The Effect of IT Human Capability and Absorptive Capacity on Knowledge Transfer

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Abstract

The purpose of this study is to examine the relationship between IT human capability and knowledge transfer and the role of absorptive capacity between them. From the test of both measurement and structural model using Partial Least Squares (PLS), IT human capability is found to be significant to absorptive capacity and knowledge transfer. Absorptive capacity is also significantly related to knowledge transfer. The interesting result found in this study is that the path of absorptive capacity drawn from IT human capability to knowledge transfer is stronger than the direct relationship between IT human capability and knowledge transfer, indicating that absorptive capacity plays an important role in knowledge transfer.

This result indicates that IT personnel with stronger technical skill, interpersonal skill and management capability are more likely to acquire and learn knowledge effectively from outside expertise. Moreover, this study shows that absorptive capacity, the individual's ability to utilize external knowledge is derived from IT human capability and strongly effects on transferring knowledge from outsourcing vendors. This study suggests IT related managers that the development of IT human capability and absorptive capacity should be recognized for a successful exploitation of outside knowledge within a firm. It is also a necessary condition for a successful IT implementation and maintenance independently and economically from outside vendors.

Keywords : IT Human Capability, Absorptive Capacity, Knowledge Transfer, IT Outsourcing

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1. Introduction

The role of Information technology in a firm has been escalated and became a core factor in a firm to enhance competitive advantage. In early ages of adopting information technology, firms tended to focus only on product quality and efficiency by mass production. However, in uncertain and fast-shifting environments where technology innovation, customer needs and market trends have changed so fast, new knowledge, ideas, and innovative services are the core competencies in a firm along with developing off-the-shelf technology. The core competency of firm is, therefore, to absorb information and knowledge quickly and apply them to the process in order to cope with uncertainty and sudden changes [Upton, 1995].

Firms have emphasized on fast absorbing information to increase value for competitive advantage, and gave a light on information technology as a tool for accelerating to assimilate, assemble and utilize knowledge and information within a firm. For example, a highly interdependent and connective integrate system can collect and distribute knowledge throughout the firm and share and apply them effectively to firm process [O'Brien 2003]. Many studies on the relationship between information technology and knowledge acquisition and transfer showed that knowledge transfer can be influenced not only by the spending on information technology but rather by the interrelation with resources and capabilities a firm could pertain [Kim et al., 2003].

Therefore, the study of an effective knowledge process, which becomes one of the firm's core competences to enhance performance, is needed to be studied by examining firm resources and capabilities confronting a volatile and uncertain environment and how they could be interact with the process of information technology. IT human capability and individual's absorptive capacity are considered as core capabilities in a firm to cope with dynamic environment by acquiring and utilizing new knowledge effectively. However, since the definition and measurement of absorptive capacity are quite obscure and difficult, the empirical study on absorptive capacity has not been profound. In addition, the factors facilitate knowledge transfer have not been studied since knowledge is found to be complex and contextualized in a large system. Thus, research on what factors will facilitate knowledge transfer in an IT outsourcing environment is needed to enhance a successful IT implementation and maintenance in a post-outsourcing contract [Sambamurthy et al., 2005].

Having studied the relation between information technology and firm resources and capabilities, the differences on IT performance among firms in using a similar information technology could be explained. The information technology paradox which argues the bias of the relationship between information technology and firm performance could also be understood with this study.

With such lack of perspectives on the knowledge transfer and other capabilities on information technology, the following research questions are raised :

- *Why certain firms are more efficient than others in using information technology?*
- *Does IT human capability influence on the degree of absorptive capacity and knowledge transfer?*

The purpose of this study is, therefore, to investigate the relationship between IT human capability and knowledge transfer in an IT outsourcing firm and examine the role of absorptive capacity between them. In this study, individuals' absorptive capacity is placed to show the relationship between IT human capability and knowledge transfer. In turn, this study examines the role of IT human capability and absorptive capacity on knowledge transfer in an IT outsourcing project in order to emphasize IT human capability for an efficient knowledge transfer, which could lead to a better management in using information systems.

