

A Study on the Business Process and Organizational Performance of Information Technology Infrastructure Capabilities

Woo-Hyoung Lee¹⁾, Myoung-Ho Lee²⁾

1) Hankuk University of Foreign Studies, Business Administration (leewh@hufs.ac.kr)

2) Hankuk University of Foreign Studies, Business Administration (leemh@hufs.ac.kr)

Abstract

This study develops and tests a model examining the relationship between IT infrastructure and firm performance. Then, this study conceptualizes the characteristics of IT infrastructure. The application of the resource-based view of the firm, IT infrastructure is defined in terms of technical support and human/organizational competence. The theoretical framework is based on the concept of business processes. Performance on business process is modeled in terms of IT infrastructure used in the process.

According to the findings, IT investments influenced business process, and business process, in turn, had an influence on the company's accomplishments. Therefore, the corporations that are planning an investment or currently investing are recommended to create an environment for long-term improvements in performance by improving business process, rather than focusing on short-term results

1. Introduction

A body of literature emerged in the early eighties highlighting how information technology(IT) infrastructure can provide organizations with a competitive advantage. Building a responsive IT infrastructure has recently been identified by top information systems(IS) executives as the most important IS management issue. Despite the strategic importance of and significant investment in IT infrastructure, little empirical research has been reported which studies the characteristics and the organizational impact of IT infrastructure. In addition to, the empirical literature on the business value of IT infrastructure has shown mixed results. Research on IT infrastructure is still in its early stage. Empirical research is needed to provide a better understanding of the characteristics and impact of IT infrastructure.

The purpose of this study is to conceptualize and measure the important features of the infrastructure for "Information Technology" (IT), review the effects of the structured environmental variables, and thereby, verify the influences of the IT infrastructure and organization. To this end, the following objectives are set up;

1. A conceptual framework for IT infrastructure capacity and its competitiveness will be developed;
2. A scale will be developed to measure the IT infrastructure capacity.
3. A conceptual model which can explain about the relationship among environmental variables of the organization, IT infrastructure capacity and organizational competitiveness will be developed;
4. A study model based on the conceptual model will be developed, and thereby, the model and the hypotheses will be tested;

In order to achieve the above objectives, a model which describes the relationship between IT and organizational performance will be developed to be tested.

2. LIRERATURE REVIEW

2.1 IT Infrastructure and Business Process

As discussed in the previous chapter, the sole fact that a company possesses IT resources does not create much business value and thus the company would fail to achieve competitive advantages in the long term. Therefore, business processes that act as intermediate benefits need to be applied in an effective manner so that IT resources can influence in any form on the company. So rather than directly connecting IT resources to accomplishments of a corporation, it is considered better to establish a model which indirectly relates them through a business process that serves as an intermediate benefit. Such an approach using an intermediate benefit between an independent variable and a dependent one is called process-oriented approach. This approach helps understand when and how IT recourses are converted to an accomplishment.

There has not been much research using the process-oriented approach, particularly in the field of IT infrastructure. But it is meaningful to verify models using this approach because it shows that a certain technology or an application plays a key role in a certain process.

Therefore, this research adopts an alternative model connected by an intermediate process between IT resources and accomplishments in a company, and views that the intermediate process improves the company's business process.

IT infrastructure is a major business resource and an important source of competitive advantage[8][11]. IT infrastructure not only assists a corporation in automated business activities but also in reshaping, redesigning business process[13]. It also serves both as an obstacle and an enabler to plan or change business processes[14]. Applying possible technologies and platforms contributes to a successful business process[2]. To change processes among departments requires changes in the roles of information system management and of IT departments that provide infrastructure[5][6]. Caron et al.[2] pointed out that a high possibility of using characteristics of IT infrastructure(such as standardization and connectivity) is one of the major factors that lead to a better realization of strategic IT application.

Resources are meaningful only in an environment where they can generate solid accomplishments to attain competitive advantages[12].

However, to possess a process supplying a competitive advantage is not enough in a current environment. Corporations need to renew their processes to adapt to the changing business environments. It is more difficult to assess investment in IT infrastructure than in IT projects because IT infrastructure is shared for a long time with others in the company and embedded into its IT projects and business process [15].

2.2 Organizational Performance

Many researchers argue that a competitive advantage is achieved when investment returns higher than an industry average are accomplished during a period of time that is long enough to change the characteristics of competition in an industry[3][12].

In documents on relationship of IT and accomplishments, some approaches propose evaluating IT accomplishments against financial performance(for example, [1][4][7]). These approaches attempt to confirm results from IT investments through changes in financial indices such as ROI, ROA, or sales increase. And these show the promised result of

connection between IT and corporate accomplishments. Additionally, IT researchers emphasize the strategic impact of IT using market share(for example, [4][10][9]). Clemons[3] says a strategic system has two sources, increases in profits and in market share, that benefits corporations.

