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Research on the Evaluation of Communication Network Planning Program based on Grey Relational Coefficient

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Abstract

Aiming at the problems of less supporting data and strong uncertainty in the evaluation of the support effectiveness of the combat communication network planning scheme, a communication network planning scheme screening method based on the grey relational coefficient is proposed. The communication network planning scheme evaluation model and the aggregation evaluation screening model are constructed, and the support effectiveness of multiple communication network planning schemes is evaluated and verified. The method is flexible and reconfigurable, and can meet the requirements of planning and evaluation of battle communication network in complex battlefield environments.

Keywords

Grey relational coefficient; Communication network; Planning scheme; Evaluation model.

1. INTRODUCTION

The application of deep reinforcement learning information technology in military has effectively realized the generation of combat communication network planning solutions, but as a comprehensive evaluation and decision-making problem with multiple objectives and influencing factors, the evaluation and screening of combat communication network planning solutions faces the real problems of many influencing factors, extensive levels involved, and little supporting data. The use of gray correlation coefficient method can effectively deal with the lack of available information for combat communication network planning, system uncertainty and other problems, which can provide scientific assessment and guidance for information and communication command authorities to verify the feasibility of communication network planning programs, predict the effectiveness of communication network security, and effectively avoid risks.

2. EVALUATION MODEL CONSTRUCTION

2.1. Evaluation index system construction

In order to successfully achieve the combat mission objectives and complete the communication network security tasks, combined with the communication network security model and characteristics, and with reference to the relevant regulations for the operation and maintenance of the communication network and the adjustment and withdrawal of the relevant requirements, communication network planning program evaluation should focus on achieving

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the goal of high efficiency, flexibility and resistance to destruction of the communication network.

High efficiency refers to the high utilization efficiency of various resources in the communication network. In battle communication network is a communications facilities and communication network under the premise of limited resources available, for planning staff, all kinds of communication equipment should be in good health, at the same time to maximize the use of the existing communication resources, give full play to the communication capability of the currently available communications equipment, improve the comprehensive use of communication network planning efficiency.

Flexibility refers to the strong connectivity and expansion capability of a communication network. Under the influence of combat operations, communication network planning may be adjusted with the change of combat missions or the occurrence of emergency situations. Therefore, the coverage capability of communication network should be able to meet the maneuvering adjustment in a certain area, and at the same time, it should have certain connectivity capability to ensure the adjustment and change of different access units. In addition, some communication resources should be reserved for important communication link resources and communication nodes to prepare for the opening of new services and the flexible adjustment of the combat communication network.

Destruction resistance refers to the communication network has a strong network survival and destruction resistance. Combat area battlefield environment and communication network planning conditions are complex, communication network should have strong robustness, in the enemy fire and communication network interference with a certain degree of anti-destructive survivability and anti-interference ability, in the event of failure of the extra-territorial communication network, the impact of the scope should be controlled and the communication network has a certain degree of rapid repair capability.

Based on the above analysis, for the above three goals, the high utilization rate of decomposition for the equipment health resource utilization, communication network flexibility into network coverage, network connectivity and extend the network capacity, anti-destroying ability of communication network survivability of network and network protection ability, a total of seven principles, and establish the communication network planning index system hierarchy as shown Figure 1.

(1) Communication equipment health degree

The health degree of communications equipment mainly reflects the intact degree of communications equipment, which is the physical basis for the high efficiency of the overall communication network. It consists of the equipment integrity rate, equipment utilization and equipment deployment time. It mainly evaluates the equipment health degree of combat communications equipment from the hardware perspective by analyzing and judging the actual situation of equipment.

(2) Communication resource utilization

The utilization of communication resources aims to reflect the actual utilization efficiency of various kinds of communication resources in the current combat communication network, which mainly consists of frequency utilization, network address utilization and service bandwidth overhead. It focuses on evaluating the utilization efficiency of communication network from the perspective of software resources.

(3) Network coverage capability

Communication network coverage capability refers to the size of the combat area and the number of means that the communication network can provide support, which is composed of network coverage and the number of business means. In a certain operational area, the greater

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the coverage of the communication network, the richer the service means, the richer the available support means, and the stronger the flexibility of the network[1].

