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USING THE ELECTRE MLO MULTI-CRITERIA DECISION-MAKING METHOD IN STEPWISE BENCHMARKING – APPLICATION IN HIGHER EDUCATION

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Abstract. *The purpose of this paper reflects in a study of an optimal development path in the ELECTRE-based stepwise benchmarking context. In the paper, multi-criteria decision-making is first described as a tool for stepwise benchmarking, where the ELECTRE MLO ranking method is used. In order to make the problem of finding the optimal path easier and significantly reduce the number of the paths that have to be considered, we are proving the theorem showing that it is better to make gradual progress than "skip steps". As an illustration of these considerations, the ELECTRE MLO method is applied to the benchmark teaching assistants of one faculty of Belgrade University, according to the marks given by their students. We are looking for an optimal development path by using our theorem that substantially reduces the number of cases. We are also checking that the paths with no steps skipped are superior to the paths in which steps are skipped, in accordance with the theoretical result we have obtained. Thus, we are demonstrating that one should first look up to the colleague who is a little better than him/her, and then gradually improve until he/she has reached the level of the individual given the best mark.*

Key words: *multi-criteria decision-making, ELECTRE, benchmarking, evolution path, higher education*

1. Introduction

Benchmarking is a management tool representing a systematic process of measuring the quality of products or services against the best representative ones in the field of interest. This process includes comparison with the direct competitor and comparison against the given benchmark, or standard one strives to achieve. In this paper, an example of the teaching assistants of one faculty of Belgrade University, in which the teaching assistants are compared with one another according to the marks they have received from students, is used as an illustration. The marks are based on a total of ten criteria.

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Benchmarking is mostly used for the purpose of comparing the state policies at the international level. Benchmarks are always provided by the most developed countries. There are a lot of studies on this topic; see (Arrowsmith et al.,2004; Petrović et al., 2012; P. Hong et al., 2012; Petrović et al., 2014; Brehmer et al., 2019; M. Petrović et al., Omega, 2018; Petrović et al., Journal of Sustainable Business and Management Solutions in Emerging Econo, 2018). The socioeconomic, geostrategic and cultural influences of one country are often neglected during a mutual comparison, so the question is whether the measures transferred from other countries are always applicable; see (Dolowitz and Marsh, 1996; Bauer, 2010; Lundvall and Tomlison, 2012). In spite of the differences, it is clear that country leaders, especially the leaders of those in the same region, in the European Union, or those tending to enter the European Union, can follow one another (Rose 1991). International benchmarking is broadly applied even in information and communication technologies.

