An Empirical Investigation of the Influence of Critical Factors on ERP Information Quality

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ABSTRACT

In this research study a model is developed to investigate the relationship between critical factors and the quality of the information obtained from an enterprise resource planning (ERP) system. Nine critical factors that influence ERP information quality and four information quality dimensions pertinent to ERP deployments were identified and modified from literature. A questionnaire was used to collect data from the ERP system users in a production firm that had implemented an ERP system. The data collected were analyzed using multivariate techniques such as factor and multiple regression analyses. The results and the implications of the findings of the study are discussed.

INTRODUCTION

Over the past decade and a half firms have invested heavily in enterprise resource planning (ERP) systems to manage their information needs. The direct access to ERP information by multiple stakeholders within the firm for decision-making has increased the need for firms to ensure high quality information output from their ERP systems. Most researchers focus on critical factors that facilitate the "going live" of the ERP system. There is a dearth of studies that have investigated specific critical factors that influence ERP information quality. In this study, we address this literature gap by investigating the impact of critical factors on information quality obtained from the ERP system.

Past quality studies (Saraph et al., 1989; Flynn et al., 1994; Black and Porter, 1996; Samson and Terziovski, 1999; Gyrna, 2001) indicate that firms which focus on critical factors

will register improvements in information quality. ERP research (Vosburg and Kumar, 2001; Xu et al., 2002; Madapusi and Kuo, 2007; Madapusi et al., 2007; Madapusi, 2008) lends support to the findings of the quality studies by emphasizing the importance of critical factors in ensuring ERP information quality. A synthesis of quality as well as ERP research indicates that user evaluations would provide a good indication of the impact of critical factors on ERP information quality.

BRIEF LITERATURE REVIEW

Rockart (1979) defined the critical factors approach as the limited number of areas in which results, if they are satisfactory, will enhance a firm's competitive performance. The critical factors approach has been widely used in quality literature as a means to improve quality performance. In one of the early empirical studies on critical factors in quality research, Saraph et al. (1988) identified eight critical factors of quality management such as top management leadership, role of the quality department, training, product/service design, supplier quality management, process management, quality data and reporting, and employee relations. A number of studies have since focused on identifying critical factors for quality improvement: Flynn et al. (1994) identified seven factors of quality management; Black and Porter (1996) identified ten critical factors necessary for successful implementation of total quality management (TQM); Berry (1996) identified seven critical world class quality system components and related them to performance; Samson and Terziovski (1999) identified critical TQM factors and examined their relationship to performance.

The critical factors approach is widely prevalent in ERP systems literature. Many failures and near failures of ERP system deployments have been attributed to the lack of a critical factors approach to implementation (Buckhout et al., 1999; Umble and Umble, 2002). Most studies, however, identify and discuss the critical factors that are necessary for overall ERP deployment success. There are very few studies that have specifically examined the critical factors necessary for ensuring information quality in an ERP system. Xu et al. (2002) identifies critical factors such as top management support, training, communication, employee relations, project teams, quality controls, and change management as crucial in achieving high ERP information quality. Researchers such as Vosburg and Kumar (2001), Madapusi and Kuo (2007), Madapusi et al. (2007) also focus on the importance of adopting a critical factors approach for ERP information quality management.

Past research indicates that researchers focused on identifying different dimensions of information quality. Wand and Wang (1996) used an "internal" and "external" view of data to identify information dimensions. Wang and Strong (1996) used a "fitness of use" of approach to postulate four information dimensions – internal, contextual, representational, and accessible. Ballou et al. (1998) used an information product approach to identifying information quality dimensions. They used an input-output model (akin to an information manufacturing system) to suggest that information outputs are information products that have measurable attributes such as timeliness, quality, cost, and value.

A perusal of the above discussions suggests that past studies concur on the impact of critical factors on information quality. There is, however, a lack of empirical studies in ERP research that have rigorously assessed the influence of critical factors on information quality output from the ERP system. In this study, we synthesize quality and ERP literature to identify a

set of critical factors that firms should focus on to increase the quality of information obtained from their ERP systems. The above postulated relationship is presented in Figure 1 below.

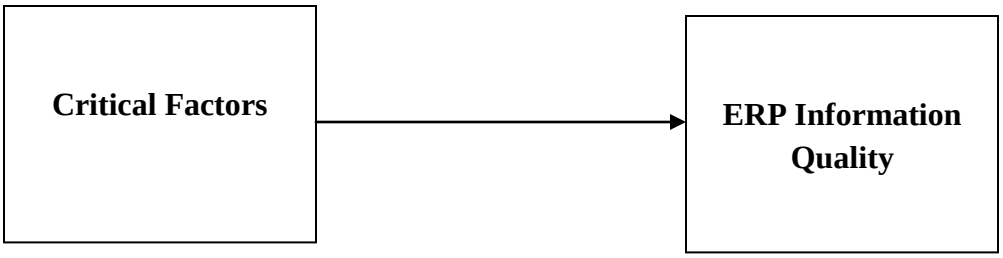

Figure 1: The Relationship between Critical Factors & ERP Information Quality

RESEARCH METHODOLOGY

Data were collected through a questionnaire from ERP system users in a production firm that had implemented an ERP system. The questionnaire was developed from a synthesis of quality and ERP research. The questionnaire was validated through a two step process – first with a focus group of academicians and then with a focus group of practitioners. Appropriate changes were made to the questionnaire as a result of the inputs from the two focus groups.

