An Approach to Measuring the Website Quality Based on Neutrosophic Sets

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ABSTRACT

Gathering the attitudes of the examined respondents would be very significant in some evaluation models. Therefore, an approach to the evaluation of websites based on the use of the neutrosophic set is proposed in this paper. An example of websites evaluation is considered at the end of this paper with the aim to present in detail the proposed approach.

KEYWORDS: **neutrosophic set; single valued neutrosophic set; website quality; website evaluation; multiple criteria decision making.**

1. INTRODUCTION

A company's website can have a very important role in a competitive environment. It can be used to provide information to its customers, collect new and retain old users and so on.

A website can be visited by various groups of users that could have different requirements, needs and interests. In order to assess the quality of a website, it is necessary to obtain as realistic attitudes of its visitors about the fulfillment of their expectations and the perceived reality as possible.

The evaluation of the quality of websites has been considered in numerous studies, for which reason many approaches have been proposed. Some of them have been devoted to determining the impact of the website quality on customer satisfaction, such as: Al-Manasra *et al*. (2016), Bai *et al*. (2008), Lin (2007) and Kim and Stoel (2004).

Some other studies have been intended to determine the quality of websites and/or define the elements of the website that affect its quality, such as: Canziani and Welsh (2016), Salem and Cavlek (2016), Ting *et al*. (2013), Rocha (2012), Chiou *et al*. (2011) and Kincl and Strach (2012).

In some of them, the evaluation of websites has been considered as a multiple criteria decision making-problem, including the FS theory or its extensions, such as: Stanujkic *et al*. (2015), Chou and Cheng (2012), Kaya and Kahraman (2011), and Kaya (2010).

It is also known that a significant progress in multiple criteria decision making has been made after Zadeh (1965) proposed the Fuzzy Sets (FS) theory, thus introducing partial belonging to a set, expressed by using the membership function.

The FS theory has later been extended in order to provide an effective method for solving many complex decision-making problems, often related to uncertainties and predictions. The Interval-Valued Fuzzy Set (IVFS) Theory, proposed by Turksen (1986; 1996) and Gorzalczany (1987), the Intuitionistic Fuzzy Sets (IFS) Theory, proposed by Atanassov (1986) and the Interval-Valued Intuitionistic Fuzzy Set (IVIFS) Theory, proposed by Atanassov and Gargov (1989), can be mentioned as the prominent and widely used extensions of the FS theory.

In the IFS, Atanassov introduced the non-membership function. Smarandache (1998) proposed the Neutrosophic Set (NS) and so further generalized the IFS by introducing the indeterminacy-membership function, thus providing a general framework generalizing the concepts of the classical, fuzzy, interval-valued fuzzy and intuitionistic fuzzy sets.

Compared with the FS and its extensions, the NS can be identified as more flexible, for which reason they have been chosen in this approach for collecting the respondents' attitudes.

Therefore, this manuscript is organized as follows: in Section 2, the NSs are considered and in Section 3, the SWARA method is presented. In Section 4, a procedure for evaluating companies' websites is considered and in Section 5, its usability is demonstrated. Finally, the conclusion is given.

2. PRELIMINARIES

Definition. *Fuzzy sets* (FS). Let *X* be the universe of discourse, with a generic element in *X* denoted by *x*. Then, the FS $\tilde{A}$ in *X* is as follows:

$$\tilde{A} = \{x(\mu_A(x)) \mid x \in X\}, \tag{1}$$

where: $\mu_A : X \to [0,1]$ is the membership function and $\mu_A(x)$ denotes the degree of the membership of the element *x* in the set $\tilde{A}$ (Zadeh, 1965).

Definition. *Intuitionistic fuzzy set* (IFS). Let *X* be the universe of discourse, with a generic element in *X* denoted by *x*. Then, the IFS $\tilde{A}$ in *X* can be defined as follows:

$$\tilde{A} = \{x < \mu_A(x), \nu_A(x) > \mid x \in X\}, \tag{2}$$

where: $\mu_A(x)$ and $\nu_A(x)$ are the truth-membership and the falsity-membership functions of the element *x* in the set *A*, respectively; $\mu_A, \nu_A : X \to [0,1]$ and $0 \le \mu_A(x) + \nu_A(x) \le 1$.

