



Knowledge Creation and Sharing in Telework

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INTRODUCTION

We are witnessing the emergence of more distributed organizational structures, thanks to the advancement in information and communication technologies (or ICTs). The concept of telework in which people work away from the home office in various set-ups has received a great deal of attention in the business world, especially among knowledge workers. Given that knowledge has become the driving force of the new society, effective facilitation of knowledge creation and sharing among distributed entities could be instrumental for the success of a telework program and for improved teleworker productivity (Jarvenpaa and Ives, 1994). Despite the imperative, there has been a lack of attention on investigating knowledge management issues from the perspective of telework.

The objective of this research was to conduct an exploratory investigation of factors that are expected to significantly affect the dynamics of knowledge creation and sharing among teleworkers. Draw on the SECI model (Nonaka, 1994) that theoretically explains the reproductive process of organizational knowledge, we analyzed how telework caused changes in the social and task relationships, accessibility of organizational knowledge, and the usage of electronic media as a knowledge-sharing channel. For this, related data were gathered from teleworkers in Japan through interviews and a survey questionnaire. Empirical findings and their corresponding implications are discussed from the perspective of distributive knowledge creation and sharing.

THEORY

The SECI model (Nonaka, 1994) offered a conceptual basis that related the studied dimensions to the knowledge creation and sharing process by teleworkers. According to the model, the formation of knowledge involves spiraling interactions between explicit and tacit knowledge, through which four self-transcendence processes of *socialization*, *externalization*, *combination*, and *internalization* are implicated. In short, the underpinning of the SECI model is depicting the conversion between tacit knowledge and explicit knowledge through the social mechanisms. It explains organizational knowledge creation and sharing through the management of knowledge transfer from an individual dimension to an organizational dimension.

According to Nonaka and Konno (1998), knowledge is embedded in *Ba*, where knowledge is acquired through individual experiences or reflections on the experience of others. It is an abstract platform or shared space created to advance individual and collective knowledge in each stage of *socialization*, *externalization*, *combination*, and *internalization*. As an abstract space for promoting organizational communication, four *Bas* were introduced, one *Ba* for each stage. Among them, we believe that *originating Ba* for *socialization*, *interacting Ba* for *externalization*, and *cyber Ba* for *combination* offer a theoretical relevance to the studied dimensions.

In brief, *originating Ba* promotes socialization in a world where individuals share feeling, emotions, experiences, and mental models and is the primary *Ba* from which the knowledge creation process arises.

Interacting Ba is the shared space where tacit knowledge is made explicit and thus supports the externalization process. *Cyber Ba* is a space that supports the combination phase of knowledge conversion. This is where explicit knowledge is further transformed into more complicated knowledge sets.

RESEARCH METHODOLOGY

Survey Design

A survey was designed to study (1) Telework impacts on *social and work relationships*; (2) Teleworkers' view regarding the *accessibility to knowledge*; and (3) Teleworkers' perception regarding the *usage of communication media*. In addition to the three categories of question items, the survey included question items regarding demographics, telework mode (i.e., mobile work, telecommuting) and experience, teleworking frequency, and the role of ICT support.

Survey items that adopted a seven-point Likert-scale response format were developed after an extensive literature review and thorough scrutiny by co-authors. Pre-testing of survey items was conducted to identify any constructional defects. The instrument was then validated in accordance with the procedure recommended by Straub (1989). Lastly, it was presented to industry practitioners for review and their suggestions were incorporated into the final version.

Data Collection

Survey data were collected from teleworkers of twelve companies in Japan with a sizable telework program in place. Copies of the questionnaire were mailed to telework coordinators of those organizations and they distributed the questionnaire to teleworkers. Participants could return the completed survey either to their coordinator or directly to us. In addition, the questionnaire was posted on the web and coordinators were asked to distribute the URL among teleworkers who preferred to respond through the web. With the indirect distribution of survey questionnaires through telework coordinators and additional usage of the web as a feedback channel, the response rate was not measured, potentially constituting a weakness of this research.

A total of 58 teleworkers returned the completed surveys. Most of the participants were male (84%); only 9 were female (16%). Among the respondents, the majority held an information-system related job (64%), followed by research and development (12.5%) and finance and accounting (9%). This job distribution indicated that surveyed people were mostly professionals undertaking knowledge intensive tasks. The majority of respondents were either mobile workers or telecommuters.

