

# ERP ALIGNMENT FOR POSITIVE BUSINESS PERFORMANCE: EVIDENCE FROM KOREA'S ERP MARKET

**SORA KANG**  
Hoseo University  
Choongnam, Korea 336-795

**JONG-HUN PARK**  
Sogang University  
Seoul, Korea 121-742

**HEE-DONG YANG**  
Ewha Womans University  
Seoul, Korea 120-750

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## ABSTRACT

This paper aims to examine conditions under which investment in enterprise resource planning (ERP) has a positive influence on business performance. Our empirical analysis on Korean firms that invested in ERP systems reveals how organizational integration modes need to be aligned with ERP systems for positive results from the ERP investment. Organizational integration modes refer to simultaneously used methods — people, standardization, and centralization — by which an organization coordinates and controls the activities of different departments within the same organization. The degree of alignment between ERP and integration modes is determined by the clarity of the ERP objectives, and positive results in terms of operational efficiency are correlated with the degree of alignment between ERP and these three integration modes.

**Keywords:** Enterprise resource planning systems; Clarity of ERP objectives; Integration modes.

## I. INTRODUCTION

The enterprise resource planning (ERP) system makes promises that it will enable organizations to integrate information about their entire enterprises seamlessly, including customer orders, production, purchasing, inventory, distribution, human resources, and receipt of payments [7, 16, 32, 34, 51, and 76]. With expectations of such potential benefits, a number of firms throughout the world have made huge investments in ERP systems. This has caused many scholars to examine whether ERP investment indeed produces a positive effect on business performance [9, 14, 23, 35, and 58]. Previous studies, however, have provided somewhat conflicting results on this issue: Some showed that ERP investment improved overall business performance [4], while others showed that ERP investment enhanced business performance only in specific areas [14 and 35]. These mixed findings imply that ERP investment does not always yield positive effects on business performance, leading us to adopt a contingency perspective on its effectiveness.

The purpose of this study is to examine the conditions under which ERP investment has a positive influence on business performance. In particular, the alignment between an ERP system and organizational integration modes (hereafter referred to as “ERP alignment”), which is the state where a firm achieves a proper fit between the nature and requirements of its ERP system and the arrangement of its organizational integration modes, plays a central role in our model. Organizational integration

modes refer to methods by which an organization simultaneously coordinates and controls the activities of different departments within the same organization, using primarily the modes of people, standardization, and centralization [3, 11, 13, 21, 48, 52, and 65].

Despite the importance of ERP alignment, few studies have investigated the ideal profile of alignment between ERP and organizational integration modes. We believe that such an investigation is important since ERP is likely to have an enormous impact on the integration modes of an organization [9 and 50]. Each integration mode used by a firm must adapt to the requirements of ERP so the firm successfully introduces and implements the ERP system [39, 63, and 66]. For example, the need for face-to-face interaction among organization members may well decrease following ERP investment because once information is entered into the ERP system, all departments in need of that information can access it in real time [20]. ERP investment may also increase standardization and centralization because organizational practices and processes should be modified to best practices available in ERP and because ERP can provide information about organization-wide activities to headquarters and executives in almost real time.

In addition, this study proposes that the clarity of ERP objectives is one of the primary factors that determine the degree of ERP alignment. A firm with a well-clarified ERP objective has a better understanding of the functional characteristics of the system and, thus, is likely to achieve a better ERP alignment [8 and 22]. In reality, a number of firms have invested in ERP systems for poorly examined reasons, such as to obey the government's policy or simply to follow the ERP investment made by partners or competitors. Such organizations, which are simply riding on the bandwagon, are likely to have no specific objectives for adopting ERP, which makes it difficult or impossible to achieve proper ERP alignment. As a result, there should be a substantial difference in the pattern of integration modes between those with well-formulated ERP objectives and those without such objectives. It is further expected that such a difference in ERP alignment will result in different business performance.

The paper is structured as follows: Section II describes the characteristics of ERP systems and the research issues; Section III defines the study's critical concepts—such as the clarity of ERP objectives, ERP alignment, and business performance—and develops hypotheses about causal relationships between these critical concepts; Section IV describes the research context and methodology, which is followed by empirical results in Section V; Section VI discusses the findings and their implications; and Section VII concludes the paper.

## II. CHARACTERISTICS OF AN ERP SYSTEM

Legacy information systems have long been criticized for lack of integration and for isolated focus on certain functions. In these older systems, the same information is collected and processed multiple times in different places, and it is often hard to retrieve the right piece of information in real time. When these legacy systems were created, tasks and processes were often narrowly defined in concert with the division of labor. Information remained as a local good, resulting in information asymmetries between different locations, functional groups, and parts of the organizational hierarchy. ERP helps an organization overcome such problems by implementing standard, enterprise-wide processes and databases [9 and 55]. Since the ERP system is based on best practices — i.e., the best way of doing each process — any firm that installs such a system has access to a wide range of best practices [27 and 55].

The definition and scope of ERP varies among scholars. For example, Wylie [75] defined ERP as a set of applications designed to bring business functions into balance. Markus, Tanis and Fenema [47] asserted that ERP integrates inventory data with financial, sales, and human resources data, enabling organizations to price their products, produce financial statements, and manage their people, materials, and money resources better. Kumar and Hillegersberg [33] defined ERP as an information system package that integrates information and information-processing processes within and across functions in an organization. This study uses a more generic definition of ERP to encompass the core aspects of previous studies' definitions as much as possible, defining ERP as a set of applications that support the efficient operation of business resources, and integrate and manage the general requirements of a firm.

An ERP system has four main characteristics [12]. First, ERP can be regarded as a multinational system, since it contains the national laws and representative businesses of various countries. Second, reference models in the ERP system embody best business practices; the reference models supposedly reflect the most preferred business models in terms of the data employed and business processes, as well as organizational structures. Third, because ERP integrates all business processes of an organization with one database, all departments throughout the organization can access the same information in real time. Fourth, the parameters of ERP provide room for a firm to be able to customize the system to fulfill its specific circumstances.

