STRUCTURED KNOWLEDGE MANAGEMENT – USING TEAMSPRIT TO FACILITATE ORGANIZATIONAL LEARNING

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Abstract

Knowledge management is a complicated process that requires close collaboration among the people involved. Such collaboration is often easier said than done. Nonaka and Takeuchi’s SECI model provides a process-oriented view of knowledge creation. In this paper, we propose the use of a Web-based group problem-solving system called TeamSpirit to support knowledge externalization, knowledge combination, and knowledge internalization – three of the four major backbones of the SECI model. Once knowledge has been created, it is critical that there is an intention for knowledge sharing and a capacity for knowledge adoption to facilitate organizational learning. In an empirical study, we found that subjects using TeamSpirit achieved high degrees of knowledge externalization, combination, internalization, as well as a knowledge-sharing intention and knowledge adoption. Possible explanations of the findings are discussed.

Keywords: Knowledge management, Mass collaboration, TeamSpirit, Experimental Method
1 INTRODUCTION

Three significant components of knowledge management are the solicitation of ideas from members of an organization, the assimilation of these ideas, and the creation of new insights. These processes are part of Nonaka et al.’s knowledge-creation model (Ikujiro Nonaka, Ryoko Toyama, & Noboru Konno, 2000). Nonaka and Takeuchi divide knowledge into tacit knowledge and explicit knowledge (Nonaka & Takeuchi, 1995). Tacit knowledge consists partly of technical skills – the kind of informal, hard-to-pin-down abilities captured in the term “know-how.” After years of experience, master craftsmen develop a wealth of expertise. But they are often unable to articulate the scientific or technical principles that underlie what they know. At the same time, tacit knowledge has an important cognitive dimension consisting of models and beliefs. Because explicit knowledge is formal and systematic, it can be easily communicated and shared.

Knowledge is created through the conversion of tacit knowledge into explicit knowledge or vice versa. There are four types of conversions. Socialization involves the sharing of tacit knowledge among individuals. Externalization requires the expression of tacit knowledge and its translation into a comprehensible form that can be understood by others. Combination involves the conversion of different types of explicit knowledge into new explicit knowledge. Finally, internalization of newly created knowledge is the conversion of explicit knowledge into the organization's tacit knowledge (Nonaka & Konno, 1998). Nonaka et al. label their model the SECI model, an acronym of the four conversions.

Knowledge creation requires a platform; Nonaka et al. call theirs ba (Nonaka, Toyama, & Konno, 2000). A ba can be a physical space such as an office, or a virtual space such as email communication.

Although the SECI model has been around for years, applications of knowledge conversion on a ba platform have seldom been reported in the literature. In this paper, we propose a group problem-solving system called TeamSpirit and structured it as a ba for SECI model. We also compare it with other implementations of ba, such as email and face-to-face communication. We also report the results of an empirical study evaluating the performance of these three platforms for knowledge management.

TeamSpirit was originally designed as a web-based GDSS (Group Decision Support System) (Chen, Liou, Wang, Fan, & Chi, 2007a). Although GDSSs have proven to be useful tools for improving performance in virtual meetings (Diehl & Stroebe, 1987; Gallupe et al., 1992; Kay, 1995), little has been done to explore its usefulness in related areas such as knowledge management and innovation. After exploring TeamSpirit’s functionality, we discovered that it can be used to implement the SECI model, for reasons we discuss in Section 3.1.

2 LITERATURE REVIEW

(Content of this section will be provided upon request.)

