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The Importance of Change Management after ERP Implementation: An Information Capability Perspective

Seung Lee
Small Business Corporation

Ho Lee
Yonsei University

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Seung Chang Lee
Small Business Corporation
Seoul, Korea
lee_seungchang@yonsei.ac.kr

Ho Geun Lee
School of Business
Yonsei University
Seoul, Korea
h.lee@yonsei.ac.kr

Abstract

When firms implement enterprise resource planning, they need to redesign their business processes to make information flow smooth within organizations. ERP thus results in changes in processes and responsibilities. Firms cannot realize expected returns from ERP investments unless these changes are effectively managed after ERP systems are put into operation. This research proposes a conceptual framework to highlight the importance of the change management after firms implement ERP systems. Our research model is empirically tested using data collected from over 170 firms that had used ERP systems for more than one year. Our analysis reveals that the eventual success of ERP systems depends on effective change management after ERP implementation, supporting the existence of the valley of despair.

Keywords: ERP effectiveness, change management, information capability, organization citizenship behavior, IS innovation resistance, IT assets, user IT capability

Introduction

Many companies have recently implemented enterprise resource planning (ERP) in an attempt to improve their competitiveness in markets. According to an industry report, at least 30,000 firms around the world have invested in ERP in the past few years. One study estimates that between 1.5 and 6.0 percent of annual revenues are spent on ERP implementation (Mabert et al. 2001). However, ERP implementation has not been easy. Although ERP systems can improve organizational coordination, efficiency, and decision making, they have proven very difficult and costly to build. They require not only large technology investments but also fundamental changes in the way businesses operate.

Despite the large investment, many companies have failed to achieve the hoped-for financial returns from ERP implementation. According to Koch (2002), 40 percent of ERP project managers are unsatisfied with performance improvement from ERP spending. James and Wolf (2000) have found that only 10 to 15 percent of the surveyed firms have achieved expected performance improvement; the remaining firms are experiencing significant discrepancies between goals and results in key performance measures in ERP operations.

According to Pyun (2002), many firms that have introduced ERP to their organizations are experiencing a "valley of despair" (see Figure 1). ERP systems bring about not only a change in IS environment but an overall change in organizational structures and business processes. Companies that have managed to launch ERP systems often fail to achieve expected performance improvements because they are not equipped with effective change management capabilities. Once an ERP system is launched and put into operation, companies need to rework their business processes to make the information flow smooth within the organization. Employees have to take on new job functions and responsibilities. Organizations that either do not understand how

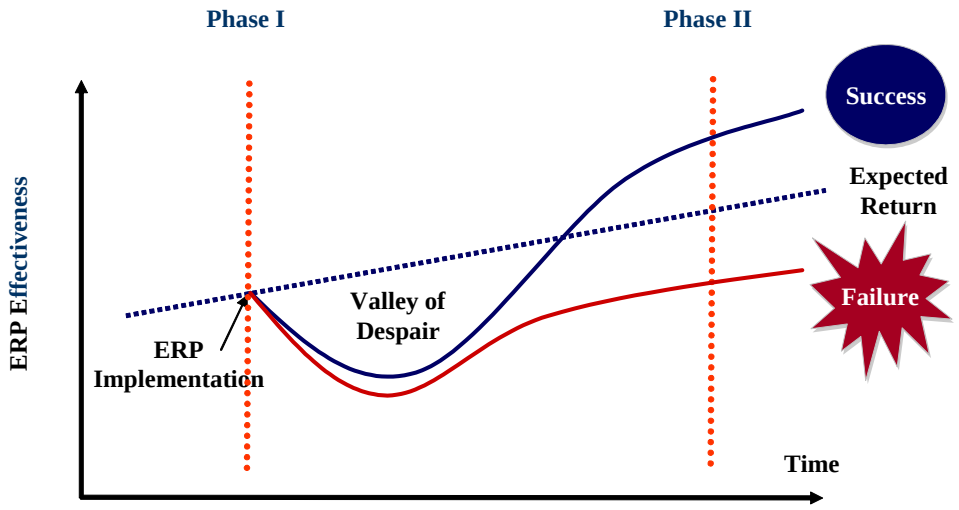

Figure 1. Valley of Despair
(Source: J. Pyun, "Can ERP Improve Business Performance?," *CIO Perspective* (2:8), 2002; used with permission.)

(Many firms experience a temporary decline in performance after ERP implementation. This performance drop, called valley of despair, occurs because of process changes required for ERP implementation. Firms that overcome this performance decline through effective change management can realize expected returns as ERP systems stabilize. Many firms fail to reach their target performance level because they are not equipped with effective change management programs.

much change will be required or are unable to make this change may not be able to achieve a higher level of functional and business process integration. Launching an ERP system is one thing; improving firm performance with ERP is another.

We understand that launching ERP systems is a formidable task, requiring significant resources of the organization. The central claim of this paper is that effective change management after ERP system launch is more important than the ERP implementation itself. This study proposes a conceptual framework for change management and its consequences after ERP system implementation. Our research model is empirically tested through a field survey. We have collected survey data from over 170 firms that had used ERP systems for more than one year. Our analysis reveals that the eventual success of ERP systems depends on effective change management after ERP implementation, supporting the existence of the valley of despair.

