Decision Support Systems 46 (2008) 149–157

Contents lists available at ScienceDirect

Decision Support Systems

journal homepage: www.elsevier.com/locate/dss

The implementation factors that influence the ERP (enterprise resource planning) benefits

Shih-Wei Chou [a,*], Yu-Chieh Chang [b,1]

[a] Department of Information Management, National Kaohsiung First University of Science and Technology, 2 Juoyue Rd, Nantz District, Kaohsiung 811, Taiwan, ROC
[b] Department of Marketing Management, Shu-Te University, 59, Hun Shang Rd., Yen Chao, Kaohsiung County, 82442, Taiwan, ROC

ARTICLE INFO

Article history:
Received 30 January 2007
Received in revised form 4 June 2008
Accepted 19 June 2008
Available online 1 July 2008

Keywords:
ERP implementation
Customization
Organizational mechanisms
Intermediate ERP benefits
Overall ERP benefits

ABSTRACT

Improving the performance of ERP systems remains an important issue. This study examines ERP performance at the post-implementation stage, particularly from the perspective of managerial intervention. Specifically, we proposed that both customization and organizational mechanisms affect intermediate benefits (including coordination improvement and task efficiency), which in turn influence overall benefits. A firm-level survey was used to collect data. Our findings support the proposed hypotheses. We also provide implications for both managers and researchers.

1. Introduction

Quite a few companies use a powerful information system (IS) such as ERP (enterprise resource planning) for handling complicated business applications, e.g., a diverse range of customer services. The reason ERP is so popular is that it can improve operational efficiency and business efficacy [8,10,15,27]. ERP improves operational efficiency by integrating business processes and providing better access to integrated data across the entire enterprise, while to enhance efficacy, a company may redesign its business practices by using the templates (or best practices) embedded in the ERP [5,16]. Despite low cost and risk, and high system quality of ERP [9], the failure rate of ERP implementation ranged from 40 percentage to 60 percentage [15].

The high failure rate of ERP implementation might be attributed to the difference in interests between customer organizations that aim to provide the optimum solutions for business problems and ERP vendors who prefer a generic solution applicable to a broader market [9,21]. In other words, how to bring organizational processes and functions into closer alignment with the best practice of ERP becomes critical. As prior work failed to address this in a systematic way, this study focuses on the salient factors that affect alignment. To this end, we used organizational information processing theory (OIPT) [11], which serves as an analytical lens to understand how alignment can be handled appropriately. Alignment is defined as the activities that aim for reducing uncertainty. Applying this to ERP context, the reason ERP enhances organizational performance is that the uncertainty about statuses of tasks and the environment is suitably addressed [21]. Quite a few factors may hinder the end-to-end connectivity of data and process and in turn lead to the uncertainty, such as organizational misfit (i.e. data, process, use) [22], organizational resistance [4], adaptation problems (ERP adaptation, or process adaptation) [9], and differentiation among sub-units [8]. While prior work argued that uncertainty can be addressed, such as intra-organizational standardization, or inter-organizational homogenization [2], they failed to address the uncertainty from the perspective of organizational intervention, particularly in the post-implementation stage of ERP. This study aims to fill the foregoing gap.

This study focuses on a post-implementation phase (or the acceptance stage of IS implementation) of ERP [1,21] because many firms have used ERP over a period of several years and the

* Corresponding author. Tel.: +886 7 6011000x4114; fax: +886 7 6011042.
E-mail addresses: swchou@ccms.nkfust.edu.tw (S.-W. Chou), andy@mail.stu.edu.tw (Y.-C. Chang).
[1] Tel.: +886 7 6158000x6302.

0167-9236/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.dss.2008.06.003

success of the initial stage (i.e. the ERP implementation phase) does not necessarily lead to the benefits for the post-implementation phase [15]. Following Gattiker and Goodhue [8], the performance of a post-implementation phase is measured by both intermediate benefits and overall benefits. While Gattiker and Goodhue [8] argued that ERP performance, in terms of reducing information uncertainty, is affected by the original features possessed by sub-units of an organization such as interdependence and differentiation among sub-units, this study contends that ERP performance is also influenced by two salient interventions—organizational mechanisms (OM) [18] and customization [8,9]. The latter refers to the modification of ERP software when an organization is confronted with the misalignment between the process options offered by the ERP and the business process that the organization desires [22]. On the other hand, OM represents a variety of structured and unstructured interactions between technology (e.g. ERP) users and technology providers. In our context, OM refers to those activities aimed at improving organizational acceptance of the system by bringing organizational processes into closer alignment with the best practices of ERP.

To test the proposed model, we adopted a survey method of collecting data and assessing the hypotheses. The contributions of this study are two-fold. First, this study simultaneously identified two salient antecedents, customization and OM in terms of both strategic alignment and operational alignment, from which ERP performance can be improved. Second, following Gattiker and Goodhue [8], this study conceptualized ERP performance as intermediate benefits and overall benefits. We further delineated the relationships among customization, OM, and the foregoing benefits, including the mediating role of the intermediate benefits between the salient antecedents (i.e. customization and OM) and the overall ERP benefits. This is the first empirical study (to the best of our knowledge) exploring how post-implementation performance of ERP was affected by both customization and OM.