3. Conceptual framework

The following conclusions can be drawn and used as the bases for the development of the conceptual model.

1. Empirical studies that attempt to establish a direct link between IT and its business value and impact have failed to produce consistent results. Alternative theories and approaches are needed to provide better explanations for the productivity paradox. Then, Multi-faceted measures are needed to capture both technology asset and intellectual asset.
2. The mere existence of IT is not sufficient for producing business value. IT must be effectively applied to and used by the intermediate business process to have any impact on the firm. Thus, the relationship between IT and firm performance is better modeled as an indirect link through IT impact on the intermediate business process.
3. Adopting such a process-oriented perspective provides a promising approach for a better understanding of how and when IT investment is converted into firm performance.

3.1 Research model

The research model corresponds closely to the conceptual framework.

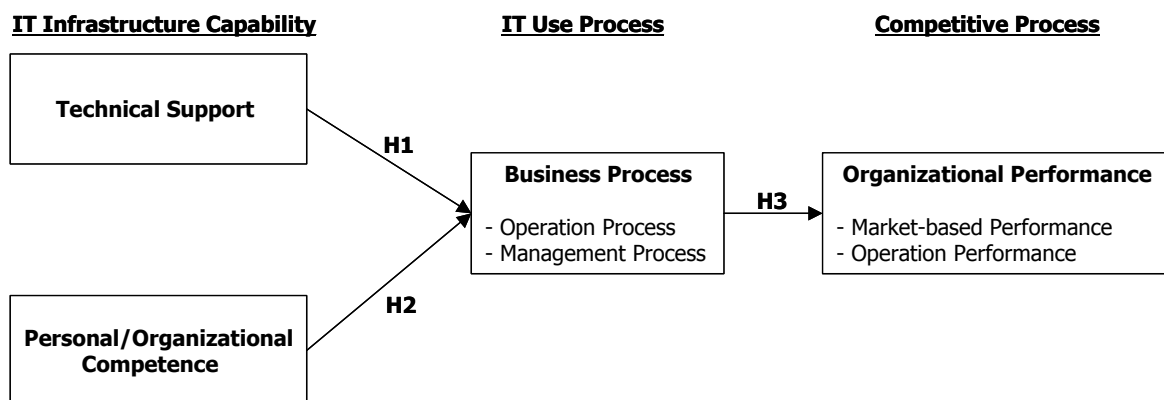


Fig. 1. Research Model

3.2 Research Hypotheses

Hypothesis 1 : The technical support positively affect the business process

Hypothesis 1-1 : The technical support positively affect the operation process

Hypothesis 1-2 : The technical support positively affect the management process

Hypothesis 2 : The personal/organizational competence positively affect the business process

Hypothesis 2-1 : The personal/organizational competence positively affect the operation process

Hypothesis 2-2 : The personal/organizational competence positively affect the management process

Hypothesis 3 : The Business process positively affect the organizational performance

Hypothesis 3-1 : The business process positively affect the market-based performance

Hypothesis 3-2 : The business process positively affect the operation performance

4. Result

4.1 Findings

A survey was conducted for this research. 150 copies of questionnaire was distributed each to computation departments and other departments with return rates of 58% (87 replies) and 63% (95 replies) respectively. Among returned replies, those non-applicable or those returned from only either department were excluded. That left 82 replies (return rate 55%) from either department.

4.2 Validity and Reliability Analyses

(1) Validity Analysis

Factor analysis was conducted to analyze the validity of the survey. Factor analysis was conducted separately for independent variables (technological supporting, human resource/organizational capabilities) and for parameter (business process). The table below shows the results of the factor analysis.

<Table 4-1> Factor Analysis: IT Infrastructure variables

	Comm.	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
Connectivity3	.622				.690			
Connectivity 5	.814				.803			
Connectivity 6	.793				.755			
Co-ownership3	.811						.866	
Co-ownership4	.825						.787	
Mgt. Knowledge1	.745			.780				
Mgt. Knowledge2	.824			.806				
Mgt. Knowledge3	.670			.686				
participation1	.732		.674					
participation2	.764		.792					
participation4	.664		.628					
participation5	.773		.832					
flexibility1	.597		.457					.534
flexibility	.835							.904
training1	.799					.868		
training2	.824					.841		
Mgt. Knowledge(1)	.765	.806						
Mgt. Knowledge(2)	.840	.886						
Mgt. Knowledge(3)	.821	.891						
Eigen Value		2.933	2.621	2.381	2.004	1.595	1.539	1.444

