World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:4, No:5, 2010

Evaluating Service Quality of Online Auction by Fuzzy MCDM

Wei-Hsuan Lee, Chien-Hua Wang, and Chin-Tzong Pang

Abstract—This paper applies fuzzy set theory to evaluate the service quality of online auction. Service quality is a composition of various criteria. Among them many intangible attributes are difficult to measure. This characteristic introduces the obstacles for respondent in replying to the survey. So as to overcome this problem, we invite fuzzy set theory into the measurement of performance. By using AHP in obtaining criteria and TOPSIS in ranking, we found the most concerned dimension of service quality is Transaction Safety Mechanism and the least is Charge Item. Regarding to the most concerned attributes are information security, accuracy and information.

Keywords—AHP, Fuzzy set theory, TOPSIS, Online auction, Service quality

I. Introduction

THE online auction business model has developed and thrived in a short time and become one of the most outstanding electronic commerce models. Some of the online auction sites are Yahoo, Ruten, Taobao, Eachnet, and eBay, to name but a few. The success factors of auction sites are considered to be many. One of the main factors is that sellers and purchasers can have direct contacts with no time and geographical constraints. In this kind of setting, not only can sellers sell items for relatively high prices, but purchasers can transact satisfactorily [11]. In other words, both parties acquire best mutual economical benefits. Another factor is that auction sites bring intense network flow since bidders have to check newest prices offered by sellers while updating their bids when necessary. This intensity becomes the niche itself as well. Owing to these advantages, there is no doubt why auction business model is instantaneously popular and prosperous nowadays. With a plethora of auction sites, the good service quality offered turns out to be the key reason affecting consumer behavior and consumer loyalty. Thus, learning to evaluate the quality and upgrade it are our focus here.

In order to measure the service quality, we tend to adopt the well-known SERVQUAL model [14] to investigate, extract, adjust, and evaluate information found in both production business and service business. However, in our study [22], the SERVQUAL model modified by Parasuraman, Zeithaml and Berry (PZB) is not an appropriate management tool for on-line business at all. Another thing to note here is that advanced technology contributes to increasing demands from consumers. And using single evaluative criterion to measure appears to be inadequate, not to mention different evaluators obtain subjective views and different results. In short, there are much uncertainty and fuzziness in this kind of analysis and the problems mentioned above are just too hard to tackle.

To solve the problems we enumerated earlier, we use Multiple Criteria Decision Making Method (MCDM) to assist decision makers in quality and quantification evaluation. We then choose a group to demonstrate an alternative to assess and then measure pros and cons and decide execute priorities [4].

Additionally, the Analytic Hierarchy Process (AHP) [17] and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [8] proposed in this method are widely used and proved successful in great many fields [24].

As for the cognitive uncertainty generated from users' subjective judgments, we then use the fuzzy set theory [26] to deal with linguistic variables and linguistic values [25, 27-29]. We are convinced this will empower decision makers in decision analysis.

This paper approaches the problem by applying MCDM in the hope of assessing auction sites with good service quality. Through the presentation of literature reviews, we then will use the AHP to establish a hierarchical structure of auction sites based on the goal, the dimension and the criteria for evaluation. We also will implement experts' opinions and consider measured weights.

Lastly, we will take TOPSIS to generate a list of rating order on auction sites service quality so that e-sellers can take this model as their managerial strategy in the business.

II. Literature reviews and research methods

A. Service quality

SERVQUAL was proposed by PZB in 1988, the most evaluative tool in the service quality domain. In SERVUAL, there are five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. In the service quality evaluation of information service industry [6,13] there are still some problems about the evaluative tools by the five dimensions of SERVQUAL despite many papers based on them have been proposed. The most important problem is whether it could be measured by the five dimensions. Xie et al.[22], for example, utilized the five dimensions to estimate the service quality of search websites and found they could not be used to

Wei-Hsuan Lee is with the Department of Information Management, Yuan Ze University, Taoyuan, 32003, Taiwan, ROC (e-mail: whlee@saturn.yzu.edu.tw).

Chien-Hua Wang is with the Department of Information Management, Yuan Ze University, Taoyuan, 32003, Taiwan, ROC (e-mail: thuck@saturn.yzu.edu.tw).