Theoretical background on each constructs used in this study is explained in following section. Followed by research background, hypotheses are developed based on previous research and the hypothesis model is examined in detail to draw a conclusion.

2. Theoretical Background

2.1 Knowledge Transfer and IT Performance

Many companies have actively adopted information technology as IT becomes important factor in business processes. However, unexpectedly, the performance and success of using IT in a firm have not been clearly proved and many researchers have doubted its consequences. IT productivity paradox which means the amount of IT investment could not lead to the certain level of expected performance can result from the lack of measurement methodologies for intangible profits such as knowledge and process efficiency [Brynjolfsson and Hitt, 1996; 1998].

The phenomenon of IT productive paradox could also put it in a way that the success or performance of IT should be measured not by the amount of financial investment but by how well managed and used IT in a firm process [Bakos and Jager, 1995; Willcocks and Lester, 1999]. Stratopoulos and Dehning [2000] studied the relation of IT cost and benefit based on the firm data from "Computerworld" and the increased financial performance was found in which companies using IT efficiently. Many researchers also insisted that the lack of management skill in IT usage is a reason unable to lead to a certain level of performance in a firm [Sanatos and Sussman, 2000; Brynjolfsson and Hitt, 1998]. IT performance in a firm should be also considered a "lag effect" since IT performance could be seen after certain amount of time of adopting, training and exploiting IT knowledge [Jain, 2003].

Effective performance in IT is also derived from many aspects of resources in a firm such as human, business, strategic, and organizational resources [Kim, 2000; Papp, 1999; Pinsonneault & Rivard, 1998]. Effective knowledge transfer within a firm and among co-

operated firms can also provide a successful performance in a firm. Argote and Ingram [2000] argued that when knowledge is transferred and adopted appropriately to the new context, the performance can be positively affected. Therefore, IT human capability include IT management skill is important to obtain and develop in a firm to get advantages from IT investment and achieve competitive advantages. Specially, in IT outsourcing situation where IT knowledge and expertise are adopted from outside venders, human capability of understanding new technology and applying it into business process is crucial in IT success.

2.2 IT Human Capability

The management and effective use of information system are as important as developing and installing a giant integrated system to get competitive advantage through information systems in a firm. Thus, IT resources such as human capability, technical infrastructures and organizational supports have been studied in many different aspects to manage and use information systems wisely. Although many IT resources are interdependent and correlated for a system to operate and manage, the IT human resource which enables technical development and system management is the most important factor in IT efficiency and success.

Previous studies on IT resources showed that IT infrastructure is a vital resource to enhance firm performance and competitive advantage in a dynamic and information intensive environment [Barney, 1991; Bharadwaj, 2000; Weill, et al., 2002] and the amount of investment on such IT resources have been increasing [Byrd and Turner, 2000]. Broadbent et al. [1999] stated that technical and human IT capability are the fundamental structure of shared and standardized IT application, and the information technical resources are provided by IT human capability to shared information services. Born [2002] and Duncan [1995] also mentioned that information system infrastructure should lead to a fast response to customer demands and environmental changes, and thus firms with potential IT human capability could control and manage fast changing environments and customer needs.

Many other studies also emphasized the role of IT resources for an efficient management [Kim and Cho, 1997; Weill et al., 2002; Born, 2002]. Bharadwaj [2000] reported that internal IT resources are positively related to firm performance, and Born [2002] insisted that an internal IT human capability strongly effect on firm's short-term or long-term efficiency. Moreover, Ross et al. [1996] stressed that acquiring and developing internal IT resources are one of important step to increase long-term revenue and competitive advantage. And, training and retaining IT human resources can drive to significant consequences by using information systems without extra hidden cost spending outside expertise and outsourcing vendors [Broadbent, et al., 1999; Weill, et al., 1998; Venkatraman, 1994].

