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ORIGINAL SCIENTIFIC PAPER

Selection of the location of a goods transportation center using the moora method

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Abstract: The location of goods transport centers in the Republic of Srpska can be observed in several ways, two of which are of decisive importance, namely, the position and strength of the flows that converge in certain nodes and the mutual relationship between the located and projected capacities in the observed nodes. The special importance of individual goods transport centers is the variety of logistics services provided. Especially in places where multiple branches of traffic meet and engage multiple entities in meeting transport demand. The factors used in selecting the basic criteria for choosing the location of freight transport centers in the Republic of Srpska are the position they occupy on railway and road routes, i.e. corridors. According to the basic definition, the role and task of goods transport centers is the collection of cargo and other shipments by road vehicles, if necessary, storage, formation of transport handling units and shipment by rail and other modes of transport for a specific goods transport center, where the goods are delivered to the recipient. Taking into account all the above, seven basic criteria were selected for the subject analysis: social, legislative, ecological, organizational, technical, technological and economic. During the research, a survey was used, on the basis of which the mentioned criteria were evaluated. By applying multi-criteria analysis, the weight of individual criteria and the value of alternatives according to criteria were determined. By applying the MOORA mathematical method, the city of Doboj was chosen as the optimal location for the construction of a goods transport center.

Keywords: goods transport center, logistics, multi-criteria analysis, mathematical method MOORA.

INTRODUCTION

Contemporary trends in the development of the economy and society, strategic and technological trends in developed countries of Europe and the world have led to a new concept of optimizing the movement of material goods, i.e. optimizing the transport process, developing new technologies and providing transport services in a modern logistical, rational and economical way. The development of large economic centers within the framework of large agglomerations in the world conditions a high level of development of goods transport centers (RTC), which represent the imperative of the modern transport process.

The formation of a commodity transport center enables a rational division of work on the transport market, concentration of commodity work, selection of the most favorable carrier of transport in macro distribution and concentration of activities with unique servicing of urban wholes of industrial zones, then in macro distribution with a unique information system in all links of the logistics chain.The place and role of the goods transport center is not only to connect certain subjects (demanders, providers and connectors of transport services) into a single transport chain, but the multiplication task is to make it continuous, but ultimately continuous. In addition, goods transport centers, as links in the logistics chain, represent a link in connecting all participants in the transport process, thus creating a unique transport system with the possibility of fitting into a single transport market.

Bosnia and Herzegovina, as a European country, cannot be included in world trends, nor in cooperation and organization of traffic without the construction of goods transport centers in larger agglomerations. Bearing this in mind, and going to meet the modern solutions applied in Europe, the basic idea was to develop a methodology based on multi-criteria decision-making aimed at solving the tasks of choosing the optimal location of the goods transport center. Such tasks represent a complex interdisciplinary process with a high degree of expert activity.

Starting from the analysis of logistics flows and processes in the region, attention is focused on the main tasks that are solved when choosing the optimal location of the goods transport center. It is based on the assumption and knowledge that in the logistics chain of supply, economic organizations, city infrastructure facilities and citizens, goods transport centers have a very important role. The success of the economy and city infrastructure depends on their ability to dispose of goods and provide quality logistics services. The assumption is that the existence of a goods transport center with an optimal location, assortment and quantities of goods with a focus on elements and transport and storage systems makes a key contribution to the improvement of the economy and business.

When solving such problems, the decision-making process requires the use of a large number of rules, the consideration of a large number of alternatives and criteria, in addition to the fact that the attributes that describe certain conditions can be of a qualitative or quantitative nature. Namely, in the modern decision-making process, the trend is to include a large number of expert teams and interested parties who are existentially interested and located in the studied area and who can feel direct or indirect impacts through the process of solving the problem itself. At the same time, we should not forget the fact that every facility integrated into a logistics system affects the efficiency, effectiveness and costs of its operation.

CRITERIA USED FOR THE SELECTION OF THE RTC LOCATION

The large number and heterogeneity of location factors clearly indicate that location problems are of an interdisciplinary nature and often require the application of complex procedures when choosing the best location for rtc construction. There are numerous methodologies, as well as models that are directed towards this kind of problem. The criterion is a component that is present in almost all procedures related to the selection of the location or area of the rtc, that is, the terminal, regardless of the various models and methodologies used. As already mentioned, the process of choosing the area or location of the rtc, that is, the terminal, can be performed in two phases, from the aspect of two levels of observation, which refers to the macrolocation and microlocation procedure.

