KNOWLEDGE TRANSFER THROUGH COMMUNITIES OF PRACTICE: DIFFUSION OF NEW TECHNOLOGY IN THE INTERNATIONAL CIVIL AVIATION DOMAIN

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Abstract- Organizations learn when individual members learn. Among the various ways of individual learning, communities of practice play an important role. As a result, communities of practice enhance knowledge transfer—one mode of organizational learning. However, there is a paucity of quantitative analysis on communities of practice. This study therefore analyzed the effect of communities of practice associated with international meetings in the civil aviation domain on knowledge transfer between organizations. This was accomplished through a questionnaire survey and structural equation modeling (SEM). The results statistically supported the assertion made by previous studies that communities of practice enhance knowledge transfer. Moreover, it was found that communities of practice mediate the influence of other factors on knowledge transfer. That is, the protectiveness of the organization to which participants belong has a negative impact, and the unambiguity of meeting objectives and their orientation toward the public interests have a positive impact on the efficacy of communities of practice and on knowledge transfer.

Keywords- Community of Practice, Knowledge Transfer, Organizational Learning, Platform

I. INTRODUCTION

In modern business, one of the most important resources is knowledge, which enables organizations to generate competitive advantage [1] [2]. Therefore, companies need to acquire useful knowledge continuously. Organizations learn through their member individuals [3]. Therefore, when studying knowledge transfer, it is important to analyze the relationship between individual learning and organizational learning. Considering the fact that a community of practice (CoP) [4] plays an important role in individual learning, it is also important for knowledge transfer. However, there is a paucity in empirical research, especially quantitative analysis, on the effect of a CoP on knowledge transfer. This study quantitatively analyzes the effect of a CoP on knowledge transfer. The next section begins with a review of previous studies about knowledge transfer and related concepts. Then, details relating to the data collection and the analysis method, as well as the result, are presented. Finally, results of the study are discussed.

II. PREVIOUS STUDIES

As an introduction to our research, this section starts with a literature review on the mechanism of knowledge transfer. Then, CoPs and platforms, which play important roles in knowledge transfer, are discussed.

2.1. Mechanism of Knowledge Transfer

Knowledge transfer is defined as "the process through which organizational actors – teams, units, or organizations – exchange, receive and are influenced by the experience and knowledge of others" [5] (pp. 832). Knowledge transfer comprises several components such as source, recipient, channel, knowledge, outcome, routine, and context [6]. Characteristics of each component and of the external context influence the effectiveness and the efficiency of knowledge transfer. Such components include motivation by source and recipient organizations ([6]-[8]), relationship between source and recipient ([9], [10]), and channel [11]. However, the entire mechanism of knowledge transfer should be analyzed further.

2.2. Community of Practice ad Knowledge Transfer

Organizations learn when their individual members learn [3]. Therefore, studying knowledge transfer requires an analysis of the relationship between individual learning and organizational learning.

A CoP [4] plays important role in individual learning. A CoP is defined as "a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" ([12] pp. 4). In the case of a "cross-border" CoP, which consists of members belonging to different organizations, members who share common interests transfer knowledge from one organization to another through continuous interaction. Previous research also implies that a CoP enhances knowledge transfer [13]. However, there is a paucity of research on the relationship between CoPs and knowledge transfer. The number of quantitative analyses on CoPs are also very limited [14].

2.3. Platform

Knowledge is transferred not only through an individual tie between a source and a recipient, but also among multiple organizations at opportunities where many organizations meet together, such as

seminars and conferences. In addition, these opportunities outside of organizations facilitate the establishment of relationships between organizations. Such social instruments like meetings are sometimes referred to as social platforms. A social platform is defined as a "place or system that creates outcome and value through participation, communication, interaction and mutual influence by multiple actors" [15]. Another concept related to social platform is "ba." "Ba" is a relationship among actors, based on physical, imaginary, and mental places, which acts as a shared context or a platform for creation and storage of knowledge [16]. In other words, "ba" is a relationship developed on a social platform especially related to knowledge creation. For knowledge creation, "ba" should be self-organized with its own original intention, objectives, direction, mission, etc. [17]. Effective "ba" also involves commitment by participants, direct experiences by participants, an open border to outside, a mixture of different participant backgrounds, and impromptu interactions [17]. Therefore, social platforms and "ba" contribute to knowledge transfer by connecting actors. However, there is a paucity of quantitative analysis concerning the effects of platforms and "ba" on knowledge transfer.

