Design and Simulation on Information Providing Service for Temporary Voluntary Organizations

Abstract

To get more benefit, most of all organizations gather and analyze various data. Especially, these systems work well in profit-making organizations. In recent years, universities which are permanently voluntary organizations became active in order to know themselves. However, there are no such systems in temporary voluntary organizations. Therefore, these organizations cannot always decide something correctly. In this paper, we not only design a mechanism to solve this problem occurred in temporary voluntary organizations but also simulate this mechanism by using simple example.

Keywords: Information Providing, Temporary Voluntary Organizations

1 Introduction

In recent year, we have become to be able to analyze a large-scale data because Information and Communication Technology (ICT for short) has been highly developing. Most of organizations as well as end users store various data in their computers. Computer users can analyze various data individually by their own Personal Computers (PCs for short) which have high performance hardware. Most of all profit organizations had stored data to get more benefit by analyzing it. For example, these data include number of staffs, number of branches, advertisements, clients attributes and behaviors, income and profits, and so on. Voluntary associations and organizations have some difficulties to analyze that kind of data and to make a strategy for their management due to few analysts in the organizations even though they have such data. Research institutes and universities which do not pursue profits improve their conditions, performances, management, and so on by using the method of Institutional Research (IR for short).

This method is available for temporary voluntary associations and organizations. For example, we assume that there are the people who live in a local community and they have to decide to hold a festival, to sell special products, or to build new institutions. In this case, they will create temporary organizations. Usually, these organizations will be voluntary. These similar temporary voluntary organizations exist in the world. However, a decision that is produced from a temporary voluntary organization hardly contribute to the other similar organizations. It is very hard to provide a temporary voluntary organization with the information created by the other organizations because there are no such systems. In

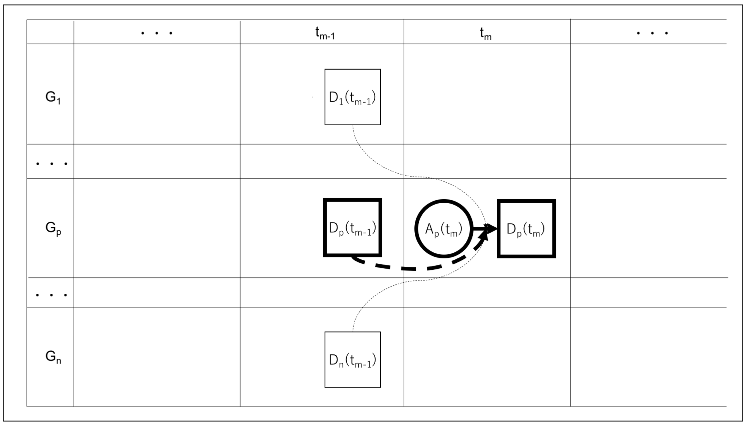

Figure 1: Traditional Mechanism

this paper, we design a method to provide such temporary voluntary organizations with available information to obtain the best decisions.

2 Preliminary

2.1 Cases based on Experiences

There is the influence of leadership soft skill with school improvement [1]. This skill include communication skill to gather various data. In other words, organizations having no soft skills will be ruined. For example, universities in USA raise donation for their better performance and management after using data [2].

2.2 Institutional Research

Many permanently voluntary associations and organizations exist. University is one of these organizations. Universities must check themselves on the aspects like scientific research, education, and social contribution. Many universities pay attention to Institutional Research (IR for short). IR is used to support institutional planning, decision-making and improvement by providing information and its analysis [3]. To share and co-develop informational systems to gather various data, virtual environments were introduced [4][5]. To gather various data from students and teachers, some questionnaire survey systems were introduced in many universities [6][7]. These are activities of IR.

3 Design

In this section, we show a design on information providing service for temporary groups. These groups mean organizations and associations. We explain the traditional mechanism and propose our design.

3.1 Traditional Mechanism

We assume that a temporary voluntary group exist independently. The group can use its own information to decide something. Unfortunately, the group hardly uses the information provided by the other groups because there are no services providing information one another. The group can only use its own attributes and its own previous decision. The following formula represent the situation.

$$D_p(t_m) = F_p(A_p(t_m), D_p(t_{m-1})) \tag{1}$$

Here, the symbols used in the formula (1) are as follows.

