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The Moderating Effect of Media Synchronicity in the Communication Media Use and Knowledge Creation

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Social communications using information and communication technologies (ICT) for social interactions have been making a significant impact on task performance in organizations. However, most of the existing studies on ICT (e.g., telephone and email) have only focused on technical improvement of communication efficiencies (e.g., information exchange and storage). In this paper, we claim that ICT may be another alternative source of knowledge creation that enables employees to work, find solutions, and achieve their goals faster and better. We investigate the impact of ICT in terms of both tasks and social aspects with knowledge creation as task performance. Also, we investigate the moderating effect of media synchronicity on these relationships. This study contributes to the understanding of contemporary communications media usage and its performance in organizations. We collected and analyzed survey data of 248 company employees, using PLS. The results indicate that task urgency and social influence directly affect ICT usage, and even knowledge creation. Also the media synchronicity moderates the relationship between the characteristics of a given task and ICT usage and the relationship between ICT usage and knowledge creation. Theoretical and practical implications of these findings are also discussed in the paper.

Keywords : IS Usage, Media Richness Theory, Media Synchronicity Theory, Information and Communications Technologies, Task Characteristics, Social Influence, Knowledge Creation

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Ⅰ. Introduction

Organizations may conduct various collaborative tasks via information and communications technologies (ICT). The effects of ICT have been variously shown to involve the following: knowledge creation and operation efficiency in inter-organizations [Malhotra *et al*., 2005] and task performance in organizations [Rice, 1992], organizational structure [Lee and Grover, 1999], and social information exchange for social activities in social networks [Anderson *et al*., 2007]. Specifically, there has been tremendous interest in the usage of ICT for generating innovative ideas and knowledge creation among employees of corporate organizations [Lee and Grover, 1999]. In addition, ICT provides information services and products for people's everyday lives [Anderson *et al*., 2007]. Much of the discussion originated from the theory of innovation [Rogers, 1995] and focused on the important role of ICT [Paul, 2006]. Lee and Grover [1999] investigated the mediating role of communications technology between business environment variables and organizational structure, and found a direct role for ICT in terms of the organizational aspects.

Prior ICT research has focused on the relationship of people to ICT and its effects; however, upcoming IT development emphasizes person-to-person connections via the technologies. The conventional view of interaction, namely or sociability is exchanging information between people who maintain ties; furthermore, communications media, which are characterized as socially networked and very personalized, are based on fast broadband networking systems. They actually reinforce business processes by sharing ideas and knowledge and by finding necessary information from mutual employees via person-to-person social relational networking. Thus, the task and behaviour characteristics of people may influence the type of business processes as well as the choice of technologies. Indeed, many people intentionally adopt ICT that enables them to accomplish their task purposes and personal goals simultaneously. As such both the characteristics of the task [Kahai and Cooper, 2003; Rice, 1992; Sheer and Chen, 2004] and social influence [Carlson and Davis, 1998; Carlson and Zmud, 1999; Schmitz and Fulk, 1991; Trevino *et al*., 2000; Webster and Trevino, 1995] actually determine the ICT usage.

Specifically, we expect that newly emerging social networking systems via ICT will have a profound impact on the task performance in terms of the capability to cope with contingency situations in organizations. For instance, social networking solutions (e.g., Web 2.0 applications) result in more flexible personalized answers than knowledge management systems or groupware. In this way, ICT may offer another alternative source of knowledge transfer that enables employees to work, find solutions, and achieve their goals faster. Task-oriented activities may enable end users to choose the media type, including personal involvement in a socially connected organization environment. Although there are some proven links between social presence and media richness via previous research, new communications media that are highly "person-oriented" have emerged and may be used to achieve effective performance in wireless work environments.

To date much research has investigated the relationships between the use of ICT and task performance, but the results appear less clear. A possible reason for erratic results might be that the explanations of media type have too broad a scope. In addition, communications media implemented in organizations contain a bundle of interrelated characteristics, and prevalent media theories do not adequately explain their complexity. In recent, media synchronicity theory (MST) regards the synchronicity of the communication media as the critical characteristics affecting communication processes [Dennis and Valacich, 1999; Dennis *et al*., 2008]. Synchronicity is defined as "*the extent to which individuals work together on the same activity at the same time; i.e. have a shared focus*" [Dennis and Valacich, 1999, p. 5]. MST focuses the ability of media to support synchronicity for the improvement of communication performance and asserts that communication performance will depend on the fit between a medium's synchronicity and the communication processes [Dennis *et al*., 2008, p. 583].

Based on those assumptions, we investigate the effects of ICT in terms of the relationship between both tasks and social aspects and knowledge creation as task performance. This study contributes to the understanding of contemporary ICT usage and its performance in organizations. In summary, our research aims to resolve the question of how characteristics of tasks (e.g. complexity, urgency) influence ICT usage, and how social relationships affect ICT usage. In addition, this study aims to investigate how media synchronicity moderates the association of task characteristics and social influence with ICT usage and the relationship between ICT usage and knowledge creation.

The next section reviews theories on media and their usage. Section 3 proposes research model and hypotheses, and Section 4 provides the explanation of research methodology. And Section 5 presents the results of this study. Finally, in Section 6, we discuss findings, implications, and limitations of this research.

