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SERVICE QUALITY MANAGEMENT IN THE LIBRARIES AT THE UNIVERSITY OF NIŠ FACULTIES USING THE VIKOR METHOD

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Abstract
In its operation, a library as an educational and cultural institution is primarily concerned with the various needs of its users. These needs are very complex in the contemporary world which is characterized by the application of information and communication technologies. The heterogeneity and complexity of users' needs affect the quantity and quality of services provided, but also require daily monitoring of trends, acquiring new knowledge as well as a constant education of the employees. The paper aims to analyze the quality of the services provided by the libraries at the University of Niš. In order to achieve this, the author has applied one of the methods of multi-criteria analysis, i.e. the VIKOR method. Using this method, the ranking of libraries is performed on the basis of the following criteria simultaneously: the time spent on searching through the library fund in the available computer databases, the size of the available space and the size of the available library fund. The results of the application of the mentioned method indicate that this application is justified, because it represents a basis for an objective solution to the problem of selecting a library that provides the highest quality of customer service.

Keywords:
library, faculty, multi-criteria analysis, the VIKOR method.

1. Introduction

A constant intellectual challenge in the decision making sphere, in every domain of human activity is the choice of the optimal solution, i.e. the best alternative in order to achieve a certain aim. Before the multi-criteria analysis was invented and developed, the ranking among the given alternatives had been based on a single criterion which enabled the best solution to be determined easily. However, such a choice, which considered only one criterion significantly reduced the reality of the problem that was to be

solved (Čupić, et al. 2001).

The multi-criteria analysis (MCA), on the other hand, enables making a decision when there are more criteria according to which certain values ought to be maximized and others minimized (Blagojević, et al. 2012). In order to make the best decision it is necessary to define the relevant criteria and determine their so-called weight coefficients for given alternatives. Nowadays, a number of methods of multi-criteria analysis (ELECTRE, PROMETHEE, AHP, SAW, SPW, TOPSIS, VIKOR) is applied, and some of them have a wide application in various enterprises. These methods are often called "soft optimization techniques" in contrast to the mathematically strictly profiled standard optimization methods.

Contemporary management of service quality in the libraries represents a multidimensional process which includes defining the alternatives, the choice of evaluating criteria and pointing out the measures that are necessary for the increase of provided service quality level in the libraries.

The main objective of this paper is to show the possibility of applying the MCA, i.e. VIKOR method to the faculty libraries, in order to determine the quality of service. To manage the service quality it is necessary to establish the service quality level in the libraries and then perform their ranking.

The main task of the library is to enable the access to the information needed and its use (Kosanović 2008). In addition, "a dynamic surrounding and the change of the users' habits affect librarianship and daily operations in the library in a complex way. One of the most important aspects of these operations is the need to offer services to the users at the places where they spend most of their time, regardless of the nature of these places. In the virtual world this is widely accepted and implemented". (Sofronijević 2011).

The paper aims to determine and analyze, using the exact scientific method (multi-criteria decision making method), the quality of the services provided in order to satisfy the needs of the users, the teaching staff and the students of the University of Niš, but also to point out the necessity of improvement of the service quality in some libraries. The main criteria for determining the service quality are: the time spent on searching through the library units in the available computer databases, the size of the available space and the size of the available fund. For this purpose, a questionnaire was conducted at all faculties of the University of Niš, and those are: the Faculty of Philosophy, the Faculty of Electronic Engineering, the Faculty of Medicine, the Faculty of Mechanical Engineering, the Faculty of Economics, the Faculty of Civil Engineering and Architecture, the Faculty of Sport and Physical Education, the Faculty of Technology, the Faculty of Occupational Safety, the Faculty of Science and Mathematics, the Faculty of Fine Arts and the Faculty of Law.

2. The multi-criteria decision making method - VIKOR method

The choice of an academic library that provides the highest quality customer service is a part of the overall problem of an objective selection that is performed not only by one, but by a variety of criteria (some of which are in conflict) at the same time. "All the classical optimization methods use only one criterion in decision making or resolving problems, thus drastically reducing the reality of the problems that are to be solved" (Čupić et al., 2001). The complexity of the solution to this problem requires the application of a multi-criteria model, i.e. a multi-criteria analysis method (MCA), such as, for example, the VIKOR method (method of multi-criteria compromise ranking), which enables ranking of different libraries according to different criteria simultaneously. In doing so, the decision maker must assign to each criterion

a certain weight expressed by weight coefficients (j = 1,2,…..,n), according to the importance it has in the final decision making for the solution of the given problem.

