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Analysis of Gray Situation Decision-Making for Energy-saving Scheme in Ganjiang New District Hospital, Jiangxi Province

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ABSTRACT : *This paper presents a gray situation decision analysis for energy saving schemes in hospitals in Ganjiang New Area, Jiangxi Province. By applying the gray situation decision theory, the energy-saving scheme of Ganjiang New Hospital in Jiangxi Province is classified into 3 types of events and 12 types of countermeasures, and a gray situation decision model is established to realize the decision optimization of the energy-saving scheme of Ganjiang New District Hospital in Jiangxi Province.*

KEYWORDS -*Gray Situation Theory; Energy-Saving Scheme, Ganjiang New District Hospital in Jiangxi Province*

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I. INTRODUCTION

Hospitals are an important component in public institutions, and for the energy saving and emission reduction of the whole society, the energy-saving demonstration role of hospitals has a very important significance [1]. Due to the special functional attributes of the hospital building itself, which leads to high energy consumption [2], so it is of great practical significance to study the optimization of energy saving solutions in hospitals. This study intends to use the gray situation decision-making method to explore the decision making research of energy-saving schemes for the hospital of Ganjiang New District Hospital in Jiangxi Province [3], and provide scientific reference and experience exchange for the decision making of energy-saving schemes.

II. THE MAIN CONSTRUCTION CONTENT AND KEY PROJECTS OF THE ENERGY-SAVING SCHEME FOR THE GANJIANG NEW DISTRICT HOSPITAL IN JIANGXI PROVINCE

The hospital construction project of Ganjiang New District Hospital in Jiangxi Province mainly includes one building for emergency medical treatment, one building for medical examination, administrative and scientific research, and related supporting facilities such as sewage treatment, garbage room, liquid oxygen station and underground garage, etc. The project covers a total area of 53409.81 ㎡ with a total construction area of 140388.00 ㎡. Jiangxi Ganjiang Green Health and Wellness Industry Co., Ltd. as the construction unit has carefully organized and prepared the "Energy Conservation Report of Ganjiang New District Hospital", which highlights the following energy conservation solutions for this project. The energy saving solutions for this project are: (1) construction scheme energy saving (a1): ①building scheme energy saving (b1), ②project site energy saving (b2), ③main energy-using process and equipment energy saving (b3), ④energy measuring apparatus equipment scheme energy saving (b4). (2) Energy conservation measures (a2): ①building energy conservation measures (b5), ②electrical energy conservation measures (b6), ③HVAC energy conservation measures (b7), ④water conservation measures (b8), ⑤energy conservation management measures (b9). (3) Resource supply scheme (a3): ①electrical energy supply (b10), ②water resource supply (b11), and ③natural gas resource supply (b12).

III. GRAY SITUATION DECISION OF ENERGY SAVING SCHEME IN GANJIANG NEW DISTRICT HOSPITAL ,JIANGXI PROVINCE

Chinese scholars have put forward a creative gray situation decision-making theory in management science, which can effectively improve the level of decision making [3]. And it is necessary to use gray situation decision making[4] in the energy saving scheme of Ganjiang New District Hospital in Jiangxi Province, in order to improve the energy saving efficiency of the hospital.

2.1Tectonic situation Sij

Set the major energy efficiency programs as event sets (ai): construction scheme energy saving (a1), energy-saving measures (a2), resource supply scheme (a3)

(ai)= (a1，a2，…，a3)

Energy conservation measures are set as a set of countermeasures (bj): (1) building scheme energy saving (b1), (2) project site energy saving (b2), (3) main energy-using process and equipment energy saving (b3), (4) energy measuring apparatus equipment scheme energy saving (b4), ① building energy conservation measures (b5), ②electrical energy conservation measures (b6), ③ HVAC energy conservation measures (b7), ④water conservation measures (b8), ⑤energy conservation management measures (b9),①Electrical energy supply (b10), ② water resource supply (b11), and ③ natural gas resource supply (b12).

(bj)= (b1，b2，…，b12)

Combine event ai and response bj into a situation matrix, i.e., Sij=(ai,bj). The situation for this scenario is a 3-row*12-column situation matrix.

2.2 Target set (Kp) and decision matrix mode

As required by the gray situation decision theory, set the target set K pand set the target set Kp= (investment size K1, technical difficulty K2, and implementation effect K3). Based on the target set, set three single-objective decision matrices(K=1,2,3) and one integrated decision matrix[4，5]

2.3 Calculation of the effect measure γ ij(k)

Calculate γ ij(k) according to the literature[3-5], which is the effect measurement matrix.