## III. THEORY AND HYPOTHESES

### 3.1. ERP alignment

In order to develop hypotheses regarding the effect of ERP on business performance, we need to operationalize the concept of IT alignment in terms of the ERP context. Insights are available from strategic alignment theory. According to this theory, a firm's business performance improves as the firm achieves better fit among its business strategy, its information system strategy, its organization infrastructure, and its information system infrastructure [24, 37, 38, 43, 61, 68, 62, and 74]. Among these four components, ERP alignment relates to the alignment between organizational infrastructure and information system infrastructure; it refers to a state in which an organization appropriately changes its use of integration modes to meet the requirements of its ERP system so it harmoniously utilizes its new

information system and existing integration modes for internal coordination and control.

An organization strives to maintain internal consistency, where organizational elements are well aligned with one another. Organizations may deviate from that equilibrium temporarily, but must quickly pursue a new internal consistency to overcome the chaotic state [9 and 35]. For example, following its adoption of a new information system, an organization deviates from an internally consistent state since it has difficulty aligning the new system with existing organizational elements in the beginning and it needs time to proceed to the alignment. The magnitude of such chaos will be significant with a new system like ERP because its impact is organization-wide [9 and 35]. A new equilibrium will be realized once integration modes fit the characteristics and requirements of ERP [15].

Organizational integration refers to coordination and control of the business activities of departments to accomplish the entire organization's objectives [7, 36, 46, and 65]. Based on a review of the coordination and control literature [3, 11, 13, 21, 36, 48, 52, and 65], three specific integration modes can be identified: people-based, standardization-based, and centralization-based.

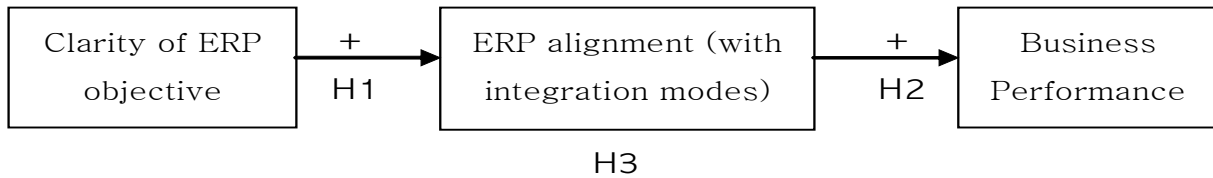
People-based integration coordinates and controls the activities of departments by relying on face-to-face interactions among organization members [6, 7, 45, and 60]. People-based integration includes meetings and committees among organization members. Implementing ERP can decrease an organization's need for personal contact to coordinate and control the activities of departments [20] since, once information is entered into the ERP system, all departments in need of that information can access it in real time. Therefore, firms that invest in ERP may well reduce the frequency of people-based integration while maintaining a state of internal consistency.

Standardization-based integration coordinates and controls the activities of departments by formalizing the way to perform activities across departments. This integration mode relies on standardized work procedures, rules, and policies [6, 7, and 45]. The effectiveness of standardization-based integration increases as the process of conducting specific activities is codified, which depends on the ability to structure specific activities into a set of identifiable procedures, rules, and formulas. This integration mode is consistent with coordination by standardization [65] and bureaucratic control [3 and 6]. The need for standardization-based integration may well increase in an organization after it adopts ERP, since the system is a package of standardized best business practices [30].

Centralization-based integration coordinates and controls the activities of departments based on hierarchical authority [6, 7, and 45], where conflicts between departments are resolved by higher-ranked managers [71]. Conflicts between departments are likely to increase after an organization adopts ERP because the system requires adoption of cross-functional working processes [9]. Therefore, implementation of ERP is associated with increased intervention and coordination by higher-level managers, which implies increased centralization.

In summary, then, an internally consistent state maintained by a firm will be upset at least temporarily after it adopts an ERP system, because the ERP system has an enormous influence on the working processes and integration modes of an organization. However, the firm will reach a new internally consistent state as soon as it aligns integration modes to the characteristics and requirements of ERP. In doing so, the firm decreases the

Figure 1. The research model



use of people-based integration and increases the reliance on standardization and centralization-based integration. Figure 1 depicts the model employed in this research.

### 3.2. The effect of clarity of ERP objective on ERP alignment

As we have discussed, the introduction of ERP requires an organization to change its usage level of various integration modes. An organization can reach an internally consistent state as it achieves a new alignment between ERP and the integration modes; however, this is accomplished at different rates of speed after investment in ERP, and some organizations achieve better fit than others. The achievement of ERP alignment should depend on whether an organization had a well-formulated objective for investing in the ERP system. Hence, it is proposed that the better clarified the firm's ERP objective, the better the eventual ERP alignment.

Since an organization adopts an information system like ERP as a means of achieving a strategic goal, the objective should be formulated consistent with the strategic goal of the organization [5, 24, 38, and 43]. Therefore, an organization with a well-formulated ERP objective means will properly understand not only the roles of ERP in achieving its strategic goal, but also the impacts of the system on other organizational components. To illustrate this argument, consider a firm following a low-cost strategy. If it has a solid strategic sense, the main purpose of the ERP system would be to reduce operating costs as much as possible. In that case, the system will be expected to change tasks and processes to make them more efficient, and perhaps to make some redundant and unnecessary. With a clear objective, the company will take into account such impacts and will develop a plan to eliminate unnecessary tasks and processes while preparing for its ERP investment. In contrast, if a company adopts a new ERP system without a well-formulated objective, the company probably does not clearly understand the role of the system or its likely effects on other components. In this case, unnecessary tasks and processes will still remain even after the ERP implementation.

Therefore, it can be argued that an organization which clearly recognizes the objective in adopting an ERP system, changes organizational integration modes in accordance with the characteristics and requirements of the ERP system [8 and 22]. Conversely, firms jumping on the bandwagon without a well-formulated ERP objective will overlook the effects of the system on other organizational elements.