Ⅱ. Theoretical Backgrounds

2.1 Information and Communications Technologies

ICT has quickly emerged since the evolution of internet technologies and rapidly diffused in business organizations as well as individuals in society. Lee and Grover [1999] argue that ICT integrates people with computer systems and enables people to receive, send, share, or disseminate information in an organization or inter-organizations. To date, prior media theories are mainly concerned with the size or volume of information that is transmitted. For example, a face-to-face meeting involves a richer medium than an e-mail. Also, these theories focus on the appropriate selection of media, which depends on the fit between the task and the media capacity.

Recently, the characteristics of communications technologies have been largely explained as the phenomenon that users enjoy universal access and social interaction, and reciprocal interdependence via humanly interconnected network communications applications and technologies [Licoppe and Smoreda, 2005]. In case of the communications media, earlier users may influence later users to adopt the same

type of communications technology, based on previous studies suggesting that the characteristics of organizations influenced the adoption of communication technologies [Keen, 1987; 1988; 1991]. A social relation is considered as a social resource, which can be represented as an informational source. The importance of a social relation can be determined by the frequency of exchanges and the intimacy of the exchanges [Brown *et al.*, 2007]. Interpersonal exchanges have the potential to generate higher informational value than an official and formal relationship provides [Licoppe and Smoreda, 2005]. This phenomenon can be explained by interpersonal trust which is defined as "the word, promise, verbal or written statement of another individual can be relied upon" [Rotter, 1967]. Interpersonal trust is regarded as the willingness of a party to engage in transactions with others. The formation of interpersonal trust is related to more interpersonal relationships than official relationships. This affects whether people will engage in social exchange in general and cooperative interactions in particular [Nahapiet and Ghoshal, 1998].

ICT enables a sender to adopt a certain medium to process information related to tasks. In this process, the sender estimates the volume and time sensitivity of information, and then tries to find the best fitness solution to transfer to the communication partner. Moreover, ICT specifically emphasizes sharing information and knowledge to achieve end user goals in organizations using communications technologies in socially networked contexts: members of an organization, inter- or intra-organization, and private relationships. The new ICT enables continuous online presence and has the potential to connect a variety of locations while = supporting full interaction with mobile systems. This new regime of "connected" presence enables information seekers or searchers to find necessary information on a real-time basis: "connected presence" [Licoppe and Smoreda, 2005]. ICT is beginning to complement firm-initiated communications technologies. This largely affects the core business process of organizations, resulting in a more distributed organization structure. Therefore, attaining better understanding of recent communications technologies is needed with new media theories which can help explicate with these issues.

Contemporary literature does not provide insights into communications technologies based on synchronicity in contingent contextual situations. In this study, thus, the linkage of ICT and the synchronicity of communication media in different contingent contextual situations may provide a more specific indication of these technologies' effects on organizations in a turbulent business environment.

2.2 Theories on Media Choice

Since scholars agree that ICT significantly alters the interaction between task and media and outcomes in organizations, it is important to understand the effects of ICT to increase the benefits of their use. Many theories have been developed in this regard. According to Carlson and Zmud [1999], theories on organizational communication are classified into three dimensions: 1) motivation factors of use of a specific media, 2) the characteristics of the use itself, and 3) the effects of that use.

Of various theories on media use, media richness theory (MRT) and MST have received the most attention by researchers. The characteristics of each ICT based on MRT and MST are summarized in <Table 1>. MRT states that different communication media have different degrees of richness which influences the transmission of information and knowledge [Daft and Lengel, 1986]. According to this theory, richness is defined as the ability of media to convey nonverbal cues and personality traits and supply agile feedback [Daft and Lengel, 1986]. When individuals work together in a team or an organization, they have to take into account which communication media is appropriate for them to perform a certain task [Dennis and Kinney, 1998].

According to this theory, the use of ICT is related to the characteristics of task and the needs and experience of the users in their social context [Carlson and Davis, 1998; Carlson and Zmud, 1999; Trevino *et al*., 1987]. First, many researchers have examined the hypothesis about the characteristics of task. For example, Trevino *et al*. [2000] argue that job equivocality influences the choice of medium. Also, Rice [1992] notes that information-lean media is more appropriate for analyzable tasks, where as information-rich media can support unanalyzable tasks that can be accomplished via socializing, interpretation, and situational constraints. Thus, task analyzability influences media choice and use. Employees in an unanalyzable task tend to perform their work on the basis of personal experience, intuition, and socialization with other employees, because the task is much less predictable and more complex. People are more likely to choose rich communication media (e.g., face-to-face, telephone) that enable them to clearly identify problems and communicate effectively. Real-time feedback is vital for unanalyzable work [Van de Ven *et al*., 1976; Zmud *et al*., 1990]. Second, there are many researches that examine the ef-

<Table 1> Comparison of Media and their Characteristics

Medium	Social Cues	Synchronicity		Information richness
Face-to-face	Facial expressions	High	(High)	High
Telephone	Verbal language	Medium	(High)	Medium/High
E-mail	Textual language	Low	(Low)	Medium
Instant Messenger	Textual language	Medium	(High)	Medium
Blog	Textual language	Low	(Low)	High
KMS	Textual language	Low	(Low)	High
e-learning systems	Textual language	Low	(Low)	High
Video conference	Hybrid language	High	(High)	High
Telephone conference	Hybrid language	Low-Medium	(Low)	High
Short message service	Textual language	Low	(Low)	Low
Voice message service	Verbal language	Low	(Low)	Medium

Note) Texts in parenthesis in Synchronicity are the characteristics reclassified in this study for empirical analysis.