Literature Review

ERP Effectiveness

The measurement of information systems effectiveness has been a central concern of both academics and practitioners (Grover et al. 1996). Firms have invested significant resources in IS to improve business performance. However, it has been a challenging task to appropriately evaluate IS effectiveness. Marchand et al. (2000, 2002) state that the link between IS and business performance is not a direct relation, and that a more complex interaction among people, information, and information systems is most likely to catalyze a direct improvement in business performance.

ERP systems not only transform an IS environment but also affect business processes and employee behavior at a firm-wide level. Markus and Tanis (1999) stress that the outcome of ERP implementation is a dynamic concept, consisting of multiple dimensions: (1) business index **(**ROI, better decision making, etc.), (2) operational metrics (labor costs, orders shipped without errors, cycle times, inventory levels, etc.), and (3) information capability (information quality, effective use of information, user satisfaction with information, etc.). Firms are generally interested in the business index or the operational metrics when they adopt ERP. However, the use of these variables to assess the outcome of ERP implementation requires caution because they may have confounding effects with factors unrelated to ERP.

With ERP, corporations redesign business processes to make information flow smoothly within organizations. Bharadwaj (2000) argues that this firm-wide information capability creates superior firm performance. Marchand et al. (2002) note companies that use information effectively achieve better business performance. Thus, we use information capability as a measure of ERP effectiveness in this study. Information capability represents firms' capabilities associated with effective information use and information management. Information capability is thus an intermediating outcome variable, which will eventually lead to improved firm performance, such as business index or operational metrics.

Organizational Citizenship Behavior

Organizational citizenship behavior (OCB) encompasses employees' positive discretionary behaviors which go beyond delineated role expectations (Van Dyne et al. 1995). OCB should be voluntary (not prescribed and formally rewarded) and altruistic (of benefit to others rather oneself). Organ (1988) states that OCB consists of five characteristics: altruism, conscientiousness, civic virtue, sportsmanship, and courtesy.

Prior studies generally support a positive relationship between OCB and individual-level, group-level, and organizational-level performance (Podaskoff et al. 2000). Smith et al. (1983) argue that OCB facilitates organizational performance by lubricating the social machinery of organizations. OCB plays an important role in building relationships and contributes to the formation of social capital, a resource derived from the relationship among organizational members (Bolino et al. 2002). Podsakoff and MacKenzie (1997) explain how OCB positively influences organizational performance: (1) OCB enhances coworker or managerial productivity, (2)- OCB facilitates coordination of activities between team members and across workgroups, (3) OCB enhances the stability of organizational performance by reducing the variability in a work unit's performance, and (4) OCB enhances an organization's ability to adapt to environmental changes.

ERP systems not only transform an IS environment but also affect business processes and employee behavior at a firm-wide level. ERP requires that firms integrate discrete business processes in sales, production, finance, and logistics. Information supplied by ERP is structured around cross-functional business processes to improve management reporting and decision making. Employees have to take on new job functions and responsibilities as a result of this reengineering. One of the leading causes of ERP failures is not system functionality but rather the organization's ability to adapt to the system functionality. OCB is extra behavior over official-role behavior, and thus can enhance a firm's ability to adapt to organizational changes resulting from ERP adoption. It is essential for a firm to leverage OCB to ensure effective change management. Firms need to train employees and create work environments that foster discretionary behaviors like OCB.

Change Management

Change management is usually required when changes occur in the environment where an organization operates. Environmental variables which cause changes may be political, economical, sociological, or technological (Jury 1997). An IS implementation, such as ERP implementation, involves sweeping changes to organizational structure, business processes and core competencies at a firm-wide level.

Traditional ways of managing changes have their roots in Lewin's (1952) three-stage model: unfreezing–changing–refreezing. According to this model, the organization prepares for change, implements the change, and then strives to regain stability after the change. This model, which treats change as an event to be managed during a specified period, may be appropriate for organizations that are relatively stable and bounded, and whose functionality is sufficiently fixed to allow for detailed specifications. Under more turbulent and uncertain organizational conditions, however, such a model is becoming less appropriate for change management. Orlikowski and Hofman (1997) present an improvisational model to manage technological change for firms with more dynamic and unstable environments. The improvisational model is built on the dual assumptions that IT-enabled changes are an ongoing process, and that all changes cannot be anticipated in advance. The improvisational model stresses the interactive relationship between the technology and the organizational context (including culture, structure, roles, and responsibilities) for change management.

Many academics and practitioners agree that IT-enabled change is different from more general change processes, and that the change must be managed to be successful (Benjamin and Levinson 1993; Macredie and Sandom 1999; Yetton et al. 1994). Benjamin and Levinson (1993) claimed that managers must know how to integrate the technology, business process, and organization in order to achieve the desired goals with the technology. Change management is the process of managing changes

to hardware, software, documentation, or procedures related to newly implemented information systems. The aim of the change management is to align an organization to best adopt new information systems.