The observed multi-criteria optimization method was developed so that the decision maker is offered a variety of alternatives that represent a compromise between the desires and possibilities, or those that represent a compromise between different interests of those who make the final decisions. From the finite reduced set of non-inferior solutions, the decision maker chooses the compromise solution, i.e. the feasible solution that is closest to the ideal solution (Fig.1.) or the solution whose distance from the ideal point $F^*(f_1^*, f_2^*)$ in the space of criterion functions is the shortest and represents a compromise for mutual concessions made between the alternatives (Puška 2011).

The VIKOR method is a method for multi-criteria ranking frequently used in various decision making problems. It is especially used in cases where the criteria are mainly quantitative in nature.

It is developed on the basis of compromise programming elements and starts from the "limit" forms of L_p – metrics (Kherzian et al., 2011). It is necessary to find the compromise solution that is closest to the ideal solution (Fig. 1.).

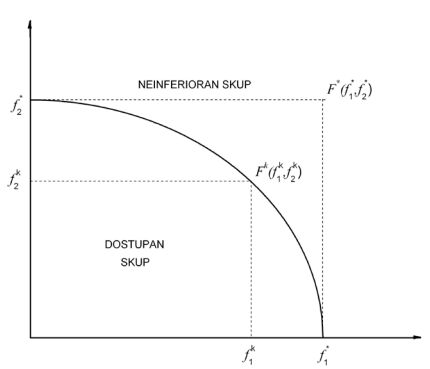


Fig.1. Ideal and compromise solution

"As a measure of the distance from the ideal point, the following metrics is most frequently used" (Opricović 1986) and (Liu and Wang, 2011):

$$L_{pi}(F^* - F) = \{\sum_{j=1}^{n}[w_j \frac{f_j^* - f_{ij}}{f_j^* - f_j^-}]^p\}^{\frac{1}{p}}$$

$$1 \leq p \leq \infty, \; i = 1, 2, \ldots m \qquad (1)$$

It represents the distance between the ideal point $F^*(f_1^*, f_2^*)$ and the point $F(f_1, f_2)$ in the space of criterion functions (Opricović 1986). Its minimization determines the compromise solution $F_c(f_{1c}, f_{2c})$. According to (Freimerand Yu, 1976), p represents the balancing factor between the total utility and the maximum individual deviation. Larger values of p increase the weight given to individual deviations, while smaller values of p emphasize the group utility. In applying the VIKOR method, the following labels are usually used in literature:

A – an alternative,

f –a criterion

m – the number of alternatives

i – the ordinal number of an alternative, i = 1,2,3,…..,m

n – the number of criteria

j – the ordinal number of a criterion, j = 1,2,3,....,n

f_{ij} – the value of the i–th alternative for the j–th criterion function

w_j –the weight of the j–th criterion function (expresses its relative importance)

v – the weight of the satisfaction of the majority of the criteria

Q_i –the measure for multi-criteria ranking of the i–th alternative

The essence of the VIKOR method is, after finding the Qi value for each alternative separately, to choose an alternative that has the lowest value (i.e. the shortest distance from the "ideal point"). The starting point for the implementation of the VIKOR method is determining the initial

decision table (Tab.1.), which is then converted into a quantified initial decision table (Tab.2.), in which qualitative assessments are converted into the quantitative ones by bipolar scale. Then, the initial decision matrix is formed.

$$\begin{matrix} f_1 & f_2 & f_n \\ w_1 & w_2 & w_n \end{matrix}$$

$$R = \begin{matrix} A_1 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} f_{11} & \cdots & f_{1n} \\ \vdots & \ddots & \vdots \\ f_{m1} & \cdots & f_{mn} \end{bmatrix}$$

Each row of the matrix corresponds to one alternative, and each column to one criterion (j=1,2,…..,n) and values ,…, and ,…, written above the matrix represent the criteria and their weight coefficients, respectively (Srđević, et al. 2002).

