韓國 컴퓨터情報學會 論文誌
第12卷 第1號, 2007. 3.

2007-12-1-3-8

한국 중소기업 기업관리 패키지에 관한 실증적 연구

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An Empirical Study on ERP Package in Korean SMEs

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요 약

최근 들어, 중소기업에서의 기업자원관리시스템 구현에 관한 관심과 연구가 꾸준히 증가하고 있다. 본 연구에서는 중소기업에서의 기업자원관리(ERP) 소프트웨어 품질, 벤더의 지원, 사용자 정보 만족도 및 ERP 구현 성과와의 관련성을 규명하였다. 이와 같은 실증연구를 통하여 ERP 소프트웨어 품질과 벤더의 지원이 중소기업에서의 성공적인 ERP 구현과 밀접한 관련이 있음을 제시하였다. 본 연구는 내부자원이 상대적으로 부족한 중소기업의 ERP 시스템 구현에 있어서 패키지 소프트웨어 품질과 벤더의 지원에 대한 의존성과 중요성에 관한 시사점을 제공하였다.

Abstract

In recent years, there has been a growing concern about enterprise resource planning (ERP) implementation in small and medium-sized enterprises (SMEs). In this study, we investigate the relationship among ERP software quality, vendor support, user information satisfaction, and performance of ERP implementation. The empirical findings of this paper will allow SMEs to identify the importance of relationships with vendors and software itself for the successful implementation of ERP systems. The results provide a useful basis for the SMEs which have limited information capability to focus their attention on the software quality and vendor support in overcoming difficulties and obstacles facing the ERP implementation.

▸ Keyword : 기업자원관리(Enterprise resource planning), ERP 구현(ERP Implementation), 중소기업(Small and medium-sized enterprise), 소프트웨어 패키지(Software package), 소프트웨어 품질(Software quality), 벤더 지원(Vender support), 정보시스템 성공(Information system success)

• 제1저자 : 김승권, 교신저자 : 박승봉
• 접수일 : 2007.3.4, 심사일 : 2007.3.19, 심사완료일 : 2007. 3.25.
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Ⅰ. Introduction

Recently, enterprise resource planning (ERP) systems are considered to be "the price of entry for running a business" [1]. Since early 1990s, the ERP software market has been and continues to one of fastest growing segments of the information technology (IT) industry with growth rates averaging from 30% to 40% per year [2]. Initially designed for large organization, ERP software is now also thought for to be of some benefits in equipping smaller firms which have user populations and fewer financial resources [3].

The development of software application in-house requires the commitment of substantial human resources and hardware utilization as well as an extended period of time [4]. Thus, many organizations are turning to software application packages to fulfill their need for new software. The ERP project is also large, complex and difficult and it requires large investment in capital and management time [5]. Smaller businesses usually have limited experience with information system (IS) and limited resource to spend on new development. Those limitations made small businesses use outside consultant and packaged software and generally rely on the vendor to provide technical support [6, 7]. However, there has been little previous research on the successful acquisition and implementation of ERP software package in small and medium-sized enterprises (SMEs) [8].

Since 2001, Korean SMEs have made significant investments in ERP systems, because of several reasons occurred from inside and outside of organizations. The most general is the competitive need, and the others should be awareness of ERP benefits and other motives from external forces, such as requirements or encouragements of large business and government. The purpose of this paper is to find a relationship among ERP software quality, vendor support, user information satisfaction, and the performance of SMEs by conducting an empirical study.

This article is structured as follows. We first briefly discuss the concept of ERP implementation in SMEs and introduce factors influencing performance of ERP implementation. We then describe the methodology and discuss the results of an empirical study. We conclude by noting the managerial and research implications of the study's findings

Ⅱ. Related Works

Most small businesses are generally lack of the experiences, expertise, and resources to develop application software in-house. Because profit potential is not as great with small organization, vendors of IS have typically not focused major efforts on the small business market. With a rapid development of information technologies and settlement of low price IT-based environment, it has became possible for small businesses to obtain the benefits from IS environment, which are formerly available only to larger companies [9]. In fact, investing relatively small amount of money, small business have purchased the software packages such as accounting and inventory control packages [6].

