

A Framework of Group Decision-Making in Network Environment

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Summary

The group decision-making (GDM) problem in network environment is a new research topic. It should be paid more attention. First, this paper gives a review of the relevant research on GDM in network environment and points out limitations of the existing research results. Then, the paper analyzes the main characteristics of the GDM problem in network environment. On the basis of this, a framework of GDM in network environment and its descriptions are presented. Furthermore, main research contents and meanings on GDM in network environment are also given. The work of this paper has important guiding significance to investigate GDM problems in network environment.

Key words:

group decision-making (GDM); network environment; decision support; information/knowledge

1. Introduction

Since group decision-making (GDM) has many practical backgrounds in society, economy, management and engineering, etc. [1-3], theory and methods of GDM and group decision support system (GDSS) have been a very important research field in information science. We can find abundant research results on GDM and GDSS. With the development of knowledge-based economy and information technology (IT), many new GDM problems attract extensive attention, such as problems how to finish a GDM in network environment and how to integrate GDM technology with IT, and so on. In order to fit changes of GDM way and improve the efficiency and quality of GDM, we are faced with the new challenge in research on theory and methods of GDM. In this paper, characteristics of GDM problems in network environment are analyzed. Furthermore, research prospects for GDM problems in network environment are also given.

2. Literature Review on GDM

At present, research on theory and methods of GDM in network environment is a new topic, but there is a little of research results. We can find some relevant research results. They mainly focus on the following five respects.

1) With respect to the GDM problem with dynamic characteristic, we only find two articles for this research topic. Bendoly and Bachrach [4] study the multiple-period GDM problem. Zhuge and Shi [5] study the conflict GDM problem in dynamic environment.

2) With respect to the GDM problem with different formats of preference information. Chiclana et al. [6] propose an approach to solve GDM problems with three preference formats, i.e., preference orderings, utility values and fuzzy preference relations, where the preference orderings and utility values are uniformed into the fuzzy preference relations. Then these uniformed representations are aggregated into a collective opinion based on the concept of fuzzy majority. The most desirable alternative is selected using two quantifier guided choice degrees of alternatives. Based on the work of [6], Fan and Jiang [7] propose an approach to solve GDM problems with four preference formats, i.e., preference orderings, utility values, fuzzy preference relations and multiplicative preference relations. In the approach, ordered weighted geometric operators are used to aggregate preference information of each expert and to rank the alternatives.

3) With respect to the GDM problem with multiple granularity linguistic assessment information, we only find two articles for this research topic. Herrera et al. [8, 9] propose the conception of multiple granularity linguistic assessment information and give an approach to integrate multiple granularity linguistic assessment information.

4) Fuzzy GDM methods and GDM methods based on linguistic variables are new research hotspots in recent years. Many scholars' research results can be found in [10] and [11].

5) With respect to the implement and application of GDSS in network environment, we can see the several new research results. For example, Tain and Ma [12] study the GDSS for selection of R&D projects. Ngai and Wat [13] study the fuzzy DSS based on web for risk analysis of e-commerce development. Deb and Bhattacharyya [14] study the fuzzy DSS for layout plan of manufacturing facilities.

To sum up, we can see that there are still some shortages in the existing research results of GDM, which includes the following five aspects.

a) Research results of the GDM problem with dynamic characteristic are very few. Research on the GDM problem with multiple stages is not considered.

b) For GDM problems with different formats of preference information, we can see some important and valuable research results, but these have not involved the preference information in the form of voting in GDM analysis.

c) For GDM problems with multiple granularity linguistic assessment, the proposed several conceptions and processing approaches are very important, but there is still a wide gap between the theory and practical application.

d) For fuzzy GDM methods and GDM methods based on linguistic variables, we can see a lot of research results, but GDM problems with multiple stages are not involved in fuzzy case.

e) In implement and application of GDSS in network environment, cases with multiple stages and multiple groups are not considered.

We can see that the existing research results on GDM still can not solve GDM problems in network environment well, but the existing relevant conceptions and methods are very helpful for further research.

