An Empirical Investigation of Mediation Effects between Information Communication Technology Implementation and Firm Performance: Role of Knowledge Absorptive Capacity and Knowledge Management Capability

Kyung Hoon Yang[a] , Chulmo Koo[b] , Chang E. Koh[c], Dae-Yong Lee[d]

[a]*Department of Information Systems, University of Wisconsin-La Crosse, 233 Wing Technology Center, 1725 State Street, La Crosse, WI*

[b]*School of Business Administration, Chosun University, Gwang-Ju Tel: 062--230-6831, Fax: 062-226-9664, E-mail:helmetgu@chosun.ac.kr*

[c] *Department of Information Technology & Decision Sciences College of Business Administration University of North Texas Phone & Fax: (940) 565-3625 E-mail: kohce@unt.edu*

[d] *School of Business Administration, Chosun University, Gwang-Ju Tel: 062-230-6829, Fax: 062-226-9664, E-mail:dyblee@chosun.ac.kr*

Abstract

This research examined the mediation effects of knowledge absorptive capacity (KAC) and knowledge management capability (KMC), between information communication technology (ICT) implementation and firm performance. In the past, studies investigated KAC and KMC separately. While studies of KAC focus on the flow of information, those of KMC focus on knowledge creation triggered by innovative information. However, KAC and KMC are not mutually exclusive and as such we investigated them together in this research. We surveyed 126 companies and analyzed hypotheses with LISREL analysis.

This research provided empirical support for the Nonaka's contention that the information processing has a positive effect on knowledge creation. We also found that there is a mediation effect between ICT implementation and firm performance. Not only is there a direct effect of ICT implementation on firm performance, but there is an indirect effect through KAC and KMC. KAC has a positive effect on both KMC and firm performance. However, it has been discovered that while KMC has mediation effect, it is not significant as an independent factor for firm performance.

Keywords: ICT implementation, Knowledge Absorptive Capacity, Innovation, Knowledge Management Capability, Firm Performance

Introduction

It is widely accepted that Information Communication Technology (ICT) increases effectiveness and efficiency of an organization as well as its productivity [4][5][8][26]. However, there remains so many questions about the relationships between ICT and the firm's performance [13][14]. The lack of understanding about the connection between ICT and performance makes ICT investment decisions complicated and difficult to make. The ICT investment decision gets more complicated because the return on ICT investment is also affected by the ability of the firm to effectively manage the investment [28]. Therefore, Nonaka et al.[37] examined the effect of ICT and knowledge creating and Nonaka and Konno [34] studied that virtual place (email, teleconference) provide a transcendental platform to knowledge creation process, especially knowledge conversion [34]. A few studies have looked at the role of management ability in the relationship between ICT and firm's performance [40][45][47].

The above mentioned management ability is increased interest on either knowledge creation [34] or learning [25]. Both increasingly adopted as management ability have broadly developed to a general management practice. Cohen and Levinthal[9] referred March and Simon [29]' assertion of innovation that is borrowing rather than invention. On the other hand, Nonaka and his colleagues [31][34][37] xplain that the process of knowledge creating is taking knowledge out of the embedded, historic dependent, context sensitive, specific in the individual and aims problem definition.

Interestingly, Nonaka et al [32] and Cohen and Levinthal [9] created the similar notion of theories based on the process perspective. More precisely and distinctively, knowledge creation is "from being to becoming" p.8, [35]

and expanding [34] based on four-stage conversion process (socialization, extermination, combination, internalization) vs. Van den Bosch et al. [51] suggest that Cohen and Levinthal's knowledge absorptive capacity(KAC) as feed back loop cycles (absorptive capacity→learning→new absorptive capacity) out of knowledge environment. They focused on a component of innovative capabilities.

In recent study, there are shown that the relationship between type of knowledge and KAC [25], knowledge source and KAC [54]. However, there is little research on how learning or acquiring based on KAC affects knowledge in the creation processes (Knowledge Management Capability; KMC[45]. Nonaka and his colleagues [31][32][34][35][36][37] argue that the concept of innovation has put too much emphasis on how to deliver information and knowledge, but too little emphasis on information and knowledge are actually created. He further argues that flow of information plays an important role in a firm's knowledge system [32].

