Group Decision-Making Model of Control Experiments in Crisis Management

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Abstract

As one of the most important technical decision model, Group Decision Supporting System (GDSS) has been paid more and more attention for its effects on constructing the group decision innovation capability and sustainable strategic competitiveness in the problem-solving tools. The study aims to explore the impacts of GDSS to decision process and decision effectiveness via series of urgencies, and furthermore analyze the differences of group decision process together with outcomes under different group decision making supporting mode. Additionally, by the specific control experiment our study ought to explore scientific model of urgent group decision as well as application scope and pre-assumptions.

Keywords: group decision-making; control experiment; crisis urgency; GDSS

1. Introduction

Research on Group Decision-making Supporting System (GDSS) involves fields of management, behavioral science, computer science, mathematics, psychology and sociology disciplines, which remains a study hot point in international conferences and academic journals. Watson et al (1988) [1] conducted an experimental study; the results show that face-to-face GDSS members on group decision-making process presents higher satisfaction. Chun and Park (1998)[2] delivered a GDSS research literature review, pointing out that the GDSS group in some cases, some aspects will be better than the manual group and group without any outer support. Studies by Fjermestad and Hiltz (1998)[3] have shown no significant differences between GDSS supporting groups and face-to-face group with no supports.

According to research done by Dennis and Gallupe (1993) [4], Nunamaker et al (1991) [5], there are three structures embedded in the GDSS technology, which can lead the interactions between the groups, these three structures are the simultaneity, anonymity and process structured. Previous researchers from the following three aspects evaluate the impact of GDSS: effectiveness, efficiency, and participant satisfaction. (Chun and Park, 1998[2]; Nunamaker et al., 1991)[5]. Of all the evaluation indexes, the quantity of ideas, decision time, and decision quality and decision satisfaction are the most common ones. Generally, the application of GDSS would increase the quantity of ideas elevated. (Dennis et al., 1996[6]; Hung et al., 1997[7]). The idea quantity is also the alternative option in our study. Some research indicate that compared to face-to-face group, GDSS group need more decision time, just as Easton (1989) [8] and Lewis (1982) [9] did. Although previous research results on GDSS decision quality appear some conflicts, GDSS groups in general raise the items. Decision quality is already used in many GDSS positive research to measure the effectiveness of group work (Sambamurthy, Poole, 1992[10]). Some positive study found that satisfactions of GDSS group participants are higher than non-GDSS counterparts, (Dennis et al. 1990[11]; Post 1992[12]; Vogel and Nunamaker 1990[13]). Other relevant experiments manifests the opposite analysis or results. (Easton et al., 1989[8]; Gallupe, 1990[14]; Watson, 1988[1]).

The main conclusion above is generally built on the typical business decision-making problems; however, there is little research on

the complexity aspects of sudden crisis event group decision-making. It is necessary to study the system support and manually difference about complex group decision-making in order to elevate the GDSS theory and technology to improve efficiency and effectiveness of group decision making.

2. Control experiment and technical design

2.1. Experiment objective

We use the control experiment to test differences of group decision process and results performances by crisis urgencies decisions under different decision supporting model.

Control experiment is one of testing method frequently used in scientific research, which is applied to find the influence from target factors to specific test. Typically, one control experiment is divided into experimental group and control group, of which the experimental group admits variable handling while control group does not. By controlling other variables and randomly assigning members of experimental group & control group, make irrelevant variable a considerable impact on the experimental and control groups. Therefore, the differences between two sectors above could be regarded as the leading factor by experimental variables.

In our study, we offer or do not offer GDSS for experimental participants, and explore impacts from group decision process by GDSS through comparing, analyzing results of control experiment. Additionally, we also expect to find the weakness as well as shortcomings of GDSS in order to lay positive foundations for the improvement and application scope of GDSS.

2.2. Procedural designs

The experiment applied 2*3 factor design, and is divided into experimental group and control group according to the system support. Each group ought to face the same crisis urgency which is cut in three stages, and every group need offer a team of alternative options to make group decision in each stage. In the end, one option case will be chosen as the final solution for the team.

Each group owns the same hardware resources and gets the task done independently. Also each group would acquire the current spot-time scenario information of crisis urgencies by the projection scream tool. Every member in the team owns a computer connecting the Internet, but they are only permitted to use GDSS system(namely system team below); members of control group are not allowed to use GDSS system, but are permitted to search the similar incidents in the history at their own disposal (we call it as manual team below). One point should be instructed that each group at the very beginning should raise the alternative options, and then make the final program in order for group decision. In the stage of alternatives, members need to raise one program without any mutual exchange. System group check example case by CBR and then raise program, while manual group with no GDSS finish the step through individual experience as well as the internet. In the group decision stage, members of system group achieve anonymous exchanges by Bulletin Board offered from system, and provide AHP score through GDSS. By system setback the process could not end until certain common sense achieved.

