IGFSS evades confirmation bias in construction management

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Abstract: Rational people must be affected by the fluctuation of subjective factors in the process of behavioral decision-making. This kind of fluctuation is the confirmatory bias. Based on the decision problem in construction management, this paper establishes a group decision support system (GFSS) based on fuzzy analytic hierarchy process, and improves the system flow through the expert clustering analysis results based on projection pursuit. Then the system is promoted and our system is applied in the actual engineering project. Finally, through the comparison of decision accuracy, it is proved that the system is obviously scientific and accurate compared with the Delphi decision method.

1. Introduction

Simon Kuznets pointed out: "Because the world is too big and too complex, and the ability of the human brain to process information is very limited, human decision-making cannot be rational in many cases." Coincidentally, Kahneman and Tversky also proved the hypothesis of bounded rationality through behavioral psychology experiments. So how to overcome the confirmatory bias is particularly important [1]. This paper will focus on the impact of confirmatory bias in engineering project management behavior decisions and how to overcome the impact of confirmatory bias on rational behavior.

2. Summary of confirmatory deviations

2.1 Types of confirmatory deviations

Behavioral economics believes that this bias is inevitable, which means that people are often only willing to see the facts they want to see.

Taber and Lodge confirmed through two sets of student experiments that the confirmatory deviations coexisted in the 6 categories shown below, and finally determined that all experimental samples were all accompanied by confirmatory deviations:

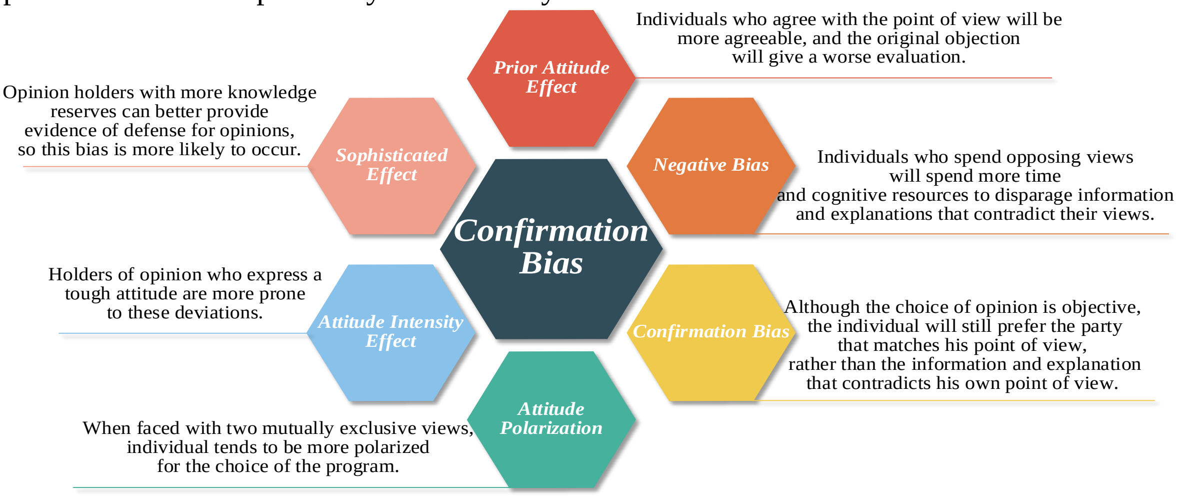

Figure 1 Six manifestations of confirmatory bias

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2.2 Reasons for the formation of confirmatory deviations

Based on previous data and research, this paper believes that the reasons for causing confirmatory bias in rational people's behavioral decision-making are as follows: 1. Rational people have their own unique worldview, so accepting information that contradicts their own views will bring their own worldview. A certain degree of shock can even lead to mental stress. Even rational people are affected by perceptual thinking and produce irrational emotions, which leads to confirmatory bias. 2. When emotional aversion is caused by loss and remorse, rational people as the main body of behavioral decision-making will be confirmed by deviating deviation. The occurrence of the resulting and wrong additions, resulting in the wrong cycle of death [3].

3. Research status

Although the current recognition of confirmatory bias at home and abroad has matured and can reasonably recognize the perceptual bias in behavioral decision-making, there are few reasonable and effective programs to avoid the risks and losses caused by confirmatory bias. Therefore, based on the existing research, this paper takes the decision-making in the project management process as the starting point and analyzes how to reduce the risk of confirmatory deviation.

4. Establish a scientific decision analysis system

In the traditional behavioral decision-making field, the decision-making layer only judges by means of heuristic analysis, and even resorts to experts and evaluates by Delphi method, and finally it is difficult to achieve the purpose of reducing the influence of subjective factors on the results. In this paper, for the construction enterprise, from the perspective of the project management, the group decision support system based on the fuzzy analytic hierarchy process as shown in Fig. 2 is established to provide a choice for the behavior in the project management.