In intuitionistic fuzzy sets, indeterminacy $\pi_A(x)$ is $1 - \mu_A(x) - \nu_A(x)$ by default (Atanassov, 1986).

Definition. *Neutrosophic set* (NS). Let *X* be the universe of discourse, with a generic element in *X* denoted by *x*. Then, the NS *A* in *X* is as follows:

$$A = \{x < T_A(x), I_A(x), F_A(x) > \mid x \in X\}, \tag{3}$$

where $T_A(x)$, $I_A(x)$ and $F_A(x)$ are the truth-membership function, the indeterminacy-membership function and the falsity-membership function, respectively, $T_A, I_A, F_A : X \to]^-0,1^+[$ and $^-0 \le T_A(x) + I_A(x) + F_A(x) \le 3^+$ (Smarandache, 1999).

Definition. *Single valued neutrosophic set* (SVNS). Let *X* be the universe of discourse. The SVNS *A* over *X* is an object having the form

$$A = \{x < T_A(x), I_A(x), F_A(x) > \mid x \in X\}, \tag{4}$$

where $T_A(x)$, $I_A(x)$ and $F_A(x)$ are the truth-membership function, the intermediacy-membership function and the falsity-membership function, respectively, $T_A, I_A, F_A : X \to [^-0,1^+]$ and $^-0 \le T_A(x) + I_A(x) + F_A(x) \le 3^+$ (Wang *et al*., 2010).

Definition. *Single valued neutrosophic number*. For the SVNS *A* in *X* the triple $< t_A, i_A, f_A >$ is called the single valued neutrosophic number (SVNN) (Smarandache, 1999).

Definition. *Basic operations on SVNNs*. Let $x_1 =< t_1, i_1, f_1 >$ and $x_2 =< t_2, i_2, f_2 >$ be two SVNNs, then additive and multiplication operations are defined as follows (Smarandache, 1998):

$$x_1 + x_2 =< t_1 + t_2 - t_1 t_2, i_1 i_2, f_1 f_2 >, \tag{5}$$

$$x_1 \cdot x_2 =< t_1 t_2, i_1 + i_2 - i_1 i_2, f_1 + f_2 - f_1 f_2 >. \tag{6}$$

Definition. *Scalar multiplication*. Let $x =< t_x, i_x, f_x >$ be a SVNN and $\lambda > 0$, then scalar multiplication is defined as follows (Smarandache, 1998):

$$\lambda x_1 =< 1-(1-t_1)^\lambda, i_1^\lambda, f_1^\lambda >. \tag{7}$$

Definition. *Power*. Let $x =< t_x, i_x, f_x >$ be a SVNN and $\lambda > 0$, then power is defined as follows:

$$x_1^\lambda =< t_1^\lambda, i_1^\lambda, 1-(1-f_1)^\lambda >. \tag{8}$$

Definition. *Score function*. Let $x =< t_x, i_x, f_x >$ be a SVNN, then the score function s_x of *x* can be as follows:

$$s_x = (1 + t_x - 2i_x - f_x)/2, \tag{9}$$

where $s_x \in [-1,1]$ (Smarandache, 1998).

Definition. *Accuracy function*. Let $x =< t_x, i_x, f_x >$ be a SVNN, then the score function s_x of *x* can be as follows:

$$h_x = (2 + t_x - i_x - f_x)/3, \tag{10}$$

where $h_x \in [0,1]$ (Smarandache, 1998).

Definition. *Ranking based on score and accuracy functions*. Let x_1 and x_2 be two SVNNs. Then, the ranking method can be defined as follows (Mondal & Pramanik, 2014):

(1) If $s_{x1} > s_{x2}$, then $x_1 > x_2$;
(2) If $s_{x1} = s_{x2}$ and $h_{x1} \ge h_{x2}$, then $x_1 \ge x_2$.

