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Fuzzy Multiple Criteria Decision Making Model with Fuzzy Time Weight Scheme

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Abstract

In this study, we purpose a common fuzzy multiple criteria decision making model. A brand new concept-fuzzy time weighted scheme is adopted for considering in the model to establish a fuzzy multiple criteria decision making with time weight (FMCDMTW) model. A real case of fuzzy multiple criteria decision making (FMCDM) problems to be considering in this study. The performance evaluation of auction websites based on all criteria proposed in related literature. Obviously, the problem under investigated is a FMCDM problem with historic data and recent data. Since the evaluated criteria proposed in the literature cannot be defined precisely and numerically, fuzzy linguistic terms can be used to aggregate them numerically. It not only conforms to human cognition but also benefits interpretation. Furthermore, notice that the literature considered contains certain amount of historic data. Equally weighted historic data is usually considered in FMCDM problems, and this approach would introduce bias owing to the collected data for a certain long time period. As a result, fuzzy time weighted technique is adopted to resolve this issue.

Keywords: *FMCDM, fuzzy time weight, FMCDMTW, auction website*

1. Introduction

Decision making is an important task of managers. Decision-making correctted or not were often affected greatly, even related to corporate survival. Generally, the formations of decision-making were from the managers to determine the performance by the objects in the assessment criteria. In the past, the managers usually evaluated assessment object with single evaluation criterion. Related research [3, 6, 7] has indicated that a single assessment criterion is often unable to cover all the essence of the evaluation object today. Today's decision-making activities, managers often deal with the problem contains multiple evaluation criteria. For example, buying a car, we usually will consider a number of factors, assessment attributes such as price, comfort, safety, performance and fuel consumption, performance, appearance, etc [10, 14, 19]. These evaluation criteria sometimes conflict with each other, such as price and safety; others cannot be quantified, such as security. Assessment methods used in the past were usually with only single indicator such as of the minimum cost or maximum effective. Some researchers have indicated that diverse and complex social environment at present day; managers face increasingly complex problems, and often need to make a choice between mutually exclusive goals. Selection or evaluation method with single criterion has been inconsistent with the needs of the actual problem.

For multi-objective decision problem, the Multiple Criteria Decision Making (MCDM) approach has been proposed. MCDM is a process in which managers make decisions among conflicting, not taking into account schemes [9]. Multi-criteria decision making, however, face a problem that is in most of the decision-making problems, the decision makers majority face fuzzy information, rather than binary options. Decision makers need to consider a number of criteria in the assessment of the program, some quantifiable criteria, such as price; some qualitative information cannot be quantified, such as safety [4]. Feature more, for the different decision makers the emphasis will be different on the same criteria.

Zadeh proposed fuzzy theory in 1965, Bellman and Zadeh combined with fuzzy theory and multi-criteria decision-making to propose a Fuzzy Multiple Criteria Decision Making

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(FMCDM) approach, this approach has been used to solve the problem of the uncertainty in the actual decision-making problems. After that, the fuzzy MCDM is widely discussed [20, 25]. Fuzzy theory allows people to describe the ambiguity in multi-criteria decision making problem. As hybrid intelligent methods were appalied on decision optimally, the FMCDM become an important direction of MCDM [26]. The FMCDM has been widely used in the actual decision-making problem. Some recent researchs aim similar problem wtih autonomous agent-entity approach [17].

To propose effective assessment criteria is the first step of establishing FMCDM model assessment criteria. Some researches pointed out that if the assessment criteria are bias or wrong, the entire assessment tasks will become meaningless. Assessment criteria of many subjects there is no absolute standard, the value of criteria are changed because different people, events, time, manner, and matter. Therefore, it is quite difficult to establish assessment criteria to assess the subject. In particular, the implementation of the evaluation plan itself does not have the expertise to establish assessment criteria, the criteria for the establishment of the need to consolidate the views of professionals. Professional advice, however, sometimes it is not easy to obtain, or need non considerable cost and time-consuming. In order to overcome this difficulty, this study proposes a method of assessment criteria construct instead of expert opinions collected from literature. In the past, the same method is also used in a variety of studies, for example: The related researches through the literature review to establish management conceptual framework [18], or established through the same assessment criteria of the operating performance of the online store.