Source: Kettinger and Lee. 2002; Licoppe and Smoreda, 2005; Vickery *et al*., 2004, Dennis *et al*., 2008.

fects of social influence on media use [Fulk and Boyd, 1991; Schmitz and Fulk, 1991]. These studies emphasize the effects of social influences on media use that communication media traits or task characteristics?. People sharing a particular social context (e.g. peer pressure, cultural background, shared common sense) are more likely to share an attitude toward media, and then this attitude influences their behaviour toward ICT [Schmitz and Fulk, 1991].

Rather than the richness of media, MST regards the synchronicity of media as the critical factor in communication process [Dennis and Valacich, 1999; Dennis *et al*., 2008]. Dennis *et al*. [2008, p. 576] define "*synchronicity*" as "*the ability to support individuals working together at the same time with a shared pattern of coordinated behaviour*." Moreover, MST describes five dimensions of media that influences information processing and transmission: *transmission velocity, parallelism, symbol variety, rehearsability,* and *reprocessability*.

Among them, transmission velocity, parallelism, and symbol variety affect information transmission [Dennis *et al*., 2008]. Symbol variety means "the number of ways in which a medium allows information to be encoded for communication" such as verbal, nonverbal, visual, auditory, graphical, etc. [Dennis *et al*., 2008, p. 585]. Parallelism refers to "the extent to which signals from multiple senders can be transmitted over the medium simultaneously" [Dennis *et al*., 2008, p. 585]. And then, transmission velocity means "the speed at which a medium can deliver a message to intended recipients" [Dennis *et al*., 2008, p. 584]. At the same time, rehearsability and reprocessability influence information processing [Dennis *et al*., 2008]. Rehearsability is "the extent to which the media enables the sender to rehearse or fine tune a message during encoding, before sending" [Dennis *et al*., 2008, p. 587]. And reprocessability is "the extent to which the medium enables a message to be reexamined or processed again, during decoding, either within the context of the communication event or after the event has passed" [Dennis *et al*., 2008, p. 587].

According to this theory, parallelism, rehearsability, and reprocessability are asynchronous characteristics. For example, an asynchronous medium such as e-mail has high parallelism, high rehearsability, and high reprocessability. In contrast, transmission velocity and symbol variety have a positive impact on a synchronous characteristic. For example, a synchronous medium such as face-to-face communication has high transmission velocity, but low parallelism and low rehearsability.

Ⅲ. Research Model and Hypotheses

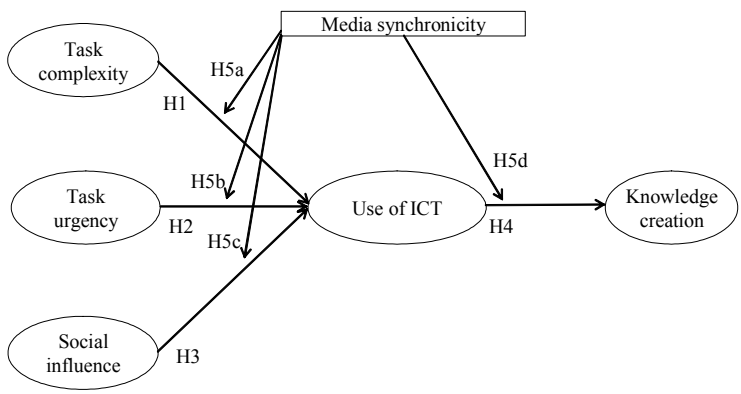
We explore the relationship between task characteristics and the use of ICT and even the relationship the use of ICT and knowledge creation as task performance [Dennis and Kinney, 1998; Markus, 1994; Rice, 1992]. In addition, since the development of ICT has resulted in more active social networks, social factors may influence the use of ICT [Fulk *et al*., 1987]. A firm can support the selection of various technologies for communications and can be persuaded to use them in a variety of working spheres: workgroup and project group. On the other hand, people also efficiently communi-

cate with individual peers, or their social network, and choose an option from various media: messenger, SMS, or cell phone. Therefore, we investigate how people use particular ICT for a specific task, and how social factors moderate the relationship, as shown in <Figure 1>.

3.1 Task Characteristics and Use of Communications Media

Generally, task complexity has been used interchangeably with ambiguity, uncertainty, and unstructured information [McKeen *et al*., 1994]. Task complexity is explained as ambiguity and uncertainty in the user's surrounding environment, in the context of business practices. The conceptual definition of task complexity in this study is based on Jiang and Benbasat's study [2007]. They define task complexity as "*a function of the number of distinct acts that must be completed and the number of distinct information cues about the attributes of the task-related stimulus object an individual has to process when performing a task*."

Typically, high task complexity needs a large volume of data or information to process the work and a processing technology capable of disseminating cognitive resources for better decisions [Jiang and Benbasat, 2007]. On the contrary, simple tasks require less information processing than complex tasks [Speier *et al*., 2003]. Owing to the complexity of tasks, in some cases, a certain amount of information processing may need not only a high cognitive capacity [Speier *et al*., 2003] but also a suitable communication technology, to communicate with a partner about complex matters. Appropriate ICT usage can effectively represent knowledge that is verbal or nonverbal, text or pictorial, facial or non-facial, and efficiently enhance the level of cognitive capacity via communications [Carney and Levin, 2002] in high complexity tasks. Dennis and Kinney [1998] found that task equivocality [e.g., multiple and possibly conflicting interpretations) did not improve decision quality and time. They argued that MRT may be a better fit for simple tasks than for complex tasks. We, therefore, construct the following hypotheis:



<Figure 1> Research Model

Hypothesis 1: Task complexity is positively related to use of information and communications technologies.