The benchmarking process includes making different decisions, ranging from the manner of choosing the most relevant statistical data, all the way to the role model which is considered as the best to improve certain characteristics. The main question is as follows: Who or what should we look up to in order to become better? To learn from the best in a certain field is not always the best of options. One should also be realistic when assessing abilities. The main purpose of this paper is to more closely examine this topic and particularly answer the question of whether it is better to make gradual progress or “skip steps”. The answer is provided as the central theorem of this paper. There are many studies on striving towards slightly better, gradual progress; see (Moore, 1999; Hambelton and Gross, 2008; Lim et al., 2011). We look for someone or something who/which is a bit better, i.e. for an appropriate benchmark in each step of such progress, thus coming to the so-called evolution of progress. At this point, the most important thing is to choose the best evolution path. In Chapter 3 herein, an example of the teaching assistant who obtained the worst marks is presented. He should first look up to the colleague who is a little better than him, after which he should gradually improve until he has reached the level of the teaching assistant who has received the best marks. If uniform progress is made, then the ideal evolution path is obtained, which is difficult to achieve in practice because a non-uniform benchmark distribution is typical for situations in which we deal with realistic data. The DEA (Data Envelope Analysis) method is one of the popular operational research methods often used in benchmarking; see (Ramon et al., 2018; Ji et al., 2019; De Blas et al., 2018; Gidion et al., 2019). It is based on linear programming and was created in the paper (Charnes et al., 1981). In this paper, a modification of the ELECTRE I method developed in order to serve as a benchmarking tool is used. This is the ELECTRE MLO method that first appeared in the study (Petrović et al., 2012). The ELECTRE I method was introduced by Roy B., in the paper (Roy 1968). The method is now only of a historical interest as the method representing the base on which other, more useful methods have been created. The most popular and the most frequently used modifications of ELECTRE I are ELECTRE IV (Figueira et al., 2005) and ELECTRE Is (Roy and Skalka, 1987). The family of the ELECTRE methods solve the following three very important problems, namely: making a choice (Hassan. et al., 2018; Wang Y and Xeo., 2018; Tavassoli et al., 2018), ranking (Dias et al., 2018; Harsoyo and Jati, 2018) and sorting (Pereira et al, 2019; Pereira and Ishizaka, 2019; Ishizaka et al., 2019; Singh, 2019). The methods which solve the alternatives ranking problem are especially important for benchmarking. The ELECTRE III method deals with these issues; see (Bouysson and Roy, 1986; Papadopulos and Karagiannidis, 2008; Ishizaka and Giannoulis, 2010; Hashemi et al., 2016; La Fata et al., 2019). Over time, modifications of ELECTRE III have developed; see (Galo et al., 2018; Doumpos and Figueira, 2019). Before the ELECTRE MLO method appeared, the alternatives forming a cycle had been thought to be indifferent and had been ranked at the same hierarchical level. This approach can lead to obtaining imprecise levels (i.e. levels containing many more alternatives than other levels). In the paper (Petrović et al., 2012), the problem of cycles for the ELECTRE MLO method is solved based on an important result obtained in the study (Anic and Larichev, 1996) which solved the problem of cycles for the original ELECTRE method. The problem of cycles is solved by introducing a modified concordance index and the AST (Absolute Significance Threshold), which represent its limit, above which no cycle will appear in a graph. The ELECTRE MLO method will help us find the best evolution path. By this method, alternatives are ranked into levels, so that we can clearly see a hierarchy between them. By applying this method, a tree (a graph without a cycle) is obtained. The best alternative, i.e. the one being a benchmark to all other alternatives, is on top of the tree. The worst candidate needs to make progress gradually towards the top, choosing the best benchmark every step of the way. He looks for the optimal path, the path which is closest to the ideal one.

Although benchmarking is mostly used in foreign policies, its specific application in higher education is demonstrated in Chapter 3. Benchmarking is applied in higher education; see (Ganushchak-Yefimenko et al., 2017; Padro and Sankey, 2012; Placek et al., 2017; Paliulis and Labanaskis, 2015). Various studies on the quality of lectures, the lecturer's capability and the students' evaluation of their lecturers in higher education have been carried out; see (Millis and Cottell, 1997; Ramsden, 2003; Wei, 2007; Spehl et al., 2019). They have been aimed at improving the quality of higher-education facilities. The paper (Wachtel, 1998) provides the arguments "for" and "against" students' evaluation of their lectures. The authors of the paper (Sullivan and Skanes, 1974) pay special attention to the characteristics of the lecturers with succesful academic carriers who were given excellent marks by their students.

In the Methodology chapter of this paper, our main result is proven. In Chapter 3 of this paper, the theorem is applied to a concrete example of benchmarking the teaching assistants of one faculty of Belgrade University, and how to choose an optimal development path and make gradual progress towards the top is illustrated.

2. Methodology

As stated in the Introduction, ELECTRE MLO is a good benchmarking tool.

ELECTRE MLO (Multi-Level Outranking) first appeared in the study (Petrović et al, 2012) as a tool in stepwise benchmarking; it is a modification of ELECTRE I. The result of the application of ELECTRE MLO to realistic data is a hierarchical structure of alternatives (e.g. in Figure 1 of Chapter 3).