Byrd and Turner [2000] divided IT infra-

structure resources into technical infrastructure (connectivity, compatibility and modularity) and IT human infrastructure (technical management capability, business knowledge, management capability and technical skill). Specially, many researchers showed that IT human capability could result in different IT performance with same amount of IT investments. Weill [1992] insisted that IT human capability is an important factor to produce an effective outcome. Byrd and Turner [2001] also showed from their empirical study on IT human resources that IT human capability effects significantly on the relation between information technology and IT performance.

Therefore, flexible IT infrastructure is the core capability of information systems in a firm and produce successful firm performance. However, such IT success could result from how information systems are controlled and managed efficiently by IT human capability, and thus IT human capability should be internally developed and possessed in order to understand IT usage and management.

2.3 Absorptive Capacity

The rapidly growing information technology and globalization have resulted in uncertain and volatile environment and increasing customer demands. Firm's ability to deal with such a rapidly changing environment became an important factor. Absorptive capacity which enables product and service innovation by fast absorbing and utilizing new knowledge and information, therefore, is considered as a core factor in a firm [Lane et al., 2002; Teece et al., 1997].

Absorptive capacity is a capability of understanding new knowledge and information and applying them into a process, and considered as an important factor in studying organizational learning and knowledge management. Cohen and Levinthal [1990], who first introduced absorptive capability theory, referred absorptive capacity as a capability to acquire new informational value and exploit it to a commercial value. They also insisted that the level of accumulated knowledge and endeavor to use them is related to the level of absorptive capacity in a firm.

The concept and definition of absorptive capacity have been modified and translated by many researchers based on the theory developed by Cohen and Levinthal [Lane and Lubatkin, 1998; Van den Bosch et al., 1999; Zahra and George, 2002]. Van den Bosch et al. [1999] categorized knowledge absorption into efficiency, scope and flexibility. They showed that absorptive capacity is defer from organizations' formation-functional, divisional, matrix-integrated system capability, coordination capability and social capability, and insisted that the greater in uncertain and dynamic environments, organizations would try developing absorptive capacity. Zahra and Goeorge [2002] defined absorptive capacity as a dynamic capability consisted of firm's routine and process, and said that competitive advantage can be achieved by mutual inter-correlation between knowledge acquisition and commercial utilization.

Similarly, Liao et al. [2003] measured absorptive capacity by knowledge acquisition and dissemination in their study on the adaptation in changing environments for small and mid size enterprises and revealed that enterprises with higher absorptive capacity is more flexible and better adapt in an uncertain situation. Lane et al. [2001] also found out in their study on the effect of absorptive capacity on International Joint Venture (IJV) that absorptive capacity plays an important role in inter-organizational learning and performance.

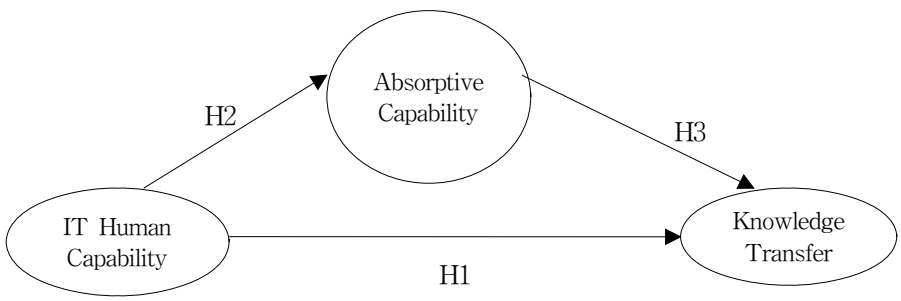
Based on many research on absorptive capacity, it is shown that new knowledge can be acquired and utilized effectively by absorptive capacity. Especially in an IT outsourcing situation where outsourcing vendors deliver their expertise to clients, absorptive capacity of acquiring new knowledge from vendors and exploit them into an outsourced system could be important to maximize its system usage.

