ELSEVIER

Information & Management 40 (2002) 25–40

INFORMATION & MANAGEMENT

www.elsevier.com/locate/dsw

The critical success factors for ERP implementation: an organizational fit perspective

Kyung-Kwon Hong, Young-Gul Kim*

□□□□□□□□ □□□□□□ □□ □□□□□□□□□□□ □□□□□ □□□□□□□□ □□□□□□□□ □□ □□□□□□□ □□□ □□□□□□□□□□ □□□□□□□□
□□□□□□ □□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□ □□□□□ □□□□□□□□ □□□□□ □□□□□

Received 20 May 2001; accepted 1 September 2001

Abstract

Since early 1990s, many firms around the world have shifted their information technology (IT) strategy from developing information systems in-house to purchasing application software such as enterprise resource planning (ERP) systems. IT managers responsible for managing their organization's ERP implementation view their ERP systems as their organizations' most strategic computing platform. However, despite such strategic importance, ERP projects report an unusually high failure rate, sometimes jeopardizing the core operations of the implementing organization. This study explores the root of such high failure rate from an ''organizational fit of ERP'' perspective. Based on the relevant literature, we define the concept of organizational fit of ERP and examine its impact on ERP implementation, together with ERP implementation contingencies. The results from our field survey of 34 organizations show that ERP implementation success significantly depends on the organizational fit of ERP and certain implementation contingencies.

□□□□□□□□ ERP implementation; Organizational fit; ERP adaptation; Process adaptation; Organizational resistance

1. Introduction

Under the pressure to proactively deal with the radically changing external environment, many firms have changed their information system (IS) strategies by adopting application software packages rather than in-house development [12,25]. An application package such as enterprise resource planning (ERP) system is one solution to the information technology (IT) industry's chronic problems of custom system design: reduced cost, rapid implementation, and high system quality [28]. Although application packages have these benefits over custom design of applications, packaged software has problems of their own: uncertainty in acquisition [14] and hidden costs in implementation [29].

In a survey of the IT managers responsible for managing their organization's ERP projects, two-thirds of the respondents viewed their ERP systems as their organizations' most strategic computing platform [47]. Despite such perceived importance, it was reported that three quarters of the ERP projects were judged to be unsuccessful by the ERP implementing firms [13]. What makes ERP implementation so unsuccessful? Swan et al. [46] argued that the root of such high failure rate is the difference in interests between customer organizations who desire unique business solutions and ERP vendors who prefer a

* Corresponding author. Tel.: +82-2-958-3614; fax: +82-2-958-3604.
□□□□□ □□□□□□□□□: kyungkh@kgsm.kaist.ac.kr (K.-K. Hong), domino2@unitel.co.kr (Y.-G. Kim).

0378-7206/02/$ – see front matter
PII: S0378-7206(01)00134-3

generic solution applicable to a broad market. Such conflicting interests led us to explore an organizational fit perspective of ERP implementation.

An important criterion used in selecting an ERP system is the ERP fit with the current business processes [9]. Although the fit between ERP and the organizational context is believed to be critical for successful ERP implementation, few examined the organizational fit issues of ERP empirically. Soh et al. [44] suggested that the organizational fit of ERP might be worse in Asia, because the reference process model underlying most ERP systems is influenced by European or US industry/business practices, which are different from Asian business practices.

The relative invisibility of the ERP implementation process is also identified as a major cause of ERP implementation failures [13]. Markus and Robey [33] attributed such invisibility to the unpredictably complex social interaction of IT and organization. The critical challenge of ERP implementation is believed to be the mutual adaptation between the IT and user environment [49]. Such mutual adaptation process brings the organization's existing operating processes and the packaged software's embedded functionality into alignment through a combination of software configuration and organizational change [49]. But there are conflicting views on which type of adaptation, package adaptation or organizational adaptation, is more desirable in the different contexts.

ERP diffusion agencies including ERP vendors and consulting firms recommend strongly that ERP projects embody the universally applicable 'best practice' and should be implemented without extensive adaptation of the packaged software [1]. In contrast, some academics maintain that the notion of 'best practice' is illusory and potentially disruptive because ERP does not provide models for every process of every industry and most firms usually reconfigure or add new functionality to ERP systems for optimal use within their unique context [46].

Besides, since ERP philosophy is process-based, rather than function-based, ERP necessitates disruptive organizational changes [17,49,50]. Successful ERP implementation must be managed as a program of wide-ranging organizational change initiatives rather than as a software installation effort [18]. Such IT-driven initiatives require change of the organization's socio-technical system, which is intertwined of technology, task, people, structure, and culture [7]. Thus organizational resistance to change is identified as a critical success factor for ERP implementation [26,34]. In this study, we define the concept of organizational fit of ERP and empirically examine its impact on ERP implementation success along with the moderating roles of ERP implementation contingency variables such as ERP adaptation, process adaptation, and organizational resistance.

This paper is organized in five sections. First, ERP related literatures are reviewed. The next section introduces the research model and hypotheses. Research methodology is then described, followed by the presentation of the results. The paper concludes with the discussion of the research findings and implications for future research and practice.

2. Theoretical perspectives

[illegible]

Because of the multiplicity of the organizational dimension, researchers studying IS contingencies have typically focused on the fit between specific organizational dimension and IS [21,23]. In a review of the IS contingency research, Weil and Olson [51] found that over seventy percent of the studies followed a model assuming that the better the fit among the contingency variables, the better the performance. They categorized the contingency variables of interest to IS researchers into strategy, structure, size, environment, technology, task, and individual characteristics.

Attributing the inability to realize value from IT investments to lack of alignment between the business and IT strategies, Henderson and Venkatraman [19] developed the 'strategic alignment model', emphasizing the multivariate fit among business strategy, IT strategy, organizational infrastructure and processes, and IT infrastructure and processes. With an exploratory survey of small business, Marius and Ashok [30] hypothesized that packaged software implementation success is positively associated with the degree of vendor fit with user organization and the degree of software fit with user organization, respectively.