The sets of the criteria G_{ij}^{+}, G_{ij}^{-}, $G_{ij}^{=}$ are now defined for two alternatives, A_i and A_j, in the following manner:

$G_{ij}^{+}=\{g_k\,|g_k(A_i)>g_k(A_j)\}$,

$G_{ij}^{-}=\{g_k\,|g_k(A_i)<g_k(A_j)\}$, (1)

$G_{ij}^{=}=\{g_k\,|g_k(A_i)=g_k(A_j)\}$;

where $g_k(A_i)$ are marks for the alternative A_i and the criterion k, and the ω_k is a weight factor for the criterion k. Let the $I_{1,...,}I_m$ be a set of marks for any criteria and $|I_k|=maxI_k-minI_k$ be a scaled score range of the criterion k. Allow us to define the normalized value of the marks and the normalized value of the weight factor, as follows:

$$\omega_k = \frac{\omega_k}{\sum_{k=1}^{n}\omega_k} \qquad g_k^*(a_i) = \frac{g_k}{|I_k|} \tag{2}$$

For the ELECTRE I method, the concordance and discordance indices are defined in the following manner:

$$C(a_i,\ a_j) = \frac{\sum_{g_k \in G_{ij}^{+} \cup G_{ij}^{=}} \omega_k}{\sum_{k=1}^{n} \omega_k} \tag{3}$$

$$d(a_i,\ a_j) = max_{g_k \in G_{ij}^{-}} \frac{g_k(a_j) - g_k(a_i)}{|I_k|} \tag{4}$$

The given concordance index is modified by applying the following equation:

$$C(a_i,\ a_j)^* = \frac{\sum_{g_k \in G_{ij}^{+}} \omega_k}{\sum_{\{k|g_k \in G_{ij}^{+} \cup G_{ij}^{=}\}} \omega_k} \tag{5}$$

Let us then define the parameter l (i, j), applying the following equation:

$$l(i,j) = \frac{d(a_i,\ a_j)}{\sum_{\{k|g_k \in G_{ij}^{+}\}} \omega_k \left(g_k^*(a_i) - g_k^*(a_j)\right)} \sum_{\{k|g_k \in G_{ij}^{+}\}} \omega_k^* \tag{6}$$

Theorem 1 (Anić, Larichev): The parameter λ is chosen, so that, for each arranged pair of alternatives:

$\{(a_i, a_j) \in A \times A | (a_i\, S a_j) \wedge \neg(a_j\, S a_i)\}$ holds inequality:

$$\lambda < \frac{l(a_i, a_j)}{l(a_i, a_j) + 1} \tag{7}$$

At this point, S is a binary relation, where $a_i\, S a_j$ implies that a_i is at least as good as the alternative a_j.

This theorem provides a sufficient condition for the construction of a relationship when cycles do not appear.

The parameter λ is the limit value of the modified concordance index, an there is no cycle. Alternatives are not indifferent, either.

The following equation defines the AST:

$$AST = max_{i,j} \frac{l(a_i,a_j)}{l(a_i,a_j)+1}. \tag{8}$$

The modified performance indicator scores $a^*_{i_s k} = \begin{cases} a^*_{i_{s-1}k} & if \quad a^*_{i_{s-1}k} > a^*_{i_s k} \\ a^*_{i_s k} & otherwise \end{cases}$

For each criterion k, the difference between the scores of the alternatives from adjacent levels of performance is as follows:

$$R^{\pi}_{sk} = a^*_{i_{s+1}k} - a^*_{i_s k} \tag{9}$$

The ideal step is as follows:

$$\mu^{\pi}_k = \frac{\sum_{s=1}^{m-1} R^{\pi}_{sk}}{m-1} \tag{10}$$

For each criterion k on the path π, the variation measuring the mean-squared difference from the increment step is depicted, thus obtaining the distance from the ideal path:

$$DPV^{\pi}_{ik} = \frac{1}{m-1}\sum_{s=1}^{m}(R^{\pi}_{sk} - \mu^{\pi}_k)^2 \tag{11}$$

The overall value of the variation for all criteria is as follows:

$$DPV^{\pi}_i = \frac{\sum_{k=1}^{n} DPV^{\pi}_{ik}\omega_k}{\sum_{k=1}^{n}\omega_k} \tag{12}$$