- $D_p(t_m)$ means the decision that the temporary voluntary group G_p can obtain at the time t_m.
- F_p means the function as a process of the discussion in that a temporary voluntary group G_p using $A_p(t_m)$ and $D_p(t_{m-1})$.
- $A_p(t_m)$ means the attributes that the temporary voluntary group G_p originally has at the time t_m.
- $D_p(t_{m-1})$ means the decision that the temporary voluntary group G_p obtained at the time t_{m-1}.
- t_{m-1} means the previous time of the time t_m.

$A_p(t_m)$ affects the decision $D_p(t_m)$ greatly because the group G_p cannot use the information from the other groups. Figure 1, which consists of a circle, squares, and arrows, explains the formula (1). Here, the circle means the attribute, the squares mean the decisions, the broken arrows mean the effects on the decisions by the decisions of the other groups, and the solid arrows mean the effects on the decisions by the attribute. The thin arrows mean the attributes and the decisions influence the decision indirectly, for example, rumor, entries of blogs, and so on. The thick arrows mean the attributes and the decisions affect the decision directly, for example, number and sort of participants, fund of the group, opinions created from the group, and so on.

3.2 Proposed Service

We assume that n temporary voluntary groups exist. The proposed service is greatly different from the traditional mechanism mentioned in Section 3.1. One of these temporary voluntary groups can use not only its own data but also the data from other organizations in order to decide something. The following formula represent the situation.

$$D_p(t_m) = F_p\left(A_p(t_m), \bigcup_{j=1}^{n} D_j(t_{m-1})\right) \tag{2}$$

Here, the symbols used in the formula (2) are as follows.

- $D_p(t_m)$ is the decision that a temporary voluntary group G_p can obtain at the time t_m. The group G_p is one of similar temporary voluntary groups. The number of these groups is n.

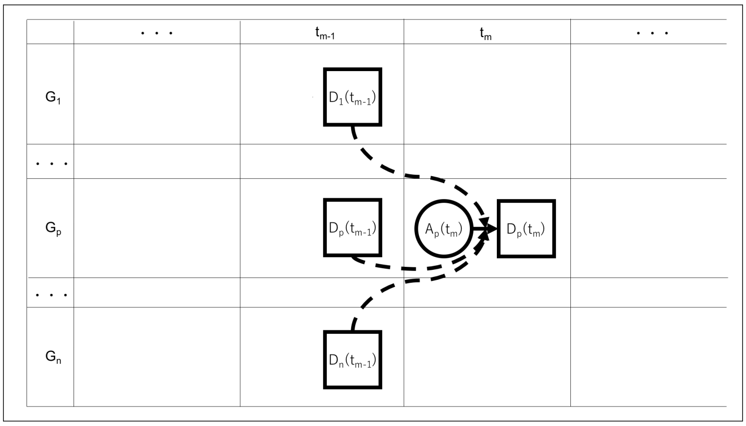

Figure 2: Proposal Mechanism

- F_p means the function as a process of a discussion in that a temporary voluntary group G_p using $A_p(t_m)$ and $D_j(t_{m-1})$ where $j = 1, \cdots, n$.
- $A_p(t_m)$ means the attributes that a temporary voluntary group G_p originally has at the time t_m.
- $D_j(t_{m-1})$ means the decision that a temporary voluntary group G_j obtained at the time t_{m-1}.
- t_{m-1} means the previous time of the time t_m

The decision $D_p(t_m)$ is greatly affected by $A_p(t_m)$ and $D_j(t_{m-1})$ where $j = 1, \cdots, n$. In our proposed service, a group can use the data from own and other decisions at the time t_{m-1} when the group decides something at the time t_m. Figure 2, where the symbols used in the figure are same as the ones mentioned in Section 3.1, explains formula (2). Our service enables a group to decide something precisely by providing not only own data but also data obtained from other groups.

4 Conceptual Simulation

In this section, we show a conceptual simulation using our service. We assume that three temporary voluntary groups (G_1, G_2, and G_3 shown in Table 1) exist. These groups intend to decide whether their reunion should be held. Each group has number of committee members, estimate number of participants, and initial capital as attributes .

4.1 Discussion in G_1 at time t_0

There are no own and other decisions. Therefore, the formula (3) shows that the group G_1 starts discussing at time t_0 with only its own attributes ($A_1(t_0)$).

$$D_1(t_0) = F_1(A_1(t_0), \emptyset) \tag{3}$$

Figure 3 shows that G_1 could decide nothing at t_0. That is to say, $D_1(t_0)$ means “undecided”.