Definition. *Single Valued Neutrosophic Weighted Average Operator*. Let $A_j =< t_j, i_j, f_j >$ be a collection of SVNSs and $W = (w_1, w_2, ..., w_n)^T$ is an associated weighting vector. Then, the Single Valued Neutrosophic Weighted Average (SVNWA) operator of A_j is as follows (Sahin, 2014):

$$SVNWA(A_1, A_2, ..., A_n) = \sum_{j=1}^{n} w_j A_j = \left(1 - \prod_{j=1}^{n}(1-t_j)^{w_j}, \prod_{j=1}^{n}(i_j)^{w_j}, \prod_{j=1}^{n}(f_j)^{w_j}, \right). \tag{11}$$

where: w_j is the element *j* of the weighting vector, $w_j \in [0,1]$ and $\sum_{j=1}^{n} w_j = 1$.

3. The SWARA Method

The Step-wise Weight Assessment Ratio Analysis (SWARA) technique was proposed by Kersuliene *et al.* (2010). The computational procedure of the adapted SWARA method can be shown through the following steps (Kersuliene *et al*., 2010; Stanujkic *et al*., 2015):

***Step* 1**. Determine the set of the relevant evaluation criteria and sort them in descending order, based on their expected significances.

***Step* 2**. Starting from the second criterion, determine the relative importance s_j of the criterion j (C_j) in relation to the previous j-1 C_{j-1} criterion, and do so for each particular criterion as follows:

$$s_j = \begin{cases} >1 & when\ significance\ of\ C_j \succ C_{j-1} \\ 1 & when\ significanse\ of\ C_j = C_{j-1} \\ <1 & when\ significance\ of\ C_j \prec C_{j-1} \end{cases}. \quad (12)$$

where C_j and C_{j-1} denote criteria.

Using Eq. (11) respondents can more realistically express their opinions compared to the ordinary SWARA method, proposed by Kersuliene *et al*. (2010).

***Step* 3**. The third step in the adapted SWARA method should be performed as follows:

$$k_j = \begin{cases} 1 & j=1 \\ 2-s_j & j>1 \end{cases}. \quad (13)$$

where k_j is a coefficient.

***Step* 4**. Determine the recalculated weight q_j as follows:

$$q_j = \begin{cases} 1 & j=1 \\ \frac{q_{j-1}}{k_j} & j>1 \end{cases}. \quad (14)$$

***Step* 5**. Determine the relative weights of the evaluation criteria as follows:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}, \quad (15)$$

where w_j denotes the relative weight of the criterion j.

4. PROCEDURE FOR EVALUATING WEBSITES BASED ON THE SINGLE VALUED NEUTROSOPHIC SET AND THE SWARA METHOD

In their studies, many authors have identified different phases in the multiple criteria decision-making process. In order to precisely define the procedures for evaluating websites, the below phases have specially been emphasized:

- the selection of evaluation criteria
- the determination of the weights of the criteria
- the evaluation of alternatives in relation to the criteria
- the aggregation and analysis of the results

Selection of Evaluation Criteria

The choice of an appropriate set of the evaluation selection criteria is very important for the successful solving of each MCDM problem.

In many published studies, a number of authors have proposed different criteria for the evaluation of various websites. For example, Kapoun (1998) has proposed the use of the following criteria: Accuracy, Authority, Objectivity, Currency and Coverage. After that, Lydia (2009) has proposed Authority, Accuracy, Objectivity, Currency, Coverage and Appearance for evaluating the quality of a website. For the evaluation of websites at the California State University at Chico (http://www.csuchico.edu/lins/handouts/eval_websites.pdf), the so-called CRAAP test, based on the following criteria: Currency, Relevance, Authority, Accuracy and Purpose, has been proposed.

In this approach, the proven set of the criteria adopted from the Webby Awards (http://webbyawards.com/judging-criteria/) is proposed for the evaluation of the quality of websites. This set of the evaluation criteria is as follows:

- Content (C_1),
- Structure and Navigation (C_2),
- Visual Design (C_3),
- Interactivity (C_4),
- Functionality (C_5) and
- Overall Experience (C_6).

