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The Impact of ERP Systems on Organizational Performance:
The Role of Antecedents and Moderators

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ABSTRACT

Research on the link between investments in ERP systems and organizational performance has often led to mixed results. Besides internal organizational factors, many external contextual factors come into play. This study examined the role of firm size, industry, and duration of ERP system's use in influencing the performance impact of ERP systems through moderating the relationships between antecedent variables, ERP-induced benefits, and improvement in overall organizational performance. Using a sample of 200 participant firms, and structural equation modeling (SEM) analysis, the author confirmed the significant role of business process re-engineering and organizational fit and alignment as antecedents to ERP-induced benefits in information quality, and coordination/integration. Data and information quality was in turn confirmed as a significant predictor of organizational performance. Furthermore, the roles of industry, firm size, and time elapsed were also confirmed as significant moderators to the influence of the antecedent variables on ERP benefits and organizational performance.

KEYWORDS

Antecedents, Business Process Re-Engineering, Contextual Factors, Enterprise Resource Planning, ERP-Induced Benefits, Moderating Variables, Organizational Fit, Organizational Performance

INTRODUCTION

An Enterprise Resource Planning (ERP) system is an enterprise application that embodies an implementation of the core business processes and administrative functions within the entire organization. Although there is an abundance of definitions (Acar et al., 2017a; Beheshti & Beheshti, 2010; Davenport, 1998; Holland & Light, 1999; Klaus et al., 2000; Shaul & Tauber, 2013), an ERP system is fundamentally characterized with four salient features: cross-functional integration, a central and shared database, embodiment of best industry practices, and a modular architecture—all intertwine and collectively serve to produce a comprehensive, consolidated, and unified view of the organization

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and its operations. Influenced by technology and competitive dynamics, business organizations are increasingly moving towards more inter- and intra-organizational integration to enable and facilitate more efficient execution of transactions and flow of information resources between the different organizational units. Enterprise systems have played a pivotal role in these transformations, as evidenced by the evolution of Material Requirement Planning (MRP) to Manufacturing Resource Planning (MRP II), then to Enterprise Resource Planning (ERP) systems. The latter systems are increasingly fanning out and bridging inter-organizational boundaries to link separate business partners and alliances.

The Information Systems (IS) literature makes generous claims about numerous ERP system benefits, tangible and intangible, operational and strategic, accruing to the adopting organization (Gabryelczyk, 2020; Khattak et al., 2013; Uddin et al., 2020; Usman et al., 2019). Empirically, however, the evidence to support these claims is either lacking or inconclusive. Indeed, there is plenty of evidence to refute a considerable proportion of this ever expanding list of potential ERP benefits, thanks to more than two decades of IS research devoted to the issue of Information Technology (IT) benefits and performance impact on the organization. Thus, although the well-known IT productivity paradox has long been settled, the question of just what an ERP system can do for an adopting organization, in return for the huge cost needed to implement these costly systems, remains an ever relevant and not sufficiently answered question to date.

There is a great deal of empirical research to date that has explored the impact of ERP systems on organizations. However, existing IS research has produced either of three conclusions: 1) investments in ERP projects failing to achieve expectations, 2) positive outcomes and impact on organizational performance, and 3) mixed, and often conflicting, results regarding the overall impact of ERP systems on organizational performance. Moreover, a preponderance of the existing IS research focuses primarily on the success (or failure) of the ERP implementation project, rather than on the post-implementation impacts of these systems (Alzoubi & Snider, 2020; Coşkun et al., 2022; Gattiker & Goodhue, 2005; Hietala & Paivarinta, 2021; Mahraz et al., 2020; Motiei et al., 2015; Nour & Mouakket, 2011; Shatat & Shatat, 2021). Yet implementation success stories are not guaranteed to extend beyond the “go-live” stage (i.e., post-implementation). Additionally, post-implementation success indicators, focusing on broad organizational performance parameters, are fundamentally more strategically oriented than implementation success indicators.

It can be argued that organizations, with all their idiosyncrasies, exist in their own dynamic environments that are characterized with unique constraints and contextual factors. Consequently, the performance benefits of ERP systems are presumed to be influenced by an array of organizational and environment antecedents, which may include, inter alia, such factors as business process redesign, top management support, organizational culture, user training and support, and organization fit or alignment with the ERP system (Amade et al., 2022; Hasan et al., 2019; Tarigan et al., 2020; Vargas & Comuzzi, 2020). These factors serve as contextual elements characterizing the overall environment that determines the extent of the ultimate performance impact on the organization (Ruivo et al., 2014; Uwizeyemungu & Raymond, 2012). Therefore, any discourse about ERP systems impact cannot ignore these differences in environmental and organizational contexts. But that is precisely what a substantial number of research studies have done, largely ignoring these important contextual factors, such as industry, size and age of the organization, business alliances and interdependencies, etc., that might account for the presence or absence of any significant ERP performance outcomes. An inevitable consequence of the disparate approaches and foci of existing ERP literature is the inconsistent results produced by these studies.

A prime goal of the present research is to examine the post-implementation impact of ERP systems on the overall organizational performance by considering not only the requisite conditions (factors) for the ERP-induced benefits to take effect (impact), but also the contextual factors that might moderate such impact. More specifically, building on the works of Chou and Chang (2008), and Gattiker and Goodhue (2005), and guided by the process and the Technology-Organization-Environment (TOE) models, this study investigates the post-implementation performance impact of ERP systems at an intermediate level (ERP-induced benefits) and an overall level (overall performance benefits). This study aims to provide answers to the following two related research questions: (1) do ERP systems entail any significant benefits to the organization and, if so, under what conditions? (2) do these benefits translate to an ultimate overall performance impact on the organization? By answering these research questions, this study aims to contribute to existing knowledge regarding why some organizations get positive results, while others do not, and the likely reasons for the discrepancies.

The rest of this paper is organized as follows. First, a background and relevant literature review is presented, followed by a section that develops the research model and hypotheses. In the following section, the research methodology is discussed, followed by the empirical results and analyses. Then a discussion and implications of the empirical results are presented, followed by a conclusion.

BACKGROUND

The cumulative literature to date on the performance impact of ERP systems presents a puzzling array of inconsistent, often irreconcilable, findings that swing back and forth between positive results, negative results, or no impact at all, suggesting that the more-than-three-decades-old IT productivity paradox (Brynjolfsson, 1993) might still be lingering on. The author offers the following reasons for the stark discrepancies in the reported ERP performance impact in prior studies:

1. differences in how ERP performance impact is conceptualized and operationalized,
2. variations in the level (dimension) and unit of analysis,
3. differences in the timescale of analysis.

The varied definitions of performance have led to innumerable concepts of firm performance, which have made systematic and consistent comparisons between findings of different research studies a very daunting and challenging endeavor. As Galy and Sauceda (2014, p.310) carefully note that, “Answers to the question of the return on investment in information technologies have created controversy because of the varied definitions of firm performance”, which has led to a diversity of performance measures, with no consensus of how to measure it (Lucia-Palacios et al., 2014). Among the various performance denotations adopted in prior literature, one for example finds “financial performance benefits”, “non-financial performance benefits”, “operational performance”, “managerial performance”, “organizational performance”, “strategic performance”, or “strategic advantage” (AlMuhayfith & Shaiti, 2020; Bialas et al., 2023b; Saldanha et al., 2022). This lack of a uniform definition remains one of the many outstanding challenges facing ERP research (Akrong et al., 2022; Zendehdel et al., 2022).

The differences and variations in the level or unit of analysis have also made confirmation of reported results difficult and problematic, as prior literature has examined ERP performance impact at various levels, including process, system (e.g. Supply Change Management), business unit, firm, or even individual employee (Akrong et al., 2021)—further complicating cross-confirmation of research results. Additionally, the discrepancies in the time scale when the ERP performance impact is measured present the most formidable obstacle in reconciling research findings across ERP research studies. This timescale maps to the standard project lifecycle, from inception to production, at any point of which the ERP system’s success may be measured (Kirmizi & Kocaoglu, 2022). Broad (generic) stages typically include pre-implementation, implementation, and post-implementation (Alaskaria et al., 2021).