Chin-Tzong Pang is with the Department of Information Management, Yuan Ze University, Taoyuan, 32003, Taiwan, ROC (e-mail: imctpang@saturn.yzu.edu.tw).

describe the users' needs. Besides, some papers suggest that they have to be modified to adapt for different information service industries. Kettinger & Lee[10], for example, deleted the dimension of Tangibles in their research. Pitt et al.[15] separated Tangibles and Empathy into another two dimensions through factor analysis. As to other related literatures were shown as Table 1. Through these literatures in Table 1, establish this paper hierarchy framework by AHP method.

B. Analytic hierarchy process (AHP)

The AHP proposed by Satty [17] has been a tool at the hands of decision makers and researchers, and it is one of the most widely used MCDM tools. Its validity is based on the thousand of actual applications in which the AHP results were accepted and used by the decision makers [20, 23]. It provides a methodology to calibrate the numeric scale for the measurement of quantitative as well as qualitative performance. It involves decomposing a complex decision into a hierarchy with goal at levels and sublevels of the hierarchy. Therefore, the AHP can be considered to be both a descriptive and a prescriptive model of decision making. Additionally, one of the major advantages of AHP is that it calculates the inconsistency criteria as a ratio of the decision maker's inconsistency and randomly generated criteria. Although a higher value of inconsistency criteria requires reevaluation of pairwise comparisons, decisions obtained in certain cases could also be taken as the best alternative [16].

C. Fuzzy set theory

Some terms of expression, such as "not very clear" and "very likely", can be heard very often in daily life, and their commonality is that they are more or less tainted with uncertainty. With different daily decision-making problems of diverse intensity, the results can be misleading if the fuzziness of human decision-making is not taken into account. However, since Zadeh [26] was developed fuzzy set theory, and Bellman and Zadeh [2] described the decision-making method in fuzzy environments, an increasing number of studies have dealt with uncertain fuzzy problems by applying fuzzy set theory. With such an idea in mind, this paper includes fuzzy decision-making theory, considering the possible fuzzy subjective judgment of the evaluators during online auction service quality evaluation. This method for establishing online auction service quality can be made more objective. The applications of fuzzy set theory in this paper are elaborated as follows.

1) Fuzzy number: Fuzzy numbers are a fuzzy subset of real numbers, and they represent the expansion of the idea of confidence interval. According to the definition made by Dubois and Prade [5], those numbers that can satisfy these three requirements will then be called fuzzy numbers, and the following is the explanation for the features and calculation of the triangular fuzzy number.

For example, the expression "online auction service quality" represents a linguistic variable in the context of this paper. It may take on values such as "fair", the membership functions of expression values can be indicated by triangular fuzzy numbers (TFN) $\mu_A \times (X) = (L, M, U)$within the scale range of $0-100$,

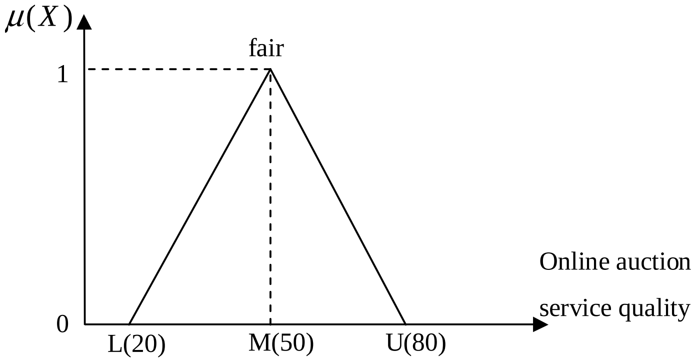

Fig. 1: Triangular membership function of fuzzy number

the evaluators can subjectively assume their personal range of the linguistic variable $\mu_A(fair) = (20, 50, 80)$, which are as shown in Fig. 1. Comparing with the traditional investigative research, the importance degree for the serving attribute used 5-points of Likert Scale, applying TFN that the utilization of linguistic variables is rather widespread at the present time, and the linguistic values found in this paper are primarily used to assess the linguistic ratings given by the evaluators.