The meaning of the proposed evaluation criteria is as follows:

- ***Content***. The content is the information provided on the website. It is not just a text, but also music, a sound, an animation or a video – anything that communicates the website's body of knowledge.
- ***Structure and Navigation***. The structure and navigation refer to the framework of a website, the organization of the content, the prioritization of information and the method in which you move through the website. Websites with the good structure and navigation are consistent, intuitive, and transparent.
- ***Visual Design***. A visual design is the appearance of a website. It is more than just a pretty homepage and it does not have to be cutting-edge or trendy. A good visual design is high-quality, appropriate and relevant for the audience and the message it is supportive of. It communicates a visual experience and may even take your breath away.
- ***Interactivity***. Interactivity is the way a site allows a user to perform an action. Good interactivity refers to providing opportunities for users to personalize their search and find information or perform some action more easily and efficiently.
- ***Functionality***. Functionality is the use of technology on a website. Good functionality means that a website works well. It loads quickly, has live links and any new technology that has been used is functional and relevant for the intended audience.
- ***Overall Experience***. Demonstrating that websites are frequently more or less than just the sum of their parts, overall experience encompasses the content, a visual design, functionality, interactivity and the structure and navigation, but also includes the intangibles that make one stay on the website or leave it.

Determination of the Weights of the Criteria

In this approach, the SWARA method is used for determining the weights of the criteria. The SWARA method has been chosen because it is relatively simple to use and requires a relatively small number of comparisons in pairs.

The determination of the weights of the criteria is done by using an interactive questionnaire made in a spreadsheet file. By using such an approach, the interviewee can see the calculated weights of the criteria and can also modify his/her answers if he or she is not satisfied with the calculated weights.

Evaluation of Alternatives in Relation to the Evaluation Criteria

In this phase, there are several sub-phases that can be identified.

The evaluation of alternatives in relation to the chosen set of the criteria is also done by using an interactive questionnaire made in a spreadsheet file.

For each criterion, declarative sentences are formed. The respondents have a possibility to fill in their attitudes about the degree of truth, indeterminacy and the falsehood of the statement.

For the sake of simplicity, the respondents fill in their attitudes in the percentage form, which are later transformed into the corresponding numbers in [0,1] intervals.

For completing the questionnaire, it is necessary that between 30 and 90 fields should be filled in, which can be dissuasive for a significant number of respondents. However, this approach can be good because it can distract uninterested respondents from completing the questionnaire, thus reducing the number of the completed questionnaires with incorrect information.

In addition, the Overall Experience criterion has also been used to assess the validity of the data entered.

Aggregation and Analysis of Results

In the Aggregation and Analysis phase, several components, sub-phases, could be identified, such as:

- the determination of the overall ratings and the ranking order of the considered alternatives,
- the assessment of the validity of the data in the completed questionnaire and
- the determination of the overall group ratings and the ranking order of the considered alternatives etc.

The first of them – the determination of the overall ratings – is mandatory, whereas the others are optional.

The determination of the overall ratings and the ranking order of the considered alternatives. The process of assessing the determination of the overall ratings and the ranking order could be shown through the following steps:

- the calculation of the overall single valued neutrosophic ratings of the alternatives by using the SVNWA operator based on the values of the criteria C_1-C_5;
- the calculation of the score function by using Eq. (9) for each alternative; and
- the sorting of the considered alternatives based on the values of the score function and the determination of the best one. The alternative with the highest value of the score function is the best one.

The assessment of the validity of the data in the completed questionnaire. The *Overall Experience* criterion is omitted from the calculation of the overall single valued neutrosophic ratings because it plays a special role in the proposed approach. More precisely, the ratings filled in for this criterion are used to assess the validity of the data in the completed questionnaire.

