Development of Idea Generation Consistent Support System That Includes Suggestive Functions for Preparing Concreteness of Idea Labels and Island Names

Jun MUNEMORI^{†a)}, Member, Hiroki SAKAMOTO[†], and Junko ITOU[†], Nonmembers

SUMMARY In recent years, networking has spread substantially owing to the rapid developments made in Information & Communication Technology (ICT). It has also become easy to share highly contextual data and information, including ideas, among people. On the other hand, there exists information that cannot be expressed in words (tacit knowledge) and useful knowledge or know-how that is not shared well in an organization. The idea generation method enables the expression of explicit knowledge, which enables the expression of tacit knowledge by words, and can utilize explicit knowledge as know-how in organizations. We propose an idea generation consistent support system, GUNGEN-Web II. This system has suggestion functions for a concrete idea label and a concrete island name. The suggestion functions convey an idea and the island name to other participants more precisely. This system also has an illustration support function and a document support function. In this study, we aimed to improve the quality of the sentence obtained using the KJ method. We compared the results of our proposed systems with conventional GUNGEN-Web by conducting experiments. The results are as follows: The evaluation of the sentence of GUNGEN-Web II was significantly different to those obtained using the conventional GUNGEN-Web.

key words: KJ method, groupware, framework level, Web base system

1. Introduction

In recent years, networking has spread substantially owing to the rapid developments made in Information & Communication Technology (ICT). In addition, the use of smartphones and tablet terminals has spread widely, which has made it possible to conduct meetings anywhere, anytime. It has also become easy to share highly contextual data and information, including ideas, among people.

On the other hand, there exists information that cannot be expressed in words (tacit knowledge) and useful knowledge or know-how that is not shared well in an organization. The idea generation method enables the expression of explicit knowledge, which enables the expression of tacit knowledge by words, and can utilize explicit knowledge as know-how in organizations. The idea generation method is a technique that extracts and systematically arranges an idea. Brainstorming [1] and mind mapping [2] are utilized widely to solve problems in the idea generation method. The KJ method* [3] is a representative idea generation method that is widely used in Japan. The KJ method consists of *label*

making, *group formation* (island making), *illustration*, and *documentation*. The *label* is a written down version of the idea using a letter or a picture.

An idea generation support system that can rearrange ideas from multiple people from these scenes has been developed. Young classified effects of the idea generation support system at a secretary level, a frame level, and a generation level [4]. The objective of the secretary level is to reduce the workload on the user. The frame level provides the idea framework by providing stimulation to guide the contents of the concept. The generation level generates concepts that were missed by a user.

Many support systems based on the KJ method have been developed since the 1980s [5]–[12]. These systems have computerized the enforcement environment of the idea generation method; however, these systems mainly provide support at the secretary level. The examination about the contents of the idea that what kind of real idea should give is not done. In addition, it is important that the meaning and intention of the idea of each person is received precisely when multiple people participate in the idea generation method. To that end, it is necessary to accurately generate idea labels.

We propose an idea generation consistent support system, GUNGEN-Web II. This system has a suggestion function for a concrete idea label and a concrete island name. These are structured such that they convey an idea and the island name to other participants more precisely. This system also has an illustration support function and a document support function. In this study, we aimed to improve the quality of the sentence obtained using the KJ method, relative to that obtained using GUNGEN-Web [11], which was the support system intended for the secretary level.

In this article, we introduce the KJ method and the idea generation support system in Chapter 2. In Chapter 3, we describe the idea generation consistency support system, GUNGEN-Web II. The results of the application experiment of the system are presented in Chapter 4, and in Chapter 5, we present our conclusions.

Manuscript received March 16, 2017.

Manuscript revised August 10, 2017.

Manuscript publicized January 19, 2018.

[†]The authors are with Wakayama University, Wakayama-shi, 640–8510 Japan.

a) E-mail: munemori@sys.wakayama-u.ac.jp

DOI: 10.1587/transinf.2016IIP0033

*The KJ method is a registered trademark of the Kawakita research institute.

