Relationship between IS Performance and Goal: An Empirical Study

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Abstract

Annual IT budget of major companies in South Korea is 44.7 billion Korean Won on average in 2007. A survey shows that among these companies, 58% of them had decided to increase the budget compared to that in previous year. In this study, we investigate relationship between IS investment goal and IS performance with moderating effect of process for IS infrastructure maintenance. For this purpose, we used a set of data with 271 responses gathered from manufacturing industry in 2006. Our results show that the relationship exists but varies across the task characteristics and there's no moderating effect. This finding implies that practitioners should be aware of that different goals need to be established based on task characteristics and more effort to harmonize the process with task activities is required to them.

1. Introduction

Many companies adopt information systems (IS) because they believe that they can get more benefits by using information technology (IT) [5]. In fact, annual IT budget of major companies in South Korea is 44.7 billion Korean Won on average in 2007 [3]. A survey shows that among these companies, 58% of them had decided to increase the budget compared to that in previous year [3]. As this figure keeps growing, IT has been considered one of core resources together with the others such as asset, labor, skill, raw material in order to run enterprises [6][16].

Many studies on organizational factors that affect IS success have been conducted in several perspectives. Saunders and Jones [18], for example, identified that factors such as mission, size, goals, top management support, IS executives hierarchical placement, maturity of IS function, size of IS function, management style, evaluator perspective, culture, and IS budget size have the impact on IS success. Moreover some other researches [2][4][13][19][20] described the organizational culture, the performance management system, and the change management process as common causes of IS failure .

Although previous studies were remarkable, none of these dealt with fundamental contribution of IS goal toward very specific performance factor. Thus, in this study, we are interested in the relationship between IS performance and IS goal. More specifically, the objective of this study is to investigate the relationship involving eight different performance factors in sales/operation

division and also to investigate whether process for IS infrastructure maintenance modifies strength and form of the relationship. For this purpose, we used a set of data with 271 responses from manufacturing industry and an ordered probit regression. Considering the research question and the data source, result of this study may not be easy to generalize but subsequently tell us current status of how the goal is associated with the performances in such division for real.

The next section of this paper, we present the literatures related this issue. In Section 3, we address data, measurement, multiple imputations for missing values. In Section 4, we describe analysis methods including centering the quantitative predictor (i.e., independent variable) and an ordered probit regression. In Section 5, we present results of the analysis. In Section 6, we discuss final remarks including limitations and implications.

2. Factors affecting IS in present study

As mentioned in previous section, a goal is one of factors that affect IS success [18]. A goal is a thing that an individual is trying to accomplish. In other words, it is an object or an aim of an action [14]. In psychological perspective, it is found that there's a relationship between goal setting and performance [14] but in this domain, they merely discussed the difference in level of achievements based on strength of goals.

Meanwhile, relatively small number of researches studied the relationship undertaking task characteristic. In such studies, a general idea found is that a goal led to different level of performance depending on characteristics of the task [12][21]. Grounded on these studies, we expect that the relationship exists but the IS goal will not contribute to all the IS performance at the same time because each task have different characteristics. In this study, we picked task efficiency as a IS goal although IS can be used to improve many different aspects.

By the way, Melville et al. [15]'s study of how IT influences organizational performance addressed the role of processes. Based on former studies, the authors suggested that organizational performance is influenced by activities and their operational efficiency. In addition, IT is according to description in Grants [7], physically existing equipment such as communication technology, workstations, servers, printers, and so on. Although single equipment component usually has commodity characters, it requires immense efforts by technical and managerial personnel to establish rules on distribution and management within systems [17]. Grounded on these, we expect to see that the relationship between IS performance and IS goal is moderated by process for maintaining IS infrastructure.

3. Data

3.1. Data description

A set of data with 271 responses used in this study was gathered from several companies in manufacturing industry in South Korea in 2006. As summarized in Table 1, in this data, eight variables represent contribution of IS toward performance factors (i.e., IS performance) in sales/operation division. With regard to the objective of this study, these variables are obviously the dependent variables. Another variable, importance of task efficiency as one of IS investment goals is also included in this data and was decided to be an independent variable. In addition, the other variable that represents the existence of guideline/process for IS infrastructure maintenance was selected as a moderator variable. For reference, first two variables indicate

industry type (i.e., manufacturing) and firm size.

