Title	Effects of Negotiation Meta-Information on Group Decision Support
Author(s)	KOSHIBA, Hitoshi; KATO, Naotaka; KUNIFUJI, Susumu
Citation	
Issue Date	2007-11
Type	Conference Paper
Text version	publisher
URL	http://hdl.handle.net/10119/4094
Rights	
Description	The original publication is available at JAIST Press http://www.jaist.ac.jp/library/jaist-press/index.html, KICSS 2007 : The Second International Conference on Knowledge, Information and Creativity Support Systems : PROCEEDINGS OF THE CONFERENCE, November 5-7, 2007, [Ishikawa High-Tech Conference Center, Nomi, Ishikawa, JAPAN]

Effects of Negotiation Meta-Information on Group Decision Support

Hitoshi KOSHIBA[†] **Naotaka KATO**[‡] **Susumu KUNIFUJI**[†]
[†]Japan Advanced Institute of Science and Technology (JAIST)
Graduate School of Knowledge Science
[‡]Industrial Research Institute of Ishikawa (IRII)
hkoshiba@jaist.ac.jp, kato@irii.go.jp, kuni@jaist.ac.jp

Abstract

In this paper, we report the effects of "negotiation meta-information (NMI)" on an Analytic Hierarchy Process (AHP)-based Group Decision Support System (GDSS). Our objective is to develop a new type of GDSS with a communication support function for the group consensus making process. We approached this problem by considering awareness. We proposed two types of information – self-confidence value and evaluation time. These are called NMI. To evaluate were referred to as the effective less of NMI in generating certain clues regarding the possibilities of compromise among group members, we conduct an experimental test with graduate students. Our results suggested that the analysis of the possibility of compromises is more effective in an NMI environment than in a non-NMI environment. Thus, our study revealed that NMI is useful as a communicational support tool in a GDSS.

Keywords: Group decision, GDSS, Awareness, Communication

1 Introduction

In the past, we have reported on important types of awareness in group decision making[1] – Atmosphere Awareness, Knowledge Awarenesss[2], and Context Awareness. Further, we suggested that a group decision support system (GDSS) must provide Knowledge Awareness as well as Context Awareness. Knowledge Awareness implies being aware of a person's knowledge, sense of value, and purposefulness. On the other hand, Context Awareness implies being aware of the context of a situation, discussion, and/or human relationship. However, we have not reported any specific function with regard to the awareness.

In this study, we propose a new function based on Knowledge Awareness, i.e., supporting group member communication. Our approach is to provide Knowledge Awareness through communication support. Furthermore, we endeavor to verify the effects of this newly proposed function.

2 Issue

In the past, most researchers employed the operations research approach (mathematical approach) to resolve conflicts involved in Analytic Hierarchy Process (AHP)[3]-based group decision making. This research approach is interesting as well as useful. However, the group decision-making process is related to human communication. Therefore, we must consider functions that support communication in a GDSS.

In a group decision making process, communication with other group Members is indispensable. However, existing researches on GDSS do not cover the essential elements of this communication support function. In this study, we attempt to provide this function for an AHP-based GDSS.

The AHP uses pairwise comparisons. It requires the ratio assessment of each pair, which is easy to. However, we cannot obtain information about a person's sense of value, confidence, and/or personal feelings based on the value of the pairwise comparisons. For example, although two users, A and B, can obtain the same rating, we cannot determine whether A believes that "it is definitely this value" and/or B thinks that "it may be this value."

In situations involving negotiations or persuasion, this type of information is important. For example, other group members may not give as much importance to a certain contentious issue as you do. In this case, it may be possible to conduct an amicable negotiation. Therefore, it is important to know "what he or she is thinking" and/or "how much self-confidence does he/she possess." This is an important view factor in in-

Table 1. Scale for subjective sense

Level	Label
1	having no strong confidence
2	having no confidence
3	having no confidence a little
4	having a little confidence
5	having confidence
6	having strong confidence

tegrative bargaining[4].

3 Propose

In this study, we propose the concept of negotiation meta-information (NMI). NMI includes two types of information: (1) subjective sense value and (2) time of rating operation. The former is a meta-information of pairwise comparisons and it indicates the degree of self-confidence, consent, and determination. However, in this paper, subjective sense value is henceforth defined as follows: Subjective sense value is a person's degree of pairwise comparison value. We use a six-point scale, as shown in Table 1, to evaluate this ratio.

4 Experiment

The purpose of this experiment is to evaluate the effectiveness of the NMI in generating certain clues regarding the possibilities of compromise among group members.

4.1 Method

We set two decision-making themes-"selection of a choice topic for an informal lab seminar" and "selection of a place of travel with laboratory members." The structure of these themes makes it difficult to arrive at a logical solution. Thus, these themes are optimal for this experiment.