2. The KJ Method and Idea Generation Methods

2.1 KJ Method

The KJ method [3] was developed by Jiro Kawakita and is a widely used creativity technique in Japan. The KJ method is also referred to as an *Affinity Diagram*, which includes the seven management and planning (MP) Tools [13], and categorizes multiple idea cards (also called labels) into groups for review and analysis. The method consists of a divergence part and a convergence part. The process of the typical KJ method is as follows: (1) preparing idea cards along a specified theme (similar to brainstorming), (2) forming groups (also called islands making) by intuitively gathering similar idea cards (not categorization), (3) labeling each group name, (4) allocating each group spatially to an illustration by appreciating the relationship among groups (also called illustration), and (5) describing sentences to express what the illustration implies (also called documentation). The KJ method usually involves several participants who use several dozen idea cards.

2.2 Related Work

The KJ method is performed using paper; however, systems that realize the KJ method on computers have been developed. Using computers, various functions can be added to the KJ method. In this section, the various systems for brainstorming support and KJ method support are described.

2.2.1 Brainstorming Support System

Idea Expander [14] was a tool that supports group brainstorming at the frame level. The participants engaged in group brainstorming by using a chat window. This system supported the idea of the group by displaying the photograph in conjunction with the chat, in a chat window during the group brainstorming activity. The number of ideas increased from an average of 12.0 to an average of 14.3 by the brainstorming for 14 min. to perform with one set of two people. The participant who was shown an idea in pictorial form might be influenced by his/her cultural background [15].

IdeaGens [16] was a web-based idea supporting groupware that utilized crowdsourcing at the frame level. A user could present an idea in reference to a hint of the idea named inspiration by a facilitator. When a proficient facilitator used *inspiration*, the number of ideas increased from an average of 10.2 to an average of 12.9 for ten minutes. The proportion of ideas that were evaluated as being the most original increased by 16%.

2.2.2 KJ Method Support System

The KJ editor [7] was comprised of a local screen, wherein the view area moved the expressway to the movement of the

mouse, and a universal screen, which provided an overview. This system attached great importance to user interface.

D-ABDUCTOR [5] regarded a process of the KJ method as the editing work of the figure and was a system developed for the automatic drawing function of the figure. The characteristic of this system was the indication method for the idea.

The Designers' Environment [10] allowed inputs using gestures and sounds on a tablet PC. This support system could perform screen operation by distinguishing multiple users by using Diamond Touch Table [17].

GUNGEN [6], [8] was a MacOS-based system that could realize the KJ method at the dispersion spot on multiple computers. The main functions of GUNGEN included screen sharing, an idea input function, and an island making function; however, it did not have a support function for creating illustrations.

KUSANAGI [9] connected the multiple computer screens and increased the working area. This system realized operation by using the GLIA middleware. The system enabled the participants to use multiple windows using multiple mice.

GUNGEN-Web [11] was a web-based KJ method support system that realized idea collection and the KJ method even the participants were from distant places. In addition, this system supported touch operation in iPhone and iPad as well as mouse operation on the computer. This system supported Diamond Touch Table [17] and provided a flexible work environment. However, the system did not include an illustration support function.

G-Pad [12] was a GUNGEN-Web [11]-based system. The screens of the tablet terminals of multiple stands could be assembled together to perform the KJ method. This system implemented a function that enabled the combination or separation of the screen, which allowed one-touch input and expanded the working space.

2.3 Evaluation Method

There are a few studies on quantitative evaluation of the KJ method [18]. One such rating system was proposed by Yagishita et al. [19] and has used the Analytic Hierarchy Process (AHP) [20]. This system provides a method for evaluating the contents of sentences based on the pair comparison by using AHP for the sentence from the KJ method result. The system evaluates the contents of sentences by substituting *existence* or *nothing* for *substitute plan*. The general satisfaction = (evaluation (satisfaction) from the viewpoint of *existence*) in / (evaluation (dissatisfaction degree) from the viewpoint of *nothing*). If general satisfaction is 1, it is average. The better the evaluation of the sentence, the larger the general satisfaction number.

3. GUNGEN-Web II

3.1 Design Policy

(1) Label making

It is important that the meaning and the intention of a participant's idea is conveyed precisely when multiple participants use the idea generation method. To that end, the system provides a function that suggests easy-to-understand idea substitutes by using a template to support the label making process with concreteness.

