International Journal of Mechatronics, Electrical and Computer Technology (IJMEC)
ISSN: 2305-0543 (Online), ISSN: 2411-6173 (Print)
Vol. 12 (46), Oct. 2022, pp. 5301-5306

IEEE Nigeria Consultants' Network (CN)

Evaluation of Business-to-Consumer E-Commerce Websites

Mahboubeh Afzali
Department of Electrical and Computer Engineering.
Graduate University of Advanced Technology,
Kerman, Iran
afzali.mahboubeh@gmail.com, m.afzali@kgut.ac.ir
Tel Number: +34- 33776611

***Abstract*—with the rapid growth of e-commerce websites, business-to-consumer (B2C) e-commerce has been considered as an effective retailing channel. However, customer satisfaction and trustable e-commerce website have been the main challenges which should be addressed through evaluation of e-commerce website. For the aim of evaluation, different criteria should be taken into consideration leading to multi criteria decision making problem. The result of evaluation determines the perceived service quality of B2C ecommerce websites as the result of the difference between the expected service level (which expectation is derived from information obtained before the service experience) and perceived service level (the actual). In this paper, an Analytical Hierarchy Process (AHP) method is developed to assign importance degree for each. Moreover, sensitivity analysis is performed to rank the influence levels of main criterion. The results show that navigation, protection of customer credit card information and accuracy of delivered goods are the most effective criteria on e-commerce website evaluation.**

Keywords*—Evaluation of e-commerce websites, Multi-criteria decision-making, B2C e-commerce websites, AHP, sensitivity analysis

I. INTRODUCTION

E-commerce is considered as a new paradigm of business model with advent of recent development in Internet [1] for consumers as well as companies to buy products and services in this way [2]. E-commerce has facilitated traditional business way through provision of less taxes and rents, reduction of business transactions cost, enhancing sustainable business [3,4]. E-commerce model is classified in five groups including business-to-business, business-to-consumer (B2C), consumer-to-consumer, consumer-to-business and business-to-government [5,6]. B2C which is the initial business model provides directly purchase products and services for customers. The advantages of B2C are extensive development [7,8] and influential, retailing channel for ordinary consumers [4, 5]. A lot of B2C e-commerce websites are developed to increase sales volumes.

The rapid growth of B2C information-technology-based commercial model has caused several challenges regarding the continuous customer's satisfaction and trust for B2C e-commerce websites [9,10,11]. Thus, it is necessary to evaluate B2C e-commerce websites to define the contribution of each effective criteria on online customer satisfaction and to select the most satisfactory website.

Since different conflicting criteria are effective on evaluation e-commerce website, this challenge is considered as multi criteria decision making (MCDM). For example, data envelopment analysis (DEA) approach is applied to evaluate the importance degree of B2C ecommerce. It is noted that numeric weights are not necessary to be assigned in DEA [12]. Fuzzy AHP is applied to evaluate the B2C e-commerce strategy. Thus, fuzzy theory is integrated with AHP to fulfill the B2C e-commerce manager's needs [13].

However, most of the previous papers focus on evaluation of B2C e-commerce website based on quality of service viewpoints without considering difference between expected and perceived service levels [14, 15, 16]. In fact, the difference between the expected service level, which implies obtained information with respect to service experience, and perceived service level [17] plays important role in customer satisfaction and trustable of e-commerce websites. Therefore, some papers focus on SERVQUAL method to measure the gap between customer expectations of service quality (in terms of five dimensions such as tangibles, reliability, responsiveness, assurance, empathy) and their service perceptions. In [18], the authors utilized the evaluation criteria of SERVQUAL in assessing only by the perceived service level without referring the gap between the expected service level and the perceived service level. However, it is noticed that the core of SERVQUAL should be modified according to e-commerce technique because it was developed for traditional commerce. Therefore, E-SERVQUAL (E-S-QUAL), developed by [19] evaluate electronic service quality in the e-commerce environment because E-S-QUAL reflects important criteria from the customer's point of view. A fuzzy hierarchical TOPSIS has been proposed based on E-S-QUAL for evaluating e-commerce [20]. Although E-S-QUAL can be a competitive and effective tool for assessing B2C e-commerce website service quality, it should be adjusted based on Iranian website and customers expectations.

In this paper, evaluation of B2C e-commerce websites framework was proposed based on integrating AHP method and E-S-QUAL to consider the gap between the expected and perceived service level. Furthermore, according to Iranian

Article History:
Received Date: Jun.10, 2022, Accepted Date: Aug. 02, 2022, Available Online: Oct. 01, 2022

website and infrastructure of communication, sub-criteria are modified through interviewing with experts. Finally, sensitive analysis is conducted to rank the influence levels of main criterion.