<Table 4-2> Factor Analysis: Business Process

	Comm.	Factor1	Factor2	Factor3	Factor4	Factor5
Supplier's Relationship 1	.743		.776			
Supplier's Relationship 2	.849		.890			
Supplier's Relationship 3	.739		.845			
Process Management 3	.763			.667	.483	
Process Management 4	.764			.803		
Process Management 5	.857			.838		
Customer's Relationship 2	.818					.829
Customer's Relationship 4	.812				.402	.740
Product/ Service enhancement 2	.799				.863	
Product/ Service enhancement 3	.839				.839	
Sales and Marketing Support 1	.704	.735				
Sales and Marketing Support 2	.846	.916				
Sales and Marketing Support 3	.746	.812				
Eigen value		2.352	2.312	2.056	1.925	1.634

(2) Reliability Analysis

To analyze reliability of the survey, Cronbach's alpha, which is most representative of Internal Consistency Reliability, was used. Following table is the results.

<Table 4-3> Reliability Analysis

			Initial Items	Delete Items with Factor Analysis	Final Items	Cronbach`s α
Independent Variable	Connectivity		6	3	3	.7723
	Co-ownership		6	4	2	.6232
	CEO`s participation		5	1	4	.7983
	Flexibility		3	1	2	.5322
	Training		3	1	2	.6625
	Mgt.	IS Department	3	0	3	.7657
	Knowledge	Non IS Department	3	0	3	.8792
Intermediate Variable	Supplier`s Relationship		4	1	3	.8125
	Process Management		8	5	3	.7532
	Customer`s Relationship		5	3	2	.6694
	Product/ Service enhancement		5	3	2	.7481
	Sales and Marketing Support		4	1	3	.8040
Dependent Variable	Market Performance		7	4	3	.6622

4.3 Verification of Hypotheses

(1) Hypothesis 1

Multiple regression analysis was used to verify the hypothesis. The results indicated that the co-relational variable between suppliers and technological supporting is sharing. The co-relational variable to customer relations is access, to expansion of products and service sharing, and to sales and marketing supporting also sharing. Therefore, Hypothesis 1 was partly adopted.

(2) Hypothesis 2

Multiple regression analysis was used to verify the hypothesis. The results showed that the co-relational variable between suppliers and human resource/organizational capabilities and suppliers is flexibility and managerial knowledge. The co-relational variable to process management is organizational knowledge, to customer relations IT training and managerial knowledge, to expansion of products and service and to sales and marketing supporting managerial knowledge. Therefore, Hypothesis 2 was partly adopted.

<Table 4-4> Result of Hypothesis 1, 2

D.V.	I.D			Beta	t	Sig.	F	Adj.R ²
		B	St. error					
Supplier's Relationship	Connectivity	2.613E-02	.085	.037	.308	.759	2.230	.093
	Co-ownership	.167	.094	.207	1.769	.081		
	participation	-7.2E-02	.118	-.075	-.606	.546		
	flexibility	-.203	.119	-.209	-1.701	.094		
	training	-.12E-02	.113	-.012	-.107	.915		
	Mgt. Knowledge	.409	.147	.357	2.776	.007		
Process Management	Connectivity	-2.4E-02	.077	-.038	-.310	.757	1.838	.066
	Co-ownership	9.613E-02	.086	.134	1.115	.269		
	participation	-6.1E-02	.112	-.070	-.547	.585		
	flexibility	-.149	.109	-.171	-1.360	.178		
	training	-.134	.103	-.155	-1.304	.197		
	Mgt. Knowledge	.393	.137	.383	2.874	.005		
Customer's Relationship	Connectivity	.161	.081	.235	1.993	.050	2.773	.127
	Co-ownership	1.426E-03	.090	.002	.016	.987		
	participation	-.110	.112	-.119	-.981	.330		
	flexibility	.116	.114	.112	1.018	.312		
	training	-.271	.108	-.286	-2.520	.014		
	Mgt. Knowledge	.246	.141	.220	1.748	.085		
Product / Service enhancement	Connectivity	.124	.099	.154	1.258	.213	1.801	.062
	Co-ownership	-.211	.110	-.228	-1.920	.059		
	participation	-6.1E-02	.137	-.055	-.441	.661		
	flexibility	-.128	.139	-.115	-.921	.360		

ement	training	1.309E-03	.131	.001	.010	.992		
	Mgt. Knowledge	.375	.172	.285	2.183	.033		
Sales and Marketi ng Support	Connectivity	7.505E-02	.081	.102	.928	.357	4.781	.237
	Co-ownership	.294	.090	.350	3.264	.002		
	participation	-.178	.112	-.179	-1.583	.118		
	flexibility	.139	.114	.137	1.223	.225		
	training	1.400E-02	.108	.014	.130	.897		
	Mgt. Knowledge	.308	.140	.258	2.191	.032		