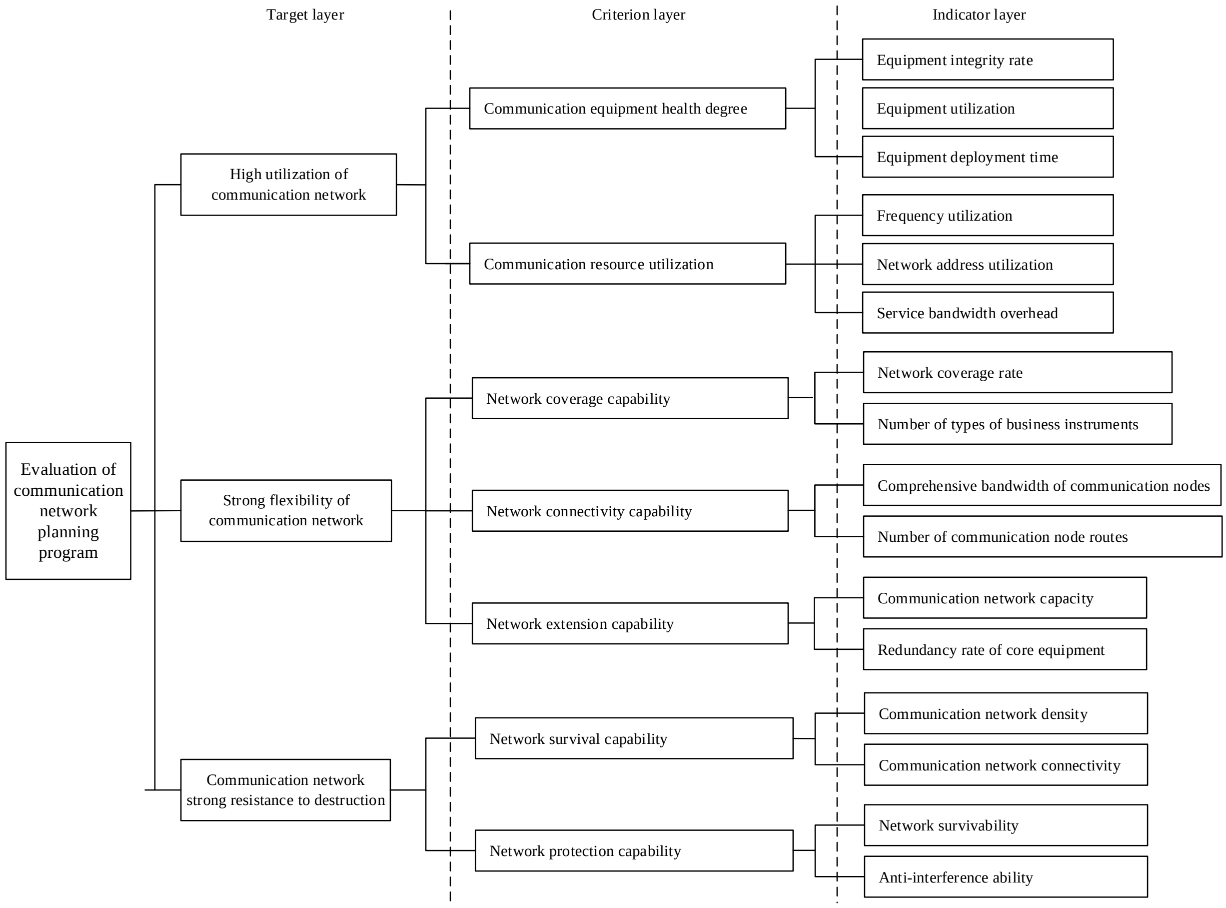

Figure 1. Hierarchical structure of communication network planning scheme index system

(4) Network connection capability

The communication network connection capability aims to reflect the network communication interaction capability that the current communication network can provide in a certain period of time. The connection capability of a communication network node can determine the number of units it can guarantee, which is an important manifestation of network flexibility.

(5) Network extension capability

The expansion capability of the communication network aims to reflect the support capability of the communication network in response to service changes. It is mainly composed of the capacity of the communication network and the redundancy rate of core devices, and can directly provide the flexible networking capability of the communication network.