The rest of paper is organized as follow: B2C e-commerce criteria and AHP method is explained in Section 2. Moreover, the analysis of results is presented in section 3. The sensitivity analysis is also provided in this section. Finally, conclusion is drawn in section 4.

II. Methodology

A. B2C e-commerce Criteria

For the aim of B2C e-commerce evaluation, the main impact factors should be extracted through studying the past studies. Since complexity and competition has been raised in the e-commerce context, more than one dimension should be taken for B2C e-commerce to satisfy customers' requirements resulting in enhancing competitiveness.

In order to determine the successful delivery of the high quality service, we should define the customer expectations. Therefore, customers' viewpoints play important role in evaluation of service quality to improve customer satisfaction and service quality [21]. SERVQUAL has been applied to assess service quality of websites to fill the gap between customer expectations and perceptions. SERVQUAL model proposed in 1985, focused on 10 main service quality criteria including reliability; responsiveness; competence; access; courtesy; communication; credibility; security; understanding/knowing the customer; tangibles [22]. SERVQUAL criteria [19]. Moreover WebQual 4.0 [23] including website usability, information quality and service interaction is not sufficient measurement due to ignoring provided quality of service. Besides, E-S-QUAL including efficiency, fulfillment, availability and privacy and 22 sub-criteria are considered for the evaluation of B2C e-commerce website. However, these metrics are too many for e-commerce website. Therefore, 4 main criteria and 16 sub criteria are extracted according to 5 experts for Iranian e-commerce websites.

The extracted criteria for the aim of Iranian B2C e-commerce evaluation as follows

Efficiency implies the ease and speed of accessing and using the site which consists of search process, navigation, speed of transaction complementation, speed of loading of first page, organization of information and website.

Privacy expresses degree of being safe and protecting customer information which is composed of protection of customers' web behaviors information, degree of sharing of customer information with other sites, protection of credit card customer information.

Fulfillment focuses on degree of fulfillment to site promises regarding order delivery and item availability which involves lead time, order tracking, availability of goods, customer service, and accuracy.

System availability is related to technical functioning aspects of the site which includes being always access for business, rate of failure, rate of freezing a page.

B. AHP Method

The process of hierarchical analysis is one of the most famous multi-criteria decision making techniques developed by [24]. This method can be useful when the decision-making action is faced with several options and decision indicators. Indicators can be quantitative or qualitative. The basis of this method includes steps to AHP pairwise comparisons. The process of ranking and prioritizing options is as follows.

Hierarchical construction: At this stage, the problem is defined and the purpose of the decision is drawn in a hierarchical manner from the factors and elements that make up the decision. The process of hierarchical analysis requires breaking the decision problem with several hierarchical indicators of levels. For this purpose, a decision tree is used, which consists of four levels: The first level includes the overall purpose of the decision. At the second level are the general criteria on which decisions are made. At the third level, the sub-criteria are placed, and at the last level, the decision options are presented, which are the indicators for evaluating tourist attractions. Figure 1 shows the hierarchical structure of prioritization of tourist attraction evaluation indicators.

Paired comparisons: At this stage, experts make comparisons between decision criteria and sub-criteria and determine their score relative to each other. These comparisons are based on values from 1 to 9. The preference of one option or factor over itself is equal to one, so the principle of the inverse of one factor over another and the preference of one over one factor or option over itself are the two main properties of the binary comparative matrix in a criterion or option. These two properties make it possible to answer $n(n-1)/2$ questions to compare AHP.

Calculate relative weight: Different methods are used to calculate the relative weight [24]. Among these methods, the special vector method has been used.

The final weight of the options: In a hierarchical process, the final weight of the options is obtained from the sum of the product of the importance of the criteria in the weight of the options, taking into account all the "priority vectors" that lead to a "hierarchical composition principle". To do this, judgments at all levels of the hierarchy will be used

Calculate data validity (incompatibility rate): As mentioned earlier, it is a mechanism by which the response validity (I.R.) mismatch rate is measured based on the AHP judgment of the respondents to pairwise comparisons. The results are acceptable in the case of being the value of consistency ratio below 0.1.

III. Methodology

A. B2C e-commerce Criteria

A hieratical process is formed, for the evaluation system of e-commerce websites based on Fig. 1. This hierarchal process composed of three levels including top level, containing the aim of this research, the second level, including the main criteria, and the third level, involving the sub-criteria, to provide the evaluation.