In ERP research, Gattiker and Goodhue [10] suggested that while inter-dependences among sub-units

give rise to better fit of ERP with global operation needs, differentiation among sub-units develop poor fit of ERP with local operation needs. Soh et al. [44] also suggest that ERP misfit stems from the firm-, or country-specific requirements that do not match the capabilities of ERP. Swan et al. [46] argue that organizational misfits of ERP exist due to the conflicting interests of user organization and ERP vendors. Thus, the concept of organizational fit seems to be the core research construct to explain the implementation success in diverse IT implementation contexts. In the ERP implementation context, however, the impact of organizational fit of ERP was not empirically tested. In this paper, based on Markus and Robey [32] definition, we define organizational fit of ERP as the congruence between the original artifact of ERP and its organizational context and will examine its impact on ERP implementation success empirically.

□□□ □□□ □□□□□□□□□□□ □□□□□□□□□□□□

Implementation of a technical innovation is viewed as a dynamic process of mutual adaptation, that is: ''re-invention of the technology and simultaneous adaptation of the organization'' [27]. Adaptation may address the user' procedures, assumption, knowledge, or relationships as well as physical aspects of the technology [48]. In the adaptation stage of IT implementation model, an IT application is developed, installed, and maintained; organizational procedures are revised and developed; organization members are trained both in the new procedures and in the new IT application [4]. The adaptation concept is applicable not only to custom software but also to off-the-shelf packages [34]. Most studies on the implementation of application software packages emphasize the critical nature of the adaptation process [10,14,28].

From the duality perspective of technology, ERP is a ''technological artifact bundling material and symbolic properties in some socially recognizable form (e.g. hardware, software, practice)'' [36]. The adaptation of ERP and organizational processes is an iterative process entailing on-going social action that is clearly constrained by both the structural properties of the organization and the built-in properties of the ERP [50].

There are two alternative approaches to the implementation of a packaged software: package adaptation to organizational needs and organizational adaptation to the package [7]. ERP implementation also involves business process change (BPC) and ERP adaptation to align the software with the business processes [20]. Which direction is desirable depends on one's point of view and various implementation contingencies [27,40].

Typically, ERP vendors recommend process adaptation and discourage ERP adaptation for fear of potential performance and integrity degradation as well as maintenance and future upgrade difficulties. On the other hand, the user departments of the customer organization would prefer ERP adaptation to process adaptation which will necessitate the significant changes in their work environment.

3. Research model and hypotheses

This study examines the relationship between the organizational fit of ERP and ERP implementation success. The effects of three implementation contingencies on this relationship are explored as moderating variables. The research model is illustrated in Fig. 1 and discussed below.

□□□ □□□ □□□□□□□□□□□ □□□□□□□

While some firms announced ERP implementation success, many others reported negative results of ERP implementation [5,6]. An ERP implementation failure may be fatal to a firm: either wasting enormous sums of money or destroying the competitive advantage of the firm [5,6]. To manage ERP implementation successfully, a high level ERP implementation success measure is required [39]. Markus and Tanis [34] argued that a minimum set of success metrics includes project metrics, early operational metrics, and long-term business results. In this study, we define ERP implementation success from the ERP implementation project perspective.

While there is a wide range of configurations available in any major ERP product, ERP is frequently unable to model some of the adopting firm's existing procedures [10]. A critical challenge in ERP implementation has to do with first identifying gaps between the ERP generic functionality and the specific organizational requirement, and then deciding how these gaps will be handled [1,44,49,50]. For the successful

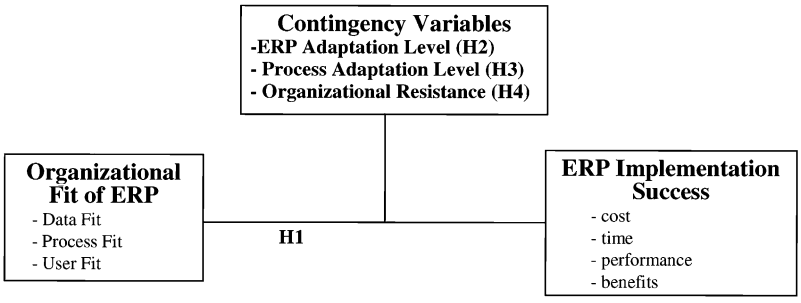

Fig. 1. Research model.

implementation of ERP, organizational fit of ERP is important, because organizational misfit of ERP requires massive changes in the adopting organization's business process, ERP systems, or both [37]. Besides, while there must be the minimum organizational fit level which ERP implementation is destined to fail regardless of whatever adaptations, none of the ERP vendors acknowledge the fact or attempts to assess the implementation feasibility based on the organizational fit of ERP. Laughlin [26] regarded matching functionality with ERP as one of the major factors for ERP implementation. This leads to our first hypothesis.

Hypothesis 1. Organizational fit of ERP is positively related to ERP implementation success.

[illegible]

Technological adaptation is referred to as the adjustments and changes following the installation of a new technology in a given setting [48]. While ERP vendors presume that ERP embodies the universally applicable best practices, most organizations adapt ERP to their unique organizational contexts [46]. ERP adaptation increases the feature-function fit between ERP and the adopting organization, which is likely to result in lower resistance, reduced training needs, less organizational adaptation [2]. It is also argued that re-invention or adaptation of an innovation might reduce mistakes resulting from the implementation uncertainty [40].

Brehm et al. [3] contend that ERP implementation success depends on the type and extent of ERP adaptation, identifying eight ERP adaptation types. Glass [11] categorized ERP adaptation types into customization, extension, and modification. ERP customization (also called configuration) is to choose among the reference processes and set the parameters in ERP without changing the ERP source code. ERP extensions utilize the ''user exit'' function for local code, a specialized programming language and third-party bolt-on software to fill the gap between ERP functionality and organizational requirements. In contrast, ERP modification changes the ERP source code. In this paper, we restrict ERP adaptation to extension and modification because customization does not change the basic ERP identity.

In base relation, we hypothesize that organizational fit of ERP is positively related to ERP implementation success. In the case of low ERP adaptation, we expect that organizational fit of ERP will be more strongly associated with ERP implementation success, because the low level of ERP adaptation would not affect the initial organizational fit of ERP value significantly. But in the case of high ERP adaptation, we expect that organizational fit of ERP will not be as strongly associated with ERP implementation success as in low ERP adaptation because the high level of ERP adaptation would have reduced the gap between ERP and organization, mitigating the effect of organizational fit of ERP. Thus, when the level of ERP adaptation is low, we expect a stronger the base relationship and expect the opposite when the level of ERP adaptation is high.