3. Analysis of GDM Problems in Network Environment

Many important practical GDM problems, for example, strategic selection of regional economic development, selection of senior talents or leaders, selection of R&D projects, selection of large engineering projects, etc., have the following characteristics.

a) The process of GDM is mostly based on internet. GDM analysis usually needs that each expert or group gives his/her preference assessment information for the decision problem on internet.

b) When each expert or group gives his/her preference information for the decision problem, in order to enhance the quality of GDM, the relevant information/knowledge needs to be provided.

c) The process of GDM is very complicated. It is composed of multiple stages and is participated by multiple groups (namely multiple organizations). For example, the GDM process of selection of Natural Scientific Foundation of China (NSFC) projects is composed of the first comment, comment by letter, joint comment and so on. The expert or group who offers preference information is often different in different stages.

d) The subjective judgment or preference information provided by each expert or group is mostly in multiple formats and multiple granularities, For example, the point values (e.g. 1, 2, 3, 4, 5, etc.), fuzzy linguistic assessment

terms (e.g. excellent, good, moderate, bad, etc.) and voting (e.g. pass, fail, etc.). Besides, the preference information in the form of point value and fuzzy linguistic assessment term has the characteristics with multiple granularities, i.e., the grade number of point values set or the term number of linguistic terms set is different.

e) In network environment, all kinds of preference information provided by experts come from multiple stages and multiple groups. So, it needs to aggregate or synthesis the all preference information, to analysis the consensus of GDM and to select the most desirable alternative.

On the basic of above analysis, we think that GDM problems in network environment have characteristics such as multiple stages, multiple groups and multiple formats of preference information. The GDM process has complicated and also needs the support of relevant decision information/knowledge. They are obviously different from GDM problems that were studied in the past.

We can see that it is very difficult to use the existing theory and methods of GDM to solve GDM problems in network environment. The main problem is that the existing theory and methods do not consider how to solve GDM problems with multiple stages, multiple groups and multiple formats of preference information in network environment. Also, they do not consider how to push decision information/knowledge effectively to each expert or group. Therefore, it urgently needs to propose the effective theory and analysis methods to solve GDM problem in network environment. This is a new research topic. It is also abstracted from management science practice. The research is valuable not only in theory, but also in application. On the other hand, in order to improve the practicability and flexibility of GDSS in network environment and to improve the efficiency and quality of GDM, theory models and effectively algorithms of GDM in network environment also need to be developed.

4. Framework of GDM in Network Environment and Main Research Contents

The GDM problem in network environment is complicated. It has many characteristics, such as multiple stages, multiple groups, multiple formats of preference information, multiple information/knowledge, and so on. In this paper, we give a framework of GDM in network environment (see Fig. 1).

It can be seen in Fig. 1 that the framework of GDM in network environment is divided into six layers.

1) Layer of decision process. The process of GDM in network environment is divided into multiple decision stages. In each decision stage, the corresponding decision

group analyzes the current decision alternative set and gives the decision analysis result at this stage.

2) Layer of decision group. The different decision group participates in decision analysis at each stage.

3) Layer of network environment. This layer includes Internet, Intranet and Extranet. The decision groups which distribute in different fields make their decision or judgment in each stage through this layer.

4) Layer of decision alternative. The decision alternative sets for decision analysis at each decision stage are different.

5) Layer of decision model. This layer includes the decision model, information processing model, knowledge reasoning model and information/knowledge pushing model which support decision groups.

6) Layer of decision resource. This layer includes data and information resource in various organizational information systems. It also includes the tacit knowledge and explicit knowledge which comes from these data and information resource.

decision problems are complicated, so a same decision alternative often needs to be assessed by experts from different fields.

2) Methods for processing and aggregating the intra-group information/knowledge resource. In network environment, the business activities, management activities as well as some traditional resources (e.g. fund, personnel and materials) in an organization have already been informatized through numerous information systems, such as electronic data interchange (EDI), management information system (MIS), manufacture resource plan (MRP), enterprise resource plan (ERP), supplier relationship management (SRM), customer relationship management (CRM), office automation (OA), knowledge management (KM), content management (CM) and so on. But the data, information and knowledge provided by these systems are often in multiple formats. In order to push the appropriate decision information/knowledge to the appropriate experts or group, problems of information processing, knowledge