The process of assessing the validity of the data could be accounted for through the following steps:

- Calculate the value of the score function based on the ratings of the *Overall Experience* criterion, and do so for each alternative.
- Determine the ranking order of the alternatives based on the value of the score function.
- Calculate the correlation coefficient between the ranking order obtained based on C_1-C_5 and the ranking order obtained based on the *Overall Experience* criterion.

Based on the value of the correlation coefficient, the questionnaire could be either accepted or rejected.

The determination of the overall group ratings and the ranking order of the considered alternatives. In the case of real examinations, when more than one respondent is involved in the evaluation, it is necessary to determine the overall group ratings, and based on them the final ranking order of the alternatives.

The process of determining the overall group ratings and the final ranking order of the alternatives is as follows:

- the calculation of the overall group ratings by using the SVNWA operator, based on the overall ratings;
- the calculation of the score function of the overall group rating by using Eq. (9) for each alternative, and
- the sorting of the considered alternatives based on the values of the score function and the determination of the best one. The alternative with the highest value of the score function is the best one.

5. A NUMERICAL ILLUSTRATION

In this numerical illustration, one case of selecting websites is considered. The initial set of the alternatives has been formed based on the keyword “vinarija”, which is the Serbian word for a “winery”, in the Google search engine.

The list of eight top placed websites is as follows:

- Vinarija Zvonko Bogdan - http://www.vinarijazvonkobogdan.com/
- Vinarija Coka - http://www.vinarijacoka.rs/
- Vinarija Dulka - http://www.dulka-vinarija.com/
- Vinarija Milosavljevic - http://www.vinarija-milosavljevic.com/
- Vinarija Kis - http://www.vinarijakis.com/
- Vinarija Vink - http://www.dobrovino.com/
- Vinarija Matalj - http://www.mataljvinarija.rs/
- Vinarija Aleksandrovic - http://www.vinarijaaleksandrovic.rs/

From the above, a set of five alternatives has been formed[1], denoted A_1 to A_5.

The survey has been conducted by email, with the aim to collect the attitudes from the respondents regarding the significance of the criteria and the ratings of the alternatives.

The interactive questionnaire made in the spreadsheet was used for attitudes gathering, so the participants had an opportunity to see the results and possibly change their own attitudes.

The attitudes obtained from the first of the three examinees are given in Table 1, which also accounts for the weights of the criteria calculated based on the examinees’ responses.

Table 1: The responses and weights of the criteria obtained from one of the evaluated respondents

Criteria		s_j	k_j	q_j	w_j
C_1	Content		1	1	0.22
C_2	Structure and Navigation	0.90	1.10	0.91	0.20
C_3	Visual Design	1.20	0.80	1.14	0.25
C_4	Interactivity	0.60	1.40	0.81	0.18
C_5	Functionality	0.90	1.10	0.74	0.16

The attitudes obtained from the three examinees, as well as the appropriate weights, are presented in Table 2 as well.

[1] This paper is not intended to promote any of the above-mentioned wineries.

Table 2: The attitudes and weights obtained from the three examinees

	E_1		E_1		E_1	
	s_j	w_j	s_j	w_j	s_j	w_j
C_1		0.22		0.20		0.20
C_2	0.90	0.20	1.10	0.22	1.00	0.20
C_3	1.20	0.25	1.10	0.25	1.10	0.22
C_4	0.60	0.18	0.60	0.18	0.90	0.20
C_5	0.90	0.16	0.90	0.16	0.90	0.18

The following are the responses obtained from the three examinees regarding the evaluation of the websites.

Table 3: The ratings obtained from the first of the three examinees

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	<1.0, 0.0, 0.0>	<1.0, 0.2, 0.0>	<1.0, 0.0, 0.0>	<0.7, 0.3, 0.0>	<0.8, 0.2, 0.2>	<0.9, 0.1, 0.1>
A_2	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.6, 0.0, 0.2>	<1.0, 0.0, 0.0>	<0.7, 0.0, 0.0>
A_3	<0.9, 0.0, 0.0>	<0.9, 0.0, 0.0>	<0.7, 0.2, 0.3>	<0.5, 0.0, 0.0>	<0.9, 0.0, 0.0>	<0.7, 2.0, 2.0>
A_4	<0.7, 0.0, 0.3>	<0.7, 0.3, 0.3>	<0.6, 0.4, 0.2>	<0.4, 0.0, 0.0>	<0.9, 0.0, 0.0>	<0.5, 0.0, 0.2>
A_5	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.7, 0.0, 0.2>	<1.0, 0.0, 0.0>	<0.9, 0.0, 0.2>