*Hypothesis 1: The clarity of the ERP objective has a positive effect on ERP alignment.*

### 3.3. The effect of ERP alignment on business performance

Prior research has proposed that, in order to implement IT properly, a firm must modify organizational elements, including

the usage level of integration modes, according to the requirements of the IT system in which it has invested [19]. Applying these arguments to the present research, the usage level of a firm's integration modes should correspond to the nature of its ERP systems. For example, the usage level of people-based integration should decline if ERP is properly implemented in the organization, so increases in coordination by people-based integration after the introduction of ERP signify that the system is not properly implemented in that organization. Likewise, no change or decrease in the degree of standardization-based integration after ERP has been adopted implies inappropriate operation of the system within the organization. The same argument applies to the reliance on centralization-based integration following ERP investment.

Relying on previous studies' contention that IT alignment has a positive effect on business performance [19], it is reasonable to expect that, the better the ERP alignment with integration modes within an organization, the better its business performance. Therefore, the following hypothesis is proposed:

*Hypothesis 2: ERP alignment has a positive effect on business performance.*

### 3.4. Clarity of ERP objective and business performance through ERP alignment

If an organization adopts ERP without a well-formulated objective, it is unlikely to gain the expected benefits from the system. Some firms adopt an IT-based system like ERP without clearly recognizing the objective and characteristics of the system, and many have a tendency to invest in an IT system simply because others do [1, 25, 28, 31, 41, 42, and 54]. Such irrational adoption of IT is more likely to end up a failure than a success [1], so it is important for an organization to develop a well-formulated ERP objective in order to attain the expected benefits of the system.

In general, firms with clear recognition of their ERP objectives can better understand the roles, characteristics, and requirements of the system than firms without such recognition; they are also better at figuring out the effects of the system on the various parts of their organization. As a result, a firm with a well-formulated ERP objective is more likely than a firm without such an objective to properly tune the use of integration modes to the characteristics and requirements of the ERP system and, therefore, to accomplish better alignment between ERP and integration modes [8 and 22]. It can be argued, all else being equal, the better clarified the ERP objective, the better the alignment between the ERP system and integration modes, and the better the business performance. This leads to the following hypothesis:

*Hypothesis 3: The level of ERP alignment mediates between the clarity of ERP objectives and business performance.*

## IV. RESEARCH METHODOLOGY

### 4.1. Research context

The ERP market in Korea was chosen as the context for this research. This choice was motivated by the need to collect a sufficient number of observations for an empirical analysis while controlling for the potential effects of institutional differences across nations.

An ERP system was first implemented in Korea by Samsung Electronics Corporation in 1994, and such systems have since been used in a wide range of industries, including distribution, finance, manufacturing and telecommunications. The ERP market, which consists of both domestic and foreign ERP products, is one of the fastest growing IS markets in Korea. Many Korean firms prefer foreign ERP products because of their high brand recognition in the market, and most large domestic system integration companies tend to work as agents for popular foreign ERP products [40]. Consequently, more than 80% of the Korean ERP market has been captured by four large foreign producers: SAP, Oracle, SSA, and BAAN. In the meantime, domestic ERP vendors have customized traditional MIS packages to target ERP niche markets where expensive foreign products cannot fit well into the unique Korean business environment [64].

Recently, the Korean government has played an important role in prompting small- and medium-sized domestic firms to implement ERP. The government has organized a task-force group to support IS implementation in such firms and has announced a policy of financial support for the implementation of 30,000 ERP systems among them.

Interviews and site visits have shown that Korean companies have adopted ERP systems with different degrees of clarity about their ERP objectives. Some firms introduced ERP without any specific objectives, simply relying on the reports of ERP consulting firms that emphasized the positive aspects of their ERP solutions. The Korean IT market has witnessed a burst of popular IT solutions whose fancy buzzwords quickly became everyday terminology. Consulting firms offered seminars about ERP, and presented an ERP exhibition in May 1999 to promote attention to ERP. This artificial trend has worked as the main driver for the popularity of IT solutions. In contrast, some organizations had relatively clear objectives related to productivity enhancement.

Globalization has accentuated Korean firms' need for the standardization and integration of their localized businesses and has worked as a major motivator for their adopting ERP systems. Many domestic firms hoped to revolutionize their internal business processes by importing the business processes embedded in ERP systems. These ERP adopters wanted to benchmark foreign advanced business processes through business process reengineering (BPR) projects, and they thought ERP to be the right solution.

Some user companies have expressed regret that they did not pay sufficient attention to organizational changes in relation to the adoption of ERP systems. Most were aware that they could improve internal communications and integrate data resources by implementing ERP systems; however, they were not effective in redefining their organizational structures and the role of each function within the structures. This led to mediocre integration or insufficient changes in organizational integration modes.

### 4.2. The sample and data collection

The sample consisted of Korean firms that had invested in ERP systems during the period 1998- 2001. Considering the expected lags involved in the effect of ERP investment on business performance, the study focused on firms that had implemented ERP for more than a year as of 2002. To identify sample firms, we relied on various sources of information, including academic journals published by the Korean Information Processing Society and the Korean Information System Academic Society; periodicals such as *Software Industry*, *Chief Information Officer* and the *Weekly Economist*; industry magazines published by major Korean ERP consulting companies; and the homepages of ERP vendors like SAP Korea and Oracle. Based on a thorough review of such data sources, 341 firms were identified as the target sample firms.

The primary data source was a structured questionnaire, for which most of the measurement items were adopted from previous studies. To avoid losing any meaning in the translation process, we independently repeated translation between Korean and English and cross-validated our translated items. An interview-based pre-test with the IS executives of two sample firms verified the content validity of our questionnaire items.

