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Study on Priorities for Achieving Sustainable Development Goals

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Abstract

Accurately clarifying the 17 Sustainable Development Goals and prioritizing their achievement is a prerequisite for sustainable development in the world. This paper combined Ucinet and Gephi to draw the network relationship diagram among 17 goals, and through the establishment of DEMATEL-ISM goal priority evaluation model, provides guidance for the United Nations and other organizations to decide the order of goal realization, and helps them to get greater returns.

Keywords

Multiple Correlation Analysis; DEMATEL-ISM Algorithm; Network Relationship Structure.

1. Introduction

The 17 Sustainable Development Goals (SDGS) formulated by the United Nations guide the goals and direction of global development from 2015 to 2030[1~2].These goals are not independent of each other, but have a hidden correlation. For example, the results achieved in achieving some goals can also have a positive or negative impact on others. Prioritizing the achievement of goals and considering such issues as climate change and pandemics to better advance the work of the United Nations have become the focus of global attention.

Wireless sensor network (WSN) is a set of sensor nodes with sensor detecting, communication and event processing capabilities deployed in the monitoring area. These nodes form a multi-hop and self-organizing network system by wireless communication way [3-5]. It is put forward and studied by the US military for military needs. With the rapid development of wireless communication technology, micro computer technology, system on chip and low-power embedded device, the application field of wireless sensor network is wider and wider. Because of its wide coverage and self-organizing ability, wireless sensor network has made great changes in information sensing field by adopting the advantages of wireless communication, low energy consumption and high reliability [6].

2. DEMATEL-ISM Model

2.1. A Network of Relationships between 17 Goals

We think of correlation. 0.5 is a strong correlation. It can be seen intuitively from Figure 1 that most data fall above 0.5. According to statistics, there is a strong relationship between 74.39% of the targets, and a relationship network diagram can be established.

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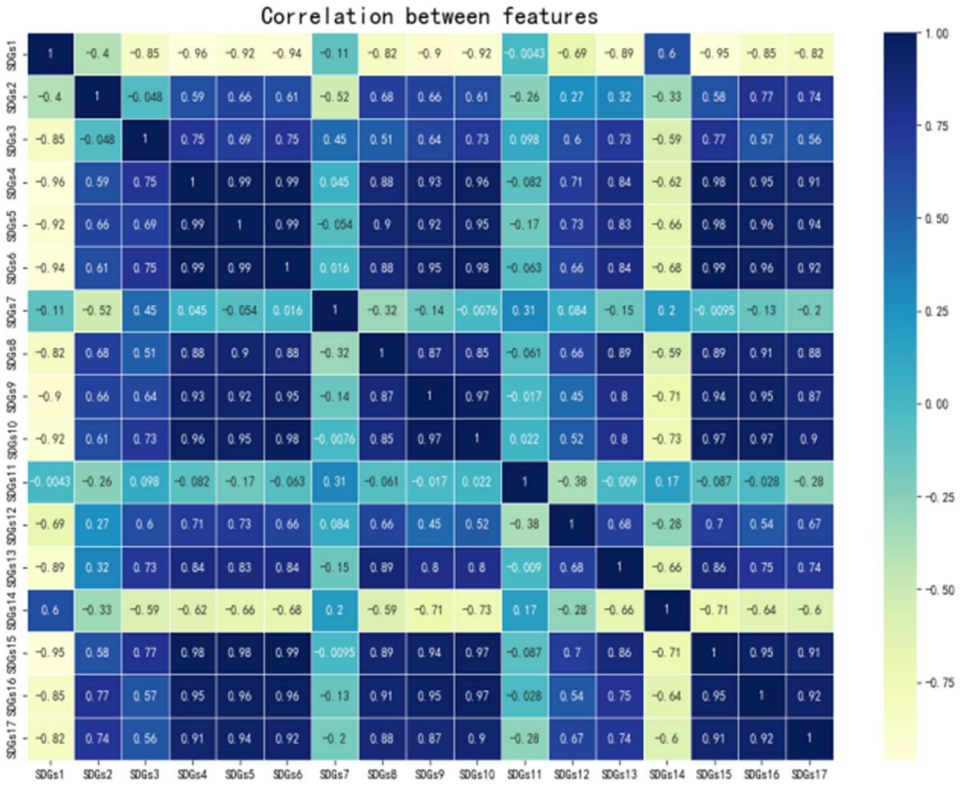