The mentioned macro and micro levels of observation require the definition of a set of certain criteria that can partially or completely differ and match. Based on the very structure of the problem and criteria, the selection and application of the optimization methodology and model is approached, as well as the evaluation of the solution regarding the location of the RTC. The procedure for selecting criteria for the realization of the definition of the area of the RTC, i.e. the terminal, can be different, starting from expert evaluation, to the hierarchical generation of criteria aimed at interest groups, certain participants - decision makers, along with their interests and goals.

Therefore, we can generate and classify criteria in relation to different points of view of the system and also of the decision maker. The choice of criteria may contain the subjective application of the individual decision-maker. For the selection of the area, that is, the location of the RTC, the criteria can be grouped in three ways (Kebić et al., 2004):

- According to the level of observation, to the criteria related to the determination of the macrolocation and microlocation of the goods terminal, that is, RTC;
- According to interest groups that are able to make certain decisions and to create influence on the concept of terminal development. This first of all refers to users of terminals and services, then owners and investors, operators, also to society from the aspect of socio-management institutions, population and others;
- According to the type of criteria and its corresponding position in one of the areas from the aspects of technology, economy, technique, organization, legal regulations, ecology and interest of the state.

The area for the construction of a goods transport center, that is, a goods terminal, must be coordinated according to the specific needs of the users of the center and the socio-economic system located in the narrower area, as well as in the wider area. The expectations of RTC users are reduced to the quality of logistics services and affordable prices, i.e. the provision of lower service prices. It would be desirable for the center - terminal to be located in the area as close as possible to its users, and if it is of an open type to provide accessibility for all types of goods, i.e. cargo, also to integrate as many types of transport as possible and to provide the option of connecting within the international transport network networks and others (Zečević, 2006).

The terminal as a system in the economic environment must be viewed as a profit center with all elements that directly and indirectly affect the results of the Cost-Benefit analysis. This means that the terminal must be in a location with a strong economic and logistical environment that will attract goods, transport flows and all other supporting activities that support these flows (service systems, catering, shops, post offices, banks, insurance companies, customs services, etc.) .). The level of infrastructure construction, the presence of subsystems that enable synergistic effects, the possibility of expansion, legal regulations and the possibility of efficiently activating the location without ownership and other legal restrictions are very important criteria that are taken into account by investors, terminal owners. Quality connections with other logistics centers and the possibility of inclusion in national and international logistics networks are also important decision criteria. Of extreme importance for the terminal is its position in relation to the main transport axes, corridors or roads within urban areas.

Society and the state want the terminal to promote the development of all activities, to be in the function of the development of the entire system, to protect and preserve natural resources. It is desirable and necessary for the terminal to fit into the environment, to be in accordance with spatial and urban plans at the observed location, to fit into development plans at all levels, from city or regional to national or international planning levels.

The criteria listed and shown in Figure 1 do not constitute a complete set of possible criteria that are applied in solving location problems. At the next level, the mentioned criteria can be broken down into sub-criteria, and depending on the system being observed, modeled. Thus, for example, transport costs, as part of logistics costs, can be broken down into costs of local collection transport, local distribution transport in the gravity zone of the terminal, costs of remote transport between terminals in the logistics network, costs of transporting containers, exchangeable transport vessels, etc. Degree of breakdown criteria depends on the specific setting of the location problem. In addition to the fact that not all criteria have been mentioned, not all of those mentioned have to be applied to specific location problems. When choosing criteria, their power in terms of selective action on alternative solutions for the location of goods terminals is important.

The generation and classification of criteria according to technological, economic, ecological, legal-regulatory, organizational and technical character gives the possibility of selection and observation of the shortcomings of locational alternatives from the aspect of significant areas for the development of the terminal. This approach gives the possibility of a general overview of the advantages and disadvantages of potential locations. The selection of criteria from all groups is a guarantee of its successful construction, development and sustainability. Each location methodology or model that is based on one or two groups of the mentioned criteria represents a partial procedure for choosing the location of a goods transport center, that is, a goods terminal.

When comparing the choice of cities for RTC locations in the region or in the country, in addition to these criteria, the state's interest in financing RTC should also be taken into account. The choice of the location of the RTC largely depends on the decision and the state's ability to finance the construction of the RTC.

