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Information Technology and Organizational Learning: Functional and Organizational Issues

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Abstract

A comprehensive model that delineates the interrelationships among computer systems, organizational context and organizational learning is absent. This study aims to fill this void. Unlike previous research, this study investigates the role of computer systems, i.e., organizational learning computer systems (OLCS), in facilitating organizational learning. In our framework, we argued that contextual variables mediated the impact of OLCS on organizational learning. In order to test the feasibility of this framework, we conducted an empirical study. This study employed a survey instrument, which contained data collected from 500 organizations in manufacturing, service industry, and academic institutions. A total of 165 usable responses were analyzed. The results indicate that OLCS have a positive impact on the organizational learning processes. Both "problem characteristic" and "organizational culture" moderate the influence of OLCS on organizational learning. The implications of the study are provided, and future research is suggested.

**Keywords**: OLCS, organizational context, organizational learning

Background

A comprehensive framework concerning organizational learning has been proposed by Huber (1991). This framework identified four constructs, which are crucial to the effectiveness of organizational learning; they are knowledge acquisition, information distribution, information interpretation, and organizational memory. Since Huber's comprehensive view of organizational learning theory was published, at least four researchers have referenced this framework in conducting related studies (Goodman and Darr 1998; Nonaka and Takeuchi 1995; Hernes 1999; Robey et al. 2000). However, other researchers criticized that Huber's framework did not examine the role of computer systems for acquiring knowledge and enhancing the effect of organizational learning. They have proved that computer systems are changing many organizational processes including communication (Kiesler and Sproull 1987), group decision making (Kiesler et al. 1984), coordination (Rice and Shook 1990), and collaborative work (Kraut et al. 1992). Despite previously mentioned criticism, there are relatively few field studies that examine the effect of computer systems on facilitating organizational learning (Orlikowski 1993a, Constant et al. 1996, Goodman and Darr 1998).

Orlikowski (1993b) argued that organizational context, such as corporate strategies and structure and culture, is one of the critical factors that influence the adoption and using of IT. A similar concept was presented in Orlikowski (1993a), which reveals that a number of organizational elements, such as mental models (which affect how people understand and appreciate IT) and structural properties (reward systems and workplace norms), significantly influence the implementation and usage of IT. Although several researchers (Orlikowski 1993b, Orlikowski 1993a, Dutton and McLean 1991, Henderson and Clark 1990) have investigated the impact of organizational context on the applicability of IT in an organization, there are relatively few empirical studies that examine the role of organizational context, which serves as a moderator between IT and organizational learning. The purposes of this study are: (a) to examine the role of computer system in facilitating organizational learning (b) to realize the impact of organizational context on the effect of adopting OLCS to facilitate organizational learning.

Research Methodology

In order to explore the impact of OLCS and organizational context on organizational learning, we developed the research framework in Figure 1. There are two research questions. (a) Does OLCS play a role in facilitating organizational learning? (b) What types of organizational context may moderate the effect of OLCS on facilitating organizational learning?
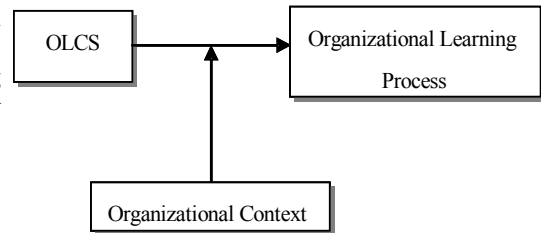
Description of the Variables