III. OBJECTIVES

Considering the discussion above, two objectives are established as follows. First, the effect of a CoP, especially a "crossborder" CoP, on knowledge transfer is analyzed. That is, the relationship between the activeness of CoPs associated with platforms and the efficacy of knowledge transfer occurring in these CoPs is analyzed quantitatively. Second, the factors that activate CoPs are analyzed. Here, it is hypothesized that the factors found to be effective on knowledge transfer by previous studies also contribute to knowledge transfer through activating CoP, and this hypothesis is tested quantitatively.

Task characteristics, organizational characteristics, and platform characteristics are hypothesized to encourage development of CoPs. Among task characteristics, dependence on border crossing and task variability are selected and included in the model. Among organizational characteristics, that is, the characteristics of organizations that CoP members belong to, protectiveness is selected. Among platform characteristics, that is, the characteristics of platforms that CoPs are based on, clarity of objectives and orientation to public interest are selected. Details of each constructs and selection criteria are discussed in section 4.2.

IV. METHOD

4.1. Research Site

One form of social platform that facilitates knowledge transfer is a meeting comprised of employees from different organizations [18]. In this study, data are collected concerning international and domestic meetings in Japan in the civil aviation domain. Each meeting aims to develop directions and/or rules regarding the development and implementation of new aviation technology and to share knowledge. These meetings fit the definition of social platform as set out by Shikida et al. [15] above, as various participants create the rules for the implementation of new technology, etc. In addition, a group naturally formed by the participants of these meetings meets the definition of a CoP [12] for sharing their interests and continuous interaction. Considering their objectives, the meetings are suitable for data collection on knowledge transfer concerning new technologies. In addition, preliminary research has found that members of the civil aviation CoPs share knowledge on new technology for aircraft operation and related information, as well as knowledge needed for the application to use new technologies, during breaks and after the meeting, off-line or via e-mail. Hence, these meetings are also suitable for data collection on knowledge transfer through CoP.

4.2. Theoretical Model

Each hypothesis is based on a prediction that knowledge concerning new technology is transferred through CoPs associated with meetings. That is, the factors enhancing knowledge transfer activate CoPs, which further contribute to knowledge transfer. The hypotheses are tested by structural equation modeling (SEM) (Fig. 1).

4.2.1. Community of Practice and Knowledge Transfer

A CoP is important for individual learning and organizations learn through individuals. Hence, a CoP should be important for organizational learning. It is predicted that the more active a CoP is, the more effectively knowledge is transferred.

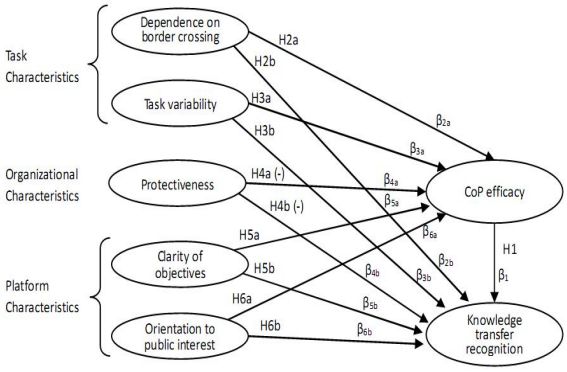


Fig. 1. Theoretical Model

However, generating a metric directly measuring the activeness of a CoP is difficult. Instead, CoP efficacy, the extent to which individual CoP members feel the relationships in the CoP are effective, is applied. CoP efficacy is high when individuals feel that they have established friendly and tight relationship with other participants. Similarly, the extent of knowledge

transfer should directly be measured by the volume or the outcome of knowledge transferred. However, due to difficulty measuring knowledge transfer, previous studies have applied proxy variables that measure subjective perception (e.g. [19]-[21]). Especially in this study, it is difficult to apply a single metric for the outcome of knowledge transfer, as different types of organizations are involved, such as private companies, government bodies, and international organizations. Therefore, knowledge transfer recognition, the extent to which individuals feel that knowledge transferred is important for their job, is measured. Knowledge transfer recognition is high when individuals feel that the knowledge transferred is important for their job. Therefore, H1 is established as follows: Hypothesis 1 (H1): CoP efficacy is positively related to knowledge transfer recognition.