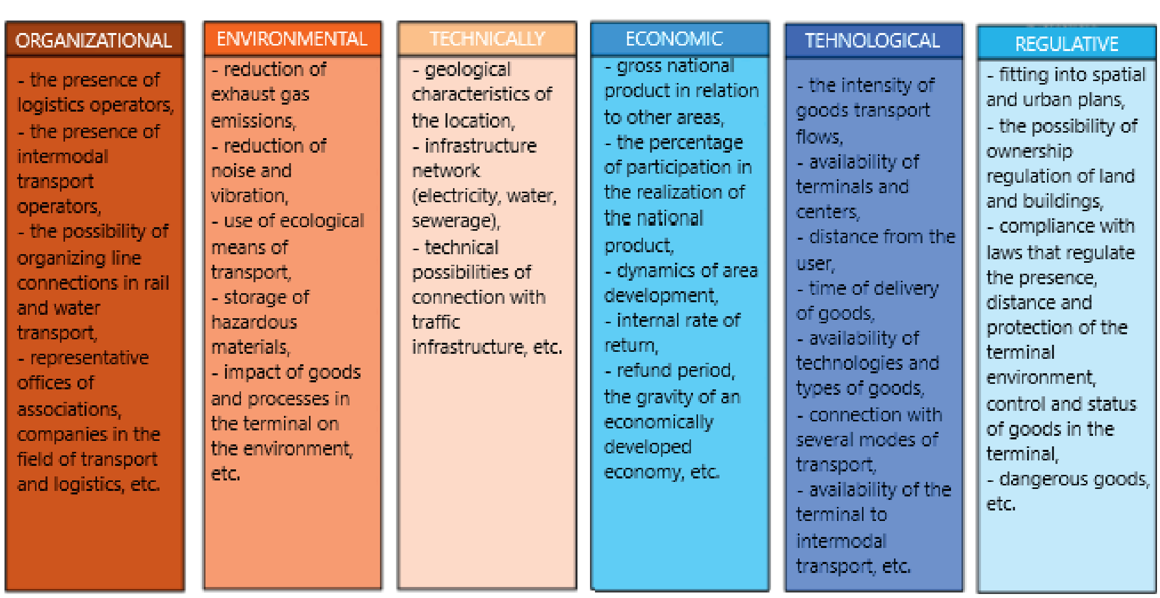

__Figure 1.__ RTC location selection criteria according to area affiliation (Zečević, 2006)

In these examples, quantitative and qualitative data are not detailed and allow us to observe differences and adequacy in analyzing regions. It should be emphasized that the comparative analysis of the RTC process must be complete and include all levels and criteria, because there are connections between the macro level and the detailed level of RTC operations. Omitting one of the comparative steps can give a false picture and lead to incomplete or wrong conclusions.

OVERVIEW OF POSSIBLE ALTERNATIVES FOR THE CONSTRUCTION OF RTC AND THE APPLICATION OF MOORE'S MATHEMATICAL METHOD FOR THEIR RANKING

The location of goods transport centers in the Republic of Srpska can be observed in several ways, two of which are of decisive importance, namely, the position and strength of the flows that flow in certain nodes and the mutual relationship between the located and projected capacities in the observed nodes. The special importance of individual goods transport centers is the variety of logistics services provided. And especially in places where multiple branches of traffic meet and engage multiple entities in meeting transport demand.

The Republic of Srpska is located on the Balkan Peninsula (geographical region of Southeastern Europe). The area of The Republic of Srpska is approximately 25,000 square kilometers, which is only slightly more than the area of Vojvodina, while the length of its border is a whopping 2170 kilometers, which is only slightly less than the much larger Serbia. The problem of The Republic of Srpska is the traffic infrastructure, which is not conducive to its development. No major road or railway corridor passes through The Republic of Srpska. A special category of problems when it comes to the traffic situation of The Republic of Srpska is air traffic. The main problem of air traffic is the fact that the only international airport in the Republic of Srpska is located near Banja Luka, which is at a great distance from, for example, Herzegovina.

The position of The Republic of Srpska also has certain advantages, i.e. access to an international river such as the Sava, proximity to the Adriatic Sea and the important Dubrovnik international airport, proximity to the interna-