According to the 5-level method, the three targets (Investment scale K1, technical difficulty K2 and implementation effect K3) are quantified, among which investment scale K1 corresponds to "large→small", technical difficulty K2 corresponds to "easy→difficult", and implementation effect K3 corresponds to "good→ bad"", respectively determine its corresponding "5-1" level.The single-objective decision-making matrix (K=1,2,3) is obtained by 12 experts applying subjective weighting method to weighting and averaging the specific targets. After calculating the effect measurement of each single-objective decision matrix, the effect measurement of the comprehensive decision matrix can be calculated according to the average weight value.The calculation process is as follows:

$$M^{(1)}=\begin{vmatrix} 2.417 & 3.417 & 4.667 & 1.583 & 3.500 & 4.750 & 4.417 & 1.333 & 2.333 & 2.417 & 1.417 & 1.083 \\ 2.333 & 3.333 & 4.667 & 1.500 & 3.500 & 4.667 & 4.500 & 1.417 & 2.917 & 2.000 & 1.250 & 1.167 \\ 2.500 & 3.500 & 4.750 & 1.667 & 3.583 & 4.833 & 4.500 & 1.500 & 2.250 & 2.333 & 1.500 & 1.250 \end{vmatrix}$$

In this study, gray system theory and application software (version 7) (GSTA V7.0) was used. By applying the intelligent gray target decision in the gray decision model [5] and calculating the consistent effect measurement matrix based on the target measurement requirements, the following results were obtained.

$$M_{ij}^{(1)}=\begin{vmatrix} 17.0723 & 29.1205 & 44.1807 & 7.0241 & 30.1205 & 45.1807 & 41.1687 & 4.0120 & 16.0602 & 17.0723 & 5.0241 & 1.0000 \\ 8.0090 & 5.0060 & 1.0000 & 10.5105 & 4.5045 & 1.0000 & 1.5015 & 10.7598 & 6.2553 & 9.0090 & 11.2613 & 11.5105 \\ 14.9701 & 8.9820 & 1.4970 & 19.9581 & 8.4850 & 1.0000 & 2.9940 & 20.9581 & 16.4671 & 15.9701 & 20.9581 & 22.4551 \end{vmatrix}$$

2.6 Calculation of the comprehensive effect measurement

The calculation of the comprehensive effect generally adopts the weighting method. Suppose the weights of the targets M 1, M 2 and M 3 are 0.30, 0.30, and 0.40, respectively, and the comprehensive effect measurement is:

$$M^{(\Sigma)}=\begin{vmatrix} 13.5124 & 13.8308 & 14.1503 & 13.2436 & 13.7815 & 14.2542 & 13.9987 & 12.8148 & 13.2815 & 14.2124 & 13.2688 & 12.7352 \end{vmatrix}$$

From the above comprehensive effect measurement, the main ranking of countermeasures can be obtained as shown in Table 1 below.

Table 1 The main sequence of events

Order of situation	Optimal situation	Sub-optimal situations	tertiary situation
Comprehensive effect measurement value	14.2542	14.2124	14.1503
Countermeasures	electrical energy conservation measures (b6)	electrical energy supply (b10)	main energy-using process and equipment energy saving (b3)

The optimal sequence of countermeasures for each event is shown in Table 2 below.

Table 2 The optimal sorting table of countermeasures

Events	construction scheme energy saving (a1),	energy-saving measures (a2),	resource supply scheme (a3)
Countermeasures optimization ranking	$B_3>b_2>b_1>b_4$	$b_6>b_7>b_5>b_9>b_8$	$b_{10}>b_{11}>b_{12}$

IV. CONCLUSION

The research results show that in the construction scheme energy saving (a1), the priority of attention should be main energy-using process and equipment energy saving (b3) > project site energy saving (b2)> building scheme energy saving (b1)> energy measuring apparatus equipment scheme energy saving (b4) ; among energy-saving measures (a2),, the order of priority attention is: electrical energy conservation measures (b6)> HVAC energy conservation measures (b7)> building energy conservation measures (b5)> energy conservation management measures (b9)> water conservation measures (b8) ; In the resource supply plan (a3), priority is given to: Electrical energy supply (b10)> water resource supply (b11)> natural gas resource supply (b12). These priority rankings are consistent with the economic, technical and environmental conditions of the Ganjiang New District Hospital's energy saving plan. The gray situation decision-making method is a good technical support for the decision-making and implementation of the energy-saving plan of the Ganjiang New District Hospital in Jiangxi Province.

REFERENCES

[1]. Xiao Feii, Study on Design of Electrical Equipment Selection and Energy Saving Scheme in Hospital, *Electric Engineering, 18(10),* 2020, 82-84.
[2]. Huang Jingi, Energy-saving Renovation Scheme and Effect Evaluation of HVAC System in Large Hospital Buildings, *Building Technology Development, 46(15),* 2019, 144-146.
[3]. Liu Sifeng, Dang Yaoguo, Fang Zhigeng, et al, *The Grey System Theory and Its Application*(Beijing: Science Press, 2012).
[4]. Nansheng Wu, Zaohong Zhou, Liming Zen. The Structural Analysis and the Grey Situation Decision-making Research of Sustainable Forest Management Engineering Systems. *Journal of simulation, 3(6),*2015,110-116.
[5]. Zhou Zaohong. Measures to Control Environmental Pollution and the Use of Gray Situation Decision-making for Family-run Livestock Breeding Farms. *Nature Environment and Pollution Technology,13(4),* 2014, 757-762.

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