EXTERNALIZATION METHOD AND ITS EVALUATION OF KNOW-HOW INFORMATION FOR CARE PLANNING PROCESSES BY AWARENESS OF NOVICES

Kaoru Eto, Minoru Mukuda and Yasuo Kabasawa

Faculty of Engineering, Nippon Institute of Technology , 4-1 Gakuendai, Miyashiro, Minamisaitama, Saitama, Japan

Tatsunori Matsui

Faculty of Human Sciences, Waseda University, 2-579-15 Mikajima Tokorozawa, Saitama, Japan

Abstract: The know-how information to perceive care needs based on assessment results is crucial to improve the quality of care service. We developed a know-how information sharing system for care planning processes. We propose a method that externalizes and shares know-how information by visualizing and observing care plans drawn by experts in various forms that allow beginners to notice the differences between the plans of novices and experts. Sharing know-how information is possible by recording, accumulating, and referring to what has been observed when comparing documents. This system two-dimensionally maps and visualizes each document based on the differences among documents perceived by the assessment results. Externalizing and sharing know-how information are supported by visualization. Trial results in a care facility confirmed that our system effectively externalized and shared know-how information. Improvement in individual capabilities, organization growth, and the possibility of rejuvenation were confirmed by using our system.

1 INTRODUCTION

The acquisition of capabilities to perceive care needs based on assessment results is crucial to improve the quality of care service. However, based on advanced cognitive power and judgment, insight, and a discerning eye, know-how information is needed for perception. Therefore, it is difficult for beginners to exactly perceive care needs. To solve this problem, we propose a method that externalizes and shares know-how information for care planning processes by awareness of novices.

In recent years in business administration, much attention has been paid to the role knowledge management plays in company strategies. Many studies have investigated methods to externalize and share tacit knowledge (Choudrie, 2005). Know-how information has mainly been studied as part of knowledge management. Research on knowledge management has also been conducted in the medical

treatment and nursing fields (Abidi, Cheah, and Curran, 2005). These researches emphasized the externalization and the sharing of the know-how information possessed by experts themselves using information and communications technology (ICT). However, directly treating know-how information is difficult because the information about which an expert is not conscious can't be externalized. Moreover, since the externalized know-how information includes many premises, such as the situation of the scene and its context, it has intentional disagreement between the provider and the user of the know-how information. The problem of burying useful know-how information, sharing, and transfer is also difficult. Therefore, an approach is needed that complements sender intentions about the information and establishes an implicit premise.

In this study, we propose a method that visualizes and observes care plans drawn up by experts in various forms that allow beginners to notice the differences between the plans of novices

and experts. With the proposed method, we expect that the knowledge to be acquired about which experts are not conscious as well as the knowledge required for an on-site level for beginners who will notice the differences between novices and the skillful. Moreover, since beginning users of the information noticed the know-how information, which is named in their own words, such transfer of preconditions as a scene's situation and its context are carried out smoothly; sharing and internalizing know-how information is performed easily and is considered a connection to the practical use of knowledge. Furthermore, when a beginner repeats and uses this system, an important education effect is acquired in the process of sharing, based on externalizing the know-how information. Internalization, socialization, and individual capability improve to attain organization growth and rejuvenation. Based on such an idea, we developed a know-how information sharing scheme called KISS. In this paper, we clarify its effectiveness from the results of a two-year trial experiment in a care facility.

2 EXTERNALIZATION OF KNOW-HOW INFORMATION

Our concrete method of externalizing know-how information by allowing beginners to notice the difference from experts is shown in Figure 1. Tacit knowledge is used when experts assess clients and compile charts from which they perceive care needs. Therefore, the following questions have such explicit knowledge as theories and rules and such tacit knowledge as original viewpoints, original patterns, and conceptualization based on experience: How is this life changing? What are the harmful factors for it? What are its remaining abilities? What are its basic care guidelines? On the other hand, the externalization of tacit knowledge is fueled by metaphor and/or analogy (Nonaka and Takeuchi, 1995). Association through analogy is carried out by rational thinking and focuses on the structural/functional similarities between two things to detect differences (Nonaka and Takeuchi, 1995). We adopted a method of enabling the externalization of know-how information by supporting the cognitive process of analogy. The function is explained below that supports the four steps of the cognitive process of analogy:

(1) Retrieval: past similar experiences recollected from memory. A beginner observes charts that reflect the assessments drawn up by experts and reads their contents.