A further review of existing ERP literature indicates multiple overlapping streams of research. One stream of research suggests that investments in ERP projects have been met by outright failure, or failure to achieve expectations. Several research studies provide evidence of the lack of significant benefits from ERP systems (Acar et al., 2017b; Andries & Ungureanu, 2022; Gupta et al. 2018; Hitt et al., 2002; Poston & Grabski, 2001; Ruivo et al., 2017; Wieder et al., 2006). For example, Wieder et al. (2006) examined the impact of ERP systems on business process performance and indicated no significant differences between ERP adopters and non-adopters, either at the business process level, or at the overall firm level. Studying Romanian companies, Andries and Ungureanu (2022) found that the implementation of an ERP system did not significantly improve return on assets and productivity, neither did the time of implementation make any significant difference. Other studies, such as Poston and Grabski (2001), produced partial results indicating performance improvements in some areas, but neutral or negative performance impacts on other areas. Similarly, Gupta et al. (2018) achieved mixed results by examining the role of cloud-based ERP services on the performance of an organization, comprised of financial performance and marketing performance. Positive impact was found for marketing performance, but not for financial performance.

The second research stream indicates positive outcomes to ERP systems (AlMuhayfith & Shaiti, 2020; Anderson et al., 2011; Bialas et al., 2023a; Elsayed et al., 2021; Galy & Sauceda, 2014; Hendricks et al., 2007; Hitt et al., 2002; Hunton et al., 2003; Kallunki et al., 2011; Madapusia & D'Souza, 2012; Matolcsy et al., 2005; Nicolaou et al., 2003; Nicolaou, 2004; Ruivo et al., 2020; Santoso et al., 2022; Tarigan et al., 2021). For instance, Ince et al. (2013) found positive effects of ERP systems on firm performance and competitive advantage. Likewise, Hunton et al. 2003) compared the performance of firms adopting ERP systems with the performance of non-adopting firms and indicated significant improvement of ROI of the adopting firms. Similarly, Nicolaou et al. (2003) and Nicolaou (2004) examined whether the implementation of ERP systems influences the long-term financial performance of a firm, comparing adopters and non-adopters and concluding that firms adopting enterprise systems exhibit higher differential performance only after two years of continued use. Matolcsy et al. (2005) also tracked two-year performances of adopting and non-adopting groups of companies, indicating that the adoption of ERP systems leads to sustained operational efficiencies and improved overall liquidity, whereas Kallunki et al. (2011) show that the use of enterprise systems results in improved firm performance in the long run. Kharuddin et al. (2015) found that ERP adoption extensiveness, reflecting system complexity and maturity, was significantly associated with organizational performance. Finally, AlMuhayfith and Shaiti (2020) examined the impact of ERP system usage, influenced by contingency factors, on business performance of Small and Medium Enterprises (SMEs) in Saudi Arabia. Their findings indicated a significant relationship between ERPs usage and business performance.

The third strand in prior ERP literature is clearly distinguished by its inclusion of several environmental and contextual factors while examining the performance impact of ERP systems. Notwithstanding the crucial role of these contextual variables in explaining and refining any observed performance findings, there is such a scant body of literature characteristic of this stream of research. Few notable examples include Chae et al. (2018), Dehning & Richardson (2002), Hunton et al. (2003), Kallunki et al. (2011), and Ramdani et al. (2013). Hunton et al. (2003), for example, included firm size as a moderator and reported a significant interaction between firm size and financial health and performance for ERP adopters. Kallunki et al. (2011), on the other hand, investigated the role of formal and informal management control systems as mechanisms mediating the effect of enterprise resource planning systems adoption on firm performance. Furthermore, using the TOE framework, Ramdani et al. (2013) investigated the impact of technological, environmental, and organizational factors on the adoption of ERP systems by SMEs.

The analysis of the previous research clearly suggests that more research effort is needed to fill the void in the ERP research literature. It highlights the need for further research examining contextual moderators to the ERP-induced improvements in organizational performance, to establish the specific requisite conditions (i.e., contextual factors) under which the ERP system's performance improvements can be more accurately ascertained. This current research work is an effort in that direction.

RESEARCH MODEL AND HYPOTHESES

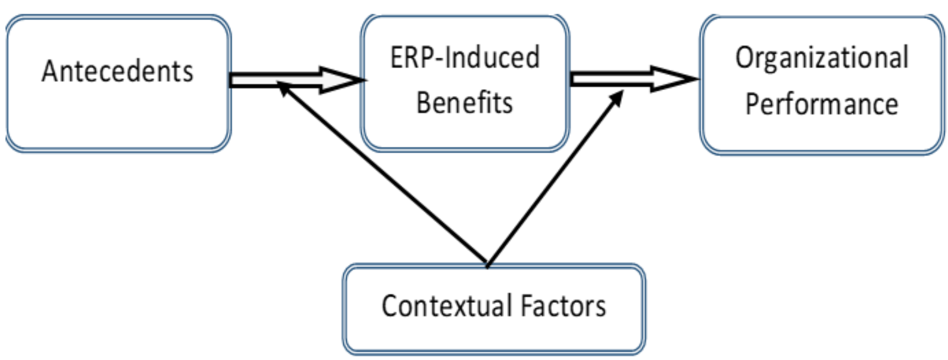
There is a general recognition in the literature that investments in IT (such as ERP) is a necessary, but not sufficient condition for performance improvements (Hu & Quan, 2003). Ultimate improvements in organizational performance is the result of numerous interactions and convergence processes, "each of these processes is influenced by a multitude of technological, organizational, industry, and competitive environmental factors" (Hu & Quan, 2003, p.4). The role of these contextual variables in influencing and moderating cause-and-effect relationships in organizational performance has long been recognized in the managerial leadership literature as the contingency theory (Fiedler, 1965). This theory has been used in the IS literature, for example, to explain the role of IT and the chief information officer (CIO) by studying contextual factors, such as environmental uncertain, information intensity, and other organizational variables, and their impact on the effectiveness of this role (Hu & Quan, 2003; Kearns & Lederer, 2004; Mao et al., 2015).

Closely related to the contingency theory is Tornatzky and Fleischer's (1990) technology–organization–environment (TOE) framework, which suggests that technological, organizational, and environmental factors in the organization's broad environment influence and drive the adoption and use of technological innovations ((Bamufleh et al., 2021; Catherine & Abdurachman, 2018; Christiansen et al., 2022; Lutfi et al., 2022; Ramdani et al., 2013; Tornatzky & Fleischer, 1990; Watjatrakul & Vatanapitukpong, 2021; Xu et al., 2017; Zhu & Kraemer, 2005; Zhu et al., 2010). The TOE framework, argued as a generic adoption theory (Bialas et al., 2023a; Zhu et al., 2003), is particularly relevant to this current research, as it captures the underlying domains of the critical contextual factors in a typical organizational environment, thereby underpinning the conceptualization of the ERP performance as shown on the framework in Figure 1.

Antecedents and Pre-Requisites of ERP Benefits

The process-oriented view of IT impacts claims that an organization must go through a requisite adaptation-transformational process as an implementation imperative before reaping any performance benefits from its ERP adoption (Barua et al., 1995; Häkkinen & Hilmola, 2008; Hu & Quan, 2003; Hustad & Stensholt, 2023; Lee et al., 2020; Watjatrakul & Vatanapitukpong, 2021). The absence of this adaptation and transformation stage, which engenders a poor fit between ERP systems and organizational business processes, has been widely recognized as the root cause of many ERP adoption failures (Amade et al., 2022; Hustad & Stensholt, 2023; Law & Ngai, 2007; Yen et al., 2011). ERP systems are designed and equipped with industry-standard best practices that force adopting organizations to undergo significant organization-wide process re-engineering and redesign changes to accommodate the new system (Law & Ngai, 2007; Yen et al., 2011). A quintessential requirement

Figure 1. Theoretical framework



therefore is an organizational fit with the ERP system, which refers to the overall congruence between the ERP functionalities and organizational processes, needs and requirements (Hu et al., 2023; Nwankpa, 2015; Watjatrakul & Vatanapitukpong, 2021; Zhu et al., 2010).

This paper examines two antecedent variables, business process re-engineering (BPR) and ERP/organizational fit and alignment. Business process re-engineering aims at bringing the organization's processes into strict compliance with the best practices embodied in the ERP system. Several research studies examined the role of BPR on improving organizational performance (Bradford & Florin, 2003; Elbashir et al., 2008; Hameed et al., 2022; Law and Ngai, 2007). For example, Law and Ngai (2007) examined the association between the extent of business process improvements (BPI) and perceived organizational performance and confirmed the existence of a significant association. Similarly, Elbashir et al. (2008) found a positive and significant relation between business process performance and organization performance. However, Bradford and Florin (2003) found no significant relationship between the degree of business process reengineering and implementation success. Likewise, Ram et al. (2013) also found no significant relationship between BPR and organizational performance. The latter two findings seem to contradict the widespread claims made about the role and benefits of business process re-engineering in improving organizational performance, directly or indirectly. In this study, BPR is posited as an antecedent to ERP-enabled benefits, comprising improvement in intra-organizational coordination and integration (COO), and improvement in data and information quality (DIQ). Hence the following two hypotheses:

Hypothesis One A ($H1_a$): Business process re-engineering (BPR) is an antecedent to ERP-induced improvement in intra-organization coordination and integration (COO).
Hypothesis One B ($H1_b$): Business process re-engineering (BPR) is an antecedent to ERP-induced improvement in data and information quality (DIQ).