In contrast to the implementation of custom system, implementation of software package comprises a number of different tasks. First, there is need to change the procedures for working with the package. Second, there is also need to change some of the programs in the package for satisfying user's own requirements. Finally, the user becomes dependent on the package for continuous maintenance in using software package [10]. Gross and Ginzberg [11] reported 38 issues classified by potential obstacle to implement software package successfully. They concluded that the key obstacles to the implementation of software package may come from the uncertainty in the package modification time and cost, vendor viability, and the ability of package to meet user needs.

Another problem in the adoption of software

package may be originated from the misfits between the software package capabilities and organizational requirements [12]. Montazemi [13] argues that a few small businesses have formal software selection policies and most of them have a difficulty in implementing software package to generate harmony with the end user requirements. He also argues that the user satisfaction of small business is mainly concerned with the number of system analysts, degree of analysis of information requirements, and level of participation and computer literacy.

Although there are no formal procedures for selecting software packages which properly reflect the organizational requirements, several literatures present a guideline to evaluate the selection process of software package. Margaret [4] presents four-step approach which are commonly used in the selection process of application packages: (1) study of the existing needs; (2) demonstration of the package by the vendor; (3) contact with current users of the package; and (4) interviews or survey of those who will be using the system. In case of ERP, Umble et al. [14] provides a thirteen-step software selection process to understand right way of the ERP adoption procedure reflecting organizational goals and requirements. In addition, Sprott [15] presents four criteria for enterprise application package selection as follows: (1) applicability; (2) integration; 3) adaptability; and (4) upgradability.

As more and more companies choose to install ERP software package to solve their problems, the question arises of how to select best package to meet the needs and goals of individual organization. There are two different views in the same ERP implementation depending on the selection of software package. A good choice of ERP package software allows for organization to obtain great benefits responding organizational requirements. However, it is also accompanied with a high risk problem resulting from the characteristics of ERP package implementation such as high cost and complexity [16].

In addition to software quality, vendor support also influences user's perceptions of the information satisfaction. Most small businesses have the insufficient computer knowledge and experience which is needed for performing feasibility study, information requirement analysis, IS planning, and hardware and software selection. As argued by Cragg and King [8], small businesses are largely dependant on the vendors' respond and support due to the lack of skills or lack of the internal expertise. According to research conducted by Lucas et al. [10] and Marius and Ashok [17], vendor support has been found to be a critical element for the success of the software package implementation.

There have been many studies on the factors that contribute to IS success [18, 19]. The need to evaluate the contribution of the IS function to the organization has been begun in the late 1970s and the studies of the beginning stage were focused on the economic aspect including multiple assessment measures which are essential to develop a clear picture [19]. To better understand the dynamics of factors affecting IS success, DeLone and MacLean [9]analyze and classify the previous research mainly based on the communication research of Shanon and Weaver [20] and information influence theory of Mason [21]. This model provides a comprehensive and multidimensional model of IS success and presents six interrelated dimensions as dependant variables for IS success measure such as system quality, information quality, system use, user satisfaction, individual impacts, and organization impacts. They also argue that system quality and information quality affect use and user satisfaction. Use can mutually give a negative or positive effect to the user satisfaction [18, 20, 21].

In order to obtain greater simple way to guide selection of measures, Saunders and Jones [22] proposed IS function performance evaluation model which surveys how to select the measures from the multiple dimensions of the IS functions based on the organizational factors and the prospective view.

They use the Delphi method to identify the dimensions of IS function performance and measures of IS functions and to understand the importance of IS function dimension. These findings result in the research model illustrated in Figure 1 and the prediction contained in hypotheses 1-3:

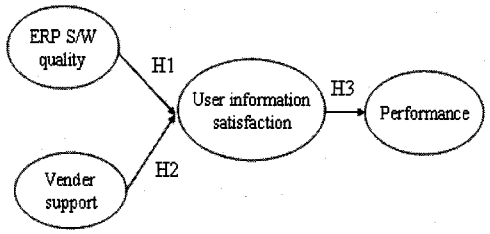

Fig. 1. Research model
그림 1. 연구모형

H1: As the ERP software quality increases, the perceptions of the user information satisfaction will increase.

H2: As the vendor support for ERP package increases, the perceptions of the user information satisfaction will increase.

H3: As the perceptions of the user information satisfaction increases, the performance of ERP implementation will increase

III. Methodology

1. Data collection

The design of survey and questionnaire items follows the design of the study by the Small Business Corporation (SBC) which is funded and operated under a cooperative agreement with the Ministry of Commerce, Industry, and Energy of Korea. Until September 2004, total 6,530 small firms had implemented more than one or two modules of ERP system.

