An Extended VIKOR Method for Ranking Online Graduate Business Programs

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***Abstract*—The purpose of this study was to introduce an alternative multicriteria decision making methodology for ranking the best online business programs. The Extended VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) algorithm was used in order to strengthen the ranking methodology created by U.S. News & World Report and also make the sensitivity analysis of the results. The findings demonstrated that VIKOR algorithm is remarkably successful to determine the best programs which have acceptable advantage or stability in the ranking related to different criteria weights.**

***Index Terms*—Distance education, MBA rankings, multicriteria decision making, VIKOR method.**

I. Introduction

By the use of many indicators, criteria and the statistical data, the ranking of the best graduate business programs (MBA) worldwide have been created and also published annually by some world famous organizations and magazines. Certainly, official ranking lists are of great interest to candidates who are deciding to choose the right MBA Program. Also each year, schools are striving to provide more quality programs in order to improve their positions assigned by rankings [1]. Consequently, these rankings are becoming popular and important marketing tool every day. However, these rankings have also been a controversial subject and a target of criticism especially in academic society and media. The criticism usually focuses on the reliability of the scoring system, adequacy of selected indicators and criteria, also the accuracy of the criteria weights. Moreover, in recent years, as a consequence of growing demand for the online graduate business programs, the rankings of the online MBA programs also are becoming increasingly popular. Hence the rankings for online MBA programs also tend to attract some criticisms and arguments.

Admittedly, the common aim of the academic studies that assess or discuss the reliability of ranking systems is to improve the overall ranking system in order to produce more accurate ranking results. From this point, the purpose of this study was to introduce an alternative multicriteria decision making methodology for ranking the best online MBA programs. The Extended VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) algorithm was used in order to strengthen the ranking methodology created by U.S. News & World Report and also make the sensitivity analysis of the results. The findings demonstrated that VIKOR algorithm is remarkably successful to determine the best programs which have acceptable advantage or stability in the ranking related to different criteria weights.

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II. Online MBA Ranking Systems

There are various popular MBA ranking systems that publish an annual list of the best programs worldwide or in US level. The major MBA ranking providers can be summarized as follows [2]:

U.S. News & World Report [3]: U.S. News and World Report publishes annually the best MBA programs in US level. By surveying deans, MBA program directors and corporate recruiters, it uses a scoring system that takes ratings by business school deans and program directors, ratings by recruiters of the schools, placement statistics, and student selectivity as main indicators.

Financial Times [4]: Financial Times publishes six rankings annually relating to MBA, EMBA, master in finance, master in management programs, non-degree executive education courses, and ranking of top European Business Schools. In the ranking system, career progression of alumni, diversity of faculty, students and board members, the international experience of students, and faculty research and publication are considered as indicators.

Bloomberg Business week [5]: Bloomberg Business week publishes the list of the best MBA programs every two years. The rankings are based on student satisfaction survey, corporate recruiter surveys, as well as research articles and books written by faculty.

Forbes [6]: Forbes publishes the MBA ranking list every two years, and its ranking is based solely on return on investment. It separates schools intofour regions (U.S., Europe, Canada and Asia-Pacific) and the overall performance is calculated by looking at the ranking position within each region.

The Economist [7]: The Economist' MBA school rankings are published every October, and the rankings are broken down by region, including worldwide, Asia, Europe and North America. The rankings are based primarily on survey data from students, alumni and business schools.

Besides ranking systems for the Global MBA, the ranking systems for the online MBA programs in US or worldwide have become available especially in the last three years. The most popular ranking systems for the online MBA programs are "the Best Online Graduate Business Programs" published by US News and World Report, and "the Online MBA Listing" published by Financial Times. Both rankings use overall scoring system considering different indicators, criteria and criteria weights. In this study, the ranking system of the US News and World Report and its ranking list for the year 2013 was used in order to show how VIKOR

methodology can overcome the weaknesses of the standard scoring systems that the ranking results depend strongly criteria weights given.

III. VIKOR METHOD

The VIKOR methodology (Vlse Kriterijumska Optimizacija I Kompromisno Resenje, the Serbian name, means Multi-criteria Optimization and Compromise Solution) [8] was first introduced by Opricovic [9] and Opricovic and Tzeng [10]-[12]. The method can be defined as a multi-criteria optimization of complex systems [11], [12] and it is based on ranking and selecting from a set of alternatives under conflicting criteria. Assuming that each alternative is evaluated according to each criterion function, the compromise ranking could be performed by comparing the measure of closeness to the ideal alternative [12], [13]. The compromise solutions could be the basis for negotiations, involving the preference of decision makers by criteria weights[14].The VIKOR algorithm also determines the weight stability intervals for the obtained compromise solution with the input weights given by the experts [9], [10].