3. Research Model and Hypothesis

This research model consists of three variables, IT human capability, absorptive capacity and knowledge transfer in order to examine the effects of IT human capability on knowledge transfer and the role of absorptive capacity between the relationship of IT human capability and knowledge transfer. Control variable is project complexity which might effect on the knowledge transfer.

3.1 IT Human Capability and Knowledge Transfer

IT personnel having not only technical skills but managerial and social capability could be better to understand new knowledge and interact with outside workers. Haines and Goodhue [2003] indicated that clients tend to involve and participate more in an outsourcing project team when they have more capability and knowledge on the project. Bartlett and Ghoshal [2002] argued that a process converting information into knowledge can be performed by social interaction with IT expertise who understands the process. Griffith et al. [2003] also stated that companies should possess explicit knowledge which enables to understand vendors' ability and expertise.



〈Figure 1〉 Research Model

In Ko et al. study [2005] on antecedents of knowledge transfer, they showed that the interpersonal relationship and communication skills of IT employees related to the outsourcing vendors for an information system project can influence the transfer of complex knowledge such as software functionalities and procedures. Relevant technical skills and technical management skills also facilitates the transfer of technology and knowledge outside boundaries [Chen, 2004]. Therefore, the level of firm's IT human capability would effect on the degree of knowledge transfer.

H1 : The degree of IT human capability is positively associated with the degree of knowledge transfer

3.2 IT Human Capability and Absorptive Capacity

According to absorptive capacity theory, firm's innovation and creativeness could drive from firm's capability of information absorptiveness and utilization [Attewell, 1992; Cohen and Levinthal, 1990; Dougherty, 1992]. Information system capability can integrate and distribute information and resources effectively throughout an organization and enhance competitive advantage and vale creation [Hope and Hope, 1997; Laudon, 2002]. Especially, IT knowledge and management skills of IT personnel can easily understand and absorb new knowledge and use it effectively. Tsai [2001] argued that a person with relevant prior knowledge on IT and management is likely to have a better understanding of new technology and turn it into a better utilization and exploitation to a newly adopted system. Mowery et al. [1996] stressed that firm's individual absorptive capacity for learning and exploiting new knowledge depends on the investment of relevant technology-based capabilities. Cohen and Levinthal [1990] also suggested that R&D investment which includes development of human capability is necessary condition for the creation of absorptive capacity.

Sambamurthy et al. [2003] suggested that IT capability with interpersonal skill can enhance communication and cooperation with partners and acquire their demands and absorb new knowledge quickly. Suh et al. [2002] also indicated that formal or informal communication methods are positively related to acquiring knowledge performance from outside boundaries through capacity of adopting and assimilation of knowledge. Therefore, the level of IT human capability in a firm would effect on the degree of individual IT absorptive capacity in a firm.

H2 : The degree of IT human capability is positively associated with the degree of absorptive capacity.

3.3 Absorptive Capacity and Knowledge Transfer

Absorptive capacity which refers to the individual's ability to acquire, integrate and utilize knowledge transferred from outside vendors is considered as a core facotor in a firm

to leverage new and fast chainging information into internal operation and management. Many studies on knowledge transfer show that the understanding of acquired knowledge and absorptive capability are factors affecting knowledge transfer performance [Cohen and Levinthal 1990]. As Szulanski [1996] indicated that an effective knowledge transfer can be achieved when receivers acquire knowledge and utilize it in their own benefit, absorptive capacity would be related to the effectiveness of knowledge transfer.

Moreover, other studies revealed that IT personnel with higher level of absorptive capacity could better exploit sources of technical knowledge from outside vendors [Makhija and Ganesh, 1997; Tsai, 2001]. Chen [2004] argued that the ability to absorb information and knowledge is a necessary condition for a successful exploitation of knowledge from outside boundaries. He also revealed in his empirical study on knowledge transfer that absorptive capacity plays a direct role in determining the performance of knowledge transfer. Szulanski [1996] also insisted that the lack of absorptive capacity could lead to inadequate knowledge transfer. Accordingly, the degree of individual IT absorptive capacity in a firm would effect on the degree of knowledge transfer.

