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METHODS FOR SUBSTANTIATING DECISIONS ON THE CHOICE OF THE COMPOSITION OF TELECOMMUNICATIONS EQUIPMENT

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ABSTRACT

Telecommunications is an important component of modern infocommunication. When designing them, there are requirements for strict consideration of a set of requirements that contradict their quality. This determines the need to use multidimensional optimization methods when choosing design solutions from a variety of suitable options. Previously, when designing telecommunications equipment, only strictly permitted design options were selected that meet specified quality constraints.

With the increasing complexity and cost of the designed telecommunications equipment, it is necessary to find optimal design solutions. This presents the main aspects of the choice of technical means of building a network, a set of indicators for their selection is presented. Using the example of the choice of switches, the problem of comparative assessment and their selection is solved using the method of analysis of hierarchies and *network analysis method*. The use of such a DSS will significantly reduce the complexity of calculations, increase the efficiency of decision-making and their quality and, ultimately, increase the success of the implementation of planned projects at the early stages of their justification.

Keywords: *Analysis Of Hierarchies, Criteria, Network Analysis Method, Switch, Telecommunication Networks, Telecommunication Equipment.*

1. INTRODUCTION

It is known that one of the disadvantages of project management is the insufficient validity of decisions in the development and management of projects, especially when choosing the composition of equipment, new technologies, automation complexes, software, etc.

Taking into account the wide range of modern equipment, systems and technologies offered on the market, a wide range of equipment characteristics, the process of choosing the best samples and forming the optimal composition of technical means presents significant complexity.

Decisions made at this stage are often unreasonable, associated with subjectivity and, as a result, lead to a decrease in the investment attractiveness of projects, an increase in unreasonable costs and their payback periods.

Considering the high cost of modern telecommunication equipment, the problem of making decisions on the choice of equipment composition is undoubtedly relevant and requires a solution [1].

Modern telecommunication networks are an interconnected (coordinated) set of three components:

- system-technical solutions (requirements, composition, physical and logical structure, protocol profile, design methodology, including substantiation of system requirements and their analysis by system components, modeling methods, test methods);

- regulatory and technical documents (standards, protocols, recommendations) governing the creation, operation, interaction and development of the network;

- hardware and basic software packages that provide the creation of object complexes of the network and perform the necessary list of functions for the transmission, transfer, processing and storage of information, as well as its protection from accidental and intentional effects [2].

It can be said that the first component reflects the specifics of the network, its uniqueness; the second regulates standard solutions, conditions and restrictions determined by the existing

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regulatory and normative-technical documents. The third component - hardware and software - is the real material basis of the created network. If for many years the development of such complexes is carried out in full within the components of the system (purchased products were usually only cryptographic means of information protection), then in the last 15-20 years the object complexes of modern telecommunications networks are ready hardware and software for various purposes (switches, routers, cryptographic information protection devices, multiplexers). Currently, there is a large range of this equipment from different manufacturers that perform the same functions and meet the requirements of a particular network [3].

Given that telecommunications networks are complex systems that operate for a long time and require large organizational and material costs, the task is to choose the right technical means for their creation, which are widely used and enable the operation of promising applications.

Contributions of the paper: This paper offers a a comprehensive methodological approach is proposed for conducting a comparative assessment and choosing the optimal equipment, which allows making rational decisions when creating a model of an optimal telecommunications network. This article, in turn, presents the use of the analysis of hierarchies, criteria, network analysis method in the context of the implementation of an optimal telecommunications network.

The rest of this paper is organized as follows. Section 2 gives an insight of the related works. In Section 3 the used methodology is presented. Experimental results are presented in Section 4. Section 5 concludes the paper and gives guidance on layout, style, illustrations and references and serve as a model for authors to emulate.

2 LITERATURE REVIEW

The main aspects of the choice of technical means

One of the most important issues to be addressed in the design of information and telecommunications networks is the choice of telecommunications equipment that implements the selected system and technical solutions, technologies and meets the requirements of the network.

First, a selection of possible types of equipment whose characteristics meet the system and technical requirements of the designed network is made. Typically, modern equipment must be able to transmit multimedia information (including speech, video and data, including in real time) with the support of service quality (QoS) mechanisms for individual applications, provide high reliability of service, and have good performance characteristics.