2. Research model and hypothesis development

2.1. Enterprise resource planning (ERP) systems

ERP refers to those ISs that aim for both standardization and integration of the business operations, from order capturing to accounting and procurement to warehousing [13]. The main role of standardization is to enforce the data consistency and the connections of activities related to certain business processes that occur simultaneously in various functions [8]. On the other hand, integration aims to connect information and processes of distinct sub-units of the organization [23]. With the help of the above features, business can achieve an "end-to-end" connectivity, thus, bringing various diverse functions and divisions together, which in turn improve performance.

2.2. Intermediate and overall ERP benefits in a post-implementation phase of ERP

Following Gattiker and Goodhue [8], this study measured ERP performance in terms of a two-stage model—i.e. intermediate ERP benefits and overall ERP benefits, because understanding the intermediate benefits helps us explain why certain overall effects do or do not occur. Several intermediate ERP benefits may affect the final firm-level ERP performance, such as coordination improvements, task efficiency [8], and operational performance [15]. Although the aggregate-level (or firm-level) trends and benefits can be observed and speculated about, quantitative empirical research has yet to offer a well-accepted explanation regarding the intermediate benefits that in turn affect the overall performance following ERP implementation. Specifically, ERP intermediate benefits were measured in terms of coordination improvement and task efficiency in this study [8].

Our research model is based on the premise that the salient antecedents that affect the standardization and integration should be carefully addressed, because they denote the main focus of ERP. Quite a few antecedents have been identified by prior work, including institutional isomorphism [2,15], organizational misfit/fit (data, process, use) [22], adaptation mechanisms (ERP or process adaptation) [9], characteristics of sub-units (e.g. interdependence and differentiation) [8], ongoing learning effects [21], and so on. In this study, customization and OM were chosen as the variables that may influence ERP benefits, because they may affect standardization and integration. In addition, in the post-implementation stage of ERP, organizations may rely on the intervention (such as customization and OM) that brings business processes into alignment with the best practices of ERP. Fig. 1 lists our research model.

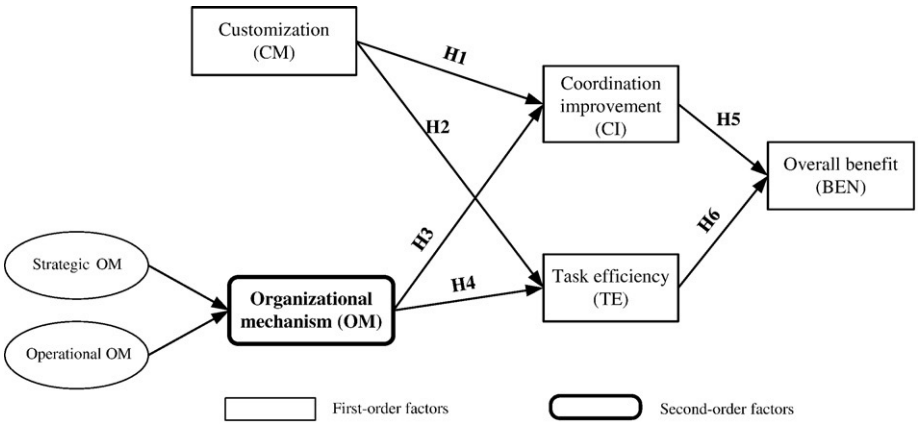

Fig. 1. Research model.

2.3. Customization

As the best practices provided by the ERP vendors and consulting firms may not supply models of every process to every industry [26], this implies that it is difficult to achieve the expected "connections" among the databases and activities related to a certain business process, unless ERP data items, ERP processes, and ERP input/output screens are either appended or altered [9]. In other words, function misalignment is when ERP functionality does not fit with the organizational requirements.

Using customization to solve function misalignment has been suggested by prior work [21,22]; misalignment was addressed by using two different approaches—non-core and core customization. While the former includes the modification to the interface of an add-on module or a query/reporter writer facility, implementing the latter entails the revision of the base code [22]. Both of the above approaches were used in this study because they refer to a wide variety of adaptation of ERP [8].

As suggested by prior work [21], customization led to integration because a well-designed ERP customization has the capability to integrate the vastly ignored manufacturing information with the popular administrative functions of an organization. This also implies that different sub-units of an organization will share the same information, which is available to those needed in real time, about various business functions in the organization. As a result, knowledge dissemination and sharing are rather smooth. Given that customization has the capability to address misalignment and facilitate integration, we expect that customization positively affects both task efficiency and coordination improvements. This leads to hypotheses 1 and 2.

H1. For a firm that has implemented ERP, greater customization is associated with greater coordination improvements of ERP accrued to that firm.

H2. For a firm that has implemented ERP, greater customization is associated with greater task efficiency of ERP accrued to that firm.

2.4. Organizational mechanisms

In addition to the customization, this study argued that OM may address the misalignment that is derived from the organizational acceptance of ERP. Prior work showed that ERP does not necessarily lead to integration and standardization. Weil and Olson [29] proposed that several salient contingency variables such as strategy, structure, size, environment, technology, task, and individual characteristics, may affect the standardization and integration. Further, Hong and Kim [9] explained how organizational fit (e.g., process fit) affects integration, which in turn influences ERP performance. On the other hand, Gattiker and Goodhue [8] argued that an ERP tends to have a good fit for global operation needs when there is high interdependence among sub-units. In addition, they argued that an ERP tends to have a less good fit for local operational needs when there is higher differentiation among sub-units. Their empirical study found that given an ERP, greater interdependence leads to greater improvements in coordination, while greater differentiation reduces benefits.