Then the best and worst values, f_j^* and f respectively, are determined for each criterion separately. (For the criteria with the request for the minimum value, the lowest value is the best and the highest value is the worst). For clarity and easier calculation, the values dij are introduced, (needed for determining the S_i and R_i values), defined as:

$$d_{ij} = \frac{f_j^* - f_{ij}}{f_j^* - f_j^-}$$

by means of which the complex linear normalization is performed, in order to get all matrix elements, which in general have different metrics, as dimensionless values (Srđević 2005). Then the values S_i (pessimistic solution) and R_i (expected solution) are evaluated (Opricović and Tzeng, 2004) using the formulas:

$$S_i = \sum_{j=1}^{n} w_j \frac{f_i^* - f_{ij}}{f_j^* - f_j^-} = \sum_{j=1}^{n} w_j d_{ij}$$
$$i = 1, 2, \ldots m$$

$$R_i = max_j\, w_j d_{ij} \qquad i = 1, 2, \ldots m \quad (2)$$

After calculating these values, one gives the importance to these solutions, i.e. defines their weights v, and each decision maker prefers what values will be given to them. Then the values S^* and S^- and R^* and R^- are determined, defined as:

$$S^* = min_i\, S_i \qquad R^* = min_i\, R_i$$
$$S^- = max_i S_i \qquad R^- = max_i\, R_i \quad (3)$$

And then the values QS_i, QR_i and Q_i (compromise solution) are calculated for each alternative, thus forming three independent ranking lists.

$$QS_i = \frac{S_i - S^*}{S^- - S^*} \qquad QR_i = \frac{R_i - R^*}{R^- - R^*}$$

$$Q_i = v \cdot QS_i + (1 - v) \cdot QR_i \quad (4)$$

The value v is introduced as a weight of "the maximum group utility", whereas 1 - v is the weight of the individual deviation (Opricović and Tzeng, 2005).

The value QS_i represents a measure of a deviation, which expresses a request for maximum group utility (the first ranking list) while QR_i represents a measure of a deviation expressing a request for minimizing the maximum distance of an alternative from "the ideal point" (the second ranking list). The value Q_i represents the formation of the compromise ranking list that combines the values QS_i and QR_i (the third ranking list). By choosing the value for v (the weight of the satisfaction of the majority of the criteria), one may favour the influence of the value QS_i or QR_i in the compromise ranking list

Q_i (Nikolić et al., 2010).

The alternative A_i is considered to be better than the alternative A_k (with respect to all criteria) if $Q_i < Q_k$., while the compromise ranking list Q_i for $v = 0.5$, is taken as the authoritative ranking list. The value $v = 0.5$ represents a consensus between maximum group utility when $v > 0.5$ and maximum individual deviation when $v < 0.5$ (Nikolić, et al. 2010), (Liu and Wang, 2011), (Opricović 1986). That means that larger values of v ($v > 0.5$) show that the decision maker stresses the greater relative importance to the strategy of satisfying the majority of criteria (Nikolić, et al. 2010).

The best alternative is the one that has the lowest value for Q_i and that is at the first position in the compromise ranking list.

However, if the alternative at the first position in the ranking list does not meet the conditions U_1 (to have an "acceptable advantage") and U_2 (to have an "acceptable stability"), then it is considered not to be better than the alternative at the second position.

2.1 The U_1 condition

The alternative A', the first in the compromise list Q_i for v = 0.5, has an "acceptable advantage" over the following alternative A" if (Liu and Wang, 2011):

$Q(A") - Q(A') \geq DQ$ where DQ is the threshold of the "acceptable advantage" and has the value: DQ = min (0.25;), where 0.25 stands for the size of the "acceptable advantage" threshold that limits the threshold for cases with a small number of alternatives.

2.2 The U_2 condition

The first alternative in the compromise list Q_i (for v = 0.5), must have an "acceptably stable" first position when the weight v is changed. This means that it must meet at least one of the following sub-conditions:

- It must be the first in the ranking list QS_i
- It must be the first in the ranking list QR_i
- It must be the first in the ranking list Q_i for $v = 0.25$ and $v = 0.75$.