Many companies now offer network equipment in the telecommunications market. Many development companies now have standard telecommunications equipment networks. The peculiarity is that the means of cryptographic protection of information, the scope of their development is narrow and the choice has a number of features [4].

The following can be used as indicators to select equipment:

- technical characteristics (characteristics) are the most important for a particular network (performance, number and types of ports, supported protocols);
- reliability;
- mass characteristics of the equipment;
- compliance with the specific requirements of the customer (availability of certificates, experience in other projects, features of the software, etc.);
- Prospects for the release of this series of equipment, compatibility with other series;
- stability of technical support of the manufacturer;
- availability of the most complete technical documentation;
- cost characteristics, etc.

The exact set of indicators for the selection of hardware is determined by the specifics of the network. In addition, the importance of each of these indicators is different for different networks. For example, for specialized telecommunications networks with protected performance, the indicators that characterize their reliability and security are important; For some networks, which involve the exchange of large amounts of information, the most important thing is performance; cost indicators with limited financial resources, etc. b. is important [5].

Ali Karevan et al. presented a reliability-based and sustainability-informed maintenance optimization model for telecommunications equipment. It considers several risk attributes associated with sustainability dimensions (i.e. social, economic and environmental aspects) [6].

In [7] comparative studies of the effectiveness of methods for choosing the preferred design solution, taking into account the totality of quality indicators and information received from experts, have been carried out. It is shown that the hierarchy analysis method is the best with a small standard deviation of decision-making by experts. This means that it is better to use more experienced and qualified experts in a small number than a large number of experts with a large standard deviation of decision-making.

[8] discussed the features of the application of multicriteria optimization methods when choosing the optimal design options for telecommunications facilities, taking into account a set of quality indicators. Examples of multicriteria analysis and selection of optimal options for various telecommunications facilities, in particular, options for building a radio network of a mobile communication system, structure and routing methods in multiservice networks, ad-hoc networks, sensor and executive networks, as well as 4th generation mobile communication technologies.

A.A. Zazarinny et al. considered the problem of choosing technical means for building telecommunication networks. The main aspects of the choice of technical means for building networks were also presented, a set of indicators for their selection was proposed. The method of selection and an example of calculation by this method are given [9].

Arsany Basta et al. proposed three optimization models that aim at minimizing the network load cost as well as data center resources cost by finding the optimal placement of the data centers as well the SDN and NFV mobile network functions. The optimization solutions demonstrate the trade-offs between the different data center deployments, i.e., centralized or distributed, and the different cost factors, i.e., optimal network load cost or data center resources cost. The paper proposed a Pareto optimal multi-objective model that achieves a balance between network and data center cost. Additionally, they used prior inference, based on the solutions of the single objectives, to pre-select data center locations for the multi-objective model that results in reducing the optimization complexity and achieves savings in run time while keeping a minimal optimality gap [10].

The purpose of the [11] is to identify and analyze critical risk factors (CRFs) for enhancing sustainable supply chain management practices in the Indian telecommunication industry using interpretive structural modelling (ISM). Risk factors are identified through a literature survey, and then with the help of experts, nine CRFs are identified using a fuzzy Delphi method (FDM).

The above mentioned works used different methods of decision-making, which have both advantages and disadvantages.

The use of the axiomatic method of narrowing the Pareto set, which is considered in work 10, is not intended to highlight the best solution, it only excludes non-optimal options, reducing the choice space.

In the hierarchy analysis method [7], an attempt was made to circumvent the weaknesses of the Delphic method, while simultaneously applying its strengths related to the modernization of decision-making and planning operations under uncertainty. Unlike the Delphi method [12], numerous interactions and discussions are supported in MAI. Consequently, new and meaningful knowledge is emerging as the group examines the assumptions underlying personal judgments. Opinions that fall out of the common channel are provided for in calculations, but are not deleted.

The hierarchy analysis method also takes over something from the Delphi method. In particular, the use of questionnaires is similar to those used in the Delphi method for forwarding questions to many interested parties. Its superiority lies in the fact that various interested persons are involved in the process, whose opinions otherwise could not be taken into account.

The article proposes a method for analyzing hierarchies and a method for analyzing networks to solve problems.