While the impact of fit on performance has been recognized by prior work, most of this work focused on implementing ERP [9,17], or attributed alignment to characteristics of an organization (e.g. interdependence and differentiation) which may not be modified easily [8]. In contrast, our model focuses on performance after ERP implementation and proposes appropriate managerial intervention—i.e. management provides the necessary enabling conditions for facilitating the alignment.

To develop organizational interventions, we drew on Leonard-Barton's [14] mutual adaptation theory, which describes the alignment as dynamic processes that involve re-invention of the technology and simultaneous adaptation of the organization during the implementation of a technical innovation. Applying this to our context, mutual adaptation can be interpreted as alignment between business processes and ERP systems, in which organizations perform various adaptation tasks such as user's procedures, assumption, knowledge, or relationships as well as features of ERP applications [9]. Other studies suggested what organizations should do to facilitate alignment, including revising existing organizational procedures, developing new organizational procedures, and training end-users to accommodate to both the new procedures and the new ERP applications [9,22].

Despite the foregoing studies, a systematic approach to ERP alignment is still missing. To fill this gap, we borrowed OM from Nambisan et al. [18] because it represents a variety of organizational interventions aiming for IT application's integration into business processes. We further divided OM into two parts—strategic OM and operational OM. The former refers to the ERP alignment fulfilled at the level of top management, whereas the latter indicates that groups or roles improve the alignment between systems and business processes at the local, operational level. Operational OM involves those activities that aim to facilitate the operational efficiencies of ERP alignment. For example, relationship managers have a responsibility to maintain dialogue between users and IS providers [25]. Other examples may include customer support unit that takes responsibility for raising technological awareness, or educational activities such as attending conferences/trade shows [20]. On the other hand, strategic OM may incorporate those activities performed by visionary teams (such as IT steering committees) that aim to facilitate not only the establishment of the strategic focus on IS alignment for organization members but the combination of the business and technical knowledge [12]. Other possible activities may include IT benchmarking projects [25], as well as specific activities such as sending users to IT conferences and trade shows [20]. Finally, an organization may initiate a variety of taskforces (such as a strategic IT planning team and advanced technology groups) for IS alignment [18].

In sum, for those firms that have implemented OM, their ERP users are more likely to become familiar with ERP and how to apply ERP to business applications effectively because of the alignment. This, in turn, leads to both greater coordination improvements and task efficiency. Thus:

H3. For a firm that has implemented ERP, the greater the extent to which the OM is perceived to be characterized by strategic OM and operational OM, the greater the coordination improvements will be.

H4. For a firm that has implemented ERP, the greater the extent to which the OM is perceived to be characterized by strategic OM and operational OM, the greater the task efficiency will be.

Finally, following prior work [8], we believe that the overall benefits are positively associated with the intermediate benefits of ERP. Thus:

H5. For a firm that has implemented ERP, greater improvements in coordination with other sub-units are associated with greater overall ERP benefits.

H6. For a firm that has implemented ERP, greater task efficiency is associated with greater overall ERP benefits.

3. Research methodology

3.1. Measurement and data collection

This study used a cross-sectional firm-level survey to empirically assess our research model. To analyze the collected data and test the hypotheses, we adopted partial least square (PLS). The items in our questionnaire were adapted from measures that had been validated by prior research. Specifically, as shown in Tables A1 and A2, the three antecedent variables (i.e. customization, strategic OM, and operational OM) came from prior studies [8,18,24] and were adapted to suit ERP implementation context. The two OM dimensions were then used as indicators to create the superordinate OM construct. In addition, the items concerning both the intermediate and overall ERP benefits were also adapted from previous literature [8]. To measure the constructs, this study employed a five-point Likert scale from "extremely disagree (1)" to "extremely agree (5)."

While we borrowed the questions from existing scales where possible, as an additional means of ensuring that questionnaire items match the theoretical constructs, we conducted interviews with ten managers of local manufacturing facilities; they answered the questions of the prototype questionnaire and were asked to explain their interpretations of the answers. We also extracted descriptions of business environments and ERP systems from these interviewees. The above information was then compared to their replies to the questionnaire items. The foregoing processes led to refinements of many questionnaire items.

Table 1
Profile of companies and respondents

Industry	# of company	# of response	Percentage
Technology/network	11	23	13.9
Manufacturing	11	24	14.6
Products/food and beverage	9	21	12.7
Electric machinery and electronics	5	15	9
Construction	6	14	8.4
Shipping/transportation	5	15	9
Non-profit (e.g. education, government)	10	20	12
Financial	4	12	7.2
Telecommunication	3	11	6.6
Entertainment and others	6	11	6.6
Total	70	166	100

Table 2
Demographic information of respondents (N=166)

Measure	Items	Freq.	Percentage (%)
Company size	1–100	28	16.8
	100–300	44	26.5
	300–500	24	14.5
	500–1000	34	20.5
	1000+	36	21.7
Position	Employee	30	18
	Chief employee	60	36.3
	Manager	56	33.7
	Director	20	12
Time elapsed (years)	1–2	17	10.2
	2–3	17	10.2
	3–4	11	6.4
	4–5	35	21.6
	5–6	17	10.2
	More than 6	69	41.4
ERP implementation alternatives	(a) Packaged S/W provided by domestic vendor	90	54.2
	(b) Packaged S/W provided by international vendor	76	45.8

Next, the initial version of the survey instrument was refined through a pre-test with 52 respondents from 28 organizations of Taiwan. We then assessed the internal consistency and discriminant validity of the instrument. Cronbach's alpha values range from 0.609 (for customization) to 0.916 (for task efficiency). Because of low item-to-total correlation (less than 0.5), two items from customization were dropped.