According to the nature of TFN and the extension principle put forward by Zadeh [26], the algebraic calculation of the triangular fuzzy number.

Addition of triangular fuzzy numbers $\oplus$:

$$(L_1,M_1,U_1) \oplus (L_2,M_2,U_2) = (L_1 + L_2, M_1 + M_2, U_1 + U_2). \quad (1)$$

Multiplication of a triangular fuzzy numbers $\otimes$:

(a)

$$(L_1,M_1,U_1) \otimes (L_2,M_2,U_2) = (L_1 L_2, M_1 M_2, U_1 U_2). \quad (2)$$

(b) Any real number k,

$$K \otimes \mu_A(X) = (K,K,K) \otimes (L,M,U) = (KL, KM, KU). \quad (3)$$

Subtraction of a triangular fuzzy numbers $\ominus$:

$$(L_1,M_1,U_1) \ominus (L_2,M_2,U_2) = (L_1 - L_2, M_1 - M_2, U_1 - U_2). \quad (4)$$

2) Linguistic variable: According to Zadeh [27-29], it is very difficult for conventional quantification to express reasonable those situation that are overtly complex or hard to define. Thus, notion of a linguistic variable is necessary in such situations. A linguistic variable is a variable with lingual expression as its values. One example for the linguistic variable is "online auction service quality". It means service quality that customer experiences during the consumption by the online auction. The possible values for this variable could be "very dissatisfied", "not satisfied", "fair", "satisfied" or "very dissatisfied". The evaluators were asked to conduct their judgments, and each linguistic variable can be indicated by a triangular fuzzy number within the scale range of $0-100$. Also the evaluators can subjectively assume their personal range of the linguistic variable.

TABLE I: Service quality measurement in prior studies

Study	Context	Dimensions
Shohreh and Christine [19]	Service quality of online travel agencies	Content & purpose, accessibility, navigation, design & presentation, responsiveness background, personalization & customization
Barnes and Vidgen [1]	Website quality of online shopping	Tangibles, reliability, responsiveness, assurance, empathy
Loiacono et al. [12]	Website quality of website usage	Information quality, tailored communications, trust, response time, ease of understanding, intuitive operations, visual appeal, innovativeness, emotional appeal, consistent image, on-line completeness, relative advantage
Wolfinbarger and Gilly [21]	E-service quality of B2C commerce	Efficiency, system availability, fulfillment, privacy, responsiveness, compensation, contact
Shih T. L. [18]	Decision making factors of C2C online auction	Transaction safety mechanism, website promotion, operation convenience, charge item, customer service
Hsieh T. Y. [7]	E-service quality of online auction	Efficiency, system availability, privacy/ security, compensation, personalization, reputation, playfulness

3) The overall valuation of the fuzzy judgment: The overall valuation of the fuzzy judgment copes with the fact that every respondent perceives differently toward every criterion. The subsequent valuation of the linguistic variable certainly varies among individuals. We integrate the overall fuzzy judgment by Eq. (5).

$$E_{ij} = (1/m) \otimes (E_{ij}^1 \oplus E_{ij}^2 \oplus \ldots \oplus E_{ij}^m) \tag{5}$$

where $\otimes$ is the multiplication of fuzzy numbers, $\oplus$ the add operation of fuzzy numbers, E_{ij} the overall average performance valuation of online auction i under criterion j over m assessors.

E_{ij} as a fuzzy number can be represented by triangular membership function as Eq. (6) shows

$$E_{ij} = (LE_{ij}, ME_{ij}, UE_{ij}). \tag{6}$$

Buckley [3] stated that the three end points can be calculate by the method proposed as:

$$LE_{ij} = \left(\sum_{k=1}^{m} LE_{ij}^k\right)/m, \tag{7}$$

$$ME_{ij} = \left(\sum_{k=1}^{m} ME_{ij}^k\right)/m, \tag{8}$$

$$UE_{ij} = \left(\sum_{k=1}^{m} UE_{ij}^k\right)/m. \tag{9}$$

4) Defuzzification: The result of fuzzy synthetic decision of each alternative is a fuzzy number. Therefore, it is necessary that the nonfuzzy ranking method for fuzzy numbers be employed during service quality comparison for each alternative. In other words, Defuzzification is a technique to convert the fuzzy number into crisp real numbers, and the procedure of defuzzification is to locate the Best Nonfuzzy Performance (BNP) value. There are several available methods serve this purpose. Mean-of-Maximum, Center-of-Area, and α-cut Method[30] are the most common approaches. This paper utilizes the Center-of-Area method due to its simplicity and doesn't require analyst's personal judgment.