Since its introduction, The VIKOR methodology has been used in many areas such as healthcare applications[15],airline industry [16]-[19], material selection [20]-[24], contractor selection [25], improving tourism policy implementation [26], railway route planning [27], insurance company selection [28], financial performanceevaluation [29], optimization of multi-response processes [30],strategy improving for cruise product sales [31], improving information security risk [32], renevable energy planning [33], [34], creating assessment systems for teaching materials [35], university performance ranking [36], university selection for the future development [37], assessment of university innovation capital indicators [38], vendor or supplier selection [39], [40], brand marketing [41], risk or quality safety evaluation[42], [43], evaluating banking performance [44], personnel training selection [45].

The compromise ranking algorithm of VIKOR has the following steps [11]:

1) Determination of the best f_i^* and the worst f_i^- values of all criterion functions, $i = 1, 2,\ldots,n$. If the ith function represents a benefit then:

$f_i^* = \max_j f_{ij}, \quad f_i^- = \min_j f_{ij}$

If the ith function represents a cost then:

$f_i^* = \min_j f_{ij}, \quad f_i^- = \max_j f_{ij}$

2) Computation of the values S_j and R_j, $j = 1, 2,\ldots,J$, by the relations

$$S_j = \sum_{i=1}^{n} w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-) \quad (1)$$

$$R_j = \max_i \left[wi (f_i^* - f_{ij}) / (f_i^* - f_i^-) \right] \quad (2)$$

where w_i denotes the weights of criteria.

3) Computation of the values Q_j, $j = 1, 2,\ldots,J$, by the relation

$$Q_j = v(S_j - S^*) / (S^- - S^*) + (1 - v)(R_j - R^*) / (R^- - R^*) \quad (3)$$

where

$S^* = \min Sj$, $S^- = \max Sj$, $R^* = \min Rj$, $R^- = \max Rj$

"v" is introduced as the weight of the strategy of ''the majority of criteria'' (or the maximum group utility), usually $v = 0.5$.

4) Rank the alternatives, sorting by the values S, R and Q. The results are three ranking lists.

5) Propose as a compromise solution, for given criteria weights, the alternative (a'), which is the best ranked by the measure Q_{min} if the following two conditions are satisfied:

C1: Acceptable advantage:

$$Q(a'') - Q(a') \geq DQ \quad (4)$$

where a'' is the alternative with second position in the ranking list by Q, $DQ = 1/(J - 1)$; J is the number of alternatives.

C2: Acceptable stability in decision making:

The alternative a ´must also the best ranked by S or/and R. This compromise solution is stable within a decision making process, which could be: "voting by majority rule" (when $v > 0.5$ is needed), or "by consensus" $v \approx 0.5$, or "with veto" ($v < 0.5$). As indicated before, v represents the weight of the decision making strategy ''the majority of criteria'' (or ''the maximum group utility'').

If one of the conditions is not satisfied, then a set of compromise solutions is proposed, which consists of:

- Alternatives a ´and a ´´if only condition C2 is not satisfied, or
- Alternatives a´, a´´,….,a^k if condition C1 is not satisfied; and a^k is determined by the relation

$$Q(a^k) - Q(a') \approx DQ \quad (5)$$

IV. AN EMPIRICAL STUDY

For generating the online MBA ranking list, U.S. News and World Report firstly collects data and several statistical information from regionally accredited institutions that offer a master's in business MBA program through internet-based distance education courses [3].Then the data are scored, categorized under five major areas that consist of various indicators and criteria. Finally all indicators and also categories are weighted in order to get the overall score of the institutions. The main categories, indicators and the weights used in the ranking methodology are summarized in the Table 1. The detailed information about the criteria and their components can be found on the web page of the U.S. News and World Report [3].

In this study, top hundred online MBA programs according to the ranking list of US News and Report for the year 2013 were ranked again in accordance with the overall scores of universities for five categories (criteria) and their category weights indicated in the Table I. By the use of VIKOR algorithm, S_j, R_j and Q_j values were calculated for each ranking alternatives (universities, online MBA programs). In the model, v value was considered 0.5 (the maximum group utility).Table II summarizes the best 20 universities (online

MBA programs) according to the *Q* values. Name of the universities were indicated in the appendix.

TABLE I: CRITERIA AND THE WEIGHTS USED IN THE RANKING METHODOLOGY

Category (Criteria)	Weight (%)	Ranking Indicators
Student engagement	28	Graduation rate, best practices, program level accreditation, class size, one year retention rates, time to degree deadline.
Admissions selectivity	25	GMAT Scores, GPA scores, acceptance rate, employee sponsorship, experience, letters of recommendation (general), letters of recommendations (professionals).
Peer reputation	25	A school's weighted mean of scores on a 1-5 scale from marginal to outstanding as submitted by peer institutions, multiplied by 20.
Faculty credentials and training	11	Ph.D. faculty, tenured faculty, financed training, hours of faculty training, continuing faculty education, peer review.
Student services and technology	11	Student indebtedness, Technologies accessible to students, service available to students.

