 vs. 2.65, $p = 0.235$), thus, H1a and H1b are not supported. Our data provides updated empirical evidence different from existing studies. Nowadays, firm size is no longer a critical factor to determine how firms choose between BPR or customization approaches, nor their BPR or customization level. Other firm characteristics determine ERP adaptation strategies and adaptation level.

Further examining *industry* effect (Table 5), we found that traditional and high-tech manufacturing firms show a similar distribution on BPR level. Roughly 60% of firms choose a low level of BPR, while the remaining 40% choose a high level of BPR, suggesting that industry type does not affect BPR level (H2a). However, in terms of *customization*, a much larger portion of high-tech firms (76.2%) choose low customization, compared to traditional manufacturing firms (52.9%). Chi-square results also show there is a significant difference ($p = 0.05$**) between these two industries on customization. We further conduct a *t*-test and the results in Table 7 show that while firms in traditional industries or high-tech industries choose similar BPR levels (mean 3.18 vs. 3.20, respectively, $p = 0.902$), firms in traditional industries choose a much higher level of customization than firms in high-tech industries (mean 3.24 vs. 2.42, $p = 0.002$***). Thus, in our case, industry type is a critical factor affecting the level at which firms customize their ERP systems, supporting H2b.

When examining *top management involvement* (Table 5), we found that firms with a low level of top management involvement mostly choose low BPR (82.6%) and low customization (75%); a low-low situation. On the other hand, firms with a high level of top management involvement seem to have higher intention to choose high BPR (47.6%), but low customization (32%) is still observed; (a high-low scenario). The chi-square test result also confirms that there is a significant difference between high and low levels of top management involvement in terms of firms' BPR levels ($p = 0.001$***, Table 5). A *t*-test result in Table 8 further shows that firms with a high level of top management involvement choose high level BPR (mean = 3.30) vs. those firms with a low level of top management involvement (mean = 2.74), and the difference is significant ($p = 0.019$**), supporting H3a. On the other hand, level of top management involvement does not affect firms' ERP customization choices or adaptation levels (2.25 vs. 2.72, $p = 0.122$), and H3b is not supported.

Table 7. Industry vs. BPR and customization level.

		BPR level			Customization level		
Industry	Count	Mean	SD	*p*-value	Mean	SD	*p*-value
Traditional	34	3.18	1.114	0.902	3.24	1.415	**0.002*** **
High tech	101	3.20	1.020		2.42	1.227	

Note: ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

Table 8. Top management involvement vs. BPR and customization level.

Top management involvement	BPR level				Customization level		
	Count	Mean	SD	*p*-value	Mean	SD	*p*-value
Low	24	2.74	1.214	**0.019****	2.25	1.359	0.122
High	125	3.30	1.004		2.72	1.354	

Note: ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

In Table 5, we found that when firms choose a big-bang approach, many more firms (61.1%) chose a low level of BPR and, similarly, a greater portion of firms (77.4%) choose a low level of customization. This low-low (BPR and customization) phenomenon shows that when firms use a big-bang approach, the speedy ERP implementation does not allow firms to conduct a high level of BPR or customization. On the other hand, firms choosing a phased-in approach are more likely to conduct a high level of BPR (47.6%) than firms choosing a big-bang approach (39.9%). Similarly, more firms choosing phase-in ERP (39.8%) conduct a high level of customization than firms using a big-bang approach (24.6%). The significant chi-square results ($p = 0.078$* and $p = 0.039$**, respectively) support H4a and H4b. A *t*-test result in Table 9 further reveals that firms choosing a phased-in approach has a significantly higher BPR level than firms choosing big-bang (3.30 vs. 2.59, $p = 0.048$**). In terms of customization level, firms choosing a phased-in approach also show higher level of customization than firms choosing a big-bang approach (2.88 vs. 2.40, $p = 0.046$**), providing more empirical evidence to support H4a and H4b.