3 RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

We believe TeamSpirit can be used effectively to support the knowledge conversion tasks described in Nonaka’s SECI model because it facilitates creative group problem-solving and collaboration. In our study, we examined knowledge externalization, knowledge combination, and knowledge internalization in three ba platforms: TeamSpirit, face-to-face, and email. Then, we evaluated whether successful knowledge conversion leads to increases in knowledge adoption and the intention to share knowledge.
Our research model is illustrated in Figure 1. It contains three major stages in our study:

- **Knowledge creation platform:** Here we compared the three types of platforms (TeamSpirit, email, and face-to-face) on their effectiveness.
- **Knowledge conversion:** According to Nonaka et al. (Ikujiro Nonaka, Ryoko Toyama, & Noboru Konno, 2000), knowledge is created through the conversion of tacit and explicit knowledge and vice versa. We applied our three platforms to knowledge externalization, knowledge combination, and knowledge internalization.
- **Knowledge sharing and adoption:** According to Andrews and Delahaye (Andrews & Delahaye, 2000), knowledge creation requires ongoing collaborative learning. Knowledge contribution (sharing one’s knowledge) and knowledge adoption (importing knowledge from another source) have been identified as critical parts of the core organizational learning process for knowledge creation. After the knowledge-conversion processes were completed, we enabled participants to absorb and share their knowledge, thereby creating it (Eriksson & Dickson, 2000).

We provide detailed descriptions of the implementation of each collaboration platform in the following sections.

### 3.1 TeamSpirit

The technical aspects of TeamSpirit have been reviewed extensively by Chen et al. (M. Chen, Liou, Wang, Fan, & Chi, 2007a). However, this paper is focused on its application to knowledge management. The design of the process to support knowledge management using TeamSpirit is illustrated in Figure 2.
This diagram shows that participants in a meeting are assisted by facilitators. Although individuals are physically dispersed in the meeting room, they are connected via the Web. They participate in the activities anonymously, so nobody knows which idea came from whom. The session consists of three stages: brainstorming, evaluation, and multi-aspect decision-making. These stages are employed to construct two mental models. The first involves the ideation process: idea generation, idea consolidation, and idea creation. The second involves the divergence, assimilation, and convergence of the ideas.

In a real world, we assume that people working at different places are interacting and collaborating asynchronously to apply and create knowledge. TeamSpirit implements several features of the Web to facilitate both distributed and asynchronous group activities. How TeamSpirit is used to support knowledge externalization, combination, and internalization is illustrated in Figure 3.
The first group activity for TeamSpirit participants is a structured brainstorming session. In this session, participants generate ideas and learn of other participants’ ideas without knowing which participant generated which one. Because this is a process in which people express their inner thoughts, it is a knowledge externalization process.

The idea generation (brainstorming) stage is followed by the idea consolidation stage, in which similar ideas are merged to avoid duplication. Then, participants rate the consolidated ideas. Because explicit knowledge is merged and selected, this process is knowledge combination.

The ideas are then further evaluated, first using the Multi-Aspect Brainstorming tool and then the Multi-Criterion Evaluation tool. The Multi-Aspect Brainstorming tool allows participants to explore the selected ideas from different aspects. For example, in brainstorming new expansion plans, participants might focus on their strengths, weaknesses, opportunities, and threats (SWOTs). The discussion is then “converged” in these four areas. Finally, participants evaluate each SWOT alternative using the Multi-Criterion Evaluation tool. This can be achieved only if ideas become part of their self-transcendence (internalization).

**Figure 3**  How TeamSpirit Achieves Knowledge Externalization, Combination, and Internalization
3.2 Face-to-face

In these sessions, there is no GDSS to facilitate the participants’ discussions. After they receive the discussion topic, they mull it over and write their ideas on a piece of paper (externalization). The notes are then handed to the group leader, who consolidates the ideas. Next, the organized ideas are written on a white board. Participants vote for the 8 best ideas (combination), which remain on the white board so they can absorb and understand them. They then propose one final idea. As the participants absorb and understand the 8 ideas and propose the final idea, they become part of their self-transcendence (internalization).

3.3 Email

Knowledge conversion during the email sessions is similar to that in the face-to-face sessions. In Nonaka et al.’s original work (Ikuiro Nonaka, Ryoko Toyama, & Noboru Konno, 2000), email and face-to-face were both used for knowledge creation, with email participants assigned as the control group. Although email was not designed as a vehicle for knowledge management, it is nonetheless a communication tool that can be adapted for this purpose. Team members first receive the discussion topic from the team leader, who then articulates their ideas by typing them in as emails. This is knowledge externalization. When the team members have questions, they ask the group leader for answers.