So far, similar studies wewe processed literatures as equivalent and give the same weight to establish assessment criteria [7, 11]. However, the subjects of rapid change for a number of assessment criteria. With time progresses, many ideas and technologies continue to change, thereby affecting the decision-makers to change the emphasis of the assessment criteria. In addition, the same subject may be has the new assessment criteria, or disappearance of the old assessment criteria. This phenomenon is more obvious in recent years, especially on emerging network technology. Therefore, in the evaluation of subject which evolution fast techniques or content, the equivalent assessment criteria, it is possible to make the entire assessment criteria errors. To avoid this error caused the failure assessment; this study proposed a new literature review and the concept of aggregate that is Fuzzy Time Weight (FTW), the main concept of this method is to consider the time dependency of the assessment criteria. Assessment criteria, in addition to consideration of the evaluation criteria proposed in the literature, the number of occurrences and the extent referenced literature compiled additional time corresponding to the consideration of the relationship. The purpose is to consider the applicability of the assessment criteria on aging. This study, combined with Fuzzy Time Weight and Fuzzy Multiple Criteria Decision Making into Fuzzy Multiple Criteria Decision Making with Time Weight model (FMCDMTW)

To illustrate the FMCDMTW model, the auction site, for example, the establishment and operation of the description of the proposed auction site service performance evaluation system. The auction site is a new transaction method, and its content evolved quickly. The related research pointed out that the auction site whether subsisting entirely dependent on users of buyers and sellers are willing to continue to use the trading platform for trading [15, 16]. In other words, the service performance of the auction site determines whether the site can be sustainable. Therefore, how to effectively measure the auction site operator and service performance, website operators are concerned about the issue, but also an important reference for the user choice of trading platform indicators [21, 24].

The first work to establish a good performance evaluation model is to propose effective evaluation criteria. Considerable research has proposed different auction site assessment criteria [23, 28]. However, past research settled the assessment criteria as time equivalent. The selection while ignoring the auction site in the development of just a decade or so since, technically have a significant progress. Due to the technology cannot provide many of the services in the past; today have become the norm and basic services such as e-cash flow. Thus the assessment criteria changed a lot over time different, and time equivalent assessment criteria selection methods do not seem to apply on this topic. This study summarized the assessment criteria proposed in the literature, the weight fuzzy time model was used to sort and filter out the study required evaluation criteria.

After the completion of the study to select the auction site assessment criteria, followed by assessment criteria to establish auction website operating performance questionnaire. The questionnaire topics linguistic variables in the fuzzy method were used to express the vagueness of evaluators' semantics. Through the questionnaire, the importance of the evaluation criteria and site assessment criteria performance were evaluated by the users of the auction site. The questionnaire results through Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to sort the Website total performance. This method not only can provide the auction site operators and managers to understand their performance and competitive ability, can also provide the user to select a service with excellent performance in auction sites.

2. Research Method

According to the purpose of this study, literature and information collection and sorting, the main database is Taiwan master's and doctoral thesis. In this study, a total of 127 master's and doctoral thesis from the Nation Digital Library of Theses and Dissertation in Taiwan database (http://etds.ncl.edu.tw/theabs/index.html 2013) [27] in screening studies auction site service performance, distribution of papers published time interval from January 1998 to December 2012. Replace the expert advice with literature, the purpose is overcome the expert advice on the acquisition and aggregation is not easy, while reducing the cost of the assessment tasks. In this study, 127 papers as 127 experts. To each article we will analyze service performance evaluation method with the auction site and integration in order to obtain important assessment criteria.

2.1. Obtained the Evaluation Criteria of Auction Site

Network auction has been just the trade form coming out in development in recent ten years; the user is at the stage of break-in to this kind of transaction formally. So, with the progress of relevant science and technology and gradual progress of time, the user, to the performance that the auction website shows, concerned angle and proportion are being produced and changed constantly. Base on the performance of user's service for auction website varies with gradual progress of time greatly; the turnover auctioned adds a new line of consumer's consciousness with all increasing on day too. While the literature is put in order, we find though the time block that relevant literature are issued is not big, but service performance that consumers mind has some changes every year.