Table 4: The ratings obtained from the second of the three examinees

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	<0.8, 0.2, 0.2>	<1.0, 0.0, 0.0>	<0.7, 0.3, 0.1>	<0.7, 0.3, 0.2>	<1.0, 0.0, 0.0>	<0.8, 0.1, 0.1>
A_2	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.6, 0.0, 0.2>	<1.0, 0.0, 0.0>	<1.0, 0.1, 0.1>
A_3	<0.7, 0.3, 0.2>	<0.9, 0.0, 0.0>	<0.7, 0.2, 0.3>	<0.5, 0.0, 0.0>	<0.9, 0.0, 0.0>	<0.7, 0.2, 0.2>
A_4	<0.7, 0.0, 0.3>	<0.7, 0.3, 0.3>	<0.6, 0.4, 0.2>	<0.4, 0.0, 0.0>	<0.9, 0.0, 0.0>	<0.5, 0.1, 0.2>
A_5	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.7, 0.0, 0.2>	<1.0, 0.0, 0.0>	<0.9, 0.0, 0.0>

Table 5: The ratings obtained from the third of the three examinees

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	<0.9, 1.0, 1.0>	<0.9, 0.0, 0.2>	<1.0, 0.0, 1.0>	<0.7, 0.3, 0.2>	<1.0, 0.0, 0.0>	<0.9, 0.0, 0.1>
A_2	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.6, 0.0, 0.2>	<1.0, 0.0, 0.0>	<1.0, 0.1, 0.1>
A_3	<0.6, 0.3, 0.2>	<0.9, 0.0, 0.0>	<0.5, 0.2, 0.3>	<0.5, 0.3, 0.3>	<0.9, 0.3, 0.4>	<0.7, 0.0, 0.0>
A_4	<0.6, 0.0, 0.3>	<0.5, 0.3, 0.4>	<0.4, 0.4, 0.2>	<0.4, 0.0, 0.0>	<0.9, 0.3, 0.3>	<0.7, 0.0, 0.2>
A_5	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<1.0, 0.0, 0.0>	<0.7, 0.0, 0.2>	<1.0, 0.0, 0.0>	<0.9, 0.0, 0.0>

The remaining part of the evaluation process is explained on the first of the three examinees.

The overall SVNN ratings calculated by using the SVNWA, i.e. by using Eq. (11), are shown in Table 4. The ranking order obtained based on the values of the score function, calculated by using Eq. (9), is also presented in table 6.

The ranking order obtained based on the Overall Experience criterion is given in table 6, too.

Table 6: The ranking orders obtained on the basis of the ratings of the first of the three examinees

	C_1- C_5	Score	Rank	C_6	Score	Rank
A_1	<1.000, 0.006, 0.000>	0.9936	3	<0.9, 0.1, 0.1>	0.80	3
A_2	<1.000, 0.000, 0.000>	0.9997	1	<0.7, 0.0, 0.0>	0.85	2
A_3	<0.826, 0.001, 0.001>	0.9118	4	<0.7, 2.0, 2.0>	-2.15	5
A_4	<0.695, 0.004, 0.018>	0.8345	5	<0.5, 0.0, 0.2>	0.65	4
A_5	<1.000, 0.000, 0.000>	0.9997	1	<0.9, 0.0, 0.2>	0.85	1

The Pearson correlation coefficient between the two ranking orders, shown in Table 6, is 0.884, which is indicative of the fact that the data in the questionnaire are valid.

The ranking orders obtained from the three examinees obtained based on the ratings of the criteria C_1 to C_5 are shown in Table 7.

