ELECTRE METHODS IN SELECTION OF OPTIMAL INVESTMENT IN RESIDENTIAL FACILITIES

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Abstract

This paper presents the application of ELECTRE method of multi-criteria decision-making in the analysis of criteria for selecting optimal investment in residential buildings. The method is based on a multiple comparison of alternatives, considering two parameters: the index of concordance (agreement) and the index of discordance (disagreement). Generally accepted criteria for evaluating alternatives were taken into account: the area of a flat, the state in which the flat is, location, functionality, the quality of construction, floor, the number of floors in the building, elevator, central heating, environment, natural illumination of the flat and the view from the flat. The severity of the criteria and ratings of alternatives according to these criteria were obtained by expert estimates. Applying ELECTRE method the influence of subjective factor that determines the severity of criteria is minimized. A sensitivity analysis of investment criteria has been carried out, as well as a sensitivity analysis in relation to the threshold of significance for the indexes of concordance.It has been concluded that, when applying ELECTRE method, different severity of criteria does not always have a crucial role. Thus, the subjective factor which determines the severity of criteria cannot completely throw out the decision-making alternatives that have good rating according to most criteria.

Key words

ELECTRE methods; indexes of concordance and discordance; multi-criteria analysis; optimal choice; residential facilities; threshold of significance

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1 INTRODUCTION

One of the issues that arise in construction investments is how to select one or more offers for investing from a large number of facilities [1]. The example that follows relates to the selection of residential properties for investment. The criteria, as well as the weight or importance of each of the criteria and score scales have been obtained in consultation with experts in the field of construction investments.

The selection of optimal investment in residential facilities is a very important investors' decision. Therefore, the choice of the optimal investment in residential structures is devoted special attention and the path to optimal decisions is analyzed in detail. In the decision-making process itself research are carried out aimed at achieving the best results. This process is influenced by a large number of criteria that needs special attention; first they have to be well determined, then they should be analyzed, so that at the end of the process the decision can be made. If it is possible it is necessary to reduce the influence of subjective (human) criteria and introduce objective measurable ones (technical norms, standards and other) in this process. This approach will contribute to proper decision-making, risk reduction and better business results. Analysis and procedural decision-making in a particular issue become more complicated if the decision relates to the choice among a large number of residential facilities.

For all these reasons this paper provides one of the possible perspectives on how to select optimal investment in residential facilities, which is based on the simultaneous consideration of multiple criteria that characterize a specific facility, which uses modern information and intelligent techniques in the decision-making process.

2 METHODS

Multi-criteria analysis is one of the most widely used methods of decision-making in scientific, business and engineering world. It is used in situations where it is necessary to reach a decision based on many criteria. No matter how capable the decision-maker may be, he is not good enough to consider all the criteria. Another problem that arises is not technical in its nature. This is subjectivity, i.e. favoring certain criteria without rational justification.

Multi-criteria analysis helps us to increase the quality of decision-making by reducing the subjective influences and provides more explicit results. In recent decades, this area has rapidly evolved and thus, today there are over 100 different methods in multi-criteria analysis.

Essentially, there are two different approaches to multi-criteria analysis: quantitative (American School) and qualitative (French School).

Let us assume that an investor needs to decide on one of the offered investment plans. At the very beginning the investor decides which criteria will be relevant to him in decision-making, as well as how essential each of the criteria will be. He also decides on the score scale for each criterion.

Classical methods of quantitative analysis imply that each plan is assigned a numerical value based on the rating by different criteria i.e. that the construction of so-called utility function is carried out on the basis of which we can easily determine which plan is the best. The investor decides to accept the plan with the highest value.

Numerous examples show that this approach is not good, especially in volatile markets. It may happen that a plan leads by all criteria except by one, which in the given situation may prove to be crucial, and thus its overall rating is the greatest. Obviously, such a plan cannot be accepted without additional analyses.