In this study, the concept and calculation method of to fuzzy time weight method was applied to obtain 25 auction sites service performance assessment criteria. The process is as follows:

The analysis referenced Papers ranged from 1998 to 2012 in this study, and triangular fuzzy numbers were used to create fuzzy time weight membership function, as Figure 1:

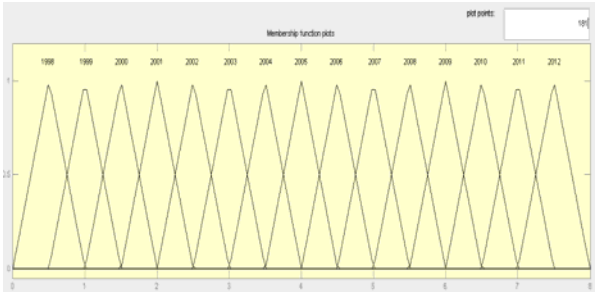

Figure 1. Time Weight Membership Function of Assessment Criteria

Then, the numbers of occurrences in accordance with the assessment criteria as well as time weight to be calculated and screening steps are as follows:

Step 1: Obtain the fuzzy time weight of each criterion.

The fuzzy time weight $t\tilde{w}_j$ of assessment criterion j:

$$t\tilde{w}_j = (tl_{ij}, tm_{ij}, tu_{ij}), i = 1998,1999,...,2012 \quad (1)$$

$$tl_{ij} = \frac{\sum_i (l_{ij} \times T_{ij})}{T_j^*}$$
$$tm_{ij} = \frac{\sum_i (m_{ij} \times T_{ij})}{T_j^*} \quad (2)$$
$$tu_{ij} = \frac{\sum_i (u_{ij} \times T_{ij})}{T_j^*}$$

Where T_{ij} is the number of criterion j occurrences in the year i thesis

T^* is the total number of criterion j occurrences in the all thesis

Step 2: Defuzzification for all assessment criteria

The purpose is to convert the fuzzy time weight of each criterion into a single accurate numerical tw_j, then the priority of each evaluation criteria can be obtained.

$$tw_j = \frac{tl_{ij} + tm_{ij} + tu_{ij}}{3} * \theta, i = 1998,1999,...2012 \quad (3)$$

θ is the weight of relationship

After the above steps, we can obtain the 25 assessment criteria in 5 cognitive domains for auction sites [1, 2, 5, 8, 12, 13, 27], as Table 1:

Table 1. The Assessment Criteria

Item	Cognitive domains	Assessment criteria
C1	Website Design	Correctness
C2		Informative
C3		Visibility
C4		Entertaining
C5	Ease of Operation	System stability
C6		Goods browsing speed
C7		Performance search engine
C8		Learning and tips
C9	Website Promotion	Auction type diversification
C10		The number of members
C11		Community features
C12	Customer Service	Arbitration trading disputes ability
C13		Timely response services provide
C14		Internationalization
C15		A complete path of communication
C16		Transaction insurance
C17		Customized
C18		Payment diversification
C19		Diversification of goods delivery
C20	Security Trading Mechanism	Reliability of member credit evaluation system
C21		Reliability of goods
C22		The establishment of the blacklist
C23		The security of the cash flow
C24		Logistics security
C25		Data confidentiality

2.2. Site Users Determine the Criteria Weight to Obtained the Evaluation Criteria of Auction Site

In this study, 25 assessment criteria as a basis for the design of the questionnaire, the survey object are auction site users. The purpose was to evaluate the service performance of two major auction sites of Taiwan. The questionnaire is divided into two main parts: The first part is a measure of the attention of users for the assessment criteria and the second part is the satisfaction of user for the performance of auction site on the criteria. By the returned questionnaires, the application of fuzzy theory to get the auction site assessment criteria weights, and then integrate the users' assessed value of the two major auction sites. Finally, the service performance of the auction site's ranking order and the details were obtained by TOPSIS method. The detailed steps are as follows:

Step 1: Determining the importance of the evaluation criteria of semantic variable and fuzzy numbers

Each site user through Likert scale with different linguistic variables to express the degree of importance of each evaluation criteria, as Figure 2.

