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# Examining The Factors That Affect ERP Assimilation

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# EXAMINING THE FACTORS THAT AFFECT ERP ASSIMILATION

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## Abstract

*The aim of this study is to identify the factors that influence the assimilation of enterprise resource planning (ERP) systems in the post-implementation stage. Building on organizational information processing theory (OIPT) and absorptive capacity (AC), we propose an integrated model, which examines the relationship among organizational fit, absorptive capacity, environmental uncertainty, and ERP assimilation. Based on the survey data from 98 firms that have implemented ERP, most of the proposed hypotheses were supported, showing that initial fit, potential AC, realized AC, and heterogeneity jointly affect ERP assimilation. Task uncertainty (hostility and heterogeneity) negatively moderates the relationship between initial fit and ERP assimilation. The implications for both theory and practice are discussed.*

*Keywords: ERP assimilation, ERP fit, environmental uncertainty, absorptive capacity*.

# 1 INTRODUCTION

The aim of Enterprise resource planning (ERP) systems is to solve industry's chronic problems of custom system design by reducing cost and implementation time, and to provide high system quality. Despite the purported benefits, empirical evidence shows that many ERP projects have failed and led companies to financial difficulty, and the failure rate of ERP implementation ranges from 40 percent to 60 percent (Liang et al. 2007; Xue et al. 2005).

The main barrier preventing firms from using ERP is the organizational fit of ERP, which refers to the extent to which the "best practices" provided by ERP vendor demonstrate their fitness to the customer's organizational context (Hong and Kim 2002, Wang et al. 2006). While the role of organizational fit of ERP in affecting ERP success has been recognized by prior studies, few of them consider its impact on ERP assimilation. Assimilation is defined as the extent to which information technology (IT) applications become deeply embedded within the organization's work processes and the use of IT is no longer perceived as new (we use assimilation and post-implementation interchangeably in this paper to make the delineation clear) (Ahuja and Thatcher 2005, Purvis et al. 2001). After ERP implementation, ERP systems usually replace old legacy systems and their use is often mandatory. ERP assimilation is important because of the dynamic feature of ERP—initial success could result in later failure and early failure could lead to ultimate success (Larsen and Myers 1999). Besides, the potential value of ERP applications is unable to be recognized until they are extensively assimilated in an organization (Liang et al. 2007, Purvis et al. 2001).

In addition to organizational fit of ERP, assimilating ERP has to overcome other types of barriers (Wang et al. 2006). The first barrier that a firm may encounter is environmental uncertainty, referring to the extent to which a firm is unable to confidently determine the probabilities of how environments will influence the success of a decision-making task (Daft and Lengel 1986). Environmental uncertainty has been conceptualized as dynamism, hostility, and heterogeneity (Karimi et al. 2004). Dynamism is defined as the rate of change and innovation of production and service technologies, as well as the unpredictability of customer taste. Hostility focuses on task environments' restrictiveness, and refers to the extent to which firms should face some very tough competition in the availability of resources. Finally, heterogeneity refers to the extent of similarity or differentiation within a firm's task environments. While prior research has recognized the role of environmental uncertainty in affecting information systems (IS) success and IS users' tasks, the link between environmental uncertainty and ERP assimilation has been largely overlooked. The major challenge of ERP assimilation is to align the existing organizational processes with the "best practices" embedded in the ERP systems, which in turn involves mutual adaption between the IT vendor and user environment (Hong and Kim 2002, Liang et al. 2007). The difficulty with the above mutual adaptation, ERP package adaption or organizational adaptation, tends to be exacerbated when environmental uncertainty increases. This is so because when firms face great environmental uncertainty, they need either more information to minimize uncertainty or various structural mechanisms for coordination and generation of rich information, from which an informed decision can be reached.

A firm's limited absorptive capacity (AC) (Cohen and Levinthal 1990, Zahara and George 2002) can be treated as another barrier of ERP assimilation. AC refers to a firm's capability to acquire and apply knowledge, aimed to enhance the firm's ability to gain a competitive advantage. AC includes potential AC and realized AC—potential AC is comprised of knowledge acquisition and assimilation, and realized AC focuses on knowledge transformation and exploitation. Successful ERP assimilation necessitates wide-ranging organizational change initiatives rather than installing ERP software only (Hong and Kim 2002, Liang et al. 2007). Studies note that the success of using ERP systems depends on a recipient company's ability to absorb the task-related and process-related knowledge embedded in ERP systems (Park et al. 2007). They also suggest that the more individual ERP users have the absorptive capacity, the more likely they are able to reinvent their use of ERP to fit their task environment, leading to better ERP performance. While prior studies have recognized the role of

absorptive capacity in ERP performance, they fail to consider the impact of a firm's AC on ERP assimilation. Examining ERP assimilation from the perspective of a firm is important because undertaking ERP initiatives require change of the firm's socio-technical systems, which are intertwined of organizational fit, people, firm's AC capacity and task environments.