Hypothesis 2. There is an interaction effect of the level of ERP adaptation on the relationship between

organizational fit of ERP and ERP implementation success.

□□□□ □□□□□□□ □□□□□□□□□□

ERP implementation may cause radical organizational changes that need to be carefully managed [2,17,18]. Unlike the design and development of a custom software, implementation of a packaged software requires that its implementing organization adapt some of its organizational processes to fit the basic business practices that are embedded in such application packages [8,28]. When ERP implementation involves adapting the existing business processes to the standard business process of ERP, other organizational components (e.g. organizational structure, measurement compensation, organizational culture, training, etc.) and their interactions must also be changed together [17].

The adaptation of organizational process in BPC literature emphasizes the need to take account of the management of organizational change. Grover et al. [15] empirically found that change management is the most critical source of BPC implementation. Since process adaptation induces the same effect on the relationship between organizational fit of ERP and implementation success as ERP adaptation, based on the same reasoning for hypothesis two, when the level of process adaptation is low, we expect a stronger relationship and expect the opposite when the level of process adaptation is high.

Hypothesis 3. There is an interaction effect of the level of process adaptation on the relationship between organizational fit of ERP and ERP implementation success.

□□□□ □□□□□□□□□□□□□□ □□□□□□□□□□

ERP implementation will affect most of the company's business functions and influence users directly. Resistance to a change stems from change in the job content and uncertainty of the new system [22]. Any ERP project team will face a certain level of organizational resistance due to its disruptive change [26]. Previous IS research, based on different theoretical perspectives, has made a substantial progress in understanding the resistance introduced by IS implementation. In a political perspective, Markus [31] explains resistance to IT implementation in terms of power distribution misfit of IS. She noted that the political perspective appears to be primarily applicable for cross-functional IS. In an MRP study, Cooper and Zmud [4] suggested that organizational resistance and lack of MRP understanding had more explanatory power of inhibiting MRP infusion within its work environment than the task fit of MRP.

Since the organization and process changes induced by ERP implementation force involuntary changes and frequently lead to different power and resource allocations, ERP implementation usually triggers a diverse group of overt and covert opponents within the organization. Based on this realization, we expect that organizational resistance will moderate the relationship between organizational fit of ERP and ERP implementation success. When the level of organizational resistance is low, we expect the stronger base relationship and expect the opposite when the level of ERP adaptation is high.

Hypothesis 4. There is an interaction effect of the organizational resistance on the relationship between organizational fit of ERP and ERP implementation success.

4. Research method

□□□□ □□□□□□ □□□ □□□□ □□□□□□□□□□

The target of this study was the organization that has implemented ERP. We used the key informant method for collecting information on a social setting by interviewing (or surveying) a selected number of participants. Fifty firms were identified from the lists provided by the ERP vendors. We contacted the ERP project managers in charge of ERP implementation in each firm. About 350 survey questionnaires were sent to the ERP project manager of each firm, who forwarded our questionnaires to his/her project team members in charge of individual process. In total, one hundred and six questionnaires were collected from 34 firms. One case was dropped due to incomplete data entry. Two missing values, one item for implementation success and another item for ERP adaptation, were identified and replaced with the

average value of the rest of the items. On the average, three or four persons per firm participated in our survey (Appendix A).

[illegible]

We first conducted a series of in-depth interviews with various ERP project managers and members to examine the external validity of our research model. We then developed the questionnaire items based on the literature and the field visits, as well as the comments gathered from the interviews. The survey questionnaire was revised through four rounds of line-by-line discussion with the help of business process experts with significant ERP project experience. To pretest the reliability and validity of the instruments, we conducted a pilot study, using the 32 questionnaire responses from six firms. Some items were revised on the basis of the pilot result. The operational definitions of the variables used are summarized in Table 1.

[illegible]

ERP implementation success, the dependent variable in this study, is different from the traditional IS success measure in that it is not evaluated by the general users but by the project team members. Implementation project success is frequently defined in terms of the achievement of some predetermined goals, which normally include multiple parameters such as time, cost, function [34]. In this study, we measured ERP implementation success in terms of the perceived deviation from the expected project goals such as cost overrun, schedule overrun, system performance deficit, and failure to achieve the expected benefits.

[illegible]

ERP technological artifacts are basically characterized as integration of data and process within and across functions of an organization [6,24,34]. In a traditional software application perspective, Soh et al. [44] examined organizational fit of ERP in terms of data, process, and output. Considering that user interface plays an increasingly critical role for the mission-critical enterprise systems such as ERP, we operationalized the organizational fit of ERP construct in terms of data, process, and user interface fit of ERP before or at the initial implementation period.

[illegible]

We identified the type of ERP adaptation based on the industry expert interviews and developed the ERP adaptation measurement. We confirmed that the ERP adaptation instrument was applicable to different ERP systems through a series of the project team's reviews and pretests. Process adaptation and organizational resistance measurements were developed and evaluated based on the relevant literature and validated through a series of in-depth discussion with different ERP project teams.

[illegible]

Respondent firms consist of 25 manufacturing firms and nine non-manufacturing firms, including service and distribution firms. Firms were using four ERP products: SAP R/3 (14), UniERP (13), Oracle ERP (6), Bann BPCS (1). Table 2 shows profiles of the respondent firms in terms of annual revenue and number of total employees.

Table 1
Operational definitions of variables

Variable	Operational definition
Implementation success[a]	The degree of deviation from project goal in terms of expected cost, time, system performance and benefits
Organizational fit of ERP	The degree of alignment between ERP model and organization needs in terms of data, process and user interface
ERP adaptation	The extent of efforts and time spending in ERP alteration to align with organizational process needs except for ERP customization
Process adaptation	The extent of efforts and time spending in process change to align with ERP
Organizational resistance	The strength of negative organizational response to ERP implementation

[a] Reverse scale.