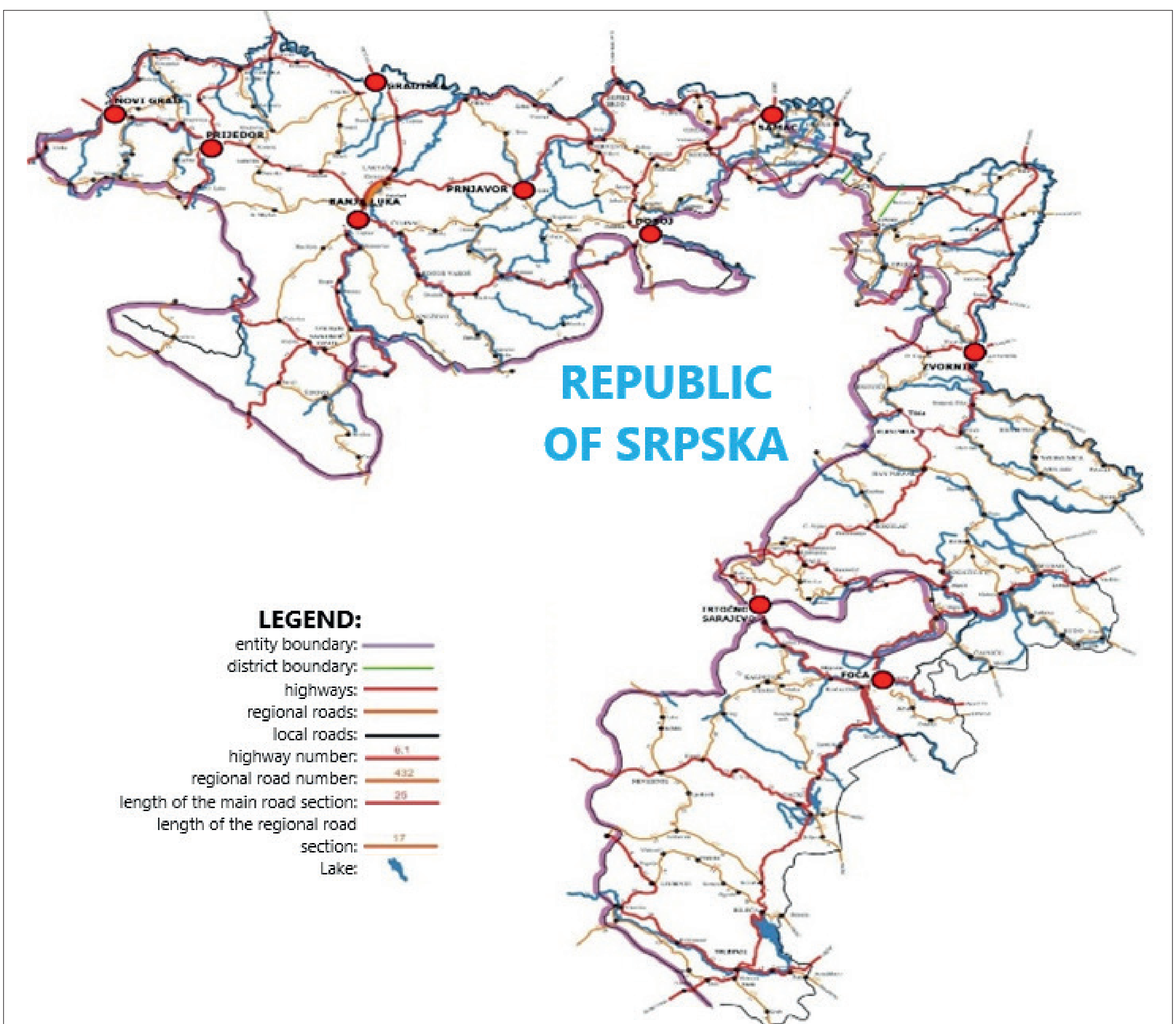

Figure 2. Proposal for RTC locations in The Republic of Srpska (Authors)

tional road corridor that connects the west with the south and east of Europe (Belgrade-Zagreb highway), connection with corridor Vc which connects central and eastern Europe with the southern Adriatic and the future Adriatic-Ionian road route, as well as the position of the eastern part of The Republic of Srpska, which abuts the Drina, a river with enormous potential in various spheres - from energy to tourism. However, as it usually happens in our case, these potentials are almost completely unused.

Presentation of potential alternatives for the construction of the RTC

The basic criteria used in the selection of areas for RTC locations in The Republic of Srpska are the position they occupy on railway and road routes, i.e. corridors. Based on this criterion, the areas-cities were taken into consideration: Gradiška, Novi Grad, Prijedor, Banja Luka, Prnjavor, Doboj, Zvornik, Šamac, East Sarajevo and Foča. The location of these cities is shown in Figure 2. These cities correspond to the requirements where RTCs could be built. The basic criteria used in the selection of areas for RTC locations in The Republic of Srpska are the position they occupy on railway and road routes, i.e. corridors. Based on this criterion, the areas-cities were taken into consideration: Gradiška, Novi Grad, Prijedor, Banja Luka, Prnjavor, Doboj, Zvornik, Šamac, East Sarajevo and Foča. The location of these cities is shown in Figure 2. These cities correspond to the requirements where RTCs could be built.