On the other hand, qualitative analysis takes into account all criteria when comparing alternatives, so that the previously described plan with such an analysis cannot be the only recommended one. In this paper ELECTRE methods have been applied that belong to the group of qualitative analysis methods. Using the methods of qualitative analysis, such as ELECTRE methods are, usually the plans that are mutually incomparable will emerge; namely, a partial arrangement on the set of all plans will be formed. Maximal elements in such a relation are those that are recommended by ELECTRE methods. From these maximal elements the investor has to choose the plan that will be accepted. These methods do not provide a unique solution, but from a large number of plans they set aside a few that are the best.

This paper is accompanied by the software package ALAN which significantly facilitates an investment decision to the investor.

2.1 ELECTRE methods

ELECTRE is a group of multi-criteria decision making methods developed in Europe in the mid-sixties. ELECTRE is the acronym for French words ELimination Et Choix Traduisant la REalité.

This approach was first introduced into the theory of decision making by French mathematician Bernard Rua and his colleagues at the consulting company SEMA [2]. The need for such a system of multi-criteria analysis arose due to the risk that could not have been avoided in the conventional methods by which the appropriate utility function has been analyzed. ELECTRE methods eliminate the subjectivity of a decision maker pretty much. These methods have gained in importance especially after psychological research in the seventies which preferred qualitative methods [3], [4].

ELECTRE methods were later developed in different directions owing to their great applicability, so that variations of ELECTRE I, ELECTRE II, ELECTRE III, ELECTRE IV, ELECTRE IS, ELECTRE TRI and others were created.

Also, the basic method and one of its modifications originated from practical needs to remove cycles from the graphs of superiority will be considered here [5].

Basic concepts and definitions

Let us denote the alternatives that we will study with $A_1, A_2, \ldots, A_n$. Let them be evaluated by the criteria: $K_1, K_2, \ldots, K_m$ with weights $\omega_1, \omega_2, \ldots, \omega_m$ and score scales $I_1, I_2, \ldots, I_m$. Each score scale is some finite subset of natural numbers and their diameters are: $|I_1|, |I_2|, \ldots, |I_m|$. Alternative evaluations will be marked with $a_{1k}, a_{2k}, \ldots, a_{nk}$ by the k^{th} criterion. The criteria, their weights, score scales and evaluations of the alternatives according to the criteria are determined by the decision-makers themselves (managing board, board of directors…) through voting or in some other way. Now, let us consider two alternatives with indexes *i* and *j* and introduce the marks [6]:

$$K_{ij}^{+} = \{k \mid a_{ik} > a_{jk}\},\ K_{ij}^{-} = \{k \mid a_{ik} < a_{jk}\} \text{ and } K_{ij}^{=} = \{k \mid a_{ik} = a_{jk}\} \tag{1}$$

Let us also introduce the marks:

$$\omega_k^* = \frac{\omega_k}{\sum_{k=1}^{m} \omega_k} \quad \text{and} \quad a_{ik}^* = \frac{a_{ik}}{|I_k|} \tag{2}$$

The first of these is called a standardized score of the k^{th} criterion, and the other one – a standardized score of the i^{th} alternative by the k^{th} criterion.

Index of agreement (concordance)

One of the fundamental differences between quantitative and qualitative analysis will be pointed out here. Quantitative analysis gives particular values (utility function) to alternatives and they are ranked based on that. In contrast, qualitative analysis raises the hypothesis that the alternative A is better than the alternative B and analyzes the arguments that are in favor of this hypothesis and the arguments that oppose it.

In ELECTRE methods, the arguments in favor of the hypothesis that alternative A is better than the alternative B are contained in the so-called index of agreement with that hypothesis, namely with the index of concordance. In the original ELECTRE method the concordance index takes into account a set of criteria by which alternative A is not worse evaluated than the alternative B.

Therefore, let A_i and A_j be the alternatives that are compared [7]. Then the index of agreement with the hypothesis that A_i is better than A_j is defined by the equation

$$C_{ij} = \frac{\sum_{k \in K_{ij}^{+} \cup K_{ij}^{=}} \omega_k}{\sum_{k=1}^{m} \omega_k} \tag{3}$$

Obviously, the higher index of concordance, the closer we are to accept a hypothesis. The question remains how big the threshold can be considered as a sufficient reason to accept the hypothesis when exceeded by the index of agreement (concordance).