Table 1: Assumption and Final Decision in Conceptual Simulation

group number	attributes: number of committee members	estimate number of participants	initial capital	final decision
G_1	10	600	\$1,000	held
G_2	10	100	\$300	not held
G_3	10	300	\$2,000	held

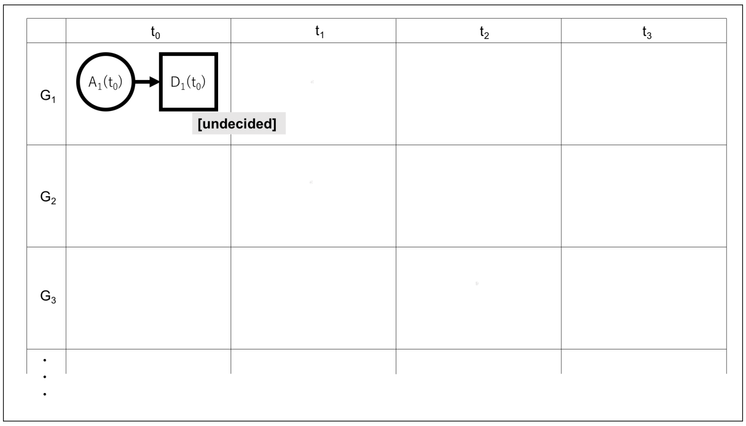

Figure 3: Discussion in G_1 at time t_0

4.2 Discussions in G_1 and G_2 at time t_1

The formula (4) and (5) show that the group G_1 and G_2 start discussing at time t_1 with these own attributes ($A_1(t_1)$ and $A_2(t_1)$) and the decision ($D_1(t_0)$), respectively.

$$D_1(t_1) = F_1(A_1(t_1), D_1(t_0)) \tag{4}$$

$$D_2(t_1) = F_2(A_2(t_1), D_1(t_0)) \tag{5}$$

Figure 4 shows that G_1 could decide that its reunion would be held at t_1. That is to say, $D_1(t_1)$ means "held". This figure also shows that G_2 could decide that its reunion would not be held at t_1. That is to say, $D_2(t_1)$ means "not held". The reason why the reunion for G_2 will not be held, for example, is that there is some fear to be in deficit after holding the reunion because of small estimate number of participants.

4.3 Discussion in G_3 at time t_2

The formula (6) shows that the group G_3 starts discussing at time t_2 with these own attributes ($A_3(t_2)$) and the decisions ($D_1(t_1)$ and $D_2(t_1)$).

$$D_3(t_2) = F_3(A_3(t_2), D_1(t_1) \cup D_2(t_1)) \tag{6}$$

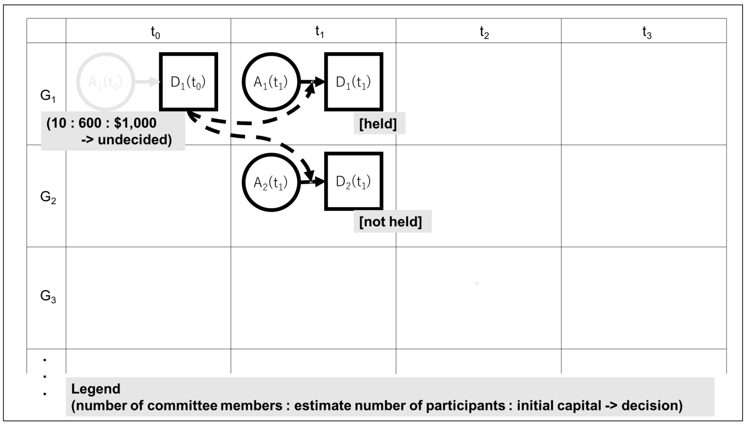

Figure 4: Discussions in G_1 and G_2 at time t_1

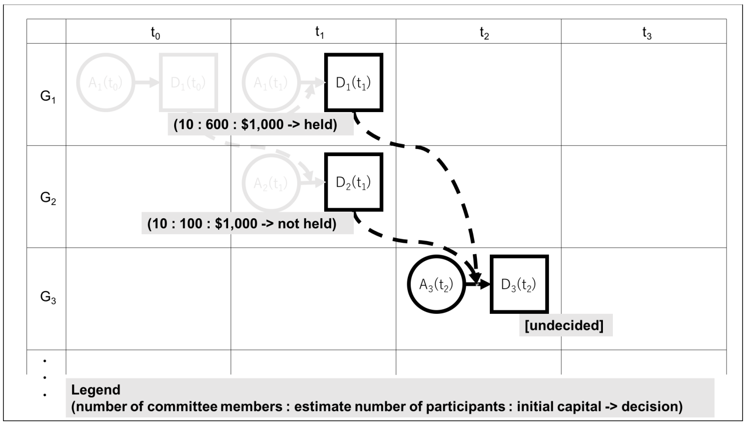

Figure 5: Discussion in G_3 at time t_2

Figure 5 shows that G_3 could decide nothing at t_2. That is to say, $D_3(t_2)$ means "undecided" because $D_1(t_1)$ is "held" while $D_2(t_1)$ is "not held". Then the group G_3 put off a decision next time.