Figure 1. Research Framework

There are three types of variables in this study. The first type of variable is OLCS, which represents the computer systems that facilitate organizational learning. Given that the objective of this study is to explore the features that computer systems may have in facilitating organizational learning, we therefore defined a term OLCS as representing such computer systems. As the literature indicates (Goodman and Darr 1998; Brown and Duguid 1991; Walsh and Ungson 1991; Huber 1991; Constant, Sproull, and Kiesler 1996), the computer systems with "knowledge acquisition," "knowledge distribution," "broadcasting," "updating," and "memory" features can be considered as OLCS. Therefore, OLCS is not a specific IS. Instead it is simply an organization's IT infrastructure as an enabler for organizational learning. Hypothesis 1 was developed to examine the possible features of OLCS that facilitate organizational learning. We adopted factor analysis, Pearson correlation, and regression analysis to verify this hypothesis. The second type of variables selected for analysis is organizational context. Although a lot of organizational variables may have impact on OLCS in facilitating organizational learning, we only selected two of them, i.e. "problem characteristic" and "organizational culture." The reason for such a selection is that the nature of the task structure will influence the form of problems and solutions to be exchanged. The demands on the communication, search, acquisition, and organization for information of OLCS may be quite different provided the problem characteristic is different. Organizational culture is one of the most critical factors that may either facilitate or constrain the employment of OLCS for organizational learning. A culture of creativity and sharing should facilitate the role of OLCS and organizational learning. However, a lack of trust will usually lead to reluctant to contribute knowledge to or adopt it from the learning community. Finally, the processes of organizational learning consist of "decision to contribute" and "decision to adopt." For an individual to contribute knowledge, one has to formulate the tacit and explicit knowledge about what has been learned, what the problems were, what kind of know-how I used to solve the problems, and what the context for a solution was. The other activity for "contribute" is to delivery such knowledge to the person who needs it. In order to do so, knowledge has to be represented in a way that is meaningful and easy to understand to others. In order to adopt knowledge, an individual has to search for the possible solutions and match the problems to the appropriate solutions.

Data

Data were collected from firms of Taiwan through a survey instrument. An initial version of the survey instrument was developed based on the theory-grounded operationalization of the various constructs. This version was subsequently revised through pretesting with academic and industrial experts who have knowledge concerning "computer-aided system that facilitates organizational learning." The instrument was further pilot tested with CIOs from different firms. The multiple phases of instrument testing and development resulted in a significant degree of refinement and restructuring of the survey instrument as well as establishing the initial content validity (Nunnally 1978).

The responding firms represent a wide variety of organizations in manufacturing and service industry, and academic institution. There was an even distribution among the types and sizes of these organizations. A total of 165 usable responses were returned, providing a response rate of 33%. Given that the survey was unsolicited and the instrument quite complex, this response rate can be considered satisfactory and comparable to other studies in IS research (Raho et al., and Jain 1998)

Results

Validity and Reliability

Factor analysis using principal components factor analysis with factor extraction and VARIMAX rotation was conducted to examine the unidimensionality/convergent and discriminant validity (Price and Mueller 1986). The four commonly employed decision rules were applied to identify the factors (Hair et al. 1979): (1) minimum Eigen value of 1; (2) minimum factor loading

of 0.4 for each indicator item; (3) simplicity of factor structure; and (4) exclusion of single item factors. Reliability was evaluated by assessing the internal consistency of the indicator items of each construct by using Cronbach's α (Cronbach 1951). The results of factor analysis relating to unidimensionality/convergent validity are shown in Appendix A.

Findings

The first objective of this research is to investigate the causal relationship between OLCS and organizational learning process. Therefore, the first hypothesis is:

> **Hypothesis 1:** *The functions of OLCS are negatively related to the organizational learning process.*

We used simple regression analysis to achieve this objective. However, in order to assure the accuracy of regression analysis, a correlation analysis is usually conducted first. Therefore, we employed Pearson correlation to examine the linear association between constructs. The result of Pearson correlation analysis in Table 1 indicates that OLCS and organizational learning process are related. Therefore, we employed simple regression analysis to examine the causal relationship between OLCS and organizational learning process. This result is demonstrated in Table 2. From this table, causal relationship between OLCS and organizational learning processes seems to exist. In other words, we may claim that the functions of OLCS have a significant impact on the organizational learning process.