(2) Mapping: both features and structure are connected to past similar experiences and matched with a target's knowledge: The chart group, which visualized the assessment result, is observed to grasp that the relevant viewpoint has been narrowed down and expanded.

(3) Evaluation: analogy appropriateness evaluated with reference not only to the external similarity but also structural similarities and targets. The two-dimensional mapping result is observed of the perceived document group that visualized the difference between the perceiving documents as a result of assessment.

(4) Learning: experience that solved the target using past similar experience is accumulated as abstract knowledge through induction and abstraction of the relations, common patterns, rules, etc.

A beginner's perceiving document is mapped and visualized on the same two-dimensional plane as the experts' perceiving documents so that the beginner can observe them. There is an effect that easily extracts patterns in the visualization of information. A beginner records what has been noticed by comparing charts as the results of assessment and two-dimensional mapping of the perceiving document group.

Thus, beginners gradually notice the differences between experts and novices by repeating the cognitive process of analogy. This awareness becomes a trigger that will separate explicit and tacit knowledge. Know-how information is included in this awareness. Externalizing and sharing know-how information are realized because a beginner records and refers to awareness. Moreover, the charts, which are one source of information media in the process that externalizes tacit knowledge to enable beginners to assess a client's condition and perceive care needs based on results, play an intermediate role of tacit and explicit knowledge.

3 USE OF SYSTEM

As examples of system use, mapping into two-dimensions added new cases, and displaying of charts and the search results of documents by user name are shown.

3.2.1 Mapping Several users' Perceiving Documents on Two-dimension

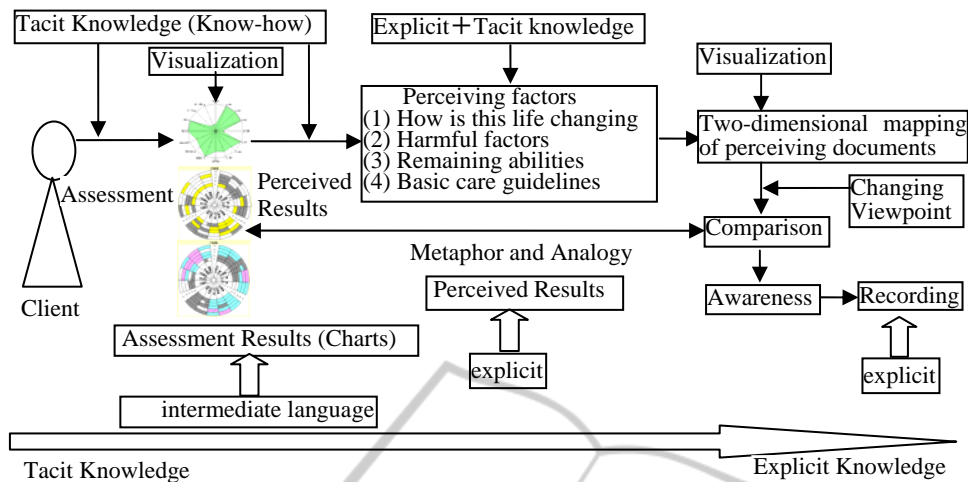Nurses and care workers assess a patient/client and

Figure 1: Externalization of tacit knowledge.

separately draw up a care plan and discuss it. The similarity of their documents can be simultaneously displayed in two dimensions. Noticing differences is promoted by exhaustively comparing these results. This function shows different viewpoints of co-workers, different occupational descriptions, and shared information. Furthermore, the "Ba (field)," which is the context shared by co-workers who mutually conduct interactions, is offered. The mapping result of new cases at the same plane as the model cases is shown in Figure 2. The number beside the round mark is a case number. The state of 106 examples is expressed as four colors. The stars are new cases. In Figure 2, arrows indicate whether the mapping of a user's case is appropriate (Eto, Matsui, and Kabasawa, 2006). On this screen, four persons' documents are in different positions. The KOMI Chart is compared to explore why they differ.