IEEE Office - SEET Complex, Federal University of Technology, Owerri, Nigeria, https://aeuso.org
EISSN: 2305-0543, PISSN: 2411-6173

It is noted that Expert Choice 11 software is chosen to assign ralative importance degree of criteria to each other. At first, the comparison matrix for the relative importance degree of the main criteria to each other should be formed to calculate relative weight of main criteria as well as consistency ratio.

Therefore, Fig. 2. is obtained for the importance degree of each main criteria. As it is shown, efficieny contribute as the most effective metric on the e-commerce website evaluation. Moreover, privacy and fulfillment playe the same degree and ranked as the second effective criteria with 0.28. Finally, availability is the last important metric with degree of 0.127. Moreover, the consistencr ratio is gotten 0.01 which shows acceptable results.

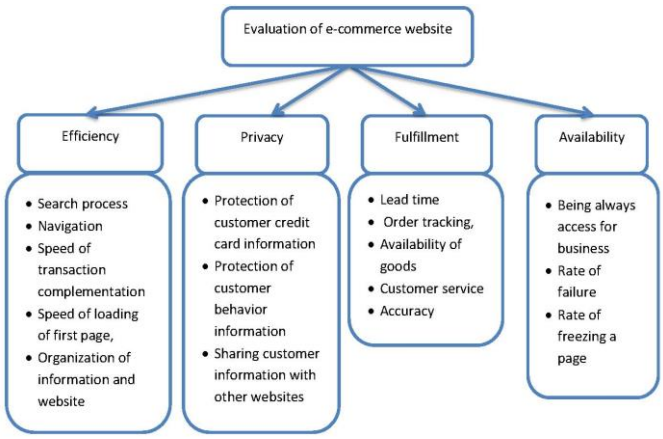

Fig. 1. Hirarical structure of evaluation of e-commerce website

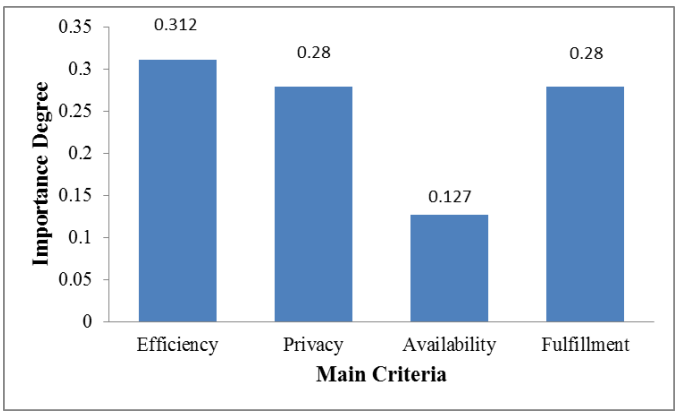

Fig. 2. Importance degree of main criteria with respect to e-commerce website evaluation

Furthermore, the relative importance degree of each sub-criteria with respect to main criteria are gotten. To do so, the relative comparison of sub-criteria significance to each other with respect to each main criterion is compted to get the weight of each sub-criteria.

Hence, weight of efficiency criteria is shown in Fig. 3. The consistency ratio is calculated as 0.02. Among efficiency criteria, navigation gets the highest rank of 0.438. Furthermore, organization of information and website is the second metric affecting on website assessment. However, quick transaction complementation is the last effective metric of efficiency criteria. Similar to efficiency, weight of privacy, fulfillment and availability subcriteria are demonstrated in Fig. 4., Fig. 5. and Fig. 6., respectively with respect to their own main criteria. Furthermore, consistency ratio is computed 0.04, 0.05 and 0.02 for privacy, fulfillment and availability which mean the results are acceptable.