Scott Morton (1991) claimed that change management is a core element for effective IS operations, emphasizing that firms should commit to change management activities for IS success. Many scholars have emphasized the importance of change management when IT is employed for organizational transformation (Bostrom and Heinen 1977; Kettinger and Grover 1995; Leavitt 1965). These scholars stress that effective change management requires a socio-technical system (STS) approach. The STS approach defines interrelated and mutually adjusting subsystems (technology, people, management, and structure) and presents a joint optimization of technology and people for radical changes of organizational structures and work design (Taylor 1998). It proposes that bargaining and conflict resolution should be employed at the earliest possible stage to enhance employees' acceptance of newly designed working environments. Change management after ERP implementation needs to employ the STS approach, which is people-oriented and diagnostic.

Research Framework

Research Model

This study claims that ERP without effective change management programs cannot produce expected returns; change management plays a critical role for firms' performance improvement after ERP implementation. Thus, the role of change management is emphasized as a mediating variable for ERP success. Our research model proposes that four antecedent variables influence the effectiveness of change management which, in turn, determines ERP effectiveness (see Figure 2). These independent variables include organizational citizenship behavior (OCB), resistance to IS innovation, user IT capability, and IT assets. The first three are user-related while IT assets are related to the IT department of organizations. The user-related variables influence ERP effectiveness through the mediating variable of change management effectiveness whereas IT assets influence both change management effectiveness (mediating variable) and ERP effectiveness (dependent variable). Thus, IT assets influence the ERP effectiveness both directly and indirectly (via change management effectiveness).

Hypotheses

Organizational Citizenship Behavior

Organ (1988, p. 4) defines organizational citizenship behavior (OCB) as "individual behavior that is discretionary, not directly or explicitly recognized by formal reward systems, and that eventually promotes the effective functioning of the organization." Organizational citizenship behavior has emerged as an important factor because official in-role behavior has limits in explaining organizational performance (Mackenzie et al. 1991). Organ (1988, 1990) finds that firms with employees who are always willing to help coworkers and to comply with policies and regulations demonstrate higher performance than other firms. In the long run, OCB represents extra-role behavior that is interrelated with job performance and organizational effectiveness (Bateman and Organ 1983; Smith et al. 1983). Borman and Motowidlo (1997) and Podsakoff and Mackenzie (1997) insist that extra-role behavior such as OCB has a closer bond with organizational performance.

Since ERP transforms business processes in organizations, employees have to take on new job functions and responsibilities. OCB can facilitate works in new processes by lubricating the social machinery of organizations. Employees with OCB are more likely to comprehend the program designed for change management, and display a positive reaction toward new processes and responsibilities.

H1: *Organization citizenship behavior is positively related to change management effectiveness in firms using ERP.*

Information System Innovation Resistance

Resistance to change is a conduct of behavior that prefers maintaining the status quo under the pressure to alter (Zaltman and Wallendorf 1983). It is associated with the degree to which individuals feel themselves threatened by changes (Ram 1987). Many corporations confront continuous resistance from their employees when they introduce innovation into the organization (Boonstra and Vink 1996; Brown and Quarter 1994; Mealiea 1978; Neck 1996; Resnick 1978). Change management can effectively balance forces in favor of a change over forces of resistance (Stebel 1992).

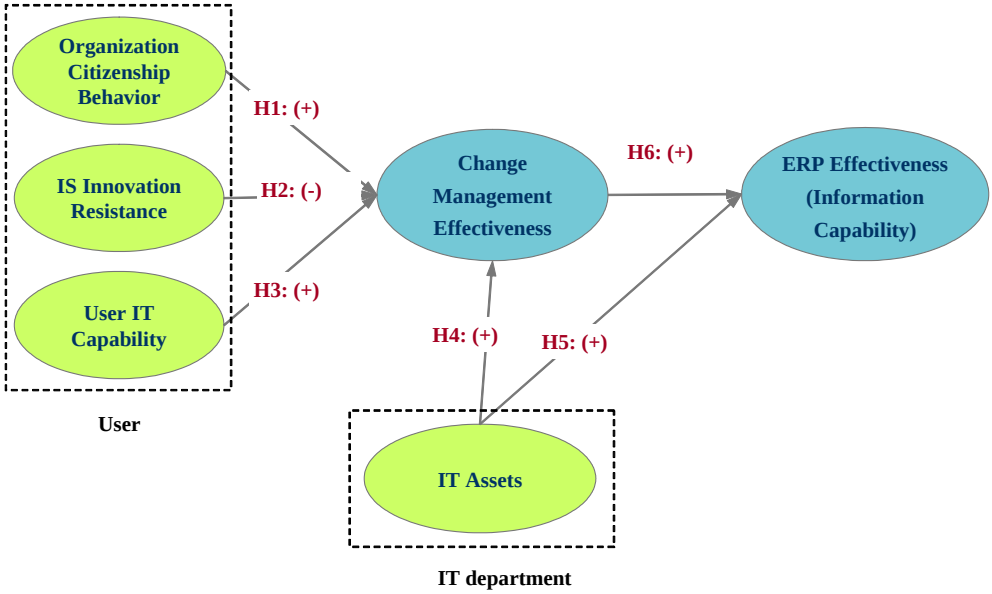

Figure 2. Research Model

In order to overcome the resistance to change, it is more important for a company to find out the origin of resistance than to apply coercive or oppressive force (Kettinger and Grover 1995). Most ERP systems are deeply intertwined with corporate business processes and it is difficult to make a change in only one part of the business without affecting other parts as well. Many organizations fail to overcome this resistance to IS innovations, binding their firms to outdated business processes and systems. Thus, resistance to IS innovations clearly serves as a barrier to change management of ERP operations.