4.2.2. Task

Among task characteristics, dependence on border crossing and task variability are examined in the study. Dependence on border crossing refers to the extent to which the execution of an organizational task depends on the knowledge acquired from outside and is included in the model due to the importance of border crossing on experiential learning [22]. On the other hand, as knowledge becomes obsolete quickly in modern business [23], organizations must continuously acquire more and new knowledge from outside. As such, it is deemed that the variability of tasks would influence the activeness of knowledge transfer for each task. Dependence on border crossing. It has been found that specialists working in organizations tend to seek knowledge through an external network, as it is difficult to find necessary knowledge inside of the organization. Similarly, at the organizational level, the more organizations depend on knowledge acquired from outside, the greater the motivation for knowledge transfer is [10]. Considering this, it is expected that the individuals in charge of a task with high dependence on border crossing would tend to acquire knowledge through participation in cross-border meetings (H2b). Here, based on the viewpoint that knowledge is transferred through a CoP, H2a is also established as a
part of H2b: Hypothesis 2a (H2a): Task's dependence on border crossing is positively related to CoP efficacy. Hypothesis 2b (H2b): Task's dependence on border crossing is positively related to knowledge
transfer recognition.

Task variability. Knowledge flows into and out of organizations through a gatekeeper who acts as a focal point. The more rapidly the knowledge and the technology required for the task change, the more gatekeepers organizations require [21]. Here, assuming that organizations behave to increase the number of gateways to its outside environment, high task variability would also encourage its members to
acquire knowledge through participating in crossborder CoPs (H3a). In addition, H3b concerns the direct effect that task variability has on knowledge transfer. Hypothesis 3a (H3a): Task variability is positively related to CoP efficacy. Hypothesis 3b (H3b): Task variability is positively related to knowledge transfer recognition.

4.2.3. Organizations

Among organizational characteristics, protectiveness, that is, the extent to which organizations intend to restrict the disclosure of their knowledge to the outside is selected for study. In the modern business world, information security is a focus for many organizations. However, excessive security measures may prevent knowledge transfer. Protectiveness of organizations may influence knowledge transfer as follows. Economic incentive is one of the factors that enhance knowledge transfer [7]. Here, as it is predicted that negative incentive toward knowledge disclosure will increase knowledge protectiveness, the rotectiveness will negatively influences knowledge transfer (H4a). On the other hand, for a CoP to be effective, a favorable and mutually beneficial connection must be established between its members, where they willingly present their knowledge. High protectiveness of the CoP members' organizations will prevent the establishment of such connections, with negative impact on the CoP efficacy (H4b).

Hypothesis 4a (H4a): Protectiveness of organizations is negatively related to CoP efficacy.Hypothesis 4b (H4b): Protectiveness of organizations is negatively related to knowledge transfer recognition.

4.2.4. Platform

Among platform characteristics, clarity of objectives and orientation to public interest are selected for examination. Clarity of objectives refers to the extent to which the platforms (meetings) have clear objectives, which are understood by their participants. As it would be relatively easy for administrators of
meetings to set their objectives, it is expected that analyzing this factor would lead to a useful practical
implication. Orientation to public interest refers to the extent to which the activities and the objectives of the platforms promote the public interest of general society outside of the platform. Orientation to public
interest was selected because it is a key criterion that distinguishes between "for-profit" platforms such as a shopping mall on the internet and public platforms like meetings in the civil aviation domain.

Clarity of objectives. Clear objectives are one of the most important conditions for effective "ba"
[17]. Clear objectives will activate the "ba" by leading participants in an appropriate direction. Stimulating
interaction by participants and adequate control by the organizer are also important keys for an effective
platform [24]. Clear objectives will make a platform more effective by improving interaction and by
facilitating organizer moderation. In addition, if the platform is activated by sharing clear objectives, the
associated CoP will become more effective (H5a), and, then, the knowledge transfer will be enhanced

(H5b). Hypothesis 5a (H5a): Clarity of objectives positively correlates with CoP efficacy. Hypothesis 5b (H5b): Clarity of objectives positively correlates with knowledge transfer recognition. Orientation to public interest. "Ba" must have its own original intention, objectives, direction, and mission to contribute to knowledge creation [17]. If a "ba" is oriented to public interest, then the conditions above are likely to be met and knowledge transfer will be facilitated (H6b). Here, based on the viewpoint that knowledge is transferred through CoPs, H6a is also established as a part of H6b. Hypothesis 6a (H6a): Orientation to public interest is positively related to CoP efficacy. Hypothesis 6b (H6b): Orientation to public interest is positively related to knowledge transfer recognition.