The refined instrument, in the form of a self-administered questionnaire, was then used to collect data from organizations of Taiwan. Next, the research assistant distributed the questionnaires to 1100 organizations, which belong to the major ERP associations of Taiwan—i.e. Chinese Enterprise Resource Planning Society (CERPS). The members of CERPS are primarily materials and scheduling personnel at plant and central level, as well as consultants and employees of IT vendor. The total amount of returned responses was 269 (24% of response rate). The participating companies employed one of three different types of ERP systems—custom-built IS, ERP solutions provided by domestic vendors, and ERP solutions provided by international vendors. As the last two of the above IS represent the suitable ERP, useful respondents were those who used these types of ERP—the total amount of them was 184. Out of the 184 responses, 18 responses were deleted from further analysis, including incomplete data and the time elapsed since ERP implementation was less than 1 year. As a result, 166 responses across 10 industries were used in the data analysis. Tables 1 and 2 illustrate the respondents' characteristics based on their industry types and demographics.

Four control variables were included in our study: company size [15], position [15], time elapsed since implementation [8], and ERP implementation alternatives [28]. The reason for choosing these variables is that they play an important role in affecting the ERP (or IT) performance, although these variables do not relate directly to our theoretical model. We employed ANOVA to test the effect of these variables on ERP benefits; only one of these control variables (i.e. time elapsed since implementation) was found to be significant. Regarding the impact of elapsed time on ERP

Table 3
Task efficiency for time elapsed since ERP implementation

Time elapsed (years)	Number of firms	Task efficiency (Mean (S.D.))
1–2	17	3.73(0.71)
2–3	17	3.98(0.7)
3–4	11	4.16(0.53)
4–5	35	3.67(0.76)
5–6	17	4.06(0.4)
More than 6	69	4.09(0.5)

S.D.: Standard Deviation.

benefit, only the influence on task efficiency was significant ($F=3.367$, $p<0.01$). As shown in Table 3, the observations were segmented into five categories based on the number of years elapsed since ERP implementation. These results indicated that time elapsed since ERP implementation has a positive effect on task efficiency. For the first four years, the task efficiency increased steadily, yet it decreased for the fifth year. After that, the task efficiency increased but at a decreasing rate.

4. Data analysis and results

4.1. Analysis methods

To test the theoretical model, this study used PLS because it represents a structural equation modeling technique from which both reliability and validity of the theoretical constructs are evaluated. In addition, PLS can be used to not only assess the relationships among the salient constructs, including direct and indirect effects, but also allow latent constructs to be modeled as formative indicators as was the case with our data [3]. While the measurement and structural models are examined together, a PLS model is analyzed and interpreted in two stages: the assessment of the reliability and validity of the measurement model, and the assessment of the structural model. This study employed PLS-Graph Version 3.0.

To validate our measurement model, we assessed three types of validity: content validity, convergent validity, and discriminant validity. Content validity is established by ensuring consistency between the measurement items and the extant studies. This was done by interviewing senior practitioners and conducting pilot test of the instrument. We assessed convergent validity by examining composite reliability and average variance extracted (AVE) from the measures [3]. He suggested that for studies employing PLS, 0.7 is a recommended threshold value for the measures of the construct reliability. As shown in Table 4, the values of composite reliability ranged from 0.791 to 0.947, which suggest the acceptability of the construct reliability. Regarding the AVE, 0.5 is an acceptable value [7]. In Table 4, the AVEs of our measures ranged from 0.559 to 0.856, which indicate the acceptability. In addition, as shown in Table A3 in Appendix, the weights and loadings of the measures in our model were significant on their path loadings at the level of 0.01. Finally, we verified the discriminant validity of our instrument by examining the square root of the AVE as recommended by Fornel and Larcker [7]. We found evidence

Table 4
Reliability of constructs

Measures	Items	Composite reliability	AVE	Cronbach's alpha
Customization (CM)	3	0.791	0.559	0.609
Coordination improvements (CI)	4	0.898	0.688	0.847
Task efficiency (TE)	3	0.947	0.856	0.916
Strategic organization mechanisms (SOM)	3	0.91	0.718	0.869
Operational organization mechanisms (OOM)	4	0.901	0.696	0.855
Overall ERP benefits (BEN)	4	0.916	0.785	0.861

in support of the discriminant validity from Table 5—the square root of the AVE for each construct was greater than the levels of correlation involving the construct. The inter-construct correlations of this table also indicated that each construct shared larger variance with its own measures than with other measures.