Step 2: Obtain the fuzzy weight of each assessment criteria

Through the following formula to integrate the value of important degree of n assessment criteria with m evaluators, then obtain the fuzzy weight $\tilde{w}_j$, of j evaluation criteria.

$$\tilde{w}_j = (l_j, m_j, u_j),\ j = 1,2,...,n \tag{4}$$

$$\begin{aligned} l_j &= \underset{i}{Min}\{l_{ij}\},\ i = 1,2,..m \\ m_j &= \left(\prod_{i=1}^{m} m_{ij}\right)^{1/m},\ i = 1,2,...,m \\ u_j &= \underset{i}{Max}\{u_{ij}\},\ i = 1,2,...,m \end{aligned} \tag{5}$$

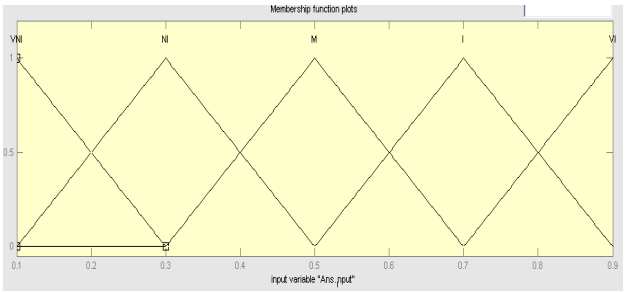

Figure 2. The Membership Function of "Importance of Assessment Criteria"

Step 3: The Defuzzification of Fuzzy Weights of Assessment Criteria

Its main purpose is to change the fuzzy weight of 25 assessment criteria into a clear single number value (Ofj) ,it can learn importance degree and priority of each assessment criterion, and often the fuzzy method to melt of the opinion includes ' the maxima-minimum set method ', ' the greatest average law ' and ' center law ', among them it is the simple and most easy method to calculate too that it is the most general that center law is and is adopted, so, this research utilizes center law to change the fuzzy weight of n assessment criteria.

In this study, the center of gravity method is applied to conversion the fuzzy weight of 25 assessment criteria into a single value (ofj)

$$of_j = \frac{l_j + m_j + u_j}{3},\ j = 1,2,...,n \tag{6}$$

2.3. Integrated Assessed Value on the Auction Website of Evaluators

Service performance of k auction site (At,t=1,2,…,k) appraisal by m assessor, and the auction site service performance were decided by calculating performance of n criteria Cj(j=1,2,…,n). As follows:

Step1：Measure the satisfaction of evaluators on each assessment criterion obtained by Likert scale as Figure 3.

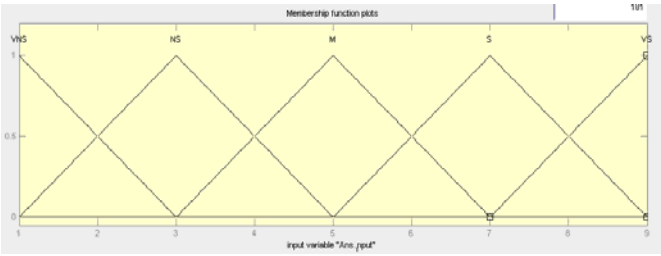

Figure 3. The Membership Function of “Satisfaction of Assessment Criteria”

Step 2：Integrated the satisfaction of assessment indicators in different auction sites $\tilde{P}_{tj}^{\ i} = \left(l_{tj}^{\ i}, m_{tj}^{\ i}, u_{tj}^{\ i}\right)$ (i=1~m, j=1~n, t=1~k) represented by m evaluators, which means performance of At on criterion Cj.

$$\tilde{X}_{tj} = \left(l_{tj}, m_{tj}, u_{tj}\right) \tag{7}$$

$$\begin{aligned} l_{tj} &= \underset{i}{Min}\left\{l_{tj}^{i}\right\}, i = 1,2,...m \\ m_{tj} &= \left(\prod_{i=1}^{m} m_{tj}^{i}\right)^{1/m}, i = 1,2,...,m \\ u_{tj} &= \underset{i}{Max}\left\{u_{tj}^{i}\right\}, i = 1,2,...,m \end{aligned} \tag{8}$$

2.4. Applied TOPSIS Method to Evaluate the Performance of Auction Site

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) were mainly used for solving the decision problem of many criteria and its basic idea lies in defining and solving positive ideal solution and negative ideal solution. First, so-called and ideal to solve, mean, and take the place of select scheme benefit most heavy or cost minimum criterion value. On the contrary, shoulder ideal solving minimally for benefit or heaviest criterion value of cost, that is to say this method purpose lies in looking for a best scheme, and scheme this distance ' positive ideal solution ' to close most, from ' negative ideal solution ' most far.