We recognized the need for research that investigates how KAC and KMC are related and how ICT affects KAC and/or KMC. This research focuses on the direct and indirect relationships between the stage of pre-adoption through post-adoption of ICT, KAC, KMC and firm's performance. We address the following research issues: (1) How does ICT affect KAC and KMC? (2) Does KAC facilitate KMC? and (3) Do KAC and KMC affect the role of ICT which, in turn, affects firm's performance ? We address this research in our report as follows: (1) We summarize the literature on ICT adoption and application as well as KAC and KMC, (2) We present our research model and hypotheses, (3) We discuss data collection, analysis and tests And (4) We discuss the results and limitations of the research and suggest possible future research topics.

Literature Review

Knowledge Absorptive Capacity (KAC)

In early days of research of innovation, innovation was considered more of an idea of borrowing in a pre-given information [30]. Utterback [50] claims that innovation can be achieved through the external stimulus or internal pressure for new things such as products and technology. Thus, innovation can be defined as the suggestion, development, and realization of ideas pertaining to product/service, production process technology, administration system, plan and policy program [12]. Knowledge Absorptive Capacity (KAC) is one of the concepts evolved from the study of innovation. Cohen and Levinthal [9] suggest that a firm desire to gain knowledge from external sources if the knowledge is less expensive to acquire than make, then assimilate it into the firm and exploit it within the firm. The process of acquiring knowledge is called 'learning' or 'absorptive capacity' [25]. Later Cohen and Levinthal [9] assert that KAC is an ability to recall and use pre-existing knowledge and new knowledge can be enhanced through cognitive structure, which means accumulated prior knowledge assists the

ability to add new knowledge into memory system. They classify technical knowledge acquisition into three categories based upon previous research: (1) Knowledge obtained by R&D itself, (2) Competitors' spillover knowledge, and (3) Knowledge from external sources such as government agencies and universities. External pressure for knowledge allows the firm to stimulate R&D investment to create, learn and share the knowledge among its departments (other internal units). KAC is considered as "a set of firm abilities to manage knowledge, p.186" [54], more broadly as the ability to absorb innovative ideas. The process of KAC includes various activities from evaluating the value of external knowledge, finding and recognizing the knowledge that can create value, and to making external knowledge its own and applying the acquired knowledge to practical applications. Cohen and Levinthal [10] augmented the definition of KAC to include the ability predict future technology advance under uncertainty in addition to the ability to acquire external knowledge.

Zahra and George [54] enhanced the concept of KAC as a dynamic capability entailing 'knowledge creation' and 'utilization' to acquire, assimilate, transform and exploit knowledge. The acquisition and assimilation processes in which firms seek and distribute knowledge into the organization represent the 'potential absorptive capacity.' On the other hand, the processes of transformation and exploitation of knowledge to solve actual problems explain the 'realized absorptive capacity.' Knowledge sources, complementary knowledge and KAC is needed moderators such as activation trigger and social mechanism integration. Social integration mechanism affects the process of potential KAC and realized KAC. The firm's potential and realized capacity brings the consequences of new products, patents, innovative processes, innovation, and new technology advance.

Knowledge Management Capability (KMC)

Nonaka [33] compares information with knowledge as "information is a flow of messages," and "knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder (p.15)." Nonaka and his colleagues [32][33][34][35] argues that organizations tend to pay more attention to simple information processing process to address imminent decision problems rather than the process of transforming information or information creation into knowledge. Also, they note that the fragile transmission of knowledge is raised between individual and organization [35]. Knowledge management is often defined as the process of "the generation, representation, storage, transfer, transformation, application, embedding, and protection of information" [1]. Nonaka et al. [35] contend that the organization knowledge creation should focus on defining a situation in order to act on it, and continuous process in consistent with a new context rather than 'utilizing' [9] and 'managing'[54]. The concept of knowledge management includes innovation diffusion theory, absorptive capacity, managerial cognition, and organizational learning [41]. Alavi and Leidner [1] regard knowledge management an

organizational process that helps a firm be aware of knowledge and create value.