We also assume that an urgent task involves matters needing frequent and immediate feedback from the communication partner, so they may choose suitable ICT for correspondence to deal with the urgent work. Dennis and Kinney [1998] explained "immediacy of feedback," which is the degree on which a medium can provide rapid feedback using communication. Feedback can be categorized as two types: "concurrent and sequential" [Dennis and Kinney, 1998]. Concurrent feedback is usually simultaneous and occurs during the transactions of communication, whereas sequential feedback occurs in the middle of communication, while pausing, confirming, interrupting, or redirecting.

As feedback is important to understand and adjust the message in a sender-receiver transactional relationship, an urgent task not only needs to be concurrent but also requires rapid sequential feedback from the communication partner. Therefore, urgent tasks require communication tools to fully deal with text-only, vocal, or virtual cues, and fast understanding of the sender and receiver's purpose. Many researchers have indicated the importance of immediate feedback and studied the fitness between the message and media [Carlson and Davis, 1998; Dennis and Kinney, 1998; Rice *et al*., 1994; Trevino *et al*., 1987; Zmud *et al*., 1990]. However, they didn't explain when immediate feedback is necessary. Urgent work must overcome various situational constraints: time, location, and presentation of social presence. Among emerging ICT, a certain technology might need to be selected appropriately to provide suitable information processing at the right time and a scale of explanation fully matched to the task urgency. Thus, we hypothesize the following:

Hypothesis 2: Task urgency is positively related to use of information and communications technologies.

3.2 Social Influence and Use of Communications Media

Communication behavior can be affected by various factors: subjectivity, social relations, retrospective rationality, work group norms, and co-workers' and supervisors' attitudes and behaviors [Carlson and Davis, 1998; Webster and Trevino, 1995]. Socially connected relationships have an important influence on technology usage by private or public social members [Carlson and Davis, 1998; Carlson and Zmud, 1999; Trevino *et al*., 1987]. Carlson and Davis [1998] state that social relationship tasks and media selection depend on groups or individuals. Interaction among members or individuals, therefore, may lead to mutual understanding, result in shared beliefs, and influence their information processing via communications technologies. Social influence has a significant effect on ICT usage [Carlson and Zmud, 1999).

According to the Webster and Trevino [1995], the media choice behavior of interdisciplinary workers is a determinant of the value of electronic media, choice of media, and use of media. Also, the level of communication partner closeness determines how efficiently relevant information can be acquired from the tasks. On-

going interplay between close friends or coworkers may increase the level of understanding when people face diverse tasks and choose appropriate media for each task. Social affinity (personal) might help users to choose the type of communication technology and integrate task-oriented information with the selected media. Thus, we propose the following hypothesis:

Hypothesis 3: Social influence is positively related to use of information and communications technologies.

3.3 Use of Communications Media and Knowledge Creation

Knowledge is classified as two types: know-how, experience, and tacit (i.e., implicit) and explicit information [Nonaka, 1994]. Explicit information can be transmitted without loss of integrity via lean communication media, while it is difficult to formalize know-how, experience, and complex knowledge for rich communications media in order to maintain the overall integrity of means [Nonaka, 1994].

Thus, knowledge transfer and creation is closely related to ICT usage [Murray and Peyrefitte, 2007]. Knowledge transfer via media in an organization is vitally important and requisite to disseminate and create new knowledge. ICT plays a key role in the transferability of knowledge and the capacity of information to be transmitted within a given time x [Murray and Peyrefitte, 2007]. Thus, the more employees use ICT, the more employees share knowledge among partners and create new knowledge [Hansen, 1999; Reagans and McEvily, 2003].

Hypothesis 4: Use of information and communications technologies is positively related to knowledge creation.

3.4 The Moderating Effects of Media Synchronicity

In general, most tasks require various communication processes. People perform more communication processes to accomplish better task outcomes. MST asserts that communication performance results from the fit between media capabilities and communication processes needed to accomplish a task [Dennis *et al.*, 2008].

With regard to media capabilities, MST suggests that ICT should fit two fundamental communication processes: conveyance process which leads to individual understanding and convergence process which leads to common understanding [Dennis *et al.*, 2008]. In addition, two sub-processes necessary for these processes are both information transmission and information processing. According to MST, high synchronicity media is appropriate for convergence processes, while low synchronicity media is suitable for conveyance processes. Since conveyance processes focus on the transmission of raw information and the subsequent retrospective analysis, people do not need to work together or synchronize for conveyance processes [Dennis *et al.*, 2008; pp. 581-582]. Thus, users will only need low synchronicity media for the improvement of conveyance processes [Dennis *et al.*, 2008]. While convergence processes focus on the shared understanding, people do need to work together or synchronize for convergence processes. Thus, users will

only need high synchronicity media for the improvement of convergence processes [Dennis *et al.*, 2008].