The most extensive possibilities of the compared methods for solving the problems under consideration have NAM, as a further development of MAH. NAM and MAH in the complex make it possible to make decisions on the selection of samples more reasonably due to their greater informativeness results. It is advisable to use these methods in the presence of qualified experts who provide objective prioritization for the compared characteristics of samples.

In hierarchical structures, the importance of criteria affects the priorities of alternatives.

In structures other than hierarchical, the importance of alternatives affects priorities criteria. The analytical network method is a generalization of the hierarchy analysis method, since it allows taking into account both the influence of the importance of criteria on the priorities of alternatives, which occurs in the hierarchy analysis method, and the influence of the importance of

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alternatives on priorities criteria that are not taken into account in the hierarchy analysis method.

3. METHODOLOGY

3.1 The analysis of hierarchies

In the 70s and 80s, the American scientist T.L. Saati designed and developed the "analytic hierarchy process" (AHP), a powerful method for benchmarking and ranking objects characterized by sets of criteria and indicators, quantitative and qualitative. In the literature, this method is also called the method of analysis of hierarchies (MAH). The method is used for many tasks. Here are the main ones:

- Comparative analysis of objects (multi-criteria ranking).
- Multi-criteria selection of the best object (best alternative).
- Distribution of resources between projects.
- Designing systems for quantitative and qualitative characteristics.

This method requires the following conditions to be met for successful application:

- sufficiently qualified experts take part in the procedure, who do not allow significant errors in estimates; moreover, the MAH requires that the group of experts be consolidated, i.e. having common positions and striving for consistency in their assessments;
- for a set of compared objects ("alternatives"), a common system of criteria can be built;
- scores on "negative" criteria are not dangerously close to the constraints [12].

Hierarchy analysis method steps:

1) Representation of the original problem in the form of a hierarchical structure.

The goal is the highest level of the hierarchy (level 1). There can be only one object at this level. At the next down levels are the criteria. According to the system of these criteria, compared objects (called "alternatives") are evaluated. The alternatives are at the lowest level. The task may contain several levels of criteria, but usually 3-level hierarchies (goal - criteria - alternatives) and 4-level (goal - complex criteria - criteria - alternatives) are used.

Making expert judgments at each level of the hierarchy using paired comparisons: the criteria are compared in pairs with respect to the goal, alternatives - in pairs with respect to each of the criteria.

Accordingly, matrices of paired comparisons are filled in: one for criteria, n matrices for alternatives; here n is the number of criteria.

Pairwise comparison operation: two objects at the same level are compared in terms of their relative importance for one higher-level object. If the criterion has a certain numerical measure, for example, mass, productivity, price, then it is convenient to take the ratios of the corresponding characteristics (given or calculated) in a certain scale of ratios as a result of the assessment. If the criterion does not have a measure taken, then the comparison in the MAH is carried out using a special "scale of relative importance" (other names: "scale 1-9", "Saaty scale"). This scale has 9 degrees of preference, selected taking into account the experimentally established psychophysiological characteristics of the person performing the comparison.

The numbers from this scale are used to show how many times the item with the higher preference rating is dominated by the item with the lower rating relative to a common criterion or property. In MAH and NAM, the dominance of one object over another is a) by preference; b) by importance; c) by probability.

In the operation of pairwise comparison, the values of inverse preference estimates are used: if the advantage of the i-th alternative over the j-th one has one of the above values, then the preference estimate of the i-th alternative over the j-th one will have an inverse meaning. That is, in the MAH, all matrices of pairwise comparisons (MPS) are inversely symmetric.

Mathematical processing of matrices of pairwise comparisons to find local and global priorities.

With the exact process of determining the vector of local priorities, the problem is reduced to finding the eigenvector of the matrix of pairwise comparisons:

$$A \cdot X = \lambda \cdot X,$$

where A is a matrix of paired comparisons (MPS), X is an n-dimensional vector composed of the sought priorities, λ is the eigenvalue of MPS;

and the subsequent normalization of this vector:

$$a_{ij} = ({a_{ij}}^1 \cdot {a_{ij}}^2 \cdot \ldots \cdot {a_{ij}}^s)^{\frac{1}{s}}.$$

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In the problem under consideration, the desired one is the vector corresponding to the maximum eigenvalue.