The ERP/organizational fit and alignment (OFA) involves both strategic and operational alignment (Chou & Chang, 2008; Kang et al., 2008; Panda, 2022; Sieber et al., 2023; Velcu, 2010; Wang et al., 2021). Strategic alignment is a 'global' requirement that must be met as a necessary condition for operational alignment. Being an extremely costly IT investment, an ERP system must be envisioned to support the strategic objectives of the organization. There is little research attention given to operational fit and alignment in prior literature, with notable exceptions including Nwankpa (2015) who found a positive association between organizational fit and ERP system usage, and Zhu et al. (2010) who also confirmed the relevance of organizational fit to the ERP post-implementation success. This paper departs from these earlier works by positing a relationship between organizational fit as an antecedent and ERP-enabled benefits as a consequence. The two related hypotheses are therefore as follows:

Hypothesis Two A ($H2_a$): ERP/Organizational fit (OFA) is an antecedent to ERP-induced improvement in intra-organization coordination and integration (COO).
Hypothesis Two B ($H2_b$): ERP/Organizational fit (OFA) is an antecedent to ERP-induced improvement in data and information quality (DIQ).

ERP-Induced Benefits and Organizational Performance

The implementation of an ERP system is expected to provide the organization with an array of benefits that will likely translate into significant improvements in overall organizational performance to justify the cost of the investment. Prior studies examined various types and levels of such benefits including, inter alia, operational benefits, intermediate benefits, and process benefits ((Lee et al., 2020; Ruivo et al., 2020). More specifically, Chou and Chang (2008), and Gattiker and Goodhue (2005) modelled these as "intermediate benefits" posited to impact overall firm benefits. A significant and important requirement of all information systems is the provision of actionable information for managerial perusal, and an ERP system is no exception. It is argued that if an ERP system is to have any overall impact on organizational performance, it would have to be through enhancing the availability and relevance of data and information throughout the organization. The second group of hypotheses are therefore stated as follows:

Hypothesis Three A ($H3_a$): ERP-induced data/information quality (DIQ) is positively associated with improvement in intra-organizational coordination (COO).
Hypothesis Three B ($H3_b$): ERP-induced data/information quality (DIQ) is positively associated with overall organizational performance (OOP).

The first hypothesis above provides for a theorized relationship between the two ERP-induced benefits. This is theoretically plausible and consistent with prior studies (Gattiker and Goodhue 2005), as improved and more timely data and information flows are likely to engender improvements in coordination and synchronization activities across the various units of the organization.

A closely related ERP benefit that is largely overlooked in the IS literature is improvement in intra-organizational coordination and integration. ERP systems are expected to facilitate seamless integration between functional units, thereby breaking functional barriers and providing for synchronization and unfettered communication between these units. Literature suggests that greater coordination and interdependence between organizational units is associated with greater overall benefits from an ERP system (Gattiker & Goodhue, 2005). One of a few studies that specifically examined the impact of improvement in coordination on overall organizational benefit is Chou and Chang (2008) who reported a significant impact on overall performance. Similarly, Gattiker and Goodhue (2005) found coordination improvements to have a significant impact on overall ERP benefits at the local (plant) level. The author proposes the following hypothesis to test the relationship between improvement in coordination as an ERP-enabled benefit and overall organizational performance as follows:

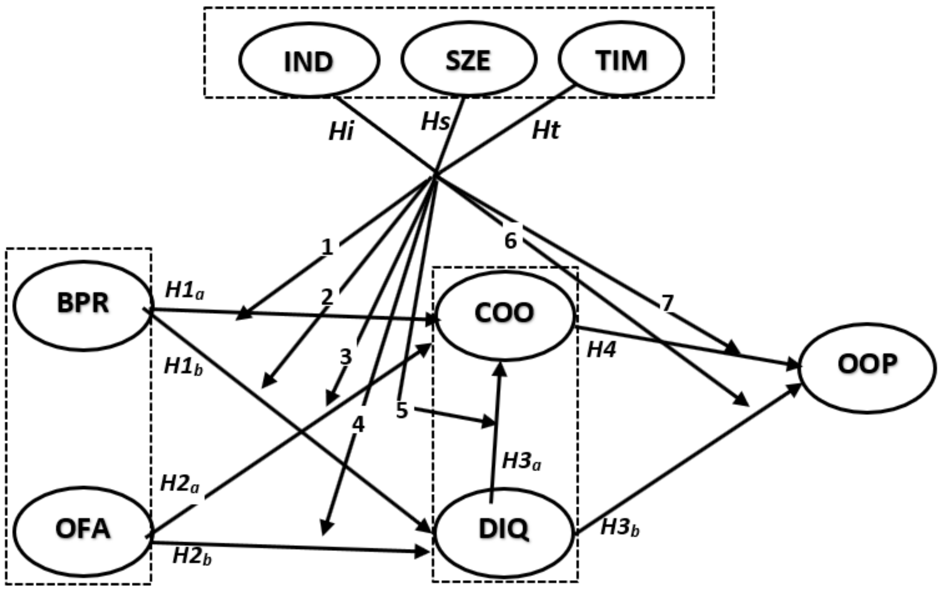
Hypothesis Four (H4): ERP-induced intra-organizational coordination (COO) is positively associated with overall organizational performance (OOP).

Contextual Factors as Moderators

Prior literature generally shows little interest in contextual factors other than as control variables (Benitez et al., 2018; Bradford & Floring, 2003; Chou & Chang, 2008; Elbashir et al., 2008; Gattiker & Goodhue, 2005; Rai et al., 2006; Ruivo et al., 2014). In this study, three contextual variables are examined—comprising the three dimensions of the TOE framework: industry, organizational size, and length of adoption and use of the ERP system. Each of these contextual variables is posited as a moderator of either the relationships between antecedents and ERP-enabled benefits, or between the latter and overall organizational performance. Following Benitez et al. (2018) and Elbashir et al. (2008), industry is reclassified into two main categories. Firm size (measured by employee head count) is recoded as small (less than 100 employees) and large (more than 100). Time elapsed since ERP system implementation is also recoded as short (1-8 years) and long (more than 8 years). The following three base hypotheses are proposed, each includes seven related sub hypotheses covering the seven relationships in the research model, as depicted on Figure 2.

Hypothesis I (H_i): Type of industry moderates the relationships between antecedents and ERP-enabled benefits, and ERP-enabled benefits and overall organizational performance.
Hypothesis S (Hs): Firm size moderates the relationships between antecedents and ERP-enabled benefits, and ERP-enabled benefits and overall organizational performance.
Hypothesis T (H_t): Duration of ERP system's use moderates the relationships between antecedents and ERP-enabled benefits, and ERP-enabled benefits and overall organizational performance.

Figure 2. Research model



RESEARCH METHODOLOGY

Survey methodology was used to address the research problem for this study, following a descriptive research design using quantitative analysis of the data gathered from a cross-sectional survey. IBM SPSS 26 was used for standard statistical analysis, and IBM Amos 26 was used to perform structural equation modeling (SEM). Statistical significance for all tests was set at the 95% level ($\alpha = 0.05$).

Covariance-based (CV) SEM with the maximum likelihood (ML) estimation technique, built into Amos 26, was chosen for this study. Literature suggests that ML-based covariance SEM and the maximum likelihood (ML) method are quite robust against mild violations of normality, and even under conditions of severe violations of the normality assumption, simulation studies have shown that they are still consistent (Reinartz et al., 2009; Schermelleh-Engel et al., 2003; Strasheim, 2014).

Scale Development

To address the research questions in this study and test the related hypotheses, a cross-sectional, multi-industry survey was conducted. To develop the scales for this survey, the author adopted an established research tradition that involves a systematic and staged process of formulation and refinement of the measures. First, following an extensive literature review and guided by the study's research framework, a comprehensive list of scales and reflective measures was developed during the period spanning September-October, 2019. The scales were then refined and the draft questionnaires were given to a group of eight fellow academics to review for theoretical soundness and consistency. The author then distributed the pilot survey to his class of MBA students who were mostly line managers with extensive hands-on managerial expertise.