Table 2
Profile of respondent firms

Range	Frequency	Percentage
Annual revenue		
More than $1 billion and above	6	17.6
$100 million to below $1 billion	14	41.2
$10 million to below $100 million	11	32.4
Less than $10 million	3	8.8
Total	34	100
Number of employees		
10,000 and above	2	5.9
1000 to below 10,000	8	23.5
100 to below 1000	21	61.8
Less than 100	3	8.8
Total	34	100

[illegible]

Instrument validation is a prior and primary process in empirical research. We followed Straub's [45] guidelines to validate the instruments used in our research.

[illegible]

Content validity means how representative and comprehensive the items were in creating the scale. The content validity of the instruments was established through the adoption of the relevant construct in the literature, a series of reviews with the help of business process experts with deep ERP knowledge, and a pilot pretest.

[illegible]

Reliability is the accuracy or precision of a measuring instrument, that is the extent to which the respondent can answer the same or approximately the same questions the same way each time [45]. The internal consistency reliability was assessed by calculating Cronbach's alpha values. The reliability results of the constructs are summarized in the fifth column of Table 3. The internal consistency (Cronbach's alph) of the construct ranged from 0.75 (for implementation success) to 0.93 (for process adaptation). Given the exploratory nature of the study, the result seems acceptable.

[illegible]

Construct validity is established by relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumption they are employing. In order to obtain evidence of the construct validity of an instrument, a researcher must make use of both a convergent validity and a discriminant validity [35].

For convergent validity, we evaluated the item-to-total correlation, based on the correlation of each item to the sum of the remaining items. This approach assumes that the total score is valid and thus the extent to which the item correlates with the total score is indicative of convergent validity for the item. Table 3 shows the correlations for each of research variables whose item-to-total correlation score was greater than 0.4. Discriminant validity was checked by factor analysis. In Table 3, discriminant validity was confirmed when items for each variables loaded onto single factors with loadings of greater than 0.5 [16].

Since each variable was measured by the multi-item constructs, we conducted factor analysis to check the unidimensionality of the items. Table 4 provides the factor pattern matrix that shows the loadings of each item on independent and dependent variables. Five factors emerged with no-cross construct loadings above 0.5, indicating good discriminant validity. The instrument also demonstrated convergent validity with factor loadings exceeding 0.5 for each construct. These results confirm that each of these construct is unidimensional and factorially distinct and that all items used to operationalize a particular construct is loaded onto a single factor.

5. Results

The correlation matrix between variables is presented in Table 5. A common concern of any regression analysis is the multi-collinearity that may exist among the independent variables [16]. In our model, multicollinearity is not a problem since we have only one independent variable. Correlations among the proposed moderating variables do exist but would not pose a serious problem since their values are less than 0.5 [16] and each of them will be analyzed separately.

Table 3
Summary of reliability and validity of the measurement

Measure	Items	Mean	S.D.	Reliability (Cronbach's alpha)	Convergent validity (correlation of item with total score-item)	Discriminant validity (factor loading on single factors)
Implementation success (R)[a]	4	4.06	1.60	0.75	0.451, 0.613, 0.590, 0.551	0.655, 0.799, 0.802, 0.773
Organizational fit of ERP	11			0.83	0.798, 0.806, 0.759, 0.746	0.890, 0.896, 0.865, 0.857
Process fit	4	3.49	1.32	0.90	0.620, 0.714, 0.595, 0.666	0.790, 0.854, 0.768, 0.823
Data fit	4	3.95	1.26	0.82	0.515, 0.637, 0.548	0.600, 0.737, 0.637
User fit	3	3.71	1.33	0.74	0.741, 0.826, 0.814, 0.767, 0.624, 0.603	0.822, 0.890, 0.881, 0.836, 0.724, 0.702
ERP adaptation	6	4.57	1.46	0.89	0.845, 0.842, 0.825, 0.830, 0.775	0.904, 0.903, 0.890, 0.894, 0.854
Process adaptation	5	4.63	1.36	0.93	0.682, 0.804, 0.797, 0.748, 0.603	0.798, 0.892, 0.889, 0.844, 0.726
Organizational resistance	5	4.33	1.50	0.89		

[a] Reverse score.

Table 4
The result of factor analysis[a]

Scale items	Factors				
	1	2	3	4	5
ORGFIT1	**0.745**	−0.255	−0.003	0.070	0.187
ORGFIT2	**0.752**	−0.347	0.012	0.010	0.187
ORGFIT3	**0.744**	−0.250	0.018	−0.048	0.166
ORGFIT4	**0.756**	−0.217	−0.015	0.027	0.083
ORGFIT5	**0.714**	0.019	−0.203	0.059	0.090
ORGFIT6	**0.754**	0.063	−0.037	−0.156	0.079
ORGFIT7	**0.629**	−0.278	−0.055	−0.091	0.137
ORGFIT8	**0.681**	−0.196	−0.061	0.056	0.265
ORGFIT9	**0.546**	−0.228	0.048	−0.258	−0.294
ORGFIT10	**0.585**	−0.039	0.050	−0.446	−0.175
ORGFIT11	**0.735**	0.052	−0.060	−0.248	0.061
ERPADPT2	−0.189	**0.669**	0.270	0.066	−0.160
ERPADPT3	−0.172	**0.806**	0.220	−0.066	−0.177
ERPADPT4	−0.205	**0.788**	0.256	0.058	−0.237
ERPADPT5	−0.135	**0.846**	0.114	0.106	−0.169
ERPADPT6	−0.186	**0.737**	0.071	0.057	−0.087
ERPADPT7	−0.162	**0.643**	0.361	0.118	0.100
PROCADPT1	−0.113	0.260	**0.838**	0.128	−0.104
PROCADPT2	−0.081	0.165	**0.848**	0.203	−0.117
PROCADPT3	0.126	0.180	**0.871**	0.145	−0.069
PROCADPT4	−0.081	0.139	**0.847**	0.212	−0.027
PROCADPT5	−0.063	0.262	**0.780**	0.189	0.038
ORGRST1	0.079	0.083	0.217	**0.745**	−0.199
ORGRST2	−0.062	0.015	0.314	**0.786**	−0.191
ORGRST3	−0.168	−0.096	0.321	**0.792**	−0.035
ORGRST4	−0.192	−0.015	0.230	**0.800**	−0.068
ORGRST5	0.011	0.230	−0.030	**0.778**	0.023
PJTSUC1	0.115	−0.059	−0.124	−0.220	**0.635**
PJTSUC2	0.089	−0.235	−0.199	0.040	**0.781**
PJTSUC3	0.346	−0.357	0.049	−0.077	**0.648**
PJTSUC4	0.323	−0.216	0.184	−0.335	**0.555**
Eigenvalues	5.91	4.37	4.29	3.78	2.34
Percentage of variance explained	19.1	14.1	13.9	12.2	7.5
Cumulative percentage	19.1	33.2	47	59	66.7

[a] Extraction method: principal component analysis; rotation method: varimax with Kaiser normalization.