Individuals who use mainly high synchronous media are more likely to be motivated to use ICT than those who don't use such media, since media synchronicity makes it easier for them to gain information requirements they need to process when performing a task. If a task at hand is complex and urgent, individuals will spend more time to assess and deliberate on the information using ICT since media that support higher levels of synchronicity can generate expectations of rich information transmission and rapid interaction with others regarding the task. Conversely, individuals who

<Table 2> Demographic Characteristics of the Sample

Categories		Frequency			Percentage (%)		
		total	Sync	Async	total	Sync	Async
Gender	Male	139	99	40	60.2	63.9	52.6
	Female	92	56	36	39.8	36.1	47.4
	Total	231	155	76	100.0	100.0	100.0
Age	20～29	65	46	19	28.1	29.7	25.0
	30～39	92	66	26	39.8	42.6	34.2
	40～49	46	25	21	19.9	16.1	27.6
	50～59	28	18	10	12.1	11.6	13.2
	Total	231	155	76	100.0	100.0	100.0
Position	Top level manager	11	6	5	4.8	3.9	6.6
	Direct level manager	24	14	10	10.4	9.0	13.2
	General level manager	17	11	6	7.4	7.1	7.9
	Middle level manager	45	28	17	19.5	18.1	22.4
	Task manager	58	47	11	25.1	30.3	14.5
	General employees	76	49	27	32.9	31.6	35.5
	Total	231	155	76	100.0	100.0	100.0
Number of employees	1～100	95	60	35	41.1	38.7	46.1
	100～500	58	40	18	25.1	25.8	23.7
	500～1,000	20	13	7	8.7	8.4	9.2
	1,000～5,000	45	32	13	19.5	20.6	17.1
	Over 5,000	13	10	3	5.6	6.5	3.9
	Total	231	155	76	100.0	100.0	100.0
Industry	Financial business	14	9	5	6.1	5.8	6.6
	Manufacturing	56	36	20	24.2	23.2	26.3
	Distribution	26	19	7	11.3	12.3	9.2
	Transportation	3	0	3	1.3	0.0	3.9
	Electronics	8	7	1	3.5	4.5	1.3
	IT and related services	37	24	13	16.0	15.5	17.1
	Construction	17	11	6	7.4	7.1	7.9
	Medical and related services	9	8	1	3.9	5.2	1.3
	Government	26	17	9	11.3	11.0	11.8
	et cetera	35	24	11	15.2	15.5	14.5
	Total	231	155	76	100.0	100.0	100.0

Note) Sync = Synchronicity group, Async = Asynchronicity group.

use low synchronous media are less likely to be motivated to use ICT, since lower synchronicity increases time lag and decreases level of interaction between senders and the recipients [Dennis *et al*., 2008]. Likewise, high synchronicity media users are more inclined to use ICT to enhance social relationships in order to increase the possibilities to gain more information in appropriate time. In contrast, low synchronicity media users are forced to use ICT less, because they tend to be more interested in processing information rather than transmitting information.

In sum, MST argues that synchronous ICT increases users' motivation to participate in ICT but makes it harder for them to process information and/or knowledge [Dennis and Valacich, 1999; Dennis *et al*., 2008]. However,

<Table 3> Operationalization and Sources of the Variables

Variables	Items
Task Complexity [Adapted from Dennis and Kinney, 1998]	1. My task can be done on the basis of the breadth and deep knowledge. 2. My task requires a variety of information. 3. My task requires various kinds of experience. 4. My task is linked to several other tasks.
Task Urgency [Adapted from Kahai and Cooper, 2003]	1. My task requires a fast feedback from me. 2. My task should be carried out concurrently. 3. My task should be carried out in a real time basis. 4. My task is always accessible at any time.
Social Influence [Carlson and Zmud, 1999; Trevino *et al*., 2000]	1. My colleagues in the office use current media actively. 2. My colleagues in the office confirm the current media as a useful tool to communicate. 3. My seniors in the office use current media actively. 4. My seniors in the office confirm the current media as a useful tool to communicate.
The Usage of media [Jarvenpaa and Staples, 2000; Murry and Peyrefitee, 2007] Note) *** represents the type of SCTs	1. I usually use *** to discuss some task-related subjects 2. I usually use *** to discuss an idea, procedure, and policy 3. I usually use *** to arrange schedule and share information 4. I usually use *** to find some difficult solutions and to solve sensitive issue in the organization
Media Synchronicity [Dennis *et al*., 2008]	Which communications media do you prefer and use dominantly to communicate with your partners? Example) Face-to-face/Telephone/E-mail/Instant Messenger/Blog/KMS/ e-learning systems/Video conference/Telephone conference/Short message service/Voice message service
Knowledge Creation [Malhotra *et al*., 2005]	Using <ICT> has helped you … 1. … better understand the needs of customers. 2. … better understand new or emerging markets. 3. … find better ways of distributing/selling the products. 4. … improve service for the end customers.

low synchronicity media increases their capabilities to process information. Therefore, we may expect to see different levels of relationships hypothesized in this study based on media synchronicity. Hence, our last hypothesis is as follows:

Hypothesis 5: The media synchronicity moderates the relationship between (a) task complexity and use of ICT, (b) task urgency and use of ICT, (c) social influence and use of ICT, and (d) use of ICT and knowledge creation, respectively.