Table 1. Variables in the data

Type	ID	Explanation
Dependent (*Contribution of IS toward…*)	Perf1	Decreases in lead-time of ordering process
	Perf2	Decreases in lead-time of returning process
	Perf3	Decreases in returning rate of end product
	Perf4	Decreases in defect rate of end product
	Perf5	Decreases in order cancellation
	Perf6	Increase in sales plan accuracy
	Perf7	Decrease in management expenses over the sales
	Perf8	Increase in turnover rate of bonds
Independent	TE	Task efficiency (IS investment goal)
Moderator	Inf	Guideline/process for IS infrastructure maintenance

3.2. Measurement scale

For the dependent variables, five-point Likert scale namely: "Not Very Contributing", "Not Contributing", "Neutral", "Contributing", "Very Contributing", ranging from 1 to 5 respectively, was used. To measure the independent variable, five-point Likert scale namely: "Very unimportant", "Unimportant", "Neutral", "Important", "Very important", ranging from 1 to 5 respectively, was used. The moderator variable however, is dichotomous response format in which the responses are 0 = "Not established", 1 = "Established".

3.3. Multiple imputations

It is not uncommon for datasets to have missing values. This may occur because of unit nonresponse (i.e. the respondent did not provide any data at all), item nonresponse (i.e. the respondent did not answer some questions on a questionnaire), or answering questions with the "Don't Know" response category. Ignoring missing values leads to a loss of degrees of freedom and statistical power in subsequent analysis. In this study, there were 17.6 ~ 21.9% of missing values including responses of "Don't know" after the data was divided into right different models (see the next section). So, it was necessary to deal with it using multiple imputations. This was performed with a function, AmeliaView provided by Amelia Library in R version 2.5.1 [9] in order to fill up the missing. After that, five sets of data for each model were created and all the records in the data became available except where unit nonresponse appeared. The results provided in this study are the combined results from these five datasets.

4. Analysis method

In order to avoid the collinearity risk between the independent variable and the interaction term (i.e. TE*Inf), the independent variable was centered by subtracting the mean [1] while the moderator variable is not centered [11]. After that, univariate regression was involved. Thus, there were eight different models involving eight different dependent variables. Since the dependent variables (i.e., IS performance) is measured with a five-point ordered rating scale, an appropriate regression model is an ordered probit regression [22] using a function zelig provided by Zelig Library in R version 2.5.1 [10]. The ordinary least squares (OLS) regression on the other hand, is not appropriate because it is inefficient and cannot restrict the estimated dependent value to the range of the variable [8].

An ordered probit model posits that an underlying latent variable y_i^* measures the continuous value of IS performance (i.e. Perf1 ~ Perf8), where y_i^* itself is not observed. The latent variable is a combination of independent variable and moderator variable as shown in Eq. (1):

$$y_i^* = \beta_0 + \beta_1 x_i + \beta_2 z_i + \beta_3 xz_i + \varepsilon_i, \quad i = 1, ..., n, \qquad \text{Eq. (1)}$$

where n is the number of respondents, β is a vector of

parameters, x_i is independent and z_i is moderator variables for i th respondent, and ε_i is a random error term, assuming a standard normal distribution across respondents.

5. Results

In this study, we are interested in association between IS performance and IS goals with moderating effect of process for IS infrastructure maintenance in the ordered probit regression model so this is a two-tailed hypothesis. The results are described with coefficients and t-values in Table 2. Note that with the overall alpha level at 0.1, we tested each coefficient at the Bonferroni adjusted alpha level of 0.0125 (0.1/8, t-value: 2.241). This is very conservative compared to involving ordinary significant level.

Table 2. Coefficient of univariate regression

Dependent Variable	IV & Interaction term	Ordered probit	
		Coefficient	T-value
Perf1	TE	0.325	3.568
	Inf	1.000	5.674
	TE*Inf	-0.314	-2.058
Perf2	TE	0.310	3.399
	Inf	0.981	5.553
	TE*Inf	-0.304	-1.989
Perf3	TE	0.167	2.910
	Inf	-0.276	-1.644
	TE*Inf	-0.127	-0.901
Perf4	TE	0.052	0.930
	Inf	-0.404	-2.361
	TE*Inf	0.050	0.351
Perf5	TE	0.326	2.403
	Inf	0.741	3.302
	TE*Inf	-0.406	-2.037
Perf6	TE	0.104	1.847
	Inf	-0.569	-3.310
	TE*Inf	-0.107	-0.742
Perf7	TE	0.343	2.408
	Inf	0.753	3.235
	TE*Inf	-0.404	-1.961
Perf8	TE	0.376	2.523
	Inf	0.792	3.339
	TE*Inf	-0.437	-2.078

*The shaded cells indicate significance at the Bonferroni adjusted alpha level.
* TE: Task efficiency (independent variable)
* Inf: Process for IS infrastructure maintenance (moderator)

Base relationship indicates direct an association between dependent variable and independent variable. As shown in Table 2, six of them appeared to be significant. This result implies that task efficiency is associated with IS contribution toward performance factors except Perf4 and Perf6. IS contribution toward Perf1, Perf2, Perf3, Perf5, Perf7, and Perf8 is positively related with IS goal of task efficiency so as the goal that is task efficiency becomes more important, IS contribution to following performance factors: reducing lead-time of ordering process, reducing lead-time of returning process, reducing returning rate of end product, reducing order cancellation, reducing management expenses, and increasing turnover rate of bonds is enhanced more. On the other hand, no relationship between task efficiency and IS contribution to reducing defect rate/increasing sales plan accuracy is found. One possible explanation for this is difference in task characteristics.