In contrast to TeamSpirit and face-to-face, email allows participants to type in their ideas without being confronted with others’ ideas. This allows them to express their ideas without fear of interruption.

The next step is knowledge combination. The group leader collects all the ideas from the participants and consolidates them. Then, the organized ideas are emailed to the participants for a vote. The ideas that receive the most votes are chosen. In our study, this number was eight.

To internalize the top ideas, the participants collectively agree on one good final idea by absorbing and understanding the eight chosen ideas. This final idea internalizes the ideas of all the participants.

3.4 Hypothesis development

Nonaka et al. (Ikuiro Nonaka, Ryoko Toyama, & Noboru Konno, 2000) have argued that knowledge needs a physical context to be created and ba offers such a context. Comparing our three bas, we hypothesized that different knowledge platforms can achieve different results. Because its component tools can be structured to accommodate knowledge tasks, we expected TeamSpirit to perform better than the other two platforms. Second, because face-to-face communication can avoid misunderstandings and allow ideas to be formulated more clearly, we expected it to perform better than email. This point was strengthened in our minds by Lee’s (H. Lee & Choi, 2003) claim that there is a positive relationship between collaboration and knowledge conversion. Because our three platforms may generate different levels of collaboration, we hypothesized that they differ in the quality of knowledge conversion that they produce.

We thus put forth the following hypotheses:

H1-1: TeamSpirit achieves better knowledge externalization than email.
H1-2: Face-to-face achieves better knowledge externalization than email.
H1-3: TeamSpirit achieves better knowledge externalization than face-to-face.
H2-1: TeamSpirit achieves better knowledge combination than email.
H2-2: Face-to-face achieves better knowledge combination than email.
H2-3: TeamSpirit achieves better knowledge combination than face-to-face.
H3-1: TeamSpirit achieves better knowledge internalization than email.
H3-2: Face-to-face achieves better knowledge internalization than email.
H3-3: TeamSpirit achieves better knowledge internalization than face-to-face.

In addition, we expected all three types of knowledge conversion activities to produce knowledge creation. This expectation is based on several arguments of other authors. First is the claim of Nonaka et al. (Ikujiro Nonaka, Ryoko Toyama, & Noboru Konno, 2000) that an organization creates knowledge by promoting the interaction between explicit knowledge and tacit knowledge. Second is the claim of Yeh et al. (Y. C. Yeh, Yeh, & Chen, 2012) that knowledge creation is facilitated by group discussion and interaction. Third is Andrews and Delhaye’s (Andrews & Delahaye, 2000) claim that knowledge creation depends on knowledge adoption (importing it from another source) and knowledge contribution (sharing it with others) as core organizational learning processes. This led us to choose knowledge-sharing intention and knowledge adoption as the components of our operational definition of knowledge creation in forming H4 and H5.

H4-1: The greater a team’s knowledge externalization, the stronger its knowledge-sharing intention.
H4-2: The greater a team’s knowledge combination, the stronger its knowledge-sharing intention.
H4-3: The greater a team’s knowledge internalization, the stronger its knowledge-sharing intention.
H5-1: The greater a team’s knowledge externalization, the greater its knowledge adoption.
H5-2: The greater a team’s knowledge combination, the greater its knowledge adoption.
H5-3: The greater a team’s knowledge internalization, the greater its knowledge adoption.

4 EXPERIMENTAL DESIGN AND PROCEDURE

We adopted a $3 \times 2$ mixed factorial design for the experiment. The between-subjects factor was knowledge platform (TeamSpirit, face-to-face, and email). The within-subjects factor was measurement time (pre-test, post-test). Before the platform task was introduced, participants in all three groups filled out a pre-test questionnaire that asked about their past experience with email collaboration. After the task, they were asked to fill out a post-test questionnaire that asked about the experience with the task.