Thus, it follows (Nikolić et al., 2010) that if the first alternative from the ranking list does not meet one or both conditions (the U_1 and U_2), it is not "acceptably" superior over the alternative in the second position and possibly other alternatives, and a set of compromise solutions is formed which consists of the first, the second, and some of the following alternatives.

In case that the first alternative does not satisfy the U_1 condition (or both conditions, the U_1 and U^2), a set of compromise solutions contains the alternatives from the compromise ranking list up to the one over which the first alternative has an "acceptable advantage" expressed by DQ.

If, however, the first alternative does not satisfy only the U_2 condition, the compromise set is formed from the first and the second alternative only (Opricović 2009).

Finally, the results of the VIKOR method are reflected in:

- the ranking lists based on the QS_i, QR_i and Q_i value
- the set of compromise solutions (in case the U_1 and U_2 conditions are not satisfied).

Such results are the basis for decision making and the adoption of the final solution (the multi-criteria optimal solution).

3. Ranking the libraries of the University of Niš faculties using the VIKOR method

In this paper the VIKOR method has been applied in order to rank the libraries of the University of Niš faculties according to the quality of services provided to the users of library funds.

In further text, the alternatives B_1, ...,B_n shall represent:

B_1 – The library of the Faculty of Philosophy

B_2 – The library of the Faculty of Electronic

Engineering

B_3 – The library of the Faculty of Medicine

B_4 – The library of the Faculty of Mechanical Engineering

B_5 – The library of the Faculty of Economics

B_6 – The library of the Faculty of Civil Engineering and Architecture

B_7 – The library of the Faculty of Sport and Physical Education

B_8 – The library of the Faculty of Technology

B_9 – The library of the Faculty of Occupational Safety

B_{10} – The library of the Faculty of Science and Mathematics

B_{11} – The library of the Faculty of Fine Arts

B_{12} – The library of the Faculty of Law.

In these libraries, the questionnaire was conducted in 2012. with a great number of questions out of which the author chose the following criteria as the most significant for the analysis of the library work:

f_1 – the time it takes to search the library fund through the available databases: COBISS, SATIS, ISIS, WINISIS, CLIPER and MS. ACCESS on the computers (the request for minimization)

f_2 – the size of the available library space (the request for maximization)

f_3 – the size of the available library fund (the request for maximization).

Based on the electronic data bases of the faculties in which the questionnaire was conducted, the author estimated the time of searching through the library fund in order to satisfy the users' needs. According to the obtained data (Review of the questionnaire) some libraries have no electronic data bases at all, but use classical card catalog (libraries B_6, B_7 and B_9), some of them have only local electronic data bases that can be browsed through only in these libraries (B_2 has SATIS, B_4 -MS.ACCESS, B_5-ISIS and B_8-WINISIS), and some of them, besides the local electronic bases, have COBISS. Net, the library-informational net, which enables the transparency of intellectual productions and accelerates searching through the library fund at any place outside the faculty, i.e. decreases the time of providing services to the users.

The author determined that the shortest time to search through the library fund is in those libraries that, besides the local electronic bases, possess COBISS, and he named it as short time; to those that have only local electronic bases he assigned average time, and to those which do not use any electronic data base, long time (Tab.1.).

In data obtained from the questionnaire, space surface is expressed in m^2. The author classified their values into five groups: from 0-99m^2, from 100-199m^2, from 200-299m^2, from 300-499m^2 and more than 500m^2 and named them in Tab.1. very small, small, average, large and very large, respectively.

The author examined the size of available library funds at University of Niš faculties, and also classified obtained data into five categories: from 5000-9999 units, from 10000-19999, from 20000-49999, from 50000-99999 and more than 100000 units and named them in Tab.1. very small, small, average, large and very large, respectively.

However, one can choose other criteria from the conducted questionnaire, but that would be the topic of some other research.

If we start from the assumption that the library of the Faculty of Medicine (B_3) is the best of all surveyed libraries in terms of the given criteria related to the provision of customer service, then the application of the VIKOR method should prove the validity of this hypothesis.

