

ERP System Performance in a Hospital

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Abstract

Objective: To measure the performance of a hospital enterprise resource planning (ERP) system and suggest various system improvements. **Methods:** A survey based on a 5-point Likert scale questionnaire and an exclusive interview was administered to 102 employees with a one-year experience of using an ERP system at one university hospital. In order to analyze the factors affecting the ERP system performance, multiple regression analysis and Chi-square test were conducted. **Results:** All three examined variables-system quality, information quality and integration of hospital information resources-affected the ERP system performance positively. However, the system quality variable had the lowest mean score indicating that the ERP system was difficult to understand for many users. User characteristics were not significantly associated with information quality satisfaction. **Conclusion:** On the basis of the study results, we recommended some suggestions to improve the ERP system performance. In order to reduce users' dissatisfaction with the new system, hospitals should publicize the needs of the ERP system for the employees, design more effective training programs, and provide more decision-supporting information for managers. (*Journal of Korean Society of Medical Informatics 13-2, 77-82, 2007*)

Key words: Enterprise Resource Planning, ERP Performance, Economic Analysis

I. Introduction

Hospitals in Korea are increasingly introducing management strategies and information systems widely used in the other industry in order to improve efficiency of their operation and gain competitive advantages over other hospitals. Enterprise resource planning (ERP) is a recent attempt to improve hospital

performance by providing solutions for enterprises addressing the continued emphasis on controlling costs through improved resource management. At a minimum, an ERP system contains a central database, common control system and process models. ERP systems are multi-functional in scope, tracking a range of activities, such as supply chain management, human resources and general financials. The functions are integrated so that

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when data are entered into one of the functions, they are immediately available to all related functions. ERP is modular in structure and usable in any combination of modules. ERP links different parts of the organization by coordinating all business processes including purchasing, logistics, financial and staff¹⁾. ERP controls the entire enterprise to support goals like improving organizational performance and customer responsiveness²⁾.

ERP systems do, however, suffer two classes of problem: implementation and structural. The former concerns the transition from the pre-to post-ERP implementation. Mistakes made during implementation may, however, show up much later. Typical problems encountered after the implementation are users who are unwilling to upgrade to a new technology³⁾ and ERP systems that are inflexible for adaptation to the processes (e.g. purchasing, logistics, and financial management) of the particular organization⁴⁾. Organizations usually need to go through a major reengineering process to implement ERP.

While ERP is widely used in other industry, only a few hospitals in Korea have introduced ERP, possibly due to a lack of understanding about ERP, high initial investment, user resistance, and uncertain economic return⁵⁾. Therefore, therefore there are very few studies in hospital ERP in Korea. Moreover, most studies on hospital ERP were based on stand-alone ERP systems which were not fully integrated with hospital information systems such as CPOE (Computerized Physician Order Entry) and EMR (Electronic Medical Record)¹⁾.

The purposes of this study were to identify the factors influencing ERP performance, analyze the relationship between user characteristics and the two key ERP performance variables of user satisfaction and workload reduction.

II. Materials and Methods

1. Subjects

In order to analyze the level of user satisfaction with the ERP system, a questionnaire survey was administered to 102 employees at one university hospital with 2,080 beds in Seoul from October 9 to 13, 2006. The study

hospital has introduced EMR as well as ERP in April, 2005 in order to improve patient services as well as hospital operation. A stratified random sampling survey was conducted by selecting 110 ERP users (about 10% of the total ERP users) from three departments (nursing, medical supporting, and administration) and 102 users responded to the survey with 92.7% response rate. All users had at least one year of ERP experience.

2. Methods

(1) Test of Hypotheses on the ERP Performance

DeLone and McLean⁶⁾ categorized the attributes of information system success factors into 6 groups: system quality, information quality, system usage, user satisfaction, and individual impact. Seddon and Kiew⁷⁾ later suggested 'usefulness of system' instead of 'system usage' from this success category. Based on these studies, we derived the following hypothesis by using 'usefulness of system', 'user satisfaction', 'individual characteristics', and 'organizational characteristics' as system performance measures.

Hypothesis 1: System quality (e.g., ease of learning, report understandability, and system terminology understandability) influences the ERP performance.

Hypothesis 2: Information quality (e.g., accuracy, currency, and reliability) influences the ERP performance.

Hypothesis 3: Integration of hospital resources (e.g. integration with CPOE, consistency with the accounting data, and accuracy of inventory data) influences the ERP performance.

These hypotheses were tested by multiple regression using the sum of performance variables as a dependent variable.