What is a novelty in ELECTRE methods is the principle that a hypothesis for which index of agreement is big enough is not accepted if there is a great opposition to this hypothesis. The reasons for rejecting the hypothesis are contained in the so-called index of disagreement or discordance.

If we examine the hypothesis that the alternative A_i is better than the alternative A_j the index of discordance with this alternative is defined by the following relation

$$d_{ij} = \max_{k \in K_{ij}^{-}} \frac{a_{jk} - a_{ik}}{|I_k|} \tag{4}$$

Let us also introduce the thresholds of concordance and discordance. These are the consecutive numbers p and q so that $0 < q < p < 1$. We will say that the i^{th} alternative is better than the j^{th} if it is valid that $C_{ij} \geq p, \quad d_{ij} \leq q$. This will be marked with

$$A_i \succ A_j \tag{5}$$

In this way a relation between the alternatives is formed.

This relation is not a linear arrangement, and the maximal elements, i.e. the elements out of which there are no better, make a set called a core. Core elements are potential candidates for selection by decision makers. Decision makers are still to decide which alternative (or alternatives) to choose from those offered in a core.

A modification of the above-described basic ELECTRE method has been used for decision making in this paper. In this modification the index of concordance takes into account only those criteria by which alternatives being compared have different ratings. The modified index of concordance [5] is

$$C_{ij}^{*} = \frac{\sum_{k \in K_{ij}^{+}} \omega_k}{\sum_{k \in K_{ij}^{+} \cup K_{ij}^{-}} \omega_k} \tag{6}$$

This modification has been introduced to enable that the defined relation becomes a relation with strict arrangement and thus prevents the occurrence of cycles that indicate a great possibility of making a wrong decision [7].

3 SELECTION OF OPTIMAL INVESTING IN RESIDENTIAL FACILITIES – RESULTS

3.1 Formulation of the problem

From the literature review, it can see that factors that builds developer perception and consumer preferences can be developed into price modeling from different countries [8],[9]. Wang et al. presented a real estate price forecasting model based on Support vector machine[10]. Suppose that an investor has decided to invest in real estate in the center of Belgrade. Fifteen offers have been collected for the flats whose prices range from 100,000 euros to 150,000 euros. The investor is willing to buy three of these 15 apartments and he wants to get a core from which to extract the 3 apartments by ELECTRE method.

3.2 Identifying the criteria for decision-making

Based on expert opinion the following criteria important for decision-making on the investment are identified [11]:

1. Area of the flat
2. State in which the flat is
3. Location
4. Functionality
5. Quality of construction
6. Floor
7. Number of floors of the building
8. Elevator
9. Central Heating
10. Environment
11. Natural illumination of the flat
12. View from the flat

By the criterion *Area of the flat* we can evaluate it with rates 1 – 3 as follows: 1 – if it is a flat up to 60 square meters, 2 – if it is from 60 to 75 square meters and 3 – for the flats larger than 75 square meters.

According to the *State in which the flat is*, we can give rates 1 – 3, depending on whether the flat needs renovation or not, and rate 3 are received by flats that are "deluxe" arranged: 1 – the flat needs renovation, 2 – the flat does not need to be renovated, 3 – the flat is “deluxe” arranged.

The criterion *Location* ranks the place or part of the city where the facility is located and the demand for flats in this part of town. The rates are from 1 – 4 as follows: 1 – cheap and unwanted location, 2 – average price and wanted location, 3 – expensive or more wanted location, and 4 – exclusive location.

By the criterion *Functionality* rates from 1 – 3 are given, depending on the functionality of the housing unit, i.e. the layout of rooms and their size. Rates are: 1 – for flats of poor functionality, 2 – for flats of average functionality, and 3 – for flats with excellently conceptualized functionality.