When designing testing questions of urgent crisis, the task in three stages will be divided into 3 categories according to the complexity, namely simple, general complex, complex. At the same time, every stage all establishes a set of program as the “standard key”. In detail, each experiment simulates a group decision process under the context of urgent crisis, such as tsunami, rainstorm. All the experimental subjects are originated from the true historical incidents, and take into account of possible best decision in the specific environment. If the decision was a failure one, we would adjust them correspondingly.

3.Control experiment process

The experiment is divided by system group and manual group just as the Figure1 shows below.

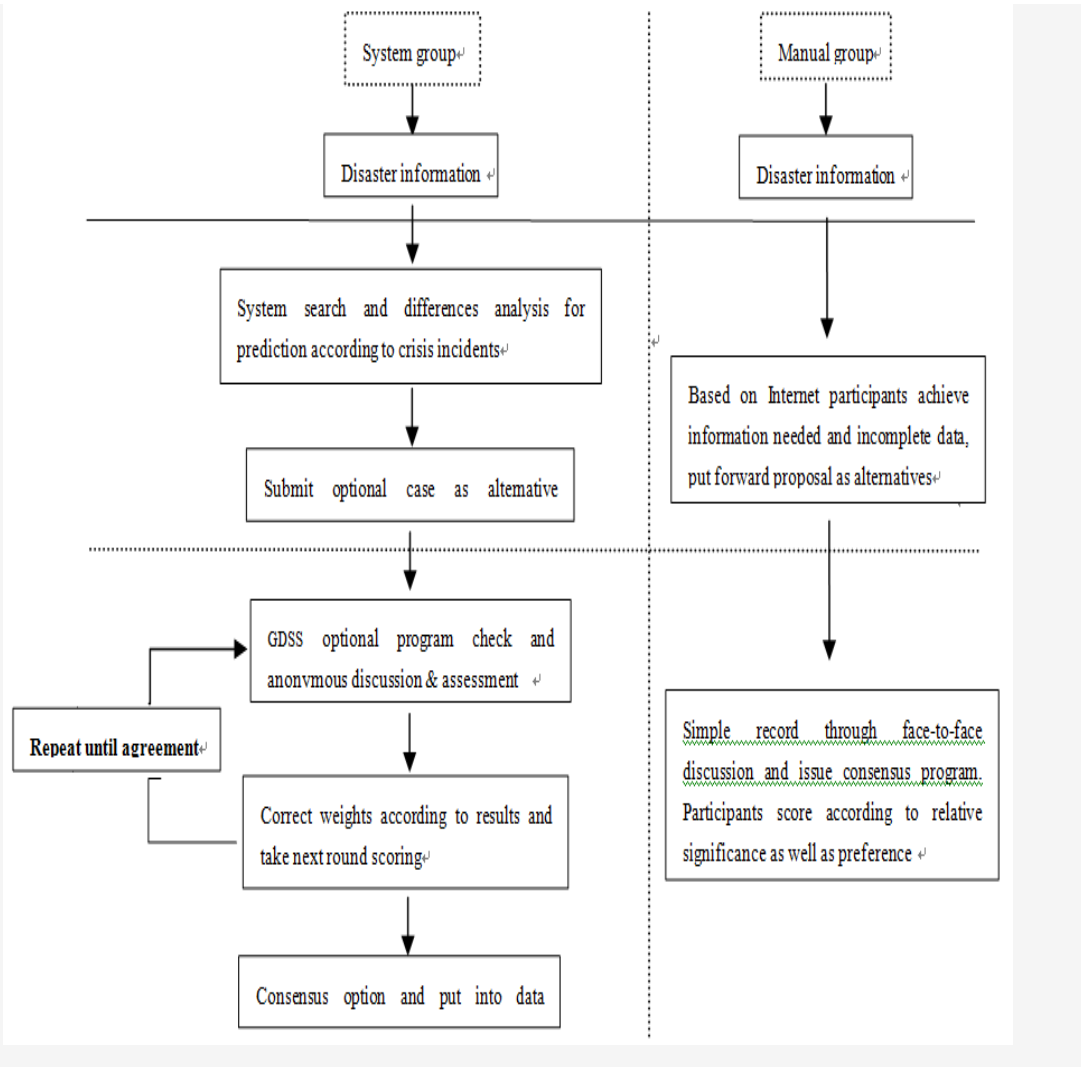

Fig.1 Experiment group and process

3.1. System groups embedded with GDSS

For system group, each stage is comprised of three parts:

Display current disaster information

The host is responsible for providing current information of urgent incident for experimental participants, including disaster state quo, development, side effects, etc.

Raise alternative options participants select traits of disaster according to current development, and carry out search about historical examples by the use of CBR deductive system. Through this step, it ought to search the correspondent crisis decision program.

Each participant makes discrepancy analysis and predictions according to the incomplete disaster information admitted.

Each participant analyzes the known information, and ought to raise the alternative as the optional program accompanying with their own judgment, experiences, tuition, knowledge and preferences.

The optional program ought to be stored and submitted to the host. the group decision

After accumulating all the alternatives raised by the participants, the host takes the merger process, and chooses the feasible options as the option sets for all participants. With the aid of GDSS participants start to make group decisions via human-computer interaction.