Ⅳ. Research Methodology

4.1 Sample and Data Collection

In order to analyze our research model, we conducted a survey based on a heterogeneous sample from various industrial firms in Korea. Employees in firms used all types of ICT applications as well as applications owned by the firm. A questionnaire was developed from the literature and checked and tested via the methodology procedure. We collected data with the help of a commercial data acquisition company

<Table 4> Factor Structure Matrix of Loadings and Cross-loadings of Variables (Total Sample)

Items	TC	TU	SIF	Use	KC
TC1	**0.813**	0.443	0.343	0.414	0.239
TC2	**0.820**	0.457	0.317	0.380	0.246
TC3	**0.781**	0.414	0.330	0.317	0.269
TC4	**0.780**	0.529	0.281	0.340	0.396
TU1	0.514	**0.815**	0.493	0.481	0.497
TU2	0.494	**0.864**	0.405	0.514	0.428
TU3	0.368	**0.820**	0.375	0.461	0.371
TU4	0.507	**0.768**	0.430	0.423	0.437
SIF1	0.406	0.432	**0.782**	0.348	0.357
SIF2	0.381	0.560	**0.834**	0.459	0.430
SIF3	0.211	0.283	**0.767**	0.369	0.266
SIF4	0.278	0.370	**0.839**	0.365	0.401
Use1	0.412	0.539	0.397	**0.805**	0.417
Use2	0.453	0.411	0.406	**0.783**	0.341
Use3	0.184	0.360	0.283	**0.640**	0.243
Use4	0.263	0.392	0.340	**0.751**	0.386
KC1	0.354	0.428	0.365	0.426	**0.831**
KC2	0.273	0.348	0.407	0.368	**0.795**
KC3	0.304	0.504	0.368	0.373	**0.862**
KC4	0.232	0.464	0.361	0.383	**0.807**

Note) 1 = Task Complexity, 2 = Task Urgency, 3 = Social Influence, 4 = Use of Information and Communications Technologies, 5 = Knowledge Creation.

via a web survey over two days. We selected our sample based on the size of company: large, medium, and small. To increase the response rate and data quality, we provided cash incentives of around five dollars. A total number of respondents was 280. Of those responses, 231 were complete and usable. <Table 2> shows the demographic analysis.

4.2 Measures

<Table 3> summarizes the operational definitions of the research variables and their sources. Since most measures used in this research were available, this study used questions drawn from previous literature and adapted to serve the purposes of this study. The respondents were asked to indicate their responses to each of the survey questions. All items except media synchronicity were measured on a seven-point Likert scale that is anchored with "Strongly Disagree" and "Strongly Agree."

Ⅴ. Data Analysis and Results

This study uses partial least squares (PLS) analysis for data analysis. PLS, a structural equation modelling technique, assesses both the measurement model, for the relationships between constructs and their items, and the structural model for the relationships among constructs [Fornell, 1982]. PLS analysis reported in this study was performed using SmartPLS (version 2.0).

5.1 The Measurement Model

This study tested the measurement model by

<Table 5> Reliability of Variables

Categories	Variable	# of items	Composite reliability	Average Variance Explained (AVE)
Total	Task Complexity	4	0.876	0.638
	Task Urgency	4	0.889	0.668
	Social Influence	4	0.881	0.650
	Use of ICT	4	0.834	0.559
	Knowledge Creation	4	0.894	0.679
Sync	Task Complexity	4	0.870	0.626
	Task Urgency	4	0.899	0.690
	Social Influence	4	0.867	0.621
	Use of ICT	4	0.838	0.567
	Knowledge Creation	4	0.896	0.684
Async	Task Complexity	4	0.882	0.651
	Task Urgency	4	0.863	0.616
	Social Influence	4	0.904	0.702
	Use of ICT	4	0.823	0.539
	Knowledge Creation	4	0.883	0.654

Note) Sync = Synchronicity group, Async = Asynchronicity group.

examining reliability, convergent validity, and discriminant validity [Gefen *et al*., 2000]. First, individual item reliability was tested using a criterion cut-off of 0.5 or higher factor loading score [Gefen *et al*., 2000]. As <Table 5> shows, the results met the recommended criterion.

Second, convergent validity was examined using a criterion cut-off of 0.5 or higher average variance extracted (AVE) and 0.7 or higher composite reliability [Gefen *et al*., 2000]. The results in <Table 5> demonstrate that all variables meet these recommended criterions.

Finally, this study examined the discriminant validity in three ways [Gefen *et al*., 2000]: 1) by ensuring whether questions measuring each construct load on their intended construct more highly than other unintended constructs, 2) by examining whether AVE is greater than the variance shared between the construct and other constructs in the model, and 3) by confirming whether the diagonal elements (the square roots of the AVE) of this matrix is greater than the off-diagonal elements in the corresponding rows and columns. <Table 4> shows the factor structure matrix for the constructs of this study. Results shown in <Table 6> indicate that this research met the criterions related to AVE. Thus, the results in <Table 4> and <Table 6> suggest that all of the constructs in this study had adequate discriminant validity.

<Table 6> Correlation Between Constructs, AVEs, and Square-root of AVEs

Categories		1	2	3	4	5
Total	1	**0.799**				
	2	0.575	**0.817**			
	3	0.398	0.520	**0.806**		
	4	0.458	0.577	0.483	**0.748**	
	5	0.355	0.530	0.455	0.472	**0.824**
Sync	1	**0.791**				
	2	0.642	**0.831**			
	3	0.410	0.495	**0.788**		
	4	0.492	0.612	0.510	**0.753**	
	5	0.382	0.557	0.501	0.533	**0.827**
Async	1	**0.807**				
	2	0.466	**0.785**			
	3	0.405	0.596	**0.838**		
	4	0.502	0.550	0.458	**0.734**	
	5	0.319	0.492	0.394	0.436	**0.809**

Note) 1: Figures in shaded diagonal are values of the squared root of the AVE.
2: Sync = Synchronicity group, Async = Asynchronicity group.
3: 1 = Task Complexity, 2 = Task Urgency, 3 = Social Influence, 4 = Use of Information and Communications Technologies, 5 = Knowledge Creation.