Lastly, in case of interaction term, none of them appeared to be significant. This means that the interaction term is not related to IS contribution toward performance factors involved in this study. In short, there's no moderating effect. So, it seems that obeying the process doesn't make any difference. However, assuming that job performance would increase once people become familiar with the process, we can infer that those respondents were not fully familiar with the process.

6. Final remarks

As with any other study, there are also some limitations. Most of all, the results of this study is not easily generalized since very specific performance factors were involved. Nevertheless, these findings

provide implication to practitioners because, from reliable data source, they provide us with current status in the industry and division. First, as shown in the results, the relationship between IS performance goal is found in most cases but not in all the cases as we expected and no moderating effect is found. Thus, the results indicate three things. First, it validates existence of the relationship between IS performance and task efficiency. Second, the relationship is different across types of task. With regard to this, different goal setting needs to be established based on task characteristics. Third, respondents might not be familiar with the process. If so, more effort to harmonize it with task activities is required to managers in this division in manufacturing industry. We expect that these findings eventually would enable us to give more differentiated advice to practitioners concerning how to enhance the contribution of IS toward firms' performance.

[Reference]

[1] L. Aiken, S West, Multiple Regression: Testing and Interpreting Interactions, Sage University Paper Series on Quantitative Application in Social Sciences, Sage, Newbury Park, 1991.

[2] T. Bikson, B. Gutek, Implementation of Office Automation, Santa Monica, CA: Rand Corporation, 1984.

[3] Digital Times, 58% of firms increase annual IT budget, http://www.dt.co.kr/contents.html?article_no=2007030502013960600003, 2007.

[4] D. Eastman, Improving cross-cultural communication during complex information systems development. Journal of Management Systems, 3 (1) (1991) 19-31.

[5] C.R. Franz, D. Robey, Organizational context, user involvement, and the usefulness of information systems, Decision Science 17 (summer) (1986) 329-356.

[6] R. Glazer, Marketing in an information-intensive environment: Strategic implication of knowledge as an asset, Journal of Marketing 55 (October) (1991) 1-19.

[7] R. Grant, The resource-based theory of competitive advantage: Implications for strategy formulation, California Management Review 33 (3) (1991) 114-135.

[8] W.H. Greene, Econometric Analysis, 4th edition, Prentice Hall International, Inc., 2000.

[9] J. Honaker, G. King, M. Blackwell, Amelia II: A Program for Missing Data, http://gking.harvard.edu/amelia/, 2007.

[10] K. Imai, G. King, O. Lau, Zelig: Everyone's Statistical Software, http://gking.harvard.edu/zelig/, 2007.

[11] J. Jaccard, R. Turrisi, C. Wan, Interaction Effects in Multiple Regression, Sage University Paper Series on Quantitative Application in Social Sciences, Sage, Newbury Park, 1990.

[12] S. Jackson, S. Zedeck, Explaining performance variability: Contribution of goal setting, task characteristics, and evaluative contexts. Journal of Applied Psychology 67 (1982) 759-768.

[13] K. Legge, Information technology: Personnel management's lost opportunity? Personnel Review 18 (5) (1989) 2-61.

[14] E. Locke, K. Shaw, L. Saari, G. Latham, Goal setting and task performance: 1969-1980, Psychological Bulletin 90 (1981) 125-152.

[15] M. Melville, K. Kraemer, V. Gurbaxani, Review: Information technology and organizational performance: An integrative model of IT business value, MIS Quarterly 28 (2) (2004) 283–322.

[16] A. Menon, R. Varadarajan, A model of marketing knowledge use within firms, Journal of Marketing, 56 (October) (1992) 53-71.

[17] J. Ross, C. Beath, D. Goodhue, Developing long-term competitiveness through IT assets, Sloan Management Review 38 (1) (1996) 31-42.

[18] C. Saunders, J. Jones, Measuring performance of the information systems function, Journal of Management Information Systems 8 (4) (1992) 63-73.

[19] S. Seilheimer, Importance of the human factor in the information system life cycle, Journal of Systems Management 38 (7) (1987) 24-27.

[20] A. Templer, Managers downplay the role of the HR function in introducing new technology, Personnel Administrator, 30 (7) (1985) 88-96.

[21] J. Terborg, H. Miller, Motivation, behavior, and performance: A closer examination of goal setting and monetary incentives, Journal of Applied Psychology 63 (1978) 29-39.

[22] T. Zavoina, W. McElvey, A statistical model for the analysis of ordinal level dependent variables, Journal of Mathematical Sociology 4 (1975) 103-120.