The DPV^{W}_i value is the worst path, where the total difference between the scores of the alternatives a_i and the target a_m for each criterion k is obtained when only moving by one level. The number ρ^{π}_i is the relative measure of the evolution path π.

$$\rho^{\pi}_i = \frac{DPV^{\pi}_i}{DPV^{W}_i} \tag{13}$$

Now, the difference between the scores of the alternatives from the two concrete levels are subjected to examination:

$$R^{\pi}_{j-1k} = a^*_{i_j k} - a^*_{i_{j-1}k} = a \tag{14}$$

$$R^{\pi}_{jk} = a^*_{i_{j+1}k} - a^*_{i_j k} = b \tag{15}$$

$$R^{\pi}_{j+1k} = a^*_{i_{j+2}k} - a^*_{i_{j+1}k} = c \tag{16}$$

$$\mu = \frac{\sum_{s=1}^{m-1} R^{\pi}_{sk}}{m-1} \tag{17}$$

The following inequalities read as follows: $a \le a+b \le a+b+c$ Ultimately, the main result of our study is formulated and proven.

Theorem 2: If alternatives are compared according to one single criterion, it is always better to follow the order of events and move one level at a time than move on to the next level only to immediately have a “break” after that.

Proof:

Invoking the previously said, the next inequality must be proven:

$$\frac{1}{m-1}\left(\sum_{s=1}^{j-1}(R_{sk}^{\pi}-\mu)^2+(a-\mu)^2+(b-\mu)^2+(c-\mu)^2+\sum_{s=j+2}^{m-1}(R_{sk}^{\pi}-\mu)^2\right)$$
$$\leq \frac{1}{m-1}\left(\sum_{s=1}^{j-1}(R_{sk}^{\pi}-\mu)^2+(a+b-\mu)^2+\mu^2+(c-\mu)^2\right.$$
$$\left.+\sum_{s=j+2}^{m-1}(R_{sk}^{\pi}-\mu)^2\right) \tag{18}$$

From the right-hand side of the inequality, the addendum $(a+b-\mu)^2$ represents the skipped step and the pause of the value μ^2.

The rest of the left-hand and the right-hand sides is the same; so, after canceling out, the following is obtained:

$$(a-\mu)^2+(b-\mu)^2 \leq (a+b-\mu)^2+\mu^2$$
$$a^2-2a\mu+\mu^2+b^2-2b\mu+\mu^2 \leq a^2+b^2+2\mu^2-2a\mu-2b\mu+2a\,0 \leq 2ab \tag{19}$$

Now, the theorem is proven.

Remark 1: That the step skipped at the j-th moment is equivalent to the step skipped at any other moment has been proven.

3. Application

Human resources allow us to understand the sum of all the knowledge and skills of a certain group of people. These skills and knowledge should be a product of one's, especially higher, education in today's developed world. It is very important that, during their education process, students should be taught by high-quality lecturers, who will prepare them for making further progress.

The students of one faculty of Belgrade University evaluated their teaching assistants according to a total of 10 criteria (Regularity of practice, Regularity of consultation, Comprehensibility and manner of presentation, Encouraging students to be more active, Importance of practice, Providing useful information, Assistant responds to students' questions, Being professional and ethical in communication, Being objective and impartial in evaluation, General impression) on a scale from 1 to 5. The evaluation was anonymous. We accessed and used the data, the average marks given for the teaching assistants according to each of the 10 criteria. The teaching assistants of this faculty were generally given good marks, so that the normalization of those marks was performed by giving the value 1 to the marks below 3 and creating a uniform integer scale from 2 to 9 for the values ranging from 3 to 5.

The example only included the teaching assistants who were evaluated by more than fifty students, for the reason of which fact the marks can be considered as realistic. Table 1 shows the evaluation criterion, the weight factor for the criterion and the obtained normalized marks for the teaching assistants. Each criterion is given an appropriate weight factor according to its importance (Table 1). Since the faculty at which our research study was carried out is a technical science faculty and the teaching assistants hold practical classes, the order of the most important criteria is as follows: *Encouraging students to be more active*, *Importance of practice*, *Comprehensibility and manner of presentation*. *Regularity of practice* and *Regularity of consultation* is a duty on the part of all those employed at the faculty, but it does not affect much the quality of the lecturers.