(6) Network survival capability

The survivability of communication network refers to the ability of a communication network to resist interruptions caused by external influences. It is composed of communication network density and communication network connectivity, and reflects the overall stability of the communication network structure itself. The stronger the network survivability, the stronger the stability of the communication network, and better to maintain the smooth communication of the combat communication network.

(7) Network protection capability

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Communication network protection capability refers to the ability of the communication network to cope with local damage, attack and interference to maintain the normal work of the communication network when the communication network is interfered or attacked. It is composed of the communication network anti-destruction ability and the network anti-interference ability.

2.2. Evaluation index model construction

2.2.1 Communication equipment health model

(1) Equipment integrity rate

The equipment integrity rate is the ratio between all currently available equipment and the total number of equipment.

$$R_{eq} = \frac{1}{n} \times \sum_{i=1}^{n} \frac{T - T_{mt}}{T} \times 100\% \tag{1}$$

where T is the total number of current communication equipment, T_{mt} is the number of current equipment in fault and maintenance, and the current available equipment in good condition is equal to the total number of communication equipment minus the number of equipment failure and daily maintenance of communication equipment.

(2) Equipment utilization

Equipment utilization is the ratio of all currently available equipment minus spare equipment to all available equipment.

$$R_{ut} = \frac{T - T_{mt} - T_{sp}}{T - T_{mt}} \times 100\% \tag{2}$$

(3) Equipment deployment time

Equipment deployment time refers to the average time required for all communication network equipment to deploy.

$$R_{eq} = \frac{1}{n} \times \sum_{i=1}^{n} t_{eq} \tag{3}$$

2.2.2 Communication resource utilization model

(1) Frequency utilization

Frequency utilizationrefers to the ratio between the currently used frequency and the total divided frequency band.

$$R_{fr} = \frac{F - F_B - F_{sf} - F_{ac} - F_{in}}{F} \tag{4}$$

where, F_B is the forbidden frequency band and frequency point, F_{sf} , F_{ac} and F_{in} are the frequency bands eliminated to avoid co-frequency interference, adjacent frequency interference and intermodulation interference, respectively.

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(2) Network address utilization

The network address utilization refers to the utilization of IP resources in the communication network. The network address utilization is the ratio of the weight of the current node to the actual IP resources allocated to the mode.

$$R_{ip} = \frac{S_V}{2^n}, 2^n \geq S_V, n \in N_+ \tag{5}$$

(3) Service bandwidth usage

Service bandwidth usage is the ratio of the bandwidth used for management and communication to the total bandwidth of a communication network. It should be as small as possible.

$$R_{se} = \frac{\sum_{i=1}^{n} B_{ma} + \sum_{i=1}^{n} B_{sc}}{B} \tag{6}$$

B is the total， B_{ma} is the total bandwidth occupied by management, B_{sc} is the total bandwidth occupied by internal communication.

2.2.3 Network coverage capability model

(1) Network coverage rate

Network coverage refers to the ratios of the coverage of all current communication network nodes to the area of the current combat area. The higher the coverage rate of the combat communication network, the wider the radiation range of the communication network in the current combat area, which is more convenient for the adjustment of the communication network of the mission force[2].

$$R_{ca} = \frac{\bigcup_{i=1}^{n} S_i}{S} \times 100\% \tag{7}$$

(2) Number of types of business instruments

The richer the type of available business means, the more flexible it is to improve the overall communication planning of operation.

$$M_{se} = K(K \in N_+) \tag{8}$$

K is a positive integer that reflects the available communication means of the current communication network, such as satellite, shortwave, microwave, etc.

2.2.4 Network connectivity capability model

The stronger the connectivity of the communication network, the more communication equipment it can accommodate and the more task forces that can implement communication support and the flexibility is correspondingly improved.