Further, we set decision hierarchies. These hierarchies have the same structure and number of comparison characteristics. The experimental method is as follows:

1. The input subjects for pairwise comparisons were regarded as inputs for the evaluation of each subject.

2. The subjects answered the following question: "Please answer compromise possible characteristics with a direction in the top 3."

3. The other subjects checked the pairwise comparison values by referring to and without referring to the NMI.

4. Guessing the characteristics on which he/she could compromise (with direction).

The term "direction" mentioned in the method stated above can be elucidated as follows: Consider a case wherein the pairwise comparisons of A and B are being discussed and we need to determine which of these characteristics can be compromised. There are three approaches to resolve this issue: "I can compromise both A and B," "I can compromise A but not B," and "I can compromise B but not A." These options are referred to as directions. We applied counterbalancing to NMI display the condition.

We set the items to evaluate the score as follows: (1) Match the pairwise comparison characteristics, (2) match the characteristic ratings of the possibilities of compromise, and (3) match the direction of compromise. For each item that is matched, we added one point. Thus, the best score was nine.

4.2 Subjects

Twenty-nine people participated in this experiment. The subjects for pairwise comparison comprised 12 students. On the other hand, 17 graduate school students participated in the experiment involving the guessing of the possibilities of a compromise. All the subjects individually operated the system.

However, the subjects for reading the possibilities of the compromise-checked data were particular two subjects' data. This is because at the beginning of the experiment on the possibilities of compromise, only two input subjects were available for the pairwise comparison data. Hence, we discuss the representativeness of the pairwise comparison data in another section.

4.3 System

We developed a GDSS known as Flip-Flop AHP (FF-AHP) for this experiment. This system provides the basic group-decision support function as well as other AHP-based GDSS tools[5], for example, GUI-based based hierarchy making function, screen sharing (this function includes TCP/IP base communication), an interactive pairwise comparison input, eigenvector calculation, etc.

Table 2. Results of experiment

Subject ID	With NMI	Without NMI	Difference
1	5	1	4
2	0	4	−4
3	3	4	−1
4	1	0	1
5	0	0	0
6	1	2	−1
7	4	3	1
8	5	1	4
9	4	1	3
10	1	0	1
11	1	1	0
12	2	1	1
13	1	2	−1
14	2	0	2
15	3	0	3
16	1	0	1

In addition, the FF-AHP provides the following specialized functions: Interactive subjective sense input, logging operation time, and NMI display. A screenshot of the FF-AHP system is shown in Figure 1. In this figure, the areas enclosed by the dotted line are hidden in the non-NMI mode.

4.4 Result

The results of the experiment are shown in Table 2. In this table, 16 subjects are listed. This is because we did not include the data of one subject who answered "did not refer to the NMI" in after enquete.

The score obtained when the subjects referred to the NMI is $\overline{X} = 2.1 \quad (U = 2.8)$ and that when the subjects did not use the NMI is $\overline{X} = 1.3 \quad (U = 1.9)$. A comparison of the two situations was carried out by employing the one-sided Wilcoxon signed-rank test. It was observed that the subjects obtained a higher score when they referred to the NMI as compared to the case when they did not refer to the NMI ($P = 0.051$).

The representativeness of the pairwise comparison data of this experiment is shown in Table 3 and Table 4. These tables suggest that we can consider this data to be representative.

Further, we analyzed the data of 12 subjects. The relation between the possibilities of a compromise and the NMI (confidence and operation time) was investigated by employing Pearson's correlation coefficient test. The results of the test indicated that no relations existed.

Table 3. Representative character of standard data: deviation of mean value

Theme	Subject	Importance	Confidence	Time
Seminar	A	48.0	49.8	49.5
	B	59.2	51.8	49.7
Travel	A	49.6	50.6	46.9
	B	46.0	39.8	53.6

Table 4. Representative character of standard data: deviation of unbiased variance

Theme	Subject	Importance	Confidence	Time
Seminar	A	40.6	44.5	47.9
	B	52.9	45.1	45.2
Travel	A	43.0	53.7	46.8
	B	42.6	50.4	45.2

5 Discussion

Our results suggest that with the NMI environment, it is possible to determine the possibility of compromises more effectively than without the NMI environment, although there is no relation between them.

In the experiment, all the subjects individually operated the system. In real-world group decision making, group members can communicate among themselves. Thus, we can obtain more peripheral information (e.g., Atmosphere Awareness). Therefore, in the real world, we could make more accurate guesses.

Our study has revealed that NMI is useful as a communication support tool in a GDSS.