H3 : The degree of IT absorptive capacity is positively associated with the degree of knowledge transfer.

4. Research Methodologies

4.1 Definition of Constructs

To examine the research model, three constructs, IT human capability, absorptive capacity and knowledge transfer were used, and project complexity was used as a control variable. The definitions and source of measure-

〈Table 1〉 Definition and Measurement of Variables

Constructs	Dimensions	Description	Source and Measurement
IT Human Capability	Technology Management Skills	Abilities to deploy IT in the most effective manner to support the business strategies	5 items from Byrd and Turner
	Business Functional Skills	Abilities to understand the business processes to provide the technical solution to a given business problem	5 items from Byrd and Turner
	Interpersonal and Management Skills	Abilities such as planning, organizing, writing, teaching, and leading	6 items from Byrd and Turner
	Technical Skills	Skills in several technical areas	7 items from Byrd and Turner
Absorptive Capacity	The individual's ability to acquire, assimilate, transform and exploit knowledge		5 items from Zahra and George, 2002
Knowledge Transfer	The extent to which clients acquire, absorb and utilize knowledge of outsourced IT from vendors		3 items from Simonin
Project Complexity	The complexity of the relationships among the IT elements		8 items from Xia and Lee

ment of each construct are described in <Table 1>.

4.2 Measurement and Data Collection

An empirical field study using survey instruments was conducted to test the model and hypotheses. The survey measurements were 7 Likert-scales and developed based on previous studies and interviews with managers in IT industries. Each survey items was modified and pre-tested for diminishing mistranslation and misusage to apply in a real world setting.

The unit of analysis of this study is information system development project. The character of system project used in this study mostly falls in either customizing systems such as a packaged ERP, SCM and CRM system or adopting unit system such as accounting system and manufacturing system. The survey was answered from at least two project team members and the averaged data was used for hypothesis testing. Excluding surveys with unmatched and missing items, total of 87 project samples were used out of 107 collected surveys. <Table 2> shows the characteristics of respondents.

5. Data Analysis and Result

5.1 Test of Measurement Models

To analyze the research model, Partial Least Squares (PLS) Graph version 3.0 was used. PLS has the ability to test both principal components analysis and path analysis simultaneously with relatively small sample sizes [Barclay et al., 1995]. Prior to the path analysis, the validity and reliability of measurement items were tested by examining internal consistency, individual item reliability and discriminate validity. Since each measurement items used in this research reflects the corresponding construct and has high correlation among them, all the measurement items were analyzed with reflective indicators [Wixom and Watson 2001].

As shown in <Table 3>, individual item reliability was tested by the loading and cross-loading of each measurement items on its respective constructs. The loading value of each items are shown to exceed 0.7 or above, which is suggested to accept items for the test [Chin

〈Table 2〉 Demographic data for respondents

Industry	Frequency	%	# of employees	Frequency	%	Position	Frequency	%
Finance	29	33%	above 3000	28	32%	Executive	16	8%
Manufacture/Distribution	36	41%	above 1000	48	55.20%	Manager	53	28%
Telecomm.	7	8%	above 300	9	10%	Director	88	46%
Service	15	17%	above 100	0	0.00%	Employee	35	18%
			above 50	2	2%			
Total	87	100%	Total	87	100%	Total	192	100%

1998].