The process of solving the location problem using multi-criteria analysis

In the process of solving the problem of multi-criteria analysis, goals are defined, criteria are chosen to measure the achievement of goals, alternatives are specified, the performance of alternatives according to different criteria is transformed so that they have the same metric, weighting coefficients are assigned to the criteria in order to determine their relative importance, choices are made is the appropriate method of multi-criteria analysis for ranking the alternatives and finally the best alternative is determined. In our case, the criteria for choosing the RTC location were defined, namely: Organizational (K1), Environmental (K2), Technical (K3), Economic (K4), Legal-regulatory (K5), Technological (K6) and State interest in financing of the RTC (K7), and the areas - locations, i.e. the alternatives are defined as follows: Gradiška (A1), Novi Grad (A2), Prijedor (A3), Banja Luka (A4), Prnjavor (A5), Doboj (A6), Šamac (A7), Zvornik (A8), East Sarajevo (A9) and Foča (A10).

The problem solving process is preceded by recognition, i.e. identification of the decision-making problem itself. The identification of the decision-making problem refers to the collection and classification of data, then data processing and finally the interpretation of the collected and processed data, which is a prerequisite for the correct identification of the problem. The first step in the identification phase is the collection of relevant data and information by the decision maker from a number of sources. The main goal is to extract the most significant and relevant data and information that are of crucial importance for a given decision-making problem. The essence of this phase is to collect and process data so as to enable the formation of a decision-making model.

Application of the MOORA method

The entire procedure of preparation and collection of input data required for the application of the MOORA method to the ranking of the selection of areas for the location of the RTC is shown in Figure 3.

We will present the mechanism and method of its application to the selection of the RTC location. As the MOORA method consists of two approaches: the ratio system approach (eng. Ratio System Approach-RS) and the reference point approach (eng. Reference Point Approach-RP), the procedure for applying this method to the obtained data consists of the following stages (Gatarić, 2017):

- initial, normalized and weight-normalized decision matrix (common steps for both approaches),

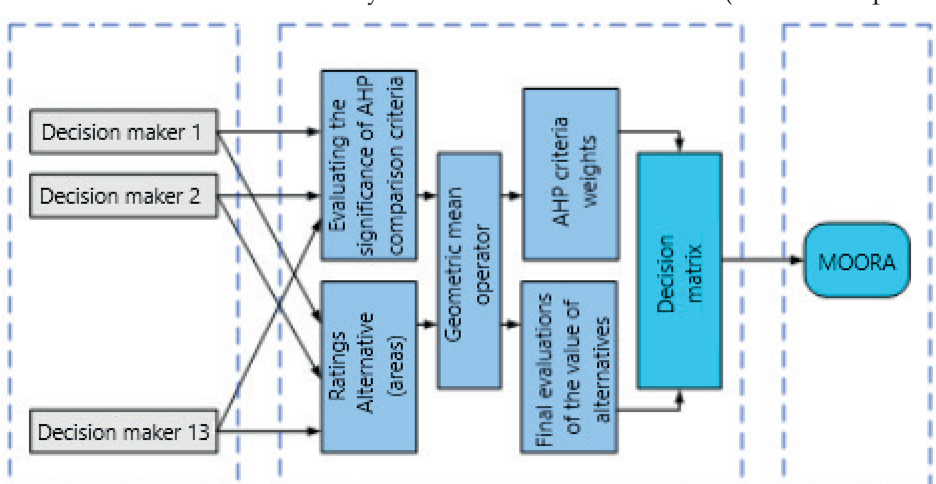

Figure 3. The flow of preparation and collection of input data required for the application of the MOORA method (Gatarić, 2017)

- approach to the relationship system and
- reference point approach.

Initial, normalized and weight-normalized decision matrix

The input values, i.e. the initial data for almost all methods, are the weights of the criteria and the values of the alternatives in relation to each criterion, which are the elements of the decision matrix. The initial decision-making matrix is presented in the following table.

Step 1. In this step, the values of the alternatives are transformed into dimensionless quantities, i.e. quantities that do not depend on the system of units. The MOORA method is based on vector normalization, which is the most complex. Therefore, the normalized decision matrix $R = [r_{ij}]_{10x7}$ contains normalized elements from the previous table and is shown in the following table 2.