The survey was mailed to those who had been SBC members and experienced the implementation of ERP with a self-addressed and postage-paid return envelope. A total 1,022 different responses were received for a response rate of 15.7%.

Concerned with missing values, total 16 unit non-responses which did not answer all questionnaire items were found and eliminated, and 74 partially missing values which are item non-responses, needed to be imputed. For data analysis, the single imputation method was applied to manipulate them. According to the suggestion of Harrel's research [23], the ratio of missing value was 7.4% and fairly adequate for adopting the single imputation

2. Reliability and validity

The reliability of the measurement was determined by means of the Cronbach's alpha test which measures internal consistency. According to the study, conducted by Nunnally [24], the internal reliability test is considered to be acceptable for basic research when the reliability coefficient surpasses the 0.80 level. All four measures tested surpassed the 0.80 level.

Table 1. Reliabilities of the item
표 1. 측정항목의 신뢰성

Construct	Mean	Standard deviation	Reliability (α)
UIS 1	3.72	0.737	0.855
UIS 2	3.66	0.772	
UIS 3	3,76	0.759	
UIS 4	3.57	0.862	
IMP1	3.65	0.770	9.034
IMP2	3.59	0.747	
IMP3	3.59	0.752	
IMP4	3.57	0.765	
EPQ1	3.34	0.796	0.805
EPQ2	3.15	0.809	
EPQ3	3.17	0.792	
EPQ4	3.21	0.815	
VNS 1	3.09	0.921	0.938
VNS 2	3.04	0.865	
VNS 3	3.11	0.818	
VNS 4	3.12	0.815	
VNS 5	3.17	0.846	
VNS 6	3.06	0.813	
VNS 7	3.16	0.806	
VNS 8	3.23	0.776	

The Table 1 shows that the reliabilities of the items are ranged from 0.8047 to 0.9378. Thus, the reliabilities of each construct were within acceptable range for this type of research.

As shown in Table 2, all items had high loading on their factors. Most exhibited loading higher than 0.60 on their respective factors, signifying desirable measurement convergent validity.

Table 2. The results of factor analysis
표 2. 요인분석결과

Scale item	Factor			
	1	2	3	4
UIS 1			0.630	
UIS 2			0.698	
UIS 3			0.753	
UIS 4			0.722	
IMP1	0.807			
IMP2	0.847			
IMP3	0.841			
IMP4	0.738			
EPQ1				0.725
EPQ2				0.681
EPQ3				0.648
EPQ4				0.695
VNS 1		0.776		
VNS 2		0.755		
VNS 3		0.825		
VNS 4		0.755		

Referring to the Table 2, factor 1 represents the impact of ERP adoption, factor 2 for the vendor support, factor 3 for the user information satisfaction, and factor 4 for the ERP package quality, respectively. Discriminant validity was demonstrated by examining whether each item loaded higher on the construct it measured than on any others. The overall result indicated that the measurement exhibited reasonable discriminant validity.

3. Confirmatory factor analysis

To test that four constructs measured which consist of ordinal value having a uni-dimensional latent variable, we estimate the polychoric correlations and their asymptotic covariance matrix, using PRELIS. The result of correlations and test-statistics give us the estimated polychoric correlation, the LR-chi-square, the degree of freedom, and the P-value [25]. LESLEL present the RMSEA measure and P-value of population discrepancy [26]. Our P-value of RMSEAs is distributed from 0.995 to 1. It means that there is no violation of approximate underlying bivariate normality based on previous research result [25, 26].

In order to investigate the appropriate of the measurement model structure, four constructs models were generated based on the overall goodness of model fit indexes. The four construct models were user information satisfaction (UIS), impact of ERP (IMP), ERP package quality (EPQ), and vendor support (VNS). As previous research demonstrated, a good model is considered to have a good model-data fit if the ρ-value is above .05, to degrees of freedom is smaller than 3, the GFI is above 0.90, and the NFI is above .90 [27, 28, 29]. As shown in Table 3, all model fits indicators of four models are good. Therefore, our measure of four constructs satisfies the one dimension and convergent validity requirements.