Table1. The marks obtained (after the normalization) for teaching assistant of the faculty of Belgrade University which is the subject matter of the research.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
ω	1	1	4	5	4	3	3	2	2	3
A_1	7	7	7	6	7	7	7	6	7	6
A_2	7	7	5	6	6	6	6	6	6	6
A_3	8	7	7	6	7	6	6	6	7	7
A_4	7	7	3	4	4	4	5	5	5	4
A_5	6	7	4	4	4	5	5	5	6	5
A_6	6	4	3	2	2	2	3	3	3	2
A_7	8	7	7	7	7	7	7	7	7	7
A_8	9	8	8	7	8	8	8	8	8	8
A_9	8	7	6	3	5	4	5	5	5	4
A_{10}	8	7	7	6	7	7	7	7	7	6
A_{11}	9	9	8	8	8	8	8	8	8	8
A_{12}	9	9	9	9	9	9	9	9	9	9
A_{13}	9	8	4	6	5	6	6	7	7	6
A_{14}	6	6	5	4	5	4	5	4	5	5
A_{15}	9	9	9	8	8	8	9	9	9	9
A_{16}	9	9	8	8	9	8	8	8	8	8
A_{17}	9	8	8	7	8	8	8	7	8	8
A_{18}	6	5	3	3	3	3	3	3	3	3
A_{19}	6	6	5	5	5	5	6	5	5	5
A_{20}	8	8	6	5	4	7	5	6	6	6

Specialized software applied the ELECTRE MLO ranking method to these data. The value of the modified concordance index of 0.85 was chosen. The AST was 0.75. The tree in Figure 1 is a result of the application of the ELECTRA MLO method. The hierarchy amongst the alternatives and a possible development path for each alternative can clearly be seen. Weaker candidates have the aim to make the most possible uniform progress. Since the data are realistic, the ideal evolution path is non-existent. The candidates, however, need to choose the optimal evolution path in order to achieve the level of the teaching assistant who has received the highest of marks.

In every educational institution, cooperation among colleagues is advisable. Evolution paths were considered for Alternative 5. For each of those paths (Figure 2), ρ_i^{π} was calculated and the example of the calculation is given at the end of this chapter. The effect of skipping steps, either one step or two at a time, was also considered. That skipping does not improve the evolution paths (in the cases of the the two paths in Figure 2, they are clearly worse, because ρ_i^{π} is greater than the ρ_i^{π} of the first four paths in Figure 2) is clearly seen (the bottom of Figure 2), which is in accordance with Theorem 2. That the same value ρ was obtained for the two paths should not be a surprise, either, given the fact that they only differ in one alternative, A15 replacing A16 (these two alternatives have the marks that only differ from each other in a few criteria, and these two alternatives are at same tree level). So, the teaching assistant number 5 should choose one of these two best paths (the first and the second paths in Figure 2). The suggestion for the teaching assistant number 5 implies that he should first look up to the colleague who is a little better than him, and that is the teaching assistant number 2 or the teaching assistant number 20, after which he should start gradually improving until he has reached the level of the teaching assistant given the best of marks.

In our opinion, it is very important for the faculty and with respect to the quality of knowledge that the said teaching assistant should be making gradual progress. We suggest that the teaching assistants should be attending each other's practical classes so as to be able to take the advantage of learning from a better-evaluated colleague. Workshops without students could be organized for the teaching assistants in order to enable them to improve their personal teaching methods.