H2: *IS innovation resistance is negatively related to change management effectiveness in firms using ERP.*

User IT Capability

The enhancement of user IT capability has been cited as a critical factor for successful implementation of ERP. Although a team of external consultants and internal IS specialists implement ERP systems, the end users determine its success. Many researchers have pointed out critical success factors related to ERP users: adequate training and education (Cameron and Meyer 1998; Chang and Cho 2000; Delone 1988; Fink 1998; Fuerst and Cheney 1982; Liang 1986), and communication between user and IS experts (Cameron and Meyer 1998; Delone 1988; Fink 1998; Jang et al. 2000; Miller and Doyle 1987). If end users are well-trained and equipped with a broad knowledge of ERP and IT, they are more likely to understand the need for process changes and, by extension, will more readily perceive ERP usefulness. Furthermore, communication with IS personnel would be more smooth and interactive if ERP users have a certain level of IT capability. It would also facilitate a more positive response toward change management as well. Thus, our third hypothesis states that the higher the user IT capability, the more effective change management will be.

H3: *User IT capability is positively related to change management effectiveness in firms using ERP.*

IT Assets

IT infrastructure is highly valuable for meeting business goals in ERP operations. IT infrastructure consists of three assets: (1) highly competent IT human asset, (2) reusable technology asset, and (3) strong relationship between IT and business management (Ross et al. 1996). IT assets have the potential to deliver long-term competitive advantages (Ross et al. 1996) and to sustain superior business performance (Bharadwaj 2000). ERP systems require complex pieces of hardware, software, and communication technologies. It is essential for organizations to put the right technologies in the right place and have them managed by knowledgeable IS specialists. We hypothesize that organizations' IT assets enhance information capabilities through

change management effectiveness. That is, firms with high levels of IT infrastructure are able to manage changes more effectively in ERP operations. Moreover, IT assets can directly affect ERP effectiveness in firms. If organizations are equipped with an excellent IT infrastructure, they can demonstrate superior information capabilities.

H4: *IT assets are positively related to change management effectiveness in firms using ERP.*

H5: *IT assets are positively related to ERP effectiveness (information capability) in firms using ERP.*

Change Management Effectiveness

Although many scholars have pointed out the importance of change management, operationalization of its construct is not available. The term *effectiveness* represents the degree of accomplishing certain objectives. Thus change management effectiveness can be measured through both users' satisfaction and the perceived usefulness of the programs introduced for change management. If ERP users are satisfied with these programs, we can assume that those programs are effective. Similarly, change management can be considered effective if employees perceive the programs are useful. In other words, users' beliefs and attitudes toward the change management program can be used as a surrogate variable for change management effectiveness. If firms introduce effective change management programs, they will increase ERP effectiveness.

H6: *Change management effectiveness is positively related to ERP effectiveness (information capability) in firms using ERP.*

Variable Construction

Our research model includes four constructs that capture antecedent (independent) variables of change management effectiveness. Organizational citizenship behavior (OCB) is measured by four sub-constructs: altruism, conscientiousness, courtesy, and civic virtue.[1] IS innovation resistance is constructed as *intensity of acknowledgement and threats followed by the uncertainties of new information systems and new job descriptions*. There are many sources and types of user resistance to a new technology; consequently, we employ constructs used by Sheth (1981) and Ram (1987) to classify resistance into two dimensions: perceived risk and habit. The perceived risk refers to one's perception of the risk associated with the decision to adopt the innovation (organizational source). The habit refers to the stickiness of current practices that one is routinely doing (individual source).

User IT capability indicates the users' understanding of ERP functions, and their ability to demonstrate fluency in ERP operations and to communicate with IS personnel (or staff) when facing problems with ERP. Based on Ross et al. (1996), we categorized IT assets into IS human asset, technology asset, and relationship asset. These constructs for IT infrastructure are widely used Byrd and Turner (2000), Broadbent and Weill (1997), Broadbent et al. (1996), Ross et al. (1996), and Weill and Vitale (2002). Table 1 summarizes the operational definitions of the constructs and identifies their sources. All items were measured in a 7-point Likert scale.

Table 2 shows operational definitions and sources of mediating and dependent variables. The users' satisfaction and their perceived usefulness of the change management program measure the effectiveness of change management. The operational definition for change management effectiveness had to be created because there was no instrument available for this construct. During the survey, we showed respondents a card which listed multiple examples of the change management programs.[2] Survey respondents were first asked to check the programs introduced by their firms, and then to answer questions relating to their satisfaction and perceived usefulness regarding those change management programs.