Table 3. Confirmatory analysis-unidimensionality/convergent validity
표 3. 확증적 요인분석-수렴타당성

Fit index	Recommended value	UIS model	IMP model	EPQ model	VNS model
/d.	≤3.0	1.145	2.74	0.720	0.765
GFI	≥0.9	0.979	0.978	0.998	0.996
AGFI	≥0.8	0.893	0.888	0.992	0.978
RMR	≤0.1	0.027	0.011	0.009	0.008
CFI	≤0.9	0.983	0.990	0.999	0.998

The composite reliability which refers to the proportion of measure variance attributable to the underlying latent variable was calculated to verify the reliability of measure [30]. Following Sethi and King [31], the composite reliability was calculated from the factor loadings of each indicator and error variance using following formula:

$$\text{Composite Reliability} = (\sum \lambda_i)^2 \text{Variance (A)} / (\sum \lambda_i)^2 \text{Variance (A)} + (\sum \theta_\delta)$$

The value of composite reliability proposed by Werts [32] was used as an exploratory step to identify the satisfactory level of reliability. The identification of value in excess of 0.5 represents that the variance captured by the measures is greater than that captured by error components [32]. The result in Table 4 shows that the composite reliability estimates were 0.845 for UIS, 0.947 for IMP, 0.748 for EPQ, 0.884 for VNS, respectively, suggesting that all four latent variables have adequate levels of reliability.

Table 4. Confirmatory analysis-composite reliability
표 4. 확증적 요인분석-복합신뢰성

Factor	No. of indicator	Composite Reliability
UIS	4	0.845
IMP	4	0.947
EPQ	4	0.748
VNS	4	0.884

IV. Results

The characteristics of SMEs by industry type, in which ERP systems were implemented and used, are summarized in Table 5. It shows that use of ERP systems varied across types of industry. More than one-third (33.2%) were general service and miscellaneous firms, 16.4% were mechanical firms, and 13.3% were distribution firms. The remaining 37% came from various sectors, including food and beverage, textile, chemical, metal, electrical and electronic, or information service. Analyzing the industry sector where SMEs are belonged to, non-manufacturing (service) sector (50.2%) was given a little much weight in the total. In here, the manufacturing sector includes following types: food and beverage, textile, chemical, metal, electrical and electronic, and mechanical. The service sector includes general service and miscellaneous, information service, and distribution.

Table 5. Distribution by industry type
표 5. 산업유형별 분포

Industry type	Percent
Food & Beverage	1.7
Textile	3.8
Chemical	8.4
Metal	10.1
Mechanical	16.4
Electrical & Electronic	9.4
General service & Misc.	33.2
Information Service	3.7
Distribution	13.3

Table 6 shows the breakdown of IT employees of responding SMEs by industry types. Almost half of the total SMEs, which were in mechanical, general service, and miscellaneous area, had averages of IT employees with ranging from 1.76 to 2.04. On the contrary, an average of information service area was much higher than the others, and it was 4.69 employees. Considering a large standard deviation 7.80 and a frequency of information service area, this high average value seems to be somewhat exaggerated by effects of some outliers that have more than six IT employees. The average column is filled by arithmetic mean values.

Table 6. Breakdown of IT employee (by industry type)
표 6. 산업별 IT 종업원 분포

Industry type	Number of IT employee									
	Frequencya								Average	Std. dev.
	0	1	2	3	4	5	6	〉6		
Food & Beverage	0	7	6	1	0	0	0	0	1.57	0.65
Textile	2	17	9	3	2	0	0	1	1.65	1.60
Chemical	0	28	15	3	2	1	0	0	1.84	0.90
Metal	3	33	35	6	4	3	0	1	1.96	1.77
Mechanical	3	83	39	13	3	4	2	4	2.04	2.98
Electrical & Electronic	0	47	24	10	4	0	1	1	1.82	1.23
General service & Misc.	6	144	96	24	5	7	2	2	1.76	1.51
Information Service	0	14	9	3	1	2	1	5	4.69	7.80
Distribution	2	57	45	11	3	0	1	1	1.73	1.16
a Total 976 responses analyzed, excluding item non-response										

Table 7 specifies the ERP adoption frequency and the operating experience of ERP systems. Most firms (89.8%) adopted below four modules. A majority of SMEs (73.7%) adopted ERP systems in less than three functional modules. Functional modules that were most frequently adopted were accounting related with financial accounting, personnel and salary, and sales/marketing.