Due to the high correlations between the two OM constructs (0.764) as shown in Table 5 and concern about multicolinearity as justification [19], OM was viewed as a second-order factor formed by the first-order dimensions of operational OM and strategic OM. Another reason is that a change in one of the first-order factors does not necessarily imply an equal change in the other. Finally, the result of content validity showed direction of causality is from items to construct and a change in one item is not necessarily associated with changes in the other items [6]. In short, given OM was treated as a formative construct, we created a superordinate second-order construct using factor scores of the first-order constructs.

4.2. Structural model

Because of the acceptable level of validity, the proposed hypotheses were tested by PLS. The results of the PLS analyses were illustrated in Fig. 2 and summarized in Table 6. All of the hypotheses were supported as expected. As indicated in Fig. 2, the influence of customization on coordination improvement was higher than that of OM (accounting for 22.6% variance), and in a similar vein the impact of customization on task efficiency was higher than that of OM (accounting for 14.1% variance). This implies that organization can use either customization or OM for improving intermediate benefits and a firm may gain more advantage by using customization than OM. Regarding overall benefits, while both coordination improvement and task efficiency exerted a positive effect on overall benefits, the latter benefited more.

To further examine the intermediate effect of both coordination improvement and task efficiency, we first tested

Table 5
Correlation between constructs

	CM	CI	TE	BEN	SOM	OOM
CM	0.748					
CI	0.403	0.829				
TE	0.368	0.471	0.925			
BEN	0.433	0.531	0.700	0.886		
SOM	0.261	0.355	0.227	0.225	0.847	
OOM	0.318	0.385	0.171	0.221	0.764	0.834

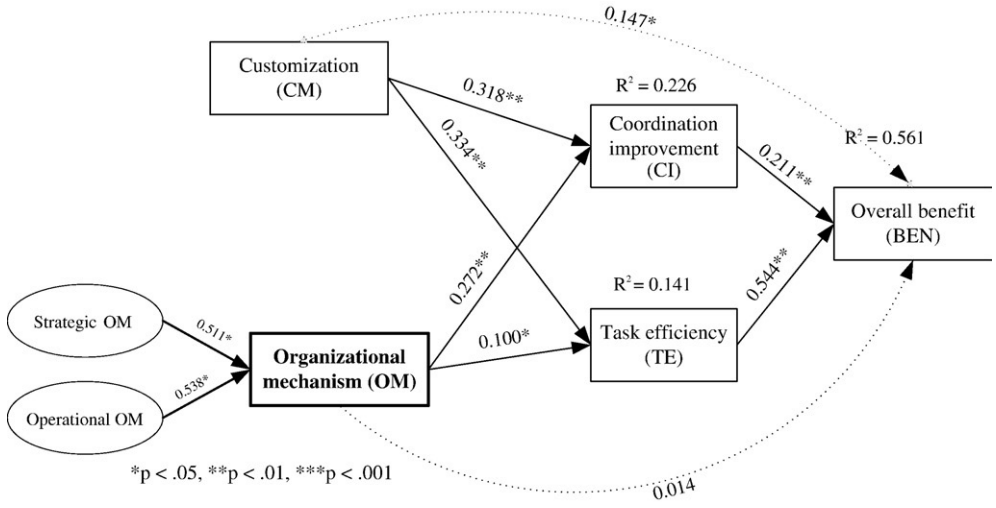

Fig. 2. Results of PLS analysis.

the direct relationships, including a model of customization and OM predicting overall benefit. The βs of customization and OM were 0.28 ($p<.01$) and 0.17 ($p<.05$) respectively, accounting for 51.8% variance. We then proceeded to see if there is a mediation effect by adding the intervening constructs (coordination improvement and task efficiency). From Fig. 2, the foregoing constructs partially mediated the relationship between customization and overall benefits because the indirect paths were significant and the direct path was lessened. On the other hand, these intervening constructs completely mediated the relationship between OM and overall benefits since the indirect paths were significant and the direct path was completely eliminated. Besides, the increase in R^2 (i.e. from .52 to .56) perhaps shows that customization and OM are not the only variables that predict the intermediate benefits.

5. Discussions, implications, and limitations

Our study provides valuable insight into the performance of ERP, in terms of intermediate benefits and overall benefits, in the post-implementation phase. This is the first empirical study, to the best of our knowledge, which provides a workable solution to ERP performance, particularly from the perspective of organizational intervention. While our model was based on Gattiker and Goodhue's [8] research, including customization, intermediate benefits, and overall benefits, we proposed an alternative way of gaining ERP benefits—i.e. strategic alignment and operational alignment. In other words, we contended that ERP benefits are affected not only by the original features of a firm (such as interdependence and differentiation of one plant) [8], but also by managerial interventions (i.e. OM or alignment). To improve ERP benefit, we proposed performing two complementary tasks—customization and OM. The former emphasizes performing the alignment of ERP software itself, whereas the latter focuses particularly on the organizational acceptance of alignment. Our empirical findings confirmed our hypotheses. The following sections elaborate on the implications of both customization and OM.