Table 1. Result of Pearson Correlation Analysis

Construct	Organizational Learning Process	OLCS
Organizational Learning Process		0.866** (0.000)
**Correlation is significant at the 0.01 level (2-tailed, N = 165		

Table 2. Result of Simple Regression Analysis

Independent variable	BETA coefficient	T Value	Significance
(Constant)		3.146	0.002***
OLCS	0.799	18.574	0.000*****
Dependent variable: organizational learning process			
*****p<0.0001; ***p<0.01			

The second research objective is to examine the effect of organizational context, which serves as a moderating variable between OLCS and organizational learning process. Contextual variables can be viewed as increasing or decreasing the effect of OLCS on organizational learning process. Factor analysis of the 8 organizational contextual items resulted in two constructs. As can be seen from Appendix A, these two constructs represent the problem characteristic and organizational culture. Therefore, the original hypothesis 2 becomes hypotheses 2.a and 2.b. They are:

> **Hypotheses 2a:** *The complexity of problem within an organization is negatively related to the effect of adopting OLCS to facilitate organizational learning.*

> **Hypotheses 2b:** *The culture of encouraging creativity within an organization is negatively related to the effect of adopting OLCS to facilitate organizational learning.*

Given the exploratory nature of the research study concerning problem characteristic and organizational culture, we experimented with culling out a different set of clusters consisting of two, three, four, five, and six groups, and used different options (Euclidean and Mahalanobis distance). To evaluate the distinctiveness of each derived cluster, equality of variable means across the cluster was tested, using the F-test. A two-cluster solution was chosen based on meaningfulness of the pattern of relationships among the variables. Table 3 shows variable means and stand deviations related to each of the two clusters. F-values and significance levels associated with are shown in the last column.

Table 3. Cluster Analyses of Organizational Context

Problem characteristic			
Variable	Simple (N=40) Mean (S.D.)	Complex (N=125) Mean (S.D.)	F
Most of the problems are complex	4.850 (1.040)	5.945 (0.806)	30.094 *****
Employees can exchange problems and solutions without difficulty	3.650 (0.745)	5.848 (0.680)	179.300 *****
Organizational culture			
Variable	Creative(N=130) Mean (S.D.)	Conservative(N=35) Mean (S.D.)	F
Employees are willing to share their knowledge and expertise	5.750 (0.779)	3.880 (1.201)	101.697 *****
Employees are encouraged to share their knowledge or creativity	5.136 (1.213)	3.560 (1.121)	36.596 *****
Employees will discuss their problems and difficulties with other colleagues	5.693 (0.698)	3.920 (1.152)	109.073 *****
Employees compete with the other members of the organization	5.586 (0.857)	3.320 (1.249)	127.316 *****
Employees may exchange their working practices in the current environment	5.586 (0.786)	3.000 (1.414)	172.552 *****
Our firm is trying to transfer to a learning organization	5.414 (1.039)	3.440 (1.294)	70.882 *****
*****$p<0.0001$;****$p<0.001$; ***$p<0.05$; *$p<0.1$			

Table 4. Pearson Correlation Analyses of Clusters

Cluster	Variables	OLCS	Organizational learning process
Problem characteristic			
Simple (N=40)	OLCS	1.000	0.785** (0.000)
	Organizational learning process		1.000
Complex (N=125)	OLCS	1.000	0.413** (0.000)
	Organizational learning process		1.000
Organizational culture			
Creative (N=130)	OLCS	1.000	0.908** (0.000)
	Organizational learning process		1.000
Conservative (N=35)	OLCS	1.000	0.533** (0.000)
	Organizational learning process		1.000
** Correlation is significant at the 0.01 level (2-tailed)			