TABLE II: VIKOR RANKING RESULTS

	S_J	R_J	Q_J	Rank (Q_J)	Rank (US News)	C_1	C_2
U1	0.175	0.057	0.000	1	2	YES	YES
U2	0.181	0.067	0.028	2	3	YES	YES
U3	0.186	0.083	0.132	3	1	NO	NO
U4	0.221	0.086	0.136	4	4	YES	NO
U5	0.251	0.097	0.167	5	7	YES	NO
U6	0.284	0.107	0.182	6	8	YES	NO
U7	0.291	0.109	0.246	7	5	YES	NO
U8	0.292	0.109	0.266	8	16	NO	NO
U9	0.296	0.109	0.272	9	14	NO	NO
U10	0.306	0.111	0.273	10	19	YES	NO
U11	0.307	0.111	0.287	11	23	NO	NO
U12	0.307	0.112	0.287	12	17	NO	NO
U13	0.316	0.117	0.294	13	15	NO	NO
U14	0.321	0.118	0.295	14	22	NO	NO
U15	0.326	0.119	0.298	15	25	NO	NO
U16	0.330	0.126	0.308	16	6	NO	NO
U17	0.332	0.127	0.313	17	21	YES	NO
U18	0.339	0.129	0.335	18	20	YES	NO
U19	0.342	0.130	0.359	19	10	NO	NO
U20	0.343	0.130	0.367	20	30	NO	NO

From the Table II, it can be seen that Arizona State University is the best ranked alternative according to the VIKOR ranking. Indiana University (Bloomington) is the second ranked alternative. Moreover, Arizona State University and Indiana University have good advantage and also good stability as they both satisfy *"condition C_1"* and *"condition C_2"*. Arizona State University is a real compromise. Inspecting the Table II, it can be noticed that the ranking positions of the top 20 universities in the VIKOR ranking are quite different from those US News and Report ranking. As a fourth ranked university, only "University of Florida" keeps the same position in both rankings. The best ranked university in the US and Report ranking (Washington State) is in the third place in the VIKOR ranking. Moreover, Washington State has no any good advantage or stability, as it cannot satisfy C_1 and C_2. It means that in can lose its position easily for different criteria weights. Arizona State University, Indiana University, University of Florida, Auburn University, University of Connecticut, California State University Fullerton, Pennsylvania State University, University of Michigan, and University of North Texas are the alternatives with good advantage by satisfying C_1.The weight stability intervals in the Table III present the stability of the best ranked university (Arizona State) for a range of weight values for each five category. For "student engagement", the top position of Arizona University will remain the same for weight values of 0 through 21%. When the weight values for "admissions selectivity" stand between 0 through 19%, Arizona will be again the top ranked university. "Faculty credentials and training" has the widest range (0 through 56%) for keeping the top position of Arizona University. However, it can lose the first place for "student services and technology" category for the range values less than 17% or greater than 32%.

TABLE III:WEIGHT STABILITY INTERVALS FOR ARIZONA UN

	Initial	W^L	W^U
Student engagement	0.11	0.00	0.21
Admissions selectivity	0.11	0.00	0.19
Peer reputation	0.28	0.18	0.54
Faculty credentials and training	0.25	0.00	0.56
Student services and technology	0.25	0.17	0.32

V. CONCLUSION

Several official ranking systems produce and publish annually the league tables and the best school ranking lists in terms of the undergraduate or graduate programs. Increasing criticisms about the methodologies used in the ranking systems are in effort to develop better evaluation systematics. Whatever the methodology used a heavy dependence between the criteria weights and the ranking results have been observed in such systems. Thus it is essential to synthesize the results by the use of sophisticated quantitative techniques and to make sensitivity analysis related to criteria weights. In this study, the ranking list for the best online MBA programs by US News and World report was analyzed by the use of VIKOR method. The VIKOR algorithm is based on the evaluation of alternatives by the closeness to the ideal solution, and it is particularly capable on solving multicriteria complex systems. The results demonstrated that the position

of universities (online MBA programs) can fluctuate in the list while taking all ranked candidates into consideration. Moreover, under the given criteria weights, the acceptable advantage and the acceptable stability of universities were calculated, reflecting one of the strengths of the VIKOR algorithm. Also the weight stability intervals showed that the position of the highest ranked university is sensitive to criteria weights. Consequently the sensitivity analysis of the proposed methodology can be successfully applied to monitor the overall performance of the schools and to determine the strengths and weaknesses ofthe online MBA programs.

APPENDIX

NAME OF UNIVERSITIES (ONLINE MBA PROGRAMS) IN THE VIKOR RANKING

Name of Universities in the VIKOR Ranking	
U1	Arizona State University (Carey)
U2	Indiana University–Bloomington (Kelley)
U3	Washington State University
U4	University of Florida (Hough)
U5	Auburn University
U6	University of Connecticut
U7	California State University–Fullerton
U8	University of Illinois–Springfield
U9	Worcester Polytechnic Institute
U10	Pennsylvania State University–World Campus
U11	University of San Diego
U12	University of Nebraska–Lincoln
U13	Georgia College & State University (Bunting)
U14	University of Massachusetts–Amherst (Isenberg)
U15	Thunderbird School of Global Management
U16	Central Michigan University
U17	University of Michigan–Dearborn
U18	University of North Texas
U19	University of Tennessee–Martin
U20	Syracuse University (Whitman)

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