(2) Island name making

It is important, for the group formation, that the island name is acquired appropriately. By using the highlight method of the idea generation method of the convergence type [21], we group good ideas and express their contents with substitute words. The idea is said to be concluded from the perspective of *what kind of* or *how is it*. Subsequently, the system has a support function to suggest the island name.

(3) Relationship illustration support

The system provides a relationship illustration support function, which clarifies the correlation of islands and makes it easy to grasp the entire idea.

(4) Documentation support

The system provides a function to list the island names for use in a sentence, thereby making it easy to generate the conclusion sentence.

(5) Use of a PC and a tablet terminal

In addition to indoor environments, such as meeting rooms, we also collected ideas in outdoor environments and performed KJ method [22]. Therefore, by using a PC and a tablet terminal, we provide support functions that can enable operations such as inputs by two participants while watching a screen.

3.2 GUNGEN-Web II Functional Design

This is a web-based system that is an extension of GUNGEN-Web [11]. The main functions of GUNGEN-Web II (as Web-II) and GUNGEN-Web (as Web-I) are compared in Table 1.

3.2.1 Idea Input Function

Figure 1 shows the idea input screen of Web-II. In the idea input screen, two reference examples of the idea are shown at the bottom of the input form. A link to an idealist function, a template-based idea categorization support function, and the island example indication function are provided by this screen. These functions are missing in Web-I. The idea list is displayed in the lower part of the idea input screen in

Table 1 Function comparison between GUNGEN-Web II (Web II) and GUNGEN-Web (Web I).

		Web-II	Web-I
Idea input	Idea input function	yes	yes
	Reference example of the idea	yes	no
	Idealist function	yes	no
Idea change	Idea change function	yes	no
Grouping (Island making)	Island name input/Change function	yes	yes
	Reference example of the island name	yes	no
	"what kind of" or "how is it" indication function	yes	no
	Island example indication function	yes	no
Illustration support	Illustration support function	yes	no
Document support	Document support function	yes	no

Fig. 1 Idea input screen.

Fig. 2 The idea list.

Fig. 2.

3.2.2 Template-Based Idea Categorization Support Function

Figure 3 shows a template-based idea categorization support function. Using this function, users can change an idea that was already input to a prepared template. It is a person (not a computer) that is changing or identifying the idea of any given sentence. The form of the templates is (cause)->(result) and (cause)->(background)->(result). For example, in the first bullet of Fig. 3, the original idea is that *it is contributed just to think*. A user changed the idea to *because it is contributed just to think, operation is simple* using the (cause)->(result) template. This function judges whether the sentence automatically fits the form of the template. If a sentence fits the form of this template, the function indicates that using gray text (see the sixth bullet sentence in Fig. 3).

An idea that has been input is changed to improve the concreteness of the idea for mutual understanding. For example, an idea without concreteness, *a parking lot is large*

Fig. 3 A template-based idea categorization support function.

is frequently shown represented as *the ultimate convenience store*. For users who do not have context, such an idea may be ambiguous. At the time of group formation, such ambiguous ideas may become important elements. Therefore, for example, we change the sentence to *I am glad* (result) *because we do not have to worry about parking space* (background) *because the parking lot is big* (cause) to fit the template. Then, we can know the background of the main idea as *we do not have to worry about parking space*. The making of the island attracts the same ideas intuitively. It is defined to be classified (not idea generation) when we group them according to words themselves. We may feel that the background behind an idea is very important for idea generation. If the background of ideas is the same, we may group those ideas in the same group (island). Thus, we can facilitate the making of an island if we gather ideas of the same background. This function is missing in Web-I.

3.2.3 Group Formation Function

Figure 4 shows the island name input screen. Character strings of (*what kind of / how is it*) [23] are displayed by an input form. This makes the participant conscious of island naming with concreteness. In addition, one reference example of the island name is shown below the lower input form. This function is missing in Web-I.

3.2.4 Relationship Illustration Support Function

Figure 5 shows the relationship illustration support function. This function consists of drawing a circle and inserting a

Fig. 4 An island naming input screen.

Fig. 5 Illustration support function.

Fig. 6 Document support function.

sign. The participants can insert a relationship icon such as *causation*, *mutual relations*, and *opposition*. This function is missing in Web-I.