4.3. Sample

The population for this study consists of organizations that send their employees to meetings related to the implementation of new technology in the civil aviation domain. Such organizations include regulators, aircraft operators (including airlines), air navigation service providers (air traffic control organizations), and manufacturers. They are in the form of public corporations, not-for-profit organizations, or for-profit private companies. Eight platforms (meetings) were selected and questionnaires were sent to 366 participants. The number of complete responses collected and deemed usable is 121 (response rate 33.1%). Respondents reside in 20 countries.

4.4. Constructs and Questionnaire

Items in the questionnaire were developed as follows. Items for CoP efficacy were developed as questions regarding the relationship with other CoP members, Items developed by Pérez-Nordtvedt et al. [10] on relationship with counterparts of knowledge transfer were referred to (4 items, $\alpha = .76$). Items for knowledge transfer recognition were developed referring to "technical exchange" construct [9], with modification to fit with the context of this research (3 items, $\alpha = .66$). Items for dependence on border crossing were developed with reference to knowledge "rareness" [10], assuming that organization would depend on sources outside to obtain knowledge which is rare in the organization itself (3 items, $\alpha = .66$). Items for task variability were developed with reference to "project task environment" construct [21] (3 items, $\alpha = .75$). Items for protectiveness were developed referring to the "partner protectiveness" construct [8], with modification to fit with the context of this research (3 items, $\alpha = .83$). Items for clarity of objectives were developed with reference to knowledge "ambiguity" construct [8] (3 items, $\alpha = .87$). Items for orientation to public interest were developed referring to the "knowledge usefulness" construct [10], with modification to measure the extent to which the activities and objectives of platforms promote the public interests (2 items, $\alpha = .77$). All items followed 5-point Likert-type scales.

4.5. Analysis

Based on the collected responses, relationships between constructs were analyzed using AMOS, a software tool for structural equation modeling (SEM). The unit of analysis is individual participants in platforms. That is, recognition by individuals concerning the outer environment, the platform, and their organizations are measured.

V. RESULTS

5.1. Explanatory power of the model

Concerning Cronbach's α for the constructs, the values for knowledge transfer recognition and dependence on border crossing are relatively low (.66 each). However, the values for other measures are more than .70, which is deemed acceptable. As indices for level of fitness, the following values are obtained: GFI = .843, CFI = .921 and RMSEA = .058. In many previous studies, validity is confirmed when GFI > .90 and CFI > .90, and a study is considered invalid if RMSEA > 0.10. Here, it is determined that the model of this study is acceptable as CFI (.921) meets the criteria for a valid model and RMSEA (.058) does not meet the criteria for an "invalid" model.

5.2. Test of Hypothesis

Standardized pass coefficients obtained are as displayed in Table 1 below.

Table 1: Standardized pass coefficients

Independent Variable	Dependent Variable: CoP efficacy	Dependent Variable: Knowledge transfer recognition
CoP efficacy	—	β_1: **.42***
Dependence on border crossing	β_{2a}: .14	β_{2b}: .12
Task variability	β_{3a}: .18	β_{3b}: **.26***
Protectiveness	β_{4a}: **−.27****	β_{4b}: .14
Clarity of objectives	β_{5a}: **.56*****	β_{5b}: .22
Orientation to public interest	β_{6a}: **.25***	β_{6b}: .01

N=121, * p < .05, ** p < .01, *** p < .001

Notably, CoP efficacy has a significant positive effect on knowledge transfer recognition in support of H1 ($\beta1 = .42$, $p < .05$). That is, a greater level of CoP efficacy leads to a greater knowledge transfer recognition. No significant effect by dependence on border crossing was found on CoP efficacy ($\beta2a = .14$, $p > .05$) or knowledge transfer recognition ($\beta2b = .12$, $p > .05$), in rejection of H2a and H2b. The effect of task variability on CoP efficacy was not significant ($\beta3a = .18$, $p > .05$), but its direct effect on knowledge transfer recognition was significant ($\beta3b = .26$, $p < .05$). H3b was supported and H3a was rejected. This implies that the task variability positively impacts knowledge transfer recognition directly, not through CoP efficacy. A strong significant negative effect of