The feedback received from these two rounds of purification was used to develop a more refined instrument, using a 5-point Likert-scale ranging from 'strongly agree' to 'strongly disagree' points. The final instrument included 16 question items, (see Table 1 below), 3 items for each of business process re-engineering (BPR), organizational fit and functional alignment (OFA), data and information quality (DIQ), and intra-organizational coordination (COO) constructs; and four items for the overall organizational performance (OOP) construct; which are all reflectively measured. Appendix A provides the full description of the measurement items.

Table 1. Research constructs, measures, and sources

Construct	Operational Definition	Number of Measures	Sources
BPR	Changes in business processes and practices mandated by the ERPS implementation imperatives.	3	(Bradford & Florin 2003; Ram et al., 2013; Ram et al., 2014)
OFA	The extent of fit (match) and alignment between the ERP's capabilities, functionalities, and operating requirements, and the organization's routines, practices, needs, and requirements.	3	(Gattiker & Goodhue, 2005; Nwankpa, 2015)
COO	Improvement in the coordination and synchronization among different units of the firm, and the consequent improvements in information and workflows.	3	(Chou & Chang, 2008; Gattiker & Goodhue, 2005)
DIQ	Improvement in the overall quality and availability of data and information, and the flexibility of generating and handling such information.	3	(Gattiker & Goodhue, 2005; Häkkinen & Hilmola, 2008)
OOP	Overall organizational performance improvement attributable to the implementation and use of the ERP system.	4	(Chou & Chang, 2008; Gattiker & Goodhue, 2005; Lucia-Palacios et al., 2014; Nwankpa, 2015)

Sample and Data Collection

The data for this study was collected from participating firms in the Middle East and North Africa (MENA) region, including United Arab Emirates, Saudi Arabia, Kuwait, Qatar, Egypt, Jordon, Oman, Lebanon, and Bahrain, through a contracted engagement with a global research firm (Dun and Bradstreet) specializing in the provision of a wide range of business information. The respondents for this survey were limited to managerial roles, executives, line managers, and senior IT leaders who are more versed with the role of IT in enhancing organizational operations and performance. The completely anonymous survey was distributed during November 2019 and January 2020, through an online questionnaire to a large sample of 14,555 potential ERP-using organizations. A total of 725 responses were returned, of which 200 were complete and 525 incomplete surveys.

To avoid potential issues with both common method and non-response biases a priori, the survey was made completely anonymous, and respondents were clearly informed that their participation was strictly voluntary and confidential. After data collection, the author tested for the non-response bias between the earlier respondents (first and second batches) and late respondents (third batch), using the Mann-Whitney U Test and the Kolmogorov-Smirnov Test. Both tests indicated there were no significant differences in the data distribution for all variables, except one variable for which the Mann-Whitney U Test indicated a significant difference, whereas the Kolmogorov-Smirnov Test provided insignificant difference between the two groups, respectively. The author concluded, however, that this was not a serious issue to threaten the validity of the research results.

The profile of the respondents represents a wide range of business organizations, and the majority of the respondents are IT/IS directors (50%), followed by functional managers (18%), and various other managerial capacities (27%). The majority of the firms (48%) had 100 employees or less, followed by medium-sized (30%), and larger firms (9%). Retail includes the largest percentage of firms (17%), followed by manufacturing (16%), and hospitality (12%).

Exploratory Factor Analysis

To derive the research constructs, the author performed exploratory factor analysis (EFA) in IBM SPSS, using principal component analysis (PCA) with the Varimax rotation method, and the number of factors set to five (known a priori). The initial results indicated that two items, BPR1 and OOP1, had poor loadings on their principal factors, and had multiple cross loadings, and thus both had to be dropped.

The factor analysis was run again with the remaining 14 variables which produced a parsimonious and sufficiently loaded indicators (all loadings very close or above .70), with five factors explaining about 79% of the variance of the 14 items. Table 2 presents the final (rotated) results of the factor analysis.

To determine whether common method bias was an issue for this study, the results of the exploratory factor analysis were used to test whether such a problem existed. Using Harman's one-factor test (Podsakoff et al., 2003), no single factor should account for more than 50% of the variance in the measurement variables. Based on the EFA results, the first factor accounted for only 39% of this variance. Therefore, the author concluded that no significant common method variance threatened the integrity of the data collected for this study.

Assessment of the Measurement Model

The statistics for the measurement model fit are presented on Table 3. All of the indices indicate an adequate model fit; in particular, $\chi^2/df=1.68$, *CFI=.969, GFI=.926, RMSEA=.059,* which are all within the recommended thresholds (Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014).

The author next examined the psychometric properties of the measurement model through a confirmatory factory analysis (CFA) to ensure the adequacy of its reliability and validity. The relevant measures are presented on tables 4 and 5. Construct reliability, which measures the internal consistency of a scale, is evidenced by Cronbach's alpha and composite reliability (CR). As indicated in Table 4, all alpha values (except for BPR, which is otherwise very close, at 0.68) are above the recommended

Table 2. Final EFA rotated factors with 14 measurement items

Variable	Component (Factor)				
	1	2	3	4	5
DIQ2	.895				
DIQ1	.855				
DIQ3	.796				
COO1		.863			
COO2		.819		.349	
COO3		.814		.312	
OOP2			.875		
OOP4			.872		
OOP3			.843		
OFA2				.807	
OFA1				.796	
OFA3		.414		.698	
BPR3					.896
BPR2					.758

Table 3. Goodness-of-fit indices for the measurement model

Model	χ^2/df	*SRMR*	*RMSEA*	*PClose*	*CFI*	*GFI*	*NFI*	*TLI*	*IFI*
Measurement	1.687	0.048	0.059	0.212	0.969	0.926	0.929	0.958	0.970
Recommended value	<3	<0.08	<0.08	>0.05	≥0.90	>0.90	>0.90	≥0.90	≥0.90

threshold of 0.70 (Nunnally & Bernstein, 1994). Table 4 also presents composite reliabilities, which measure the degree to which observed indicators indicate or share in their measurement of the construct (Fornell and Larcker 1981). The reported values are all above the recommended benchmark of 0.70 (Hair et al., 2006; Nunnally & Bernstein, 1994).

To demonstrate construct validity, the author assessed both convergent and discriminant validities. For convergent validity, the author examined the average variance extracted (AVE) and the standardized item loadings, both of which are presented on Table 4. The AVE measures the degree of shared variance between the measured variables of a latent construct. All the values for AVE reported on Table 4 are above the minimum recommended cut-of value of 0.50 (Chin, 1998; Fornell & Larcker, 1981; Hair at el., 2006), demonstrating construct convergent validity. Similarly, all of the standardized loadings on Table 4 are above the minimum value of 0.50 (Hair at el., 2006) providing further evidence of convergent validity.

Discriminant validity refers to the uniqueness of a construct. This is demonstrated by the relationship of the AVE of a construct to its correlations with all the other constructs. To satisfy the requirement of Discriminant validity, the square root of the AVE of a construct must be greater than its correlations with the other constructs (Chin, 1998). Table 5 demonstrates this, where the diagonal values represent the square root of AVE, and the off-diagonal values represent the cross-correlations with other constructs. Overall, all the measures thus adequately demonstrate the required scale properties for further structural analysis.

RESULTS AND ANALYSIS

Assessment of the Structural Model

Table 6 provides the model fit statistics for the structural model. As evident from the fit indices, the model has a very good fit. The path diagram is shown on Figure 3 and the hypothesis test results for each of the seven main research hypotheses are presented on Table 7.