3.2.2 Referring to Awareness Document

Users can search for documents by keyword and user name. When a keyword is input, the list of document file names is displayed, so a file name can be chosen. A document can also be referred to by user name search (Figure 3). Since the time at which it was written is part of the file name, the user's awareness document history can be followed by a time series.
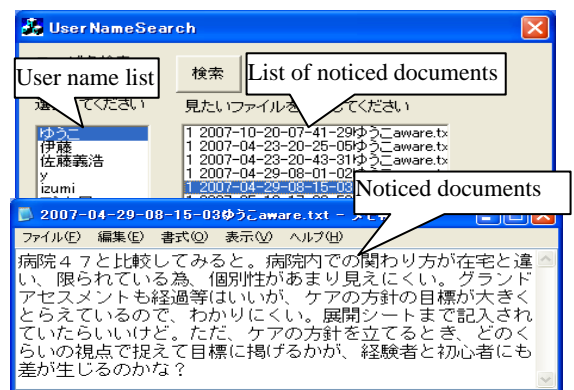
4 SYSTEM EVALUATION

One target of this study is the development of a system that can actually be used at care facilities. Therefore, an important element of system
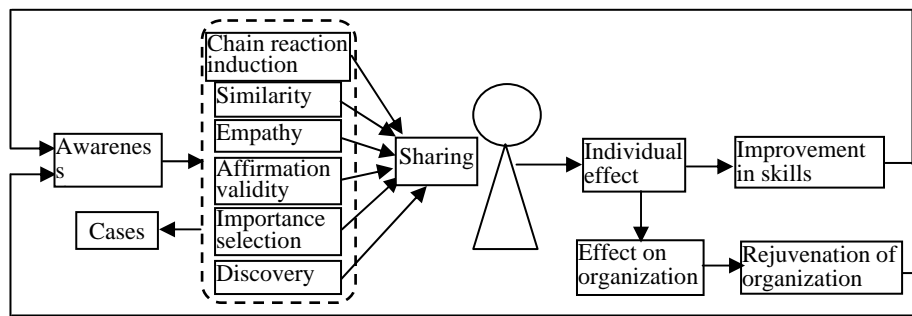
evaluation is how many care facility requests are reflected.
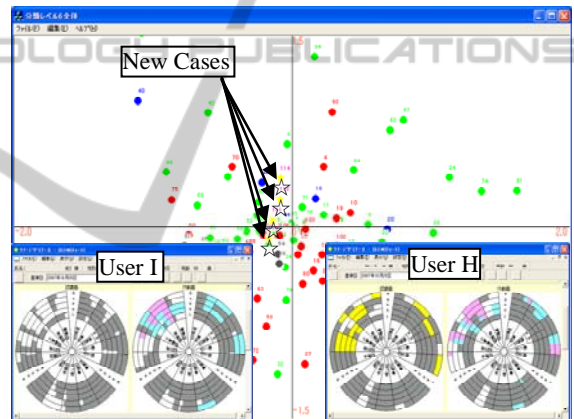
Figure 2: Two-dimensional map to add new cases and display new charts.

Figure 3: Document search result.

Figure 4: Know-how information sharing a process and effects.

4.1 Evaluation Design

We conducted a two-year trial experiment at a care center to evaluate the externalization of know-how information and sharing by KISS.

(1) Outline
The following is the experiment's outline:

- Nine users: one nurse, four care workers, and four care takers. Four were interviewed.
- The place was an in-home care support center.
- The period ran from April 2007 to March 2009.
- A Notebook computer was used.

(2) Method of Evaluation
This function was evaluated by analyzing the use and interview results. The evaluation method of the educational effects was the analysis of user interview results.