Figure 1. Target heat map

2.2. DEMATEL-ISM Model Establishment

DEMATEL can explore the mutual influence of various indicators in the system, determine the correlation between various indicators with the causal diagram, and present the logical relationship between indicators in a quantitative way. ISM can analyze the correlation sequence of various elements in the system and transform the complex relationships in the system into an intuitive multi-level hierarchical structure. Therefore, on the basis of complementation of the two, the combination of them can better ensure the integrity and systematization of the analysis of the relationship between indicators.

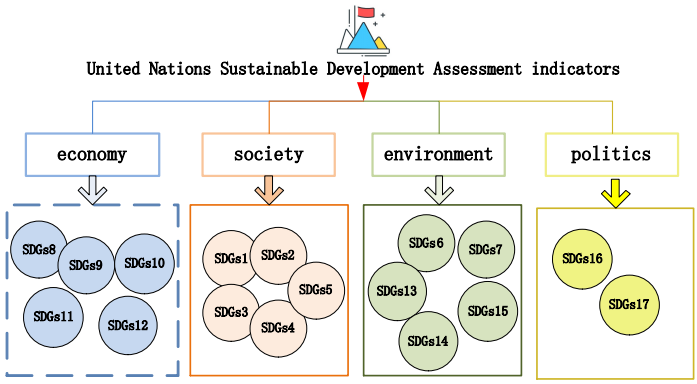

Figure 2. United Nations Sustainable Development Indicator System

According to the goals of sustainable development of the United Nations, the evaluation index system of sustainable development of the United Nations is divided into four dimensions, namely economic, social, environmental and political, with a total of 17 subordinate evaluation indicators. See Figure 2 for the specific indicators and their classification.

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① Determine the normalized direct influence matrix

Invite experts and teachers to evaluate the degree of influence among indicators, determine the level of mutual influence among indicators, divide the magnitude of influence into extremely strong, strong, strong, weak and none, and assign values of 4, 3, 2, 1 and 0 respectively. Determine the direct influence matrix $C = [c_{ij}]_{n\times n}$ based on the evaluation results, and conduct normative treatment on it. Calculate the normalized direct influence matrix $D = [d_{ij}]_{n\times n}$:

$$D = \frac{C}{\max\limits_{1\le i\le n} \sum_{j=1}^{n} c_{ij}}. \tag{1}$$

Where, $\max\limits_{1\le i\le n} \sum_{j=1}^{n} c_{ij}$ is the maximum value of the row sum.

② Calculate the global influence matrix

The comprehensive influence matrix $T = [t_{ij}]_{n\times n}$ is obtained by limit processing of matrix D :

$$T = (D + D^2 + \cdots + D^n) = \sum_{n=1}^{\infty} B^n = B(I - B)^{-1}. \tag{2}$$

Where, I is the identity matrix.

On the basis of comprehensive shadow response moment matrix, a single bit moment matrix I is added to obtain the overall influence matrix E of the index system:

$$E = T + I = [e_{ij}]_{n\times n}. \tag{3}$$

③ Determine the degree of centrality and cause

First, determine the index loudness F_i and impact level G_i:

$$F_i = \sum_{j=1}^{n} t_{ij} \tag{4}$$

$$G_i = \sum_{j=1}^{n} t_{ji} \tag{5}$$

Then, calculate the degree of centrality O_i and Cause degree K_i:

$$O_i = F_i + G_i \tag{6}$$

$$K_i = F_i - G_i \tag{7}$$

Centrality O_i represents the degree of influence that index $SDGs_i$ plays a role in the whole system. Cause degree K_i indicates the magnitude of shadow response of index $SDGs_i$ in the system.