(3) Hypothesis 3

Multiple regression analysis was used to verify the hypothesis. The results indicated that the co-relational variable between business process and a company's accomplishments is customer relations and service expansion variables. Therefore, Hypothesis 3 was partly adopted

<Table 4-5> Result of Hypothesis 3

D.V.	I.V.			Beta	t	Sig.	F	Adj.R ²
		B	St. error					
Market Performance	Supplier's Relationship	-.112	.092	-.149	-1.334	.187	2.967	.116
	Process Management	6.289E-02	.118	.065	.532	.597		
	Customer's Relationship	.192	.104	.239	1.842	.070		
	Product/ Service enhancement	-.216	.097	-.274	-2.227	.029		
	Sales and Marketing Support	.112	.102	.138	1.100	.275		

5. CONCLUSION

Many attempts to explain so-called 'paradox of productivity' have only created more controversy, failing to show consistent results on IT investments and accomplishments. This research verified that investments in IT should entail changes in business process in order to bear fruit.

According to the findings, IT investments influenced business process, and business process, in turn, had an influence on the company's accomplishments. Therefore, the corporations that are planning an investment or currently investing are recommended to create an environment for long-term improvements in performance by improving business process, rather than focusing on short-term results.

Despite such meaningful suggestions, there are some limitations in this research.

First, exogenous variables that would have prevented respondents from answering correctly about IT investments were not effectively controlled. Thus, the responses could be biased to some extent.

Second, the sample size was not big enough to cover each industry.

Therefore, future research should use a bigger sample size and put more efforts to find other variables than business process as an intermediate benefit.

References

- [1] Banker, R. and Kauffman, R., "Strategic Contributions of Information technology: An Empirical Study of ATM Networks", Proceedings of the 9th International Conference on Information Systems, 1988, pp.141-150
- [2] Caron, J. R., Jarvenpaa, S. L. and Stoddard, D. "Business Reengineering at CIGNA Corporation Experiences and Lessons from the First Five Years", MIS Quarterly, Vol. 18, No. 2, 1994, pp.223-250
- [3] Clemons, E. K. and Kimbrough, S. O., "Information Systems, Telecommunications and Their Effects on Industrial Organizations", The 7th International Conference on Information Systems, December 1986, San Diego, CA, pp.99-108
- [4] Clemons, E. K., "Information Systems for Sustainable Competitive Advantage", Information and Management, November 1986, pp.131-136
- [5] Dixon, J. R., Arnold, P., Heineke, J., Kim, J. S. and Muligan, P., "Business Process Reengineering: Improving in New Strategic Directions", California Management Review, Vol. 36, No. 4, 1994, pp.93-108
- [6] Earl, M. J., 「Management Strategies for Information Technologies」, Englewood Cliffs, NJ : Prentice Hall, 1989
- [7] Kauffman, R. J. and Weil, P. "An Evaluative Framework for Research on the Performance Effect of Information technology Investment," Proceedings of the 10th International Conference on Information System, Boston, MA, 1989.
- [8] Keen, P., 「Shaping the Future", Business Design through Information Technology」, Boston : Harvard Business School Press, 1991
- [9] Kettinger, W. J., Grover, V., Guha, S. and Segars, A., "Strategic Information Systems Revisited: A Study in Sustainability and Performance", MIS Quarterly, March 1994, pp.31-58
- [10] Liberman, M. B. and Montgomery, D. B., "First Mover Advantages", Strategic Management Journal, Vol. 8, 1988, pp.41-58
- [11] McKenney, J. L., 「Waves of Change: Business Evolution through Information Technology」, Boston, MA: Harvard Business School, 1995
- [12] Porter, M., 「Competitive Advantage: Creating and Sustaining Superior Performance」, Free Press, New York, 1985
- [13] Venkatraman, N., 「IT-Induced business reconfiguration」, In M. S. Scott-Morton(eds.), The Corporation of the 1990s: Information Technology and Organizational Transformation. New York, NY: Oxford University Press, 1991
- [14] Wastell, D. G., White, P., and Kawalek, P., "A Methodology for Business Process Redesign: Experiences and Issues", Journal of Strategic Management, Vol. 3, No. 1, 1994, pp.23-40
- [15] Xia, W., "Dynamic Capabilities and Organizational Impact of IT Infrastructure: A Research Framework and an Empirical Investigation", Dissertation of University of Pittsburgh, 1998