In terms of firm performance, Table 10 shows that firms choosing a high level of BPR have better firm performance in all three of categories. Specifically, in the *cost decrease* category, firms choosing a high BPR level have better performance than firms choosing a low BPR (3.00 vs. 3.34, $p = 0.085$*)[2]. Furthermore, firms with high level of BPR also show better *operation efficiency* than firms with low BPR (5.50 vs. 5.24, $p = 0.09$*). Lastly, firms choosing high BPR also show better *organizational benefits* than firms with low BPR (5.70 vs. 5.54, $p = 0.038$*). These results provide strong support of H5b that predicts firms with high levels of BPR have better firm performance in terms of all three firm performance dimensions. In terms of customization level (Table 11), we found that firms with a low customization level indeed have better firm performance, but only in the *cost decrease* category, than firms choosing a high customization level (3.07 vs. 3.49, $p = 0.049$**). In the *operation efficiency* and *organizational benefits* dimensions, firms choosing high or low customization levels show no significant difference, partially supporting H5a.

6. Discussion

To successfully implement ERP, solving the misfit between ERP systems and organization processes is critical. While literature has suggested that misfit can be

[2]For the cost decrease variable, we use reverse coding; the smaller the number is, the better the firm performance.

Table 9. Implementation speed vs. BPR and customization level.

Implementation speed	BPR level				Customization level		
	Count	Mean	SD	*p*-value	Mean	SD	*p*-value
Big-bang	54	3.30	1.021	**0.048****	2.40	1.335	**0.046****
Phased-in	83	2.59	1.064		2.88	1.383	

Note: ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

Table 10. BPR level vs. firm performance.

BPR Level	Cost decrease			Operation efficiency			Organizational benefits		
	Mean	SD	*p*-value	Mean	SD	*p*-value	Mean	SD	p-value
Low	3.34	1.137	0.085*	5.24	0.888	0.09*	5.54	0.887	0.038**
High	3.00	1.155		5.50	0.923		5.70	0.854	

Note: ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

Table 11. Customization level vs. firm performance.

Custom. Level	Cost decrease			Operation efficiency			Organizational benefits		
	Mean	SD	*p*-value	Mean	SD	*p*-value	Mean	SD	p-value
Low	3.07	1.071	0.049**	5.31	0.881	0.279	5.52	0.869	0.822
High	3.49	1.330		5.50	1.031		5.56	0.969	

Note: For the cost decrease variable, the smaller the number is, the better the firm performance. ***$p < 0.01$, **$p < 0.05$ *$p < 0.01$.

reduced via either BPR or customization, extant studies do not clearly explain how firms should choose their adaptation strategies and levels based on their own heterogeneous characteristics, such as firm size, industry, implementation speed, and top management involvement. Additionally, prior studies have seldom assessed subsequent ERP implementation performance after choosing different adaptation strategies (BPR or customization) and different adaptation levels. Lastly, most existing studies assume that firms should choose from one of the two adaptation strategies (BPR or customization), but overlook the possibility of simultaneously adopting both strategies. This study aims to bridge the three research gaps by proposing and empirically examining an ERP implementation framework to further understand how firms can choose appropriate adaptation strategies and adaptation levels based on their heterogeneous characteristics, while further exploring how these different choices influence subsequent firm performance. Our study contributes to extant ERP literature in the following ways.

First, unlike most extant studies that assume large companies are more likely to choose a customization strategy, our findings update our understanding of firm size on ERP implementation. Our results show that *firm size* is not a main factor affecting level of BPR and customization. Rather, *industry type* is the key

differentiator. A small firm belonging to a special industry still needs customization to fully receive the benefits of using ERP systems. Large companies, in contrast, even if they have sufficient resources and IT manpower, may still choose a low level of customization since they do not see the need for customization while undertaking the unnecessary risks and difficulties related to a highly customized ERP system. Indeed, when we interviewed our surveyed companies in the high-tech industry, many mentioned that the off-the-shelf ERP systems were sufficient enough to meet most of their business needs, so they did not choose a high level of customization, although some of the firm sizes were vast and resources were sufficient.