The criterion *Quality of construction* provides quantitative rates: BAD, GOOD, AVERAGE, VERY GOOD and PERFECT. In the evaluation the following factors which guarantee checked quality of construction are taken into account:

- Facade sandwich wall with double thermal insulation,
- Floor structure with soundproofing,
- Interior plastered walls of solid and hollow bricks,
- Floors of first-class imported ceramics in common rooms and toilets , kitchens and pantries.
- Final processing of flats was paid special attention, in both, the choice of materials and their incorporation,
- At the last level of the building there are tenants' pantries,
- The building is connected to the remote heating system,
- The building possesses an elevator from the underground garage to the highest floor,
- It has its own generator which will provide electricity for the operation of elevators, lighting in hallways and underground garage in case of power failure. Generator also provides a safe and smooth operation of retail premises and commercial apartments, in the event of a power outage.

The method of estimation is as follows:

- EXCELLENT – gets a flat who has met all the above factors at the construction,
- VERY GOOD – if 1 or 2 factors are not fulfilled,
- AVERAGE – if 3 or 4 factors are not fulfilled,
- GOOD – if 5 or 6 factors are not fulfilled, and
- BAD – if seven or more factors are not fulfilled.

The criterion *Floor* implies the desirability of the floor where people live. Rates are from 1 to 4 and they are administered as follows: 1 – basements and ground floor, 2 – lofts, 3 – the first, second and higher than the third floor, 4 – the third floor.

Within the criterion *Number of floors* of a building, rates 1 – 3 can be assigned as follows: 1 – 4 floors and more, 2 – lower buildings up to 4 floors, and 3 – for houses (buildings) up to 2 floors.

By the criterion *Elevator* the rates that can be rated are from 0 to1, depending on whether the buildings have or do not have an elevator, i.e. buildings that have both, a freight elevator and elevator that transport people. Rates are: 0 – there is no elevator; and 1 – there is an elevator.

With the criterion *Central heating* ranging from 0 – 2 it is ranked whether the apartment has central heating, and how far away it is from the heating plant, or whether it has its own substation, which provides an evaluation of heating quality. The rates are: 0 – no central

heating, 1 – with central heating without substation, and 2 – there is central heating with its own substation.

The criterion *Environment* represents an evaluation which ranges from 1 – 4 representing the facility environment and if there are the necessary facilities in the vicinity of the flat (facilities for food supply, kindergarten, school, entertainment, etc.), also the environment includes the vicinity of plants (factories) because of noise, distance from the traffic communications, etc. The method of evaluation is: 1 – there are no necessary facilities and / or it is close to a plant and / or it is away from the roads, 2 – has the necessary facilities, but the roads are bad and / or in the vicinity of a plant, 3 – it has the necessary facilities, it is not in the vicinity of a plant, but the roads are not the best, 4 – it has the necessary facilities, it is not near a plant and it has good roads.

By the criterion *Natural illumination* that is evaluated with rates from 1 – 2, the natural orientation of the flat to the sides of the world and illumination in the function of time is estimated. It is also rated whether there are facilities in the vicinity that can block natural light. The rates are: 1 – bad natural illumination, and 2 – good natural illumination.

The criterion *View from the flat* gives quantitative evaluations: BAD, AVERAGE and EXCELLENT. The method of ranking is:

- EXCELLENT – a flat with a broad view overlooking the forest, river or some memorable part of the city,
- AVERAGE – a flat that has a common view of city blocks, and
- BAD – a flat whose view is obscured by other buildings or the view of slums, landfill, cemetery, etc.

3.3 Conversion of quantitative to qualitative rankings

In this paper we will use the interval scale to quantify qualitative attributes. The scale ranges in the interval from 1 to 9. For the criterion *Quality of construction* the ratings are given in Table 1.

Tab. 1: Quantification of rates for the criterion Quality of construction

Qualitative rate	Bad	Good	Average	Very good	Excellent	Type of the criterion
Quantitative rate	1	3	5	7	9	Max

For the criterion *View from the flat* ratings are given in Table 2.