Limited prior research has examined ERP assimilation systematically and empirically. This study fills this gap by proposing an integrated model, which examines ERP assimilation from three different perspectives—the organizational fit of ERP, the environmental uncertainty, and absorptive capacity. The organizational fit of ERP refers to the notable feature of a firm which is persistent and unable to be completely changed by customizable configurations, while environmental uncertainty and a firm's AC represent the external and internal antecedent of ERP assimilation respectively. The research questions of this study are: how do the above antecedents affect ERP assimilation? Whether the relationship between organizational fit of ERP and assimilation is contingent on AC and environmental uncertainty? Based on 98 Taiwanese firms, this study contributes to the literature by showing that organizational fit of ERP exerts persistent effect on ERP assimilation. Besides, ERP assimilation is also affected by AC and environmental uncertainty.

# 2 THEORITICAL BACKGROUND AND RESEARCH MODEL

ERP post-implementation focuses on assimilating the technical features of an ERP system into the business routines so that the expected benefits of ERP can be actually realized (Markus and Tanis 2000, Rajagopal 2002). Theory suggests that at this stage, the involvement of the vendors is significantly lowered and most of the radical customizations such as process conversion and reengineering are complete (Liang et al. 2007). Following initial implementation, it is likely that ERP vendors and consultants have imparted a sufficient amount of knowledge to the end users.

However, a number of salient factors could affect the assimilation of the ERP after the implementation. Based on organizational theories, this study develops a conceptual model (Figure 1), arguing that ERP assimilation may be affected by three key antecedents--organizational fit, environmental uncertainty, and absorptive capacity. Organizational fit refers to IS contingencies, focusing on the fit between specific organizational dimensions and IS. Environmental uncertainty and absorptive capacity denote the salient antecedents derived from external task environments and internal knowledge management (KM) capability respectively. Two complementary theories were used in this study--OIPT and AC. While OIPT aims to clarify how uncertainty caused by task environment affects ERP assimilation, AC was used to explain how a firm's ability to acquire and internalize knowledge and apply this knowledge affects ERP assimilation.

## 2.1 Organizational fit of ERP

As shown in Figure 1, the first variable that tends to affect ERP assimilation is organizational fit of ERP. Research on IS contingencies recognizes the importance of the fit between different dimensions of a firm and IS (Hong and Kim 2002), noting that the better the fit among the contingency variables, the better the performance. According to Marius and Ashok's (1996) study, the success of packaged software is positively affected by the extent of vendor fit with user organization and the extent of software fit with user organization respectively. Implementing ERP is likely to experience difficulties if the user organization and ERP vendors have a different perspective on how to implement ERP systems (Hong and Kim 2002). ERP vendors aim to embody the universally applicable "best practices" and avoid performing major modifications to the packaged software, while employees are likely to resist major organizational changes caused by the ERP implementation.

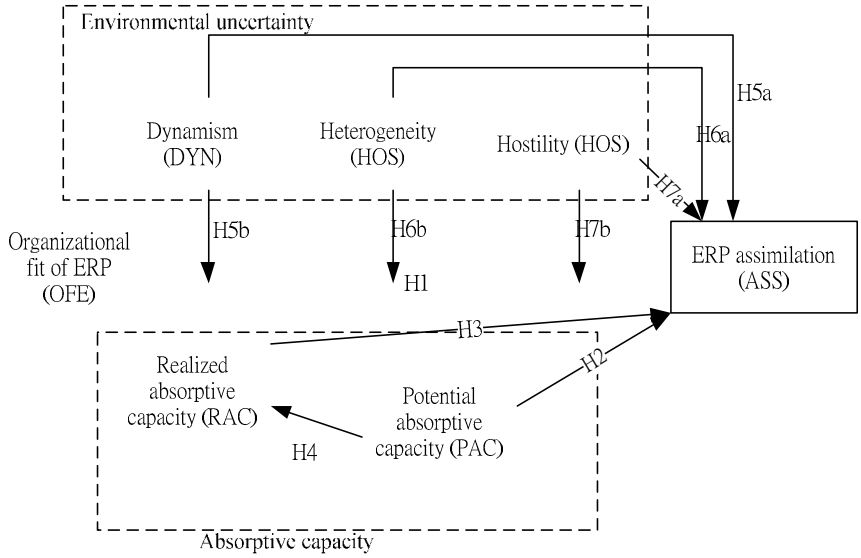


*Figure 1. A conceptual model.*

To assimilate ERP, users have to unlearn their legacy systems after the implementation of ERP and are willing to adapt to the new business processes based on ERP's best practices (Liang et al. 2007). A firm with less fit needs more software configuration and organizational changes to align the firm's existing operating processes with the "best practices" embedded in the ERP systems (Liang et al. 2007, Orlikowski 1992, Williams and Edge 1996). This in turn reduces ERP users' motivation of adapting to the new business processes because of the substantial change in the adopting firm's businesses processes, ERP systems, or both (Hong and Kim 2002). Thus, organizational fit is likely to play a crucial role in explaining the success of ERP assimilation.