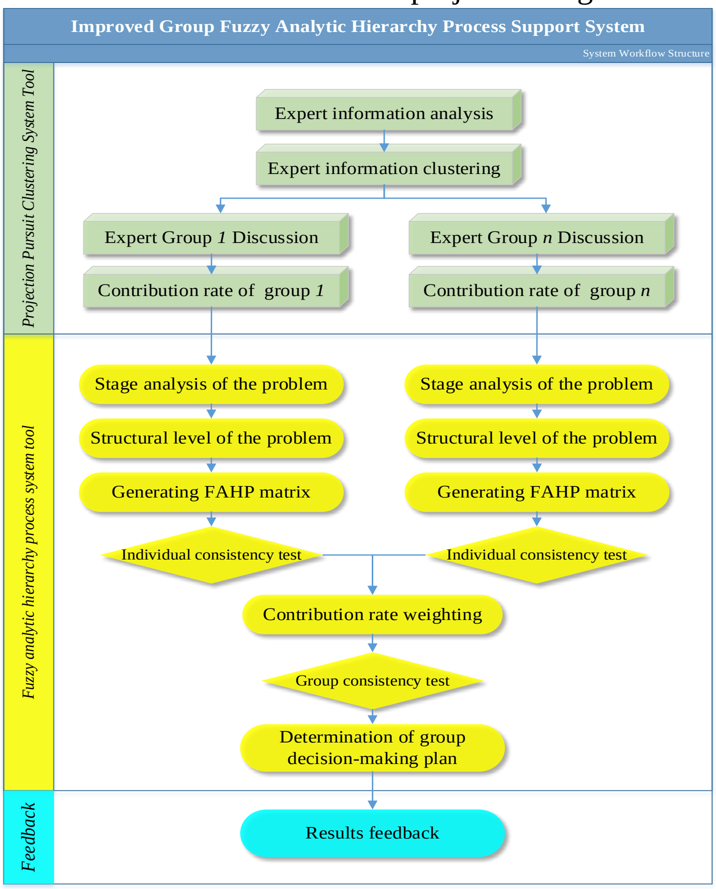

Figure 2 Flow chart of improving GFSS decision system

4.1 Phased analysis of confirmatory bias

In the face of the same problem of the project, the members of the expert group will go through two stages: first, the stage of independent thinking to give the conclusion, and then the stage of the program game giving the reference plan. Among them, the first stage is always the confirmatory deviation dominated by the veteran effect and the confirmed deviation. Throughout the second stage, it is always confirmed that the attitude intensity effect and the previous attitude effect are the dominant confirmatory deviation. Therefore, it is necessary to start from the staged performance of how to avoid the confirmatory deviation, and to achieve more rational and scientific as a whole.

4.2 Deviation processing in the thinking stage

4.2.1 Overview of deviations

Since the academic experience of each member of the expert group is different from that of the main attack, the selection results of the solutions given by the expert group for the same problem are not the same. Similarly, similar experts can give a higher degree of similarity. Therefore, this paper gives a solution to the project problem while avoiding the verifiable deviation by establishing an improved GFSS decision support system.

4.2.2 Expert Information Clustering

The decision support system provides different expert clustering scales for different scopes of application. The first step of the decision-making system is based on the static indicator data provided by the expert's unit, including gender, age, length of service, education, occupation, research direction, job performance, and ability to work [5], based on the scale range set by the system for projection pursuit. Clustering (PPE). (Note: This article takes into account the high number of indicators provided by the expert group, and the use of projection pursuit clustering instead of the purpose of achieving easy operation and minimizing manual screening. The traditional K-means method clusters the members of the expert group.)

STEP 1: Give the system calibration reference value

For the eight indicators of the assessment expert, the system provides eight scale reference tables based on the SMART principle, and different scales are divided for different indicators.

STEP 2: Normalization and standardization of sample data

First, the sample data is normalized and normalized based on the principle of maximum and minimum.

STEP 3: Building the projection index function and realizing the optimization of the function [6]

Here, we make the multidimensional data one-dimensional, that is, project the data of the 8-dimensional index into the one-dimensional direction, and finally obtain the projection value z(i) and Establishing a complex nonlinear programming model and projecting the index function to optimize. Firstly, based on the known index sample value x, we can determine the optimal projection direction by constructing a maximal programming problem about the 8-dimensional projection index, and obtain the following nonlinear optimization model:

$$s.t\quad\begin{cases} z(i)=\sum_{j=1}^{p}a(j)\cdot x(i,j) \\ r(i,j)=\left|z(i)-z(j)\right| \\ S_z=\sqrt{\dfrac{\sum_{i=1}^{n}(z(i)-\overline{z(i)})^2}{n-1}} \\ D_z=\sum_{i=1}^{n}\sum_{j=1}^{n}(R-r(i,j))\cdot(R-r(i,j)) \\ i=1,2,\cdots,n \\ \sum_{j=1}^{p}a^2(j)=1 \end{cases}$$

Where Sz is the standard deviation of the projection value; Dz is the local density of the projection value; a(j) is the unit length vector; R is the window radius of the local density; r(i,j) is the distance between the samples; u(t) is a unit step function.