Tab. 2: Quantification of the ranking for the criterion View from the flat

Qualitative rate	Bad	Average	Excellent	Type of the criterion
Quantitative rate	**1**	**5**	**9**	**Max**

3.4 Data analysis and evaluation of alternatives

The criteria weighs and rates of the alternatives according to these criteria are given in Table 3.

Tab. 3: Criteria and alternatives with rates

Criterion	w	Ik	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
Area of a flat	10	1-3	3	3	2	2	1	2	2	3	3	3	2	2	1	1	1

Criterion	w	Ik	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
State in which the flat is	6	1- 3	2	3	1	3	3	1	2	1	2	3	2	1	2	3	2
Location	10	1- 4	1	2	1	2	2	1	2	2	3	2	2	3	3	2	2
Functionality	8	1- 3	1	2	1	3	1	2	3	2	3	2	1	2	2	1	1
Quality of construction	10	1- 9	3	1	1	9	9	1	3	9	7	5	3	1	3	1	3
Floor	4	1- 4	1	2	2	1	2	2	3	4	4	4	3	2	2	2	1
Number of floors	3	1- 3	2	2	1	2	2	2	2	1	2	2	1	2	2	3	2
Elevator	6	0- 1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1
Central heating	8	0- 2	1	2	1	2	2	2	1	2	2	2	0	1	1	2	2
Environment	2	1-4	1	4	2	2	1	4	1	1	4	3	3	3	2	3	1
Natural illumination of the flat	3	1-2	2	2	1	2	2	2	2	1	2	2	2	2	2	1	2
View from the flat	5	1-9	5	1	1	1	9	5	9	1	5	5	5	5	5	9	1

Applying the original software gives a maximal absolute threshold of significance 0.78049 and the graph of alternatives superiority relation (Figure 1).

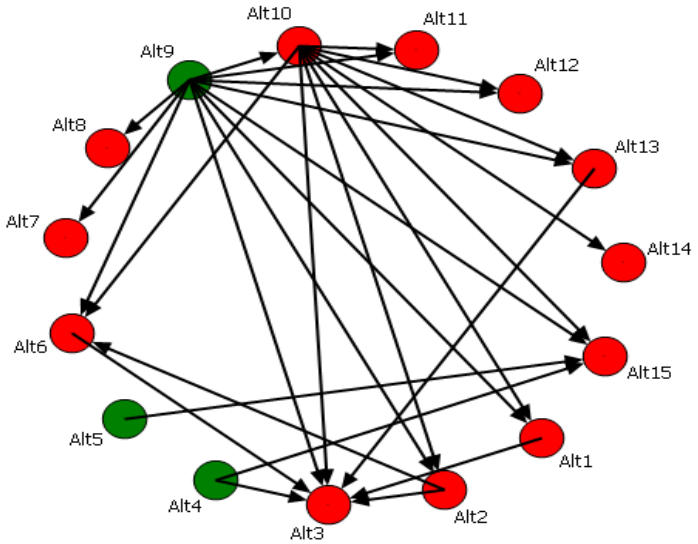

Fig 1: The graph of alternatives superiority for investing in residential facilities (p = 0.8, q = 0.35)

In this case the core of the relation is given in Table 4.

Tab. 4: The core of the relation

Core	for fixed *q: 0.35*	for fixed *p: 0.8*
Alt4	Alt9 : Always	Alt4 : Always
Alt5	Alt5 : $p > 0.618$	Alt5 : Always
Alt9	Alt4 : $p > 0.660$	Alt9 : Always
	Alt8 : $p > 0.811$	Alt10 : $q < 0.333$
	Alt14 : $p > 0.814$	Alt7 : $q < 0.333$
	Alt10 : $p > 0.833$	Alt14 : $q < 0.333$
	Alt2 : $p > 0.905$	Alt2 : $q < 0.250$
	Alt7 : $p > 0.909$	Alt8 : $q < 0.222$
	Alt1,Alt3,Alt6,Alt11,Alt12, Alt13,Alt15 : Never	Alt1,Alt3,Alt6,Alt11,Alt12, Alt13,Alt15 : Never

From this example it can be seen that the core consists of only three alternatives: 4, 5 and 9 (Figure 1). Thus, this is a very good example because the investor opts for three flats. If we want to increase the core, so that the investor has a wider choice, we can reduce the risk. The risk can be reduced in two ways: by increasing the threshold of concordance (typical for more aggressive investors) or by reducing the threshold of discordance (characteristic of investors who have a greater fear of risk).