④ Calculate the reachable matrix

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The threshold value λ is set, each element of the overall influence matrix is processed, and the weak influence relation whose index value is less than λ is discarded, and the reachable matrix Z is obtained:

$$Z = [Z_{ij}]_{n\times n} = \begin{cases} z_{ij} = 1, e_{ij} > \lambda \\ z_{ij} = 0, e_{ij} \leq \lambda \end{cases} \quad (8)$$

⑤ Establishment of multi-level hierarchical interpretation structure model

Calculate the reachable set $S(SDGs_i)$, the antecedent set $L(SDGs_i)$ and the common set $R(SDGs_i)$:

$$S(SDGs_i) = \{SDGs_i | SDGs_i \in SDGs, t_{ij} = 1\} \quad (9)$$

$$L(SDGs_i) = \{SDGs_i | SDGs_i \in SDGs, t_{ji} = 1\} \quad (10)$$

$$R(SDGs_i) = \{SDGs_i | SDGs_i \in SDGs, S(SDGs_i) \cap L(SDGs_i)\} \quad (11)$$

Where, SDGs is the set of all indicators in the system; $SDGs_i$ is a specific index in the set.

3. Result Discussion

References are cited in the text just by square brackets [1]. (If square brackets are not available, slashes may be used instead, e.g. /2/.)

3.1. Help Other Companies Prioritize Their Goals

The UN sustainable development goals, A total of 17, to process the questionnaires to experts, teachers, directly influence matrix, as shown in table 1.

Table 1. Direct impact matrix

SDGs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0	1	3	4	4	4	0	4	3	4	0	2	3	2	4	3	3
2	1	0	0	2	2	2	2	2	2	2	1	1	1	1	2	3	3
3	3	0	0	3	2	3	2	2	2	3	0	2	3	2	3	2	2
4	4	2	3	0	4	4	0	3	4	4	0	3	3	2	4	4	4
5	4	2	2	4	0	4	0	4	4	4	0	3	3	2	4	4	4
6	4	2	3	4	4	0	0	3	4	4	0	2	3	2	4	4	4
7	0	2	2	0	0	0	0	1	0	0	1	0	0	1	0	0	0
8	3	2	2	3	4	3	1	0	3	3	0	2	3	2	3	4	3
9	3	2	2	4	4	4	0	3	0	4	0	2	3	3	4	4	3
10	4	2	3	4	4	4	0	3	4	0	0	2	3	3	4	4	3
11	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
12	2	1	2	3	3	2	0	2	2	2	1	0	2	1	2	2	2
13	3	1	3	3	3	3	0	3	3	3	0	2	0	2	3	3	3
14	2	1	2	2	2	2	1	2	3	3	0	1	2	0	3	2	2
15	4	2	3	4	4	4	0	3	4	4	0	2	3	3	0	4	4
16	3	3	2	4	4	4	0	4	4	4	0	2	3	2	4	0	4
17	3	3	2	4	4	4	0	3	3	3	1	2	3	2	4	4	0

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The matrix was normalized by Python and the comprehensive impact matrix was further obtained, so as to obtain the impact degree, influence degree, centrality degree and cause degree of each evaluation index. See Table 2 for the specific results.

Table 2. Interaction results of evaluation indicators

Influencing factor	Impact degree	Degree of influence	Centrality	Cause degree	Centricity sorting
SDGs1	7.6440	7.4874	15.1314	0.1567	9
SDGs2	4.4070	4.4104	8.8174	-0.0033	15
SDGs3	5.6995	5.6959	11.3954	0.0036	2
SDGs4	8.2176	8.2141	16.4316	0.0035	3
SDGs5	8.2418	8.2415	16.4833	0.0002	1
SDGs6	8.1031	8.0996	16.2027	0.0035	4
SDGs7	0.8284	0.8318	1.6602	-0.0035	16
SDGs8	6.9586	7.1250	14.0836	-0.1663	10
SDGs9	7.7607	7.7603	15.5209	0.0004	7
SDGs10	8.0558	8.0522	16.1080	0.0035	6
SDGs11	0.4539	0.4540	0.9079	-0.0001	17
SDGs12	4.9534	4.9531	9.9065	0.0003	14
SDGs13	6.5892	6.5888	13.1780	0.0003	11
SDGs14	5.1361	5.1358	10.2719	0.0003	13
SDGs15	8.2211	8.2176	16.4387	0.0035	12
SDGs16	8.0650	8.0679	16.1329	-0.0028	5
SDGs17	7.5973	7.5970	15.1944	0.0003	8