Nonaka [33] and Nonaka et al. [35] argues that knowledge is only created by individuals in a given situation. When a firm assists creative individuals in an appropriate context, individual knowledge is disseminated through interaction of other individuals' experience and rationality. Schultze and Leidner [41] also stress that knowledge is socially built up through sharing among the participants in an organization. Knowledge management can support cross-functional teams to share their experience, ideas and rationality with others. The process of knowledge creation proceeds as follows: Knowledge is, first, is articulated by the true belief based on individuals' experience or rationality, then enlarge the initiative knowledge and shape their own perspective knowledge: enlargement stage. The knowledge in a certain context is gone through by the communication or meeting among the members would help to build up new knowledge in the context and become conceptualized: conceptualization stage. After conceptualization, the knowledge is realized in a sentence, captured in drawings based on the experiment within the firm: crystallization stage. The applicability of prototype concept may also be crystallized by the collaboration team; again, the initial concept is refined and revised through the dynamic collaboration. The final stage of knowledge is determined by the quality, worth, and value, then, justified into the level of knowledge for the firm: justification stage. In sum, the stages of organizational knowledge creation process would comprise of enlargement, conceptualization, crystallization, and justification [33].

IS researchers have refined the organizational knowledge creation process as knowledge management capability [1][18][19][23][45]. Grant [19] and Kusunoki et al. [23] draws organizational capability into the knowledge based theory.. Tanriverdi [45] introduces KMC including creation, transfer, integration, and leverage on cross-unit functions. He defined the concept of KMC based upon the studies of Venkatraman and Tanriverdi [52]. Creation can be considered as generating knowledge over the cross-unit in a firm or synthesizing with existing ones over the cross-unit. Transfer means the sharing knowledge from source unit to destination unit in which they are necessary. Integration is defined as the transferred knowledge is integrated into the existing knowledge of the recipient unit. Leverage is the integrated knowledge is actually realized into the performance of the units.

Information Communications Technology (ICT) Implementation

Nonaka et al. [37] discussed the importance of ICT as a knowledge creation tool combining knowledge-creation abilities by human beings. Also, Boynton et al. [7] empirically investigated KAC in IT use. One of the advantages of ICT use for management synergizes the management ability which idea of innovation is created and shared through the virtual place [34]. It expands knowledge to the actual point where the innovation actually is applied.

Kwon and Zmud [24] developed an ICT implementation stage model which includes innovation adoption and its diffusion; the ICT model composes of 'initiation', 'adoption', 'adaptation', 'acceptance', 'routinization', and 'infusion'. Cooper and Zmud [11] define ICT implementation as "an organizational effort directed toward diffusing appropriate information technology within a user community, p.124." ICT implementation includes both the concept of the prior adoption and post adoption of behavior with a process perspective. First, the initiation stage encompasses organizational activities that scan, search, and gather information and knowledge, discuss adopting an ICT innovation, and outline a preparation for adoption. Second, the adoption stage is the decision to install the ICT innovation with a commitment. Political and rational negotiations between functions and managers take place. Third, during the adaptation stage, the adopted ICT is used, tested, and modified. In this stage, problems are detected and suitable solutions are suggested by continuous modification and maintenance, and employees are trained for the new procedures. Fourth, the stage of acceptance represents a post-adoption behavior. In this stage, members of an organization begin to use the new ICT, and the new process spreads widely in the organization. Fifth, during the stage of routinization, post-acceptance behavior is demonstrated. In this stage, members use the ICT routinely. Organizational structure and systems are adjusted to the new ICT solution and application. Finally, infusion stage follows the stage of routinzation. In this stage, organizational effectiveness and efficiency are achieved by the ICT solution and application. This stage indicates the full achievement of the ICT in supporting organizational needs.