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[1]Organ (1988) originally proposed five sub-constructs for OCB: altruism, conscientiousness, civic virtue, sportsmanship, and courtesy. In our pilot test, we conducted an exploratory factor analysis to test the construct validity of the survey questions on OCB. The OCB items converged well into one factor except sportsmanship. Measurement of sportsmanship was converged with IS innovation resistance. Sportsmanship refers to the extent to which someone does not complain unnecessarily over small issues, and is considered a similar concept to IS innovation resistance. Thus, sportsmanship was dropped from OCB in our study.

[2]Although we had a large sample size, we conducted the survey based upon a foot-in-the-door process for this reason. We employed a professional survey firm to collect responses for this research.

Table 1. Operational Definitions of Independent Variables

Constructs		Measurement Items	Source
Organization Citizenship Behavior	Altruism	• Provide aid to other coworkers with problems or unskilled coworkers in using an ERP system.	Bateman and Organ (1983) Graham (1986) Moorman (1991) Niehoff and Moorman (1993) Organ (1988) Podsakoff et al. (1990) Smith et al. (1983)
	Conscien-tiousness	• Obey company rules, regulations and procedures in using an ERP system.	
	Courtesy	• Be cautious to prevent problems with other coworkers using an ERP system (i.e., does not abuse the rights of the others).	
	Civic Virtue	• Keep abreast of changes in the organization. • Keep up with policy and business strategy in the organization.	
IS Innovation Resistance	Habit	• Not willing to adopt new systems (like ERP) . • Prefer old processes and legacy systems.	Chang and Cho (2000) Ellen et al. (1991) Lee (1993)
	Perceived Risk	• Do not trust results of ERP systems . • ERP complicates business processes. • ERP increases work load .	
User IT Capability		• Skillfulness in using an ERP system. • Understanding new ERP business processes and functions. • Communicating with IT personnel when problems in ERP usage occur.	Broadbent et al. (1996) Stratman and Roth (1993)
IT Asset	IS Human Asset	• Ability of IT personnel to interpret business problems and develop appropriate technical solutions (i.e., support needed function, system error and down). • Technical knowledge of IT personnel (i.e., IT knowledge, ERP operating skills).	Byrd and Turner (2000) Broadbent and Weill (1997) Broadbent et al. (1999) Ross et al. (1996) Weill and Vitale (2002)
	Technology Asset	• Firm-wide hardware, software, and communication infrastructure to support business environment. • Speed and adaptability of new information technologies .	
	Relation Asset	• Level of coordination (i.e., committee and institute) on both sides of the relationship for ERP services. • A mutual understanding of each other's respon-sibilities for operating and using an ERP system.	

Information capability, a dependent variable acting as a surrogate for ERP effectiveness in our research model, represents an organization-wide measure that is not confined to the IT department or other information management support functions (Marchand et al. 2000). The information capability variable, developed and used by Marchand et al. (2000), has 58 question items. Our research model includes many variables, and asking 58 questions for just one variable (information capability) would make the questionnaire too long to get a high response rate. We have thus consulted with ERP professionals and developed a smaller set of questions to measure the information capability. Consequently, we have defined two constructs for information capability (with 13 questions): (1) information management/use (IMU) and (2) information behavior/values (IBV).

Table 2. Operational Definitions of Mediating and Dependent Variables

Constructs		Measurement Items	Source
Change Management Effectiveness	Satisfaction with CM	• Understanding of the goal of change management . • Feelings of satisfaction about change management programs.	Newly created
	Perceived Usefulness of CM	• Feelings of congruence between what the user wants and what is provided by the change management programs. • Perceived benefits of the change management programs.	
Information Management and Use	Information Use	• Facilitate executive decision-making using the ERP system. • Facilitate creativity by information use in business process. • Facilitate the management of business processes and human resources at a firm-wide level. • To ensure that ERP users perform their responsibilities consistently and with high quality to improve the efficiency of operations.	Marchand et al. (2002)
	Information Management	• Data collecting consists of the systematic process of gathering relevant information by profiling information needs of employees. • Organizing appropriately includes indexing, classifying and linking information and databases together to provide access within and across business units. • Processing information into useful knowledge consists of accessing and analyzing appropriate information sources and databases before business decisions are made. • Maintaining involves reusing existing information to avoid collecting the same information again, updating information databases.	
Information Behaviors and Values		• Facilitate information transparency as employees trust each other enough to talk about failures, errors and mistakes. • The absence of manipulating information for ERP users such as inputting inaccurate data. • The free exchange of non-sensitive and sensitive information (i.e., within teams or business units). • Employees trust formal source of information through the ERP system. • The disclosure of information about business performance to all employees (i.e., company performance, market share, company reputation).	

Research Methods and Results

Data Collection

To test our research model and hypotheses, we conducted a field survey. Before the field survey, we showed our questionnaire to three ERP consultants to verify our measures. A pilot test was conducted with 20 firms to confirm that each question could be properly understood by respondents. Sample firms for the survey were carefully chosen; corporations with at least 1 year of experience with ERP operations were selected. To measure the impact of change management on ERP effectiveness, it became necessary to ask firms that are likely to experience the valley of despair after ERP implementation. We obtained, from a Korean government organization (Ministry of Commerce, Industry, and Energy), a list of Korean firms that had implemented ERP. This list includes information useful for our survey, such as the time of ERP implementation and a contact person (project manager). Out of this list, we solicited 470 firms as a sample for the survey.