Entering GDSS, participants make anonymous discussion and mutual comparison among different programs. After that according to the preferences, each takes score and submits the results.

GDSS makes back accounting in ref-
erence to the score table, put forward such indexes consistency, conscious differences, assertive, and return to every participants.

Participants achieve a comprehensive understanding for oneself according to the feedback, and then enter into the next round for scoring.

The system repeats process a. b. c.
until the host believes agreement has been achieved.

Put the agreed case into the data sto
rage for better use after.

In the total process, GDSS makes time mark for every options as well as the process achieved, and takes record of consistency, conscious differences, assertive aspects. After agreement in each stage, the process enter into next one, this time information of a new urgent incident could be checked for a new round group decision.

3.2. Manual group without GDSS support

For the traditional face-to-face group decision group, each stage is comprised of three parts:

After the experiment the host display
current information of urgent crisis for participants, including disaster status quo, development, side disaster happening.

The host is not supposed to provide
GDSS and supporting function. Manual groups do not offer thesame example with aid of CBR, only in the assistance of individual experiences and internet search.

With the face to face discussion and
simple record, participants make record of agreed program, while each one scores according to the relative degree of significance and preference judgment. Therefore, members of manual group could not be able to achieve such feedback indexes of consistency, conscious differences as well as assertive

After all the three stages, aside from
the final feedback of standard answer from experimental participants, the system also issued satisfaction survey papers for appraisal of experiment process (only adaptive to system group).

4 Analysis of experimental results

4.1. Relevance between the assertive natures with system among participants

Tab.1 Assertive nature between system group and manual group

stage	mean of system group	St.Dev of system group	mean of manual group	St. Dev of manual group
1	0.836	0.066	0.913	0.049
2	0.859	0.055	0.922	0.045
3	0.871	0.051	0.952	0.046
Total	0.866	0.055	0.938	0.046

The assertive nature in the system group remains a relative low standard, which indicates participants present a well recognition for different options under the system support. Additionally, as time went by, system team remains a more stable assertive nature while the manual team grows worse. with development of group decision our opinion is that decision-makers could become anxious for the previous option through comparisons among other examples, and quit previous view for the mainstream one. While the incidents become more and more serious as well as complicated decision problems, participants could be more willing to accept outer opinions and make adjustments. System group is able to harvest specific intuitive results and remain assertive nature by independent thoughts. On the contrary, manual group is more easily influenced from outer elements due to face-to-face discussion and therefore the assertive nature become worse.

4.2. Relevance between the decision efficiency with system among participants

Tab.2 consensus differences between system group and manual group

stage	mean of system group	St.Dev of system group	mean of manual group	St. Dev of manual group
1	0.162	0.159	0.193	0.137
2	0.182	0.178	0.210	0.101
3	0.099	0.105	0.122	0.092
Total	0.148	0.162	0.177	0.116

In the aspect of search time for alternatives, the part of system group averages 8.1 minutes. Owing to each search in the current state of incident, participants would manifest significant difference in reading and presenting options. Additionally, from the standard deviation the first stage remains higher, just because different participant keep various in acquaintance with system time. In the next round , deviation is gradually less indicating

the applicability becomes less to individual effects, and participants are in familiar with the system. In the manual group, the average search time in every stage remains 10.2 minute and grows less gradually, we believe that participants have master relevant skills in searching data on the internet and consider the former state (namely the assistance of every search for disaster incidents). From the standard deviation every stage varies less possibly due to its searching capabilities.

Tab.3 option turnouts and measurements of consensus difference time between system group and manual group (unit: minute)

stage	average time for options in system group	St.Dev	average time for consensus in system group	St.Dev	average time for options in manual group	St.Dev	average time for consensus in manual group	St.Dev
1	19.100	4.355	39.010	4.052	20.478	5.722	13.980	4.552
2	3.612	1.334	26.120	2.011	6.385	1.462	6.323	1.356
3	2.010	0.887	36.255	1.882	5.236	2.266	4.878	1.552
Total	8.203	8.133	33.741	6.223	10.713	7.852	8.422	4.932

In the aspect of decision time, the manual group could experience a process of long discussion before individual scoring, but the consensus time still faster than the system group. The decision time is longer just because system group has achieved consensus through many round group decision. While the speed in manual group remains higher after long discussions. If the quality of group decision has an obvious elevation, we believe all the time cost is worthwhile.

5. Conclusions

According to the analysis of control experimental results for GDSS disaster group decision, we could conduct the following conclusions:

a. the system use could keep assertive nature for participants, and assertive nature of manual team is unstable even becomes more and more worse;

b. due to support of case data as well as data search system, time of alternative in every stage is superior to manual team;

c. the system support could effectively improve degree of consensus for participants, but could not effectively lessen decision time;

d. decision effects of system team keep growing stably, while the part of manual one remains unstable.

e. on the condition of more complex crisis incidents in the experimental test subjects, the effect of GDSS indicates better for group decision. The face-to-face group decision becomes even better for relative simple problems.

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