Step 2. Formation of the weight-normalized decision matrix $V = [v_{ij}]_{10x7}$. The elements of the weight-normalized matrix Vj represent the product of the elements of the normalized matrix with the corresponding criteria weights, that is, the weight-normalized performance of the i-th alternative in relation to the j-th criterion (table 3).

Table 1. Initial decision-making matrix of evaluation of alternatives in relation to the selected criteria

Selection criteria	K1	K2	K3	K4	K5	K6	K7
Areas							
weights Wj	0.0822	0.1081	0.0858	0.1788	0.0473	0.1451	0.0953
Load direction	max	max	max	max	max	max	max
A1	8.2622	6.7338	7.3276	8.0588	6.6714	8.7940	8.4081
A2	8.2882	7.9764	7.7558	8.1118	5.1132	7.6025	6.8033
A3	8.5548	7.4382	6.5172	8.2149	7.3187	7.4474	7.6336
A4	9.1641	9.1209	9.1209	8.5321	7.1451	8.5375	7.3782
A5	7.8329	7.7197	8.3182	8.2594	5.5590	8.5871	7.2351
A6	8.9657	8.2443	8.7940	8.5457	7.5901	8.7147	8.6936
A7	8.4024	7.5433	7.9611	8.0182	6.7526	7.1025	5.4934
A8	8.0891	7.1292	7.5151	8.3113	8.2164	6.3943	5.4541
A9	7.9891	7.5480	7.6002	7.7485	7.2282	8.2933	5.8575
A10	6.9951	6.8586	7.7431	6.7425	6.8737	8.1955	6.2015
Suma	684.6528	586.7866	623.6106	651.1411	476.3813	640.4464	490.3095
Sqrt	26.1659	24.2237	24.9722	25.5175	21.8262	25.3070	22.1429

Table 2. Normalized decision matrix

	K1	K2	K3	K4	K5	K6	K7
Wj	0.0822	0.1081	0.0858	0.1788	0.0473	0.1451	0.0953
Load	max	max	max	max	max	max	max
A1	0.3158	0.2780	0.2934	0.3158	0.3057	0.3475	0.3797
A2	0.3168	0.3293	0.3106	0.3179	0.2343	0.3004	0.3072
A3	0.3269	0.3071	0.2610	0.3219	0.3353	0.2943	0.3447
A4	0.3502	0.3765	0.3652	0.3344	0.3274	0.3374	0.3332
A5	0.2994	0.3187	0.3331	0.3237	0.2547	0.3393	0.3267
A6	0.3426	0.3403	0.3522	0.3349	0.3478	0.3444	0.3926
A7	0.3211	0.3114	0.3188	0.3142	0.3094	0.2807	0.2481
A8	0.3091	0.2943	0.3009	0.3257	0.3764	0.2527	0.2463
A9	0.3053	0.3116	0.3043	0.3037	0.3312	0.3277	0.2645
A10	0.2673	0.2831	0.3101	0.2642	0.3149	0.3238	0.2801

Table 3. Weight-normalized decision matrix

Column1	K1	K2	K3	K4	K5	K6	K7
Wj	0.0822	0.1081	0.0858	0.1788	0.0473	0.1451	0.0953
Load	max	max	max	max	max	max	max
A1	0.0260	0.0300	0.0252	0.0565	0.0145	0.0504	0.0362
A2	0.0260	0.0356	0.0267	0.0568	0.0111	0.0436	0.0293
A3	0.0269	0.0332	0.0224	0.0576	0.0159	0.0427	0.0329
A4	0.0288	0.0407	0.0313	0.0598	0.0155	0.0489	0.0318
A5	0.0246	0.0344	0.0286	0.0579	0.0120	0.0492	0.0312
A6	0.0282	0.0368	0.0302	0.0599	0.0164	0.0500	0.0374
A7	0.0264	0.0337	0.0274	0.0562	0.0146	0.0407	0.0237
A8	0.0254	0.0318	0.0258	0.0582	0.0178	0.0367	0.0235
A9	0.0251	0.0337	0.0261	0.0543	0.0157	0.0475	0.0252
A10	0.0220	0.0306	0.0266	0.0472	0.0149	0.0470	0.0267

Ratio System Approach

The weight/importance of each alternative is determined as the difference of the income sums $Pi, i = 1,\ldots 10$ and expenditure elements $Ri, i = 1,\ldots 10$ weighted normalized decision matrices $V = [v_{ij}]_{10x7}$.