(2) Relationship between User Characteristics and ERP Performance

In order to examine the relationship between user characteristics and ERP performance, Chi-square analysis

and contingency table were used after the ERP performance variables were converted from a 5-point scale to a 3-point scale because of the several small sized cells. Of the 13 ERP performance variables, information quality satisfaction and workload reduction were specifically examined in this analysis.

III. Results

1. Characteristics of Subjects

The study subjects comprised 102 ERP users from 10 departments, 27 (26.5%) from the nursing department, 16 (15.7%) from the logistics department, and 12 (11.8%) from the planning department. More management level users were recruited than working level users. However, 42.2% of the users had participated in less than three ERP training sessions (Table 1).

Table 1. Characteristics of the Subjects (n=102)

	Variable	Frequency	Percent (%)
Department	Nursing department	27	26.5
	Logistics department	35	34.3
	Planning department	40	39.2
Level	Working level	39	38.2
	Management level	63	61.8
Participation of ERP training	0-3 times	43	42.2
	4-6 times	37	36.3
	More than 7 times	22	21.6

2. Evaluation of ERP Performance

Table 2 summarizes the survey results on the ERP performance and their influencing factors (independent variables). Of the three influencing factors (system quality, information quality, and integration with other information resources), the mean of the system quality variable had the lowest mean score indicating that the ERP system was difficult to understand for many users. On the other hand, many users were satisfied with the quality of information provided by ERP and the degree of

Table 2. Summary of ERP Performance

	Variable	Mean±SD	
Independent variables	System quality	Ease of learning	2.4±0.8
		Understandability of report	2.7±0.8
		Understandability of ERP terminology	2.1±0.7
		Understandability of error message	2.0±0.8
		Mean	2.3±0.6
	Information quality	Accuracy	3.3±0.8
		Currency	3.1±0.9
		Reliability	3.1±0.9
		Mean	3.2±0.8
	Integration of hospital-wide information resources	Integration with CPOE	2.9±0.8
		Consistency with the accounting and logistics data	3.1±0.8
		Accuracy of inventory data	3.0±0.8
		Integration with information infrastructure	3.3±0.9
		Mean	3.1±0.7
Dependent variables (ERP Performance)	Usefulness of ERP	Time for transaction processing	2.9±0.9
		Efficiency of work processing	2.9±1.0
		Mean	2.9±0.9
	User satisfaction	Information satisfaction	3.1±0.9
		Overall satisfaction on ERP system	2.7±0.9
		Mean	2.9±0.8
	Individual job performance	Time for completing jobs	2.7±1.0
		Reduction in workloads	2.4±0.8
		Access to timely information	3.4±1.0
		Information sharing	3.1±1.0
		Mean	3.1±1.0
	Organizational performance	Improvement in cost analysis	3.4±0.9
		Improvement in purchasing plan	3.0±0.9
Improvement in financial plan		3.1±0.7	
Improvement in hospital credibility and image		3.2±0.8	
Mean		3.2±0.7	

integration with other information resources. However, the integration of accounting-oriented ERP and clinical CPOE system was found to be an area requiring further improvement.

Of the four performance factors, the effects on the overall organizational performance had the highest mean score (3.2 ± 0.7). Specifically, ERP was very effective in improving the accuracy of cost analysis with a mean score of 3.4. Although the ERP system seemed to have positive effects on job performance and providing access to updated information, it did not help reduce workload (2.4 ± 0.8) and job processing time (2.7 ± 1.0) for many users.

3. Hypothesis Testing on the Effects of System Characteristics on ERP Performance

Multiple regression analysis was performed to test the hypothesis on the effects of system characteristics on the

ERP performance. As seen in Table 3, all three factors (system quality, information quality, and integration with other information resources) significantly influenced the ERP performance and therefore the three hypotheses were proved to be valid by the regression analysis. R-square for this model was 0.634.

4. Relationship between User Characteristics and Information Quality

As seen in Table 4, the user characteristics were not significantly associated with information quality satisfaction. However, users from the administrative department were most satisfied with the information quality (40.0%), followed by users from the nursing department (37.0%). Furthermore, working level users were more satisfied with information quality than

Table 3. Results of Regression Analysis on ERP Performance

Variable	Parameter estimate	Standard error	t-value	p-value
System quality	1.215	0.233	5.20	<.0001
Information quality	2.149	0.351	6.12	<.0001
Integration with hospital-wide information resources	0.789	0.205	3.83	0.0002