Before mailing out the questionnaire, we made phone calls to each of the 341 firms to explain the research objectives and to establish their willingness to fill in the questionnaire. After this preliminary screening, the questionnaire was mailed 191 firms — specifically, to the executives who played the most critical role in introducing ERP systems into their companies and who had agreed to fill out the questionnaire. If no reply had been received after two weeks, the potential respondent was telephoned to ask them to cooperate in the research. Eventually, 124 responses were obtained. When non-response bias was examined, no significant differences were found between respondents and non-respondents with respect to number of employees, total sales, and industry type. However, of the 124 responses, 8 had to be excluded — three for incomplete data and five because their companies had implemented ERP for less than a year. In the end, 116 questionnaires remained as the sample for this study.

### 4.3. Measurement of variables

In this section, we introduce the measures for all the constructs in our research model. In the next section, we introduce the pattern analysis, which is the main methodology for the hypothesis test.

#### 4.3.1. Measures for the clarity of ERP objective

Five items were developed to measure the clarity of a firm's ERP objectives. Two of the five items measured the degree of clarity of the *general* objective for ERP implementation on a seven-point Likert scale: (1) "Did your company develop a well formulated ERP objective when investing in that system?" and (2) "Did your company invest in ERP mainly due to the ongoing trend of other firms' investment in that system?" Three items were developed to measure the degree of clarity of the *specific* objectives for ERP implementation on a seven-point Likert scale. Based on the typology of Weill [73], the specific ERP objectives were classified as transactional, strategic, or informational objectives. Since ERP can serve all three types of specific objectives simultaneously, respondents were asked to rate the

degree of clarity of their firm's ERP objective in terms of each of the types of specific ERP objectives.

The item, "Did your company invest in ERP mainly due to the ongoing trend of other firms' investment in that system?" was eventually excluded from the analysis because this item degraded the reliability of the measure of clarity of the ERP objective. With this item excluded, the Cronbach's alpha of the other four items was 0.76, which exhibits an appropriate level of reliability. Factor analysis was also employed to check the construct validity of the four items that were included. Principal component analysis was used with the varimax rotation. The result showed that all the measures exhibited the appropriate level of validity since all the items were well loaded on a single factor with an eigen value of 2.29.

#### 4.3.2. Measurement of ERP alignment

ERP alignment was defined above as a state in which an organization appropriately changes its use of integration modes to meet the requirements of its ERP system so it harmoniously utilizes its new information system and existing integration modes for its internal coordination and control. This definition suggests that changes in integration modes should be appropriate to the requirement of an ERP system.

ERP alignment was measured using the following procedure. In the first step, the change in the usage level of integration modes was measured on a seven-point scale for the people-based, standardization-based, and centralization-based modes<sup>1</sup>. The change in the use of people-based integration was measured by four items: (1) change in the number of meetings between departments; (2) change in the frequency of face-to-face interactions between departments; (3) change in the number of committees; and (4) change in the number of departments integrated. These measures were adopted from the work of Roth et al. [60], Grover [20], and Daft [7]. The change in the use of standardization-based integration was measured by three items: (1) change in the number of rules and procedures; (2) change in the extent to which tasks are standardized; and (3) change in the number of standardized work procedures and manuals. These measurements were adopted from the work of Ghoshal and Nohria [17], Malnight [45], and Daft [7]. The change in the use of centralization-based integration was measured by four items: (1) change in the extent of top management's involvement in gathering information for decision making; (2) change in the degree of top management's involvement in information interpretation; (3) change in the extent of top management's supervision of departments; and (4) change in the degree of top management's control in implementing decisions. These measures were adopted from Miller and Friesen [49], and Robbins [59]. Results from the estimation of Cronbach's alpha revealed an appropriate level of reliability (all Cronbach's alphas greater than 0.70). Further, the results of factor analysis showed that all the items were loaded on each expected latent factor with all the eigen values greater than 1 (3.34 for people, 2.75 for standardization, and 1.38 for centralization).

In the second step, a new construct, the integration effectiveness of ERP (hereafter referred to as "ERP integration"), was measured. This construct shows how effectively the ERP system is integrated with other systems (both online and off-line) for internal coordination and control. For this construct, three questions were developed assessing (1) "the extent that ERP contributes to the integration of an organization," (2) "the

perceived usefulness of ERP," and (3) "the degree that ERP helps an organization achieve organizational objectives." Respondents were asked to rate these three items on a seven-point scale, from "never effective" to "very effective." The reliability of these items was confirmed, since the Cronbach's alpha was estimated as 0.89. These items also secured a high level of validity, since all the items were loaded on a single factor with an eigen value of 1.30.

In the third step, pattern analysis, which is widely used to measure the degree of fit between variables [18, 53, 67, and 69], was applied to estimate the degree of ERP alignment.<sup>2</sup> The pattern analysis involved three phases. First, multiple regression analysis was performed with changes in the usage level of integration modes as the independent variables and ERP integration as the dependent variable. Second, based on the results from the regression analyses, a set of firms was identified which had ideally aligned ERP with integration modes; from these, we estimated the ideal change in integration modes. Finally, for each sample firm, the Euclidean distance between its change in integration modes and the ideal change in integration modes was estimated, and the distance was used as the level of ERP alignment for the firm. The less the distance from the ideal changes in integration modes, the closer the firm was to the ideally aligned firms, and the better the alignment between its ERP and integration modes. More specifically, ERP alignment was operationalized as follows:

$$\text{ERP alignment} = -\sqrt{\sum_{s=1}^3 [b_s (X_k - X_j)]^2}$$

where  $X_{is}$  = the average change of ideally (I) aligned firms'  $s^{\text{th}}$  integration mode;  $X_{js}$  = the change in the  $j^{\text{th}}$  sample firm's  $s^{\text{th}}$  integration mode;  $b_s$  = the standardized regression coefficient for the change in the  $s^{\text{th}}$  integration mode reported in Table 2; and,  $s = 1$  to 3 represent the three integration modes.