The results from the normal probability plot and Kolmogorov–Smirnov test indicated no violation of normality for the regression model (statistic = 0.54–0.72, $\square > 0.200$).

[illegible]

Correlation analysis was used for testing the base relationship between organizational fit of ERP and ERP implementation success. The base relation between organizational fit of ERP and ERP implementation success was significant ($\square = 0.51, \square < 0.002$), supporting the Hypothesis 1. In simple regression of organizational fit of ERP on implementation success, the value of $\square^2$ and adjusted $\square^2$ was 0.26 and 0.24, respectively. It indicates that 24% of the implementation success variance is explained by the organizational fit of ERP.

[illegible]

For analysis of the moderator variables, we will use the typology of moderator variables and the method

Table 5
Correlations matrix between variables

	(1)	(2)	(3)	(4)
Implementation success (1)				
Organizational fit of ERP (2)	0.51**			
ERP adaptation (3)	−0.49**	−0.58**		
Process adaptation (4)	−0.22	−0.18	0.36*	
Organizational resistance (5)	−0.46**	−0.39*	0.42*	0.42*

* □ < 0.05.
** □ < 0.01.

for identifying moderator variables developed by Sharma et al. [42]. Fig. 2 depicts this typology, which has two dimensions: whether the target variable is related to a criterion (dependent) variable and whether the target variable interacts with the predictor (independent) variable.

The target variable in cell 1 is referred to as an intervening, exogenous, antecedent, suppressor, or predictor variable depending on its other characteristics. Variables in cells 2–4 are referred to as moderator variables. The target variable in cell 2 is referred to as homologizer, which influences the strength of the relationship between the predictor and criterion variables across homogeneous subgroups. In contrast, moderator variables in cells 3 and 4 influence the form of the relationship between the predictor and criterion variables, implying a significant interaction between the moderator and predictor variables.

Cell 3 is referred to as quasi-moderator, which not only interacts with the predictor variable but is a predictor variable itself. Cell 4 is referred to as pure moderator, which interacts with predictor variables while having a negligible correlation with the criterion itself.

To test the three contingency variables, we followed the four-step procedure for identifying moderator variables [42] (described in Appendix B). The test results of the three moderating effects are summarized in Table 6. While the first line in each pair of regression models of the table shows the results of the regression run without interaction, the results of the regression run with the interaction term are in the second line.

In the first pair of regression models, it is found that the interaction term was significant at the level of 0.01. In the correlation matrix of Table 5, ERP adaptation was negatively correlated with both organizational fit of ERP (−0.58) and ERP implementation success (−0.49) at the level of significance 0.01. These two facts suggest that ERP adaptation is a quasi-moderator of the base relationship between organizational fit of ERP and implementation success, supporting the Hypothesis 2.

	Related to either criterion or predictor	Not Related to criterion and predictor
No interaction with predictor	Cell 1 Intervening etc.	Cell 2 Homologizer
Interaction with predictor	Cell 3 Quasi moderator	Cell 4 Pure Moderator

Fig. 2. Typology of moderator variables.

Table 6
The test results of the moderated regression effects

Regression model[a]	β (interaction)	□ (interaction)	□^{2}	□ (model)	Δ□^{2}
ORGFIT			0.26	0.002	
ORGFIT + ERPADPT + interaction	−0.58	**0.006**	0.47	0.000	0.21
ORGFIT			0.26	0.002	
ORGFIT + PROADPT + interaction	−0.50	**0.005**	0.44	0.000	0.18
ORGFIT			0.26	0.002	
ORGFIT + ORGRST + interaction	−0.25	0.243	0.37	0.003	0.11

[a] ORGFIT, organizational fit of ERP; ERPADPT, ERP adaptation; PROADPT, process adaptation; ORGRST, organizational resistance.

Table 7
Summaries of the moderated regression analysis

	Related to either criterion or predictor	Not related to criterion and predictor
No interaction with predictor	Organizational resistance is not moderator	
Interaction with predictor	ERP adaptation is quasi-moderator	Process adaptation is pure moderator

In the second pair of regression models, it was also found that the interaction term was significant at the level of 0.01. The correlation matrix in Table 5 shows that process adaptation is neither associated with organizational fit of ERP nor associated with implementation success. So we believe that process adaptation is a pure moderator of the base relationship between organizational fit of ERP and implementation success, supporting the Hypothesis 3.

In the third pair of regression models, there is no interaction effect. And the correlation matrix in Table 5 shows that organizational resistance is negatively associated with both organizational fit of ERP and implementation success. Based on these facts, we suggest that organizational resistance is not a moderator of the base relation but one of the intervening, exogenous, antecedents, suppressor, or predictor variable types. Table 7 summarizes the results of these moderated regression analyses.

□□□□ □□□□□□□□□□□□ □□□ □□□□□□□□□□ □□□□□□□

To properly test a contingency hypothesis, it is necessary to display interaction term graphically as well as to examine it mathematically [41]. We plotted the joint effect of the main and interaction term in Figs. 3 and 4. Figs. 3 and 4 represent the family of the base relationships between organizational fit of ERP and implementation success for different values of

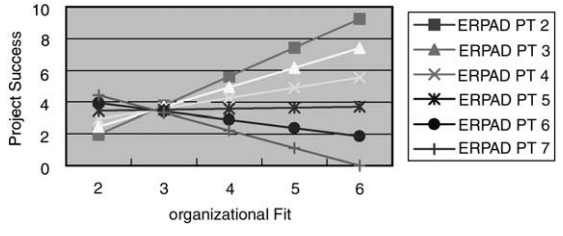

Fig. 3. Family of base relationships across ERP adaptation.