According to the concept of TOPSIS, we can define the fuzzy positive ideal solution and fuzzy negative ideal solution [21]. Then we obtain the triangular fuzzy number distance of fuzzy decision matrix to lead the distance of each auction site is the ideal solution and negative ideal solution. Finally, the common performance indicators (OPI) values are sorting to identify the best auction site. The operation steps are as follows:

Step 1：Establish fuzzy evaluation matrix and weight matrix

$$\tilde{D} = \left[x_{tj}\right]_{k\times n}, \quad t = 1,2,...,k \quad , j = 1,2,...,n \tag{9}$$

$$\tilde{W} = \left[w_{j}\right]_{1\times n}, \quad j = 1,2,...,n \tag{10}$$

Where $\tilde{x}_{tj}$ is represent the fuzzy weight of each criterion and $\tilde{w}_{j}$ represents the integrated fuzzy performance value of each criterion.

Step 2: Regularization of fuzzy assessment matrix

In order to objectively compare the assessment criteria, it's necessary to regularize the original matrix $\tilde{r}_{tj}$ is normalized assessment value and $\tilde{R} = \left[\tilde{r}_{tj}\right]_{k\times n}$ is normalized fuzzy evaluation matrix.

$$\tilde{r}_{tj} = \left(\frac{l_{tj}}{u_j^+}, \frac{m_{tj}}{u_j^+}, \frac{u_{tj}}{u_j^+}\right), \quad j \in B \tag{11}$$

$$u_j^+ = \max_t u_{tj} \quad if \quad j \in B$$

Step 3: To construct regularized fuzzy decision weights matrix

The fuzzy weight matrix $\tilde{V}$ is the normalized fuzzy evaluation matrix $\tilde{R}$ multiplied by its corresponding weight matrix $\tilde{w}$.

$$\tilde{V} = \left[\tilde{v}_{tj}\right]_{k\times n}, \quad t = 1,2,...., k, \quad j = 1,2,...., n \tag{12}$$

$$\tilde{v}_{tj} = \tilde{r}_{tj} \otimes \tilde{w}_j \tag{13}$$

Step 4: Determine the positive and negative ideal solution

The study calculated the positive and negative ideal solution as Jiang's method [22]; we define positive and negative ideal solution as follows:

$$\tilde{v}_j^+ = \sigma_{\min d\left(\tilde{v}_{tj}, \tilde{v}_j^{+*}\right)} \left\{\tilde{v}_{tj}, \quad t = 1,2,...k\right\}, \quad j = 1,2,...n \tag{14}$$

$$\tilde{v}_j^- = \sigma_{\min d\left(\tilde{v}_{tj}, \tilde{v}_j^{-*}\right)} \left\{\tilde{v}_{tj}, \quad t = 1,2,...k\right\}, \quad j = 1,2,...n \tag{15}$$

The ideal solution that is the auction site which has minimum distance between $\tilde{v}_{tj}$ and $\tilde{v}_j^{+*}$ on criterion j, then the $\tilde{v}_{tj}$ is positive ideal solution $\tilde{v}_j^+$.

Step 5: Calculation distance of the positive and negative ideal solution

Calculation distance of assessment criteria of auction site and their corresponding positive and negative ideal solution $\tilde{v}_j^+$, and $\tilde{v}_j^{-*}$

$$d_t^+ = \sum_{j=1}^{n} d\left(\tilde{v}_{tj}, v_j^+\right), \quad t = 1,2,... k \tag{16}$$

$$d_t^- = \sum_{j=1}^{n} d\left(\tilde{v}_{tj}, v_j^-\right), \quad t = 1,2,... k \tag{17}$$

Step 6: Calculation and sorting service performance indicators (OPI) of the auction site

Performance index value (OPI) is the distance d_t^- of the assessment criteria and the corresponding negative ideal solution as part of the molecule; the higher the value d_t^- means more closely the positive ideal solution.