4. Results and discussion

The evaluation of all libraries according to all criteria is given in the initial decision table (Tab.1.), qualitatively, because it is the only way to define the time spent for searching through the library fund. The values 0.3, 0.5 and 0.7 are

assigned to these qualitative estimations for the short, average and long time, respectively, in the quantified initial decision table (Tab.2.).

The values 0.1, 0.3, 0.5, 0.7 and 0.9 correspond to both space size and size of the library fund.

Qualitative assessments converted into the quantitative ones using a bipolar scale, with corresponding criteria weights determined by the decision maker, i.e. the author, are given in the quantified initial decision table (Tab.2.).

Tab.2. Quantified initial decision table

Library B_i	Criteria with weights		
	f_1 $w_1=0.4$	f_2 $w_2=0.3$	f_3 $w_3=0.2$
B_1	0.3	0.3	0.5
B_2	0.5	0.9	0.7
B_3	0.3	0.7	0.9
B_4	0.5	0.5	0.1
B_5	0.5	0.5	0.5
B_6	0.7	0.5	0.3
B_7	0.7	0.3	0.3
B_8	0.5	0.3	0.5
B_9	0.7	0.3	0.3
B_{10}	0.3	0.5	0.5
B_{11}	0.3	0.1	0.3
B_{12}	0.3	0.7	0.7

$$\begin{matrix} & f_1 & f_2 & f_3 \\ & w_1 = 0.4 & w_2 = 0.3 & w_3 = 0.2 \end{matrix}$$

$$R = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.3 & 0.3 & 0.5 \\ 0.5 & 0.9 & 0.7 \\ 0.3 & 0.7 & 0.9 \\ 0.5 & 0.5 & 0.1 \\ 0.5 & 0.5 & 0.5 \\ 0.7 & 0.5 & 0.3 \\ 0.7 & 0.3 & 0.3 \\ 0.5 & 0.3 & 0.5 \\ 0.7 & 0.3 & 0.3 \\ 0.3 & 0.5 & 0.5 \\ 0.3 & 0.1 & 0.3 \\ 0.3 & 0.7 & 0.7 \end{bmatrix}$$

In each column of the matrix ***R***, the minimum and maximum values have to be observed. For the sake of clarity, these values are shown in a separate table (Tab. 3.). It should be noted that for the criteria with the requirement for a minimum (f_1) the best value is the lowest one, and worst value is the highest one, while for the f_2 and f_3 criteria, the highest values are the best and the lowest values are the worst.

The initial decision matrix R was formed on the basis of these tables.

Tab.1. Qualitative initial decision table

Library B_i	Criteria with weights		
	f_1 $w_1=0.4$	f_2 $w_2=0.3$	f_3 $w_3=0.2$
B_1	short	small	average
B_2	average	very large	large
B_3	short	large	very large
B_4	average	average	very small
B_5	average	average	average
B_6	long	average	small
B_7	long	small	small
B_8	average	small	average
B_9	long	small	small
B_{10}	short	average	average
B_{11}	short	very small	small
B_{12}	short	large	large

Tab.3. The readings of the best and the weakest values of surveyed libraries for the given criteria.

	f_1	f_2	f_3
f_j^*	0.3	0.9	0.9
f_j^-	0.7	0.1	0.1

The calculated values of d_{ij} and $w_j d_{ij}$, needed for the formation of matrices S_i and R_i, using the expression (2), are given in Tab.4.

Tab.4.Calculated values for dij and wjdij for all libraries for all criteria

Library	d_{ij}			$w_j d_{ij}$		
B_i	f_1	f_2	f_3	f_1	f_2	f_3
B_1	0	0.75	0.75	0	0.225	0.1
B_2	0.5	0	0	0.2	0	0
B_3	0	0.25	0	0	0.075	0
B_4	0.5	0.5	1	0.2	0.15	0.2
B_5	0.5	0.5	0.5	0.2	0.15	0.1
B_6	1	0.5	0.75	0.4	0.15	0.15
B_7	1	0.75	0.75	0.4	0.225	0.1
B_8	0.5	0.75	0.5	0.2	0.225	0.1
B_9	1	0.75	0.75	0.4	0.225	0.15
B_{10}	0	0.5	0.5	0	0.15	0.1
B_{11}	0	1	0.75	0	0.3	0.15
B_{12}	0	0.25	0.25	0	0.075	0.05