Finally, the nonlinear programming function is solved by the accelerated genetic algorithm (RAGA), and then the clustering of expert information is obtained. Through the discussion with the experts of the cluster group, the results can be accelerated and can be analyzed according to the different types of experts, which provides a theoretical basis for the subsequent contribution rate weighting method and the program game.

STEP 4: Cluster weighting

This paper uses the contribution rate of the expert group to empower different programs. In this paper, by clustering different expert groups and obtaining the corresponding number of p groups of experts, the weight vi of each group is obtained by normalization.

$$v_i = \frac{N_i}{\sum_{i=1}^{p} N_i} \quad i = 1, 2, \cdots, p$$

The above processing steps are the projection pursuit system tools in the improved GFSS decision support system (IGFSS-improved group fuzzy-analytic-hierarchy-process support system), and then the system solves the deviation in the program game process, and supports The system is a fuzzy hierarchical analysis system tool.

4.3 Deviation processing in the game phase of the program

4.3.1 Overview of Bias

Throughout the second phase, it is always the confirmation of the attitude intensity effect in the deviation and the confirmatory bias dominated by the previous attitude effect. In this phase, this paper uses the group fuzzy-analytic-hierarchy-process support system based on fuzzy analytic hierarchy process (GFSS) to provide theoretical basis for expert group decision-making, and makes the group decision making more systematic. , intelligent and standardized.

4.3.2 Establishing GFSS

The system uses FAHP Tools to increase the iterative process of the hierarchical model of the problems generated by the program game, and to make up for the scientific rationality of group decision making [7]. In addition, the system (shown in Fig. 3) provides a comprehensive assessment and scientific analysis of the different decision-making scenarios of different expert groups on project issues, and achieves improvements to the traditional group decision support system, thereby reducing the verifiability bias. The impact of the outcome of the game.

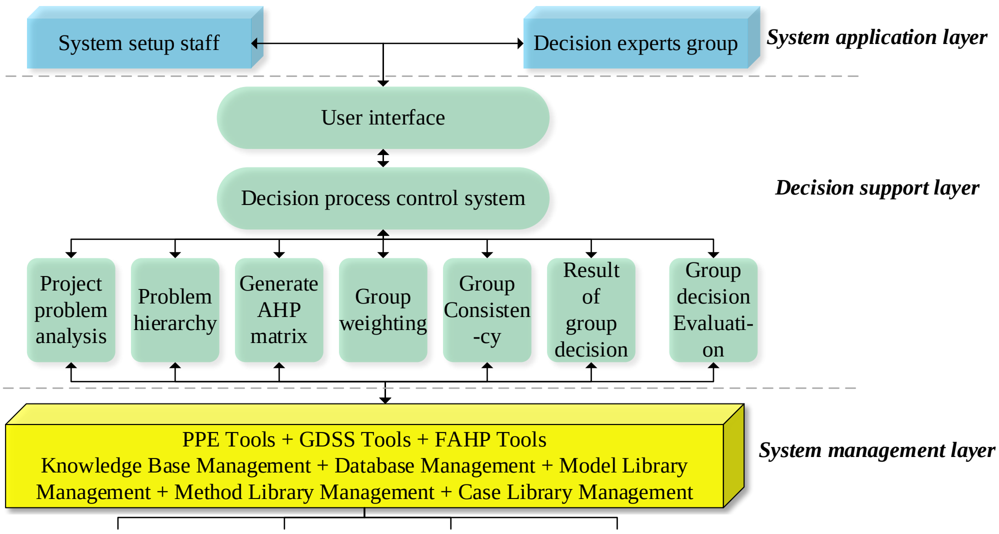

Figure 3 GFSS system functional structure

4.3.3 Architecture and working mechanism of the decision support system

SECTION 1: System application layer

The main module of the system application layer is the user module, which is mainly for the system setup personnel and decision-making expert groups and provides human interface and information excuses.

SECTION 2: System Management

The system management is responsible for improving the collaborative interconnection of the three tools in the decision system and the implementation calls of the four supporting databases.

SECTION 3: System Information Layer (Knowledge Base + Database + Model Library + Case Library)

The knowledge base contains the various specifications and objectives in the project engineering, as well as the necessary knowledge for model design and evaluation, and provides three support tools for improving the decision-making process. It is the basis and operational basis of the system information layer. The case library stores information about related problems in related fields and intermediate processes of problem processing, and stores them based on key information and corresponding descriptions of related issues. The database and model library store the data base and model basis for the decision.