$$OPI_t = \frac{d_t^-}{d_t^+ + d_t^-} \quad t = 1,2,...., k \tag{18}$$

3. Case study and Analysis

Collecting and sorting through the literature compiled 25 auction sites evaluation criteria of service performance, and these evaluation criteria had designed in questionnaire. In this

study, survey 100 site users by questionnaires and effective sample were 95%. The degree of importance of the two major auction sites contained 25 service performance assessment criteria assessed by 95 evaluators, and evaluation of the actual use of the site for the satisfaction of the criteria. Then we use the fuzzy theory and TOPSIS method to calculate the common performance indicators of two major auction sites, and finally we obtained the pros and cons of the level of service performance on two major auction sites. The data analysis procedure is as follows:

Step 1: Establish fuzzy evaluation matrix and weight matrix

According to the formula (4) to (6) obtained the 25 evaluation criteria fuzzy weight and then get the defuzzification matrix of 25 evaluation criteria. Then using the formula (7) to (8) obtained the fuzzy assessed value of the two major auction sites in each criterion of all evaluators. As Table 2.

Table 2. The Fuzzy Assessed Value of the Auction Site

Assessment Criteria	Fuzzy Weight	Defuzzification Value
C1	0.3,0.7826,0.9	0.6609
C2	0.3,0.7712,0.9	0.6571
C3	0.3,0.8001,0.9	0.6667
C4	0.1,0.5878,0.9	0.5293
C5	0.3,0.8398,0.9	0.68
C6	0.3,0.7292,0.9	0.6431
C7	0.3,0.8061,0.9	0.6687
C8	0.1,0.7017,0.9	0.5672
C9	0.1,0.6337,0.9	0.6337
C10	0.1,0.6143,0.9	0.6143
C11	0.1,0.5094,0.9	0.5095
C12	0.1,0.7836,0.9	0.7837
C13	0.3,0.7186,0.9	0.7186
C14	0.1,0.5282,0.9	0.5094
C15	0.1,0.7398,0.9	0.5799
C16	0.1,0.7918,0.9	0.5973
C17	0.1,0.6483,0.9	0.5494
C18	0.3,0.7577,0.9	0.6526
C19	0.3,0.7379,0.9	0.646
C20	0.3,0.8288,0.9	0.6763
C21	0.1,0.8214,0.9	0.6072
C22	0.3,0.8204,0.9	0.6735
C23	0.3,0.8636,0.9	0.6879
C24	0.5,0.8025,0.9	0.7342
C25	0.5,0.8649,0.9	0.755

Table 3. Positive and Negative Ideal Solution Fuzzy Number of each Assessment Criterion

Assessment Criteria	$\tilde{v}_j^+$	$\tilde{v}_j^-$
C1	0.0333,0.59255,0.9	0.0333,0.46089,0.9
C2	0.0333,0.56108,0.9	0.0333,0.46175,0.9
C3	0.0333,0.57696,0.9	0.0333,0.46976,0.9
C4	0.0111,0.36832,0.9	0.0111,0.31441,0.9
C5	0.0333,0.62,0.9	0.0333,0.52855,0.9
C6	0.0333,0.49786,0.9	0.0333,0.39805,0.9
C7	0.0333,0.55187,0.9	0.0333,0.48320,0.9
C8	0.0111,0.51882,0.9	0.0111,0.42304,0.9
C9	0.0111,0.46234,0.9	0.0111,0.40127,0.9
C10	0.0333,0.5111,0.9	0.0111,0.38676,0.9
C11	0.0111,0.33614,0.9	0.0111,0.27037,0.9
C12	0.0111,0.50132,0.9	0.0111,0.27307,0.9
C13	0.0333,0.52824,0.9	0.0333,0.42764,0.9
C14	0.0111,0.34144,0.9	0.0111,0.29143,0.9
C15	0.0111,0.50943,0.9	0.0111,0.45747,0.9
C16	0.0111,0.48799,0.9	0.0111,0.41971,0.9
C17	0.0111,0.35904,0.9	0.0111,0.30418,0.9
C18	0.0999,0.57017,0.9	0.0333,0.49861,0.9
C19	0.0333,0.53036,0.9	0.0333,0.46145,0.9
C20	0.0333,0.68941,0.9	0.0333,0.50918,0.9
C21	0.0111,0.60899,0.9	0.0111,0.50053,0.9
C22	0.0333,0.51011,0.9	0.0333,0.45518,0.9
C23	0.0333,0.67148,0.9	0.0333,0.56257,0.9
C24	0.0555,0.57963,0.9	0.0555,0.47884,0.9
C25	0.0555,0.430902,0.9	0.0555,0.41164,0.9

Step 2: To construct regularized fuzzy decision weights matrix by formula (12) and (13).