Second, this study provides empirical evidence that when the level of *top management involvement* is high, a high BPR level can be achieved, echoing earlier studies' propositions (e.g., Savage et al., 2010). A high level of top management involvement signifies the ERP project is not merely an IT project, but a strategic firm-level priority that enables firm competitiveness. However, a high level of top management involvement does not affect customization level. We also found that firms choose a big-bang implementation approach involving a low level of BPR and customization (low-low scenario), while firms choosing a phase-in approach could allow them more time to conduct high level BPR and customization (high-high scenario). These findings provide more empirical evidence to validate earlier studies' propositions and findings (e.g. Anderson et al., 2011).

Third, we found that high levels of BPR have a significant impact on all three *firm performance* categories (cost efficiency, productivity, and organizational effectiveness). On the other hand, our study also shows that low level customization can improve organizational cost efficiency (primarily in reducing operation, procurement, and inventory costs), providing empirical evidence to support earlier studies (e.g., Finney & Corbett, 2007; Mabert et al., 2003a). However, high level customization involves risks, and our analysis shows that high customization is not significantly associated with the other two firm performance aspects (operation efficiency and organizational benefits); therefore, suggesting firms should carefully choose their customization level.

Our results also provide some managerial insights. For example, we suggest the two adaptation methods (BPR and customization) are not exclusive, but could be adopted simultaneously according to firms' heterogeneous characteristics and needs, echoing earlier studies' propositions (e.g., Luo & Strong, 2004; Wei et al., 2005). Additionally, contrary to a conventional belief, we found there may not be a "best practice" for ERP implementation but, rather, a "best-fit" strategy. We provide empirical evidence to echo the statement in Swan et al. (1999): *the illusion of "best practice" in information systems for operations management*. Which implementation approach works best for firms to achieve the desired ERP outcomes depends on firms' organizational characteristics, capabilities, constraints, trade-offs, and risks that they are willing to take. Our results

show that when firms choose a best-fit implementation approach based on firm heterogeneity, they can significantly improve performance. In contrast, firms choosing limited adaptation (i.e., LBLC fine-tuners) may implement ERP system with less efforts, yet suffer from the misfit problem, and lose the opportunity to gain competitive advantages from their ERP implementation (O'Leary, 2000).

Further research might extend our study in several directions. For example, in our key informant approach, we asked the most knowledgeable and senior level IS managers to provide evaluative responses to the construct measures. Although we checked for common method and nonresponding biases, further research could benefit from using multiple methods and data sources to achieve triangulation. Furthermore, accounting based firm performance data could also be collected to more objectively evaluate the ERP outcomes.

7. Concluding Marks

Our study contributes to the ERP literature by providing a robust taxonomy that sheds light on what drives firms to make their adaptation decisions, and what adaptation approaches and levels might lead firms to better firm performance from the ERP implementation. While firms may intuitively favor customizing their ERP systems because few firms want to change the way they have been working for decades, our analysis shows that it is not beneficial if firms over-customize their systems. On the other hand, recognizing where to preserve firms' original processes is also critical during ERP implementation. It is a balancing act between adapting ERP systems and changing firms' processes to achieve the best firm performance. Our study illuminates guidelines for firms on these critical decision points based on their firm-specific characteristics and heterogeneity.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Achanga, P., Shehab, E., Roy, R., & Nelder, G. (2006). Critical Success Factors for Lean Implementation within SMEs. *Journal of Manufacturing Technology Management, 17,* 460-471. https://doi.org/10.1108/17410380610662889

Alsulami, M., Rahim, M., & Scheepers, H. (2014). Consolidating Understanding of ERP Conflicts: A Dialectic Perspective. *PACIS 2014 Proceedings, 331,* 1-11.