According to formula (2),matrices S_i and R_i are formed:

$$S_i = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.357 \\ 0.2 \\ 0.075 \\ 0.55 \\ 0.45 \\ 0.7 \\ 0.775 \\ 0.525 \\ 0.775 \\ 0.25 \\ 0.42 \\ 0.125 \end{bmatrix} \qquad R_i = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.225 \\ 0.2 \\ 0.075 \\ 0.2 \\ 0.2 \\ 0.4 \\ 0.4 \\ 0.225 \\ 0.4 \\ 0.15 \\ 0.3 \\ 0.075 \end{bmatrix}$$

From these matrices the values for S^*, S^-, R^* and R^- are then read, according to the formula (3):

$$S^* = 0.075,\ S^- = 0.775,\ R^* = 0.075,\ R^- = 0.4$$

needed for further calculation of matrices QS_i, QR_i and Q_i (for $v = 0.5$) by equation (4).

$$QS_i = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.357 \\ 0.179 \\ 0 \\ 0.679 \\ 0.536 \\ 0.893 \\ 1 \\ 0.643 \\ 1 \\ 0.25 \\ 0.536 \\ 0.071 \end{bmatrix} \qquad QR_i = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.462 \\ 0.385 \\ 0 \\ 0.385 \\ 0.385 \\ 1 \\ 1 \\ 0.462 \\ 1 \\ 0.231 \\ 0.692 \\ 0 \end{bmatrix}$$

$$Q_i(v = 0.5) = \begin{matrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \\ B_7 \\ B_8 \\ B_9 \\ B_{10} \\ B_{11} \\ B_{12} \end{matrix} \begin{bmatrix} 0.4095 \\ 0.282 \\ 0 \\ 0.532 \\ 0.4605 \\ 0.9465 \\ 1 \\ 0.5525 \\ 1 \\ 0.2405 \\ 0.614 \\ 0.0355 \end{bmatrix}$$

In order to test whether the U_1 and U_2 conditions are satisfied, it is also necessary to find the matrices Q_i ($v = 0.25$) and Q_i ($v = 0.75$):

$$Q_i(v=0.25)=\begin{matrix}B_1\\B_2\\B_3\\B_4\\B_5\\B_6\\B_7\\B_8\\B_9\\B_{10}\\B_{11}\\B_{12}\end{matrix}\begin{bmatrix}0.43575\\0.3335\\0\\0.4585\\0.42275\\0.97325\\1\\0.50725\\1\\0.23575\\0.635\\0.01775\end{bmatrix}$$

$$Q_i(v=0.75)=\begin{matrix}B_1\\B_2\\B_3\\B_4\\B_5\\B_6\\B_7\\B_8\\B_9\\B_{10}\\B_{11}\\B_{12}\end{matrix}\begin{bmatrix}0.38324\\0.2305\\0\\0.6055\\0.49825\\0.91975\\1\\0.59775\\1\\0.24525\\0.575\\0.05325\end{bmatrix}$$

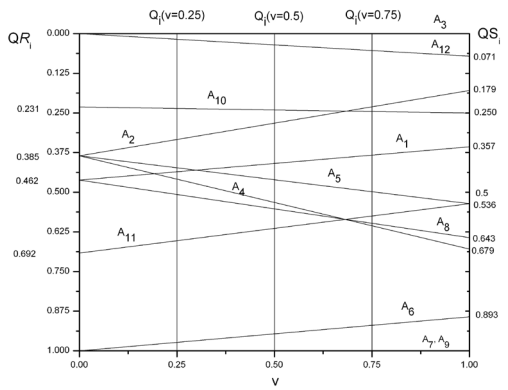
According to the obtained values for QS_i, QR_i and Q_i (v = 0.5), three independent ranking lists can be formed for each library (Tab.5).

Tab.5. Rankings of the surveyed libraries according to the criteria QS_i, QR_i and Q_i (v = 0.5).