Step 3: TO determine the positive and negative ideal solution by OPI value. The results shown in table 3, the two auction site have a great gap on the service performance.

Step 4: Calculating the distance of the positive and negative ideal solution, the results are summarized in Table 4.

Step 5: Calculating and sorting service performance indicators value (OPI) of auction site, as shown in Table 5.

Table 4. The Total Distance of the Positive and Negative Ideal Solution of Auction Website

Auction Website	d_i^+	d_i^-
YAHOO	0	1.2396
RETURN	1.2396	0

Table 5. The Order of the Service Performance Indicators (OPI)

Auction Website	OPI	Order
YAHOO	1	1
RETURN	0	2

4. Conclusion and Discoussion

Auction website performance evaluation contains multiple evaluation criteria and multi-rater and the assessment criteria have inherent fuzziness, that cause it is difficult to accurately quantify. Therefore, assessment results are often difficult to integrate and verify its objectivity. Especially when the assessment subject have different manifestations in different dimensions, the overall performance judgment will become very difficult. In addition, the need assessment criteria established by expert advice, often takes a long time and a lot of cost. In the small and medium-scale assessment of the program is more difficult to implement.

In this study, literature mining is applied to replace the expert advice because it is difficult to obtain expert advice. And we were combining with the fuzzy time weight concept, to put forward a new concept of literature mining model. We propose a new fuzzy multiple criteria decision making with time weight (FMCDMTW) model. This model can take into account the time dependencies of the evaluation criteria and provide relatively low-cost way. The concept of the fuzzy time weight is fairly simple, but it is in line with the actual situation. We think that we can further discuss the feasibility of application in other areas

As the results of this study, the service performance of Yahoo is better than the Return auction. This result can be seen during the fuzzy weight calculation. The results of the assessment from the user's point of view, decision aids for decision-makers should have considerable reference and auxiliary value.

Performance evaluation of the auction sites was as example, this study combines the fuzzy theory and technology of this stage is widely used, the aim is to propose a fuzzy multi-attribute decision making generic model. When the assessment objects with multi-attribute need multi-evaluators to assess and evaluate, especially when the object is content with fuzzy features that is uncertain to quantify. The proposed model can effectively evaluate and sort of program performance, and to apply the results of this assessment decision support.

From the above analysis that the order of the service performance of the two auction sites: Yahoo is superior to the Return, the results showed significant differences that the users' satisfaction on the two major auction site service performance.

Assess the performance of the auction website for the example, this research has combined several kinds of employing extensively and simple and feasible fuzzy theory technology of the present stage, aim at proposing a common procedure of fuzzy multiple criteria decision, as assess target with many attribute, need many people assess and assess content have fuzzy characteristic, the way that this research institute puts forward is suitable for the using of assessment of this kind of problem. The approach can assess the target to further arrange in an order clearly while combining TOPSIS technology, especially when assessing the target and arranging in an order numerously and difficultly. Choose such as large attribute makes policy regardless of the scheme, if assess the criterion and persons who assess can be confirmed, can use the way that this research institute put forward to assess and arrange in an order the track case performance.

In addition, this research regards literature as experts; put forward the brand-new literature review concept. Screen the way to assess criterion with the fuzzy time weight, when it is difficult for the expert to investigate expensively and live, can offer the comparatively economic substituting scheme not losing its objectivity. The weight concept of fuzzy time, though the concept is quite simple, we think we can further probe into the application feasibility in other fields in this kind of concept.

References

[1] Angehrn A. European Management Journal. *Designing mature internet business strategies: the ICDT model*. 1997; 15(4): 361-364.
[2] Athanassopoulos AD. Journal of Business Research. *Customer satisfaction cures to support market segmentation and explain switching behavior.* 2000; 47:191-207.