DATA ANALYSIS

Changes in social and work relationships: The interpretation of average values based on a seven point Likert scale is subjective in nature. Therefore, we applied the following heuristics to maintain consistency in the interpretation and discussion of statistical results: strongly dis-

Table 1. Summary of descriptive statistics

	Items	Mean	SD
ICT Support & productivity increase	Q6	4.96	2.00
	Q7	4.83	2.21
	Q14(R)	3.47	2.06
Social interactions with			
Outsiders increase	Q10	4.29	1.78
Co-workers decrease	Q12	4.02	1.70
Opportunity for knowledge & experience from			
Work independence	Q9	4.30	1.80
Social interactions with outsiders	Q11	3.92	1.87
	Q15(R)	3.79	2.37
Opportunity for knowledge & experience from			
Social interactions with co-workers	Q13	4.23	1.44
Opportunity for work independence			
Telework	Q8	4.32	1.94
Central office	Q16(R)	3.38	1.72

* (R) stands for "reversed question"

agree (1), disagree (2), somewhat disagree (3), undecided (4), somewhat agree (5), agree (6), and strongly agree (7).

Data analysis confirmed that ICT support had a significant role in increasing telework productivity and job performance (see Table 1). Teleworkers weakly agreed (Q10) that telework increased opportunities for personal interactions with non-corporate people. The Pearson correlation coefficient, 0.571, showed a strong positive association between the number of telework days and opportunities for external interactions. In the meantime, teleworkers were neutral regarding the effect that telework had on social interactions with co-workers (Q12).

Telework tends to result in higher work independence than central work (Q8 & Q16) and this higher work independence may lead to the enhancement of domain knowledge and experience (Q9). In the meantime, it was also acknowledged that decreased social contacts with co-workers could somewhat negatively affect the opportunity for knowledge sharing (Q13). The increase in social interactions with outsiders, however, was not regarded as crucial in improving teleworkers' domain knowledge (Q11 and Q15).

Accessibility to knowledge: In this part of the survey, telework and central work were compared in terms of perceived convenience in accessing knowledge of different levels of implicitity. To do so, we borrowed the taxonomy of organizational knowledge Wijayanayake (2000) introduced based on Wijnhoven's (1999) and Bohn's (1994) works. The scheme ranked organizational knowledge into eight levels from *simple data transfer* to *highly specialized and tacit knowledge transfer* depending on the difficulty of codification.

In our study, rather than utilizing the Wijayanayake's (2000) scheme as it is, we validated its integrity by asking teleworkers to rank the items in terms of their perceived knowledge complexity (survey items from 25i to 25viii). Here, we used knowledge complexity interchangeably with its codification difficulty and therefore its implicitity (Wijayanayake, 2000). As the data took the form of ranking and the normality assumption would be almost certainly violated, non-parametric statistics were used to compare the mean values. In the first, Friedman ranking test statistics (Chi-square= 233; df=27; Sig.=00) indicated the rejection of the null hypothesis, H_0 : Mean values of 25i, 25ii, ..., and 25viii are all equal, confirming a significant difference among them. Then, each pair of neighboring values was compared by the Wilcoxon Rank test. The results mostly confirmed Wijayanayake's (2000) taxonomy. Teleworkers, however, did not differentiate between level 1 and level 2 ($Z=0.77$ and $P=0.44$). Thus, original values for level 1 and level 2 were collapsed in the new seven-layer scheme.

Then, a comparison was made between telework and central work in terms of knowledge accessibility at each level (Table 2). The statistics indicate that teleworkers didn't recognize the difference between centralized and distributed work arrangements in accessing highly explicit forms of knowledge (level 1) such as "data required for work" and "the method of identifying simple problems encountered in a job." However, when the knowledge implicitity falls between level 2 and level 6, they perceived better accessibility in the centralized work. In the meantime,

Table 2. Information/Knowledge Accessibility: Pair-wise t-tests

New knowledge Complexity level	Mean values			t-stat.	df.	Sig. (2-tailed)
	Telework	Central work				
1	5.74(1.35)	5.84(1.29)		-76	57	.44
2	4.79(1.75)	5.51(1.37)		-4.67	56	.00*
3	5.10(1.41)	5.55(1.07)		-2.71	57	.00*
4	4.34(1.23)	5.09(1.27)		-5.20	57	.00*
5	4.07(1.37)	4.88(1.15)		-4.78	56	.00*
6	3.68(1.57)	4.74(1.26)		-6.02	57	.00*
7	3.88(1.85)	3.86(1.82)		.04	57	.96

there was no significant difference between two work modes when there is a need to acquire *non-theorized knowledge required for highly specialized jobs* (level 7).

Communication media usage: Table 3 summarizes three communication media chosen to acquire different types of knowledge. In interpreting the table, "email > DB&KB > Tel", as an example, indicates the order of preference being email statistically the highest in the mean value followed by DB&KB. As another example, "email > DB&KB = Tel" indicates the same preference sequence as the first case, but the mean values of DB&KB and Tel are not statistically different.

The summary reveals associative patterns between media use and the mode of work. In telework, email was the premier medium for exchanging various types of knowledge, except the last category where telephone usage was slightly higher than email usage without a statistical significance. It is also recognized that telephone usage in telework rose consistently as the difficulty of knowledge codification increased. The preference for telephone surpassed that of DB&KB from the third level. Besides, although gradually increased with the knowledge level, FTF usage was understandably never higher than that of telephone in telework.