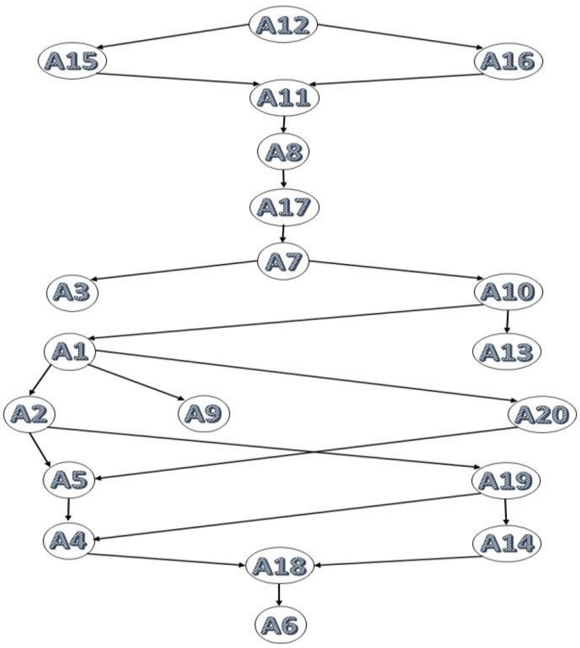

Figure1. The result of the application of the ELECTRE MLO method to the realistic data.

Path	ρ_i^{π}
A5→A2→A1→A10→A7→A17→A8→A11→A15→A12	0.1837
A5→A2→A1→A10→A7→A17→A8→A11→A16→A12	0.1837
A5→A20→A1→A10→A7→A17→A8→A11→A15→A12	0.2091
A5→A20→A1→A10→A7→A17→A8→A11→A16→A12	0.2091
A5→A10→A7→A17→A8→A11→A15→A12	0.3402
A5→A1→A10→A7→A17→A8→A11→A15→A12	0.2970

Figure 2. The evolution paths for the alternative A5, without "skipped steps" (paths 1, 2, 3, and 4), and with "skipped steps" (paths 5 and 6).

For example, we calculated ρ_i^{π} according to the equations given in the Methodology chapter for the first path in Figure 2 (A5-A2-A1-A10-A7-A17-A8-A11-A15-A12) in the following manner:

For the *Regularity of practice* criterion (k=1), the marks of the alternatives of these paths are as follows:

6-7-7-8-8-9-9-9-9-9 and DPV_{i1}^{π} for this criterion is calculated as follows:

$$\mu_1^{\pi} = \frac{\sum_{s=1}^{m-1} R_{sk}^{\pi}}{m-1} = \frac{1}{3}$$

$$DPV_{ik}^{\pi} = \frac{1}{m-1}\sum_{s=1}^{m}(R_{sk}^{\pi} - \mu_k^{\pi})^2$$

$$DPV_{i1}^{\pi} = \frac{1}{9}\left(1-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(1-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 + \frac{1}{9}\left(-\frac{1}{3}\right)^2 = \frac{18}{81}$$

It is clear that, if the marks of the adjacent alternatives for the criterion k are equal, then we obtain $R_{sk}^{\pi} = 0$.

For the *Regularity of consultation* criterion (k=2), the marks for the teaching assistant of these paths are as follows: 7-7-7-7-7-8-8-9-9-9; now, DPV_{i2}^{π} is calculated as for the previous criterion, $\mu_2^{\pi} = \frac{2}{9}$;

$$DPV_{i2}^{\pi} = \frac{2}{9}\left(1-\frac{2}{9}\right)^2 + \frac{1}{9}\left(-\frac{2}{9}\right)^2 = \frac{14}{81}$$

For the *Comprehensibility and manner of presentation* criterion (k=3), the normalized marks are as follows:

4-5-7-7-7-8-8-8-9-9; $\mu_3^{\pi} = \frac{5}{9}$ and $DPV_{i3}^{\pi} = \frac{3}{9}\left(1-\frac{5}{9}\right)^2 + \frac{5}{9}\left(-\frac{5}{9}\right)^2 + \frac{1}{9}\left(2-\frac{5}{9}\right)^2 = \frac{38}{81}$

For the *Encouraging students to be more active* criterion (k=4), the following marks were obtained:

4-6-6-6-7-7-7-8-8-9; $\mu_4^{\pi} = \frac{5}{9}$ and $DPV_{i4}^{\pi} = \frac{3}{9}\left(1-\frac{5}{9}\right)^2 + \frac{5}{9}\left(-\frac{5}{9}\right)^2 + \frac{1}{9}\left(2-\frac{5}{9}\right)^2 = \frac{38}{81}$

For the *Importance of practice* criterion (k=5), the obtained normalized marks are as follows:

4-6-7-7-7-7-8-8-8-9; $\mu_5^{\pi} = \frac{5}{9}$ and $DPV_{i5}^{\pi} = \frac{3}{9}\left(1-\frac{5}{9}\right)^2 + \frac{5}{9}\left(-\frac{5}{9}\right)^2 + \frac{1}{9}\left(2-\frac{5}{9}\right)^2 = \frac{38}{81}$

5-6-7-7-7-8-8-8-8-9 ; $\mu_6^{\pi} = \frac{4}{9}$ and $DPV_{i6}^{\pi} = \frac{4}{9}\left(1-\frac{4}{9}\right)^2 + \frac{5}{9}\left(-\frac{4}{9}\right)^2 = \frac{20}{81}$

For the *Assistant responds to students' questions* criterion (k=7), the following marks were obtained and the DPV was calculated in a manner similar to the previous one:

5-6-7-7-7-8-8-8-9-9; $\mu_7^{\pi} = \frac{4}{9}$; after the calculation, we obtained $DPV_{i7}^{\pi} = \frac{20}{81}$

For the Teaching assistants are professional and ethical in communication criterion (k=8), the obtained marks are as follows:

5-6-6-7-7-7-8-8-9-9 $\mu_8^{\pi} = \frac{4}{9}$; after the calculation, we obtained $DPV_{i8}^{\pi} = \frac{20}{81}$

For the *Objective and impartial in evaluation* criterion (k=9), the obtained normalized marks are as follows:

6-6-7-7-7-8-8-8-9-9 $\mu_9^{\pi} = \frac{1}{3}$; after the calculation, we obtained $DPV_{i9}^{\pi} = \frac{18}{81}$

For the *General impression* criterion (k=10), the obtained normalized marks are as follows:

5-6-6-6-7-8-8-8-9-9 $\mu_{10}^{\pi} = \frac{1}{3}$; after the calculation, we obtained $DPV_{i10}^{\pi} = \frac{18}{81}$

$$DPV_i^{\pi} = \frac{\sum_{k=1}^{n} DPV_{ik}^{\pi}\omega_k}{\sum_{k=1}^{n}\omega_k}$$

The sum of the weight factors for all the criteria concerned is 28.

According to this equation:

$$DPV_i^{\pi} = \frac{1}{28}\left(\frac{18}{81} + \frac{14}{81} + \frac{152}{81} + \frac{190}{81} + \frac{152}{81} + \frac{60}{81} + \frac{60}{81} + \frac{40}{81} + \frac{36}{81} + \frac{60}{81}\right) = 0{,}3448$$

Now, the worst DPV is calculated for this concrete path:

For the *Regularity of practice* criterion (k=1):

$\mu_1^{\pi} = \frac{\sum_{s=1}^{m-1} R_{sk}^{\pi}}{m-1} = \frac{1}{3}$ and $DPV_1^{w} = \frac{1}{9}\left(3-\frac{1}{3}\right)^2 + \frac{8}{9}\left(-\frac{1}{3}\right)^2 = \frac{72}{81}$

For the Regularity of consultation criterion (k=2):

$\mu_2^\pi = \frac{2}{9}$ and $DPV_2^W = \frac{1}{9}\left(2 - \frac{1}{3}\right)^2 + \frac{8}{9}\left(-\frac{2}{3}\right)^2 = \frac{32}{81}$

For the *Comprehensibility and manner of presentation* criterion (k=3) :

$\mu_3^\pi = \frac{5}{9}$ and $DPV_{i3}^W = \frac{8}{9}\left(-\frac{5}{9}\right)^2 + \frac{1}{9}\left(5 - \frac{5}{9}\right)^2 = \frac{200}{81}$

In following example, the DPV is calculated in the same manner as the previous one was.