Further, unlike tailor-made applications, the mass production of ERP package separates the critical occasions of design and implementation in time and space (Wang et al. 2006). Because of the gaps between the ERP generic functionality and the specific organizational requirement and existing procedures of the adopting firm, deciding how these gaps will be addressed becomes a critical issue (Hong and Kim 2002). Prior work (Hong and Kim 2002, Wang et al. 2006) argues that organizational fit of ERP plays a key role in the success of ERP implementation. Williams and Edge's (1996) study also shows because of the scale and integrative nature of an ERP, the effort required for a client to fit an ERP system's reference model and functionality by adjusting practices can be extensive, leading to a difficult reengineering task. Given organizational fit of ERP refers to an important IS contingency affecting the assimilation of a technical innovation, the more organizational fit a firm has, the more analyzability and predictability of work the organization unit has to undertake (Daft and Lengel 1986, Karimi et al. 2004). This in turn may help ERP assimilation. Thus,

- Hypothesis 1: Higher levels of organizational fit of ERP lead to a higher extent of ERP assimilation within the organization.

## 2.2 Absorptive capacity

Many studies have examined the impact of an organization's absorptive capacity (AC) on organizational performance in broad context, including the adopting of new technology (Nicholls-Nixon 1993), the transfer of technological knowledge (Reagans and McEvily 2003), and organizational learning (Park et al. 2007). A firm's AC is also used as the theoretical basis for understanding how its usage affects IS implementation and infusion (Boynton et al. 1994). Similar arguments have been proposed by other studies (Jansen et al. 2005, Zahra and George 2002), they suggest that organization-level prior knowledge, knowledge exploitation, and management support play a key role in IS implementation.

Following prior work (Jansen et al. 2005, Zahra and George 2002), this study conceptualizes AC as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability. We further classify AC into two interrelated components—potential AC and realized AC. Potential AC, which includes knowledge acquisition and assimilation, captures efforts expanded in identifying and acquiring new external knowledge and in assimilating knowledge obtained from external sources. Realized AC, which includes knowledge transformation and exploitation, encompasses deriving new insights and consequences from the combination of existing and newly acquired knowledge, and incorporating transformed knowledge into operations (Jansen et al. 2005, Zahra and George 2002).

In ERP context, a firm's potential AC refers to its capability for acquiring knowledge regarding ERP systems and ERP consulting firms, and internalizing new knowledge into his/her task environments. Realized AC relates to applying knowledge to the task. As Cohen and Levinthal (1990) stressed, absorptive capacity is not only the capability to understand and assimilate external knowledge (i.e., potential AC), but also the ability to exploit and commercialize it. Thus, realized AC emphasizes a firm's ability to use and share ERP knowledge in performing tasks (Park et al. 2007). As noted previously, a firm with higher absorptive is more willing to adopt new technology, adapt to new business processes derived from ERP's best practices, and assimilate the technical features of an ERP system into the business routines (Liang et al. 2007). This further indicates a firm's absorptive capacity is positively associated with ERP assimilation.

As noted previously, potential absorptive capacity includes knowledge acquisition and assimilation. Following Zahra and George (2002), we define acquisition as a firm's capability to identify and acquire externally generated knowledge that is critical to its operation. The more new external knowledge an organizational unit absorbs, the more likely the adoption of new knowledge and the transfer of process knowledge can be achieved (Cockbum and Henderson 1998). Applying this to ERP context, a firm's ability in acquiring external knowledge indicates the firm is able to absorb novel knowledge about ERP systems faster and more effective (Jansen et al. 2005, Park et al. 2007), leading to ERP assimilation.

Knowledge assimilation refers to a firm's routines and processes that allow it to analyze and interpret the information obtained from external sources, which in turn help the firm apply the knowledge in various fields (Gist et al. 1989, Zahra and George 2002). In addition, Knowledge assimilation also helps users enhance their task performance through synthesizing prior and newly acquired knowledge (Park et al. 2007). In ERP context, since a firm's knowledge assimilation is associated with its comprehension and learning of embedded logic in ERP systems, higher firms' knowledge assimilation is likely to lead to better utilize the best practices of ERP and apply them to business processes, resulting in better ERP assimilation (Chatterjee et al 2002, Liang et al. 2007). Based on the above argument, we have the second hypothesis.

- Hypothesis 2: Higher levels of potential absorptive capacity lead to a higher extent of ERP assimilation within the organization.

As mentioned before, realized absorptive capacity includes knowledge transformation and exploitation. The former denotes a firm's capability to develop and refine the routines that facilitate combining existing knowledge and newly gained and assimilated knowledge (Jansen et al. 2005, Zahra and George 2002). They also suggest that knowledge transformation tends to yield new insights, facilitate the recognition of opportunities, and at the same time, alter the way the firm sees itself and its competitive landscape. The focus of ERP post-implementation is on internal functional coordination and IT integration and innovation at global level, requiring a firm's transformation component of AC (Rajogopal 2002). Research (Liang et al. 2007, Park et al. 2007) reports that transformation stimulates combining existing knowledge and the newly acquired knowledge, which in turn helps ERP users refine the routines and align ERP systems with business processes, leading to ERP assimilation.

Exploitation is defined as a firm's capability to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations. Thus,

exploitation reflects a unit's ability to harvest and incorporate knowledge into its operations or business routines (Jansen et al. 2005, Zahra and George 2002). In ERP context, the more exploitation firms have, the more likely they establish routines that advance and use their knowledge to enhance existing business processes or encourage new initiatives within a firm (Liang et al. 2007, Rajogopal 2002). Similar arguments have been proposed by Park et al. (2007), showing the exploitation of newly acquired knowledge into everyday tasks helps organizational members establish routines and perform tasks with the above knowledge, which in turn lead to increasing knowledge and sharing activities across departments, teams, and the organization. Thus, a firm's high realized absorptive capacity indicates that the members of the firm are both technically savvy about the ERP system and familiar with how to realize ERP integration at global levels (Rajagopal 2002). Therefore,

- Hypothesis 3: High levels of realized absorptive capacity lead to a higher extent of ERP assimilation within the organization.