In this study, we used ICT implementation as the independent variable to reinforce organizational capabilities and firm's performance. We look at the influence of ICT implementation toward KAC, KMC, and firm performance.

Research Model and Hypotheses

We developed a model that incorporates ICT implementation as an antecedent as shown in Figure 1. In this model, ICT implementation enables a firm to engage in KAC and KMC, in turn, KAC and KMC enhance the firm's performance as mediators. Hence, we provide the following hypotheses for this research model. ICT implementation affects both KAC (H1) and KMC (H2). We further hypothesize that KAC influences KMC (H3) as well as firm's performance (H4). KMC leads firm performance (H5). Finally, ICT implementation makes an impact on firm's performance directly (H6).
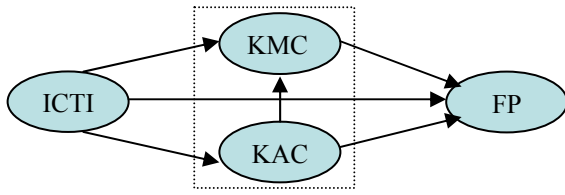
Figure 1: Research Model

ICTI: ICT Implementation
KAC: Knowledge Absorptive Capacity
KMC: Knowledge Management Capability
FP: Firm Performance

H1: ICT Implementation and Knowledge Absorptive Capacity (KAC)

Previous studies confirm this relationship between ICT and KAC [7][29]. Boynton et al. [7] found that ICT management climate cultivates ICT absorptive capacity, which leads to a high level of ICT use in organizations. Their findings suggest that effective ICT management enriches KAC which facilitates information and knowledge exchanges for product and process innovation. Scott [42] suggests that ICT could be useful in recognizing knowledge. Malhotra et al. [29] found that proper ICT infrastructure could help build a higher level of KAC and be able to acquire, assimilate, transform, and exploit information resources in the context of supply chain partners. According to the literature, we assume that ICT implementation affects a firm's management process and eventually its performance. Tippins and Sohi [47] developed an organizational learning model which consists of information acquisition, information dissemination, shared interpretation, and development of organizational memory and found a positive relationship between ICT competency and organizational learning. We suggest that ICT implementation can reinforce KAC. Thus, we set up a hypothesis. H1: ICT implementation affects positively to KAC

H2: ICT Implementation and Knowledge Management Capability (KMC)

While KAC focuses on the acquisition through information processing, KMC centers on the information and knowledge creation through management process, which includes creating, storing, retrieving, transferring, and applying knowledge [1]. Gold et al. [18] examined the organizational knowledge capability in terms of acquisition, conversion, application, and protection of knowledge and found that it is positively related to ICT infrastructure. Lee and Choi [26] also found that ICT as an enabler that has a positive effect on knowledge creation activities. ICT based communication also affects how individuals develop collaboration skills [28] and create and transfer knowledge in project team settings [39]. Tanriverdi [45] found a positive relationship between ICT and KMC. Thus, we put forth the next hypothesis. H2: ICT implementation affects positively to KMC.

H3: Knowledge Absorptive Capacity (KAC) and Knowledge Management Capability (KMC)

Kusunoki et al. [23] stated that accumulated organizational capabilities lead a continuous learning, which having a path dependent characteristics. Malhotra et al. [29] showed that ICT fosters KAC and which KAC creates knowledge in supply chain context. Szulanski [44] found that if recipient's KAC does not operate well in organization could not knowledge transfer from knowledge sources. Also, Ko et al.[22] found that KAC is positively related to knowledge transfer. Lane et al. [25] posited that KAC influences new knowledge, held and assimilated new knowledge from foreign parents, and applied the assimilated knowledge in international joint venture context. Knowledge creation as a construct includes knowledge conversion [35] and leverage knowledge [45]. We argue that the component of KAC will trigger KMC. Looking at such research conclusions, it is hopeful that KAC has a positive relationship to KMC and the following hypothesis. H 3: KAC affects positively to KMC.