3.2.5 Document Support Function

Figure 6 shows the document support function. An island naming list is displayed above the text inputting column, which the participants can use to confirm the island name. This function is missing in Web-I.

4. Experiments and Discussions

We performed the KJ method using Web-II and compared the results with those obtained using Web-I.

4.1 Experiments

The KJ method is often performed by several people in the space. The more people that participate in the KJ method, the more ideas are given, and the more likely it is that the process will end satisfactorily. However, it is performed by two people on the computer in many cases. Participation is limited by the size of the computer screen. The number of the ideas increases when many people think about an idea. As a result, many ideas cannot be displayed on a screen. Therefore, the KJ method is performed by two people in several experiments using computers [10]. In addition, even a brainstorming experiment is conducted using two people on the computer [14], [15]. Therefore, we thought that two were appropriate to compare with other experiments and experimented on the system with two people at a time.

Twenty students from Wakayama University, who had experience with using the KJ method participated in this study. All the participants were students of the design information department, and all the members used a PC and the smart terminal. Eighteen of twenty students had carried out a preliminary experiment using the same devices two months ago. The participants performed the experiment in ten sets of two people. We performed the experiments in various combinations to reduce deflection by the age or sex of the participant pair. All pairs of the experiment were given the opportunity to make each other's acquaintance. This was done because ideas are not given when the participants are tense during their first meeting. They used Web-II and Web-I on both a desktop PC (Windows 7) and a tablet terminal (iPad 2). They performed the KJ method twice for each group; the first theme was *ultimate SNS* and the second was *ultimate games*. The idea generation method (e.g., KJ method) basically supports how the person concerned with a problem proposes a good idea. For example, it is appropriate to feature the theme of a method as world peace if it is a student of the international relations department. Because all the participants were students of the design information department in this experiment, and because they seemed to be interested in SNS and a game, we did a theme with an ultimate SNS and an ultimate game.

Table 2 shows that the subjects used the systems in alternate orders to balance the experiment. *I* represents Web-I, and *II* represents Web-II. The groups are designated A to J. From A to J is a name of a group. *B4 (m/w)* shows a senior man/woman. *M1 (m/w)* shows a first year Master's student (man/woman). *M2 (m/w)* shows a second year Master's student (man/woman).

The participants were given an explanation of the experiment for each step of the KJ method. Table 3 shows the KJ method and instructions provided to the participants for

Table 2 Turn allotment of the system use.

	A	B	C	D	E	F	G	H	I	J
The first: <i>ultimate SNS</i>	I	II	I	II	I	II	I	II	I	II
The second: <i>ultimate games</i>	II	I	II	I	II	I	II	I	II	I
Member 1	M1(w)	M2(m)	B4(w)	B4(m)	M2(w)	B4(m)	B4(m)	M2(m)	M2(w)	M2(m)
Member 2	M1(m)	M2(m)	B4(m)	M1(m)	M2(w)	M2(m)	B4(m)	M1(m)	M2(w)	M2(m)

Table 3 The KJ method and usage instructions for the system.

The KJ method and usage instructions for the system	Time
The whole experiment	20 minute
-The conversation is possible between subjects -Subjects use the same terminal for the first and the second theme Idea input	
-Subjects perform the idea input from each terminal *The difference that the system depends on -In the case of GUNGEN-Web II use, reading of the idealist is possible Idea change	Up to 20 minutes / non
-Subjects perform the idea change with a desktop -Subjects perform it in 20 minutes, but is finished at that point when they finish changing all ideas -Subjects change ideas as much as possible -Subjects can use two template (<i>(cause)</i> -> <i>(result)</i> and <i>(cause)</i> -> <i>(background)</i> -> <i>(result)</i>) freely. -The idea original meaning and intention keep it intact *The difference that the system depends on -In the case of GUNGEN-Web use, we do not change an idea of it Group formation (island making)	
-The ideas to constitute an island are less than six more than two -There is no limit of the use terminal after the island making Illustration	On completion
*The difference that the system depends on -In the case of GUNGEN-Web II, subjects use the illustration support function -In the case of GUNGEN-Web, only by the movement of the island (express illustration by the position relations of the island) Documentation	On completion
-Subjects make the sentence that they connected the island name with and writes a conclusion last *The difference that the system depends on -In the case of GUNGEN-Web II, subjects use the documentation support function -In the case of GUNGEN-Web, subjects use the memo pad application of the PC	On completion

using the system.