Table 4. Construct reliabilities

Construct	Indicator	Std. Loadings	C.R.*	Item-to-Total Corr.	Cronbach's Alpha	Composite Reliability	AVE	VIF
Business process re-engineering (BPR)	BPR1	.990	8.797***	.518	0.680	0.752	0.623	1.404
	BPR2	.523	6.218***	.518				
ERP/Organizational Fit (OFA)	OFA1	.760	11.623***	.632	0.785	0.799	0.570	3.023
	OFA2	.794	12.217***	.687				
	OFA3	.709	10.634***	.583				
Data and information quality (DIQ)	DIQ1	.876	15.121***	.792	0.885	0.894	0.740	1.469
	DIQ2	.954	17.349***	.851				
	DIQ3	.737	11.839***	.696				
Intra-organization coordination (COO)	COO1	.766	12.338***	.726	0.879	0.879	0.709	2.609
	COO2	.835	13.939***	.766				
	COO3	.918	16.082***	.807				
Overall organizational performance (OOP)	OOP1	.807	13.031***	.742	0.867	0.870	0.691	N.A.
	OOP2	.874	14.518***	.766				
	OOP3	.810	13.130***	.744				

***** For unstandardized regression weights. ******* $p < 0.001$. **N.A.**: applicable to predictor variables

Table 5. Correlations between constructs and discriminant validity

	Mean	SD	BPR	OFA	DIQ	COO	OOP
BPR	7.68	1.405	***0.789***				
OFA	11.96	1.978	0.455***	***0.755***			
DIQ	11.76	1.561	0.364***	0.494***	***0.860***		
COO	12.20	1.426	0.452***	0.697***	0.412***	***0.842***	
OOP	10.93	1.926	0.226**	0.336***	0.476***	0.264**	***0.831***

Note: Square root of average variance extracted (AVE) shown on diagonal.
Off-diagonal elements are inter-construct correlations.
*** p < 0.001, ** p < 0.010

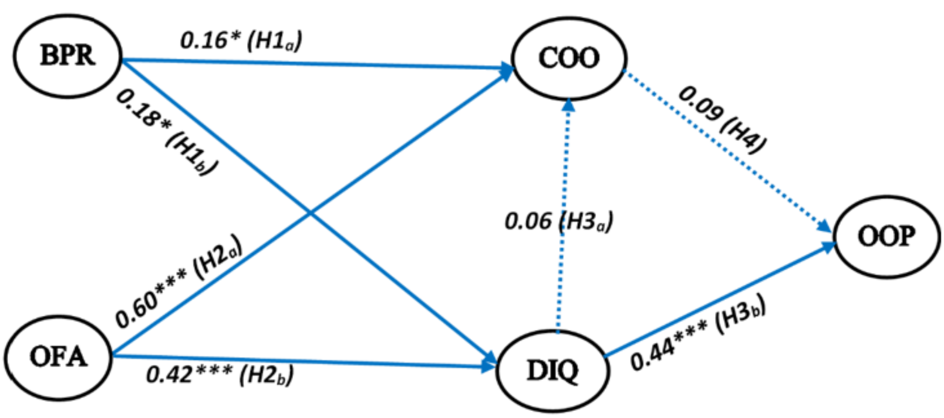
Table 6. Goodness-of-fit indices for the structural model

Model	χ^2/df	*SRMR*	*RMSEA*	*PClose*	*CFI*	*GFI*	*NFI*	*TLI*	*IFI*
Measurement	1.654	0.049	0.057	0.248	0.970	0.926	0.928	0.960	0.970
Recommended value*	<3	<0.08	<0.08	>0.05	≥0.90	>0.90	>0.90	≥0.90	≥0.90

*(Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014)

Figure 3. The structural model

*Note: ***p < 0.001, *p < 0.05*



As Table 7 below indicates, five of the seven main hypotheses are supported and two are rejected. In $H1_a$ and $H1_b$, it was hypothesized that business process re-engineering (BPR) is an antecedent to ERP-induced intra-organization coordination and integration (COO), and to ERP-induced data and information quality (DIQ), respectively. The test results support both of these hypotheses ($H1_a$: β=0.159, $p < 0.05$; $H1_{b:}$ β=0.176, $p < 0.05$). Similarly, ERP/organizational fit (OFA) is a significant antecedent to ERP-induced coordination and integration ($H2_a$: β=0.596, $p < 0.001$) and ERP-induced data and information quality ($H2_{b:}$ β=0.416, $p < 0.001$), providing support for these hypotheses.

It was theorized, as in $H3_b$, that ERP-induced improvement in data and information quality will lead to overall impact on organizational performance. This is supported by the conclusion of hypothesis $H3_b$ (β=0.442, $p < 0.001$). However, contrary to our theory and intuition, ERP-induced coordination and integration does not influence overall organizational performance (*H4:* β=0.088,

Table 7. Main hypotheses test results (H1-H4)

Hypothesis	Path	Path Coefficient	Std. Error	C.R.	Result
H1a	BPR → COO	0.159*	.086	2.164	Supported
H1b	BPR → DIQ	0.176*	.086	2.194	Supported
H2a	OFA → COO	0.596***	.108	5.735	Supported
H2b	OFA → DIQ	0.416***	. 091	4.356	Supported
H3a	DIQ → COO	0.059	.081	0.784	Not supported
H3b	DIQ → OOP	0.442***	.136	5.100	Supported
H4	COO → OOP	0.088	.116	1.100	Not supported

Note: ***p < 0.001, *p < 0.05, R^2=0.24

$p > 0.05$). The structural model was able to explain about 24% (R^2=0.24) of the total variance in overall organizational performance.

Moderation Analysis

To evaluate the possible moderating effects of the three contextual variables, industry, firm size, and time elapsed since ERP implementation, the author performed multi-group analysis in Amos 26 using a chi-square difference test between the unrestricted model and the constrained model in which structural weights were constrained equal across the two groups. A test at the global (model) level will ascertain whether the contextual factor has an overall significant moderating effect on the model. Each structural path needs to be tested separately to assess the moderating effect on that path.

To evaluate the moderating effect of industry, the author assessed the difference between its two groups, service and non-service, with regards to each of the seven hypothesized relationships in the structural model. The model level test provided the fit statistics on Table 8 and a global significant moderation ($\Delta\chi^2$=26.164, Δdf=15, p=.036), suggesting moderation effect.

Further analysis of the structural weights demonstrated, as evidenced by Table 9, that industry moderates the relationships between business process re-engineering and ERP-induced data and information quality (Hi_2: $\Delta\chi^2$=7.000, Δdf=1, p=.008), and between organization fit and alignment and ERP-induced data and information quality (Hi_4: $\Delta\chi^2$=8.215, Δdf=1, p=.004). More specifically, it appears that service business organizations tend to see more improvement in ERP-induced data and information quality as a result of business process re-engineering than non-service organizations, but less benefits from fit and alignment than non-service organizations. In summary, as related to industry type, the moderation hypotheses Hi_2 and Hi_4 are supported, but Hi_1, Hi_3, Hi_5, Hi_6, and Hi_7 are all rejected.

Next, tables 10 through 13 provide similar results regarding the moderating effects of firm size and time elapsed, respectively. The global test for firm size (fit indices shown on Table 10) indicates

Table 8. Goodness-of-fit indices of the structural model for the industry groups

Model	$\chi^2(df)$	χ^2/df	*RMR*	*RMSEA*	*CFI*	*GFI*	*NFI*	*TLI*	*IFI*
Unconstrained	254.667(141)	1.806	.037	.064	.931	.862	.860	.911	.932
Structural Weights	280.831(156)	1.800	.042	.064	.924	.846	.846	.911	.925
Recommended value*		<3	<0.08	<0.08	≥0.90	>0.90	>0.90	≥0.90	≥0.90

*(Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014)

Table 9. Moderating effects of industry type

Hypothesis With Industry Type as a Moderator	Constrained Model				(Services, n=81)	(Non-Services, n=119)		
	χ^2 (*df=142*)	CFI	RMSEA	TLI	Estimate	Estimate	$\Delta\chi^2(\Delta df=1)$	*p*-Value
Hi$_1$: BPR → COO	255.288	.931	.063	.911	0.047	0.113*	.621	.431
Hi$_2$: BPR → DIQ	261.667	.927	.065	.906	0.251	-0.018	7.000	.008**
Hi$_3$: OFA → COO	254.719	.931	.063	.912	0.494***	0.542***	.052	.820
Hi$_4$: OFA → DIQ	262.881	.926	.066	.906	0.091	0.788***	8.215	.004**
Hi$_5$: DIQ → COO	256.820	.930	.064	.910	-0.017	0.183*	2.153	.142
Hi$_6$: DIQ → OOP	256.425	.930	.064	.911	0.702***	0.415**	1.758	.185
Hi$_7$: COO → OOP	255.512	.931	.064	.911	-0.018	0.222	.846	.358

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.
Unconst. model fit: χ^2=254.667, df=141, CFI=0.931, RMSEA=0.064, TLI=0.911
BPR: business process re-engineering, OFA = organizational fit and alignment, COO = coordination and synchronization, DIQ = data and information quality, OOP = overall organizational performance

that it has moderating effect on the model ($\Delta\chi^2$=34.997, Δdf=13, p=.001). A cursory look at Table 11 indicates that firm size has a moderating effect on two of the seven structural relationships. More specifically, it moderates the relationship between organizational fit/alignment and coordination/ integration (Hs_3: $\Delta\chi^2$=5.679, Δdf=1, p=.017), and organizational fit/alignment and data/information quality (Hs_4: $\Delta\chi^2$=5.260, Δdf=1, p=.022). The author excluded the third moderating effect, between coordination and overall organizational performance (OOP), as the latter construct (OOP) was not scalar invariant between the two industry groups. This relationship was also not significant in the main hypothesis (i.e., H4).