H4: Knowledge Absorptive Capacity (KAC) and Firm Performance

Cohen and Levinthal [9] assert that the ultimate objective of KAC is to from achieve knowledge, assimilate, and apply new knowledge successfully to commercial ends. Tasi [49] interprets the 'commercial ends' as 'profit' in firms. He found that higher KAC is related to better business performance. Malhotra et al. [29] also posited KAC lead operational efficiency. Other studies confirm the relationship between knowledge capabilities and a firm's competitive advantage [46][51][54]. George et al. [17] tested and confirmed that KAC influences performance in biopharmaceutical firms. Zaheer and Bell [53] found that a firm's innovative capabilities enhance firm performance in the Canadian mutual fund companies. They explained innovativeness is closely tied to KAC. Fosfuri and Tribo [16] found that the higher level of KAC of firms earn larger shares of their sales from new or improved products systematically. Thus, we conjecture the following hypothesis. H 4: KAC affects positively to firm performance.

H5: Knowledge Management Capability (KMC) and Firm Performance

A variety of variables are used to measure the firm performance in knowledge management, including conventional performance measures such as …[6], knowledge satisfaction [3], organizational performance such as …[26], and firm performance based ROA [45]. Gold et. al. [18] attempted to measure organizational effectiveness much broadly by assessing ability to innovate, coordination of efforts, and speed of commercialization of new products, responsiveness of market change, and reduced redundancy of information and knowledge. Lee and Choi [26] used organizational effectiveness as well as financial ratio such as market share, profitability, growth rate, innovativeness, successfulness, and the size of key competitors to measure organizational performance.

Regardless of the measurement index used, they all found a positive relationship between KMC and firm performance. Thus, we suggest the following hypothesis. H5: KMC affects positively to firm performance.

H6: ICT Implementation and Firm Performance

Some researchers such as Dos Santos and Peffers [14] have made a controversial claim that there is no evidence that ICT investment and ICT applications positively affect firm's performance (e.g., market share, profitability, return on investment, etc.). However, they concede that there may be a long-term effect performance, if a firm adopts ICT application early enough to gain competitive advantage. Devaraji and Kohli [13] suggest inconsistent use of variables in different studies and inconsistent time spans during which performance is measured by different studies as possible reasons for different views and results of ICT investment. They noted that changes in firm's performance may not take a longer period of time than. Despite the controversy, the relationship between ICT implementation and firm's performance is too important to ignore and we put forth the following hypothesis. H6: ICT implementation affects positively to KMC.

Research Method

To test the hypotheses we conducted a survey study with top 1,000 corporations listed by an influential daily business publication "The Maeil Economics." We sent the survey along with a cover letter to the chief marketing ICT, accounting and finance, or human resources department. They answered the survey themselves or delegated it to others who may be more familiar with questions asked in the survey. In order to increase the response rate, we contacted potential respondents by phone and requested their cooperation before and after the survey was sent by email. A professional marketing research firm provided the survey website. As an incentive the respondent was offered a reward of online game token valued or traditional coupon for buying products about $10. The cyber money stands for a real money value for online gamers. If gamers wish to enjoy the online game, they usually buy the token with their real money. The token used in this research has a unique identified number issued by the marketing research firm. After two months of data collection from January to March 2006, we received a total of 179 responses for a response rate of 17.9 percent. When we removed 53 responses as incomplete and invalid, the actual response rate was 12.6 percent. The many invalid responses occurred due to the unreasonable answers. The demographics of the firms participated in the study are shown in Table 1. They represent a wide variety of industries including manufacturing and electronics; wholesale and retail; construction; and financial. The average number of employees employed by the participation firms was over 2,016 and the average annual sales were $383.8 million. The age of the firm, commitment to the firm, department and position of the participants are as follows.