#### 4.3.3. Business performance

Business performance was measured only in terms of operational efficiency. Supporting our judgment to do so, Ash and Burn [2], Laughlin [35], Mabert, Soni and Venkatraman [44], and Somers and Nelson [63] reported the empirical findings that ERP enhanced the efficiency and productivity of a firm. Through a survey of Swedish manufacturing firms, Olhager and Selldin [56] found that the most cited improvements related to ERP are concerned with information access and intra-organizational

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1. Scales are as follows: -3: very much decreased, -2: moderately decreased, -1: slightly decreased, 0: neutral, 1: slightly increased, 2: moderately increased, 3: very much increased.
  2. Our measure of alignment corresponds to "fit as profile deviation" in the typology of Venkatraman [70], who classified the types of fit into six categories: fit as moderation, fit as mediation, fit as matching, fit as covariation, fit as profile deviation, and fit as gestalts. He suggested that fit as profile deviation is the most appropriate when multiple variables are simultaneously examined and the concept of fit is anchored to a particular criterion like effectiveness. Our study satisfies these conditions since it examines multiple integration modes simultaneously and investigates the relationship between ERP alignment and business performance.

**Table1. Descriptive statistics of variables**

Variables	Mean	Std. dev.	Correlation											
			1	2	3	4	5	6	7	8	9	10		
1. Clarity of ERP objectives	5.03	0.89												
2. ERP alignment	-0.65	0.32	.231*											
3. Inventory cost	5.39	1.07	-.316**	-.241*										
4. Purchasing cost	5.25	1.11	-.188	-.239*	-.121									
5. Process cycle time	5.25	0.98	-.247	-.331**	-.133	-.425**								
6. ERP size	5.91	2.01	.058	-.040	-.031	.076	.051							
7. ERP customization	3.73	1.94	-.024	.019	.128	-.059	-.085	.130						
8. ERP operating period	35.77	12.18	.046	-.006	.078	.115	.001	-.320*						
9. ERP maintenance efforts	5.51	1.68	.409**	.178	.151	.391**	-.068	-.233*	-.183	-.172				
10. IT conversion effectiveness	5.36	1.52	.611**	.209	.272*	.406*	-.282**	-.249*	-.012	-.084	.215*			
11. Firm size	3478	7933	-.014	-.175	-.082	.239*	.051	.108	-.198	-.015	-.184	-.170		

\*p<0.05; \*\*p<0.01.

interaction, both of which are related to organizational efficiency, rather than profitability. Hitt et al. [26] also pointed out improved information flow as the major benefit of ERP systems and, ironically, cautioned that the business performance could be reduced shortly after the implementation of ERP is complete. In our study, operational efficiency was measured by (i) inventory cost, (ii) purchase cost, and (iii) process cycle time.<sup>3</sup> For the convenience of interpretation, these measures were reverse-scaled, since the smaller number implies better efficiency.

Since it is possible that respondents would hesitate to reveal confidential business performance information, they were asked to choose one category among seven, which best described their business performance. The reliability of the efficiency items was estimated as 0.73. Factor analysis showed that all the items were well loaded on a single factor with an eigen value of 1.33. Hence, the measure of business performance was considered to exhibit appropriate levels of reliability and validity.

#### 4.3.4. Control variables

Eight control variables were incorporated into our empirical model. *ERP size* was measured by the number of ERP modules, while the *degree of ERP customization* was measured by both the proportion of modified modules and the length of time required for the customization. Both ERP size and ERP customization were measured on seven-point scales. *Experience with ERP* in terms of operating period and maintenance efforts may have some influence on both ERP alignment and business performance. The *ERP operating period* was measured in terms of the months which had passed since ERP first started to run in an organization. The *ERP maintenance effort* was measured on a seven-point scale from “no effort at all: to “extensive effort.” In addition, the *IT conversion effectiveness* of an organization, which is its ability to convert its IS investment into valuable outputs [73], was also

controlled for. Following Weill’s [73] suggestion, IT conversion effectiveness was measured on a seven-point scale in terms of the extent of top management’s support for ERP implementation. Further, *firm size*, measured by sales volume (unit: 100 million won), was controlled for. Finally, the *industry environment* for each organization was controlled for, since the potential profitability of the industry can influence firm performance [10]. Such industry effects were controlled for by employing dummy variables in the empirical model. Table 1 provides descriptive statistics and correlations for all the variables used in this study.

#### 4.4. Method of analysis

Multiple regression analyses were conducted to test the hypotheses. In testing Hypothesis 1, ERP alignment was regressed against the clarity of ERP objectives and the control variables; the coefficient of the clarity of ERP objectives must be positive to support Hypothesis 1. In testing Hypothesis 2, business performance was regressed against ERP alignment and the control variables; the coefficient of ERP alignment must be positive to support Hypothesis 2. In testing Hypothesis 3, a hierarchical regression analysis was conducted in three steps. In the first step, business performance was regressed against the clarity of ERP objectives and the control variables to see whether the clarity of ERP objectives directly influenced business performance. In the second step, business performance was regressed against ERP alignment. In the final step, business performance was regressed against both the clarity of ERP objectives and ERP alignment, along with the control variables. This hierarchical regression analysis allowed an examination of whether ERP alignment mediates between the clarity of ERP objectives and business performance.

### V. RESULTS

#### 5.1. Test of Hypothesis 1

Pattern analysis was conducted to test Hypothesis 1. As mentioned above, the pattern analysis involved three steps. Table

3. The process cycle time is the period from when raw materials are provided by suppliers to when end products are provided to customers.

**Table 2. Phase 1 results of pattern analysis**

Independent variables	Dependent variable: ERP Integration
Usage of people-based integration	-.281 (-2.474)**
Usage of standardization-based integration	.261 (2.592)**
Usage of centralization-based integration	.284 (2.497)**
Constant	2.085 (2.178)**
R <sup>2</sup>	.157
Adjusted R <sup>2</sup>	.128
F-statistic	5.345***

The numbers in the parentheses are t-values.

\*p<0.10; \*\*p<0.05; \*\*\*p<0.01.