Park et al's (2007) empirical study found that ERP users' absorptive capacity for applying ERP systems are affected by both their AC for understanding and assimilating ERP systems (i.e. potential AC). Theory also suggests that a firm's potential AC influences its realized AC (Srivardhana and Pawlowski 2007, Zahra and George 2002). Extending their argument, an organizational unit's realized AC is likely to be affected by potential AC, because without recognizing and assimilating useful external knowledge first--potential AC, it is unlikely the organizational unit has the capabilities to apply the above knowledge to the achievement of organizational goals (Park et al. 2007, Srivardhana and Pawlowski 2007). This leads to hypothesis 4.

- Hypothesis 4: Higher levels of potential absorptive capacity lead to a higher extent of realized absorptive capacity.

### 2.3 Environmental uncertainty

Environmental uncertainty may also affect ERP assimilation. This study uses OIPT to explain the influence of environmental uncertainty on ERP assimilation, because it has been recognized as an adequate explanation for exploring the influence of organizational task environments on organizational decision making and outcomes (Karimi et al. 2004). OIPT suggests that organizations process information to reduce uncertainty, and their effectiveness relies on their capability to process information and match their information processing capacities with the uncertainty they face (Daft, 2001; Daft and lengel 1986; Dess and Beard, 1984). Uncertainty is associated with insufficient information, leading to acquisition of more data and the inability to confidently predict probabilities of how environments will affect the success or failure of a decision-making task. ERP systems can be viewed as a particular class of information processing mechanism, aimed to reduce uncertainty by either providing compatibility among disparate systems or fostering a mutual exchange of information between the departments (Gattiker and Goodhue 2005, Rajagopal 2002). For example, the administrative department may need the information of production processes so that the administrative tasks can be handled efficiently. When confronted with environmental uncertainty, a firm is more likely to rely on a powerful information-processing mechanism, such as ERP, from which the uncertainty can be minimized, resulting in more ERP assimilation.

Environmental uncertainty is measured by dynamism, heterogeneity, and hostility of the organizational task environments(Aldrich 1979, Dess and Rasheed 1991, Karimi et al. 2004). Dynamism is characterized by the rate of change and innovation in production and service technologies, such as the impact created by aligning a firm's business processes with ERP best practices (Daft et al. 1988, Srivardhana and Pawlowski 2007). The more dynamism a firm is confronted with, the more likely it faces a number of external elements that change frequently and unpredictably. This in turn makes the firm difficult to implement strategic plans and demonstrate the feasibility of them.Under this difficulty, users may bemorewilling to adapt to the new business processes based on ERP's best practices (Liang et al. 2007).This is becauseERP could provide a sky-level view and updated information of the process and their relationship to both local and organization-wide performance (Rajogopal 2002). Based on the above arguments, we propose H5a.

- Hypothesis 5a: Higher levels of dynamism in the organizational task environments lead to a higher extent of ERP assimilation within the organization.

The more environmental dynamism a firm faces, the more important the role of interdependent tasks becomes. This is so because reducing uncertainty caused by environmental dynamism entails the interaction and coordination between firms (Karimi et al., 2004). In addition, there is an increased need to link an organization with the key elements in its task environments so that the information about changes in the environments can be detected and the problems caused by the environments can be handled (Maier et al., 1997). Under such conditions, it is more likely that ERP users unlearn their legacy systems, are motivated to adapt to the new business processes based on ERP best practices, and depend on power users for solving bottlenecks (Hirt and Swanson 2001, Liang et al. 2007). Thus, the impact of initial organizational fit of ERP becomes less significant. But in the case of low dynamism, users tend to rely more on their legacy systems rather than adapting to the business processes derived from ERP's best practices because most of the problems can be solved by using the existing business routines (Boudreau and Robey 2001). Thus, the association between the initial fit of ERP and ERP assimilation becomes stronger. In sum, when the level of dynamism is low, we expect a stronger relationship between organizational fit and ERP assimilation and expect the opposite when the level of dynamism is high.

- Hypothesis 5b: The lower the levels of dynamism in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation.

According to the view of resource-dependence, hostility of environments refers to their restrictiveness and both availability of resources and the degree of competition for these resources (Miller and Friesen 1983). Hostile task environments include the following features—severely restricted regulations, an unpleasant business climate, fierce competition of price, product, technology, and distribution, a lack of labor or raw materials, and a shortage of resources and opportunities for exploitation (Karimi et al. 2004, Mintaberg 1979). More information coordination and integration is needed when decision makers are confronted with hostility because they rely more on environmental scanning for more data and more exploration (e.g., search, innovation) and exploitation (e.g., efficiency, selection, execution) are required to better reduce the threat emerged from hostility (Karimi et al. 2004, March 1991). Hostility of environments tend to foster ERP assimilation because ERP systems are aimed at information integration and coordination at global levels and establishing linkages with key elements of a firm's task environments (Liang et al. 2007). For example, all information about various activities related to a customer, product, a certain production unit or about movement of materials and products are all kept current in the ERP system (Rajagopal 2002). Based on the above arguments, we propose H6a.