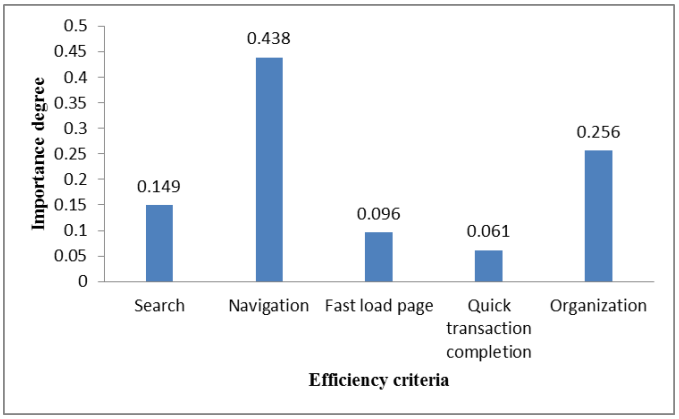

Fig. 3. Importance degree of efficiency criteria

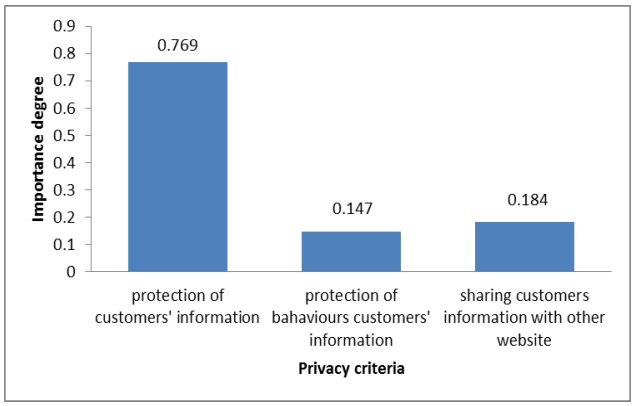

Fig. 4. Importance degree of Privacy criteria

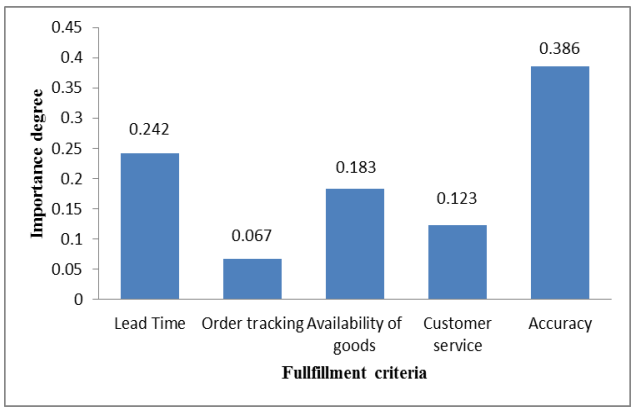

Fig. 5. Importance degree of fulfillment criteria

IEEE Office - SEET Complex, Federal University of Technology, Owerri, Nigeria, https://aeuso.org
EISSN: 2305-0543, PISSN: 2411-6173

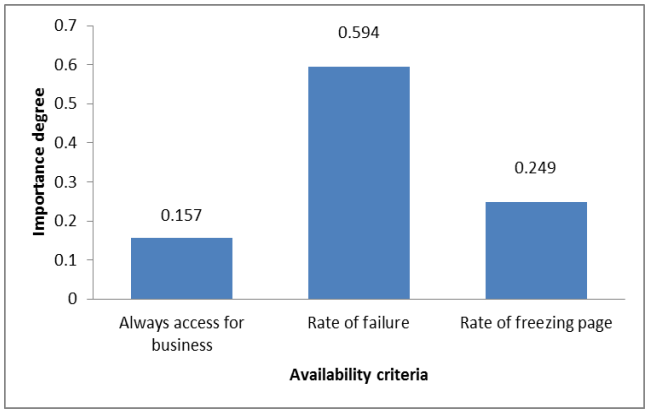

Fig. 6. Importance degree of availability criteria

Finally, the significant degree of sub-criteria are computed agoording to the multiplication of the weight of their own main metric by the sub-metric.Therefore, Table. II. is obtained to show the computed weight for all metrics.

According to Table. II. navigation contributes as the most effective metric on B2C e-commerce website valuation. Then protection of customers credit card information and accuracy of delivered goods are ranked as the second effective metric on e-commerce website assessment. Lead time with dgree of 0.88 ia the third effecticient metric. However, availability criteria have the less effect on e-commerce website evaluation. The obtained results confirms the result of which was conducted on Korea[20].

TABLE II. WEIGHT OF SUBCRITERIA FOR E-COMMERCE WEBSITE EVALUATION

Efficiency criteria	Weight
Search	0.053
Navigation	0.155
Fast load page	0.034
Quick transaction completion	0.021
Organization	0.090
Privacy criteria	
Protection of credit card customers information	0.139
Protection of customers behavior information	0.027
Sharing customers information with other website	0.015
Fulfillment criteria	
Lead time	0.087
Order tracking	0.024
Availability of goods	0.066
Customer service	0.044
Accuracy	0.139
Availability criteria	
Always access for business	0.017
Rate of failure	0.063
Rate of freezing a page	0.027

Finally, the sensitive result is conducted and the results are illustrated in Fig. 7. As seen in Fig. 7, navigation as the most effective metric on efficiency, accuracy on fulfillment, rate of failure on availability, and protection on customer's credit card information on privacy are considered. Moreover, navigation affects highly as the overall metric on e-commerce website evaluation.