Time elapsed since ERP implementation (duration of ERP use) was the third potential moderating factor. According to the survey instrument used, there are potentially four available groupings within the data, using the following time (years) cut-offs: The first cut-off is <=3/>3 years, with two groups of 39 and 161 firms, the second is <=5/>5 with 77 and 123 firms, the third is <=8/>8 with 115 and 85 firms, and finally <=10/>10 with 142 and 58 firms, respectively. Only two of these four groupings are relatively more balanced and are shown to satisfy distribution and model validity requirements. These are the groups created by the 8-year and 5-year cut-offs.

Using the 8-year cut-off groups, the model's global moderating effect (model fit indices shown on Table 12) was assessed, and the results indicated a significant moderating effect ($\Delta\chi^2$=35.640, Δdf=13, p=.001). Further analysis shows that, as evidenced by Table 13, it moderates four of the seven relationships in the structural model. More specifically, it moderates the relationship between fit/alignment and coordination (Ht_3: $\Delta\chi^2$=9.074, Δdf=1, p=.003), data/information quality and coordination (Hs_5: $\Delta\chi^2$=7.658, Δdf=1, p=.006), data/information quality and overall performance (Hs_6: $\Delta\chi^2$=5.733, Δdf=1, p=.017), and coordination and overall performance (Hs_7: $\Delta\chi^2=8.760$,

Table 10. Goodness-of-fit indices of the structural model for firm size

Model	χ^2(*df*)	χ^2/*df*	*RMR*	*RMSEA*	*CFI*	*GFI*	*NFI*	*TLI*	*IFI*
Unconstrained	242.638(141)	1.721	.029	.060	.932	.863	.856	.913	.934
Structural Weights	282.155(156)	1.809	.039	.064	.916	.843	.832	.902	.917
Recommended value*		< 3	<0.08	<0.08	≥0.90	>0.90	>0.90	≥0.90	≥0.90

*(Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014)

Table 11. Moderating effects of firm size

Hypothesis/ Firm Size as a Moderator	Constrained Model				(Small, n=97)	(Large, n=103)		
	χ^2 (*df=141*)	CFI	RMSEA	TLI	Estimate	Estimate	$\Delta\chi^2(\Delta df=1)$	*p*-Value
Hs_1: BPR → COO	224.143	.945	.055	.929	0.105*	0.019	1.020	.312
Hs_2: BPR → DIQ	223.372	.945	.054	.929	0.065	0.008	.249	.618
Hs_3: OFA → COO	228.802	.942	.056	.925	0.339**	0.877***	5.679	.017*
Hs_4: OFA → DIQ	228.383	.942	.056	.925	0.183	0.782***	5.260	.022*
Hs_5: DIQ → COO	225.660	.944	.055	.927	0.159	-0.056	2.537	.111
Hs_6: DIQ → OOP	224.036	.945	.055	.929	0.405*	0.606***	.913	.339
Hs_7: COO → OOP	227.667	.942	.056	.926	0.475*	-0.045	4.544	.033*

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.
Unconst. model fit: χ^2=223.123, df=140, CFI=0.945, RMSEA=0.055, TLI=0.928
BPR: business process re-engineering, OFA = organizational fit and alignment, COO = coordination and synchronization, DIQ = data and information quality, OOP = overall organizational performance

Δdf=1, p=.003). Interestingly, but not surprisingly, this last relationship was not even significant in the main hypothesis (H4), but now illuminated by the moderation analysis, it can be seen it was in fact significant but only for the long-duration-of-use firms, attenuated by the very weak estimate from the short-duration-of-use firms. Overall, for the time elapsed moderator, four hypotheses are therefore supported, while the remaining three hypotheses rejected.

The moderation results on Table 13 used a cut-off time of eight years for short and long duration, with a distribution of 115 and 85 firms in the two groups, respectively. To test the robustness of these results, a different cut-off of 5 years was applied, with a distribution of 77 and 123 firms in the two groups, respectively. A similar analysis was then carried out and the results are presented on Table 14. Two of the four hypotheses in Table 14 are still supported: Ht_3 and Ht_5, but hypotheses Ht_6 and Ht_7 are both rejected.

Given the nature of the time variable as administered on the survey, and the size of the research sample, there is an inherent limitation on the sizes of groups created. For instance, the two groups created with a five-year cutoff resulted in two groups of unbalanced sizes 77 and 123 firms, respectively. Similarly, with an 8-year cutoff, there are two groups with 85 and 115 firms, respectively, leading to unbalanced group sizes. Thus, to further extend and bolster the two-group moderation analysis and demonstrate the robustness of the time as a moderator, the author performed moderation analysis based on time as an interaction variable. This was possible because there are five blocks of time that can be used to create a Likert-scale type variable as follows:

This new variable, (with values 1, 2, 3…), shares the same scale as the other constructs on the model, making it possible to create an interaction term between each construct and the new time variable. The original research model, as depicted on Figure 2, but now with only the time moderating

Table 12. Goodness-of-fit indices of the structural model for the time elapsed groups

Model	$\chi^2(df)$	χ^2/df	*RMR*	*RMSEA*	*CFI*	*GFI*	*NFI*	*TLI*	*IFI*
Unconstrained	279.457(141)	1.982	.033	.070	.916	.846	.847	.892	.918
Structural Weights	323.156(156)	2.072	.047	.074	.899	.830	.824	.882	.900
Recommended value*		<3	<0.08	<0.08	≥0.90	>0.90	>0.90	≥0.90	≥0.90

*(Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014)

Table 13. Moderating effects of time elapsed (Short during <= 8 years, Long duration > 8 years)

Hypothesis/Time Elapsed as a Moderator	Constrained Model				(Short, n=115)	(Long, n=85)		
	χ^2 (*df=138*)	CFI	RMSEA	TLI	Estimate	Estimate	$\Delta\chi^2(\Delta df=1)$	*p*-Value
***Ht*$_1$**: BPR → COO	241.575	.937	.062	.917	0.083	0.064	0.071	.789
***Ht*$_2$**: BPR → DIQ	244.310	.936	.062	.915	-0.022	0.167	2.806	.094
***Ht*$_3$**: OFA → COO	250.577	.932	.064	.910	0.996***	0.358***	9.074	.003**
***Ht*$_4$**: OFA → DIQ	241.828	.937	.062	.917	0.578**	0.426*	0.324	.569
***Ht*$_5$**: DIQ → COO	249.162	.933	.064	.911	-0.139	0.213***	7.658	.006**
***Ht*$_6$**: DIQ → OOP	247.237	.934	.063	.913	0.632***	0.056	5.733	.017*
***Ht*$_7$**: COO → OOP	250.264	.932	.064	.910	-0.004	1.089**	8.760	.003**

Note: ***p < 0.001, **p < 0.01, *p < 0.05

Unconst. model fit: χ^2=241.504, df=137, CFI=0.937, RMSEA=0.062, TLI=0.916

BPR: business process re-engineering, OFA = organizational fit/alignment, COO = coordination and integration, DIQ = data and information quality, OOP = overall organizational performance

Table 14. Moderating effects of time elapsed (Short during <= 5 years, Long duration >5 years)

Hypothesis/Time Elapsed as a Moderator	$\Delta\chi^2(\Delta df=1)$	*p-Value*
***Ht*$_1$**: BPR → COO	1.977	0.160
***Ht*$_2$**: BPR → DIQ	0.398	0.528
***Ht*$_3$**: OFA → COO	6.284	0.012*
***Ht*$_4$**: OFA → DIQ	0.113	0.736
***Ht*$_5$**: DIQ → COO	4.223	0.040*
***Ht*$_6$**: DIQ → OOP	0.095	0.758
***Ht*$_7$**: COO → OOP	3.335	0.068

Note: Short duration (n=77), Long duration (n=123)

Likert scale variable

Time Range	Interpretation	Code/Value	Frequency
<=3	Implementation time less than or equal to 3 years	1	39
>3/<=5	Implementation time greater than 3, but less than or equal to 5 years	2	38
>5/<=8	Implementation time greater than 5, but less than or equal to 8 years	3	38
>8/<=10	Implementation time greater than 8, but less than or equal to 10 years	4	27
>10	Implementation time greater than 10 years	5	58
		Total:	200

variable "TIM" treated as an interaction variable, was then fitted and analyzed. The new interaction terms are as follows: TBPR (TIM x BPR), TOFA (TIM x OFA), TDIQ (TIM x DIQ), and TCOO (TIM x COO). The resulting Goodness-of-fit indices indicated that the fit could be improved by removing some of interaction terms, or their paths; specifically, TCOO was dropped from the model, and both of the relationships TBPR->COO and TOFA->DIQ were also dropped. The resulting reduced model was then fitted again, with the four remaining moderating relationships. Table 15 indicates that the model is a good fit with the data.