Table 6
Results of hypothesis testing

Hypothesis	Standardized path coefficient (direct effect)	*t*-value for path	Results
H1: customization ➔ coordination improvement	0.318	4.083	Supported
H2: customization ➔ task efficiency	0.334	4.694	Supported
H3: OM ➔ coordination improvement	0.272	3.417	Supported
H4: OM➔ task efficiency	0.100	2.159	Supported
H5: coordination improvement ➔ overall ERP benefits	0.211	3.136	Supported
H6: task efficiency ➔ overall ERP benefits	0.544	9.153	Supported

5.1. Customization, organizational mechanisms (OM) and ERP benefits

From Fig. 2, as expected, we found that both customization and OM exert a significant influence on intermediate benefits, which in turn affect the overall benefits. However, contrary to commonly accepted practices associated with ERP, functional alignment (i.e. customization) showed a better improvement in ERP benefits than that of organizational acceptance of alignment—or process adaptation in Hong and Kim's [9] terms. Their study emphasized the moderating effect of adaptation between organizational fit and ERP implementation success, while we focused on the effect of adaptation (or the main effect) on intermediate benefits at the post-implementation stage. Our findings indicate that while ERP philosophy is process-based rather than function-based, under certain circumstances function adaptation and software configuration (such as customization) [22] play a more

important role in affecting intermediate benefits than alignment of organizational processes (such as OM). The possible reason is that suitable functionality has a more direct influence on ERP benefits than process adaptation. In addition, it is more difficult to fulfill OM than customization, because OM involved implementing both strategic and operational alignment, which require a great deal of time and energy. Even though, we belief reinforcing OM is worthwhile, because as previously noted ERP philosophy is process-oriented and OM aims for the integration of key business and management process. Future research may focus on how to facilitate OM.

The second implication relates to the mediation effect of ERP intermediate benefits. As the results indicated, customization affected overall benefits either directly or indirectly through intermediate benefits, while OM influenced overall benefits only indirectly through intermediate benefits. As noted before, the effect of customization on overall benefits was partially mediated by intermediate benefits. This implies that overall benefits are not fully affected by intermediate benefits. Rather, customization also contributes to overall benefits, because it aims for providing more suitable ERP functionality or software configuration that directly improves business performance such as productivity. On the other hand, the effect of OM on overall benefits was fully mediated by intermediate benefits. As the goals of OM were to reinforce process alignment both at strategic level and operational level, its impact on overall benefits (such as productivity or profit) may not be so obvious compared with that of customization. In sum, the foregoing findings together provide us with a better understanding of the relationships between alignment and ERP benefits, particularly at the post-implementation stage. Further, we believe that it is a mistake to expect either coordination improvement or task efficiency to accrue automatically due to the successfully implementing ERP. Rather, performing alignment is usually required.

5.2. Limitations and future research

This study has three limitations. First, we emphasized a limited number of variables that may affect ERP benefits. Although these factors play a critical role in affecting ERP performance, other factors such as quality of ERP consultant and top management support may influence ERP benefits. Second, this study emphasized the impact of customization and OM on ERP benefits, but we did not consider the level of fit that may affect the forgoing relationships. Future study may take this into consideration. Finally, the usual limitations of cross-sectional surveys are ascribed to lack of causality, as is this study. In-depth process-oriented research design based on OIPT and innovation-diffusion of ERP implementation [21] may help us realize the ERP implementation process at different stages and the dynamic interrelationships between context and possible approaches when dealing with different types of misfit. These are the important issues that should be addressed in the future.

5.3. Implications for practice and theory

Our findings together with Gattiker and Goodhue's [8] provide managers a comprehensive solution to a misfit of ERP at post-implementation stage—while the latter argued that the misfit originates from the features of the sub-units, we proposed reinforcing organizational alignment to deal with the misfit. Further, as our findings suggest, both strategic and operational OM play an equally important role in affecting OM. This implies that even at the post-implementation phase addressing ERP from a strategic perspective is needed. Finally, while Hong and Kim's [9] study emphasized a one-stage measure of ERP performance at the initial stage of ERP implementation, ours focused on a two-stage measure of ERP performance at the post-implement phase. Under this circumstance, both customization and OM affected ERP benefit (as a main effect). Further, intermediate benefits completely mediated the relationships between OM and overall benefits, whereas the relationship between customization and overall benefits was partially mediated by intermediate benefits. These findings deepen our understanding of how to facilitate ERP performance.

Our findings also contribute to theory. First, in addition to a two-stage measure of ERP performance, we focused on internal alignment, which in turn facilitate ERP benefits, while Liang et al. [15] emphasized the role of external environments in affecting organizational behavior (i.e. the use of ERP). Both the studies aimed for improving performance of ERP at the post-implementation stage, but using different approaches. Second, compared to Gatitiker and Goodhue's [8] study, they identified the inherent features of a firm (i.e. differentiation and interdependence) that affect the fit between ERP and business processes, while our research proposed mechanisms for alignment—customization is directly related to ERP software, whereas OM is closely related to the organizational acceptance and usage of the software. Combine the foregoing studies, we have a deeper understanding of ERP, which in turn may help us develop advanced research on ERP.

6. Conclusions

The acquisition of ERP benefits is not automatically even after a firm has implemented ERP successfully at the initiation and adoption stage. This study proposed two complementary approaches to alignment, i.e. customization and OM, at a post-implementation stage. While Gattiker and Goodhue's [8] work argued that ERP benefits are affected by a firm's distinctive features such as interdependence and differentiation of one plant with other plants, ours examined ERP benefits from the perspective of managerial intervention. Our findings supported the proposed hypotheses. This study contributes to a deeper understanding of the relationships between the alignment and ERP benefits. Given the critical role of ERP in a competitive advantage of today's world—and even more so in tomorrow's world, our findings, together with other related findings [8,9,15], provide valuable insights into ERP.