The defuzzified value of fuzzy number can be ottained from Eq. (10)

$$\begin{aligned} BNP_{ij} = [&(UE_{ij} - LE_{ij}) \\ &+ (ME_{ij} - LE_{ij})]/3 \\ &+ LE_{ij}, \qquad 1 \leq i, j \leq m. \end{aligned} \tag{10}$$

We use the fuzzy approach on vague objects such as the satisfaction of online auction service quality. Because the evaluation is resulted from the views of linguistic variables of different evaluators, it will have the differences and ambiguity. Further, the traditional evaluation method required the evaluators to make the choice among "very dissatisfied", "not satisfied", "fair", "satisfied", and "very satisfied". That would force the evaluators to do an over-high or over-low appraisal. Consequently, it would influence the accuracy of the evaluation. As a result, in this paper, we use the membership function to measure the linguistic variables to achieve the better result, which can fairly and exactly reflect the different service quality of each online auction. Therefore, the fuzzy logic and results of the fuzzy approach are better than the traditional statistic approach.

5) TOPSIS: TOPSIS was proposed by Hwang and Yoon [8], based on the concept that the chosen/improved alternatives should be the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS) for solving a MCDM problem. Thus, the best alternative should not only be the shortest distance away from PIS, but also should be largest distance away from NIS. In short, PIS is composed of all the criteria with the best values attainable, whereas NIS is made up of all the criteria with the worst values attainable. The general step-by-step procedure using the TOPSIS is briefly listed as follows.

Step 1: Establish the original performance matrix. The structure of the performance matrix (X) is shown as Eq. (11), where x_{ij} represents the performance value of alterative i to criterion j.

$$X = [x_{ij}], \quad 1 \leq i \leq m \text{ and } 1 \leq j \leq n. \tag{11}$$

Step 2: Calculate the normalized performance matrix. The purposed of normalizing the performance is to remove the units of matrix entries by converting the performance values to a range between 0 and 1. the normalized value (r_{ij}) is calculated as

$$r_{ij} = \frac{|x_{ij} - x_j^-|}{|x_j^* - x_j^-|}, \quad 1 \leq i \leq m \text{ and } 1 \leq j \leq n. \quad (12)$$

Step 3: Compute the weighted normalized performance matrix. Considering that there is a difference in the importance of the criteria, the normalized performance matrix has to be weighted as illustrated in Eq. (13), where w_j is the weight of the criterion j, and v_{ij} is the weighted normalized performance matrix. The summation of w_j is equal to 1.

$$v_{ij} = w_j \times r_{ij}. \quad (13)$$

Step 4: Determine PIS and NIS. PIS and NIS (v_j^+ and v_j^-) are elaborated as Eqs. (14) and (15) respectively, where $1 \leq j \leq n$, C_b is associated with the benefit criteria, C_c is associated with the cost criteria.

$$v_j^+ = \begin{cases} \max\limits_{1\leq i\leq n} v_{ij} & \text{for } j \in C_b, \\ \min\limits_{1\leq i\leq n} v_{ij} & \text{for } j \in C_c, \end{cases} \quad (14)$$

$$v_j^- = \begin{cases} \min\limits_{1\leq i\leq n} v_{ij} & \text{for } j \in C_b, \\ \max\limits_{1\leq i\leq n} v_{ij} & \text{for } j \in C_c. \end{cases} \quad (15)$$

Step 5: Calculate the separation measure. The distance can be calculated by the n-dimensional Euclidean distance. The separations of each alternative from PIS (S_i^+) and NIS (S_i^-) are defined as Eqs. (16) and (17) respectively.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2}, \quad 1 \leq i \leq m, \quad (16)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}, \quad 1 \leq i \leq m. \quad (17)$$

Step 6: Calculate the relative closeness (similarity) to PIS. The relative closeness of alternative A_i with respect to A^+ can be expressed as Eq. (18), where $0 \leq RC_i^+ \leq 1$ that is, an alternative i is closer to A^+ as RC_i^+ approaches to 1.

$$RC_i^+ = \frac{S_i^-}{S_i^+ + S_i^-}, \quad 1 \leq i \leq m. \quad (18)$$

Step 7: Rank the preference order. A set of alternatives can be preference ranked according to the descending order of RC_i^+.