The participants were 90 MBA students from a prominent Taiwan university who were divided into nine teams of ten members each. Each platform task was given to three teams.

For each group, the task was to read the following news piece and create knowledge items from it:

Following the popularity of smartphones, instant messenger systems such as LINE, WeChat, M+ Messenger, and Whatsapp evolved. These services require a big user base. For promotion purposes, LINE encourages users to share its fan page as they leave their LINE account. A gift is provided for each item shared. The promotion of these services has been successful, but at the same time it created confidentiality issues. The hard-to-get privacy information became easy-to-get during the sharing.

This example shows that privacy can be compromised by certain marketing activities. Some customers refuse to use a brand that lacks strong privacy protection. If you were the manager of a company, what solutions would you propose?

The experiment consisted of the following sequence of events: (1) 5 minutes to describe the experiment to the participants, (2) 5 minutes to complete the pre-task questionnaire, (3) 20 minutes for a platform tutorial (TeamSpirit group only), (4) 55 minutes to carry out the platform task and discuss it, (5) 5
minutes to complete the post-task questionnaire. Members of the TeamSpirit and email teams were separated from one another by partitions or a distance of six meters.

Following Lee and Choi (H. Lee & Choi, 2003; Schulze & Hoegl, 2006), we measured knowledge externalization, combination, and internalization post-test by assessing agreement with a set of customized statements for each platform. Following Cho et al. and Lin (Cho, Chen, & Chung, 2010; H. F. Lin, 2007), we measured knowledge-sharing intention. Following Sussman and Siegal (Sussman & Siegal, 2003), we measured knowledge adoption.

5 PILOT AND MAIN TESTS

One week prior to the experiment, a pilot test was conducted to assess the questionnaire’s reliability and validity. Of the 100 questionnaires collected, 87 provided valid data. Both are adequate.

For the main test, we first tested the relationships between the demographic variables and the knowledge variables. It revealed no significant effects. The reliability and validity are also adequate.

We next sought to determine whether our model is the best of the available choices. The three kinds of model fit are absolute fit, incremental fit, and parsimonious fit. The results meet the minimally acceptable criteria proposed by Hu (Bentler, 1988) for all three models.

6 HYPOTHESIS TESTS

Before we conducted the hypothesis tests, we checked the data for normality and homogeneity of variance. A Shapiro–Wilk test showed that the data follow the normal distribution, and a Levene’s test showed that the variances are homogeneous. We also determined that the three groups had similar mean pre-test scores; therefore, these scores provide a common baseline for evaluating the changes at post-test.