(1) Comprehensive bandwidth of communication nodes

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The comprehensive bandwidth of communication nodes refers to the mean value of communication bandwidth that each communication node can provide and guarantee in a certain period of time[3].

$$B_{eq} = \frac{1}{n} \times \sum_{i=1}^{n} B_i \tag{9}$$

(2) Number of communication node routes

The number of routes of a communication node is an important part of the access capability of a communication node can provide at the same time.

$$N_{rt} = \frac{1}{n} \times \sum_{i=1}^{n} N_V (N_V \in N_+) \tag{10}$$

2.2.5 Network expansion capability model

The expansion capability provides the flexible networking capability of the communication network directly. The larger the capacity of the current communication network and the higher the redundancy rate of core devices, the stronger the expansion capability of the communication network in response to emergencies and the adjustment of the communication network structure.

(1) Communication network capacity

Thetotal capacity of a communication network is the sum of the transmission capacity provided by each link in the current communication network. According to Shannon’s formula, the channel capacity of noisy continuous channel is calculated as follows.

$$C = \sum_{i=1}^{E} B_i \log_2 (1 + \frac{S_i}{N_i}) \tag{11}$$

B_i represents the actual bandwidth of a certain link, S_i / N_i represents the signal-to-noise ratio of a certain link in the link set E

(2) Redundancy rate of core equipment

The redundancy rate of core devices refers to the redundancy degree of core communications equipment such as switching devices and transmission devices in the process of communication network planning and support. It can be expressed as the ratio of the number of redundant core devices to the total number of core devices in the communication network. The higher the redundancy rate, the stronger the scalability of the communication network, but it is limited by the number of communication resources and equipment utilization.

$$R_{ce} = \frac{N_{ce}}{N_e} \times 100\% \tag{12}$$

where, N_{ce} is the number of redundant core devices and N_e is the total number of core devices in the communication network.

2.2.6 Network survivability model

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The under $G=\langle V,E\rangle$ is used to define the topology of the communication network, note Vrepresents different types of communication nodes in the communication network, and link set Erepresents the communication links between communication nodes, and the network survivability is calculated and evaluated.

(1) Communication network density

The communication network density refers to the ratio between the actual number of communication links and the maximum number of communication links[4]. Where, E_S is the total number of communication links in the communication link set and N is the total number of communication nodes in the current communication network.

$$\rho=\frac{E_S}{\frac{1}{2}N(N-1)} \tag{13}$$

(2) Communication network connectivity

The network connectivity of communication network is an important index to measure the viability of communication network. The stronger the connectivity of communication network the greater its survivability.

STEP1:For the current communication network $G=\langle V,E\rangle$, the initial value of communication network connectivity $c(G)$ in the initial state is defined as 0.

STEP2:Define the connection degree of each communication node in the communication network as $d_i(i\in N_+)$, which represents the connection degree between the current communication node and adjacent node, and calculate the influence degree matrix of each node in the communication node in thecommunication network $L=(\frac{1}{d_1},\frac{1}{d_2},\frac{1}{d_3},\dots,\frac{1}{d_n})$.

STEP3: The adjacency matrix is constructed according to the connection relation of communication link, that is, when the communication link between V_i and node V_j is directly connected to $E_{ij}=1$, otherwise is0. Thus, the adjacency matrix C of the current communication network is constructed

$$C=\begin{bmatrix} E_{11} & \cdots & E_{1j} \\ \vdots & \ddots & \vdots \\ E_{i1} & \cdots & E_{ij} \end{bmatrix} \tag{14}$$

STEP4: Calculate the impact degree $I(G)=L\cdot C$ of the current communication network,find the communication network nodes with the largest impact degree in I, and delete the node and its adjacent communication links from current communication network, then note the communication network connectivity $c^{'}(G)=c(G)+1$.

STEP5:Repeat STEP2 to STEPT5 until the current communication network Gdoes not constitute a network connection.

Through the above 5 steps, the connectivity of the current communication network $c^{'}(G)$ is finally obtained.

2.2.7 Network protection capability model

(1) Network survivability

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Use the communication network cohesion to evaluate the survivability of the communication network, which specifically refers to the number of communication links that need to be disconnected to destroy the current communication network[5]. In order to improve the survivability of the communication network and prevent the communication network interruption caused by the damage of the key nodes,the average cohesion of the overall communication network is calculated as:

$$\overline{CH^*} = \frac{2\sum_{i=1}^{n-1}\sum_{j=i+1}^{n} CH_{ij}^*}{n(n-1)} \tag{15}$$

CH_{ij}^* is the bonding degree of the link between the current node (V_i, V_j), which is the minimum number of communication links that need to be disconnected to break the communication link between the current node (V_i, V_j).