III. Empirical study of online auction

A. Survey

As a result of online action market growth in Taiwan, slotting and bidding process is in now increasingly common for online auction. InsightXplorer[9] indicated that have 80% people buy items and more than 40% people sale items. The online auction doesn't need physical transaction place. As long as you can internet, which can carry out proceed transaction any time or any places. Besides, buyers are not equal to traders, anyone would like to sell items which could find buyer by online auction.

Four domestic online auctions, which provide relative auction services including Website Design, Operation Convenience, Website Promotion, Charge Item, Customer Service and Transaction Safety Mechanism, are selected to identify the critical criteria of evaluating e-service quality for online auction. The above online auctions were the most natural choices due to consumer frequent uses. Among 168 surveys, 64 were invalid for a return rate of 38%. The demographic statistics indicate that 72% respondents belong to the age group of 21-30 years, and 85% received at least college education.

The questionnaire of service quality evaluation mainly was composed of two parts: questions for evaluating the relative importance of criteria and online auction performance corresponding to each criterion. AHP method was used in obtaining the relative weight of criteria. As for the performance corresponding to criteria of every online auction, we used linguistic expression to measure the expressed performance. In order to establish the membership function associated with each linguistic expression term, we asked respondents to specify the range from 1 to 100 corresponding to linguistic term ”very dissatisfied”, ”dissatisfied”, ”fair”, ”satisfied” and ”very satisfied”. These score were later pooled to calibrate the membership functions.

We picked four major online auctions as the objects of this empirical study. Online auction A, the oldest online auction in Taiwan, with more than 8 years history, gains the highest market share by nearly 66%. The online auction B, although is only 30% currently, is rapidly growing because of using be free. Online auction C, the biggest online auction in China, gains the highest market share by nearly 84% because of using be free. The online auction D, is nearly 8% currently in China, but is still growing now.

B. The weights of evaluation criteria

Fig. 2 shows the relative weights of the six dimensions of service quality, which are obtained by applying AHP. The weights for each of the dimension are: Website Design was 0.2105, Operation Convenience was 0.1533, Website Promotion was 0.1268, Charge Item was 0.0905, Customer Service was 0.01842 and Transaction Safety Mechanism was 0.2347. The weights describe in general that consumers concern the most was Transaction Safety Mechanism, the second was Website Design, and unconcern the most was Charge Item.

Ranked by the weights, the top eight evaluation criteria are that information security was 0.0712, accuracy was 0.0704, information was 0.0599, item listing of reliability was 0.0586, system stabilization was 0.0579, providing prompt service of transaction information was 0.0557, cash and logistics flow the safety was 0.0577 and usage was 0.0527. Apparently, consumers concern how well they are treated and served during auction process. Information security and accuracy tend to allow consumers to feel relieved when using online auction.

The ranks of criteria also reflect the reason that information security or transaction safety mechanism is always concerned by consumers, particularly for the item listed of reliability usually occur differently with actual items, and feedback of