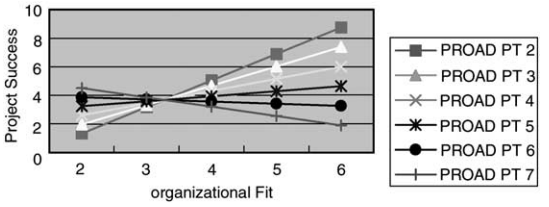

Fig. 4. Family of base relationships across process adaptation.

ERP adaptation and process adaptation, respectively. We find that the relationship between organizational fit of ERP and ERP implementation success changes from ''positive'' to ''negative'' as the level of adaptation (both ERP and process) intensifies.

In the range of ''above the inflection point'', increasing each adaptation has a negative impact on implementation success given the same level of organizational fit of ERP. In the range of ''below the inflection point'', increasing each adaptation is predicted to have a positive impact on implementation success given the same level of organizational fit of ERP.

6. Discussion

Although ERP implementation has been one of the most significant challenges for IS practitioners in the last decade, relatively little research has been conducted about ERP implementation [49,50]. In the previous section, we found that organizational fit of ERP has a significant effect on ERP implementation success. It was also found that while ERP adaptation is a quasi-moderator of the base relationship between organizational fit of ERP and ERP implementation success, process adaptation works as a pure moderator of the base relationship. Organizational resistance was not found to have a moderating effect. We will discuss these facts in detail below.

□□□□ □□□□□□□□□□□□□□ □□ □□ □□□

In the simple regression, 26% of the implementation success variance was significantly explained by the organizational fit of ERP. Lucas et al. [28] found some support for the role of organizational misfit of production system package in the implementation process. Besides, the extended models with interaction term (ERP adaptation and process adaptation) significantly explained 47 and 44% of the implementation success variance, respectively. Because the organizational fit of ERP was found to have a significant effect on ERP implementation success, project managers, before embarking on an ERP implementation project, must evaluate organizational fit of ERP and plan for appropriate type and level of adaptation.

Soh et al. [44] argue that misfit analysis requires both comprehensive understanding of critical organizational processes and detailed knowledge of the complex ERP. Before ERP adoption, thorough misfit analysis and resolution plan based on ERP knowledge will mitigate the escalating project risk over the course of implementation. To assure organizational fit of ERP, managers can also utilize the proof of concept methodology [38], where instead of developing and evaluating the exhaustive list of functional requirements, they can focus on the key process features of the organization in advance of ERP adoption.

□□□□ □□□ □□□□□□□□□□ □□□ □□□□□□□ □□□□□□□□□□

Despite the ERP vendor's caution, the practice of adapting software package has become increasingly common in reality [46]. This study found that there is a significant threshold interaction effect of ERP adaptation on the relationship between organizational fit of ERP and ERP implementation success. The impact of ERP adaptation on ERP implementation success was negative in the organizational fit range above 2.84 and positive in its range below 2.84. This might imply that, beyond a certain level of organizational fit, the higher ERP adaptation only leads to the lower implementation success.

Since process adaptation was not associated with organizational fit of ERP or ERP implementation success, it was found to be a pure moderator of the base relation. Similar to the ERP adaptation, the impact of process adaptation on implementation success monotonically decreased in the higher range of organizational fit of ERP and monotonically increased in the lower range. Since ERP adaptation as a quasi-moderator has interaction effect as well as direct effect on ERP implementation success while process adaptation has only the interaction effect, we speculate that ERP adaptation may have stronger explainability on ERP implementation success than process adaptation. This speculation is supported by the comparison of $\square^2$ change of the models one and two in Table 6 (0.21 and 0.18, respectively).

From a resource dependence view, ERP adaptation might be more exposed to threats and risks than process adaptation, because ERP adaptation requires heavier dependence upon uncontrollable resources such as consulting firms or ERP vendors than process adaptation. It might be interesting to explore ERP functionality enhancement process issues [43] for ERP implementation success.

□□□□ □□□□□□□□□□□□□□ □□□□□□□□□□

Because organizational resistance did not interact with organizational fit of ERP to explain ERP implementation success but had significantly negative association with ERP implementation success, we conclude that it is not a moderator variable. We investigated the potential mediating effect of organizational resistance between organizational fit of ERP and implementation success. Since organizational resistance also had a significantly negative relationship with organizational fit of ERP, we believe it is an intervening variable between organizational fit of ERP and implementation success with very marginal effect ($\Delta\square^2 = 0.08$) on improving the predictive validity of the model.

7. Limitation and conclusions

There are many limitations in this study. First, we focus on a limited number of variables for ERP implementation success. More relevant variables associated with ERP implementation, for example, project team competence, may be added to improve the understanding of ERP implementation success. Second, we only used perceived project metrics in defining implementation success, leaving out factual aspect of success outcome in the IS research. This was due to the difficulty in securing the factual data from the participating

organizations. Third, this paper has a common method bias because the dependent variable and independent variables rated by the same respondent. Again, this was due to the difficulty of securing data from both ERP project members and operating department personnel.

Despite the fact that more and more companies are investing in ERP for replacing their custom-built legacy systems, the research in organizational fit of ERP has been generally overlooked. While it is recognized that organizational fit of ERP is a critical selection criterion for ERP [9], the link between organizational fit of ERP and ERP implementation success was not empirically validated. Many ERP vendors just ignore the organizational fit concept and urge blind trust on ERP from their clients.

In this study, we found that organizational fit of ERP is indeed critical in explaining ERP implementation success. In addition, we found that both ERP and process adaptations interact with organizational fit of ERP on ERP implementation success. We learned that ERP and process adaptation are only effective when organizational fit of ERP is relatively low. Beyond a certain level of organizational fit, more adaptation will only lead to lower implementation success. We also learned that, since ERP adaptation also shows a significantly negative direct correlation with implementation success (while process adaptation only shows interaction effect), as many ERP vendors have claimed, process adaptation may be a safe choice than ERP adaptation when organizational fit of ERP is low.