Internal consistency was examined by using CSRI (Composite Scale Reliability index), which is similar to Cronbach's alpha. As shown in the <Table 4>, all measures meet the recommended criterion of above 0.7, and thus are to be reliable. Discriminant validity was tested by the square root of the average variance extracted (AVE), the diagonal values shown in <Table 4>. It is recommended that the square root of the AVE for each construct should be greater than other variance shared between a construct and its measures [Fornell and Larcker, 1981]. As shown in the <Table 4>, the all measures satisfy the common criterion for a validity test by the values 0.5 and

〈Table 3〉 Loading and Cross-Loadings of Measures

	IT Human Capability	Absorptive Capacity	Knowledge Transfer	Project Complexity
IT1	**0.804**	0.008	0.060	-0.118
IT2	**0.898**	0.017	-0.046	0.130
IT3	**0.794**	-0.006	-0.061	0.050
IT4	**0.899**	-0.019	0.037	-0.052
AC1	0.059	**0.783**	0.069	-0.110
AC2	-0.001	**0.878**	0.033	-0.142
AC3	-0.079	**0.862**	-0.026	0.167
AC4	0.003	**0.877**	-0.023	0.109
AC5	0.010	**0.922**	-0.058	0.003
KT1	-0.048	0.069	**0.822**	0.104
KT2	0.046	0.005	**0.859**	-0.110
KT3	0.003	-0.082	**0.872**	0.007
PC1	0.016	0.047	-0.010	**0.888**
PC2	0.011	0.033	-0.031	**0.908**
PC3	-0.031	-0.074	-0.087	**0.788**
PC4	0.083	0.081	0.084	**0.932**
PC5	-0.018	-0.092	-0.064	**0.890**
PC6	0.005	0.031	0.032	**0.912**
PC7	-0.128	-0.123	-0.017	**0.840**

〈Table 4〉 Reliability and Validity

	No. of Items	Composite Reliability				
			1	2	3	4
1. IT Human Capability	4	0.91	0.85			
2. Absorptive Capacity	5	0.94	0.56	0.87		
3. Knowledge Transfer	3	0.89	0.54	0.66	0.85	
4. Project Complexity	7	0.96	0.33	0.37	0.31	0.88

greater than the levels of correlated constructs.

5.2 Test of Structural Model

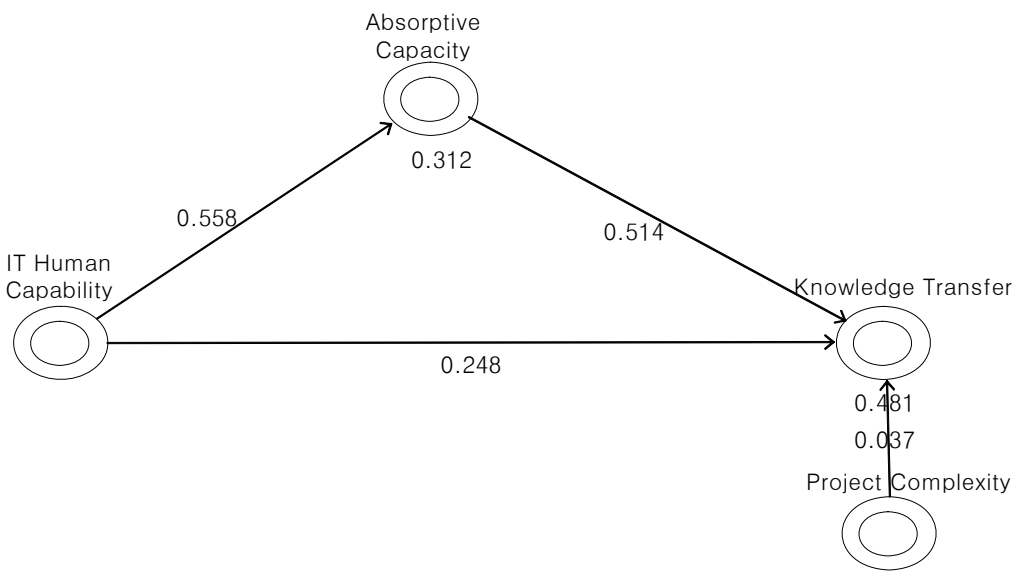
With the reliability and validity of each measurement items, the path analysis of each construct was conducted by assessing the structural model to test the proposed hypotheses. Assessment of the structural model involves estimating the path coefficients and the R^2 value, which indicates the strengths of the relationships between the independent and dependent variables and a measure of the predictive power of a model for the dependent variables respectively.