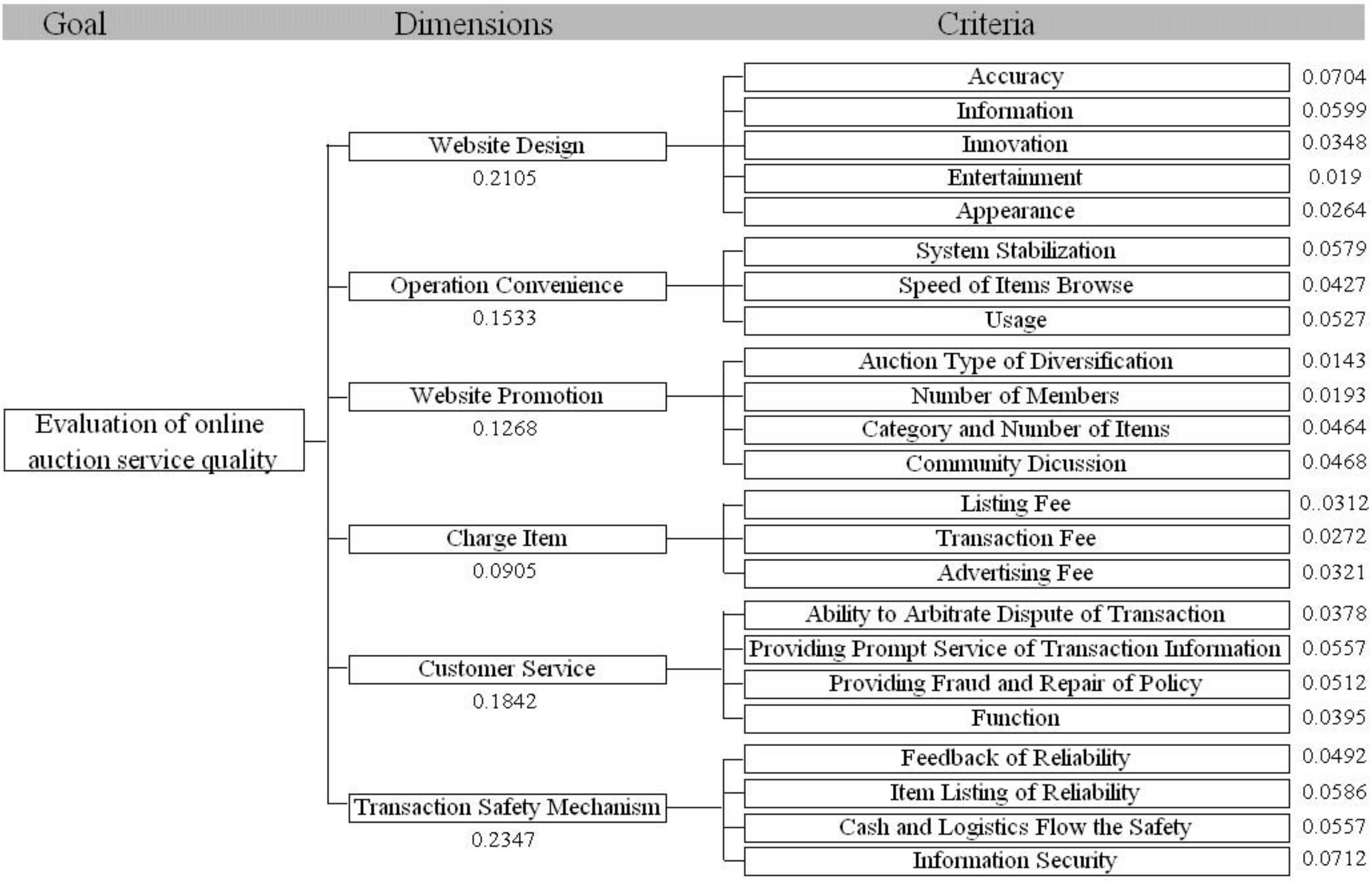

Fig. 2: Weights of the twenty-three criteria

TABLE II: Fuzzy performance measures of online auctions

Service quality evaluation criteria	Online auction A	Online auction B	Online auction C	Online auction D
Accuracy	50.13 62.12 73.15	63.11 69.49 73.49	70.75 72.58 79.06	65.52 69.50 73.34
Information	58.45 66.45 72.45	53.49 64.13 74.26	55.51 66.78 73.15	54.86 65.51 76.72
Innovation	50.76 63.45 76.12	58.55 67.18 70.76	62.15 70.51 73.51	57.15 65.51 74.82
Entertainment	58.55 67.11 70.11	73.68 79.46 84.19	49.26 58.85 68.14	60.96 68.04 76.73
Appearance	62.43 74.19 80.11	55.42 64.86 82.56	65.80 73.41 79.19	61.22 68.18 75.11
System Stabilization	57.46 65.19 74.19	55.98 65.18 72.53	53.49 58.19 66.18	76.19 79.52 81.25
Speed of Items Browse	54.38 65.43 72.12	64.53 73.85 80.12	75.59 79.95 82.57	52.16 63.49 72.50
Usage	69.58 75.84 81.08	69.63 75.45 81.37	54.38 65.43 73.50	54.82 58.71 62.83
Auction Type of Diversification	71.44 75.34 80.88	70.14 75.86 80.04	75.85 78.56 82.14	70.75 72.52 79.05
Number of Members	54.51 63.31 70.12	55.18 63.45 74.51	59.88 67.75 72.18	51.85 60.77 68.29
Category and Number of Items	73.68 79.46 84.19	52.11 60.74 79.51	52.54 65.81 78.04	68.85 74.58 81.52
Community Discussion	72.49 79.37 83.16	62.21 67.34 70.85	65.76 68.51 71.01	65.11 68.51 78.29
Listing Fee	63.16 71.57 76.19	62.49 74.49 79.86	70.49 75.86 80.51	72.98 77.55 83.19
Transaction Fee	61.21 67.37 74.45	70.20 73.86 79.15	64.85 71.08 79.55	59.82 63.08 69.72
Advertising Fee	60.14 68.16 73.14	62.27 73.19 79.85	62.49 75.65 83.33	62.48 69.37 74.19
Ability to Arbitrate Dispute of Transaction	57.46 65.19 74.19	70.71 74.86 78.43	54.11 63.85 71.66	58.55 67.11 72.56
Providing Prompt Service of Transaction Information	48.35 57.54 67.09	46.01 55.57 65.02	60.75 65.22 73.49	51.09 61.82 70.05
Providing Fraud and Repair of Policy	51.33 62.35 76.46	55.00 61.73 67.46	45.46 55.15 64.56	53.00 62.64 71.31