Therefore, for successful ERP implementation, ERP implementation managers as well as top management should be able to assess the fit between their organization and the target ERP system before its adoption and, once adoption is decided, should measure and manage the impact of ERP and process adaptations from a risk assessment approach as suggested in Brehm et al. [3] to minimize the potential business disruptions and user resistance.

Appendix A. Survey instrument

The different opinions are indicated by the numbers 1: strongly disagree; 2: disagree; 3: somewhat disagree; 4: neutral; 5: somewhat agree; 6: agree; 7: strongly agree.

Implementation success (seven-point Likert type reverse scale)

1. The cost of ERP project was significantly higher than the expected budgets.
2. The ERP project took significantly longer than expected.
3. The system performance of ERP is significantly below the expected level.
4. The anticipated benefits of ERP have not been materialized.

Organizational fit of ERP (seven-point Likert type scale)

(Process fit)

1. The processes built in ERP meet all needs required from organizational processes.
2. The processes flow built in ERP correspond to flow of organizational processes.
3. The processes built in ERP accommodate the change required from organizational processes.
4. The processes built in ERP correspond to the business practices of our company.

(Data fit)

5. The name and meaning of the ERP data items correspond to those of the documents used in our company (i.e. an sales order sheet, sales report).
6. The form and format data items of the ERP correspond to those of the documents used in our company.
7. The output data items of the ERP correspond to those of the documents used in our company.
8. The input data items of the ERP correspond to those of the documents used in our company.

(User interface fit)

9. User interface structures of the ERP is well designed to the work structure required for conducting business in our company.
10. User interface of the ERP is well designed to the user capabilities of our company.
11. User interface of the ERP is well designed to the business needs of our company.

ERP adaptation (seven-point Likert type scale)

1. Significant time and effort have been required to alter ERP data items to align with our organizational process needs.
2. Significant time and effort have been required to append new ERP data items to align with our organizational process needs.

3. Significant time and effort have been required to alter ERP processes to align with our organizational process needs.
4. Significant time and effort have been required to append new ERP processes to align with our organizational process needs.
5. Significant time and effort have been required to alter ERP input/output screens to align with our organizational process needs.
6. Significant time and effort have been required to alter ERP reports to align with our organizational process needs.

Process adaptation (seven-point Likert type scale)

1. Significant time and effort have been required to alter elementary processes to align with the ERP.
2. Significant time and effort have been required to alter our process flows to align with the ERP.
3. Significant time and effort have been required to standardize our organizational processes to align with the ERP.
4. Significant time and effort have been required to integrate our redundant organizational processes to align with the ERP.
5. Significant time and effort have been required to alter our document and data elements to align with the ERP.

Organizational resistance (seven-point Likert type scale)

1. There have been many users resisting the ERP implementation.
2. There have been many cases blaming occurrence of business problem upon ERP.
3. There have been many cases in which users persist traditional business practice even though ERP change the way of conducting business.
4. There have been many cases in which user departments did not reply to the business request of the ERP project team.
5. There have been many people wishing ERP to fail.

Appendix B. Framework for identifying moderator variables

Step 1: Using the moderated regression analysis, determine if a significant interaction exists between the hypothesized moderator variable and independent variable. If a significant interaction exists, go to step 2. Otherwise, proceed to step 3.

Step 2: Determine if the moderator variable is significantly related to the dependent variable. If it is, then the variable is a quasi-moderator. If not, the variable is a pure moderator.

Step 3: Determine if the moderator variable is significantly related to the independent variable. If it is, then it is an exogenous, predictor, intervening, antecedent, or suppressor variable. If not, proceed to step 4.

Step 4: Develop subgroups based on the hypothesized moderator variable. Test for the significance of differences in predictive validity across subgroups. If the difference is significance, the variable is a homologizer operating the error term. If a significant difference is not found, then the variable is not a moderator.

References

[1] N.H. Bancroft, H. Seip, A. Sprengel, Implementing SAP R/3, 2nd Edition, Manning Publications, Greenwich, CT, 1998.
[2] P. Bingi, M.K. Sharma, J.K. Golda, Critical issues affecting an ERP implementation, Information Systems Management (1999) 7–14.
[3] L. Brehm, A. Heinzl, M.L. Markus, Tailoring ERP systems: a spectrum of choices and their implications, in: Proceedings of the 34th Annual Hawaii International Conference on System Sciences, January, 2001.
[4] R.B. Cooper, R.W. Zmud, Information technology implementation research: a technological diffusion approach, Management Science 36 (2), 1990, pp. 123–139.
[5] T.H. Davenport, Putting the enterprise into the enterprise system, Harvard Business Review (1998) 121–131.
[6] T.H. Davenport, Mission Critical: Realizing the Promise of Enterprise Systems, HBS Press, 2000.
[7] G.B. Davis, M.H. Olson, Management Information Systems, McGraw-Hill, New York, 1985.
[8] G.B. Davis, Commentary on information systems: to buy, build, or customize? Accounting Horizons (1988) 101–103.
[9] Y. Everdingen, J. Hillergersberg, E. Waarts, ERP adoption by European midsize companies, Communications of the ACM 43 (3), 2000, pp. 27–31.
[10] T.F. Gattiker, D.L. Goodhue, Understanding the plant level cost and benefits of ERP: will the ugly duckling always turn into a swan?, in: Proceedings of the 33rd Annual Hawaii International Conference on System Sciences, 2000.