Appendix: Table 1 – Demographic data

ICT, AC, KMC, and firm's performance are major variables assessed in the study. We adopted Cooper and Zmud's [11] instrument that utilized the ICT implementation concept [24] to the MRP construction model. To assess the concept of KAC we adopted Zahra and George's [54] taxonomy of knowledge acquisition, assimilation, transformation, and exploitation. To measure KMC we adopted Tanriverdi's [45] definitions of knowledge creation, transfer, integration, and application into multiple departments. Firm's performance was measured using the 5-point items adopted from Tippins and Sohi [47] that measures sales growth rate, profit rate, and market share. To improve the reliability and validity of the survey items, we pre-tested the instrument with 40 MBA students. The findings and feedback from the pre-tests was incorporated into the final version of the instrument.

Construct Reliability

To develop instruments, we referred from the relevant research, and then, we have strictly checked the items validity provided by Jöreskog and Sörbom [21]. We first performed convergent and discriminant validity of ICT implementation, KAC, KMC, and firm's performance latent constructs and investigated the construct reliability before assessing the research hypotheses. We confirmed internal consistency reliability for each constructs and tested the data with structural equation model (SEM) of various latent constructs [2]. Our research model included mediation role and was composed of multiple-indicator measurement models which allow the most unambiguous assignment of meaning to the estimated constructs.

Each item was loaded highly on its respective construct and its Cronbach's alpha value exceeded the recommended threshold of 0.7 by Nunnally [38] and showed the sufficient convergent discrminant validity [Table 2]. Furthermore, average variance extracted (AVE), which is indicated as the total amount of variance, exceeded 0.5 by a construct compared to the variance caused by the measurement error [15]. The fit of model was assessed by the indications of indices such as normed chi-square (chi-square/degree of freedom (df, $\chi 2$), Goodness of Fit Index (GFI) and Root Means Residual (RMR) were deemed adequate [2].

Appendix Table 2- Confirmatory Factor Analysis, Discriminant Validity, and Reliability

We tested pairwise discriminant analysis of discriminant constructs from the $\chi 2$ difference from the original constructs. Two estimated constructs can be assessed by between unconstrainted parameter and constraining the estimated correlation parameter (1.0). We test a chi-square difference of the values from the

constrained and unconstrained model. A significantly lower χ2 value for the model does not perfectly correlated; thereby we achieved the discriminant validity in Table 3 [2].

Appendix Table 3-Pairwise Discriminant Analysis of Constructs

Model Estimation

The hypothesized research model was tested using SEM. Figure 2 shows the estimation value of the research model, including fit indices. SEM estimation has a normed chi-square of χ2=94.38 (df: 98), which is below the recommended threshold of 3. GFI(Goodness of Fitness Index) and NFI(Normed Fit Index) are 0.98 and 0.97 respectively. They are above the recommended threshold of 0.90. In addition, RMR(Root Means Residual)=0.055 (<=0.10) also is satisfied.
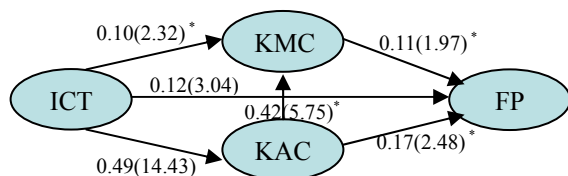

Figure 2: Estimated Model
χ2 = 94.38 (df:98), GFI = 0.98, NFI = 0.97,
RMR = 0.055

All hypotheses in this research model were significantly accepted. H1, H2 posited a positive relationship between ICT implementation and KAC (path coefficient =0.49, t-value=14.43), between ICT implementation and KMC (path coefficient= 0.10, t-value=2.32). H3: The effect of KAC toward KMC also positively exists (path coefficient=0.42, t-value=5.75). H4: KAC had a significant positive effect on firm performance (path coefficient=0.17, t-value=2.48). H5: The effect of KMC on firm performance was supported (path coefficient=0.11, t-value=1.97). Lastly, H6: ICT implementation influenced positively firm (coefficient=0.12, t-value=3.04).