Library B_i	QS_i	QR_i	Q_i (v=0.5)
B_1	5	7,8	5
B_2	3	4,5,6	4
B_3	1	1,2	1
B_4	9	4,5,6	7
B_5	6,7	4,5,6	6
B_6	10	10,11,12	10
B_7	11,12	10,11,12	11,12
B_8	8	7,8	8
B_9	11,12	10,11,12	11,12
B_{10}	4	3	3
B_{11}	6,7	9	9
B_{12}	2	1,2	2

All obtained results can be presented graphically (Fig. 2.), where the ranking of individual libraries according to all three criteria, QS_i, QR_i and Q_i, depending on the weight v, can be easily determined visually.

Fig.2. The rank of the surveyed libraries



depending on the criterion weight v

According to criterion QS_i, the best library is the library B_3, i.e. the library of the Faculty of Medicine, and according to criterion QR_i it shares the first and the second position with B_{12}, i.e. the library of the Faculty of Law. In total, according to Q_i (v = 0.5), the library of the Faculty of Medicine is still the best in the compromise list.

4.1 Verifying the U_1 condition

In case that v = 0.5, it follows:

$$Q_{12} - Q_3 = 0.0355 - 0 = 0.0355 < \frac{1}{n-11} = \frac{1}{11} = 0.0909$$

Since $Q_{12} - Q_3$ is smaller than 0.0909, it follows that the condition U_1 is not satisfied, i.e. the first library in the ranking list for Q_i, the library B_3, does not have an "acceptable advantage" over

the second one, B_{12}, which means that the library B_{12} is also a part of the set of compromise solutions. It is necessary to examine whether the library B_3 has an "acceptable advantage" over the next library, the third one in the ranking list for Q_i, B_{10}:

$$Q_{10} - Q_3 = 0.2405 - 0 = 0.2405$$

Since 0.2405 > 0.0909, it can be concluded that the U_1 condition is satisfied, i.e. the library B_3 has an "acceptable advantage" over the library B_{10}, which is not included in the set of compromise solutions.

It is not necessary to verify this condition further, for the following libraries, because it would certainly be satisfied.

4.2. Verifying the U_2 condition

The library B_3 has the first position in the ranking list for QS_i as well as in both ranking lists for Q_i, for values $v = 0.25$ and $v = 0.75$, and therefore, the condition U_2 is satisfied because two of three sub-conditions are satisfied (at least one is needed).

The final solution is then the set of solutions B_3 and B_{12}, but the decision maker, i.e. the author, may choose the library B_3 to be the best of all surveyed libraries.

5.Conclusion

Based on all stated above, it can be concluded that the multi-criteria analysis can successfully be applied to the selection of a faculty library that provides the highest quality of customer service. Using the VIKOR method, it was shown that two libraries, i.e. the library of the Faculty of Medicine and the library of the Faculty of Law are the best, because they are included in the set of compromise solutions, yet the author has chosen the library of the Faculty of Medicine as the best since it holds the first position in all ranking lists, except in the QR_i list, which can clearly be seen in Fig. 2. The last two positions in two ranking lists are occupied by the libraries of the Faculty of Sport and Physical Education and the Faculty of Occupational Safety, and in the third ranking list, in addition to these two libraries, the library of the Faculty of Civil Engineering and Architecture is also among the last three positions.

Therefore, by using the VIKOR method (multi-criteria compromise ranking method) the objective ranking of given libraries according to three different criteria has been achieved.

It should be noted that the ranking of the libraries according to the qualities of services provided can be performed on the basis of other criteria and their corresponding weights, which will be discussed in future papers.

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Review of the questionnaire–Criteria for determining the service quality level

Criteria	Faculty	Space	Fund
B_1	Faculty of Philosophy	180	35500
B_2	Faculty of Electronic Engineering	1108	77700
B_3	Faculty of Medicine	475	138083
B_4	Faculty of Mechanical Engineering	200	5300
B_5	Faculty of Economics	200	41000
B_6	Faculty of Civil Engineering and Architecture	260	15600
B_7	Faculty of Sport and Physical Education	120	10708
B_8	Faculty of Technology	100	45667
B_9	Faculty of Occupational Safety	120	12358
B_{10}	Faculty of Science and Mathematics	222	40000
B_{11}	Faculty of Fine Arts	26	16091
B_{12}	Faculty of Law	436	81000