In the non-telework environment, DB&KB and email were preferred when the exchanged knowledge stayed at the lower level (level 1 and 2). FTF, however, took over DB&KB and email as the medium of choice when the transferred knowledge reached the 3rd level and thereafter. Telephone usage expanded as well and, from the 5th level, replaced email as a preferred medium. Overall, heavy usage of email in telework even for the exchange of highly implicit knowledge and much reliance on face-to-face interactions in central work even for the exchange of less implicit knowledge was prevalent.

DISCUSSIONS

Data analysis indicated that in general the degree of social interactions with co-workers due to telework was not significantly affected, despite the expected decrease in fact-to-face contacts with them. Nevertheless, it was also recognized that decreased personal contacts could negatively affect tacit knowledge sharing among teleworkers. Maintaining the same degree of interactivity with co-workers without necessarily having much personal contact may hurt effective tacit knowledge sharing among distributed workers (Nonaka and Konno, 1998). In the meantime, telework appears to result in more social interactions with outsiders, although the interactions may have less impact on teleworkers' knowledge enhancement than do those with co-workers.

Table 3. Media usage in knowledge exchange

Knowledge Complexity levels	Telework	Central Work
1	email > DB&KB > Tel	DB&KB = email > FTF
2	email > DB&KB = Tel	email = FTF = DB&KB
3	email = Tel > DB&KB	FTF = email > Tel
4	email = Tel > DB&KB	FTF = email = Tel
5	email = Tel > FTF	FTF > Tel > email
6	email = Tel > FTF	FTF > Tel = email
7	Tel = email > FTF	FTF > Tel = email

* Tel: telephone, DB&KB: database & knowledge base, FTF: face-to-face

Higher work independence as a result of telework may positively contribute to the enhancement of workers' knowledge as indicated by Nonaka's (1994) argument on the positive role of autonomy on knowledge enhancement. This association between autonomy and knowledge advancement may be partially the result of work enlargement and augmented job responsibility telework demands (Shin *et al.*, 2000). Teleworkers also have to confront and solve problems alone when there is no helping hand and this may create more opportunities for them to absorb existing knowledge and to form new knowledge.

Teleworkers didn't see that the geographical distribution was a significant barrier in sharing either highly explicit or highly implicit knowledge. We reason that highly explicit knowledge can be relatively easily codified and therefore can be shared through ubiquitous networks. This reasoning was supported by the patterns of media usage for exchanging more explicit knowledge (see Table 3), in which the use of lean media, including email, database, and knowledge base, was preferred in both telework and central work. In the meantime, data analysis also indicates that the geographical distribution does not constitute a dividing factor anymore in acquiring highly implicit knowledge. This may become an indication that such an advanced form of tacit knowledge is hard to be conversed, and may require repeated and prolonged social interactions and engagements. When the knowledge falls between level 2 and level 6, its accessibility was perceived better in centralized work, highlighting the importance of research to enable better knowledge creation and sharing in the virtual space.

The summary of media choice (see Table 3) reveals that there was a heavy usage of email in telework even for the exchange of highly tacit knowledge and much reliance on FTF in central work even for the exchange of relatively explicit knowledge. We may interpret this media usage from two completely different perspectives. On the one hand, this usage pattern may support the subjective notion of media richness contingent on social and situational contexts and the manner in which they are utilized (Fulk *et al.*, 1987). According to the theory, the use of media in enhanced (or richer) mode may complement the lost personal contacts. On the other hand, increased usage of electronic media due to spatial separation may be the consequence of "forced" adoption despite the media's incapacity to effectively exchange tacit knowledge. The relative inconvenience of telework in obtaining tacit knowledge shown in Table 2 may support this reasoning. Overall, the synthesis of data analysis appears to indicate that telework has resulted in the upgrade of the effectiveness of knowledge codification via electronic media and also the loss of accessibility to advanced tacit knowledge.

CONCLUSIONS

Although telework is increasingly becoming an important form of virtual process arrangement for the emerging knowledge society, knowl-

edge management from such a distributive circumstance has been rarely examined. As one of the early investigations, we attempted to explore three research issues: changes in social and task relationships, accessibility of organizational knowledge, and the usage of electronic media in telework. Our study indicates that these issues have important ramifications in knowledge management and therefore should be closely examined to design an effective strategy for knowledge creation and sharing applicable to a telework program. We envision that, when truly intelligent ICTs become available and corporate processes for knowledge management activities are in place, centralized work may not necessarily be an ideal setup in creating knowledge and archiving it as organizational memory because excessive personal contacts may paradoxically limit opportunities for automated knowledge capturing, explication and organization via electronic media. Achieving this, however, demands two challenging but complementary lines of research be undertaken: the improvement of ICT intelligence and functionality; and the accumulation of soft know-how on organizational processes for effective knowledge management.

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