The moderating hypothesis test results are presented on Table 16 below, which indicates that, and consistent with the previous group analysis, the two moderating hypotheses, Ht_3 and Ht_5, are both accepted, but the other two hypotheses rejected.

The results of the three moderation scenarios, through group analysis (tables 14 & 15) and interaction variables (table 16), are combined and presented on Table 17 below. Whereas the 8-year cut-off scenario (Table 14), which has a more balanced distribution of firms between the two groups (115 versus 85), provides support for four moderation hypotheses, the 5-year cut-off scenario supports only two of the seven hypotheses. The last scenario, using the interaction term, also supports only two of the seven hypotheses. As Table 17 indicates, however, all the three scenarios support the two hypotheses Ht_3 and Ht_5. That is, these two moderation effects are consistently supported across the three moderation analyses.

The following figure summarizes the results for the entire model, structural and moderating, combining the results on tables 7, 9, 11, and 17. This is a path diagram equivalent of the research model in Figure 2. In the interest of preventing clutter and saving space, graphics are used in lieu of

Table 15. Goodness-of-fit indices of the reduced model with interaction terms

	Indices	$\chi^2(df)$	χ^2/df	*RMR*	*RMSEA*	*PCLOSE*	*CFI*	*TLI*	*CD*
Model	**Values**	17.45(10)	1.745	.036	.061	.307	.981	.965	.745
Recommended values*			<3	<0.08	<0.08	>0.05	>0.90	>0.90	-

*(Hu & Bentler, 1999; Little et al., 2007; Strasheim, 2014)

Table 16. Moderation effects of time as interaction variable

Hypothesis/Time Elapsed as a Moderator	Interaction Variable	Path Coefficient	Std. Error	Z	*p*-Value
Ht_2: BPR → DIQ	TBPR → DIQ	.106	.058	1.83	0.067
Ht_3: OFA → COO	TOFA → COO	-.274	.046	-6.02	0.000***
Ht_5: DIQ → COO	TDIQ → COO	.131	.044	2.96	0.003**
Ht_6: DIQ → OOP	TDIQ → OOP	-.013	.061	-0.22	0.826

Note: ***p < 0.001, **p < 0.01

Table 17. Summary of moderating effects of time elapsed

Hypothesis/Time Elapsed as a Moderator	*Two Groups With Cutoff (<=5/>5) Years (Table 14) (n_1=77/n_2=123)*	*Two Groups With Cutoff (<=8/>8) Years (Table 15) (n_1=115/n_2=85)*	*Time as Interaction Variable (Table 16)*	*Sustained Moderation Effect*
Ht_1: BPR → COO	Not supported	Not supported	*	No
Ht_2: BPR → DIQ	Not supported	Not supported	Not supported	No
Ht_3: OFA → COO	*Supported*	*Supported*	*Supported*	*Yes*
Ht_4: OFA → DIQ	Not supported	Not supported	*	No
Ht_5: DIQ → COO	*Supported*	*Supported*	*Supported*	*Yes*
Ht_6: DIQ → OOP	Not supported	*Supported*	Not supported	No
Ht_7: COO → OOP	Not supported	*Supported*	*	No

Note:*relationship was insignificant on the model development symbols to describe the various relationships. Structural relations are indicated with blue lines, and moderating relationships with red lines. Significant relationships are solid lines, and insignificant relationships are dashed lines.

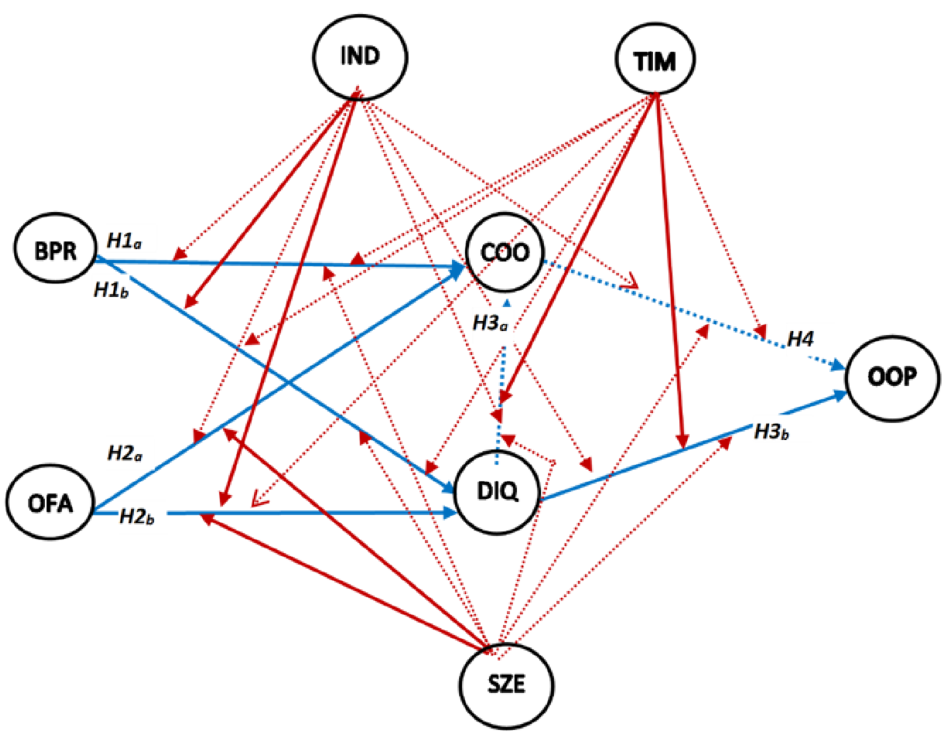
DISCUSSION AND IMPLICATIONS

Discussion of Findings

This paper examined the role of business process re-engineering (BPR) and ERP/organizational fit and alignment (OFA) as antecedents to ERP-induced benefits that are expected, in turn, to influence overall firm performance. The findings indicated that both of these variables (i.e., BPR and OFA) are significant antecedents to two ERP-induced benefits, coordination and integration (COO), and data and information quality (DIQ). However, of the two ERP benefits, only data and information quality was found to be a significant predictor of overall firm performance. Also, a significant relationship between DIQ and COO was not confirmed. The total explained variance in overall firm performance, as measured by the squared multiple correlation coefficient R^2, was 24%. This is particularly significant, given the history of unsuccessful research efforts to link firm performance improvements to IT investments and use.

The positive findings of this paper generally support similar findings regarding the overall significant impact of ERP systems on organizational performance (Al-Dhaafri & Alosani, 2021; AlMuhayfith & Shaiti, 2020; Gupta et al., 2020; Hwang et al., 2015; Nwankpa, 2018). The significant relationship between data and information quality and overall performance is supported by the findings of Gattiker and Goodhue (2005). The insignificant relationship between coordination and

Figure 4. Significant relationships in the research model
Note: Solid lines are significant, dashed lines insignificant



integration benefits and overall firm performance was somewhat unexpected, as it was theorized that these benefits would arguably speed up internal communications, transactions, and workflows; and improve the overall responsiveness of the organization to external stimuli, such as customer complaints or market changes. It also appears to contradict Gattiker and Goodhue (2005) who found in a plant-level study that coordination improvements significantly influenced plant overall performance. Similarly, Chou and Chang (2008) also found coordination improvement to significantly influence overall ERP benefits. Likewise, Nwankpa (2018) found coordination improvement as an intermediate ERP benefit to significantly affect ERP-enabled application integration, which in turn was shown to significantly influence overall ERP benefits. Hwang et al. (2015) found IT-enabled combinative capabilities (including cross-functional coordination, process improvement, and information access) to significantly influence competitive performance outcomes (including cost performance, quality, time to market, and product variety). Finally, Hwang and Min (2015) found higher levels of ERP implementation to be significantly related to organizational capability (measured by cross-functional coordination, information access, process improvement, and flexibility), and organizational capability in turn was significantly related to organizational performance (including cost performance, product variety, delivery reliability, time-to-market, and quality).