For mediation effect, the important finding of this study is that the KAC and KMC play a critical mediating role between ICT implementation and firm performance. To test the mediation role of KAC and KMC, we tested full mediation effect as well as partial mediation effect (nested mediation effect), which bring the difference of the two models with a chi-square test(χ2). In full mediation model and direct model, KMC was not statistically significance. This finding shows that KMC may less effective on firm performance compared with KAC.
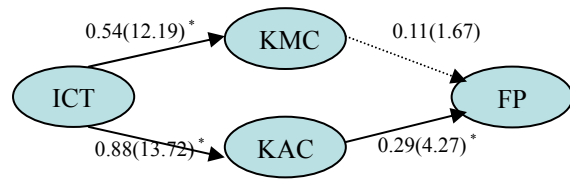

Figure 3: Full Mediation Effects
χ2=148.35(df:100), GFI=0.98, NFI=0.97,
RMR=0.057

The full mediation model and partial mediation model were presented as a good fitted model in Table 5. However, between the partial mediation model and the full mediation model there is a significant difference in χ2 difference = 53.97, df = 2, p<0.05. Thus, we assessed that the partial mediation model is more parsimonious than full mediation model. According to Morgan and Hunt [31], they showed path coefficient value (86%) of partial mediation is higher that of direct effect model (75%), because there is relatively less path connection than the partial mediation model. Dependent variable of SMR (Squared Multiple Correlation) was shown a close result among the models and NFI index of partial mediation model is indicated as more parsimonious.
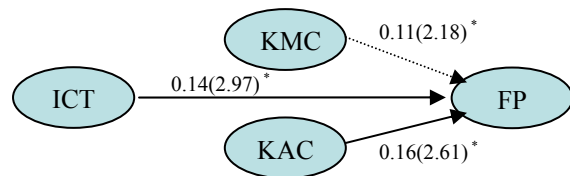

Figure 4: Direct Effect Model
χ2=210.98(df:113), GFI=0.98, NFI=0.96,
RMR=0.061

Table 5- A Comparison of Full Mediation, Partial Mediation, Direct Effect Model

Path Coefficient	Full Mediation	Partial Mediation	Direct Effect
ICT→FP		0.12(3.04)	0.14(2.97)
KMC→FP	0.11(1.67)	0.11(1.97)	0.11(2.18)
KAC→FP	0.29(4.27)	0.17(2.48)	0.16(2.61)
ICT→KMC	0.54(12.19)	0.10(2.32)	
ICT→KAC	0.88(13.72)	0.49(14.43)	
KAC→KMC		0.42(5.75)	
χ2	148.35	94.38	210.98
df	100	98	113
GFI	0.98	0.98	0.98
PNFI	0.71	0.70	0.80
FP's SMC	0.12	0.11	0.11

Conclusion

This research investigated the direct and indirect effects between ICT and firm performance through KMC and KAC based upon the data of firms in Korea and we found some significant facts.

This research obtains the same results as the suggested theory that ICT implementation (virtual place) strengthened the KMC [20][36][39][45] and KAC [29][42]. We refocused the effects of ICT to firm performance. Once again it was ascertained that there was a strong correlation between effects of ICT on firm performance [4][43].

First, we have found the relationship between KAC and KMC, many previous researches have refine KAC and attempt the construct in the concept of innovation process and extend KAC in measuring knowledge management capability [18]. However, we define as KAC has focused on an acquisition and learning of knowledge and information based on information processing from external knowledge sources, whereas KMC has weighed on a creation of knowledge based on the knowledge management capability based on the criticism of Nonaka and his colleagues [32][33][34][35][36][37]'s, which suggested that innovation triggers on knowledge creation as well as the flow of information directly effects knowledge creation.. In recent study, Lane and Koka [25] highlight that KAC has focused on innovation-related performance measures. Therefore finding through this research that active application of KAC as an organization capability is a positive factor to KMC of firm can be considered as the combined results of the knowledge creation of Nonaka and his colleagues, knowledge transfer of Szulanski [44] and Ko et. al.[22], and knowledge integration in team project of Tiwana and Mclean [48]. It has been proven that KAC strengthens KMC constructs separately in literature. In this research, the concept of KMC and KAC were encompassed and measured from a process perspective, and as a result, it showed a very significant effect.