[3] Beam CM. Auctioning and bidding in electronic commerce: the on-line auction. University of California, Berkeley; 1999.
[4] Bellman RE, Zadeh LA. Management Science. *Decision-Making in a fuzzy environment.* 1970; 17(4): 141-164.
[5] Cardozo RN. Journal of Marketing Research. *An experimental study of customer effort, expectation & satisfaction*. 1965; 2: 244-249.
[6] Chen SJ, Hwang CL. Fuzzy Multiple Attribute Decision Making: Methods and Applications, Berlin Heidelberg. *Springer-Verlag*. 1992.
[7] Chunqiao Tan. Expert Systems with Applications. *A multi-criteria interval-valued intuitionistic fuzzy group decision making with Choquet integral-based TOPSIS.* 2011; 38(4): 3023-3033.
[8] Corbitt BJ, Theerasak Thanasankit, Han Yi. Electronic commerce research and application. *Trust and e-commerce: a study of consumer perceptions.* 2003; 2(3): 203-211.
[9] Chow G, Heaver TD, Henriksson LE. International Journal of Physical Distribution & Logistics Management. *Logistics performance: definition and measurement.* 1994; 24(1):17-28.
[10] Day RL. Advances in Consumer Research. *Modeling choices among alternative responses to dissatisfaction.* 1984; 11:244-249.
[11] Ding-Hong Peng, Chang-Yuan Gao, Zhi-Fang Gao. Applied Mathematical Modeling. *Generalized hesitant fuzzy synergetic weighted distance measures and their application to multiple criteria decision-making.* 2013; 37(8):5837-5850.
[12] Fornell C. *A* National Customer Satisfaction Barometer: The Swedish Experience. *Journal of Marketing.* 1992; 56(1): 6-21.
[13] Gina C O'Conner, Bob O'Keefe. View the web as a marketplace: the case of small companies. *Decision Support Systems.* 1997; 21: 171-183.
[14] Grant WH, Schlesinger LA. Realize your customers' Full Profit Potential. *Harvard Business Review.* 1995; 73(4): 59-72.
[15] Heck EV, Ribbers PM. Experiences with Electronic Auctions in the Dutch Flower Industry. Electronic Markets. 1997; 7(4): 29-34.
[16] Hoffman DL, Novak TP. Marketing in hypermedia computer-mediated environments: conceptual foundations. *Journal of Marketing.* 1996; 60(3): 50-68.
[17] Hongbin Sun, Chunjun Zhou. A Self-Learning Network Reconfiguration Using Fuzzy Preferences Multi-Objective Approach. *TELKOMNIKA.* 2013; Vol. 11(2): 710-716.
[18] Hsu HM, Chen CT. Aggregation of Fuzzy Opinions, under Group Decision Making. *Fuzzy Sets and Systems.* 1996; 79(3): 279-285.
[19] Hung YH, Huang ML, Chen KS. *Service quality evaluation by service quality performance matrix*. Total Quality Management. 2003; 14(1): 79-89.
[20] Hwang CL, Yoon, Kwangsun. Multiple attribute decision making: Methods and Applications. New York: Springer-Verlag. 1981: 38-68.
[21] Intter CD, Larcker DF. Are non-financial measures leading indicators of financial performance? An analysis of customer satisfaction. *Journal of Accounting Research*. 1988; 36: 1-35.
[22] Jiang Jiang, Yu-wang Chen, Ying-wu Chen, Ke-wei Yang. TOPSIS with fuzzy belief structure for group belief multiple criteria decision making. *Expert Systems with Applications* 2011; 38(8): 9400-9406.
[23] Kaufmann A, Gupta MM. Introduction to Fuzzy Arithmetic: Theory and Applications. New York: Van Nostrand. 1991: 201-255.
[24] Kim S, Stoel L.. *Dimensional hierarchy of retail website quality*. Information and Management 2004; 41(5): 620-632.
[25] Klir GJ, Yuan B. Fuzzy Sets and Fuzzy Logic – Theory and Application. New Jersey: Prentice-Hall Inc. 1995: 35-88.
[26] Na Chen, Shaopu Yang, Cunzhi Pan. Application of Fault Detection based on Hybrid Intelligent Methods*. TELKOMNIKA.* 2012; 10(8): 2020-2026.
[27] Nation Digital Library of Theses and Dissertation in Taiwan, Data base available at http://etds.ncl.edu.tw/theabs/index.html accessed 31 January 2013
[28] Zhiping Chen, Wei Yang. *A new multiple criteria decision making method based on intuitionistic fuzzy information.* Expert Systems with Applications. 2012; 39(4): 4328-4334.