Function	48.54 57.32 67.53	44.45 53.86 62.95	52.14 58.81 65.51	39.25 48.52 59.82
Feedback of Reliability	57.98 70.35 76.48	53.00 62.76 71.34	57.19 65.80 71.56	56.28 66.82 74.19
Item Listing of Reliability	54.42 65.47 73.55	53.08 61.86 71.05	59.69 65.07 73.12	55.87 65.04 71.43
Cash and Logistics Flow the Safety	51.60 61.33 70.51	55.35 65.05 73.67	57.98 70.35 76.48	45.86 54.18 64.08
Information Security	74.47 77.56 80.46	72.18 79.44 88.22	74.25 78.61 83.44	63.82 71.77 79.28

TABLE III: Overall performance measures of online auctions

Service quality evaluation criteria	Online auction A	Online auction B	Online auction C	Online auction D
Accuracy	61.80	68.70	74.13[a]	69.45
Information	65.78[a]	63.96	65.15	65.70
Innovation	63.44	65.50	68.72[a]	65.83
Entertainment	65.26	79.11[a]	58.75	68.58
Appearance	72.24	67.61	72.80[a]	68.17
System Stabilization	65.61	64.56	59.29	78.99[a]
Speed of Items Browse	63.98	72.83	79.37[a]	62.72
Usage	75.50[a]	75.48	64.44	58.79
Auction Type of Diversification	75.89	75.35	78.85[a]	74.11
Number of Members	62.65	64.38	66.60[a]	60.30
Category and Number of Items	79.11[a]	64.12	65.46	74.98
Community Discussion	78.34[a]	66.80	68.43	70.64
Listing Fee	70.31[a]	72.28	75.62	77.91
Transaction Fee	67.68	74.40	71.83	64.21[a]
Advertising Fee	67.15[a]	71.77	73.82	68.68
Ability to Arbitrate Dispute of Transaction	65.61	74.67[a]	63.21	66.07
Providing Prompt Service of Transaction Information	57.66	55.53	66.49[a]	60.99
Providing Fraud and Repair of Policy	63.38[a]	61.40	55.06	62.32
Function	57.80	53.75	58.82[a]	49.20
Feedback of Reliability	68.27[a]	62.37	64.85	65.76
Item Listing of Reliability	64.48	62.00	65.96[a]	64.11
Cash and Logistics Flow the Safety	61.15	64.69	68.27[a]	54.71
Information Security	77.50	79.95[a]	78.77	71.62

[a] The best performance out of the four online auctions.