The local priority vector can be roughly calculated in a simplified way:

$$\sum x_i = 1.$$

For each row of the matrix of pairwise comparisons, we find the geometric mean of its elements:

Find the sum of all these geometric means.

$$a_{ij} = (a_{ij}{}^1 \cdot a_{ij}{}^2 \cdot \ldots \cdot a_{ij}{}^s)^{\frac{1}{s}}.$$

We divide each geometric mean by their sum ("normalization to one"). The result is a vector of local priorities of this matrix.

MAH has the ability to check the consistency of expert assessments, i.e. numbers in each matrix of pairwise comparisons. To control the consistency of these estimates, two related characteristics are introduced - the concordance index (CI) and the consistency ratio (CR):

$$C.I. = \frac{\lambda_{max} - n}{n - 1},$$

$$C.R. = \frac{C.I.}{P_n},$$

where Pn is the concordance index for a positive inversely symmetric matrix of random size estimates [image]; the elements of this matrix are obtained by a random choice from the set of admissible estimates, i.e. from numbers in the series {1/9, 1/8, 1/7, 1/6, 1/5, 1/4, 1/3, 1/2, 1, 2, 3, 4, 5, 6, 7, 8, 9}.

3.2 Network analysis method

The network analysis method (NAM) was developed by T.L. Saati, this is a development of the method of analyzing hierarchies. NAM allows you to explore influences in network structures and in hierarchies with horizontal and feedback.

The network analysis method algorithm includes the following main stages:

1 Representation of the structure of the problem in the form of a graph, which is the topological model of the problem.

2 Construction of a supermatrix.

The numerical model in the NAM is the so-called supermatrix - a matrix that shows numerically the mutual influence of elements in a network or in a hierarchy.

Elements Wij in the supermatrix W are called blocks and are matrices expressing the influence of the i-th component of the network of the matrix W on the j-th component. The Wij blocks are not necessarily square matrices.

3 "Weighing" of the supermatrix.

To obtain a solution to the problem, its original supermatrix must be transformed into a column stochastic supermatrix.

4 Obtaining the result - the limiting supermatrix.

The final operation in the MAS algorithm is to obtain the so-called limit supermatrix by sequentially raising the weighted (column stochastic) supermatrix to integer powers. The elements of the ultimate supermatrix are quantitative estimates of the influence of one element on another in the scale of relations. That is, the limit supermatrix is a solution to the problem. Two cases are possible here: 1) limit - matrix elements practically cease to change, this is the limit supermatrix; 2) cycle - matrices to some extent repeat one of the previous ones, in this case the result is obtained by finding the so-called Cesar sum (below).

In most cases, evaluations of alternatives in relation to the goal are especially important. The elements of block W31 in the original and weighted supermatrices are equal to 0. In the limiting supermatrix, they will be equal to the global priorities of the alternatives, on the basis of which it will be possible to make an informed choice of the best alternative or to solve other problems.

So, to obtain the limiting supermatrix, it is necessary to raise it to integer powers, i.e. consistently multiply by yourself. This is possible since the supermatrix is square.

The ultimate estimate of all possible influences is given by the so-called Cesar sum.

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NAM allows you to analyze systemic problems in structures of the following basic types: 1) hierarchies with backward and horizontal links; 2) network structures, consisting of clusters, which are hierarchies, networks, combined structures.

The network analysis method is applicable for all those tasks as the hierarchy analysis method, but the NAM is more time consuming, practically not amenable to "manual counting". NAM allows you to combine quantitative, statistical data with expert assessments and, thereby, create more adequate models of complex problems, for example, for forecasting and diagnostics.

So, T.L. Saati developed a diagnostic approach based on hierarchy analysis and network analysis techniques. This approach is used to solve the following problems:

1 Determination of the likelihood of diagnoses (D) considered as alternatives based on the totality of symptoms (S)

2 Choice of treatment method (s) (A) from a variety of alternative treatments

This approach, in its theoretical basis, is not explicitly based on the concept of conditional probability and statistics as a widely used Bayesian approach, but it allows combining statistical data with expert assessments of the individual characteristics of the problem under consideration. This approach is applicable to the analysis of technical problems, quality management.