Anderson, M., Banker, R. D., Menon, N. M., & Romero, J. A. (2011). Implementing Enterprise Resource Planning Systems: Organizational Performance and the Duration of the Implementation. *Information Technology and Management, 12,* 197-212. https://doi.org/10.1007/s10799-011-0102-9

Bancroft, N. H., Seip, H., & Sprengel, A. (1997). *Implementing SAP R/3.* Upper Saddle River, NJ: Prentice Hall PTR.

Banker, R., Bardhan, I. R., Chang, H., & Lin, S. (2006). Plant information Systems, Manufacturing Capabilities, and Plant Performance, *MIS Quarterly, 30,* 315-337. https://doi.org/10.2307/25148733

Brehm, L., Heinzl, A., & Markus, M. L. (2001). Tailoring ERP Systems: A Spectrum of Choices and Their Implications. *Proceedings of the 34th Annual Hawaii International Conference on System Sciences*, Maui, HI, 6 January 2001. https://doi.org/10.1109/HICSS.2001.927130

Chen, C. C., Law, C., & Yang, S. C. (2009). Managing ERP Implementation Failure: A Project Management Perspective. *IEEE Transactions on Engineering Management, 56,* 157-170. https://doi.org/10.1109/TEM.2008.2009802

Chou, S.-W., & Chang, Y.-C. (2008). The Implementation Factors That Influence the ERP (Enterprise Resource Planning) Benefits. *Decision Support Systems, 46,* 149-157. https://doi.org/10.1016/j.dss.2008.06.003

Cotteleer, M., & Bendoly, E. (2006). Order Lead-Time Improvement Following Enterprise Information Technology Implementation: An Empirical Study. *MIS Quarterly, 30,* 643-660. https://doi.org/10.2307/25148743

Davenport, T. H. (1998). Putting the Enterprise into the Enterprise System. *Harvard Business Review, 76,* 121-131.

Deep, A., Guttridge, P., Dani, S., & Burns, N. (2008). Investigating Factors Affecting ERP Selection in Made-to-Order SME Sector. *Journal of Manufacturing Technology Management, 19,* 430-446. https://doi.org/10.1108/17410380810869905

Esteves, J., Pastor-Collado, J., & Casanovas, J. (2002). Monitoring Business Process Redesign in ERP Implementation Projects. *Proceedings of Americas Conference on Information Systems (AMCIS), 125,* 865-873.

Finney, S., & Corbett, M. (2007). ERP Implementation: A Compilation and Analysis of Critical Success Factors. *Business Process Management Journal, 13,* 329-347. https://doi.org/10.1108/14637150710752272

Gattiker, T. F., & Goodhue, D. L. (2005). What Happens after ERP Implementation: Understanding the Impact of Interdependence and Differentiation on Plant-Level Outcomes. *MIS Quarterly, 29,* 559-585. https://doi.org/10.2307/25148695

Goodhue, D., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly, 19,* 213-236. https://doi.org/10.2307/249689

Hammer, M. (1990). Reengineering Work: Don't Automate, Obliterate. *Harvard Business Review, 68,* 104-112.

Hitt, L.M., Wu, D., & Zhou, X. (2002). Investment in Enterprise Resource Planning: Business Impact and Productivity Measures. *Journal of Management Information Systems, 19,* 71-98. https://doi.org/10.1080/07421222.2002.11045716

Hodge, G. L. (2002). Enterprise Resource Planning in Textiles. *Journal of Textile and Apparel, Technology and Management, 2,* 1-8.