(3) Form of Trial
Although KISS trials in care facilities could have various forms, we tried the following four forms:

- Users observed a two-dimensional arrangement of 106 examples and compared why the example's position is near or far by reviewing the KOMI chart, for example.
- Users drew up a care plan and compared it with a model example.
- Nurses or care workers assessed a care client, and users drew up a care plan and compared it with a model example and other care plans and recorded awareness.
- Users referred to the awareness documents of co-workers and recorded their awareness.

(4) Evaluation Item
Since a system must be evaluated from both its function and educational effect sides, we asked about the attainment of externalization, the sharing of know-how information, and the educational effect.

The sharing process of know-how information with our system is shown in Figure 4. A user inspects the documents of co-workers and filters information to share. In the process, highlighted examples are set as objects of a document to be referred to. When a filter is passed, it is shared for

the first time. Furthermore, improvement in individual technology is achieved by utilizing this information. The result is interlocked with an organization's rejuvenation by being reflected in an organization. Furthermore, we expected users to notice the differences, and the document contents were also affected by individual improvement in an organization's technology and rejuvenation.

4.2 Evaluation Results

The trial's evaluation results are divided into externalization of know-how information and know-how information sharing.

4.2.1 Externalization of Know-how Information

To verify whether know-how information was externalized, the results of awareness documents and interviews were analyzed.

(1) Awareness Documents
All awareness documents were coded and categorized using the Grounded Theory, which is one methodology of qualitative research. From the results, the documents were categorized into three types of differences: care environment differences, individual differences, and basic plan differences. Typical awareness documents are shown in Table 1.

- Environment differences of offered care service: Individuality did not appear enough in the hospital's care plan. In the hospital, care that directly addresses the client's life was mainly performed. Awareness about how to be concerned for care clients is obvious.

Table 1: Example of document awareness.

Category	Contents
Environment	Care plan is incorporated in which the direction of home care captured a client's individuality, for example, hobbies etc., more than the hospital. In the hospital, care about direct work on the life is mainly performed
Person	Care taker should be better understood. When making a care plan, differences appear between experts and beginners in how detailed viewpoint targets are held up.
Basic plan	When looking at the grand assessment, she wrote about the direction of life changes, the harmful factors, and the remaining abilities, but she didn't write about a basic care plan. I thought that alleviating the user's stress should've been addressed.

- Differences arising from those involved care in: Care taker should be understood more. A difference also arises between experts and beginners. Awareness by differences in occupational descriptions, experienced persons, beginners, etc. is recorded.

- Basic plan differences: a user wrote about the direction of life changes, the harmful factors, and the remaining abilities, but she didn't write about a basic care plan. Relieving stress is also required. The user noticed the differences between the assessment results and the basic plan derived from it.

When beginners noticed the differences from experts, the know-how information at the on-site level could be externalized. Moreover, the number of times KISS was used increased. A difference was found from people from different environments and with different basic plans. A tendency in which a viewpoint moved to an important element for planning an important element was seen, suggesting that user viewpoints evolved.

4.2.2 Know-how Information Sharing

Sharing know-how information was verified using the interview results with users about the directly supported function.

(1) Assessment Display Results by Several Users
Comparison examinations of the care plans of co-workers explain this difference. Moreover, discussion considered the differences in co-worker's viewpoints and utilized them. Improvement in user capabilities is accepted from these results. Furthermore, users answered that comparison examinations while using this function with a co-worker resembled mini study meetings or conferences, suggesting that this function effectively shared know-how information and that realized sharing can be checked.

(2) Referring to other's Awareness Documents
The items used to evaluate the realization of know-how information sharing by referring to awareness document are the conditions that determine the sharing properties shown in Figure 4. User answers to those conditions are shown in Table 2.

- Chain Reaction and Induction: All users looked at the awareness of others and said they noticed something.
- Similarity: Several users answered that they were similar with the same awareness.
- documents because they were working in the same organization.
- Empathy: The user was flexible, sympathized with different ideas, and accepted them.

Table 2: Attainment of know-how information sharing.