(2) Anti-interference ability

Ant-interference ability refers to the anti-interference ability of wireless equipment in communication network.

$$AJC = (PT_0 B_s G) S_A S_S S_M S_P S_C S_N S_J \tag{16}$$

where， P is the average transmit power of the current device, T0 is the duration of the signal, Bs is the average bandwidth of the current communication network equipment, Gis the antenna gain of the current, above is the inherent anti-interference ability of the wireless equipment of the communication network, other indicators are the frequency jump factor and other anti-interference improvement factors. It is related to the specific equipment used by the current communication network and can be directly obtained from the planning solution.

2.3. Standardized data processing

The purpose of data standardization processing is to eliminate the difference and influence between measurement units and values of different evaluation indicators mentioned above, and to carry out dimensional normalization processing on the data, so that the evaluation data results of different planning schemes are in the same interval, so as to carry out further comprehensive analysis and calculation of different indicators

The attributes of evaluation index system in this paper are divided into two types: benefit type and cost type, Cost-type indicators, such as equipment deployment time and service bandwidth occupancy rate, require the evaluation results to be reduced as much as possible. Efficiency indicators, such as equipment utilization, equipment comprehensive bandwidth, etc., we hope to maximize the evaluation results as much as possible[6]. The result of an indicator is denoted as $I = \{I_1, I_2, I_3, \ldots, I_n\}$, the maximum value in the result is denoted as $\max I$, and the minimum value is denoted as $\min I$.

For cost-type indicators, the evaluation after data standardization is:

$$\bar{I} = \frac{\max I - I_n}{\max I - \min I} \tag{17}$$

For the benefit indicators, the evaluation value after data standardization is:

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$$\bar{I} = \frac{I_n - \min I}{\max I - \min I} \tag{18}$$

After data standardization processing, the index values of different dimensions and values meet $I \in [0,1]$.

3. EVALUATION INDEX WEIGHT CALCULATION

The index weight calculation directly affects the reliability and accuracy of the evaluation results. By clarifying the importance of each evaluation index system, the scheme is evaluated as a whole for further screening. The current index weight calculation methods mainly include subjective weighting method and objective weighting method, as well as the comprehensive and improved method based on these two methods. The traditional subjective weighting methods include Delphi method, expert survey method, analytic hierarchy process, etc. The subjective weighting method can directly reflect the experience and intention of experts and is relatively convenient, but there is certain subjective arbitrariness in determining the index weight. Objective weighting methods include entropy method, principal component analysis method and other methods, which calculate the final weight through the relationship between the data and then determine the final weight. Although it avoids the interference of human factors, it is easy to cause some errors in the weight of the index. Therefore, in order to synthesize the advantages of the above two methods and make the actual weight calculation conclusion from multiple perspectives and all-round aspects, this paper adopts the comprehensive weight method based on grey correlation coefficient to calculate the weight of the evaluation index parameters of the communication network planning scheme.

The grey relational model based on the study and deduction of known parts of information, to extract the valuable information and conclusions, so as to realize a method, which is a correct description of the system in such aspects as resource planning and effectiveness evaluation has been widely research and application, using the grey relational method to solve the problem of communication network planning[7], It can better deal with the problems of less support data for combat communication planning, lack of available information, and strong system uncertainty. The calculation steps are as follows:

STEP1: After data standardization, r_{ij} represents the evaluation and calculation value of the Ievaluation index in the jplanning scheme, and the judgment matrix $R=(r_{ij})_{m\times n}$ is as follow:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \tag{19}$$

STEP2: The maximum evaluation value item is selected from each column of matrix R, and then the maximum scoring set O_0^+ is obtained, denoted as $O_0^+ = (r_{0^+1}, r_{0^+2}, L r_{0^+n})$ .At the same time, the minimum evaluation value item in each column is selected, and the minimum scoring set O_0^- is obtained, denoted as $O_0^- = (r_{0^+1}, r_{0^+2}, L r_{0^+n})$.