- Hypothesis 6a: High levels of hostility in the organizational task environments lead to a higher extent of ERP assimilation within the organization.

When the level of hostility increases, decision makers need a more powerful IS for exploration (risk taking and discovery) and exploitation (refinement and implementation) (March 1991) so that the possible environmental threat to the organization's performance can be effectively countered. As noted previously, the aim of ERP is to stimulate information diffusion, information coordination, and information availability for fast decision-making and organizational integration (Rajagopal 2002, Liang et al. 2007). Thus, to deal with hostility, rather than relying on legacy systems, firms are more likely to rely on power users or adapt to ERP's best practices. Similar to dynamism, the levels of hostility in the organizational environments exert the same influence on the relationship between organizational fit and ERP assimilation. Thus, based on the same reasoning for hypothesis 5b, as the level of hostility increases, we expect a weaker relationship and expect the opposite as the level of hostility decreases.

- Hypothesis 6b: The lower the levels of hostility in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation.

Heterogeneity is defined as the extent of similarity and differentiation within the task environment of a firm (Hall 1999). The more heterogeneous environments a firm faces, the more likely that the firm adopts a diverse range of approaches to very different marketing, and administration practices (Daft et al. 1988, Miller and Friesen 1983). In order to reduce the uncertainty generated by heterogeneous task environments, firms tend to rely on powerful information processing mechanisms such as ERP systems. ERP is an IT integration tool aimed at connecting all the databases and activities related to a certain business process that occur simultaneously in various functions (Rajagopal 2002). To minimize the uncertainty created by heterogeneity, decision makers need to know how their actions will affect interrelated business processes across boundaries within their organization and across organizational boundaries (Daft and Lengel 1986). Thus, the extent to which the decision makers rely on ERP assimilation increases. Thus, we propose H7a.

- Hypothesis 7a: High levels of heterogeneity in the organizational task environments lead to a higher extent of ERP assimilation within the organization.

When the uncertainty caused by heterogeneous tasks increases, decision makers have to handle more nonroutine and interdependent tasks. This in turn makes necessary for decision makers to share information on how the firm's goals can be effectively achieved (Chidambaram and Jones 1993, Karimi et al. 2004). Because the aim of ERP assimilation is to provide connectivity among various business functions in an organization--integrating the vastly ignored manufacturing information with the popular administrative functions of the organization, ERP users tend to rely more on ERP systems rather than on their legacy systems when minimizing environmental uncertainty introduced by heterogeneity (Hong and Kim 2002, Liang et al. 2007, Rajagopal 2002). Since heterogeneity causes the same effect on the relationship between organizational fit of ERP and ERP assimilation as hostility, based on the same reasoning for hypothesis 6b, when the level of heterogeneity is high, we expect a weaker relationship and expect the opposite when the level of heterogeneity is low.

- Hypothesis 7b: The lower the levels of heterogeneity in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation.

# 3 RESEARCH METHODOLOGY AND ANALYSIS

## 3.1 Sample and data collection

Survey method and partial least squares (PLS) were used to collect data and examine the proposed hypotheses respectively. This study's unit of analysis is an organization. In an attempt to include only those firms that were in the post-implementation stage of ERP, the sample that has implemented ERP for more than one year was drawn from the CommonWealth Directory of the 500 largest manufacturing firms in Taiwan, because manufacturing firms would be a better representation of ERP assimilation (Wang et al. 2006). This study was conducted in Taiwan, over a period of 6 months, from mid to late 2008. ERP project leaders refer to senior managers who not only have the experience in ERP implementation, but also possess the strategic level knowledge of a firm. In addition, based on our interviews with many ERP researchers and practitioners, ERP project leaders are the individuals most knowledgeable about every aspect of the ERP project in their firm. Thus, ERP project leaders were chosen as the key informants. The constructs of the proposed model were operationalized as formative constructs as discussed next (Petter et al. 2007).

We developed the items in the questionnaire either by adapting measures that had been validated by prior research or by converting the definitions of constructs into a questionnaire format. An English version of the questionnaire was first compiled and modified to suit the context of ERP and then translated into Chinese by a bilingual research associate. The Chinese version of the questionnaire was verified and refined for its translation accuracy by one senior associate professor and two senior doctoral students who were familiar with and had done extensive research on ERP. The draft questionnaire was pretested for face and content validity with three IS managers who have led ERP projects and with two consultants who have extensive experience in ERP implementation consultation

of ERP systems. This procedure resulted in some modifications of the wording of several survey items and dropping one and two items from potential AC and realized AC respectively.

ERP project leaders were identified with the help of the firms' chief operating officer (COO). Each COO was sent a letter of solicitation, including the goal and a brief description of the study and a copy of the questionnaire to be completed by the ERP project leader. The respondents' confidentiality was assured. A follow-up was conducted two weeks after the first mailing. A total of 98 questionnaires were received and used for analysis, yielding a 23 percent response rate, which is typical for similar surveys conducted in Taiwan or other areas (Liang et al. 2007, Wang et al. 2006).