Step 3. The sums of income and expenditure elements for all alternatives are determined by applying the formulas:

$$P_i = \sum_{j=1}^{n} v_{ij} | j \in J^{max}, \ i = 1, \ldots, m \quad (1)$$

$$R_i = \sum_{j=1}^{n} v_{ij} | j \in J^{min}, \ i = 1, \ldots, m \quad (2)$$

where: J^{max} represents a set of income, and J^{min} represents a set of expenditure criteria.

In our case, there are no expenditure criteria, ie. all of them are profitable, because a better rating is more suitable for each criterion - the aim is to maximize the rating (value) of the criteria, that is $R_i = 0$, so we have that the difference is the sum of income and expenditure elements:

Step 4. $S_i = P_i - R_i = \sum_{j=1}^{7} V_{ij}, j \in J^{max}, i = 1, \ldots 10$

Step 5. The ranking results of this MOORA method approach are as follows (tables 4 and 5):

Table 4. Ranking results using the ratio system approach of the MOORA method

K3	K4	K5	K6	K7				
0.0858	0.1788	0.0473	0.1451	0.0953				
max	max	max	max	max	P	R	P-R	Rang
0.0252	0.0565	0.0145	0.0504	0.0362	0.2387	0.000	0.2387	3
0.0267	0.0568	0.0111	0.0436	0.0293	0.2291	0.000	0.2291	6
0.0224	0.0576	0.0159	0.0427	0.0329	0.2314	0.000	0.2314	5
0.0313	0.0598	0.0155	0.0489	0.0318	0.2568	0.000	0.2568	2
0.0286	0.0579	0.0120	0.0492	0.0312	0.2379	0.000	0.2379	4
0.0302	0.0599	0.0164	0.0500	0.0374	0.2589	0.000	0.2589	1
0.0274	0.0562	0.0146	0.0407	0.0237	0.2226	0.000	0.2226	8
0.0258	0.0582	0.0178	0.0367	0.0235	0.2192	0.000	0.2192	9
0.0261	0.0543	0.0157	0.0475	0.0252	0.2276	0.000	0.2276	7
0.0266	0.0472	0.0149	0.0470	0.0267	0.2150	0.000	0.2150	10

Table 5. Rankings from best to worst alternatives using the MOORA relationship system approach

Rang	Alternative
1	A6
2	A4
3	A1
4	A5
5	A3
6	A2
7	A9
8	A7
9	A8
10	A10

Reference Point Approach - RP

The weight/importance of each alternative is determined as its maximum distance from the ideal solution, after which the alternative with the smallest distance is selected. It is Min-Maxmetrics: $A_{RP}^{*} = \left\{ A_i \middle| \min_i \max_j d_i \right\}$. Calculating the distance of the alternative, ie. in relation to the ideal point, in relation to each criterion (table 6).

Table 6. Calculation v_j - j-th and reference point coordinates (ideal alternatives)

	K1	K2	K3	K4	K5	K6	K7
Wj	0.0822	0.1081	0.0858	0.1788	0.0473	0.1451	0.0953
Load	max	max	max	max	max	max	max
A1	0.0260	0.0300	0.0252	0.0565	0.0145	0.0504	0.0362
A2	0.0260	0.0356	0.0267	0.0568	0.0111	0.0436	0.0293
A3	0.0269	0.0332	0.0224	0.0576	0.0159	0.0427	0.0329
A4	0.0288	0.0407	0.0313	0.0598	0.0155	0.0489	0.0318
A5	0.0246	0.0344	0.0286	0.0579	0.0120	0.0492	0.0312
A6	0.0282	0.0368	0.0302	0.0599	0.0164	0.0500	0.0374
A7	0.0264	0.0337	0.0274	0.0562	0.0146	0.0407	0.0237
A8	0.0254	0.0318	0.0258	0.0582	0.0178	0.0367	0.0235
A9	0.0251	0.0337	0.0261	0.0543	0.0157	0.0475	0.0252
A10	0.0220	0.0306	0.0266	0.0472	0.0149	0.0470	0.0267
Vj	0.0288	0.0407	0.0313	0.0599	0.0178	0.0504	0.0374

Based on the above table and the calculated value v_j, we get the distance matrix $D = \left[d_{ij}\right]_{10x7}$, d_{ij} the absolute value of the distance of the i-th alternative in relation to the j-th coordinate of the reference point. Matrix D and its elements are shown in Table 7.