4.4 Discussion in G_3 at time t_3

The formula (7) shows that the group G_3 starts discussing at time t_3 with these own attributes ($A_3(t_3)$) and the decisions ($D_1(t_2)$, $D_2(t_2)$, and $D_3(t_2)$).

$$D_3(t_3) = F_3(A_3(t_3), D_1(t_2) \cup D_2(t_2) \cup D_3(t_2)) \quad (7)$$

Here, the formulas $D_1(t_2) = D_1(t_1)$ and $D_2(t_2) = D_2(t_1)$ are valid because $D_1(t_2)$ and $D_2(t_2)$ are same as decisions at t_1. Figure 6 shows that G_3 could decide that its reunion would be held at t_3. That is to say, $D_3(t_3)$ means "held". The reason why the reunion for G_3 will be held, for example, is that there is a firm belief to be in surplus after holding the reunion because of enough estimate number of participants and initial capital.

As mentioned above, following our design, a group can decide something by using the decisions obtained from the other groups. The group G_3 might decide not to be held

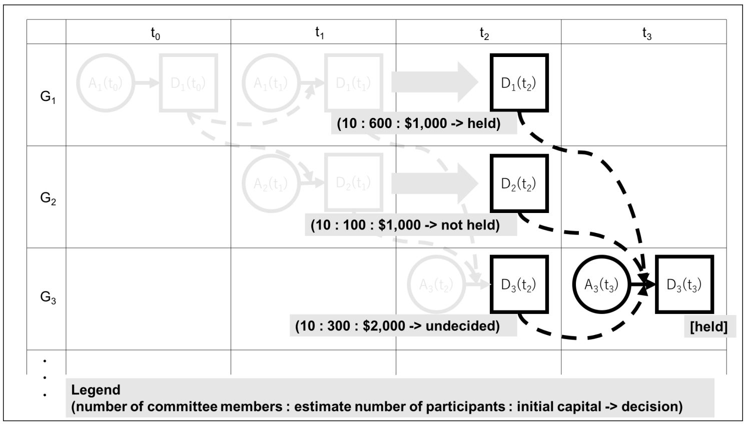

Figure 6: Discussion in G_3 at time t_3

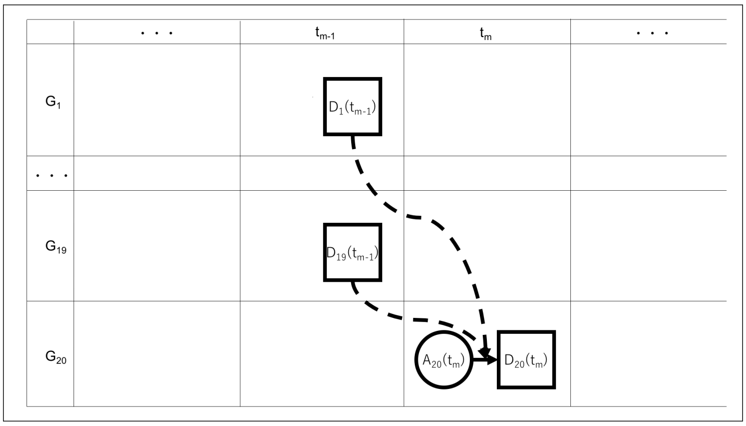

Figure 7: Schematic diagram of simulation by using cosine similarity

reunion even though there are potential to be held reunion in its attributes if the group used traditional mechanism.