6 Conclusion

In this paper, we propose a communication support function for an AHP-based GDSS. Further, we endeavor to verify the effects of this newly proposed function. In a group decision-making process, it communication with other group members is indispensable. However, existing researches on the GDSS do not cover the essential elements of such a communicational support function. Therefore, to support communication among group members, we proposed the NMI. To evaluate the effectiveness of NMI in generating certain clues regarding the possibilities of a compromise among group members,

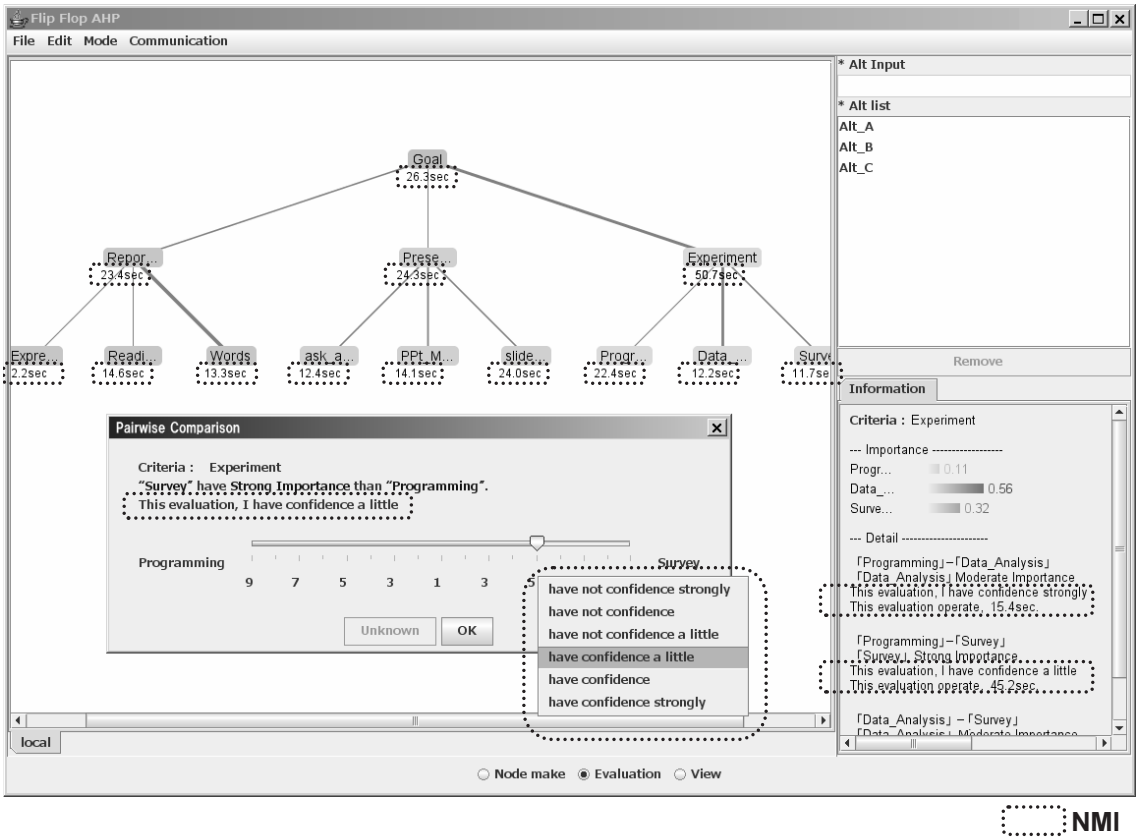

Figure 1. Screenshot of the FF-AHP system

we conducted an experimental test with graduate students as the subjects. Our results suggest that with NMI environment, the determination of the possibility of compromises is more effective than without the NMI environment. Thus, our study revealed that NMI is useful as a communication support tool in GDSS.

Acknowledgment

Our research is partly funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan, under the project Knowledge Cluster for Promotion of Science and Technology in Regional Areas.

References

[1] Hitoshi KOSHIBA, Naotaka KATO, and Susumu KUNIFUJI. Awareness in group decision -Communication Channel and GDSS-. In *Proceedings of the 9th International Conference on Knowledge-Based Intelligent Information and Engineering Systems (KES2005)*, volume 3684 of *Lecture Notes in Computer Science*, pages 444–450. Springer, September 2005.

[2] Toshihiko Yamakami and Yoshiaki Seki. Knowledge awareness in asynchronous information sharing. In *Proc. of the IFIP TC8/WG8.4 Working Conference*, pages 215–225, 1993.

[3] Thomas L Saaty. *The Analytic Hierarchy Process*. McGraw-Hill, New York, 1980.

[4] Max H. Bazerman and Margaret A. Neale. *Negotiating Rationally*. Free Press, New York, 1992.

[5] Naotaka Kato, Masanobu Chujo, and Susumu Kunifuji. A group decision support system by externalizing, sharing and reflecting individual viewpoints. In *Human-Computer Interaction, INTERACT '97, IFIP TC13 Interantional Conference on Human-Computer Interaction, 14th-18th July 1997, Sydney, Australia*, volume 96 of *IFIP Conference Proceedings*, pages 600–601. Chapman & Hall, 1997.