<Table 5> and <Figure 2> indicate the result of structural model test, which show the result of path analysis and hypothesis test. As expected from previous research, IT human capability is significantly associated with absorptive capacity (path coefficient = 0.56, $p < 0.01$), which indicates that Hypothesis 1 is

〈Table 5〉 Tests of Hypotheses

	From	To	Path Coefficient	t-value	p-value
H1	IT Human Capability	Absorptive Capacity	0.558	5.67	0.000**
R^2 = .312					
H2	IT Human Capability	Knowledge Transfer	0.240	3.271	0.001**
H3	Absorptive Capacity	Knowledge Transfer	0.514	5.714	0.000**
	Project Complexity	Knowledge Transfer	0.037	0.4328	0.333
R^2 = .481					

Note) * $p < 0.05$, ** $p < 0.01$.



〈Figure 2〉 Result of Structural Model Test

supported.

Moreover, knowledge transfer is significantly associated with the client's IT human capability (path coefficient = 0.24, $p < 0.01$) and absorptive capacity (path coefficient = 0.51, $p < 0.01$), accounting for 48.1% of the dependent variable's variance and thus supporting Hypothese 2 and Hypothese 3. <Figure 2> presents a summary of the structural model test results. This result shows that IT human capability is important to transfer knowledge from outside vendors and plays important role in building up absorptive capacity which has a significant effect on knowledge transfer in an IT outsourcing environment.

6. Conclusion and Implication

The purpose of this study is to examine the relationship between IT human capability and knowledge transfer and the role of absorptive capacity between them. From the test of both measurement and structural model using Partial Least Squares (PLS), IT human capability is found to be significant to absorptive capacity and knowledge transfer. Absorptive capacity is also significantly related to knowledge transfer. The interesting result found in this study is that the path of absorptive capacity drawn from IT human capability to knowledge transfer is stronger than the direct relationship between IT human capability and knowledge transfer, indicating that absorptive capacity plays an important role in knowledge transfer. This result indicates that IT personnel with stronger technical skill, interpersonal skill and management capability are more likely to acquire and learn knowledge effectively from outside expertise. This study also shows that absorptive capacity, the ability to utilize external knowledge is derived from IT human capability and strongly effects on transferring knowledge from outsourcing vendors. Moreover, individual absorptive capacity is found to facilitate adopt and transfer knowledge effectively.

Client firm would expect outside consultants to transfer knowledge to their IT personnel so that they can contribute to successful implementations and learn to maintain the systems independent of the consultants [Ko et al., 2005]. This study suggests IT related managers that the development of IT human capability and absorptive capacity within a firm should be recognized for a successful exploitation of outside knowledge. Moreover, it is also important for managers to notice that possessing the IT human resources with high degree of absorptive capacity is necessary for a successful IT implementation and maintenance independently and economically from outside vendors.

In addition, according to resource based theory, the possession of resources such as human capability and abosrptive capacity, which is specialized and not be able to immitate easily by others, should be considered in a firm to achive competitive advantage [Barney, 1991]. From the result of this study, managers and IT personnel would understand the importance of developing and attaining IT human capability and absorptive capacity in a firm to

adopt new knowledge from outside of firm and utilize them into a firm process, and thus enhance performance and competitive advantage by using information systems effectively.

This study has a number of limitations for future research. The project data used in this study were collected at a point of time with a cross-sectional measurement, which may not fully explain the degree of knowledge adoption and usage after knowledge has been transferred. Therefore, it is suggested to apply long-term research method to examine the effective process of knowledge transfer. Moreover, the IT outsourcing project type and knowledge type which could effect on knowledge transfer should be considered in future research. An examination of the moderating effects of the system type and knowledge type, therefore, would be recommended for future research.

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