Table 5. Results of Hypotheses Test

Hypothesis	Result	Reference
Hypothesis 1: The functions of OLCS are negatively related to the organizational learning process.	Rejected	Table 1 and 2
Hypotheses 2a: The complexity of problem within an organization is negatively related to the effect of adopting OLCS to facilitate organizational learning.	Substantiated	Table 3 and 4
Hypotheses 2b: The culture of encouraging creativity within an organization is negatively related to the effect of adopting OLCS to facilitate organizational learning.	Rejected	Table 3 and 4

As can be seen from Table 3, there are two types of clusters for each context variable. Cluster one, relative to the other cluster, represents a group of firms with simpler problem characteristic and with more creative organizational culture. In order to examine hypotheses 2.a and 2.b, Pearson correlation analyses was used to test for performance differences that were produced by adopting OLCS to facilitate organizational learning between two clusters. The results are shown in Table 4. The conclusions from table 4 are twofold (a) while the problem characteristic becomes more complex, the performance by adopting OLCS to facilitate organizational learning becomes less and (b) the effect of adopting OLCS to facilitate organizational learning is higher provided that the organizational culture is more creative. Therefore, hypothesis 2.a is substantiated, however, hypothesis 2.b is rejected. We summarize the results of all the hypotheses in Table 5.

Conclusion

This study investigated the role of computer systems, i.e., an OLCS, in facilitating organizational learning. Based on 165 respondents from organizations in manufacturing, the service industry, and academic institutions, we found that the functions of OLCS have a positive impact on the organizational learning processes. We also examined the impact of organizational context on the adopting of computer systems to facilitate organizational learning. Two interesting results were found. First, the complexity of problems within an organization is negatively related to the effect of adopting OLCS to facilitate organizational learning. Second, the culture of encouraging creativity within an organization is positively related to the effect of adopting OLCS to facilitate organizational learning. Unlike previous research, this paper examines the impact of computer systems on organizational learning in a more comprehensive way. First, we extended the IT features proposed by previous researchers (Goodman Darr 1998; Walsh 1991; Constant et al. 1996), and proved that these functions of OLCS all have a positive impact on organizational learning. These functions of OLCS include multimedia style of information presentations, synchronous and asynchronous of information transfer (Goodman and Darr 1998), bandwidth of information transmission, anonymity of sender, information indexing and sorting (Walsh 1991), and variety of functions to acquire, update, and manage knowledge for easy retrieval. Second, we conducted an empirical study to specify the organizational context that mediates the influences of the adoption of OLCS on facilitating organizational learning. Some researchers (Scott 2000; Nonaka and Takeuchi 1995; Goodman and Darr 1998, Orlikowski 1993a) claimed the importance of such intervening conditions, such as trust, organizational structure, but did not specifically identify "problem complexity" and "culture" and proved their impact empirically as our study did.

The research results support the theoretical framework shown in Figure 1. By emphasizing the features of OLCS, we may facilitate the effect of organizational learning. On the other hand, we can not overlook some salient organizational contexts while adopting IT, since it may increase or decrease the effect of organizational learning. The implications of this study are three-fold. First, this research explores the IT features that may facilitate organizational learning. Some of the features are new in supporting organizational learning. Understanding the features of IT that facilitate organizational learning is very helpful for management. Managers should emphasize the exploiting of IT capabilities; yet realize both its short-term and long-term limitations. Second, understanding the characteristics of the organizational learning process in an IT-based environment may help us to design the facilitating mechanisms accordingly. The difference of the organizational learning process between an IT-based and regular environment is therefore worth for future research. Finally, most of the previous researchers ignore the effect of the intervening conditions that may influence the effect of IT adoption. Our empirical study identified two of such important intervening conditions: problem characteristics and culture. In order to obtain the most effective way of organizational learning, it is crucial

that managers develop an OLCS adopting strategy, which combines "technology exploration" and "organizational context." Future studies may examine other contextual variables, such as organizational structure, management style, rewards etc. Moreover, identifying "why" and "in what situations" the organization context may intervene the adoption of OLCS to facilitate organizational learning will be another interesting topic.

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