Table 1 shows the respondents' characteristics, including industry, company size, position, time after implementation, and country of origin of ERP packages. Half of the respondents (50%) are smaller firms with fewer than 500 employees. 70 out of 98 firms (71.4 %) chose a local ERP package—the majority of them used the package provided by the biggest Taiwanese ERP vendor (Data Systems). As to the foreign ERP package, most of the firms used the package offered by Oracle.

| Measure | Items | Freq. | Percentage (%) |
|---|---|---|---|
| Industry | Technology/network | 31 | 31.6 |
| | Manufacturing | 42 | 42.9 |
| | Electronics | 16 | 16.3 |
| | Service | 5 | 5.1 |
| | Others | 4 | 4.1 |
| Company size | 1-100 | 23 | 23.5 |
| | 100-500 | 26 | 26.5 |
| | 500-1000 | 19 | 19.4 |
| | 1000+ | 30 | 30.6 |
| Time elapsed (years) | 1 to 2 | 18 | 18.4 |
| | 2 to 3 | 19 | 19.4 |
| | 3 to 5 | 26 | 26.5 |
| | 5+ | 35 | 35.7 |
| ERP implementation alternatives | (a) domestic vendor | 70 | 71.4 |
| | (b) international vendor | 28 | 28.6 |

*Table 1. Demographic information of respondents (N= 98)*

## 3.2 Measures

### *3.2.1 ERP assimilation*

Following Liang et al's (2007) study, the volume of assimilation was measured by the percentage of a subset of business processes that were conducted by ERP. Diversity represents the number of a firm's business functional areas automated by ERP technology. Depth refers to the vertical influence of ERP systems on their business activities, ranging from planning to decision making. Given this study focuses on how ERP is used for back office automation, the breadth dimension of ERP assimilation was not included.

### *3.2.2 Organizational fit of ERP*

Following Hong and Kim (2002), we operationalized the organizational fit of ERP in terms of data, process, and user interface fit of ERP before or at the initial implementation period.

### *3.2.3 Potential absorptive capacity and realized absorptive capacity*

Potential AC consists of acquisition and assimilation of new external knowledge (Jansen et al. 2005, Zahra and George 2002). Six items assessed the intensity and direction of efforts expended in knowledge acquisition. The other six items measured transformation and assessed the extent to which

organizational units were able to identify opportunities and predict the consequences of applying the accumulated knowledge to existing operations, structures, and strategies (Jansen et al. 2005).

#### *3.2.4 Environmental uncertainty—dynamism, heterogeneity, hostility*

There have been many debates in the literature as to whether the environment should be treated as an objective reality or a perceptual phenomenon (Dess and Rasheed 1991). Others (Karimi et al. 2004) have reported that perceptions of uncertainty, rather than actual uncertainty, are salient to decision making and strategy formulation. Following them, we used both conceptual and objective measures to avoid problems associated with using either measure alone.

# 4 DATA ANALYSIS AND RESULTS

Partial least squares (PLS-Graph Version 3.0) were used for testing the proposed model because PLS is not contingent upon data having multivariate normal distributions (Chin 1998). PLS perform an iterative set of factor analysis and a bootstrap approach to estimate the significance (t-values) of the paths by using ordinary least squares as its estimation technique.

## 4.1 Measurement model

Following recommended two-stage analytical procedures (Hair et al. 1998), confirmatory factor analysis was first conducted to examine the measurement model; then, the structural relationships were examined. The proposed model was validated by three types of validity—content validity, convergent validity, and discriminant validity. Individual item reliability is assessed based on the factor loading of the item. A factor loading less than 0.5 should be dropped--6 and 5 items were dropped from potential AC and realized AC respectively.

Content validity was established by ensuring consistency between the measurements and the extant literature. This was done by interviewing senior practitioners and pilot-testing the instrument. The convergent validity was examined by checking composite reliability and average variance extracted (AVE) from the measures (Hair et al. 1998). Although some studies using PLS suggest 0.5 refers to an accurate measure of threshold reliability, 0.7 is a recommended value for a reliable construct (Chin 1988). Table 2 lists our composite reliability values, ranging from 0.77 to 0.89. As to AVE, a score of 0.5 indicates acceptability (Fornel and Larcker 1981). Table 2 shows that our AVE ranges from 0.5 to 0.629, indicating acceptability. We verified the discriminant validity of our instrument by checking the square root of the AVE as suggested by Fornell and Larcker (1981). Table 3 confirms the discriminant validity—the square root of the AVE for each construct is greater than the levels of correlation involving the construct.

| Measures | Items | Composite reliability | AVE |
|---|---|---|---|
| Dynamism (DYN) | 3 | 0.770 | 0.530 |
| Hostile (HOS) | 3 | 0.795 | 0.571 |
| Heterogeneity (HET) | 2 | 0.873 | 0.517 |
| Organizational Fit (OF) | 7 | 0.890 | 0.537 |
| Potential absorptive capacity (PAC) | 3 | 0.832 | 0.629 |
| Realized absorptive capacity (RAC) | 7 | 0.872 | 0.500 |
| ERP Assimilation (ASS) | 3 | n/a | n/a |