4.2 Experimental Results

4.2.1 Results

We show the experimental results obtained for Web-II. Idea examples, island names, and conclusion remarks are shown below (theme: *ultimate SNS*).

(1) Examples of idea change (front: idea before the change, back: idea after the change)

- It is contributed just to think -> Because it is contributed just to think, operation is simple
- A sentence proofreads even squishiness automatically and contributes it -> Because a sentence proofreads even squishiness automatically and is contributed, I can contribute one's thing thinking to be it carelessly
- I do not depend too much -> Because I do not depend too much, a trouble does not occur for the social life
- Interchange in virtual spaces -> In virtual spaces because can interchange, do not depend on the real environment
- I can stay connected to all human beings in the real world -> It is convenient because I can mutually understand all human beings and can stay

Fig. 7 An example of illustration (ultimate SNS).

connected without using sensory perceptions even if I do not use the Internet

- I can shorten consecutive remarks and a long remark -> Because it is filled with the remarks of the same person sometimes, I want to gather it up

Figure 7 shows an example of illustration (ultimate SNS).

(2) Examples of island name

- Motivation to continue using SNS
- The SNS system that I can be complacent
- Measures against excessive information
- Structure for a brutal atmosphere to dissolve
- I can be connected to anyone in the real world without using a smartphone

(3) Example of sentence of the conclusion (general satisfaction 2.86)

I can be connected to anyone in the real world without using a smartphone. There is a structure in place for dissolving a brutal atmosphere. Therefore, we can be complacent. In addition, counter measures are taken against excessive information. Then, the motivation to continue the use of SNS in the long term is possible. In other words, ultimate SNS is the system that can ensure self-satisfaction, and can be used in the long term.

4.2.2 Comparison Results between Web-II and Web-I

Table 4 shows the average time taken for the completion of each step of the KJ method. In the *Idea input* step and *Group formation* step, we performed identically. The only difference is in watching the table of the island name (Web-II) or not watching it (Web-I) for the *Documentation* step. The *idea change* step and a part of the *Illustration* step (i.e., inserting the relation icons between islands) is a new function of Web-II. The operation of this part takes even more time.

Table 5 shows the results of KJ method, such as the number of ideas. We evaluated the sentence by using the method proposed by Yagishita et al. [19], which was based on AHP [20]. The end-points were as follows: originality

Table 4 The average time taken for each step of the KJ method (minutes).

	Web-II	Web-I	S. t
Idea input	20	20	—
Idea change	17.4	—	—
Group formation (island making)	19.3	15.7	n.s.
Illustration	7.3	3.1	**
Documentation	7.1	6.7	n.s.
Total	71.1	45.5	**

Table 5 Results of the KJ method (mean value).

	Web-II	Web-I	S.t.
The numbers of ideas	24.7	26.7	n.s.
Numbers of islands	6.7	7.1	n.s.
The evaluation of sentence	2.20	1.74	*

(0.19), convenience (0.19), degree of attractiveness (0.19), concreteness (0.14), feasibility (0.18), and the application possibility (0.10). The number in the parenthesis indicates the weight of each item. These weights are the same those used by previous studies [11], [12].

We used a *t-test (two-tailed test)* with the *correspondence* as official approval in Table 4 for each item except the *evaluation of sentence* of Table 5. In addition, when the evaluation result of a sentence from the questionnaire is higher than Web-I [23] for the past island naming pertaining the *evaluation of sentence* in Web-II, we hypothesized and adopted *t-test (one-sided test)* with the *correspondence*. There is significant difference in * with 5% level of significance, and there is significant difference in ** with 1% level of significance. The abbreviation *n.s.* indicates *not significant* while *S.t.* means *Statistical test*.

4.2.3 Questionnaire Results

After performing the KJ method, the participants were asked to complete a questionnaire. Table 6 shows the results of the questionnaire. The evaluation is based on a five-point Likert scale (1: strongly disagree, 2: disagree, 3: neither agree nor disagree, 4: agree, 5: strongly agree). For this questionnaire result, we performed Wilcoxon's mark rank sum test (two-tail test). There was a significant difference in * with a 5% level of significance, and there is significant difference in ** with a 1% level of significance. The abbreviation *n.s.* indicates *not significant*. In addition, the questionnaire result is an ordinal scale [24], which shows the median or the

Table 6 Questionnaire result.