In order to increase the response rate, we telephoned these firms asking for their participation in the survey. The method of survey was mainly based on a foot-in-the-door process. A professional survey firm was employed and its inquirers were given special training by the authors of this research to ensure consistency and integrity in the data collection process. We asked department managers (or directors), the major users of the ERP systems, to answer the questions. A total of 207 organizations participated in the survey. After data filtering to eliminate problematic responses (i.e., companies using an ERP system for less than one year; only certain modules of ERP installed; small companies with less than 70 employees; and inconsistent responses), 170 effective responses were selected for the analysis.

It should be noted that the unit of analysis in this research is an organization level. Some constructs (such as OCB and resistance to IS innovations) are originally developed as an individual-level measure, while others (such as IT assets and information capability) are a firm-level measure. During the survey, we asked respondents to answer the questions at a firm level. For instance, OCB is not an individual level measure of respondents, but an average OCB level of ERP users in their firms. All of the questions in the survey instrument are carefully expressed to ensure that respondents answer them at a firm level rather than an individual level. This was necessary because we collected data from only one survey respondent (manager of ERP user department) in each firm.

Measurement Model: Confirmatory Factor Analysis

Construct validity is examined by convergent validity and discriminant validity. After conducting CFA (confirmatory factor analysis) to test the convergent validity and discriminant validity, we have a path analysis (structural model) using LISREL 8.50. The convergent validity is checked by examining whether the *t*-value of all item loadings is statistically significant at the threshold level (Anderson and Gerbing 1988). The results excerpted by CFA are shown in Table 3. All indicators but two (GFI and AGFI) are well above the threshold value (Bentler 1990; Bentler and Bonett 1980; Jöreskog and Sörbom 1996).[3] The value of GFI (0.83) and AGFI (0.79) are close to but below the threshold level. These indicators show that our research model has an acceptable goodness of fit. Based upon the result of CFA, we have removed items with significant cross-loading. Cross-loading occurs when measurement items are loaded significantly across two constructs (Bryne 1998). OCB3 (courtesy) is dropped for this reason.

Table 3. Convergent Validity

Factors	Scale Item	Factor Loading	T Value	Factors	Scale Item	Factor Loading	T Value	Factors	Scale Item	Factor Loading	T Value
OCB	OCB1	0.64	8.99*	**ITC**	ITC1	0.83	12.77*	**IBV**	IBV1	0.62	8.13*
	OCB2	0.79	11.79*		ITC2	0.91	14.60*		IBV2	0.70	9.53*
	OCB4	0.87	13.74*		ITC3	0.67	9.58*		IBV3	0.64	8.53*
	OCB5	0.80	12.05*	**CME**	CME1	0.81	12.43*		IBV4	0.67	8.95*
ISIR	ISIR1	0.61	8.26*		CME2	0.82	12.58*	OCB: Organization Citizenship Behavior ISIR: IS Innovation Resistance ITA: IT Assets ITC: User IT Capability CME: Change Management Effectiveness IMU: Information Management and Use IBV: Information Behaviors and Values * P < 0.01		
	ISIR 2	0.73	10.13*		CME3	0.72	10.63*				
	ISIR 3	0.70	9.49*		CME4	0.84	13.17*				
	ISIR 4	0.50	6.24*	**IMU**	ITP1	0.73	10.72*				
	ISIR 5	0.65	8.73*		ITP2	0.66	9.20*				
ITA	ITA1	0.71	10.03*		ITP3	0.85	13.56*				
	ITA2	0.77	11.20*		ITP4	0.91	14.97*				
	ITA3	0.79	11.63*		IMP1	0.75	11.13*				
	ITA4	0.63	8.56*		IMP2	0.73	10.85*				
	ITA5	0.76	11.00*		IMP3	0.77	11.56*				
	ITA6	0.66	9.16*		IMP4	0.80	12.20*				

[3]The value of χ^2 was 594.26, with RMSEA = 0.035, RMR = 0.071, SRMR = 0.050, GFI = 0.83, NFI = 0.84, NNFI = 0.95, CFI = 0.96, and AGFI = 0.79.

Table 4. Discriminant Validity, Reliability, and Multicollinearity

	OCB	ISIR	ITA	ITC	CME	IMU	IBV	# of item	Cronbach α coefficient	Tolerance	VIF
OCB	0.78							4	.8583	.565	1.771
ISIR	-0.61	0.64						5	.7994	.532	1.434
ITA	0.63	-0.56	0.72					6	.8761	.543	1.878
ITC	0.62	-0.55	0.69	0.82				3	.8376	.502	1.842
CME	0.67	-0.53	0.69	0.66	0.80			4	.8740		1.993
IMU	0.53	-0.61	0.71	0.62	0.58	0.78		8	.9281		
IBV	0.65	-0.69	0.71	0.57	0.66	0.53	0.66	4	.7503		

We have used an average variance extracted (AVE) approach to test the discriminant validity of the questions (Fornell and Larcker 1981). The discriminant validity can be checked by examining whether the correlation between the constructs is lower than the square root of the AVE. As shown in Table 4, the questions have discriminant validity because squared AVE, an element of the diagonal matrix, is greater than 0.5 (Bagozzi and Yi 1988; Fornell and Larcker 1981), and also larger than the correlation between constructs (Barclay et al. 1995). We thus conclude that the questions used in our study have discriminant validity.