*Table 2. Reliability of constructs (AVE denotes average variance extracted).*

| | Mean | S.D. | DYN | HOS | HET | OF | PAC | RAC | ASS |
|---|---|---|---|---|---|---|---|---|---|
| DYN | 3.384 | 0.798 | **0.728** | | | | | | |
| HOS | 3.626 | 0.765 | 0.357 | **0.756** | | | | | |
| HET | 3.633 | 0.817 | 0.239 | 0.344 | **0.719** | | | | |
| OF | 3.589 | 0.743 | 0.214 | 0.08 | 0.000 | **0.733** | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PAC | 3.667 | 0.658 | 0.275 | 0.202 | 0.235 | 0.098 | **0.793** | | |
| RAC | 3.620 | 0.699 | 0.384 | 0.246 | 0.056 | 0.372 | 0.649 | **0.705** | |
| ASS | 3.582 | 0.865 | 0.151 | 0.141 | 0.259 | 0.294 | 0.426 | 0.409 | **n/a** |

*Table 3. Correlation between constructs (The shaded numbers in the diagonal row are square roots of the AVE).*

### 4.2 Structural model

With an adequate measurement model, the proposed hypotheses were tested with PLS, including estimates of the path coefficients and $R^2$. The former refers to the strengths of the relationships between the dependent and independent variables, and $R^2$ implies the amount of variance explained by the independent variables or the explanatory power of the structural model. A bootstrap resampling procedure was used to generate t-statistical and standard error (Chin 1998), focusing on an estimate of confidence rather than the normal approximation. Following Wang et al. (2006), resamples of 300 were chosen. Table 4 demonstrates the results of the above analyses.

The $R^2$ for the ERP assimilation is 0.309. Organizational fit has a positive effect on ERP assimilation (ß= 0.204, p<0.01) as expected. Both potential absorptive capacity (ß= 0.276, p<0.001) and realized absorptive capacity (ß= 0.233, p<0.01) positively affect ERP assimilation. Hypothesis 4 proposed a link between potential absorptive capacity and realized absorptive capacity. The path is positive and significant (ß= 0.484, p<0.001), suggesting that potential absorptive capacity has considerable influence on realized absorptive capacity. Regarding environmental uncertainty, only the path between heterogeneity and ERP assimilation is positive and significant (ß= 0.214, p<0.01). In sum, H1, H2, H3, H4, and H7a are supported as expected, and our findings don't support H5a and H6a surprisingly.

### 4.3 Moderating effects model

Moderating effects can be assured by comparing the difference between the main effect and the moderating effect models (Park et al. 2007, Wang et al. 2006). We first obtained the R-square ($R^2$) of the main effect model, which includes the independent variable, moderator, and dependent variable only. The R-square ($R^{2'}$) of the moderating effect was then obtained by including the independent variable, moderator, interaction term, and dependent variable. The interaction terms were calculated by adding the product of each indicator in the independent variable and each indicator in the moderator. The estimated effect size of f2 was derived from (R22-R12)/(1-R22). We then obtained a pseudo F-value by multiplying f2 with (n-k-1), where n is the sample size and k is the number of independent variables in the regression equation. Finally, we compared the pseudo F-value with F1, n-k-1. The above steps are aimed at testing the change of variance extracted by adding a new variable (the interaction term) into the model. The results of Table 4 show that both H6b and H7b are supported as seen in models 3 and 4 respectively, but H5b is not supported surprisingly. The results are summarized in Table 5.

| Independent variables | Dependent variable: Assimilation of ERP | | | |
|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 |
| Organizational Fit of ERP (H1) | 0.204**(2.232) | 0.193**(2.122) | 0.202***(2.359) | 0.187***(2.646) |
| Potential absorptive capacity (H2) | 0.276***(2.619) | 0.216***(2.434) | 0.274***(2.660) | 0.255***(2.388) |
| Realized absorptive capacity (H3) | 0.233**(1.906) | 0.231** (1.845) | 0.188**(1.747) | 0.198**(1.725) |
| Dynamism (H5a) | -0.099(1.253) | -0.080(0.953) | -0.016(0.219) | -0.065(0.853) |
| Hostility (H6a) | -0.026(0.251) | 0.009(0.084) | 0.041(0.460) | -0.040(0.436) |
| Heterogeneity (H7a) | 0.214**(1.944) | 0.188**(1.786) | 0.183**(1.864) | 0.227**(2.019) |
| PAC → RAC (H4) | 0.484***(6.972) | 0.4855***(9.904) | 0.486***(8.893) | 0.484***(7.071) |
| DYN * OF (H5b) | | -0.076(0.784) | | |
| HOT * OF (H6b) | | | -0.252***(2.68) | |
| HET * OF (H7b) | | | | -0.192**(1.877) |

| | | | | |
|---|---|---|---|---|
| $R^2$ | 0.309 | 0.313 | 0.361 | 0.335 |
| Differenced$R^2$($R^{2'}$) | | 0.004 | 0.052 | 0.026 |
| $f^2$ | | 0.006 | 0.080 | 0.03 |
| Test of differenced $R^2$ | | 0.524 | 7.324*** | 4.519** |