According to the calculation results in Table 2, the influence distribution diagram of the indicators is obtained. Meanwhile, the causality diagram of the evaluation indicators of the Sustainable Development Goals of the United Nations is drawn respectively with the degree of centrality and degree of cause as the horizontal coordinate, as shown in Figure 3.

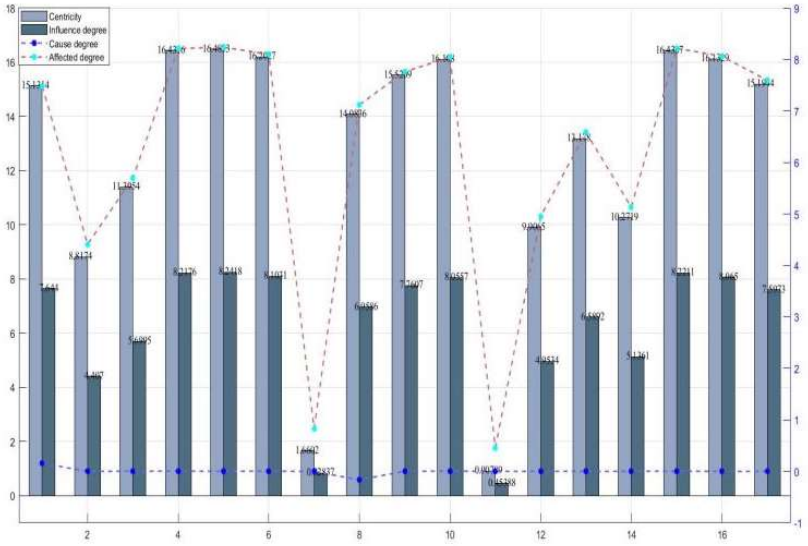

Figure 3. United Nations Sustainable Development Indicator System

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The threshold value was set as 0.15, and the reachable matrix was calculated. Based on the reachable matrix, the factors at different levels were divided, and the multi-level hierarchical structure model of Sustainable Development Goals of the United Nations was established, as shown in Figure 4.

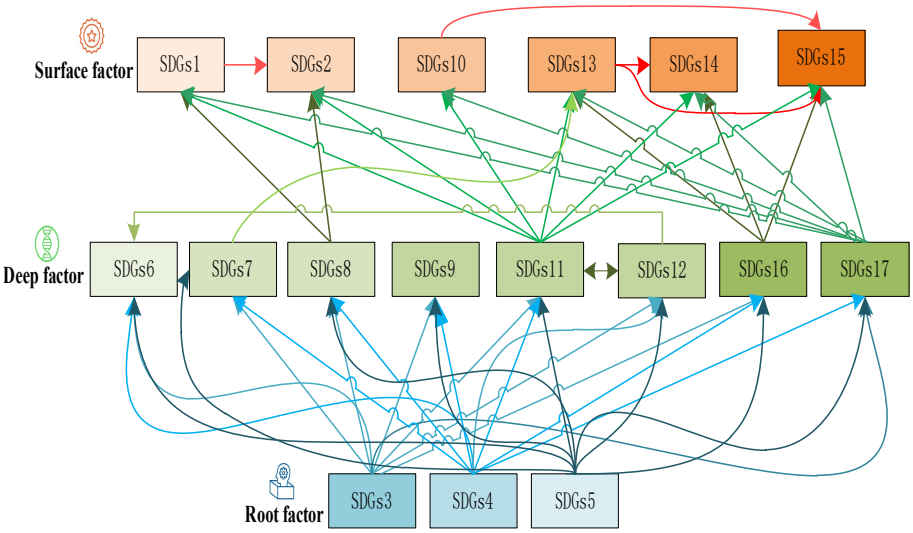

Figure 4. Target multi-level hierarchical structure model

Through DEMATEL-ISM Model, we classified 17 target success into surface factors, deep factors and root factors. In order to promote the work of the United Nations most effectively, we have chosen SDGs3, SDGs4 and SDGs5 as priorities.