TABLE IV: Overall performance measures of online auctions[b]

Rank	Online auction	Similarity to ideal solution
1	B	0.5322
2	C	0.5263
3	A	0.4745
4	D	0.4454

[b] The final ranking results shown that online auction B is the best of the four online auctions in terms of service quality, followed by online auction C, A, D, respectively.

reliability is the substantial need for consumers. Nowadays, cash and logistics flow safety becomes a public distress due to several serious fraud events occur in recent years. Consumers are more aware that transaction safety mechanism is the essential requirement of any online auction.

C. Performance measure of service quality

From the criteria weights obtained from AHP (Fig. 2.), the performance of alternatives corresponding to each evaluation criterion evaluated by respondents is measured as fuzzy number with triangular membership function. The performance of each respondent is then calculated by Eqs. (5)-(9) to obtain the overall performance measure for each online auction. Table 2 lists the fuzzy performance measure for the four online auctions.

After obtaining the performance measure in terms of fuzzy number, we defuzzify the fuzzy numbers into crisp numbers in order to conduct TOPSIS ranking procedure. We used Center-of-Area method (as Eq.(10)) to defuzzify the fuzzy numbers, which are as shown in Table 3.

In general overview, online auction C performs better in website design and transaction safety mechanism attributes, while online auction A outperforms in web promotion and charge item, online auction B has better in information security with transaction safety and online auction D has better in system stabilization with operation convenience.

D. Final ranking

In this paper, we use AHP method in obtaining criteria weight, and use TFN to assess the linguistic ratings given by the evaluators. By using TOPSIS, we aggregate the weight of evaluation criteria and the matrix of performance to evaluate the four online auctions service quality, the service quality evaluation results can be seen in Table 4.

IV. Conclusions

In the past, all auction sites all targeted at providing best service quality. It is not hard for us to see some tangible service approaches, such as the functionality of website designs, abundant information values, customer service skills . . . etc, dominating the market. However, we tend to neglect the fact that good service lies in whether consumers' expectations have been met, and we are aware that this can never be solved by looking at one single layer. This paper aims to look at this problem in every angle and determines to offer a solution with multiple criteria of evaluation.

In investigating both concerns, we establish the procedures for identifying the most important attributes of service qualify for four online auctions base on these attributes. The evaluation procedures consist of the following steps:

1) Identify the evaluation criteria for online auction service quality;
2) Assess the average important of each criterion by Analytic Hierarchical Process over all the respondents;
3) Represent the performance assessment of online auctions for each criterion by fuzz numbers, which explicitly attempts to accurately capture the real preference of assessors;
4) Use TOPSIS as the main device in ranking the service quality of the four online auctions.

The result indicates that "transaction safety mechanism" outweighs all other dimensions. This shows that consumers care for the Feedback of Reliability, Cash and Logistics Flow the Safety and Information Security by any online auction sites. Therefore, in order to encourage more buyers, every online auction site has to handle these concerns carefully. The second rank following "transaction safety mechanism" is "website design", which implies adequate information included on one auction site will influence buyers' willingness to visit that site again. Thus, paying attention to designs is also another success factor. As for the attributes, "Information Security" and "Accuracy" are all prominent. All these figures demonstrate consumers' privacy concern and accurate transaction wishes.

The final ranking results shown that online auction B is the best of the four online auctions in terms of service quality, followed by online action C, A and D. It is interesting to note that assessment of the service quality is not strongly reflected in the market share. This suggests that even though consumer service has a vital impact on electronic commerce, other factors such as H&S fees also play the important role. Furthermore, consumer perception of service quality is also dynamic and sensitive to some major incidents such transaction fraud or payment failure, which are not necessarily promptly reflected in the market share.

Finally, this paper emphasizes on the method application, and the alternative method we adopted may not all-inclusively meet each standard. Therefore, we believe the Multi-Objective Programming Method can be applied in the near future to withdraw fairer and more accurate principle.

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