4 ANALYSIS OF SENSITIVITY

4.1 Impact of criteria weights

When making a decision an important role also plays the weight of particular criteria. This is one of the disadvantages of all the methods for multiple criteria decision-making. It is clear that ELECTRE method reduces the subjective influence of the decision-maker, but still leaves the possibility that it influences the final choice.

This paper analyzes the investment criteria (w), with the starting point that all of them have the same weight, and then the weight of some criteria was changed. Table 5 shows 40 different varieties. It has been presumed that they are all the same weight, and then each of the criteria has been pointed out individually and using the software package ALAN the core of alternatives has been determined for each of these variants. In the continuation of the table the variations when two by two criteria gained greater weights have been shown.

Tab. 5: The core depending on the criteria weight

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	Core
1	1	1	1	1	1	1	1	1	1	1	1	1	A4,A5,A9,A14
2	10	1	1	1	1	1	1	1	1	1	1	1	A9
3	7	1	1	1	1	1	1	1	1	1	1	1	A5,A9
4	4	1	1	1	1	1	1	1	1	1	1	1	A5,A9
5	3	1	1	1	1	1	1	1	1	1	1	1	A4,A5,A9,A14
6	1	2-10	1	1	1	1	1	1	1	1	1	1	A2,A4,A5,A9,A10,A14
7	1	1	10-8	1	1	1	1	1	1	1	1	1	A9
8	1	1	7-6	1	1	1	1	1	1	1	1	1	A5,A9
9	1	1	5-4	1	1	1	1	1	1	1	1	1	A5,A9,A14
10	1	1	3-1	1	1	1	1	1	1	1	1	1	A4,A5,A9,A14
11	1	1	1	10-8	1	1	1	1	1	1	1	1	A4,A9
12	1	1	1	4-7	1	1	1	1	1	1	1	1	A4,A5,A9
13	1	1	1	2-3	1	1	1	1	1	1	1	1	A4,A5,A9,A14
14	1	1	1	1	10-4	1	1	1	1	1	1	1	A4,A5,A8,A9
15	1	1	1	1	2-3	1	1	1	1	1	1	1	A4,A5,A8,A9,A14
16	1	1	1	1	1	10-8	1	1	1	1	1	1	A9

17	1	1	1	1	1	7-4	1	1	1	1	1	1	A5,A9
18	1	1	1	1	1	3-1	1	1	1	1	1	1	A4,A5,A9,A14
19	1	1	1	1	1	1	1-10	1	1	1	1	1	A4,A5,A9,A14
20	1	1	1	1	1	1	1	1-10	1	1	1	1	A4,A5,A9,A14
21	1	1	1	1	1	1	1	1	1-10	1	1	1	A4,A5,A9,A14
22	1	1	1	1	1	1	1	1	1	10-8	1	1	A9
23	1	1	1	1	1	1	1	1	1	7-6	1	1	A5,A9
24	1	1	1	1	1	1	1	1	1	5-4	1	1	A5,A9,A14
25	1	1	1	1	1	1	1	1	1	1-3	1	1	A4,A5,A9,A14
26	1	1	1	1	1	1	1	1	1	1	10-4	1	A4,A5,A9
27	1	1	1	1	1	1	1	1	1	1	1-3	1	A4,A5,A9,A14
28	1	1	1	1	1	1	1	1	1	1	1	10-4	A5,A7,A9,A14
29	1	1	1	1	1	1	1	1	1	1	1	2-3	A4,A5,A7,A9,A14
30	10	10	1	1	1	1	1	1	1	1	1	1	A2,A4,A5,A9,A10
31	10	1	10	1	1	1	1	1	1	1	1	1	A9
32	10	1	1	10	1	1	1	1	1	1	1	1	A9
33	10	1	1	1	10	1	1	1	1	1	1	1	A4,A5,A8,A9
34	10	1	1	1	1	10	1	1	1	1	1	1	A9
35	10	1	1	1	1	1	10	1	1	1	1	1	A9,A14
36	10	1	1	1	1	1	1	10	1	1	1	1	A9
37	10	1	1	1	1	1	1	1	10	1	1	1	A9
38	10	1	1	1	1	1	1	1	1	10	1	1	A9
39	10	1	1	1	1	1	1	1	1	1	10	1	A9
40	10	1	1	1	1	1	1	1	1	1	1	10	A5,A7,A9,A14