protectiveness on CoP efficacy was found (β4a = −.27,
p < .01), in support of H4a. The direct effect of protectiveness on knowledge transfer recognition was not significant (β4b = .14, p > .05), in rejection of H4b. Combining these results, the negative influence of
protectiveness on knowledge transfer seems to be through reduction of CoP efficacy. The effect of clarity of objectives on CoP efficacy was positive and quite strong (β5a = .56, p < .001), in support of H5a. On the other hand, its direct effect on knowledge transfer recognition was not significant (β5b = .22, p > .05), in rejection of H5b. Hence, the positive influence of clarity of objectives on knowledge transfer seems to be through the increase of CoP efficacy. Similarly, the positive effect of orientation to public interest on CoP efficacy was significant (β6a = .25, p < .05), in support of H6a, while its direct effect on knowledge transfer recognition was not significant (β6b = .01, p > .05), in rejection of H6b. Therefore, the positive influence of orientation to public interest on knowledge transfer seems to be through the increase of CoP efficacy.

DISCUSSION

First, the results support the significant positive effect of CoP efficacy on knowledge transfer recognition. The more effective the relationship among members of CoPs associated with platforms is, the more effective knowledge transfer between organizations becomes. This is an empirical verification of Roberts' claim that a CoP enhances knowledge transfer [13]. It is interpreted that the effective relationship among members will, by increasing the frequency of interaction and willingness for knowledge transfer, encourage them to disclose their knowledge and increase the total amount of knowledge transferred. It was found that task variability influences knowledge transfer recognition directly, without influencing CoP efficacy. This result does not support the explanation by Tushman [21] that task variability activates cross-border interaction. It was found that protectiveness negatively influences knowledge transfer recognition via CoP efficacy. In other words, its negative impact on knowledge transfer was mediated by reducing CoP efficacy. This finding explains the assertion by Simonin [8] that organizational protectiveness prevents knowledge transfer. The effect of clarity of objectives on CoP efficacy was positive and quite strong. This supports the assertion by Toyama and Nonaka [17] that effective "ba" should have clear objectives. Clear objectives will encourage interaction by members and allow the organizer to establish a course towards the goal [24]. On the other hand, the fact that its direct effect on knowledge transfer recognition was not significant indicates that it influences knowledge transfer by increasing CoP efficacy. Similarly, a positive effect of orientation to public interest on CoP efficacy was found. If a platform is oriented to public interests, this attitude will encourage participants to share the same direction, objectives and mission, satisfying the condition for effective "ba" (sharing original intention, objectives, direction and mission) [17].

CONCLUSION

This study examined the effect of a CoP on knowledge transfer between organizations, as well as the effects of characteristics of task (dependence on border crossing and task variability), organizations (protectiveness) and platform (clarity of objectives and orientation to public interest). Theoretical and practical implications, as well as the limitation of this study, follow.

7.1. Implications

It was found that a CoP facilitates knowledge transfer, which matches what the literature claimed (e.g. [13]). However, the majority of previous studies are anecdotal case studies with a paucity of empirical analysis. This study contributed to the literature by testing their claims empirically using quantitative analysis. The second theoretical contribution is that this study empirically found that CoPs mediate the effect of variable factors on knowledge transfer. It was found that protectiveness negatively influences knowledge transfer recognition via CoP efficacy. This explains the mechanism of the assertion by Simonin [8] that an organization's protectiveness prevents knowledge transfer. An active CoP also mediates the effects of clarity of objectives and orientation to public interest on knowledge transfer. This supplements the explanation of good "ba" by Toyama and Nonaka [17]. As such, this study revealed a part of a mechanism of how knowledge transfer is facilitated by other factors, which were found by previous studies. Practical implications obtained from the findings are as follows. Organizations should facilitate knowledge transfer by encouraging CoPs. For this purpose, they should keep the information security measures at an appropriate level so as not to hamper the activeness of CoPs. In addition, organizers of platforms, for effective knowledge transfer, should make their objectives clear and should emphasize that the platforms contribute to public interests.

7.2. Limitation

First, this study conducted analysis in only one domain, international civil aviation. The role of a CoP may be different in other domains. Conditions through which a CoP plays a role as a mediator of knowledge transfer should be examined further through comparison with other fields. Second, the model's level of fitness is not perfect. GFI (.843) is slightly less than the sufficient level (GFI > .90). RMSEA (.058) falls within a gray zone, as it does not

fit either the valid or invalid requirements. Additional analysis using different data is expected.

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