STEP3: The correlation coefficient $\zeta_{0^+}(j)$ between each set of planning schemes and the maximum score set in the evaluation index and the correlation coefficient $\zeta_{0^-}(j)$ between each set of planning schemes and the minimum scoring set in the evaluation index are calculated respectively:

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$$\begin{cases} \zeta_{0^+}(j) = \dfrac{\min\min \Delta_{0^+ij} + 0.5\max\max \Delta_{0^+ij}}{\Delta_{0^-ij} + 0.5\max\max \Delta_{0^+ij}} \\ \zeta_{0^-}(j) = \dfrac{\min\min \Delta_{0^-ij} + 0.5\max\max \Delta_{0^-ij}}{\Delta_{0^-ij} + 0.5\max\max \Delta_{0^-ij}} \\ \Delta_{0^+ij} = \left|x_{0^+j} - x_{ij}\right|, \Delta_{0^-ij} = \left|x_{0^-j} - x_{ij}\right| \\ i \in (1,2,\dots,m),\ j \in (1,2,\dots,n) \end{cases} \tag{20}$$

If the value of $\zeta_{0^+}(j)$ is larger, it means that the correlation coefficient between the current evaluation ability value and the maximum score value in each evaluation index is larger, if the value of $\zeta_{0^-}(j)$ is larger, it means that the current evaluation ability value and the minimum score value are in each evaluation index is larger.

STEP4: Create the evaluation indexweight $w = (w_1, w_2, \dots, w_m)$, and denoted $f(w)$ as the current weight optimization function.

$$\min f(w) = \sum_{j=1}^{n} w_j^2 [1 - \zeta_{0^+}(j)]^2 + \sum_{j=1}^{n} w_j^2 [1 - \zeta_{0^-}(j)]^2 \tag{21}$$

Represents the sum of weighted distance squares between index i and the maximum score and the minimum score respectively. The smaller the value of the weight optimization function, the stronger the comprehensive guarantee efficiency of the current communication network planning scheme.

STEP5: The final weight value of each evaluation index is obtained, where

$$u_i = \sum_{i=1}^{m} [1 - \zeta_{0^+}(j)]^2 + f(w).$$
$$w_j = \frac{1}{u_j \sum_{i=1}^{n} \frac{1}{u_i}} \tag{22}$$

4. AGGREGATE EVALUATION SCREENING MODEL ESTABLISHMENT

Based on the calculation of the weight vector of each evaluation index, the method of aggregative evaluation screening value can greatly enhance the flexibility and reconfigurability of the index system[8]. The calculation method is as follows:

STEP1: The comprehensive support capability of the current operational communication network planning scheme is deeply analyzed, and the evaluation index set $I = \{i_1, i_2, i_3, \dots, i_m\}$ of the communication network planning scheme is determined. And create corresponding evaluation grades $E = \{e_1, e_2, e_3, e_4, e_5\}$ in the current planning scheme evaluation, where e_1 to e_5 respectively represent the excellent, good, general, relatively poor, poor evaluation grades, and assign corresponding values to them as 1, 0.75, 0.5, 0.25, 0.

STEP2: Membership matrix D is constructed to clarify the association degree of each element in each evaluation index set to each element in the current evaluation level.

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$$D=\begin{bmatrix} d_{11} & d_{12} & \cdots & d_{15} \\ d_{21} & d_{22} & \cdots & d_{25} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{n5} \end{bmatrix} \tag{23}$$

STEP3: Construct the index weight matrix $w_j=(w_1,w_2,...,w_m)$, and calculate the membership degree vector E, which reflects the comprehensive ability of the current planning scheme. The calculation process is as follows:

$$E=w_j\cdot D=(w_1,w_2,\ldots,w_m)\begin{bmatrix} d_{11} & d_{12} & \cdots & d_{15} \\ d_{21} & d_{22} & \cdots & d_{25} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{n5} \end{bmatrix} \tag{24}$$

Therefore, the generated communication network planning scheme is valuated, calculated and ranked, and the final available communication network planning scheme is obtained by selecting the better results of comprehensive evaluation, which completes the rapid evaluation and screening of the scheme.