Acknowledgements

The authors would like to thank the editors and the anonymous reviewers, who provide insightful and constructive comments on the paper.

Appendix A

Table A1
Definitions of the constructs

Constructs	Definitions	Key references	Items[a]
Customization	The capability of handling the lack of fit between the organization's business processes and those envisaged by the ERP package designers.	[8]	3(5)
Coordination improvement	The capability of adapting to changing conditions, coordinating and synchronizing among different units of a firm.	[8]	4(4)
Task efficiency	The efficiency and productivity of business processes.	[8]	3(3)
Strategic OM	This is defined as the class of actions whose objective is to enhance operational efficiencies.	[18,24]	3(3)
Operational OM	This refers to the activities whose aim is to learn about the environment and discover novel ways of creating values or solving old problems.	[18,24]	4(4)
ERP overall benefits	This is defined as the measure of the overall benefits of ERP on the firm such as ERP success and business performance.	[8]	3(3)

[a] Final item numbers (initial item numbers).

Table A2
Questionnaire items

Constructs	Item
Customization (CM)	1. The ERP system was altered to improve its fit with the organization 2. The ERP implementation (or modification) team was responsive to the needs of the organization 3. Individuals from this organization had a great deal of influence on how the ERP system was set up 4. A standard version of the ERP software was implemented (or modified) without changes being made to fit the particular requirements of this firm 5.When the ERP system was being implemented (or modified) in this firm, the package was changed to better meet the needs of this organization
Coordination improvements (CI)	1. ERP helps to adjust to changing conditions among different units of the firm 2. ERP has improved the coordination among different units of the firm 3. ERP facilitates the integration of important information among different units of the firm 4. ERP helps to synchronize among different units of the firm
Task efficiency (TE)	1. Due to the ERP implementation, employees such as buyers, planners, and production supervisors need less time to do their jobs 2. ERP saves time in jobs like production, material planning and production management 3. ERP helps employees like buyers, planners, and production supervisors to be more productive
Strategic OM (SOM)	1. ERP steering committee—a top management permanent team established to set priorities for ERP deployment, allocate resources, and champion/monitor IS projects 2. Strategic ERP planning team—ad hoc or permanent team set up to establish the linkage between the firm's strategic objective and its IS portfolio
Strategic OM (SOM)	3. ERP benchmarking projects—organizationally sanctioned surveys and studies of ERP practices in peer/competitor firms 4. ERP task group—temporary work groups given a well-defined mandate with respect to a specific ERP deployment project
Operational OM(OOM)	5.Customer support unit—a unit set up to help users in day-to-day ERP operations and to channel their feedback to the internal ERP group 6. User groups—organization sanctioned user group that convene periodically to discuss ERP deployment issues and to provide feedback on existing/planned ERP applications 7. Relationship manager—a full time specialized position created to manage the relationship between ERP system and line groups 8. Attending ERP conferences/trade shows—organizations often send users to ERP conferences and trade shows to enable them learn about new ERP deployment opportunities
Overall ERP benefits (BEN)	1. In terms of ERP's business impacts on the organization, the ERP system has been a success 2. ERP has seriously improved the organization's overall business performance 3. ERP has had a significant positive effect on this organization

All measures employ a five-point Likert scale from “extremely disagree” to “extremely agree.”

Table A3
Weights and loadings of the measure

Construct	Items	Mean	S.D.	Loading	*t*-value	Items Dropped (ID)
Customization (CM)	CM_1	3.880	0.860	0.497	2.647	Dropped
	CM_2	3.734	0.887	0.234	1.704	Dropped
	CM_3	3.94	0.733	0.724	6.577	
	CM_4	3.793	0.74	0.717	6.615	
	CM_5	3.995	0.765	0.799	7.497	
Coordination improvements (CI)	CI_1	3.668	0.689	0.791	8.326	
	CI_2	3.842	0.663	0.853	10.522	
	CI_3	3.897	0.632	0.859	9.517	
	CI_4	3.924	0.623	0.813	7.584	
Task efficiency (TE)	TE_1	3.94	0.679	0.922	25.003	
	TE_2	3.962	0.688	0.932	28.443	
	TE_3	3.935	0.674	0.922	26.96	
Strategic OM (SOM)	SOM_1	3.103	0.944	0.833	4.113	
	SOM_2	3.315	0.88	0.878	6.936	
	SOM_3	2.973	0.871	0.874	6.675	
	SOM_4	3.245	0.887	0.802	5.156	
Operational OM(OOM)	OOM_1	3.364	0.907	0.84	5.952	
	OOM_2	3.103	0.846	0.836	4.794	
	OOM_3	3.228	0.925	0.851	6.616	
	OOM_4	3.565	0.814	0.809	5.855	
Overall ERP benefits (BEN)	BEN_1	3.853	0.682	0.838	16.835	
	BEN_2	3.929	0.636	0.911	14.399	
	BEN_3	4.049	0.63	0.907	21.126	

S.D. indicates Standard Deviation.

References

[1] A. Barua, C.H. Kriebel, T. Mukhopadhyay, Information technologies and business value: an analytic and empirical investigation, Information Systems Research 6 (1) (1995) 3–23.
[2] J. Benders, R. Batenburg, H. Blonk, Sticking to standards: technical and other isomorphic pressures in deploying ERP-systems, Information and Management 43 (2006) 194–203.