*Table 4. Hypotheses testing (*p < 0.1, **p < 0.01, ***p < 0.001; F(0.1,1,90) = 2.77, F(0.05,1,90) = 3.96, F(0.01,1,90) = 6.965).*

| Hypothesis | Results |
|---|---|
| Hypothesis 1: Higher levels of organizational fit of ERP lead to a higher extent of ERP assimilation within the organization. | Supported |
| Hypothesis 2: Higher levels of potential absorptive capacity lead to a higher extent of ERP assimilation within the organization. | Supported |
| Hypothesis 3: High levels of realized absorptive capacity lead to a higher extent of ERP assimilation within the organization. | Supported |
| Hypothesis 4: Higher levels of potential absorptive capacity lead to a higher extent of realized absorptive capacity. | Supported |
| Hypothesis 5a: Higher levels of dynamism in the organizational task environments lead to a higher extent of ERP assimilation within the organization. | Not Supported |
| Hypothesis 5b: The lower the levels of dynamism in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation. | Not Supported |
| Hypothesis 6a: High levels of hostility in the organizational task environments lead to a higher extent of ERP assimilation within the organization. | Not Supported |
| Hypothesis 6b: The lower the levels of hostility in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation. | Supported |
| Hypothesis 7a: High levels of heterogeneity in the organizational task environments lead to a higher extent of ERP assimilation within the organization. | Supported |
| Hypothesis 7b: The lower the levels of heterogeneity in the organizational task environments, the stronger the positive relationship between organizational fit and ERP assimilation. | Supported |

*Table 5. Results of hypothesis testing.*

# 5 DISCUSSIONS

This study extends previous findings on ERP assimilation by linking both environmental uncertainty and absorptive capacity, and by measuring the influence of initial fit on ERP assimilation (Hong and Kim 2002, Wang et al. 2006). We found that initial fit of ERP still affects ERP performance in the post-implementation stage of ERP (or ERP assimilation), and this association is negatively contingent on heterogeneity and hostility. Both potential AC and realized AC positively influence ERP assimilation. Among the three antecedents of environmental uncertainty, only heterogeneity is associated with ERP assimilation significantly.

The above finding has important implications for IS practice. Since the problems associated with imperfect fit of ERP cannot be completely remedied, firms with the aim of enhancing ERP assimilation should adopt a two-fold strategy. Selecting the ERP product requires the minimum alignment between the features of the ERP and business routines before ERP implementation. In addition, firms should also focus on improving their absorptive capacity, including mechanisms that enable units to synthesize and apply current and newly acquired external knowledge, and to highlight the importance of cross-functional coordination (Jansen et al. 2005). Future work may investigate how a unit's absorptive capacity can be improved by adopting organizational mechanisms in ERP settings

such as those with coordination, system, and socialization capabilities. In addition, as suggested by Jones et al. (2008), the benefits of ERP assimilation are affected by the understanding of ERP software and business processes, which in turn is affected by various types of interventions such as software training, and work process training. Future research may consider the relationships between the above interventions and absorptive capacity.

The above finding also has managerial implications. We suggest that ERP managers should raise their awareness of the issues associated with the organizational task environments when assimilating ERP. This is so because the more environmental uncertainty a firm faces, the more likely that the firm needs accurate data for approaching their decision-making tasks. Thus, understanding the influence of task environments (particularly heterogeneity and hostility) on work processes and ERP's best practices not only improves ERP assimilation, but also mitigates the negative effect caused by the lack of initial organizational fit of ERP.

# 6 LIMITATIONS

This study has four limitations. First, this study examines ERP assimilation from two perspectives, internal AC and external task environments, but other factors may also affect ERP assimilation such as external institutional forces (e.g., institutional isomorphism) and internal human agency (e.g., top management beliefs and participation). Future work may take them into consideration. Second, although this study has been careful about identifying the most suitable key informants such as the project leaders, relying on the self-report of the single informant may still suffer perceptual and common method biases, which can not be completely screened and eliminated via statistical means. Third, we assume that the aim of ERP assimilation for every responding organization is to perform ERP applications so that they become deeply embedded within the organization's work processes and projects. Fifty, this study assumes that when a firm's ERP has been implemented, its legacy systems don't run in parallel and the tasks were not accomplished manually if they can be fulfilled by ERP systems. Finally, since the data was collected from Taiwan, the results may not be applied to other countries, thus the generalizability of our findings should be addressed in the future research.

# 7 CONCLUSION

Drawing broadly on OIPT, the theory of absorptive capacity, and the extant literature of IT adoption and diffusion, we developed and tested an ERP assimilation model. Our theoretical framework reconciles the independent contributions of three well-established streams in the literature—organizational fit of ERP, environmental uncertainty, and absorptive capacity. An integrated model is developed to test their impact on ERP assimilation. We also investigate how the relationship between initial fit and ERP assimilation is contingent on environmental uncertainty. Empirical results based on 98 Taiwanese firms largely support the proposed model and hypotheses. Our findings contribute to the ERP literature by focusing on the much neglected ERP assimilation stage. We confirm that initial fit, which has been shown to be critical to ERP adoption and implementation, is also significant in the assimilation stage. This study also underscores the important role of both absorptive capacity and task environments, which refer to internal and external antecedents respectively, in affecting ERP assimilation. Finally, it suggests that environmental uncertainty adversely moderates the relationship between initial fit and ERP assimilation.

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