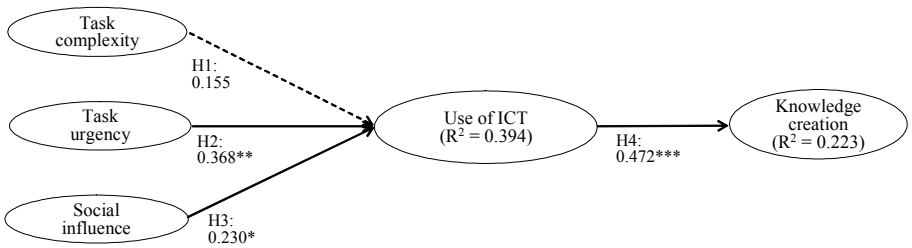
5.2 The Structural Model

With an adequate measurement model, this study tested the proposed research hypotheses with PLS. This study determined support for each hypothesis based on the sign and statistical significance for its corresponding path coefficient. <Figure 2> depicts the results of the analysis and <Table 7> summarizes detail statistics of the results.

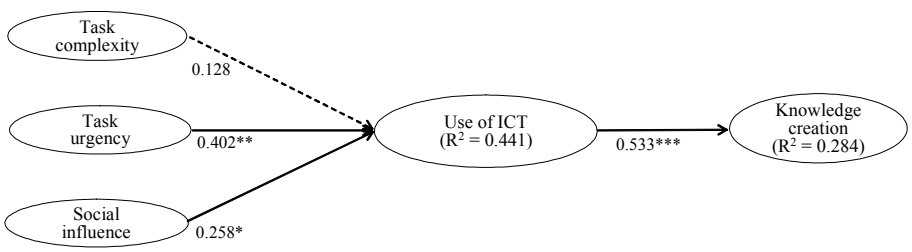
The results show that task urgency had positive effects on the use of ICT (Hypothesis 2, $t = 2.818$; $p < 0.01$) and that social influence had significant relationships with the use of ICT (Hypothesis 3, $t = 2.034$; $p < 0.05$). Also, the use of ICT significantly influenced knowledge creation (Hypothesis 4, $t = 5.187$; $p < 0.001$). However, task complexity did not significantly influence the use of ICT (Hypothesis 1, $t = 1.390$; not significant).

5.3 Testing for Moderating Effects

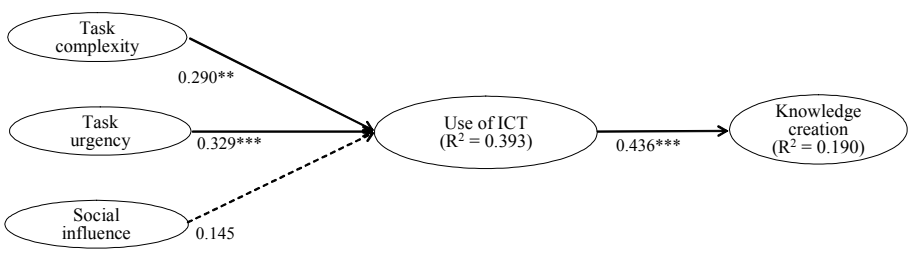
This study conducted subgroup analysis to



<Figure 2> Results of PLS analysis



(a) Results of PLS analysis for Synchronicity group



(b) Results of PLS analysis for Asynchronicity group

<Figure 3> The Moderating Effects of Media Synchronicity Group

<Table 7> Results of Path Analysis

Categories	Hypothesis		Path-Coefficient	T-value	P-value	Hypothesis testing
Total	H1	TC → Use	0.155	1.390	0.083	Rejection
	H2	TU → Use	0.368	2.818	0.003**	Adoption
	H3	SIF → Use	0.230	2.034	0.022*	Adoption
	H4	Use → KC	0.472	5.187	0.000***	Adoption

Note) 1: df = 247 and 1-tailed test.
2: TC = Task Complexity, TU = Task Urgency, SIF = Social Influence, Use = Use of Social Communications Technologies, KC = Knowledge Creation.
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

examine the moderating effects of media synchronicity on the direct relationships [Stone-Romero and Anderson, 1994]. We form the groups based on the level of synchronicity of the media which the respondents selected as their preferred information and communications technologies shown in <Table 1>. And then, this study conducted separate PLS models for the two subgroups: Synchronicity group and Asynchronicity group. As shown in <Table 5> and <Table 6>, both measurement models for two subgroups are statistically significant.

Given both adequate measurement models, the hypotheses could be tested with the original structural model. As shown in <Figure 3>, while the examined perceptions of users that have synchronous preference explain 44.1% of the variance in the use of ICT <Figure 3a>, those for users that have asynchronous preference explain 39.3% of that <Figure 3b>. Also, in a synchronous group, task complexity was not related to the use of ICT while in an asynchronous group social influence was not related to the use of ICT.