[3] W.W. Chin, The partial least squares approach to structural equation modeling, in: G.A. Marcoulides (Ed.), Modern Methods of Business Research, Lawrence Erlbaum Associates, Mahwah, NJ, 1998, pp. 295–336.
[4] R.B. Copper, R.W. Zmud, Information technology implementation research: a technological diffusion approach, Management Science 36 (2) (1990) 123–139.
[5] T. Davenport, Putting the enterprise in the enterprise system, Harvard Business Review 76 (4) (1998) 121–131.
[6] A. Diamantopoulos, H.M. Winklhofer, Index construction with formative indicators: an alternative to scale development, Journal of Marketing Research 38 (2) (2001) 269–277.
[7] C. Fornel, D.F. Larcker, Structural equation models with unobservable variables and measurement errors, Journal of Marketing Research 18 (2) (1981) 39–50.
[8] T.F. Gattiker, D.L. Goodhue, What happens after ERP implementation: understanding the impact of interdependence and differentiation on plant-level outcomes, MIS Quarterly 29 (3) (2005) 559–585.
[9] K.K. Hong, Y.G. Kim, The critical success factors for ERP implementation: an organizational fit perspective, Information and Management 40 (2002) 25–40.
[10] W. Ke, K.K. Wei, Organizational culture and leadership in ERP implementation, Decision Support Systems 45 (2) (2008) 208–218.
[11] J. Karimi, T. Somers, Y. Gupta, Impact of environmental uncertainty and task characteristics on user satisfaction with data, Information Systems Research 15 (2) (2004) 175–193.
[12] W.R. King, T. Teo, Facilitators and inhibitors for the strategic use of information technology, Information and Management 27 (2) (1994) 71–81.
[13] S. Laughlin, An ERP game plan, Journal of Business Strategy 20 (1) (1999) 32–43.
[14] D. Leonard-Barton, Implementation as mutual adaptation of technology and organization, Research Policy 17 (5) (1988) 251–267.
[15] H. Liang, N. Saraf, Q. Hu, Y. Xue, Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management, MIS Quarterly 31 (1) (2007) 59–87.
[16] H.C. Lucas, E.J. Walton, M.J. Ginzberg, Implementing packaged software, MIS Quarterly 12 (3) (1988) 537–549.
[17] J. Marius, S. Ashok, Package software: selection and implementation policies, INFOR (1996) 133–151.
[18] S. Nambisan, R. Agarwal, M. Tanniru, Organizational mechanisms for enhancing user innovation in information technology, MIS Quarterly 23 (3) (1999) 365–395.
[19] J. Neter, W. Wasserman, M.H. Kutner, Applied Linear Regression Model, 2nd ed.Irwin, 1985.
[20] S. Nilakanta, R.W. Scamell, The effect of information sources and communication channels on the diffusion of innovation in a database development environment, Management Science 36 (1) (1990) 24–40.
[21] R. Rajagopal, An innovation-diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model, Information and Management 40 (2002) 87–114.
[22] C. Soh, S.S. Kien, J. Tay-Yap, Culture fits and misfits: Is ERP a universal solution, Communications of the ACM 43 (4) (2000) 47–51.
[23] D. Slater, What is ERP? CIO 12 (15) (1999) 86–91.
[24] M. Subramani, How do suppliers benefit from information technology use in supply chain relationships, MIS Quarterly 28 (1) (2004) 45–73.
[25] M. Subramani, S. Tacono, J.C. Henderson, Bridging the IS-line interface: the role of the relationship manager, Proceedings of the First Americas Conference on Information Systems, Pittsburgh, PA, 1995, pp. 172–174.
[26] J. Swan, S. Newell, M. Robertson, The illusion of best practice in information systems for operating management, European Journal of Information Systems 8 (4) (1999) 284–293.
[27] E.T.G. Wang, J.H.F. Chen, Effects of internal support and consultant quality on the consulting process and ERP system quality, Decision Support Systems 42 (2) (2006) 1029–1041.
[28] E.T.G. Wang, G. Klein, J.J. Jiang, ERP misfit: country of origin and organizational factors, Journal of Management Information Systems 23 (1) (2006) 263–292.
[29] P. Weil, M.H. Olson, An assessment of the contingency theory of management information systems, Journal of Management Information Systems 6 (1) (1989) 59–85.

Shih-Wei Chou is a professor in the department of MIS (Management of Information Systems) at National Kaohsiung First University of Science of Technology in Taiwan where he teaches knowledge management, software engineering, object-oriented information systems, and management of information systems. He received his doctorate in Computer Science (CS) from Illinois Institute of Technology, and he holds a master degree in CS from Mississippi State University. Prior to getting his doctorate, he spent two years working in a telecommunication industry. His research interests include knowledge management, IS development and design, ERP systems, e-learning. His work has appeared in the Journal of Information Science, Journal of Computer-aided Learning, and Expert Systems with Applications, and has been presented at the PACIS, and HICSS, and other international conferences.

Yu-Chieh Chang received his Ph.D. degree in MIS from National Kaohsiung First University of Science of Technology. His research interests include ERP system, electronic commerce, and knowledge management.