Second is that the research found the mediation effects of KAC and KMC. Even though ICT is emphasized in order for a firm's process to be effectively run, KMC is also important as mediation variable between ICT and firm performance. The fact to be considered is that KMC does not appear to be the sole purpose as the independent factor for a firm performance, but does have a significant effect mediation variable. Therefore it can be said that KMC is combined with ICT and results in a successful effect. It appears that KAC also has a necessary mediation effect on ICT and firm performance.

Lastly, our research implication that there is a synergy effect of ICT and efficient task process management as suggested by Nonaka et al. [36]'s virtual place ('Ba'), therefore efficient management of KAC and KMC with ICT is important. As a conclusion, it is important to actively use ICT and externally and internally create knowledge and care and make it your own. Therefore, this research can find a meaning in both the academic and practical aspects. When first looking at the academic meaning, this research proved the direct and indirect relationship between ICT implication and KMC, KAC, and firm performance. While previous research separated KMC and KAC, this research included the relationship of KMC and KAC in order to explain the process of innovation. For the practical aspects, the managerial relationship between ICT implementation and firm performance was proved. This shows that the firm's ICT adaption, adoption, application strengthens the managerial process and the managerial process raises the firm's performance. Therefore, it is once again established an effective ICT implementation plays an important role the firm's structural process and firm performance.

Despite this research's achievements, there are the following limitations. First, the research was based on the firm's decision makers. However, out of many of those who replied, there were more of the middle managerial decision makers as opposed to the higher level executive decision makers. For better survey results pertaining strategic decision making and firm performance it would have been more beneficial to have the higher level decision makers. However, Lee and Choi [26] are quick to assure that for knowledge management and firm performance research, middle level managers are fully knowledgeable and there should be no problems with their answers. The other limit is that the measure items of KAC which was used in this research is not a verified in empirical research but is based on the concept of Zahra and George [54].

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Table 2. Confirmatory Factor Analysis, Discriminant Validity, and Reliability

Factor	Items	Loading Value	t-Value	α	Deleted item α	AVE	χ2	GFI	RMR
ICT	ICT1	0.56	10.41		0.876				
	ICT2	0.85	13.87		0.832				
	ICT3	0.78	13.23	0.873	0.846	0.8773	60.50 (df:9)	0.99	0.058
	ICT4	0.64	11.64		0.866				
	ICT5	0.84	13.63		0.835				
	ICT6	0.73	12.51		0.852				
KMC	KMC1	0.75	9.70		0.787				
	KMC2	0.82	10.00	0.834	0.769	0.8363	9.79 (df:2)	1.00	0.039
	KMC3	0.77	9.80		0.872				
	KMC4	0.65	9.00		0.822				
KAC	KAC1	0.78	10.64		0.827				
	KAC2	0.78	10.59	0.863	0.825	0.7900	7.85 (df:2)	1.00	0.031
	KAC3	0.76	10.50		0.835				
	KAC4	0.71	10.81		0.817				
FP	FP1	0.87	8.69		0.777				
	FP2	0.80	8.69	0.860	0.815	0.8607	0.00 (df:0)	1.00	0.00
	FP3	0.79	8.69		0.821				

Table 3. Pairwise Discriminant Analysis of Constructs

Models	Unconstrainted χ2	Constrainted χ2	χ2difference from the original
ICT-KMC	109.36 (df:34)	411.25 (df:35)	301.89 (df:1)
ICT-KAC	136.67 (df:34)	425.78 (df:35)	289.11 (df:1)
ICT-FP	98.85 (df:26)	325.10 (df:27)	226.25 (df:1)
KMC-KAC	40.64 (df:19)	316.30 (df:20)	275.66 (df:1)
KMC-FP	36.79 (df:13)	314.77 (df:14)	277.98 (df:1)
KAC-FP	24.03 (df:13)	293.85 (df:14)	269.82 (df:1)

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