Moreover, to confirm the support for moderation hypothesis, we observe that the significant differences between path coefficients for two sub groups emerge. We used the following equation (1) [Chin, 2000]:

$$t_{ij} = \frac{p_1 - p_2}{\sqrt{\frac{(n_1-1)\times SE_1^2 + (n_2-1)\times SE_2^2}{n_1+n_2-2}} \times \sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}, \quad (1)$$

where P_i = coefficient for path i; n_i = sample size of path i; SE_i = standard error of coefficient for path i; and t_{ij} = t-value of degree of freedom of (n_1+n_2-2).

The results are shown in <Table 8>. Our findings show that there was a synchronicity moderation effect on the relationship between task complexity, task urgency, and social influence and the use of ICT. Moreover, there was a synchronicity moderation effect on the relationship between the use of ICT and knowledge creation. Therefore, hypotheses H5a, H5b, H5c, and H5d provide empirical support in the moderation effect of synchronicity.

Ⅵ. Discussion and Conclusions

This study contributes in two ways to the

<Table 8> Comparisons of Path Analysis Between High and Low Synchronicity Groups

Hypothesis	Categories	Sync	Async	Hypothesis testing
H5a (TC → Use)	Path-Coefficient	0.128	0.290	Adoption (Higher in async group)
	Standard Error	0.100	0.097	
	Number of Sample	155	76	
	t-value	-11.804***		
H5b (TU → Use)	Path-Coefficient	0.402	0.329	Adoption (Higher in sync group)
	Standard Error	0.127	0.094	
	Number of Sample	155	76	
	t-value	4.487***		
H5c (SIF → Use)	Path-Coefficient	0.258	0.145	Adoption (Higher in sync group)
	Standard Error	0.113	0.100	
	Number of Sample	155	76	
	t-value	7.434***		
H5d (Use → KC)	Path-Coefficient	0.533	0.436	Adoption (Higher in sync group)
	Standard Error	0.088	0.084	
	Number of Sample	155	76	
	t-value	7.974***		

Note) 1: Sync = Synchronicity group, Async = Asynchronicity group.
2: TC = Task Complexity, TU = Task Urgency, SIF = Social Influence, Use = Use of Information and Communications Technologies, KC = Knowledge Creation.

extant media literature. First, a comprehensive model of ICT usage in organizations is developed by synthesizing media theories related to MRT. Our results showed that task urgency and social influence are positively related to ICT usage. Contrary to expectations, however, task complexity was not a significant determinant to ICT usage. Moreover, as hypothesized, there is a significant positive relationship between ICT usage and knowledge creation.

Second, based on MST, this study identifies differences in both synchronous group and asynchronous group. Our results also show that different levels of synchronicity preference will produce significant moderation effects on the relationship between three antecedents and the use of ICT as well as on the relationship between the use of ICT and knowledge creation.

Specifically, while synchronicity group resulted in stronger associations between task urgency and social influence with the use of ICT but weaker association of task complexity with the use of ICT, asynchronicity group demonstrated weaker relationships between both task urgency and social influence and the use of ICT but stronger relationship between task complexity and the use of ICT. Also while synchronicity group resulted in stronger association between the use of ICT with knowledge creation, asynchronicity group showed weaker relationship between the use of ICT and knowledge creation. These results imply that users

with synchronicity preference may use ICT to communicate with their partners more than users with asynchronicity preference if their task is urgent. Also, our results show that users with synchronicity preference may use a specific ICT which their partners use to communicate with their partners more than users with asynchronicity preference. However, users with synchronicity preference may use ICT to communicate with their partners less than users with asynchronicity preference if their task is complex. When their task is complex, they need more time to reflect how to solve the problem. Thus, users will select an asynchronous media to solve their task if it is a complex problem.

In conclusion, this study attempted to determine the manner in which task characteristics are related with the usage of appropriate ICT for knowledge creation. The development of ICT has affected profoundly the way people interact and communicate with others [Monge and Contractor, 2003]. Thus, an organization should match a variety of task characteristics and the types of ICT considering media synchronicity. We suggest that ICT designers and developers should engage in discussions as to how people can utilize ICT most appropriately with an aim to assist organizational managers to connect organizational processes, via linkages using point-to-point personal communication systems. This practice should enable organizations to more appropriately create knowledge for organizational purposes. Another important aspect is the selection of ICT, which may be influenced by senior or junior relationships or by close friendships. Social factors suggest very unique ways to determine the use of ICT. Not only public but also private relationships are central to the process of generating new ideas or solving problems. In sum, technology is more than the product of human actions; it is constructed by actors via the different meanings they attach to it and its various features they emphasize and use.

Despite significant implications and contribution of this study, this study is not free of limitations which can indicate possible directions for further research. First, as our sample consisted of only 231 respondents, a longitudinal study with a larger sample will be necessary to validate and improve the research model. Second, the results of this study are characteristic of only a single country, Korea. To increase the external validity of these results, future research should include more samples from multiple countries. Third, we used the characteristics of preferred communications media as a major proxy for media synchronicity, since MRT suggests the media synchronicity of these media. However, more particular measures about media synchronicity considering the exact concept of Dennis *et al*. [2008] can improve the results. It would be, therefore, fruitful if future research takes this limitation into consideration when designing a research plan. Finally, since the various types of knowledge might be dispersed over various locations, this alteration would also moderate the task and ICT usage characteristics. If these factors are taken into consideration in future research, our understanding of task characteristics and ICT usage will clearly be enhanced.

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