R-square=0.635

Table 4. Relationship between User Characteristics and User Satisfaction

		Disagree	Average	Agree	Total	χ^2 -value	p-value
Department	Nursing	4 (14.8)	13 (48.2)	10 (37.0)	27 (100)	2.80	0.59
	Medical support	10 (28.6)	14 (40.0)	11 (31.4)	35 (100)		
	Administration	6 (15.0)	18 (45.0)	16 (40.0)	40 (100)		
Level	Working	7 (18.0)	15 (38.5)	17 (43.6)	39 (100)	1.47	0.47
	Management	13 (20.6)	30 (47.6)	20 (31.8)	63 (100)		
Frequency of training	0-3 times	10 (23.3)	15 (34.9)	18 (41.9)	43 (100)	3.41	0.49
	4-6 times	5 (13.5)	19 (51.4)	13 (35.1)	37 (100)		
	Over 7 times	5 (22.7)	11 (50.0)	6 (27.3)	22 (100)		

Table 5. Relationship between User Characteristics and Reduction in Workloads

		Disagree	Average	Agree	Total	χ^2 -value	p-value
Department	Nursing	14 (51.9)	9 (33.3)	4 (14.8)	27 (100)	3.37	0.49
	Medical support	23 (65.7)	11 (31.4)	1 (2.9)	35 (100)		
	Administration	23 (57.5)	14 (35.0)	3 (7.5)	40 (100)		
Level	Working	24 (61.5)	12 (30.8)	3 (7.7)	39 (100)	0.20	0.90
	Management	36 (57.1)	22 (34.9)	5 (7.9)	63 (100)		
Frequency of training	0-3 times	20 (46.5)	19 (44.2)	4 (9.3)	43 (100)	7.60	0.10
	4-6 times	22 (59.5)	12 (32.4)	3 (8.1)	37 (100)		
	Over 7 times	18 (81.8)	3 (13.6)	1 (4.6)	22 (100)		

management level users. Contrary to previous studies on user training, training frequency was not significantly associated with information quality satisfaction.

5. Relationship between User Characteristics and Reduced Workload

User characteristics were not significantly associated with workload reduction (Table 5). Contrary to the previous ERP studies, most users from the medical support department (65.7%), followed by the administrative department (57.5%), disagreed that ERP resulted in workload reduction. Working level users displayed a higher degree of disagreement than did management level users. Furthermore, the percentage of disagreed users increased with increasing training frequency, possibly because ERP can increase the workload as the users acquire more knowledge about the ERP system.

IV. Discussion

This study was conducted to evaluate the ERP performance and to identify the factors influencing the ERP performance. The results of multiple regression analysis on performance supported the hypotheses based on the findings from the previous study by DeLone and McLean⁶⁾. That is, system quality and information quality significantly influenced the ERP performance. In addition, the regression analysis results also supported the hypothesis on the effects of the integration of other hospital information resources.

The survey results showed that the mean of the system quality variable had the lowest mean score among the three influencing factors (system quality, information quality, and integration with other information resources). This indicates that the ERP system was difficult to understand for many users. In order to further improve user satisfaction with ERP, system quality should be enhanced because it was found to be the most important success factor among all information system success factors, according to the survey conducted by Chae et al⁸⁾.

On the other hand, many users were more satisfied with the quality of information provided by ERP and the degree

of integration with other information resources. In addition, they were less satisfied (mean score less than 3.0) with the increase in time for task completion and increased workload. Choi (2005)⁹⁾ suggested that ERP system efficiency improves as users become more familiar with the system and therefore we expect that some of these problems may be reduced as the users learn and gain more experience with the system. In fact, many users complained that the ERP system was difficult to use and that its terminology was difficult to apprehend. Because the ERP system brings with it a new set of process requirements, business process redesign must be included in the planning of ERP implementation in order to effectively reduce the user workload.

Kim (2004)¹⁰⁾ found that user satisfaction increased with increasing user rank and frequency of training program participation. However, our Chi-square analysis results did not support this finding: our working level users were more satisfied with the system than management level users were, although this relationship was not statistically significant, possibly because ERP was mainly developed for working level staff with an emphasis on transaction processing rather than as a decision-making support tool for managers.

In addition, the frequency of training program participation was not significantly associated with user satisfaction, possibly because many users did not fully understand the system, despite their participation in the training program. These findings suggest that more effective user training is necessary to enhance the users' system understanding and that the ERP system should be improved so that it provides information to support decision-making for managers.

The study suffered several limitations. First, the findings cannot be generalized to other hospitals because data from only one hospital were analyzed. Second, the findings do not provide accurate information on ERP performance in hospitals because ERP had been implemented in the study hospital for only one year and most users remained unfamiliar with the system at the time of the survey.

Nevertheless, despite these limitations, we made several positive findings on ERP performance. In

summary, future study on ERP performance should monitor the progress of its performance in relation with users' behavioral changes by including more hospitals in order to effectively examine how user behavior affects ERP performance over time.

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