Table 7: The ranking orders obtained from the three examinees

	I		II		II	
	Score	Rank	Score	Rank	Score	Rank
A_1	0.99	3	0.98	3	0.93	3
A_2	1.00	1	1.00	1	1.00	1
A_3	0.91	4	0.88	4	0.78	4
A_4	0.83	5	0.83	5	0.75	5
A_5	1.00	1	1.00	1	1.00	1
R		0.884		0.884		0.795

The correlation coefficients are also accounted for in Table 7.

The obtained correlation coefficients indicate that there is no significant difference between the ranking orders obtained based on the criteria C_1 to C_5 and the *Overall Experience* criterion, which is indicative of the fact that the data in the selected questionnaires are valid.

CONCLUSION

Obtaining a realistic attitude by surveying could often be related to some difficulties, when the data collected in such a manner are then further used in multiple criteria decision making.

There are two opposite possibilities. The first one is using a greater number of criteria, often organized into two or more hierarchical levels. Such an approach should lead to the formation of accurate models. However, an increase in the number of criteria could lead to the creation of complex questionnaires, which could have a negative impact on the examinee's response as well as on the verisimilitude of the collected data.

Opposite to the previously said, the usage of a smaller number of criteria could have a positive impact on the collection of data, i.e. respondents' attitudes, on the one hand, but could also lead to the creation of less precise decision-making models, on the other.

The neutrosophic set, or more precisely single valued neutrosophic numbers, could be an adequate basis for collecting the examinee's attitudes by using a smaller number of criteria without losing precision.

By combining the SWARA method, in order to determine the importance of criteria, on the one hand, and Single Valued Neutrosophic Numbers, in order to acquire respondents' attitudes, on the other, effective and easy-to-use multiple criteria decision-making models can be created, as has been shown in the considered numerical illustration.

REFERENCES

Al-Manasra, E., Khair, M., Zaid, S. A., & TaherQutaishat, F. (2013). Investigating the impact of website quality on consumers' satisfaction in Jordanian telecommunication sector. *Arab Economic and Business Journal*, 8(1-2), 31-37.

Atanassov, K. T. (1986). Intuitionistic fuzzy sets. *Fuzzy sets and Systems*, 20(1), 87-96.

Atanassov, K., & Gargov, G. (1989). Interval valued intuitionistic fuzzy sets. *Fuzzy sets and systems*, 31(3), 343-349.

Bai, B., Law, R., & Wen, I. (2008). The impact of website quality on customer satisfaction and purchase intentions: Evidence from Chinese online visitors. *International Journal of Hospitality Management*, 27(3), 391-402.

California State University at Chico. Evaluating Information – Applying the CRAAP Test. Available online: http://www.csuchico.edu/lins/handouts/eval_websites.pdf (Retrived on 17.05.2017).

Canziani, B. F., & Welsh, D. H. (2016). Website quality for SME wineries: measurement insights. *Journal of Hospitality and Tourism Technology*, 7(3), 266-280.

Chiou, W. C., Lin, C. C., & Perng, C. (2011). A strategic website evaluation of online travel agencies. *Tourism Management*, 32(6), 1463-1473.

Chou, W. C., & Cheng, Y. P. (2012). A hybrid fuzzy MCDM approach for evaluating website quality of professional accounting firms. *Expert Systems with Applications*, 39(3), 2783-2793.

Gorzałczany, M. B. (1987). A method of inference in approximate reasoning based on interval-valued fuzzy sets. *Fuzzy sets and systems*, 21(1), 1-17.

Kapoun, J. (1998). Teaching undergrads web evaluation - a guide for library instruction. *College and Research Libraries News*, 59(7), 522-523.

Kaya, T. (2010). Multi-attribute evaluation of website quality in E-business using an integrated fuzzy AHPTOPSIS methodology. *International Journal of Computational Intelligence Systems*, 3(3), 301-314.

Kaya, T., & Kahraman, C. (2011). A fuzzy approach to e-banking website quality assessment based on an integrated AHP-ELECTRE method. *Technological and Economic Development of Economy*, 17(2), 313-334.