4. EXPERIMENTAL RESULTS

The network equipment market is very diverse in a wide range of pricing policies. The price of network equipment is determined not only by its quality, but also by the brand of the manufacturer. Table 1 shows a comparative table of switches for 2021.

Based on the results of the evaluation of the selected indicators, the least number of types of equipment (three to five) that best meet all the requirements and are comparable in terms of performance were selected.

From the remaining options, it is necessary to choose the most suitable option for this network in terms of technical and operational performance. In this case, it is usually impossible to find the best equipment for all of the above indicators. In particular, certain types of equipment with the highest performance or reliability are inferior to other characteristics;

The best equipment is more expensive in terms of the number of supported protocols and types of interfaces.

Criteria - a quantitative or qualitative characteristic that is essential for judging an object.

Alternatives are objects among which a choice must be made.

The result of solving the problem by the method of analyzing hierarchies is presented in the form of two tables - a table where all found local priorities are indicated and tables where ranked global priorities of alternatives are indicated - and diagrams of global priorities of alternatives. The alternative with the highest global priority value is the best for this purpose.

Analysis of the calculation results (Table 3, Fig. 1) shows that the best example according to the criteria of the six compared switch models is model No. 6 TP-LINK TL-SG108 with a global priority value of 0.189, and the worst one is No. 2 ZYXEL GS1200-5 with a global priority value of 0.139.

The result of solving the problem by the method of network analysis is presented in the form of three tables: the "Initial supermatrix" table, where all found local priorities are indicated by the blocks, and the "Ultimate supermatrix" tables, where quantitative estimates of the influence of one element on another are indicated in the priority ratio scale and tables, where the ranked global priorities of the alternatives are indicated. And also diagrams of global priorities of alternatives. The alternative with the highest global priority value is the best for this purpose.

Table 1: criteria and alternatives for various switch models

Criteria / Alternative	D-link DGS-1005D/I3	ZYXEL GS1200-5	TP-LINK LS1005G	Cisco SG110D-08	ZYXEL GS-108B v3	TP-LINK TL-SG108
data transfer rate	1 Gbps	1 Gbps	1 Gbps	1 Gbps	1 Gbps	1 Gbps
Bandwidth	10 Gbps	10 Gbps	10 Gbps	16 Gbps	16 Gbps	16 Gbps
table of MAC-addresses	2048	2048	2048	4096	4096	4096
network standards	IEEE 802.1p, Jumbo Frame, auto - detection MDI/MDIX	IEEE 802.1q/802.3ad/802.1p, Jumbo Frame, auto - detection MDI/MDIX	IEEE 802.1p, Jumbo Frame, auto - detection MDI/MDIX	IEEE 802.1p, Jumbo Frame, auto - detection MDI/MDIX	IEEE 802.3az, Jumbo Frame, auto - detection MDI/MDIX;	IEEE 802.1p, Jumbo Frame, auto - detection MDI/MDIX
Management options	uncontrolled	Level 2	uncontrolled	uncontrolled	uncontrolled	uncontrolled
cost, tenge	6 104	11 194	6 311	22 282	14 151	9 940

Table 2: Priority Matrix Of Criteria In Relation To The Goal And Alternatives In Relation To Each Of The Criteria:

Criteria / Alternative	Priority criteria	D-link DGS-1005D/I3	ZYXEL GS1200-5	TP-LINK LS1005G	Cisco SG110D-08	ZYXEL GS-108B v3	TP-LINK TL-SG108
data transfer rate	0.319	0.203	0.290	0.235	0.092	0.110	0.070
bandwidth	0.267	0.084	0.083	0.083	0.250	0.250	0.250
table of MAC-addresses	0.046	0.166	0.167	0.167	0.167	0.167	0.167
network standards	0.159	0.148	0.213	0.147	0.164	0.164	0.164
Management options	0.068	0.148	0.213	0.147	0.164	0.164	0.164
cost, tenge	0.141	0.262	0.142	0.252	0.071	0.113	0.160

Table 3: Global Priorities Of Alternatives

№	Alternatives	Global Priorities
I	TP-LINK TL-SG108	0.189
II	ZYXEL GS-108B v3	0.183
III	Cisco SG110D-08	0.179
IV	TP-LINK LS1005G	0.155
V	D-link DGS-1005D/I3	0.155
VI	ZYXEL GS1200-5	0.139