Cronbach's alpha coefficients (Cronbach 1951) are calculated to test the reliability of the measure. The standards vary depending on the disposition and circumstances of estimated variables but, in most cases, credibility is acquired if Cronbach's alpha coefficient rate is over 0.6 (Van de Van and Ferry 1980). As shown in Table 4, the Cronbach's alpha coefficients for all constructs are above 0.75, indicating that reliability for all of the measures is acceptable. Tolerance value and variance inflation factor (VIF) indicate that our constructs have low multicollinearity: the tolerance values are greater than 0.50, and the VIFs are lower than 1.993 (Hair et al. 1995).

Structural Model: Path Analysis

Because the validity and reliability of the measures are within acceptable levels, we have performed a path analysis to test our research hypotheses; our model includes 7 latent variables and 34 measurement variables. The results are presented in Figure 3. The research model's goodness of fit is analyzed to evaluate the reliability of the model. The number of iterations in LISREL analysis was eight. The several indicators of the LISREL analysis show that our research model has an acceptable goodness of fit, allowing us to proceed to further analysis of the path coefficients.[4]

Path analysis results, including coefficients of the paths, are shown in Figure 3. The results demonstrate that seven paths out of eight are statistically significant at the confidence level of 0.05. Three antecedents of the change management effectiveness (organization citizenship behavior, user IT capability, and IT assets) directly affect the change management effectiveness. IT assets directly influence both change management effectiveness and information capability (two dependent variables of IMU and IBV).

One antecedent variable, resistance to IS innovation, is not significantly related to change management effectiveness. We have interviewed several respondents to find out the reason for this unexpected result. One plausible explanation for this result comes from the characteristic of our survey sample firms. All the responding firms had operated ERP for more than one year at the time of the survey. For these firms, resistance to innovations was not a critical issue any more because ERP systems had already been used for a relatively long time. Managers of these firms showed more concern over firms' resource allocations for new processes (innovation) rather than struggling against process changes. Although this path is not statistically significant, we found in the separated analysis (ANOVA) that firms with low IS innovation resistance (ISIR) demonstrate a relatively high level of change management effectiveness.[5]

[4]The value of χ^2 was 744.33(df: 505), with RMSEA = 0.053, RMR = 0.083, SRMR = 0.058, GFI = 0.79, NFI = 0.81, NNFI = 0.92, CFI = 0.92, and AGFI = 0.76.

[5]Result of ANOVA analysis is not shown due to the space limit.