Table 7. Frequency of ERP adoption (by number of modules)
표 7. 도입 ERP 모듈 빈도

Number of ERP module adopted	Percent
1	17.7
2	56.0
3	16.1
4	5.0
5	2.0
6	1.2
above 6	2.0

Table 8 shows the detail of modules adopted. Two most adopted modules had a penetration rate of 60% or higher. Rest of them was under a rate of 30%. ERP duration time of post-implementation were largely distributed within under one and half year. Approximately two-third of total responding SMEs (63.9%) had operated their ERP systems for 12 months or less, and more than one-third of total SMEs (36.3%) had a year or more operating experience of ERP.

Table 8. Frequency of ERP adoption (by function)
표 8. 모듈별 ERP 도입 빈도

ERP module adopted by function	Percent
Financial accounting	79.3
Personnel and salary	63.3
Sales/ Marketing	28.2
Cost accounting	18.0
Production management	15.2
Material & procurement	14.3
Logistics	11.0

As shown in Table 9, all model fit indices of our model indicate better than those of the threshold values those proposed by previous research results [4, 6, 13].

Table 9. Comparison of value ranges of attribute
표 9. 적합성지수 비교

Criteria	Threshold	Value of model
		199.2
d.f		99
/ d.	(〈3)	2.01
GFI	(〉0.90)	0.95
AGFI	(〉0.80)	0.93
RMSEA	(〈0.08)	0.03
RMR	(〈0.1)	0.02
CFI	(〉0.90)	0.98
NFI	(0.90)	0.99

Figure 2 presents parameter estimates of the model. Results showed that ERP software quality and vendor support were significantly related to the performance of ERP implementation. Thus the results of our study support H1 and H2. ERP software

quality had stronger positive causal influence than vendor support on outcome (r12=0.42, t=4..57; r13=0.35, t=4.20). Those who more favorably perceived the ERP capability to provide adequate information to support their task or work were more likely to be satisfied. Outcome had positive influence on the performance (r21=0.82, t=17.42) and H3 also supported.

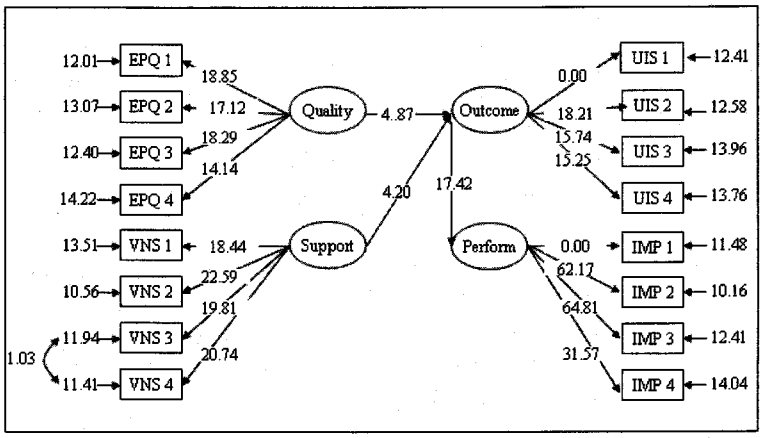

Fig. 2. Models tested in the confirmatory analysis
그림 2. 연구모델 분석결과

V. Conclusions

The purpose of this paper was to explore the relationship among ERP software quality, vendor support, user information satisfaction, and performance of ERP implementation which adopt the ERP software in Korea.

The key findings of our research were as follows. The quality of ERP software package and vendor supports affect on the performance of ERP implementation. Since SMEs have limited the IS resources and capability, they should rely heavily on the software quality and vendor support.

The results of findings provide a useful basis for the SMEs to focus their attention on the software quality and vendor support to overcome difficulties and obstacles facing the ERP implementation. This study has also suggest that the DeLone and MacLean model of IS success [9] which provides a framework for characterizing and measuring the success of IS be applied in the context of SMEs as well.

There are a lot of studies which address productivity and efficiency of IS success in SMEs. However, there is very little research addressing the impact of ERP software quality and vendor support on the user satisfaction and performance, especially studies focusing on the small and medium sized-enterprises. This study demonstrates its concern for the ERP implementation in SMEs which have difficulty in accessing techniques internally. The empirical findings of this paper will allow SMEs to identify the importance of relationships with vendors and software itself for the successful implementation of ERP systems.

The limitations of our study are as follows. The sample of the survey was restricted to firms in Korea. In addition, we focused on a limited number of variables for ERP implementation in SMEs. Thus, more relevant variables including cultural factor which has been identifying as a significant element in ERP implementations may be added.

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