5. MODEL VALIDATION

Table 1. Indicator parameter metric collection

Guidelines	Index	Plan 1	Plan 2	Plan 3	......	Plan 20
Communication equipment health degree	Communication resource utilization	98.9%	98.1%	97.4%	......	96.5%
	Equipment utilization	92.93%	93.36%	96.47%	......	85.36%
	Equipment deployment time	24min	22min	28min	......	31min
Communication resource utilization	Frequency utilization	61.2%	62.6%	66.4%	......	63.8%
	Network address utilization	71.5%	70.3%	72.6%	......	69.8%
	Service bandwidth overhead	528kb	597kb	625kb	......	646kb
Network coverage capability	Network coverage area	86.75%	83.34%	77.27%	......	76.48%
	Number of types of business instruments	3	3	3	......	3
Communication network connectivity	Comprehensive bandwidth of communication nodes	5.1M	5M	5M	......	5.3M
	Number of communication node routes	5	5	4	......	5
Communication network expansion capability	Communication network capacity	2.5G	2.7G	2.4G	......	2.5G
	Redundancy rate of core equipment	15.3%	13.7%	14.2%	......	10.8%
Network survivability	Communication network density	1.93	1.62	1.68	......	1.47
	Communication network connectivity	6	4	5	......	5
Network protection capability	Network survivability	0.572	0.484	0.466	......	0.397
	Anti-interference ability	0.364	0.343	0.281	......	0.343

On the premise that the guarantee constraints of the communication network are basically satisfied, the system can be generated through the communication planning scheme to form

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multiple sets of communication network planning scheme. Combined with the network topology, based on the constructed evaluation index model, 20 sets of communication network planning are calculated respectively, and the health degree of communication equipment, communication resource utilization, network coverage, ability of communication network connectivity, communication network extension, network survivability, and network protection ability the seven categories of index measurement, the calculation data are shown in table 1:

The original index parameters collected by above calculation are subjected to data standardization processing to obtain a standardized model input data set, as shown in Table 2.

Table 2. Standardized collection value of evaluation index data

Guidelines	Index	Plan 1	Plan 2	Plan 3	……	Plan 20
Communication equipment health degree	Communication resource utilization	0.989	0.981	0.974	……	0.965
	Equipment utilization	0.9293	0.9336	0.9647	……	0.8536
	Equipment deployment time	0.614	0.572	0.656	……	0.894
Communication resource utilization	Frequency utilization	0.612	0.626	0.664	……	0.638
	Network address utilization	0.715	0.703	0.726	……	0.698
	Service bandwidth overhead	0.753	0.794	0.836	……	0.942
Network coverage capability	Network coverage area	0.8675	0.8334	0.7727	……	0.7648
	Number of types of business instruments	1	1	1	……	1
Communication network connectivity	Comprehensive bandwidth of communication nodes	0.865	0.842	0.842	……	0.887
	Number of communication node routes	0.833	0.833	0.667	……	0.833
Communication network expansion capability	Communication network capacity	0.924	0.965	0.917	……	0.924
	Redundancy rate of core equipment	0.153	0.137	0.142	……	0.108
Network survivability	Communication network density	0.893	0.724	0.736	……	0.719
	Communication network connectivity	0.976	0.652	0.817	……	0.817
Network protection capability	Network survivability	0.572	0.484	0.466	……	0.397
	Anti-interference ability	0.364	0.343	0.281	……	0.343

On the basis of obtaining multiple sets of communication network planning results, the final weight value of each evaluation index is obtained by calculating the judgment matrix, its maximum and minimum score sets, and the correlation coefficients $\zeta_{0^+}(j)$ and $\zeta_{0-}(j)$. On this basis, the membership matrix was constructed according to the aggregated evaluation and screening model, and the membership degreeE of each planning scheme was calculated respectively, E1=0.864, E2=0.841, E3=0.824, …… , E20=0.708.

Though the above screening process, the membership degree was sequentially ranked, and the two typical schemes with high membership degree were selected asE1and E2.

6. CONCLUSION

On the basis of combat plan and the basic situation of the organization, the evaluation and screening model can be used to evaluate multiple planning schemes, and the alternative schemes with high membership degree can be selected, so as to further from the communication network organization plan according to the commander's intention, and

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support operations. The planning schemes generated and evaluated by above methods are scientific and operable to a certain extent.

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