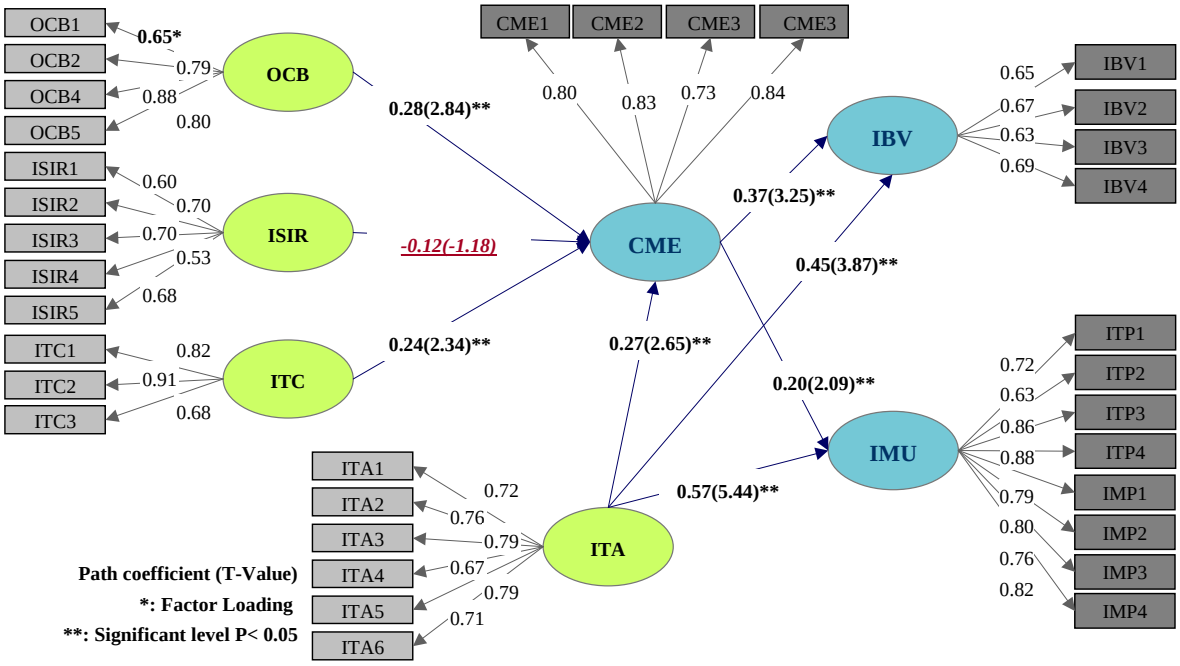

Figure 3. Results of Path Analysis for Research Model

Table 6. Results of Hypothesis Testing

Hypothesis	Estimated coefficient	T-value	Accept or reject
H1: Organization citizenship behavior is positively related to change management effectiveness in firms using ERP.	0.28	2.84**	Supported
H2: IS innovation resistance is negatively related to change management effectiveness in firms using ERP.	-0.12	-1.18	Not
H3: User IT capability is positively related to change management effectiveness in firms using ERP.	0.24	2.34**	Supported
H4: IT assets are positively related to change management effectiveness in firms using ERP.	0.27	2.65**	Supported
H5: IT assets and ERP effectiveness (information capability)			Supported
H5a: IT assets are positively related to information management and use in firms using ERP.	0.57	5.44**	
H5b: IT assets are positively related to information behavior and values in firms using ERP.	0.45	3.87**	
H6: CM and ERP effectiveness (information capability)			Supported
H6a: Change management effectiveness is positively related to information management and use in firms using ERP.	0.20	2.09**	
H6b: Change management effectiveness is positively related to information behavior and values in firms using ERP.	0.37	3.25**	

** Significant ($p < 0.05$)

Table 6 summarizes the result of hypothesis testing. Our analysis indicates that change management effectiveness significantly influences information capability (IMU and IBV). Thus, we conclude that change management effectiveness plays an important role as a mediating variable for ERP effectiveness.

Discussion and Conclusion

In this research, we have proposed a conceptual framework to highlight the importance of change management for firms after implement ERP systems. Our analysis results present several key findings. First, change management effectiveness plays a pivotal role in enhancing information capability (ERP effectiveness) after launching ERP systems. IT assets have the strongest influence on ERP effectiveness, indicating firms with superior IT infrastructure are more likely to enjoy a high level of ERP effectiveness. Although the impact of change management on ERP effectiveness is less than that of IT assets, effective change management can still significantly improve the information capability of firms in ERP operations.

Second, organizational citizenship behavior, user IT capability, and IT assets have significant effects on change management effectiveness. Although the variable with the strongest impact on change management effectiveness is OCB, its magnitude of influence was not significantly higher than those of IT assets and user IT capability. Thus, the three antecedent variables deserve equal consideration when planning to increase change management effectiveness in ERP operations. Conversely, IS innovation resistance turned out to exert insignificant influence on change management effectiveness. Resistance to process changes may serve as barriers during the ERP implementation or in the initial stage of ERP use. Once firms stabilize the use of ERP, the IS innovation resistance is not likely to act as a barrier to effective change management.

Our findings provide a clue for the hitherto inconsistent reports on ERP performance. Some firms realize significant productivity gain after ERP implementation, while others report they have not achieved hoped-for returns from the ERP investment. ERP launching by itself does not guarantee the realization of significant performance improvement. Corporations can realize significant benefits from ERP only when they overcome the valley of despair through effective change management programs. To increase the effectiveness of change management, firms need to introduce active training to improve organizational citizenship behavior and user IT capability while significantly investing in IT infrastructure.

This research offers several academic contributions. First, there have been many studies of ERP but few have investigated why ERP produces different outcomes among firms. This study provides a conceptual framework to highlight the importance of change management after ERP implementation. Without effective change management, firms cannot expect higher returns from ERP investment. The survey sample is carefully selected to investigate this post-ERP variable. The central claim of this paper is that managing changes on the user side of ERP is as important as investing in IT assets for ERP success. Second, this study has operationalized change management effectiveness and has developed measuring instruments for this construct. Many scholars have emphasized the importance of change management, but few have measured its construct in empirical settings. Our operational definition of change management effectiveness is not a perfect one but provides a good starting point for future research. Finally, this study introduces organizational citizenship behavior (OCB) to the IS community. OCB is widely recognized and studied as a key variable to explain firm performance in the organizational theory field. Our research proposes that this informal and extra behavior can play a critical role in change management involved in ERP operations.

However, our study has limits as well. We have employed the information capability as a surrogate variable for ERP effectiveness (or ERP performance). Information capability in itself is not an eventual goal for ERP adoption; firms are more interested in visible key performance measures such as reduced costs or increased profits. However, performance measures like costs and profits may be influenced by many other business variables independent of ERP. Most of these performance measures include compounding effects of non-ERP variables, and it is challenging to isolate ERP impacts from these performance measures. Information capability is a measure that can be captured at the place where a new technology (ERP) is implemented, and it is likely to lead to improvement in key performance.

The unit of analysis in this study is at a firm level. We have asked a business manager (user department) of each firm to answer questions in our survey. Some variables, such as OCB, user IT capability, and resistance to IS innovations, are measured at a firm level by these respondents. It would be necessary to collect data from several users within each firm and to aggregate them to get a firm level measure. Furthermore, business managers may not be familiar with IT infrastructure within their firms. We have assumed that business managers are well positioned to answer questions. Although this assumption was necessary to secure a large enough number of sample firms for the data analysis, it stands as a weakness in our study. Despite these limits, we hope that this paper provides a starting point for research on change management in ERP and promotes further studies in this direction.

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