SECTION 4: Decision Support Layer

As the core of GFSS, the decision support layer contains the eight most important technical sections in the system. At the same time, the location of each section in the system reflects the various steps of the group system operation. The specific collaborative operation process is shown in Figure 2.

- The decision process control section is responsible for coordinating and controlling the decision process of the expert group to ensure the normal operation of the eight major sectors.
- On the one hand, the problem decomposition section provides the expert group with the basic materials for discussion and learning by calling the case library. On the other hand, according to the different objectives, the hierarchical and affiliation are decomposed into the evaluation index system related to the decision process, and the problem hierarchy is provided. The knowledge and information necessary.
- The problem hierarchy section finds similar cases or models from the case base or model library to form a problem hierarchy diagram. At the same time, the problem hierarchy diagram generated by its independent learning ability is stored.
- The generation of the two-two comparison matrix section and the consistency processing section fully reflect the FAHP concept. Here, the user can select the preference comparison method according to his own habits or convert the user-selected preferences into appropriate data of the analytic hierarchy process according to a certain algorithm and open up the connection between the first stage and the second stage decision based on the contribution rate of the expert group. And provide users with consistency test results and related revision opinions.
- The group decision comprehensive results section implements the consolidation of the group decision results and visualizes the results of the program game to provide decision makers with decision-making plans.
- The group decision evaluation section comprehensively evaluates the decision results and provides feedback to the group decision system based on actual conditions.

5. Improve GFSS instance analysis

5.1 Single problem promotion

In this paper, the decision-making problem in an engineering project is taken as an example. In this case, the management of the owner provides three options for solving the problem to the expert decision-making group, so that the expert group can give the decision-making recommendation plan or the comparison analysis of the plan.

In the example, the management based on the theoretical basis of the Delphi method, based on the voting results of the expert group to make decisions. In the meantime, the expert group conducted a total of four rounds of voting. The voting session should prove the confirmatory deviation in the game process. It can be seen that the rational game will eventually lead to imbalance due to the fluctuation of subjective components.

This paper first enters the expert database information of this project and gives the scale comparison of the expert information indicators for such projects, and then inputs the data and model of the project into the IGFSS, and finally obtains the program weights of the four rounds of expert opinions through simulation (As shown in Fig. 4, it is obvious that the system effectively avoids the influence of the confirmatory deviation on the program game. Therefore, the recommended scheme of the operation is not the same as that obtained by the traditional Delphi method.

Through comprehensive consideration, the decision-making layer chooses A as the final solution. After project feedback, choose option A as the correct behavior decision.

5.2 Multi-problem promotion

In order to further confirm the scientific nature of this improved decision support system, this paper selects the problems that have occurred in the operation of nine engineering projects over the years. All of the above behavioral decisions are supported by expert decision-making groups based on the Delphi method. By inputting the project, expert information and importing the four libraries of related projects, the decision support system finally gave the recommended solutions for the nine problems. Through the system feedback, the feedback correct rate is as high as 89.9%, which is obviously superior to the traditional Delphi method. It can be seen that the improved group decision support system based on fuzzy analytic hierarchy process has the characteristics of rationality and science, and should be extended to various fields involving behavior decision-making.

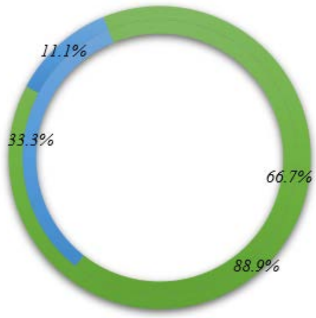

Figure 4 Comparison of decision-making schemes

The accuracy of the inner circle is judged by the traditional Delphi method. The accuracy rate of the Delphi method is 66.7%. The accuracy of the outer circle to improve the scientific decision-making system is judged. The accuracy rate of the improved scientific decision-making system is 89.9%.

6. Conclusion

The projection pursuit model has the advantages of better adaptability and fewer iterations for clustering high-dimensional static indicators.

The improved fuzzy analytic hierarchy process (AHP) is used to identify the problem contradictions in the process of behavioral decision-making, and the IGFSS is improved through the analysis of the results of expert clustering. Finally, the new decision support system of this paper is formed.

The system strengthens the system's rapid response capability, enhances the decision-making level of the project; reduces the operational difficulty, simplifies the system process; improves the satisfaction degree and confidence of the decision-making group members on the decision-making results; is not limited by time and space, fully realizes information sharing; The system significantly avoids the impact of confirmatory bias in the behavioral decision process and has been verified in practical application and promotion.

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