2 presents results from the first step, where ERP integration was regressed against changes in the usage level of integration modes. As expected, the change in the usage level of people-based integration was estimated as negative ( $p<0.05$ ), whereas the changes in the use of both standardization-based and centralization-based integration were estimated as positive ( $p<0.05$  for both modes). These results suggest that a firm can increase ERP integration when it decreases people-based integration, while it simultaneously increases standardization-based and centralization-based integration.

In the second step, a set of “ideally aligned” firms was identified, and the average change in their integration modes was estimated using the results of Table 2. By definition, ideally aligned firms must reveal a sufficiently high score for ERP integration, and their use of integration modes must have a fairly high degree of explanatory power for their ERP integration. To identify a sufficient number of ideally aligned firms among the sample firms, the two conditions were interpreted in specific ways. For the first condition, a sub-sample of firms was selected whose predicted ERP integration was greater than 5.0. (7.0 is the highest score.) For each firm, the predicted ERP integration was then estimated based on the regression results presented in Table 2. To operationalize the second condition, sample firms were selected whose deviation from the regression line in Table 2 was smaller than 0.35 in absolute magnitude. A smaller deviation from the regression line implies a stronger relationship between changes in integration modes and ERP integration. As a result, eight firms were selected that met both conditions simultaneously<sup>4</sup> and were,

4. *The profile for ideally aligned firms could be generated either empirically or theoretically [67]. We generated it empirically since it was not easy to develop a clear-cut, theoretical profile for ideally aligned firms. Generally, the empirical approach estimated the ideal profile from approximately the top 10% of sample firms. Hence, we operationalized our criteria to secure approximately the top 10% of our sample as ideally aligned firms.*

therefore, regarded as ideally aligned firms in the sample. The average change in each integration mode was estimated for these ideally aligned firms; on average, the firms decreased their use of people-based integration by 0.25, increased their use of standardization-based integration by 1.63, and increased their use of centralization-based integration by 1.13. This set of changes in integration modes was then defined to be the “ideal changes in integration modes.”

In the third step, for each sample firm, the Euclidean distance between a firm’s changes in integration modes and the ideal changes in integration modes was estimated. Having done the pattern analysis, regression analysis was then applied to test Hypothesis 1, the results of which are reported in Table 3. Model 1 presents insignificant effects of the control variables on ERP alignment. Model 2 shows that the clarity of ERP objectives was estimated as 0.250 ( $p<0.10$ ). However, since the overall significance of Model 2 was fairly low ( $F=0.831$ ,  $p>0.20$ ) due to the inclusion of too many insignificant control variables, a Model 3 regression was conducted which excluded the control variables from Model 2. The F value became significant, and the clarity of ERP objectives was estimated as positive ( $p<0.05$ ) in Model 3. This result suggests that an organization with a well formulated ERP objective achieves a better ERP alignment. Therefore, this result provides support for Hypothesis 1.

## 5.2. Test of Hypothesis 2

Table 4 contains the results of testing Hypothesis 2, which revealed that ERP alignment had a positive relationship to purchase cost and process cycle time, but it did not have a significant relationship to inventory cost. ERP alignment was estimated as -0.232 ( $p<0.05$ ) in the regression model with the dependent variable of purchase cost, while it was estimated as -0.224 ( $p<0.05$ ) in the regression model with the dependent variable of process cycle time. These results indicate that an organization is likely to notice both an improvement in purchase cost and a shorter process cycle time as it accomplishes better ERP alignment. Therefore, Hypothesis 2 is partially supported.

**Table 3. Test of hypothesis 1**

Independent variables	Dependent variable: ERP alignment		
	Model 1	Model 2	Model 3
Clarity of ERP objectives		.250* (1.786)	.229** (2.187)
ERP size	-.063 (-.595)	-.056 (-.508)	
ERP customization	.085 (.766)	.099 (.981)	
ERP operating period	-.018 (-.162)	-.020 (-.189)	
ERP maintenance efforts	.028 (.230)	-.035 (-.270)	
IT conversion effectiveness	.130 (1.03)	-.009 (-.062)	
Firm size	.019 (.156)	.048 (.420)	
Constant	-.792*** (-4.352)	-1.002*** (-4.660)	-1.005*** (-5.937)
R <sup>2</sup>	.031	.063	.055
Adjusted R <sup>2</sup>	-.042	-.011	.043
F-statistic	.422	.831	4.748**

The numbers in the parentheses are t-values.

\*p<0.10; \*\*p<0.05; \*\*\*p<0.01.

### 5.3. Test of Hypothesis 3

Hypothesis 3 states that ERP alignment mediates between the clarity of ERP objectives and business performance. Testing this hypothesis requires support for Hypotheses 1 and 2. Therefore, Hypothesis 3 was tested only for the two efficiency measures (i.e., purchasing cost and process cycle time). The results of hierarchical regression analyses on purchase cost and process cycle time are presented in Table 5.

Table 5 reveals that ERP alignment partially mediates the influence of the clarity of ERP objectives in terms of both purchase cost and process cycle time. Results from the first step of the hierarchical regression analysis show that the clarity of ERP objectives had significant negative effects on both purchase cost and process cycle time. These results indicate that an organization can increase efficiency to a higher level when it has a better-clarified ERP objective. Results from the second step of the hierarchical regression analysis were basically the same as those reported in Table 4, showing that 'ERP alignment' has a significant, positive relationship with the two efficiency measures. Results from the third step of the hierarchical regression analysis show that both the antecedent (i.e., clarity of ERP objectives) and the mediating variables (i.e., ERP alignment) were estimated as significant. These results imply that 'ERP alignment' plays a partial mediating role between the antecedent variable and each of the efficiency variables. Hence, the results

from the hierarchical regression analysis provide partial support for Hypothesis 3.

Finally, a sensitive analysis was conducted to see whether the findings are robust. Recall that in identifying "ideally aligned" firms among the sample, firms were selected that met simultaneously two conditions. Ideally aligned firms had (i) a predicted 'ERP integration' greater than 5.0 and (ii) the absolute magnitude of the difference between the actual and predicted 'ERP integration' less than 0.35. The levels of these selection criteria were modified, and the hypothesis tests were repeated to examine the robustness of the results.