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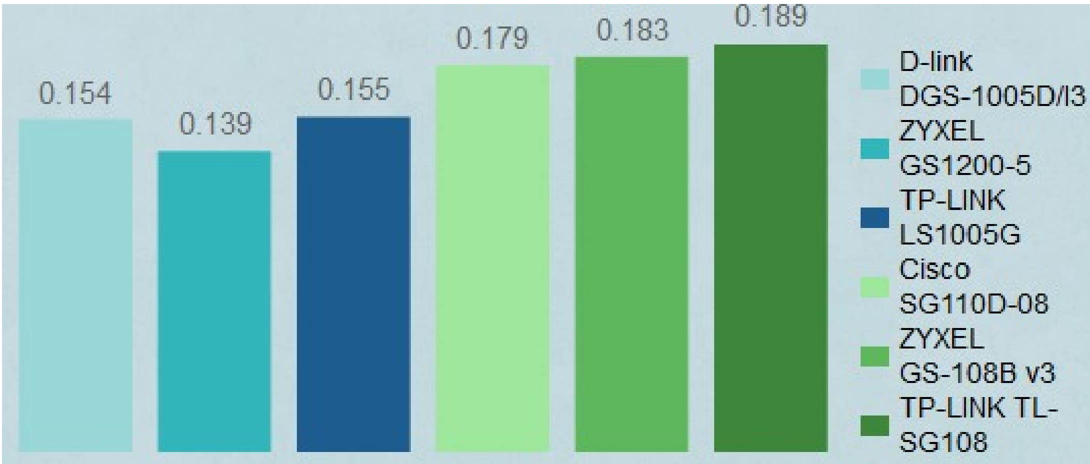

Figure 1. Diagram Of Global Priorities Of Alternatives

Table 4: Initial Supermatrix

	Alternatives	Cr1	Cr2	Cr3	Cr4	Cr5	Cr6
A1	D-link DGS-1005D/I3	0.166	0.087	0.084	0.166	0.125	0.262
A2	ZYXEL GS1200-5	0.167	0.087	0.084	0.167	0.375	0.142
A3	TP-LINK LS1005G	0.167	0.133	0.108	0.167	0.125	0.252
A4	Cisco SG110D-08	0.167	0.259	0.218	0.167	0.125	0.071
A5	ZYXEL GS-108B v3	0.167	0.217	0.253	0.167	0.125	0.113
A6	TP-LINK TL-SG108	0.167	0.217	0.253	0.167	0.125	0.160

Table 5: Ultimate Supermatrix

	Alternatives	Cr1	Cr2	Cr3	Cr4	Cr5	Cr6
A1	D-link DGS-1005D/I3	0.166	0.087	0.084	0.166	0.125	0.262
A2	ZYXEL GS1200-5	0.167	0.087	0.084	0.167	0.375	0.142
A3	TP-LINK LS1005G	0.167	0.133	0.108	0.167	0.125	0.252
A4	Cisco SG110D-08	0.167	0.259	0.218	0.167	0.125	0.071
A5	ZYXEL GS-108B v3	0.167	0.217	0.253	0.167	0.125	0.113
A6	TP-LINK TL-SG108	0.167	0.217	0.253	0.167	0.125	0.160

Table 6: Global Priorities Of Alternatives

№	Alternatives	Global Priorities
I	TP-LINK TL-SG108	0.182
II	Cisco SG110D-08	0.177
III	ZYXEL GS-108B v3	0.174
IV	TP-LINK LS1005G	0.165
V	D-link DGS-1005D/I3	0.153
VI	ZYXEL GS1200-5	0.148

The results of calculations based on the NAM (Fig. 2, Table 5) also confirm the previously obtained results based on the MAH. At the same time, the best example according to the criteria of the six compared switch models is model No. 6 TP-LINK TL-SG108 with a global priority value of 0.182, and the worst is No. 2 ZYXEL GS1200-5 with a global priority value of 0.148