[11] R.L. Glass, Enterprise resource planning—breakthrough and/or term problem? Database 29 (2) (1998) 14–16.
[12] L.L. Gremillion, P. Pyburn, Breaking the system development bottleneck, Harvard Business Review 61 (2), 1983, pp. 130–137.
[13] T.L. Griffith, R.F. Zammuto, L. Aiman-Smith, Why new technologies fail? Industrial Management (1999) 29–34.
[14] P.H.B. Gross, M.J. Ginzberg, Barriers to the adaptation of application software packages, Systems, Objectives, Solutions 4 (4), 1984, pp. 211–226.
[15] V. Grover, S.R. Jeong, W.J. Kettinger, J.T.C. Teng, The implementation of business process reengineering, Journal of Management Information Systems 12 (1), 1995, pp. 109–144.
[16] J.F. Hair, R.E. Anderson, R.L. Tatham, W.C. Black, Multivariate Data Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1995.
[17] M. Hammer, S. Stanton, How processes enterprise really work, Harvard Business Review (1999) 108–118.
[18] M. Hammer, Up the ERP revolution, Information Week (1999) 186.
[19] J.C. Henderson, N. Venkatraman, Strategic alignment: leveraging information technology for transforming organizations, IBM Systems Journal 32 (1), 1993, pp. 4–16.
[20] C.P. Holland, B. Light, A critical success factors model for ERP implementation, IEEE Software (1999) 30–36.
[21] J. Iivari, The organizational fit of information systems, Journal of Information Systems 2, 1992, pp. 3–29.
[22] J.J. Jiang, W.A. Muhanna, G. Klein, User resistance and strategies for promoting acceptance across systems types, Information and Management 37, 2000, pp. 25–36.
[23] P. Kanellis, M. Lycett, R.J. Paul, Evaluating business information systems fit: from concept to practical application, European Journal of Information Systems 8, 1999, pp. 65–76.
[24] K. Kumar, J. Hillegersberg, ERP experiences and evolution, Communications of the ACM 43 (3), 2000, pp. 22–26.
[25] K.C. Laudon, J.P. Laudon, Management Information Systems: Organization and Technology, Prentice-Hall, Englewood Cliffs, NJ, 1996.
[26] S.P. Laughlin, An ERP game plan, Journal of Business Strategy (1999) 32–37.
[27] D. Leonard-Barton, Implementation as mutual adaptation of technology and organization, Research Policy 17, 1988, pp. 251–267.
[28] H.C. Lucas, E.J. Walton, M.J. Ginzberg, Implementing packaged software, MIS Quarterly (1988) 537–549.
[29] R.K. Lynch, Implementing packaged application software: hidden costs and new challenges, Systems, Objectives, Solutions 4 (4), 1984, pp. 227–234.
[30] J. Marius, S. Ashok, Package software: selection and implementation policies, INFOR (1996) 133–151.
[31] M.L. Markus, Power, politics, and MIS implementation, Communications of the ACM 26 (6), 1983, pp. 430–444.
[32] M.L. Markus, D. Robey, The organizational validity of management information systems, Human Relations 36 (3), 1983, pp. 203–226.
[33] M.L. Markus, D. Robey, Information technology and organizational change: causal structure in theory and research, Management Science 34 (5), 1988, pp. 583–598.
[34] M.L. Markus, C. Tanis, The enterprise systems experience—from adoption to success, in: R.W. Zmud (Ed.), Framing the Domains of IT Research: Glimpsing the Future Through the Past, Pinnaflex Educational Resources Inc., Cincinnati, OH, 2000, pp. 173–207.
[35] C.F. Nachmias, D. Nachmias, Research Method in the Social Sciences, St. Martin Press, New York, 2000.
[36] W.J. Orlikowski, The duality of technology: rethinking the concept of technology in organizations, Organization Science 3 (3), 1992, pp. 398–427.
[37] R.E. Pereira, Resource view theory analysis of SAP as a source of competitive advantage for firms, Database 30 (1), 1999, pp. 38–46.
[38] C. Prosser, D. Canty, Proof of concept: an efficient way to shop, APICS—The Performance Advantage (1998) 50–52.
[39] L. Radosevich, Measuring up, CIO, Framingham 12 (23) (1999) 52–60.
[40] E. Rogers, Diffusion of Innovation, Free Press, New York, 1995.
[41] C.B. Schoonhoven, Problems with contingency theory: testing assumptions hidden within the language of contingency theory, Administrative Science Quarterly 26, 1981, pp. 349–377.
[42] S. Sharma, R.M. Durand, O. Gur-Arie, Identification and analysis of moderator variables, Journal of Marketing Research 18, 1981, pp. 291–300.
[43] J.E. Scott, L. Kaindl, Enhancing functionality in an enterprise software package, Information and Management 37, 2000, pp. 111–122.
[44] C. Soh, S.S. Kien, J. Tay-Yap, Cultural fits and misfits: is ERP a universal solution? Communications of the ACM 43 (3), 2000, pp. 47–51.
[45] D.W. Straub, Validating instruments in MIS research, MIS Quarterly (1989) 147–169.
[46] J. Swan, S. Newell, M. Robertson, The illusion of 'best practice' in information systems for operations management, European Journal of Information Systems 8, 1999, pp. 284–293.
[47] J. Sweat, ERP: enterprise application suits are becoming a focal point of business and technology planning, Information Week (1998) 42–52.
[48] M.J. Tyre, W.J. Orlikowski, Windows of opportunity: temporal patterns of technological adaptation in organizations, Organization Science 5 (1), 1994, pp. 98–118.
[49] O. Volkoff, Enterprise system implementation: a process of individual metamorphosis, American Conference on Information Systems, 1999.
[50] O. Volkoff, Using the structurational model of technology to analyze an ERP implementation, in: Proceedings of Academy of Management '99 Conference, 1999.
[51] P. Weill, M.H. Olson, An assessment of the contingency theory of management information systems, Journal of Management Information Systems 6 (1), 1989, pp. 59–85.

Kyung-Kwon Hong is a doctoral candidate at the Graduate School of Management of the Korea Advanced Institute of Science and Technology (KAIST) in Seoul. He received his BS and MS degrees in Industrial Engineering from the Hanyang University and KAIST, respectively. He has worked for Korea Telecom during 10 years. His research interests include Packaged Software Implementation, Information Systems Innovation, and Knowledge Management.

Young-Gul Kim is an Associate Professor at the Graduate School of Management of the Korea Advanced Institute of Science and Technology (KAIST) in Seoul. He received his BS and MS degrees in Industrial Engineering from Seoul National University, Korea and his PhD degree in MIS from the University of Minnesota. His active research areas are: Knowledge Management, IT Management, Data and Process Modeling and Customer Relationship Management. He has published in Communications of the ACM, Information and Management, Journal of MIS, Decision Support Systems, Database, etc.