Nine multi-item critical factors were drawn from a synthesis of ERP and quality research (Saraph et al., 1989; Black and Porter, 1996; Samson and Terziovski, 1999; Vosburg and Kumar, 2001; Xu et al., 2002; Madapusi, 2008). A seven point Likert type scale ranging from "agree" to "disagree" was used to collect data on each of the critical factors – top management support, planning, user support, training, learning, project management, communication, organizational culture, and quality improvement measurement. The four items to measure the quality of information obtained from the ERP system were drawn from Ballou et al. (1998). A seven point Likert type scale ranging from "agree" to "disagree" was used to collect data on each of the information quality dimensions – timeliness, quality, cost, and value.

The questionnaire was administered to forty ERP information users in the production firm. Two of the responses had extensive missing data and hence were discarded (effective response rate of 38/40). The internal consistency method – calculation of Cronbach's alpha – was used to evaluate the reliability of the survey instrument. Validity was checked through use of a representative collection of items, by factor analysis, and by examining the correlation coefficients computed for the nine critical factors and each of the four information quality measures. The data were analyzed using various multivariate techniques such as factor and multiple regression analyses.

RESULTS

The data collected on the critical factors were first perused to check whether the data could be analyzed using factor analysis. The results of this analysis indicate that the correlations among the factors were greater than .30, the measure of sampling adequacy ranged from mediocre to meritorious, and the Bartlett's test of sphericity was significant. The data were hence found suitable for the conduct of factor analysis. The latent root and the scree test criterion ion

the factor analysis results indicate that the multiple items in each of the nine critical factors loaded onto a single factor. The factor loadings for the nine factors ranged from .528 to .934. Summated scales were then developed for each of the nine critical factors.

The data were then examined to check whether the data could be analyzed using multiple regression analyses. The results of this analysis indicated that all the assumptions underlying multiple regression techniques – linearity, constant variance of the error terms, independence of the error terms, and normality of the error term distribution – held good. Further tests indicated that demographic data did not influence the relationships examined in this research study. The data were then subject to multiple regression analyses.

The relationships presented in Figure 1 were tested by developing separate regression models to analyze each of the four information quality measures. The results of the regression analysis are presented in Table 1. The table provides the size of the standardized regression coefficients (β), the coefficients of determination (R^2), and the F ratios (F) for the fitted models. Only significant parameter estimates of the fitted models are shown; non-significant parameter estimates are omitted from the table.

Info Quality / Critical Factors	Timeliness			Quality			Cost			Value		
	R^2	F	β	R^2	F	β	R^2	F	β	R^2	F	β
Top Management Support				.106	4.250*	.325*				.131	5.433*	.362*
Planning	.211	9.360**	.490**	.296	14.701***	.544***	.117	4.653*	.343*	.362	19.855***	.602***
User Support				.076	2.979┼	.276┼				.088	3.484┼	.297┼
Training				.111	4.490*	.333*				.116	4.713*	.340*
Learning				.078	3.048┼	.279┼				.151	5.728*	.371*
Project Management												
Communication										.077	3.002┼	.277┼
Organizational Culture										.077	2.920┼	.277┼
Quality Improvement Measurement	.140	5.703*	.374*	.141	5.747*	.376*	.116	4.592*	.341*	.184	7.904**	. 429**

Note: β: All values are standardized regression coefficients. Significance: ┼ p < .10, * p < .05, ** p < .01, *** p < .001

Table 1: The Relationship between Critical Factors and ERP Information Quality

The results of the study indicate strong support for the relationship between various critical factors and two of the four information quality dimensions – quality and value. The results further indicate marginal impact of various critical factors on the other two information

quality dimensions – timeliness and cost. Two of the nine critical factors – planning and quality improvement measurement – had strong positive influences on all the four information quality dimensions. Project management was the only critical factor that did not influence any of the four information quality dimensions.

CONCLUSION

In this study we developed a model to investigate the impact of critical factors on ERP information quality. The findings of this study have important implications for firms deploying ERP systems. The findings suggest that firms which focus on planning and quality improvement measurement will obtain increased benefits due to improved information quality. Planning indicates that the firm has structured information quality planning processes in place. The information quality plans and policies are developed using a bottom-up approach to ensure organization-wide buy-in. The firm has instituted formal continuous quality improvement and measurement policies and procedures. Data on information quality costs are readily available and information quality assurance costs are determined periodically to support continuous improvement efforts.

Top management is actively involved in the quality improvement process. This, coupled with user support ensured through organization-wide buy-in, suggests that information is a valued product within the firm. The firm has adequate training and learning programs in place to ensure adherence to quality control programs; however, without diluting the focus on quality and value, emphasis should also be placed on ensuring that quality information is obtained at low cost and in a timely manner.

The findings suggest that the firm has not actively involved the project team in information quality management activities. There is a disconnect between the project team and quality task forces as evidenced by a lack of relationship between the project management critical factor and any of the information quality dimensions. This is probably due to lack of effective communication channels to disseminate the quality improvement efforts throughout the organization. The findings also suggest that the firm needs to ensure that there is a sustained organization-wide effort to maintain commitment to the consensually developed quality improvement plans. As seven out of the nine factors do not exhibit any relationship with the time and cost information quality dimensions, the firm needs to also ensure that quality information is made available in a timely and cost-effective manner to ensure speedy and effective decision-making.

The results must, however, be interpreted with caution. The emphasis on the various critical factors as well as information quality dimensions may vary across firms and industries. Moreover, different critical factors and information quality dimensions may be emphasized by firms in different stages of the ERP implementation cycle. Future research should expand the model developed in this study to examine the critical factors-information quality linkages across the firm's supply chain – suppliers, customers, and other stakeholders.

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