5 Calculative Simulation

In this section, we show a calculative simulation using our service. We assume that twenty groups exist. All groups have three attributes respectively as shown in Table 2. We also assume that groups from G_1 to G_{19} have already decided whether they should hold their reunions or not at time t_{m-1}. In this condition, we will explain how group G_{20} can decide whether its reunion should be held or not at time t_m. In Figure 7, we show a schematic diagram of this condition. Moreover, the formula (8) explains the Figure 7.

$$D_{20}\left(t_m\right) = F_{20}\left(A_{20}\left(t_m\right), \bigcup_{j=1}^{19} D_j\left(t_{m-1}\right)\right) \tag{8}$$

We use the cosine similarity as F_{20} in the formula (8). We have to define vectors in order to use the cosine similarity. Before we explain the cosine similarity, we will show how to

Table 2: Assumption and Final Decision in Simulation by Cosine Similarity ($x_{i,j}$)

group number	attributes			final decision
	number of committee members a_1	estimate number of participants a_2	initial capital a_3	
G_1	10	600	\$1,000	held
G_2	10	100	\$300	not held
G_3	10	300	\$2,000	held
G_4	10	572	\$1,325	held
G_5	13	604	\$1,109	held
G_6	18	429	\$256	not held
G_7	4	82	\$1,449	not held
G_8	12	488	\$443	not held
G_9	12	613	\$1,686	held
G_{10}	15	402	\$1,722	held
G_{11}	18	230	\$245	not held
G_{12}	14	259	\$1,146	not held
G_{13}	10	743	\$288	held
G_{14}	12	170	\$451	not held
G_{15}	19	215	\$1,077	not held
G_{16}	2	224	\$1,047	not held
G_{17}	12	700	\$460	held
G_{18}	4	737	\$1,975	held
G_{19}	18	372	\$1,129	held
G_{20}	**19**	**191**	**\$414**	**undecided**

make vectors.

5.1 Making Vector

We treat values shown in Table 2 as numeric values simply. First, we define that $x_{i,j}$ is the value of the attribute a_i for group G_j. Here, a_1 means the number of committee members, a_2 means the estimate number of participants, and a_3 means the initial capital as shown in Table 2.

High value appeared in a vector can influence the cosine similarity we will mention later. The elements of the vector are the values of attributes since we would like to make vectors for every group. For example, the attribute a_3 will greatly influence the cosine similarity because the values shown in a_3 are higher than the other attributes in Table 2. Therefore, after normalizing $x_{i,j}$, we calculate $x'_{i,j}$.

We use the standard deviation in order to normalize $x_{i,j}$. First we have to calculate $\overline{x_i}$ which is the average of values for attribute a_i and s_i which is the standard deviation of values

Table 3: Normalization of Attributes in Table 2 ($x'_{i,j}$)

group number	attributes: number of committee members a_1	estimate number of participants a_2	initial capital a_3	cosine similarity with G_{20}
G_1	-0.434	0.936	0.041	-0.772
G_2	-0.434	-1.422	-1.171	0.513
G_3	-0.434	-0.479	1.774	-0.497
G_4	-0.434	0.804	0.604	-0.919
G_5	0.186	0.955	0.230	-0.455
G_6	1.220	0.129	-1.248	0.811
G_7	-1.675	-1.507	0.819	-0.354
G_8	-0.021	0.408	-0.924	0.231
G_9	-0.021	0.997	1.230	-0.703
G_{10}	0.600	0.002	1.292	-0.143
G_{11}	1.220	-0.809	-1.267	0.979
G_{12}	0.393	-0.672	0.294	0.568
G_{13}	-0.434	1.611	-1.192	-0.259
G_{14}	-0.021	-1.092	-0.910	0.685
G_{15}	1.427	-0.880	0.175	0.816
G_{16}	-2.088	-0.838	0.123	-0.505
G_{17}	-0.021	1.408	-0.894	-0.168
G_{18}	-1.675	1.582	1.731	-0.983
G_{19}	1.220	-0.139	0.265	0.648
$\mathbf{G_{20}}$	**1.427**	**-0.993**	**-0.974**	**1.000**

for attribute a_i. $\overline{x_i}$ and s_i are calculated by the formula (9) and (10) respectively.

$$\overline{x_i} = \frac{1}{n}\sum_{j=1}^{n} x_{i,j} \tag{9}$$

$$s_i = \sqrt{\frac{1}{n}\sum_{j=1}^{n}(x_{i,j} - \overline{x_i})^2} \tag{10}$$

Here, n is the total number of groups, that is, $n = 20$. $x'_{i,j}$ is calculated by using $x_{i,j}$, $\overline{x_i}$, and s_i as shown in formula (11).

$$x'_{i,j} = \frac{x_{i,j} - \overline{x_i}}{s_i} \tag{11}$$

We make vectors $V_{G_j}(j = 1, \cdots, 20)$ which are consisted by $x'_{i,j}$ for group G_j as shown in Table 3. V_{G_j} is shown in formula (12) because there are three attributes which are a_1, a_2, and a_3 in our situation.