		Web- II	Web-I	S.t.
(1)	Do you think that the island name that expressed the island precisely was acquired?	4.0	3.4	*
(2)	Were there new discoveries and opinions inspired by island making?	4.0	3.1	**
(3)	Was the sentence making easy?	3.7	2.8	*
(4)	As a whole, was it easy to use this system?	4.2	3.4	**
(5)	With this system, do you think that you were able to give a good result?	4.0	3.4	*
(6)	Do you want to use this system again	4.1	3.2	**

mode, but originally displayed the mean to improve clarity and intuitive understanding [25].

4.3 Discussion

(1) Idea input step

As regards the average number of the ideas, a significant difference was not observed between Web-II (24.7 ideas in 20 minutes) and Web-I (26.7 ideas in 20 minutes) with 5% level significance in Table 5. Because the idea inputted to the KJ method is similar to brainstorming, it can be compared with other brainstorming support systems. Idea Expander [14] performed brainstorming with one set comprising two participants, and the number of ideas was an average of 14.3 in 14 minutes. Participants performed brainstorming using IdeaGen [16], and the number of ideas was an average of 12.9 in 10 minutes. The average number of the ideas per minute is about the same.

(2) Idea change step

In Web-II (after a change), 93% of the ideas were changed; 75% were the *(cause)->(result)* type and 18% were the *(cause)->(background)->(result)* type.

If it was possible to change an idea to three phases ((*cause->*)->(background)->(result)), we thought that grouping became easy. The grouping is because participants collect ideas having similar backgrounds intuitively. However, it was difficult to expand every idea to three phases, and 75% of ideas were expanded to two only phases. We felt that it was difficult to expand all ideas to three phases. Education of how to generate three phase ideas is necessary beforehand.

(3) Group formation step

As for the question item *Do you think that the island name*

Table 7 The evaluation of the sentence for every each group.

	A	B	C	D	E	F	G	H	I	J	Mean
Web-II	1.14	3.25	2.09	2.86	2.89	2.76	2.37	1.62	1.40	1.58	2.20
Web-I	0.60	1.48	2.30	1.66	2.74	2.14	1.28	2.19	1.50	1.50	1.74

that expressed the island precisely was acquired? (Table 6(1)), a significant difference was observed between Web-II and Web-I, with 5% level of significance.

(4) Illustration step

As regards the icon indicating the relationships between islands, *causation* was employed 27 times, *mutual relations* was employed eight times, and *opposition* was employed eight times in ten successive experiments. As regards the icon, it was employed an average of 4.3 times per experiment as an illustration.

(5) Documentation step

As regards the ease of sentence making, a significant difference was observed between Web-II and Web-I with 5% level of significance as a result of the questionnaire result shown in Table 6(3).

As regards the sentence evaluation, a significant difference was observed between Web-II and Web-I with 5% level of significance (Table 5). In addition, a significant difference was observed with 5% level of significance for the evaluation of the question *With this system, do you think that you were able to give a good result?* in Table 6(5).

Table 7 shows the evaluation of the sentence for each group. The groups with low evaluation numbers (sequentially group A, group G, and group B) in Web-I largely improve in evaluation (0.60 → 1.14, 1.28 → 2.37, 1.48 → 3.25, respectively) by the experiment of Web-II. The highly evaluated groups (sequentially group E, group C, and group H) in Web-I did not change significantly (2.74 → 2.89, 2.30 → 2.09, 2.19 → 1.62, respectively). Therefore, it is supposed that there is a limit to the positive effect that can be seen.

(6) Learning curve of each participant and effects of a preliminary experiment

Eighteen of twenty students had carried out a preliminary experiment using Web-I two months prior to our experiment. This did not have a significant impact on the experimental sentence evaluation results (preliminary experiment 2.35 → this experiment 1.79). In addition, as a result, the students (G group) who were participating for the first time were not particularly worse than other participants.