For the *Encouraging students to be more active* criterion (k=4), the following was obtained:

$\mu_4^\pi = \frac{5}{9}$ and $DPV_{i4}^W = \frac{200}{81}$

For the *Importance of practice* criterion (k=5), the following was obtained:

$\mu_5^\pi = \frac{5}{9}$ and $DPV_{i5}^W = \frac{200}{81}$;

For the *Providing useful information* criterion (k=6), the following was obtained:

$\mu_6^\pi = \frac{4}{9}$ and $DPV_{i6}^W = \frac{128}{81}$;

For the *Assistant responds to students' questions* criterion (k=7), the following was obtained:

$\mu_7^\pi = \frac{4}{9}$ and $DPV_{i7}^W = \frac{128}{81}$;

For the Teaching assistants are professional and ethical in communication criterion (k=8), the following was obtained:

$\mu_8^\pi = \frac{4}{9}$ and $DPV_{i8}^W = \frac{128}{81}$;

For the *Objective and impartial in evaluation* criterion (k=9), the following was obtained:

$\mu_9^\pi = \frac{1}{3}$ and $DPV_{i10}^W = \frac{72}{81}$;

For the *General impression* criterion (k=10), the following was obtained:

$\mu_{10}^\pi = \frac{1}{3}$ and $DPV_{i10}^\pi = \frac{128}{81}$

$$DPV_i^W = \frac{\sum_{k=1}^n DPV_{ik}^\pi \omega_k}{\sum_{k=1}^n \omega_k} = \frac{1}{28}\left(\frac{8}{81} + \frac{32}{81} + \frac{800}{81} + \frac{1000}{81} + \frac{800}{81} + \frac{384}{81} + \frac{384}{81} + \frac{256}{81} + \frac{144}{81} + \frac{384}{81}\right) = 1.8765$$

According to the equation in the Methodology chapter, $\rho_i^\pi = \frac{DPV_i^\pi}{DPV_i^W} = \frac{0,3448}{1,8765} = 0,1837$

The same calculation was performed in the other five paths shown in Figure 2. It was concluded that one of the first two paths is the best choice for the teaching assistant A5.

4. Conclusion and Discussion

There is a saying, according to which if you do not become better, you will become worse. There is an existent constant tendency of people to make progress. This research study has shown that the ELECTRE MLO ranking method is a good tool in stepwise benchmarking.

In the Methodology chapter, a detailed description of the ELECTRE methods of multi-criteria decision-making, especially the ELECTRE MLO ranking method, which is a good stepwise benchmarking tool is given. It prescribes how to pick the best evolution path of all possible paths in the graph by calculating ρ, which is very important for everyday practice. People very often want to make progress as fast as they can so as to become the best in a certain field. The main contribution of this paper rests on Theorem 2, which shows how one should behave in order to make general progress. According to this theorem, "skipping steps" is a worse choice than making progress gradually. The best thing to do is always to learn from a colleague who is slightly better than us. The ELECTRE MLO ranking method helps us to plan our progress, i.e. "who or what we should look up to in order to become better".

The decision-making based on the application of this method has been illustrated on an example pertaining to higher education, based on the data obtained from one faculty of Belgrade University. In this example, it is concluded that there is a suggested development path for every teaching assistant. All possible evolution paths for the teaching assistant number 5 (A5) were considered as well. The best evolution path was chosen after the calculation of ρ_i^{π} . The effect of skipping steps on this concrete example was also considered, and a conclusion is drawn that it is in accordance with our Theorem 2. Since we are dealing with the realistic data, our research has resulted in two equally good evolution paths because they only differ in one alternative (i.e. A15 or A16), with very similar marks for all the criteria. The same calculation (described in detail in Chapter 2) can also be applied to any other teaching assistant. This model and approach to the problem could also be useful in other business progress planning fields.

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