3.2. Help Other Companies Prioritize Their Goals

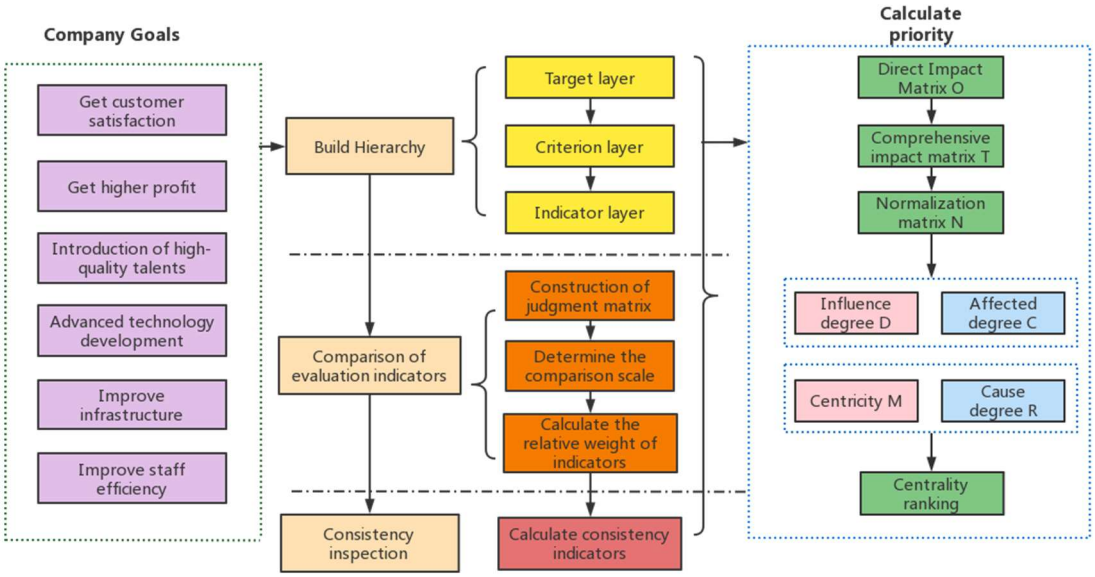

Figure 5. Flow chart

For companies and organizations to set the priority of goals, the first thing to be clear: resources are limited, the optimal goal should bring the maximum benefit. To this end, we introduce the allocation of multi-project resource management in the company. Multi-project management means that projects are presented in the way of project groups and pay more attention to the realization of organizational strategic goals and the correlation between multiple projects.

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Enterprises constantly change the resource structure according to the development and changes of their own and external environment to realize the dynamic coordination of enterprise resources.

Different from the Sustainable Development Goals of the United Nations, the company has limited resources to achieve the goals. Because the realization of multiple goals will cause resource conflicts and have positive or negative impacts on other goals, how to allocate resources rationally and dynamically should ensure that the most important goal is achieved first, which is conducive to the long-term development of the company or organization.

How can we use our model to help other companies prioritize their goals? Firstly, the priority of each target is evaluated. Based on the index score of each level determined by Delphi method, the weight of each level is calculated. Secondly, through the above formula, the direct influence matrix of corporate objectives is obtained, and then the weight of each element of each layer is obtained, and finally the priority ranking of multiple objectives is obtained. The steps are as follows:

Step 1: Determine the structure of resource requirements for the realization of each company goal.

Step 2: Analyze the resource constraints of the company.

Step 3: Prioritize your goals.

Step 4: Develop a multi-objective management resource allocation plan.

4. Conclusion

As a hot research technology, moving target tracking technology has been widely used in various fields. With the help of low cost, low power consumption, self-organization and high error tolerance of wireless sensor networks, moving target tracking based on wireless sensor networks also has broad application prospects.

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