$$V_{G_j} = (x'_{1,j}, x'_{2,j}, x'_{3,j}) \tag{12}$$

Table 4: Comparing G_{11} with G_{20}

group number	attributes: number of committee members a_1	estimate number of participants a_2	initial capital a_3	final decision
G_{11}	18	230	\$245	not held
G_{18}	4	737	\$1,975	held
G_{20}	19	191	\$414	undecided

5.2 Cosine Similarity

We calculate $Sim(V_{G_p}, V_{G_q})$ which is a cosine similarity between group G_p and group G_q. $Sim(V_{G_p}, V_{G_q})$ is calculated by using formula (13).

$$Sim(V_{G_p}, V_{G_q}) = \frac{V_{G_p} \cdot V_{G_q}}{|V_{G_p}||V_{G_q}|} \tag{13}$$

Here, $V_{G_p} \cdot V_{G_q}$ and $|V_{G_j}|$ are calculated by using formula (14) and (15) respectively.

$$V_{G_p} \cdot V_{G_q} = x'_{1,p} \cdot x'_{1,q} + x'_{2,p} \cdot x'_{2,q} + x'_{3,p} \cdot x'_{3,q} \tag{14}$$

$$|V_{G_j}| = \sqrt{{x'_{1,j}}^2 + {x'_{2,j}}^2 + {x'_{3,j}}^2} \tag{15}$$

5.3 Decision for group G_{20}

We compare group G_{20} with other nineteen groups by using formula (13). On the most right line in Table 3, the cosine similarities with group G_{20} are shown. $Sim(V_{G_p}, V_{G_q}) = 1$ means that vectors V_{G_p} and V_{G_q} turn in the same direction, that is, V_{G_p} is most similar to V_{G_q}. Conversely, $Sim(V_{G_p}, V_{G_q}) = -1$ means that vectors V_{G_p} and V_{G_q} turn in the opposite direction, that is, V_{G_p} is most different from V_{G_q}.

What we have to do is to find the cosine similarity that is the most nearly 1 in Table 3. We can find group G_{11} that has the cosine similarity 0.979 with group G_{20}. We can also find group G_{18} that has the cosine similarity -0.983 with group G_{20}. Then we verify whether group G_{20} is really similar to group G_{11}, and whether group G_{20} is not really similar to group G_{18}.

Table 4 contains group G_{11}, G_{18}, and G_{20} which are picked out from Table 2. We can understand that group G_{20} is surely similar to G_{11} and group G_{20} is not also similar to group G_{18}.

From these verification, group G_{20} can decide whether their reunion should be held by using the decision of G_{11}. Group G_{11} had already decided that their reunion was not held. Then, in this simulation, group G_{20} is proposed that their reunion should not be held.

6 Discussion

In this section, we discuss how the service we designed in Section 3 is realized.

6.1 Distributed Database

In recent year, distributed databases are developed [8][9]. These databases can have attributes and decisions of every group. The analysis of stored data can vary the final decisions. There are two analyses: one is comparison between similar groups and another is observation of estrangement from average of all groups. The stored data are still distributed when similar groups are compared each other. Wrong decisions can be implied because the groups that are not similar to each other are ignored even if these ignored groups may have useful data. We can know the average of all data if all distributed data can be gathered together. Comparing own data with average data, each group can obtain suitable information.

6.2 Information Recommendation

In our design, some facts which are obtained from every temporary voluntary group for similar purpose can be used. Not only the facts are provided to each group, but also some proposals can be recommended by implying these facts [10][11]. In each group, several proposals are available instead of deciding something implied from these facts. For example, after entering attributes to the system that realized the function mentioned above, it is very happy that a suitable proposal is recommended.

7 Conclusion

In this paper, we explained the design on information providing service for temporary voluntary organizations. Until now, what such organizations could use are only their own information such as their present attributes and previous decisions. Each temporary voluntary organizations can use information from other similar organizations by using this design.

In section 5, we showed a calculative simulation of our design. We used a cosine similarity to support temporary voluntary groups deciding their intentions. The calculation method is available if all attributes can transform numeric values.

Actually, these information are not always received perfectly. In future work, we will pay attention to the loss of information. We will investigate how the receivers use the information sent. Moreover, we will observe how the abilities of the receivers affect the decisions. We will also search for other attributes which we can use in calculative simulation. We would like to do other calculative simulation such as clustering.

Acknowledgments

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