5. Conclusion

In this study, we proposed an idea generation consistent support system, GUNGEN-Web II (Web-II), which had a suggestive function for concrete idea label making and island name making. The aim of this study was to improve the quality of the sentences obtained using the KJ method. We compared the results of our proposed systems with conventional GUNGEN-Web (Web-I) by conducting experiments.

The results are as follows:

- (1) The evaluation of the sentence of GUNGEN-Web II was significantly different to those obtained using the conventional GUNGEN-Web. The groups with low evaluation number of the sentence that they made in GUNGEN-Web largely go up in GUNGEN-Web II. However, the highly evaluated groups have almost no change. Therefore, it is supposed that the support of this system has a limit.
- (2) 93% of ideas were changed by the template-based idea categorization support function. 75% were of the type *(cause)*->*(result)*, and 18% were of the type *(cause)*->*(background)*->*(result)*.

We think that we will apply the high-level idea generation support to work to perform in a great many people in the social problems such as disaster prevention measures in the long term. So, we always carry tablet terminals and take not only the text information but also the photograph and accumulate as information. And we perform KJ method using this information, and then, it is necessary to share the result. You must explain not only the idea of the text but also the explanation of the photograph to other people using the template-based idea categorization support function of this system clearly on this occasion. We may more easily group ideas if we can increase expansion of three phases ((*cause*->)->(background)->(result)).

When many people each bring ideas on the site only in one tablet terminal and do KJ method, a screen is small. The system which we unite the terminal of several, and makes a screen wide will be necessary [12]. In addition, you must share them in a state to be seen any time to make use of experimental results [26]. You should prepare a support system to finally carry out a W type solution to the problem model [27].