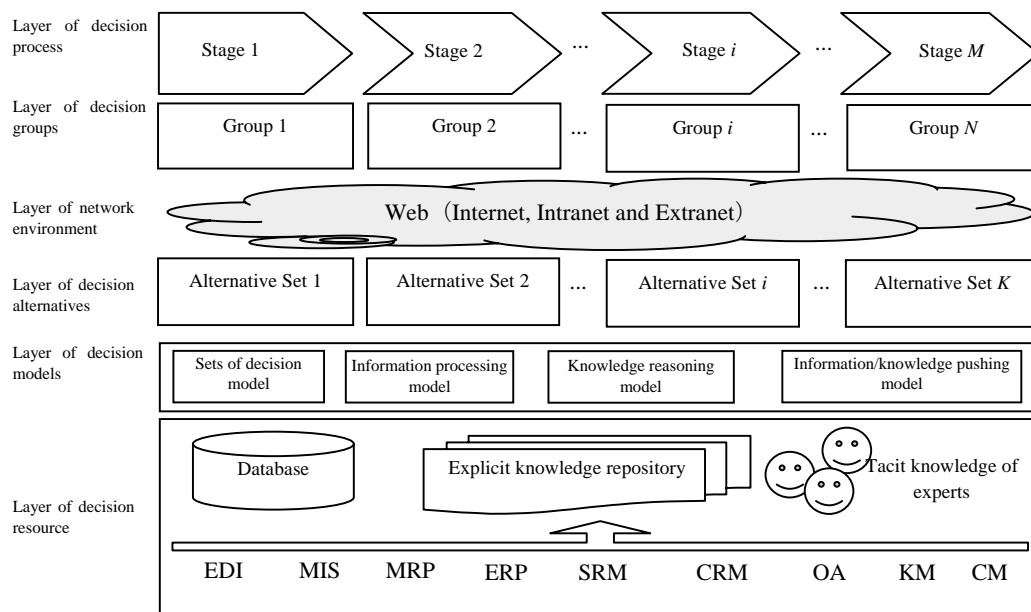


Fig. 1 The framework of GDM in network environment

On the basis of above analysis, main research contents of GDM problems in network environment includes the following five aspects.

1) The process model of GDM in network environment. The process of GDM in network often has the characteristics such as multiple stages. One reason is maybe that many decision alternatives need to be selected gradually in several different stages. For example, the selection of a NSFC project has the characteristic of multiple stages. The other reason is maybe that some

theory, method and application for GDM in network environment. This is a very important research topic presently. Main research contents for this include 5 aspects. (i) Processes of GDM with multiple stages and multiple groups need to be studied. The general procedure of GDM in network environment also needs to be studied. (ii) Uniformity methods for preference information provided by experts with multiple stages, multiple groups, multiple formats and multiple granularities need to be studied in GDM analysis. In this aspect, uniformity

methods for different formats of preference information based on constructing transformation functions or optimization models should be studied further. Consensus analysis of expert's logic judgment before and after uniforming preference information should also need to be studied. (iii) Group aggregation methods and alternative selection methods for preference information with multiple stages and multiple groups need to be studied. In this aspect, they need to be studied based on information aggregation operators or optimization models. (iv) Consensus analysis methods for GDM with multiple groups need to be studied. In this aspect, the discrepancy between the result of GDM and the assessment information of each group needs to be analyzed. Methods for evaluating the consensus degree and non-consensus degree of GDM result need to be proposed. Furthermore, algorithms of human-computer interaction and negotiations also need to be developed to improve the consensus degree of GDM with multiple groups. (v) Methods for GDM with multiple stages, multiple groups and incomplete preference information need to be studied. (vi) For solving practical GDM problems such as selection of engineering projects, selection of R&D projects and so on, models, algorithms and applications of GDM with multiple stages and multiple groups need to be given to develop the corresponding computer software.

In order to study GDM problems in network environment profoundly, it is very important to use or combine the relevant theory and methods of operation research, fuzzy mathematics, information management and knowledge management. In this way, some new conceptions, theory and methods will be developed inevitably, which include not only methods and technologies of GDM support, but also theory and methods of GDM.

5. Conclusions

With rapid development of IT, many changes of ways of management and GDM occur. The problem how to make a decision efficiently in network environment needs to be studied urgently. This paper analyzes characteristics of GDM problems in network environment and gives a framework of GDM as well as the corresponding main research contents. It has important practical meaning how to combine IT and GDM technologies and how to develop or perfect theory and methods of GDM as well as GDSS. It also has guidance meanings how to develop the new research work for GDM in network environment. However, there are a lot of basic theoretical problems for solving GDM problems in network environment, which still need to be studied and discussed. For example, the problem of formation mechanism and evaluation of "consensus" among GDM and the problem of

representation and evaluation of GDS utility still lacks the support of theory and methods presently. Therefore, these problems will be also important research contents in future.

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