Keršuliene, V., Zavadskas, E. K., & Turskis, Z. (2010). Selection of rational dispute resolution method by applying new step-wise weight assessment ratio analysis (SWARA). *Journal of Business Economics and Management*, 11(2), 243-258.

Kim, S., & Stoel, L. (2004). Apparel retailers: website quality dimensions and satisfaction. *Journal of Retailing and Consumer Services*, 11(2), 109-117.

Kincl, T., & Štrach, P. (2012). Measuring website quality: asymmetric effect of user satisfaction. *Behaviour & Information Technology*, 31(7), 647-657.

Lin, H. F. (2007). The impact of website quality dimensions on customer satisfaction in the B2C e-commerce context. *Total Quality Management and Business Excellence*, 18(4), 363-378.

Lydia M. Olson Library. (2009). Evaluating internet sources: A library resource guide. Available online: http://library.nmu.edu/guides/userguides/webeval.htm (Retrived on 10.06.2017).

Mondal, K., & Pramanik, S. (2014). Multi-criteria group decision making approach for teacher recruitment in higher education under simplified neutrosophic environment. *Neutrosophic Sets and Systems*, 6, 28-34.

Rocha, Á. (2012). Framework for a global quality evaluation of a website. *Online Information Review*, 36(3), 374-382.

Sahin, R. (2014). Multi-criteria neutrosophic decision making method based on score and accuracy functions under neutrosophic environment. *arXiv preprint arXiv*, 1412.5202.

Salem, I. E. B., & Čavlek, N. (2016). Evaluation of hotel website contents: existence-importance analysis. *Journal of Hospitality and Tourism Technology*, 7(4), 366-389.

Smarandache, F. (1998). Neutrosophy: neutrosophic probability, set, and logic: analytic synthesis & synthetic analysis. American Research Press, Rehoboth, USA.

Smarandache, F. (1999). A unifying field in logics. Neutrosophy: Neutrosophic probability, set and logic. American Research Press, Rehoboth, USA.

Stanujkic, D., Karabasevic, D., & Zavadskas, E. K. (2015). A framework for the selection of a packaging design based on the SWARA method. *Inzinerine Ekonomika-Engineering Economics*, 26(2), 181-187.

Stanujkic, D., Zavadskas, E. K., & Tamosaitiene, J. (2015). An approach to measuring website quality in the rural tourism industry based on Atanassov intuitionistic fuzzy sets. *E+M Ekonomie a Management*, 18(4), 461-470.

Ting, P. H., Wang, S. T., Bau, D. Y., & Chiang, M. L. (2013). Website evaluation of the top 100 hotels using advanced content analysis and eMICA model. *Cornell Hospitality Quarterly*, 54(3), 284-293.

Turksen, I. B. (1986). Interval valued fuzzy sets based on normal forms. *Fuzzy Sets and Systems*, 20(2), 191-210.

Türkşen, I. B. (1996). Non-specificity and interval-valued fuzzy sets. *Fuzzy Sets and Systems*, 80(1), 87-100.

Wang, H., Smarandache F., Zhang, Y.Q., & Sunderraman, R. (2010). Single valued neutrosophic sets. *Multispace and Multistructure*, 4, 410-413.

Webby Awards. Available online: http://webbyawards.com/judging-criteria/ (Retrived on 26.06.2017).

Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, 8(3), 338-353.

Abdel-Basset, M., Mohamed, M., Smarandache, F., & Chang, V. (2018). Neutrosophic Association Rule Mining Algorithm for Big Data Analysis. *Symmetry*, 10(4), 106.

Abdel-Basset, M., & Mohamed, M. (2018). The Role of Single Valued Neutrosophic Sets and Rough Sets in Smart City: Imperfect and Incomplete Information Systems. Measurement. Volume 124, August 2018, Pages 47-55

Abdel-Basset, M.; Mohamed, M.; Smarandache, F. An Extension of Neutrosophic AHP–SWOT Analysis for Strategic Planning and Decision-Making. *Symmetry* 2018, 10, 116.