References

- [1] A.F. Osborn, Principles and Procedures of Create Problem Solving, Charles Scribner's Son, New York, NY, 1963.
- [2] T. Buzan and B. Buzan, The Mind Map Book, BBC WorldWide Limited, London, 1993.
- [3] J. Kawakita, KJ method, Chuoukoron-sha, Tokyo, 1967.
- [4] L.F. Young, Decision Support and Idea Processing Systems, Wm. C. Brown Publishers, Dubuque, IA, 1988.
- [5] K. Sugiyama and K. Misue, "Good Graphic Interfaces for Good Idea Organizers," Proc. 3rd IFIP Int. Conf. on Human-Computer Interaction (INTERACT'90), pp.521–526, Cambridge, UK, Aug. 1990.
- [6] J. Munemori and Y. Nagasawa, "Development and trial of groupware for organizational design and management: distributed and cooperative KJ method support system," Information and Software Technology, vol.33, no.4, pp.259–264, May 1991.
- [7] M. Koyama, K. Kawai, and H. Ohiwa, "Implementation and Evaluation of KJ-Editor: A Card-handling Tool.," Computer Software, vol.9, no.5, pp.416–431, Sept. 1992.
- [8] J. Munemori and Y. Nagasawa, "GUNGEN: groupware for a new idea generation support system," Information and Software Technology, vol.38, pp.213–220, March 1996.
- [9] S. Nishimura, T. Yuizono, and J. Munemori, "Middleware GLIA for Developing Large Collaboration Space with Multi Networked Mice," IPSJ Journal, vol.48, no.7, pp.2278–2290, July 2007.
- [10] E. Tse, S. Greenberg, C. Shen, C. Forlines, and R. Kodama, "Exploring True Multi-User Multimodal Interaction over a Digital Table," Proc. DIS08 Designing Interactive Systems, pp.109–118, Cape Town, South Africa, Feb. 2008.
- [11] H. Goromaru, H. Sakamoto, T. Kokogawa, J. Itou, and J. Munemori, "Proposal and Application of GUNGEN-Web, which Ubiquitous System Supports the Process of Idea Generation Consistently," IPSJ SIG Technical Reports, vol.2013-GN-86 vo.1, pp.1–7, Jan. 2013.
- [12] T. Kokogawa, Y. Maeda, H. Go, J. Itou, and J. Munemori, "Improvement of Web-based Idea Generation Support System GUNGEN-SPIRAL II with Multiple Tablet Device," IPSJ Journal, vol.54, no.2, pp.639–646, Feb. 2013.
- [13] M. Brassard, The Memory Jogger Plus+ Featuring the Seven Management and Planning Tools, Goal/QPC Salem, NH, 1996.
- [14] H.C. Wang, D. Cosley, and S.R. Fussell, "Idea Expander: Supporting Group Brainstorming with Conversationally Triggered Visual Thinking Stimuli," Proc. the 2010 ACM conference on Computer supported cooperative work (CSCW2010), pp.103–106, Savannah, GA, Feb. 2010.
- [15] H.C. Wang, S.R. Fussell, and D. Cosley, "From Diversity to Creativity: Stimulating Group Brainstorming with Cultural Differences and Conversationally-Retrieved Pictures," Proc. ACM 2011 conference on Computer supported cooperative work (CSCW2011), pp.265–274, Hangzhou, China, March 2011.
- [16] J. Chan, S. Dang, and S.P. Dow, "Improving Crowd Innovation with Expert Facilitation," Proc. the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW'16), pp.1223–1235, San Francisco, CA, Feb. 2016.
- [17] P. Dietz and D. Leigh, "DiamondTouch: A Multi-User Touch Technology," Proc. 14th Annual ACM Symposium on User Interface Software and Technology (UIST 2001), pp.219–226, Orlando, FL, Nov. 2001.
- [18] K. Viriyayudhakorn and S. Kunifuji, "The Impact of the Background Knowledge and the Friendship Closeness on the Team Creativity in a Realtime Creativity Support Groupware," Proc. The Seventh International Conference on Knowledge, Information and Creativity Support Systems (KICSS2012), pp.89–96, Melbourne, Australia, Sept. 2012.
- [19] K. Yagishita, J. Munemori, and M. Sudo, "A Proposal and as Application of an Evaluation Method for Sentences of B Type KJ Method Based on Contents and Structures," Trans.IPS.Japan, vol.39, no.7, pp.2029–2042, July 1998.
- [20] T.L. Saaty, The Analytic Hierarchy Process, McGrawHill, New York, NY, 1980.
- [21] B. Miller, J. Vehar, and R. Fireston, Creativity unbound: An introduction to creative process, Williamsville, NY: Innovation Resources Inc., 2001.
- [22] T. Kokogawa, T. Ajiki, J. Itou, and J. Munemori, "Evaluation of Site-Independent Creativity Consistent Support System for Actual Work Environment," Int. J. Informatics Society, vol.5, no.2, pp.81–88, Aug. 2013.
- [23] H. Sakamoto, J. Itou, and J. Munemori, "Development of an Idea Consistent Generation Support System with a Template Input," Proc. 77th National Convention of IPSJ, vol.2015, no.1, pp.173–174, March 2015.
- [24] S. Jamieson, "Likert scales: How to (ab) use them," Medical education, vol.38, no.12, pp.1217–1218, Dec. 2004.
- [25] J. Carifio and R. Peria, "Resolving the 50-year debate around using and misusing Likert scales," Medical education, vol.42, no.12, pp.1150–1152, Nov. 2008.
- [26] H. Goromaru, J. Itou, and J. Munemori, "Development and Application of Wadaman-Web using Database System for Idea Generation Support," IPSJ SIG Technical Report, vol.2015-GW-94, no.9, pp.1–8, March 2015.
- [27] J. Kawakita and KJ method, Chuoukoron-sha, Tokyo, 1986.

Jun Munemori received the B.S. and M.S. degrees in Electrical Engineering from Nagoya Institute of Technology, Nagoya Japan, the D.E. degree in electrical and electrical communication engineering from Tohoku University, Sendai, Japan, 1979, 1981, and 1984, respectively. He is now a dean of Faculty of Systems Engineering at Wakayama University, Wakayama, Japan. His research interests include idea generation, groupware, and neurophysiology.

Hiroki Sakamoto received the B.S. and M.S. degrees in Systems Engineering from Wakayama University in 2014 and 2016, respectively. He is now with FUJITSU LIMITED, Tokyo, Japan.

Junko Ito received the M.S. degrees in Information Science from Osaka University, Japan, completed Ph.D. program, School of Information Science, Kyoto University, Japan, in 2001 and 2005, respectively. She is now an assistant professor of Faculty of Systems Engineering at Wakayama University, Wakayama, Japan. Her research interests include, interpersonal communication, the non-language information in talks and the expression, and mobile groupware.