The hypotheses H1-1 to H3-3 were then tested. Table 1 shows that TeamSpirit was better than face-to-face, and face-to-face was better than email for all three knowledge conversion processes.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Hypothesis</th>
<th>Post-test</th>
<th>Average</th>
<th>Std Dev</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Externalization</td>
<td>H1-1</td>
<td>TeamSpirit</td>
<td>3.600</td>
<td>0.770</td>
<td>6.630</td>
<td>0.000***</td>
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<tr>
<td></td>
<td></td>
<td>Email</td>
<td>2.301</td>
<td>0.418</td>
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</tr>
<tr>
<td></td>
<td>H1-2</td>
<td>Face-to-face</td>
<td>2.967</td>
<td>0.786</td>
<td>3.344</td>
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<tr>
<td></td>
<td>H1-3</td>
<td>TeamSpirit</td>
<td>3.600</td>
<td>0.770</td>
<td>2.575</td>
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<td></td>
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<td>0.786</td>
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<td></td>
</tr>
<tr>
<td>Knowledge Combination</td>
<td>H2-1</td>
<td>TeamSpirit</td>
<td>3.667</td>
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<td>0.000***</td>
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<td></td>
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<td>H2-2</td>
<td>Face-to-face</td>
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<td>0.976</td>
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<td>0.500</td>
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<tr>
<td></td>
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<td>0.734</td>
<td>3.328</td>
<td>0.002**</td>
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<td></td>
<td></td>
<td>Face-to-face</td>
<td>2.783</td>
<td>0.976</td>
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<tr>
<td>Knowledge Internalization</td>
<td>H3-1</td>
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<td>0.891</td>
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<td></td>
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<td>Email</td>
<td>2.268</td>
<td>0.568</td>
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</table>
Testing H4 and H5 was not straightforward. To do so, we needed the results from Table 1, for example, that the TeamSpirit teams achieved greater knowledge externalization than the email teams (H1-1). Then, we generated the results shown in Table 2, finding, for example, that the TeamSpirit teams had a stronger knowledge sharing intention than the email teams. Comparisons of the face-to-face teams with the TeamSpirit teams and the email teams respectively not only supported H1-2 and H1-3, but they also demonstrated that the face-to-face teams had a stronger knowledge sharing intention than the email teams, and that the TeamSpirit teams had a stronger knowledge sharing intention than the face-to-face teams. Thus, we concluded that the greater a team’s knowledge externalization, the stronger its knowledge sharing intention. This same logic was applied to testing the knowledge adoption hypothesis, with corresponding results. Thus, H4 and H5 were both supported.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Post-test</th>
<th>Average</th>
<th>Std Dev</th>
<th>t-statistic</th>
<th>p-value</th>
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<td></td>
<td>Face-to-face</td>
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<td>0.881</td>
<td>3.475</td>
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<tr>
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<td>0.550</td>
<td>3.587</td>
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<td>Face-to-face</td>
<td>3.351</td>
<td>0.577</td>
<td>5.839</td>
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<td>Face-to-face</td>
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<td>0.577</td>
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</tbody>
</table>

Table 2  Hypothesis test results (H4 and H5)

7 CONCLUSION

In our study we adapted a Web-based creative group problem-solving tool, TeamSpirit, to serve as a structured knowledge-management tool. The structure followed Nonaka’s SECI model except for the socialization component (Kwok, J-N, Huynh, & S-M Pi, 2002). The design of TeamSpirit (e.g., idea
generation, idea consolidation, and idea creation; divergence, assimilation, and convergent thinking) was based on a creative group problem-solving process. The implementation of group tools such as structured brainstorming, evaluation and rating, and multi-aspect decision-making made TeamSpirit effective in promoting outstanding knowledge management (see Figure 2 and Figure 3). To sum up, the structured brainstorming was used for knowledge externalization. Then, the consolidation, evaluation, and rating systems were used for knowledge combination. Lastly, a combination of the multi-aspect decision-making system and the structured brainstorming system was used for knowledge internalization. These steps achieved the three processes specified in Nonaka’s SECI model.

Our study illustrates how a Web-based creative problem-solving system can be used effectively for knowledge creation. TeamSpirit is successful because its component tools can be used to structure and support the knowledge-creation process.

The tests of our five hypothesis sets demonstrate the validity of TeamSpirit as a KM tool. Because of their superior management creation, teams using TeamSpirit achieved better knowledge externalization, combination, and internalization, stronger knowledge-sharing intention, and greater knowledge adoption than teams that interacted face-to-face or by email.

Although our research is limited to the use of TeamSpirit as a knowledge-acquisition tool, the proposed mapping of its components to the SECI model may be very helpful to others in adapting similar group tools for knowledge-management purposes.

Our research findings are limited by the limited functionality of TeamSpirit. From a system design standpoint, we recommend that to facilitate the management of the knowledge acquisition process virtual teams use tools that include features that support the monitoring of members’ status and provide statistics about their individual contributions. We also would expect the system to enhance the richness of a virtual team’s interactions through the use of multimedia such as audio and video conferencing. Whether increased media richness has any impact on knowledge acquisition and management is an interesting question for further investigation.

8 REFERENCES