It can be concluded from Table 5 that the change in some criteria weight may affect the number of alternatives in the core, but it is interesting that there is always an alternative A9 in the core. When the criterion *View from the flat* is gained weight, the core expands to four or five alternatives. The alternatives that are well rated are not easily ejected from the core by changing the criteria weights.

4.2 Impact of concordance and discordance thresholds

In all the above mentioned studies it was shown that the important role belongs to the core size of favorable alternatives when making decisions. If we want to increase the core so that the investor has a wider selection, we can reduce risk.

It should be underlined that the threshold of concordance in the modified method is much "stronger" than the threshold of discordance in the original method, because in the modified method only criteria by which the first alternative is better than another are taken into account for the index of concordance, but in the original method the criteria by which they are equal are also involved. If the score scales increase, then these two methods approach and ultimately give the same results.

Table 6 shows what the impact of concordance and discordance thresholds on the obtained core is. When $p \geq 0.92$ there are eight alternatives in the core, and this is the maximal number of alternatives that can be found in a core. The same maximum is obtained if q obtains values from the interval 0.1 – 0.22.

Tab. 6: The core depending on p and q

p	***q***	**Alternative**
0.79	0.35	A4,A5,A9
0.82	0.35	A4,A5,A9,A14
0.83	0.35	A4,A5,A8,A9,A14
0.86	0.35	A4,A5,A8,A9,A10,A14
0.87	0.35	A2,A4,A5,A8,A9,A10,A14

0.92	0.35	A2,A4,A5,A7,A8,A9,A10,A14
0.79	0.35	A4,A5,A9
0.79	0.33-0.25	A2,A4,A5,A7,A9,A10,A14
0.79	0.1-0.22	A2,A4,A5,A7,A8,A9,A10,A14

Obviously, ELECTRE methods eliminate some alternatives. The higher the threshold of concordance and the lower the threshold of discordance, the less is the risk that decision-makers will eliminate those alternatives which in the future may prove to be better than those that are not eliminated. It is clear that these methods reduce the influence of decision-maker's subjective influence, but still leave the possibility that he influences the final choice.

5 CONCLUSION

A serious problem caused by human errors in determining criteria weights and score scales is partially eliminated by ELECTRE methods, and at the business plan this problem is being reduced with collective decision-making through assemblies, steering committees, board of directors...

However, the application of ELECTRE methods with different criteria weight does not always have a crucial role. Thus, the subjective factor by which the criteria weights are determined cannot completely reject the alternatives that have good rates by most criteria from decision-making.

It can be concluded that those alternatives that are well evaluated remain in the core despite the fact that the criteria weight changes. It is interesting enough that in some situations a more important role belongs to rates by some criteria, than the sheer weight of these criteria.

Modified ELECTRE methods prevent the emergence of cycles by introducing absolute threshold of significance. Now decision-makers do not have to think what the minimum threshold of significance for the index of discordance they can take, but they automatically take absolute threshold of significance (ATS).

Obviously, the previous analyses show that ELECTRE methods enable us that, depending on the investors' demands, the core of the most favorable alternatives can always be formed within the scope which is most desirable for decision-making.

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