The results of the sensitivity analysis are summarized in Table 6. Five cases were examined. Case I corresponds to the initial operationalization. Case II lowers the level of predicted integration effectiveness of ERP to 4.5 while maintaining the magnitude of the difference between actual and predicted integration effectiveness. Table 6 presents highly consistent results, regardless of the changes in the levels of the selection criteria.

## VI. DISCUSSION AND CONCLUSION

This study found that an organization needs to properly align its ERP system with non-IS integration modes for being a successful implementer of ERP. An ERP system is not just a pure software package to be tailored to an organization but an

**Table 4. Test of hypothesis 2**

Independent variables	Dependent variables		
	Inventory cost	Purchase cost	Process cycle time
ERP alignment	.026 (.244)	-.232** (-2.143)	-.224** (-1.978)
ERP size	-.060 (-.483)	.086 (.651)	-.253** (-2.007)
ERP customization	.136 (1.279)	-.078 (-.725)	.234** (2.227)
ERP operating period	-.211* (-1.854)	-.311*** (-2.694)	-.124 (-1.112)
ERP maintenance efforts	-.104 (-.947)	-.172 (-1.543)	-.115 (-1.032)
IT conversion effectiveness	-.182 (-1.512)	.076 (.655)	.072 (.592)
Firm size	-.106 (-.973)	-.234** (-2.159)	-.062 (-.565)
Telecommunications industry	-.024 (-.121)	-.143 (-.691)	-.065 (-.319)
Electricity & electronics industries	-.013 (-.063)	-.346 (-1.456)	-.157 (-.651)
Machinery & metals industries	-.169 (-.574)	-.214 (-.733)	-.135 (-.473)
Pharmaceuticals industry	-.202 (-.814)	-.222 (-.887)	.072 (.293)
Chemicals industry	-.165 (-.861)	-.187 (-.979)	-.225 (-1.168)
Food & Drinks industry	-.066 (-.258)	-.143 (-.576)	-.078 (-.294)
Other manufacturing industries	-.063 (-.339)	-.054 (-.381)	-.064 (-.391)
Trade, wholesale & retailing industries	-.244 (-1.319)	-.047 (-.257)	-.278 (-1.489)
Finance & insurance industries	.082 (.337)	-.299 (-1.363)	.059 (.241)
Other services industries	-.099 (-.505)	-.084 (-.437)	-.061 (-.323)
R <sup>2</sup>	.295	.305	.297
Adjusted R <sup>2</sup>	.134	.139	.133
F-statistic	1.817**	1.830**	1.804**

The numbers in the parentheses are t-values.

\*p<0.10; \*\*p<0.05; \*\*\*p<0.01.

IS infrastructure that affects how organization members work. As such, just adopting a new information system cannot be a sufficient condition for being a successful implementer. A firm is unlikely to obtain expected benefits from ERP implementation without company-wide efforts to adjust the usage level of non-IS integration mechanisms among its organizational members.

The study has shown that the degree of 'ERP alignment', that is determined by the extent to which the ERP objectives are well-formulated. This result indicates that those firms with well-formulated ERP objectives are more likely than those without such objectives to realize better alignment between ERP and integration modes.

**Table 5. Test of hypothesis 3**

Independent variables	Dependent variable: Purchasing cost			Dependent variable: Process cycle time		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Clarity of ERP objectives	-.256* (-1.823)		-.241* (-1.759)	-.253* (-1.811)		-.243* (-1.750)
ERP alignment		-.232** (-2.143)	-.219* (-1.962)		-.224** (-1.978)	-.201* (-1.811)
ERP size	.114 (.899)	.086 (.651)	.061 (.492)	-.226* (-1.819)	-.253** (-2.007)	-.271** (-2.179)
ERP customization	-.107 (-1.007)	-.078 (-.725)	-.097 (-.908)	.205* (1.939)	.234** (2.227)	.218** (2.078)
ERP operating period	-.281** (-2.463)	-.311*** (-2.694)	-.277** (-2.445)	-.104 (-.922)	-.124 (-1.112)	-.113 (-1.001)
ERP maintenance efforts	-.122 (-1.051)	-.172 (-1.543)	-.117 (-.996)	-.066 (-.568)	-.115 (-1.032)	-.059 (-.521)
IT conversion effectiveness	.160 (1.112)	.076 (.655)	.228 (1.563)	.155 (1.089)	.072 (.592)	.216 (1.493)
Firm size	-.262** (-2.349)	-.234** (-2.159)	-.274** (-2.518)	-.091 (-.816)	-.062 (-.565)	-.102 (-.938)
Telecommunication	-.171 (-.823)	-.143 (-.691)	-.177 (-.867)	-.093 (-.452)	-.065 (-.319)	-.103 (-.493)
Electricity & electronics	-.307 (-1.264)	-.346 (-1.456)	-.325 (-1.391)	-.115 (-.482)	-.157 (-.651)	-.137 (-.581)
Machinery & metals	-.195 (-.659)	-.214 (-.733)	-.205 (-.721)	-.117 (-.413)	-.135 (-.473)	-.131 (-.454)
Pharmaceuticals	-.241 (-.958)	-.222 (-.887)	-.231 (-.932)	.052 (.213)	.072 (.293)	.063 (.255)
Chemicals	-.142 (-.757)	-.187 (-.979)	-.212 (-1.123)	-.183 (-.971)	-.225 (-1.168)	-.245 (-1.315)
Food & drinks	-.163 (-.647)	-.143 (-.576)	-.161 (-.659)	-.092 (-.371)	-.078 (-.294)	-.093 (-.382)
Other manufacturing	-.022 (-.153)	-.054 (-.381)	-.055 (-.374)	-.024 (-.171)	-.064 (-.391)	-.054 (-.377)
Trade, wholesale & retailing	-.045 (-.226)	-.047 (-.257)	-.041 (-.223)	-.271 (-1.455)	-.278 (-1.489)	-.272 (-1.473)
Finance & insurance	-.275 (-1.153)	-.299 (-1.363)	-.321 (-1.367)	.075 (.328)	.059 (.241)	.037 (.159)
Other services	-.031 (-.165)	-.084 (-.437)	-.077 (-.415)	-.011 (-.065)	-.061 (-.323)	-.059 (-.312)
R <sup>2</sup>	.293	.305	.333	.292	.297	.328
Adjusted R <sup>2</sup>	.126	.139	.164	.131	.133	.161
F-statistic	1.765**	1.830**	1.952**	1.781**	1.804**	1.922**

The numbers in the parentheses are t-values.