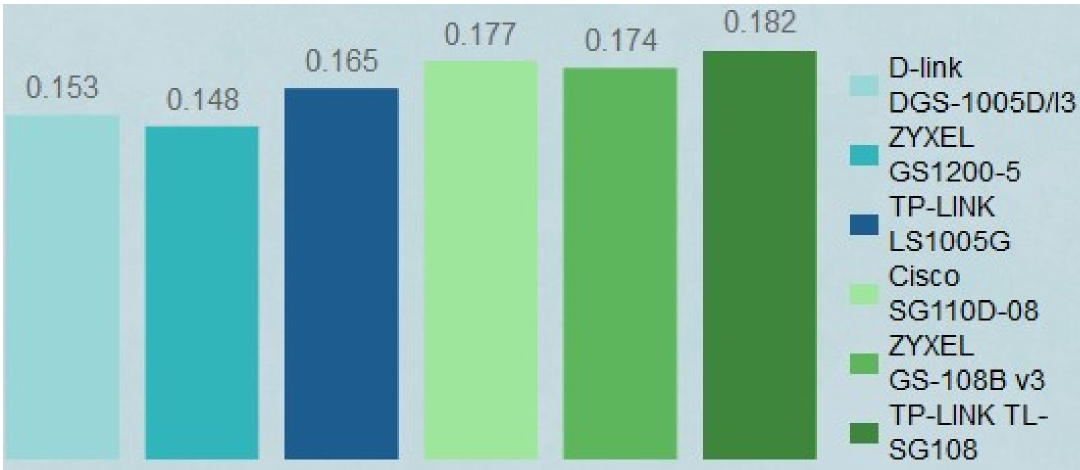

Figure 2. Diagram of global priorities of alternatives

Table 7: Global Priorities of Alternatives

Methods	Advantages	Disadvantages
Hierarchy analysis method	Step-by-step analysis for each criterion; high information content	Subjectivity of the results associated with the assignment of priorities to the compared characteristics
Method of network analysis	High information content and accuracy of calculation results	Simultaneous selection of several classes is impossible

5. CONCLUSION

Based on the research results, a comparative assessment of the applicability of the considered methods for the tasks of comparative assessment and selection of the best switch models was carried out and their advantages and disadvantages were determined.

The advantages of the hierarchy analysis method include step-by-step analysis for each criterion, high information content, while the network analysis method is characterized by high information content and accuracy of calculation results. The disadvantages of the hierarchy analysis method are the subjectivity of the results associated with the assignment of priorities to the compared characteristics, and for the network analysis method it is impossible to select simultaneously across several classes.

The network analysis method is applicable to all those tasks as the hierarchy analysis method, but the NAM is more time-consuming, practically not amenable to "manual counting". NAM allows you to combine quantitative, statistical data with expert assessments and, thereby, create more adequate models of complex problems, for example, for forecasting and diagnostics.

This approach in its theoretical basis is not explicitly based on the concept of conditional probability and statistics as a widely used Bayesian approach, but allows you to combine statistical data with expert assessments of the individual characteristics of the problem under consideration. This approach is also applicable to the analysis of technical problems, quality management.

The network analysis method has the broadest capabilities of the compared methods for solving the problems under consideration.

It is advisable to apply these methods in the presence of qualified experts who provide an objective assignment of priorities for the compared characteristics of telecommunication equipment, which is a disadvantage associated with the shortage of professional experts.

An analysis of the advantages and disadvantages of the considered methods of comparative assessment of switch models indicates the advisability of their complex application, which makes it possible to increase the validity of decisions made and reduce the risk of errors at the selection stage.

Thus, a comprehensive methodological approach is proposed for conducting a comparative assessment and choosing the optimal equipment, which allows making rational decisions when creating a model of an optimal telecommunications network.

The disadvantages of this approach are the complexity of the mathematical apparatus used, which requires qualified personnel (mathematicians, programmers), and the insufficient efficiency of the solutions obtained, associated with the complex technology of research.

In order to eliminate the noted shortcomings, a decision support system is being created based on the complex application of the proposed selection methods, the use of which will increase the efficiency and validity of the issuance of selection results, as well as the availability of work with it for non-professional users. The use of such a system will significantly reduce the complexity of calculations, increase the efficiency of decision-making and their quality, and, ultimately, increase the success of the planned projects implementation even at the early stages of their substantiation.

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