Hong, K. K., & Kim, Y. G. (2002). The Critical Success Factors for ERP Implementation: An Organizational Fit Perspective. *Information & Management, 40,* 25-40. https://doi.org/10.1016/S0378-7206(01)00134-3

Huq, Z., & Martin, T. N. (2006). The Recovery of BPR Implementation through an ERP Approach: A Hospital Case Study. *Business Process Management Journal, 12,* 576-587. https://doi.org/10.1108/14637150610691000

Hustad, E., Haddara, M., & Kalvenes, B. (2016). ERP and Organizational Misfits: An ERP Customization Journey. *Procedia Computer Science, 100,* 429-439. https://doi.org/10.1016/j.procs.2016.09.179

Ifinedo, P. (2011). Internal IT Knowledge and Expertise as Antecedents of ERP System Effectiveness: An Empirical Investigation. *Journal of Organizational Computing and Electronic Commerce, 21,* 1-23. https://doi.org/10.1080/10919392.2011.540979

Jafari, S., Osman, M., Rosnah, M., & Tang, S. (2009). A Consensus on Critical Success Factors for Enterprise Resource Planning Systems Implementation: The Experience of Malaysian Firms. *International Journal of Manufacturing Technology and Management, 17,* 396-407. https://doi.org/10.1504/IJMTM.2009.023956

Kamhawi, E. M., & Gunasekaran, A. (2009). ERP Systems Implementation Success Factors: IS and Non-IS Managers' Perceptions. *International Journal of Business Information Systems, 4,* 688-704. https://doi.org/10.1504/IJBIS.2009.026699

Kang, S., Park, J., & Yang, H. (2008). ERP Alignment for Positive Business Performance: Evidence from Korea's ERP Market. *Journal of Computer Information Systems, 48,* 25-38.

Karimi, J., Somers, T. M., & Bhattacherjee, A. (2007a). The Impact of ERP Implementation on Business Process Outcomes: A Factor-Based Study. *Journal of Management Information Systems, 24,* 101-134. https://doi.org/10.2753/MIS0742-1222240103

Karimi, J. Somers, T. M., & Bhattacherjee, A. (2007b). The Role of Information Systems Resources in ERP Capability Building and Business Process Outcomes. *Journal of Management Information Systems, 24,* 221-260. https://doi.org/10.2753/MIS0742-1222240209

Kouki, R., Poulin, D., & Pellerin, R. (2010). The Impact of Contextual Factors on ERP Assimilation: Exploratory Findings from a Developed and a Developing Country. *Journal of Global Information Technology Management, 13,* 28-55. https://doi.org/10.1080/1097198X.2010.10856508

Laukkanen, S., Sarpola, S., & Hallikainen, P. (2007). Enterprise Size Matters: Objectives and Constraints of ERP Adoption. *Journal of Enterprise Information Management, 20,* 319-334. https://doi.org/10.1108/17410390710740763

Law, C. C. H., & Ngai, E. W. T. (2007). ERP Systems Adoption: An Exploratory Study of the Organizational Factors and Impacts of ERP Success. *Information & Management, 44,* 418-432. https://doi.org/10.1016/j.im.2007.03.004

Liang, H., & Xue, Y. (2004). Coping with ERP-Related Contextual Issues in SMEs: A Vendor's Perspective. *The Journal of Strategic Information Systems, 13,* 399-415. https://doi.org/10.1016/j.jsis.2004.11.006

Light, B. (2001). The Maintenance Implications of the Customization of ERP Software. *Journal of Software Maintenance and Evolution: Research and Practice, 13,* 415-429. https://doi.org/10.1002/smr.240

Luo, W., & Strong, D. M. (2004). A Framework for Evaluating ERP Implementation Choices. *IEEE Transactions on Engineering Management, 51,* 322-333. https://doi.org/10.1109/TEM.2004.830862

Mabert, V. A., Soni, A., & Venkataramanan, M. A. (2003a). Enterprise Resource Planning: Managing the Implementation Process. *European Journal of Operational Research, 146,* 302-314. https://doi.org/10.1016/S0377-2217(02)00551-9

Mabert, V. A., Soni, A., & Venkataramanan, M. A. (2003b). The Impact of Organization Size on Enterprise Resource Planning (ERP) Implementations in the US Manufacturing Sector. *Omega, 31,* 235-246. https://doi.org/10.1016/S0305-0483(03)00022-7