Question	Answers
Chain reaction and induction	"At visiting times, since the client situations were different, I looked at the chart to create changes." "I was influenced by the difference of the amount of information, and the current time and whether one day of a client is seen correctly, and he noticed that it appeared differently, even if the same client's chart was created."
Similarity	"Although clients have lifestyles and illnesses, if seen diagrammatically, they can be arranged nearby. He noticed and we agreed about the document."
Empathy	"I wondered why Ms. M's awareness was seen. Her viewpoint was different from mine, so there would also be such a view." "In the hospital's care plan, awareness questioned why there was such a low judgment of motion from the recognition side, although a movement was seen, and I also looked at the example and felt the same."
Affirmation and validity	"The client's appearance changed due to the difference between how to talk to the concerned client and how to be concerned."
Importance and Selection	"Care performed at home and in a hospital is different. If this difference is known, it will become an advantage for the in-home care support center."
Discovery	"I observed from a different angle and discovered."

- Affirmation and Validity: As compared with the knowledge acquired from a familiar experience of it.
- Importance and Selection: The user always judged and chose the importance based on relations with his everyday practice.
- Discovery: Users are thinking about why the difference arose. Moreover, they answered the following to determine whether know-how information was sharable.

All the conditions that determine shared properties are satisfied by these results; know-how information was shared. Moreover, improvement in a user's capability can be checked from answers that include the following: "Being at home will become an advantage if the difference between being home and in the hospital is revealed," and "I observed from a different angle and discovered."

4.2.3 Know-how Information Sharing Effect

The interview results about the items for evaluating the effect of shared know-how information are shown below.
(1) Were new information, ideas, and knowledge created? "Expressing, writing, and externalizing awareness by language are difficult, but important."
(2) Were new knowledge and ideas performed? "Since awareness is important, I am teaching newcomers to record it." "We are going to devise a format that can easily record awareness at care facilities."
(3) Did change arise in the organization? "User noticed that conversation with a care client is critical, and even though it is time-consuming, he doesn't regret such time. Everybody learned to record conversation contents." "By comparing with a model example, I became aware of the care level and have confidence now." "I regarded the client as carrying out assessment and I had thorough discussions with the client." These results suggest that organizational growth or rejuvenation is checked from improvements in individual capability by sharing know-how information.

5 CONCLUSIONS

In this paper, we described the method and its evaluation of a know-how information sharing system (KISS) for a care planning process. To externalize and share know-how information, our system visualizes and observes care plans drawn up by experts in various forms that allow beginners to notice the differences between novice and expert plans. In a two-year trial, the possibility of

externalizing and sharing know-how information at the on-site level was discovered when beginners noticed differences from experts using KISS. Furthermore, organization growth and the possibility of rejuvenation were verified with improvement in individual capabilities by externalization and sharing of know-how information. These results verified that care management education is supportable by computer. Future works will confirm the effectiveness of KISS in educational facilities and build a large-range Web environment for it.

ACKNOWLEDGEMENTS

REFERENCES

Choudrie, J., 2005. The Consideration of Meta-Abilities in Tacit Knowledge Externalization and Organizational Learning," *Proc. of the HICSS '05*, IEEE, Track 8, P. 243b

Abidi, S. S. R., Cheah, Yu-N., and Curran, J., 2005. A Knowledge Creation Info-Structure to Acquire and Crystallize the Tacit Knowledge of Health-Care Experts, *IEEE Transactions on information technology in biomedicine,* Vol. 9, No. 2, pp. 193-204

Nonaka, I. and Takeuchi, H., 1995. *The Knowledge Creating Company*, New York: Oxford University Press.

Kanai, H., 2002. *KOMI Theory and The KOMI Chart System, An Introduction to Kanai Original Modern Instrument-a radical new approach to caring and nursing*, Tokyo: KYOSHIN.

Eto, K., Matsui, T., and Kabasawa, Y., 2006. Development of Know-how Information Sharing System in Care Planning Processes - Mapping New Care Plan into Two-Dimension Document Space, *Lecture Notes in Computer Science*, Springer Berlin / Heidelberg, Vol. 4252, 2006, pp. 977-984.