However, several other researchers reached mixed findings (Andries & Ungureanu, 2022; Gupta et al. 2018; Ruivo et al., 2017). For example, Andries & Ungureanu (2022) found a limited impact of an ERP implementation on organizational performance, as measured by improvements in productivity and profitability of Romania firms. Similarly, Ruivo et al. (2017) found the link between ERP use and ERP value (productivity and sales growth) insignificant in either manufacturing or services firms. In answering the pivotal question "With what organizational resources and by building what firm specific capabilities, the investment in ERP systems may bring firms competitive advantage", Hsu (2013, p.412) found other organizational resources (namely, managerial skills and organizational change management) to play a more important role than IT resources (ERP, e-Business technologies) in generating business integration capability, adding that neither IT resources nor organizational resources directly provide firms with competitive advantage (profits and market share). According to this theory then, some of the discrepancies between findings of various studies (including ours) can perhaps be traced to the missing role of organizational factors, i.e., contextual differences.

Another plausible explanation for this lack of overall insignificant relationship between coordination and integration benefits and overall firm performance is provided by Table 13, which shows the moderating effect of time elapsed since ERP implementation. Here, there is a significant moderating influence of longer time durations, which implies that coordination effects take time to make significant impact on firm performance. This significant impact is confined to the 85 firms in the long-time duration group (the second group). For the whole sample of 200 firms, however, the 115 firms in the short duration group have dampened this impact, leading to an overall insignificant impact. In other words, COO does have significant association with OOP, but only for small sized firms (as indicated by Table 11), and for firms with time duration more than 8 years (as indicated by Table 13). This is theoretically plausible, as small firms are naturally less organizationally complex and more resilient than larger firms, and consequently more able to optimize their coordination activities and processes to achieve the expected performance benefits. It is equally plausible that more coordination benefits would come with more years of ERP system use. The second insignificant finding also contradicts the author's hypothesized relationship, that ERP-induced improvement in data and information quality would influence coordination improvements.

The findings from the moderation analysis provide evidence that all the three contextual variables—industry, firm size, and duration of ERP use, are significant moderators to the influence of the other variables on overall firm performance. These findings generally support conclusions of prior studies. For example, Chae et al. (2018) found industry to be a significant moderator of the relationship between IT capability and firm performance. Similarly, Wieder et al. (2006) reported that longer use of the ERP system was associated with better firm performance. Whereas Zhu and Kraemer

(2005) found firm size to be a significant organizational variable in the context of IT adoption, Rai et al. (2006) found size to have no significant effect on firm performance, contrary to the finding here that firm size moderates the relationship between antecedent variables and ERP benefits.

Practical Implications

The results of this study suggest several practical implications. First, the importance of antecedent variables, such as business process re-engineering and ERP/organizational fit and alignment is demonstrated, as their significant correlation with ERP-induced benefits is confirmed in this study. Some of the earlier misgivings with ERP benefits could now be seen to be related to the lack of organizational readiness in terms of ensuring that these antecedent variables are accounted for in the context of the ERP implementation before any such benefits can be expected to accrue. In particular, organizational fit and alignment, which has received much less emphasis than BPR in the literature as well as in practice, appears to be crucial to the success of an ERP system in generating the expected benefits. Business organizations need to seriously examine the extent of this ERP/organizational fit and alignment as a critical ERP implementation parameter.

Literature has consistently reported increasing performance benefits with time. This study confirms this, and extends it with the significant moderating role of the duration of use on the influence of fit and alignment, data and information quality, and coordination. With longer ERP use, as the findings suggest, data and information quality will have more impact on coordination, and coordination will have more influence on organizational performance. These findings suggest that business organizations need to be patient with the continued use of the ERP system to see significant results. This was echoed by Wanchai (2019) who noted that a post-adoption period of more than four years may be needed to observe a significant impact from ERP investments on organizational performance.

Theoretical Implications

The IS literature has long recognized the importance of streamlining and optimizing business processes (through re-engineering and redesign) before implementing information systems. Much less research emphasis has, however, been given to the role of the fit and alignment between the ERP system and the business organization in predicting the ERP system's benefits. This paper's findings suggest that such alignment is perhaps a stronger predictor of an ERP benefits, and more research attention is needed to confirm this.

The findings related to the contextual factors as moderators underscore the significant role of these factors in predicting the success of ERP systems in providing the expected benefits. Firm industry, which has received limited research so far, is found to be a significant predictor of the influence of ERP/organizational fit and alignment, where non-service firms showed significantly stronger influence of fit and alignment than service firms. This provides new research insight about the differences between service and non-service firms with regards to the importance of alignment to the success of the ERP system.

The results of this study provide additional insights regarding the conditions under which time elapsed has a significant influence on ERP success. From the results of the moderation analysis, it is evident that ignoring contextual factors such as time elapsed leads to substantially confounded results, often resulting in a general conclusion or recommendation that does not apply to all the firms in the sample. For example, the results indicate that coordination has a significant influence on overall performance on later years of an ERP system's use, but the conclusion from the main (unmoderated) hypothesis was insignificant. Along the same lines, fit and alignment appears to have a stronger influence in earlier years of an ERP system's use, and data and information quality has a significant influence on overall performance also only in the earlier years of an ERP system's use. These important findings were eclipsed by the main analysis that excluded these contextual factors.

CONCLUSION

This study investigated the role of antecedent and contextual factors in influencing the ERP system's induced benefits, which in turn were posited to predict overall organizational performance. The results confirmed the significant antecedent effect of business process re-engineering and ERP/organizational fit/alignment on intra-organizational coordination and integration, and data and information quality as ERP-induced benefits. The findings also confirmed the significant relationship between data and information quality and organizational performance, but not the relationship between coordination and organizational performance.

The current research study makes four major contributions to the literature. First, the study confirmed the positive impact of ERP systems on overall organizational performance, thus validating the results of prior studies with similar positive findings. This should contribute to clarifying the 'mixed results' syndrome that has plagued ERP systems research for many years. Second, this study's findings highlight the critically important role of the ERP/organizational fit and alignment in driving ERP-induced benefits. For decades, the IS literature has emphasized the role of business process re-engineering as an antecedent to such benefits, but much less emphasis has been given to the requirement of fit and alignment. Third, this study, to the best of the author's knowledge, is the first study until now that specifically examines all the three contextual factors, industry, firm size, and time elapsed, as moderators to the influence of two antecedent factors to ERP-induced (intermediate) benefits. Numerous studies have included one or two of these contextual variables, and often only as control variables, generally with primary focus on the structural relationships. Fourth, and as a corollary to all the above, the findings of this study inform the literature of the conditions under which ERP systems are expected to produce benefits to the adopting organizations.

There are several limitations to this study. The first includes the use of subjective (perception-based), self-reported measurement of overall firm performance. While this method is commonly used in the literature because of practical reasons, objective, accounting-based measurements would theoretically be more accurate. Moreover, the analysis of the moderating effect of time was limited by the categorical nature of the time variable and our sample size. Therefore, extensive robustness checks on this moderating effect of the time variable were not possible, as the unbalanced and small group sizes would violate distribution assumptions and cannot therefore be meaningfully analyzed. Additionally, using a longitudinal, instead of a cross-sectional, study would allow tracking of ERP performance benefits to the adopting organizations, and thus provide a more accurate measurement over time of such benefits. Future research should also broaden the coverage of contextual factors to include more technological, environment, and organizational factors.

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COMPETING INTERESTS

The author of this publication declares there are no competing interests.

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APPENDIX A

Reflective survey measurement items

Business Process Re-Engineering (BPR)	
BPR1	Top management restructures work processes to leverage technology opportunities in the organization
BPR2	As part of our ERP implementation, we standardized the business processes to the extent possible to fit the ERP system
BPR3	Appropriate business process reengineering and redesign was conducted before the ERP implementation
Organizational Fit and Alignment (OFA)	
OFA1	The practices built in the ERP system meet the needs and requirements in our organization
OFA2	The process flow built in the ERP software corresponds to the process flow of our organization
OFA3	The ERP system has allowed information to flow more quickly across departments and units
Organizational Coordination and Integration (COO)	
COO1	ERP has improved the coordination among different units of the firm
COO2	ERP facilitates the integration of important information among different units of the firm
COO3	ERP helps to synchronize among different units of the firm
Data and Information Quality (DIQ)	
DIQ1	The ERP system provides employees with accurate and reliable information
DIQ2	The ERP system provides employees with comprehensive and up-to-date information.
DIQ3	The ERP system has improved the quality of reports and statements
Overall Organization Performance (OOP)	
OOP1	The implementation of the ERP system has improved productivity in my organization
OOP2	The implementation of the ERP system increased our profitability
OOP3	ERP has substantially improved the organization's overall business performance
OOP4	ERP has seriously improved the organization's overall competitive position in the market

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