Malhotra, N., Kim, S. S., & Patil, A. (2006). Common Method Variance in IS Research: A Comparison of Alternative Approaches and a Reanalysis of Past Research. *Management Science, 52,* 1865-1883. https://doi.org/10.1287/mnsc.1060.0597

Markus, M. L., Axline, S., Petrie, D., & Tanis, S. C. (2000). Learning from Adopters' Experiences with ERP: Problems Encountered and Success Achieved. *Journal of Information Technology, 15,* 245-265. https://doi.org/10.1177/026839620001500402

Morton, N. A., & Hu, Q. (2008). Implications of the Fit between Organizational Structure and ERP: A Structural Contingency Theory Perspective. *International Journal of Information Management, 28,* 391-402. https://doi.org/10.1016/j.ijinfomgt.2008.01.008

Nah, F. F.-H., Lau, J. L.-S., & Kuang, J. (2001). Critical Factors for Successful Implementation of Enterprise Systems. *Business Process Management Journal, 7,* 285-296. https://doi.org/10.1108/14637150110392782

O'Leary, D. E. (2000). *Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511805936

Panorama Consulting Group (2018). *2018 ERP Report Final*. https://cdn2.hubspot.net/hubfs/2184246/2018%20ERP%20Report.pdf

Panorama Consulting Group (2019). *2019 ERP Report Final*. https://www.panorama-consulting.com/what-does-our-2019-erp-report-reveal-about-the-erp-industry/

Peng, G. C., & Nunes, M. (2017). Establishing an Evidence-Based 9D Evaluation Approach for ERP Post-Implementation. *Industrial Management & Data Systems, 117,* 398-424. https://doi.org/10.1108/IMDS-03-2016-0087

Plant, R., & Willcocks, L. (2007). Critical Success Factors in International ERP Implementations: A Case Research Approach. *Journal of Computer Information Systems, 47,* 60-70.

Podsakoff, P., MacKenzie, S., Lee J., & Podsakoff, N. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies, *Journal of Applied Psychology, 88,* 879-903. https://doi.org/10.1037/0021-9010.88.5.879

Rajagopal, P. (2002). An Innovation-Diffusion View of Implementation of Enterprise Resource Planning (ERP) Systems and Development of a Research Model. *Information & Management, 40,* 87-114. https://doi.org/10.1016/S0378-7206(01)00135-5

Ranganathan, C., & Brown, C. V. (2006). ERP Investments and the Market Value of Firms: Toward an Understanding of Influential ERP Project Variables. *Information Systems Research, 17,* 145-161.

Reimers, K. (2003). International Examples of Large-Scale Systems—Theory and Practice I: Implementing ERP Systems in China. *Communications of the Association for Information Systems, 11,* 335-356. https://doi.org/10.17705/1CAIS.01120

Robey, D., Ross, J. W., & Boudreau, M.-C. (2002). Learning to Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change. *Journal of Management Information Systems, 19,* 17-46. https://doi.org/10.1080/07421222.2002.11045713

Rothenberger, M. A., & Srite, M. (2009). An Investigation of Customization in ERP System Implementations. *IEEE Transactions on Engineering Management, 56,* 663-676. https://doi.org/10.1109/TEM.2009.2028319

Savage, A., Callaghan, J., Dang, L., & Sun, Y. (2010). *Operating Performance in the Wake of ERP Implementation: Triangulating Results for Chinese Manufacturing Companies*. Discussion Paper Series. Charlotte, NC: Queens University of Charlotte.