Table 7. Distance matrix D

			Distance matrix D				
A1	0.0028	0.0107	0.0062	0.0034	0.0033	0.0000	0.0012
A2	0.0028	0.0051	0.0047	0.0030	0.0067	0.0068	0.0081
A3	0.0019	0.0075	0.0089	0.0023	0.0019	0.0077	0.0046
A4	0.0000	0.0000	0.0000	0.0001	0.0023	0.0015	0.0057
A5	0.0042	0.0063	0.0029	0.0020	0.0058	0.0012	0.0063
A6	0.0006	0.0039	0.0011	0.0000	0.0014	0.0005	0.0000
A7	0.0024	0.0070	0.0040	0.0037	0.0032	0.0097	0.0138
A8	0.0034	0.0089	0.0055	0.0016	0.0000	0.0138	0.0139
A9	0.0037	0.0070	0.0052	0.0056	0.0021	0.0029	0.0122
A10	0.0068	0.0101	0.0047	0.0126	0.0029	0.0034	0.0107

Step 6. Calculation of the maximum distance(d_i) alternative A_i from the ideal solution.

Step 7. Ranking alternatives by rule $A^{*} = \left\{ A_i \middle| \min_i d_i \right\}$. Both steps are shown in the following tables.

Table 8. Calculation of the maximum distance

	di=max dij	Rang
A1	0.0107	6
A2	0.0096	4
A3	0.0104	5
A4	0.0126	2
A5	0.0107	3
A6	0.0127	1
A7	0.0138	9
A8	0.0139	10
A9	0.0122	7
A10	0.0107	8

Table 9. Final ranking of MOORA alternatives using the reference point approach

Rang	Alternative
1	A6
2	A4
3	A5
4	A2
5	A3
6	A1
7	A9
8	A10
9	A7
10	A8

It is clearly visible from the table that alternative 6, which represents Doboj as a potential location, is ranked best. Second in order is alternative four, i.e. Banja Luka.

CONCLUSION

Realization of goods flows within international, national, regional and urban areas cannot be imagined without some type of logistics centers as such. Therefore, goods transport centers constitute one of the most important networks of links within logistics and logistics chains. Requirements for quality logistics service such as: completeness, speed, accuracy, reliability, safety, flexibility, economy and others can be successfully met only by transport systems based on logistics principles, cooperation, coordination and technologies of combined and intermodal transport. Partial transport systems and service providers can never independently and successfully implement strict market requirements.

The selection of the location of the RTC is an extremely complex problem that cannot be solved without defining a large number of criteria that will take into account all the requirements and interests of interested parties and a large number of factors that reflect the characteristics of the area, in order to assess the weight of the criteria. In this sense, the choice of RTC location is a multi-criteria decision-making problem, and its solution requires the application of multi-criteria analysis methods. The approach allows for each criterion function to see the form of adopted generalized criteria and the position of experimental points, and when it comes to determining the relative importance of a set of attributes or criteria, the concept of balance that characterizes these methods is used. In this way, multi-criteria analysis methods support decision makers, as they can incorporate multiple sustainability goals. The paper defines a multi-criteria analysis method that provides a holistic approach to solving the problem of RTC location selection. In the process of choosing the location of the RTC, the determination of the set of criteria by which the selection will be made is of the greatest importance. Out of a large number of criteria, the criteria for choosing the location of the RTC were defined. Several measurable and non-measurable factors are included in the criteria for comparing alternative solutions. Given that the weights of the criteria and the values of the alternatives are unclear and imprecise, they were also applied to the expansion phase of conventional methods of multi-criteria analysis.

The reason for choosing the MOORA method is not its possible simplicity and easy application, but the fact that it has mechanisms that ensure the reliability of the calculated weights (significance) of the criteria. Since in the process of determining the weight (importance) the criteria for the evaluation of the RTC location were selected in advance, a large number of decision-makers were also included, who gave their assessment of the importance of the criteria by completing the survey, thus the process of group decision-making was introduced into the overall problem solving process. . It introduces significant difficulties in obtaining a unique solution, but therefore subjectivity in assessments is avoided. Namely, by completing the survey (based on the AHP questionnaire and assessment scale), opinions on the significance of the criteria and evaluations of the alternatives were accepted. The answers obtained are considered reliable and objective, which made it possible to accurately determine the weights (importance) of the criteria. Solutions were obtained by comparative analysis of the results of the ranking of alternatives in relation to the selected criteria, applying the MOORA method of multi-criteria analysis. The best solution for choosing the RTC location is the Doboj area.

The work opens up the possibility of further directions of research in a narrower scientific field, which can be the identification of new criteria. Their quantification and evaluation and research of other methods of quantification of criteria using different techniques that successfully treat various types of uncertainty and imprecision. The work also leaves the possibility of micro-location research in the area of the selected city.

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