\*p<0.10; \*\*p<0.05; \*\*\*p<0.01.

**Table 6. Results of sensitivity analysis**

**1. Sensitivity analysis for hypothesis 1**

Independent variables	CASE I <sup>a</sup> (n=8)	CASE II <sup>b</sup> (n=12)	CASE III <sup>c</sup> (n=10)	CASE IV <sup>d</sup> (n=6)	CASE V <sup>e</sup> (n=2)
Clarity of ERP objectives	.229**	.195*	.213**	.224**	.312***

The numbers in the parentheses are the number of ideally aligned firms.

\*p<0.10; \*\*p<0.05; \*\*\*p<0.01

<sup>a</sup> ERP integration > 5.0 & Deviation distance from regression equation < 0.35

<sup>b</sup> ERP integration > 4.5 & Deviation distance from regression equation < 0.35

<sup>c</sup> ERP integration > 4.8 & Deviation distance from regression equation < 0.45

<sup>d</sup> ERP integration > 5.0 & Deviation distance from regression equation < 0.15

<sup>e</sup> ERP integration > 5.5 & Deviation distance from regression equation < 0.80

**2. Sensitivity analysis for hypothesis 2**

	Dependent variable: Purchasing cost	Dependent variable: Process cycle time
CASE I: ERP alignment	-.232**	-.224**
CASE II: ERP alignment	-.211*	-.199*
CASE III: ERP alignment	-.252**	-.243**
CASE IV: ERP alignment	-.254**	-.247**
CASE V: ERP alignment	-.201*	-.184*

The regression coefficients of the control variables are not reported here due to space constraint.

**3. Sensitivity analysis for hypothesis 3**

Independent variables	Dependent variable: Purchasing cost			Dependent variable: Process cycle time		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
<b>CASE I</b>						
Clarity of ERP objectives	-.256*		-.241*	-.253*		-.243*
ERP alignment		-.232**	-.219*		-.224**	-.201*
<b>CASE II</b>						
Clarity of ERP objectives	-.256*		-.252	-.253*		-.247*
ERP alignment		-.211*	-.201*		-.188*	-.186*
<b>CASE III</b>						
Clarity of ERP objectives	-.256*		-.249*	-.253*		-.247*
ERP alignment		-.242**	-.197*		-.244**	-.169*
<b>CASE IV</b>						
Clarity of ERP objectives	-.256*		-.247*	-.253*		-.243*
ERP alignment		-.253**	-.244**		-.247**	-.241**
<b>CASE V</b>						
Clarity of ERP objectives	-.256*		-.229	-.253*		-.227
ERP alignment		-.203*	-.232**		-.172*	-.223**

The regression coefficients of the control variables are not reported here due to space constraint.

It is found that for being a successful implementer of ERP, a firm needs to reduce its reliance on people-based integration for coordination and control of its work processes. The usage level of people-based integration should decline in order for the ERP system to be successfully implemented by organizational members. Increases in coordination by people-based integration after the adoption of ERP result in poor alignment between ERP and integration modes.

In contrast, it is found that for being a successful implementer of ERP, a firm needs to increase its reliance on standardization- and centralization-based integration after it adopts ERP. Since the ERP system consists of standardized best business practices, a firm needs to encourage its workers to use standardization-based integration more frequently than prior to ERP implementation. A successful implementer of ERP tends to rely on centralization-based integration more than prior to ERP implementation. No change or decrease in the degree of standardization- and centralization-based integration after the adoption of ERP results in poor alignment between ERP and integration modes.

This study has several important implications. In academic terms, this study is the first to examine systematically how a well-formulated objective in implementing IT works for positive results from the IT investment. Analyzing that issue in the ERP context, this study provides empirical support for previous studies' conceptual arguments that emphasized the importance of the clarity of IT objectives [8 and 22]. The finding on this issue is that the clarity of ERP objectives helps solidify the fit between information systems and organizational integration mechanisms. Another academic contribution of this study is in regard to the operationalization of 'ERP alignment'. Further, addressing what IT alignment means in the ERP context, this study provides empirical evidence for the positive effects of 'ERP alignment' on business performance.

As for practical implications, the implementation objective of an ERP system has to be defined clearly. Related efforts include not only establishing and announcing a well-formulated ERP objective, but also transmitting and sharing it among organizational members. Successful implementation of information systems cannot be achieved only through one-sided plans or orders from top management without the active participation of organizational members [57]. Because the content of an information system plays a crucial part in the implementation of that system [29], firms have to facilitate organizational members' sharing of the meaning of the system, and change usage behaviors in a desirable way [72]. Organizational members need to share both the reasons why an organization needs an ERP system and the outcome that it intends to achieve through its ERP investment.

Before concluding this study, we admit the limitations of this research hopefully to provide some directions for future research. First, our sample consists of organizations which have implemented ERP systems not for long period of time, since ERP solutions have been recently introduced in Korea. The effect of ERP implementation on business performance may take a substantial period of time to develop. Hence, it is helpful to validate our finding based on a more extended database. Second, this study found the positive effect of 'ERP alignment' on operational efficiency. Nevertheless, we need to be careful in generalizing our results not only to operational efficiency, but also to the other dimensions of business performance such as survival and profitability. It seems to be fruitful opportunities to conduct further empirical studies along this line of interest.

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