Seddon, P. B., Calvert, C., & Yang, S. (2010). A Multi-Project Model of Key Factors Affecting Organizational Benefits from Enterprise Systems. *MIS Quarterly, 34,* 305-328. https://doi.org/10.2307/20721429

Seddon, P. B., Shanks, G., & Willcocks, L. (2003). *Introduction: ERP—The Quiet Revolution*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511815072.001

Shiang-Yen, T., Peng, W. W., & Idrus, R. (2013). ERP Misfit-Reduction Strategies: A

Moderated Model of System Modification and Organizational Adaptation. *Journal of Global Information Management, 21,* 59-81. https://doi.org/10.4018/jgim.2013010104

Soh, C., Sia, S. K., Boh, W. F., & Tang, M. (2003). Misalignments in ERP Implementation: a Dialectic Perspective. *International Journal of Human-Computer Interaction, 16,* 81-100. https://doi.org/10.1207/S15327590IJHC1601_6

Somers, T. M., & Nelson, K. (2001). The Impact of Critical Success Factors across the Stages of Enterprise Resource Planning Implementations. *Proceedings of the 34th Annual Hawaii International Conference on System Sciences*, Maui, HI, 6 January 2001.

Stratman, J. K., & Roth, A. V. (2002). Enterprise Resource Planning (ERP) Competence Constructs: Two-Stage Multi-Item Scale Development and Validation. *Decision Sciences, 33,* 601-628. https://doi.org/10.1111/j.1540-5915.2002.tb01658.x

Strong, D. M., & Volkoff, O. (2010). Understanding Organization Enterprise System Fit: A Path to Theorizing the Information Technology Artifact. *MIS Quarterly, 34,* 731-756. https://doi.org/10.2307/25750703

Subramoniam, S., Tounsi, M., & Krishnankutty, K. (2009). The Role of BPR in the Implementation of ERP Systems. *Business Process Management Journal, 15,* 653-668. https://doi.org/10.1108/14637150910987892

Sun, H., Ni, W., Lam, R., & Ng, C. Y. (2016). A Stage-by-Stage Assessment of Enterprise Resource Planning Implementation: An Empirical Study from Hong Kong. *Journal of Global Information Technology Management, 19,* 104-127. https://doi.org/10.1080/1097198X.2016.1173387

Swan, J., Newell, S., & Robertson, M. (1999). The Illusion of "Best Practice" in Information Systems for Operations Management. *European Journal of Information Systems, 8,* 284-293. https://doi.org/10.1057/palgrave.ejis.3000336

Tian, F., & Xu, S. X. (2015). How Do Enterprise Resource Planning Systems Affect Firm Risk? Post-Implementation Impact. *MIS Quarterly, 39,* 39-60. https://doi.org/10.25300/MISQ/2015/39.1.03

Tsai, W.-H., Chen, S.-P., Hwang, E. T. Y., & Hsu, J.-L. (2010). A Study of the Impact of Business Process on the ERP System Effectiveness. *International Journal of Business and Management, 5,* 26-37. https://doi.org/10.5539/ijbm.v5n9p26

Van Beijsterveld, J. A., & Van Groenendaal, W. J. (2016). Solving Misfits in ERP Implementations by SMEs. *Information Systems Journal, 26,* 369-393. https://doi.org/10.1111/isj.12090

Wang, E. T., Klein, G., & Jiang, J. J. (2006). ERP Misfit: Country of Origin and Organizational Factors. *Journal of Management Information Systems, 23,* 263-292. https://doi.org/10.2753/MIS0742-1222230109

Wei, H.-L., Wang, E. T. G., & Ju, P.-H. (2005). Understanding Misalignment and Cascading Change of ERP Implementation: A Stage View of Process Analysis. *European Journal of Information Systems, 14,* 324-334. https://doi.org/10.1057/palgrave.ejis.3000547

Yen, H. R., Hu, P. J.-H., Hsu, S. H.-Y., & Li, E. Y. (2015). A Multilevel Approach to Examine Employees' Loyal Use of ERP Systems in Organizations. *Journal of Management Information Systems, 32,* 144-178. https://doi.org/10.1080/07421222.2015.1138373