IEEE Office - SEET Complex, Federal University of Technology, Owerri, Nigeria, https://aeuso.org
EISSN: 2305-0543, PISSN: 2411-6173

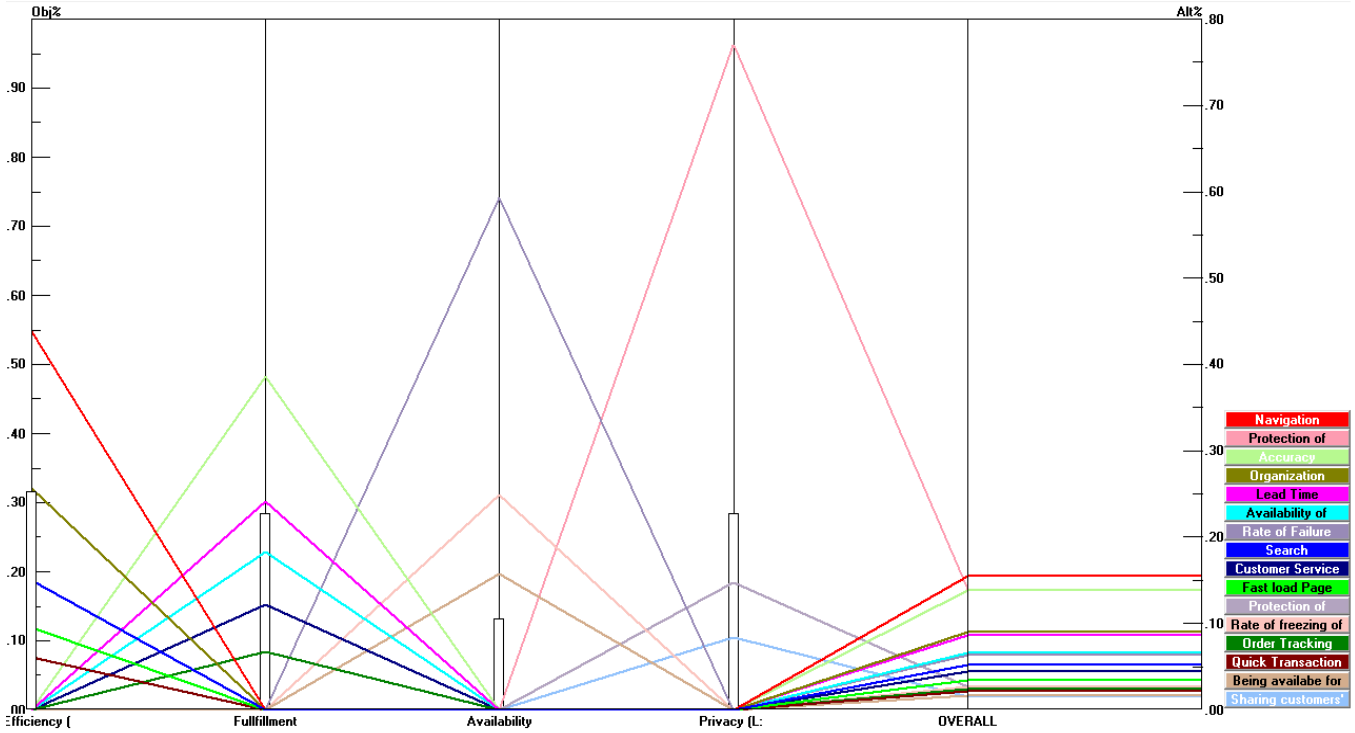

Fig. 7. Sensitivity analysis

IV. Conclusion

In this study, an efficient method integrating E-S-QUAL and AHP method is proposed for evaluation of B2C e-commerce websites. At first, the E-S-QUAL evaluation criteria are identified and modified based on infrastructre of communication as well as experts' opinions. Then, assessment scores are calculated to define the importance weights of main and their sub-criteria. The results show that navigation from efficiency criteria, protection of customer credit card information and accuracy of delivered goods are taken into consideration for the B2C e-commerce evaluation. However, quick transaction complementation, and sharing customer behavior information have the less effect on website assessment. Lastly, a sensitivity analysis is conducted to validate the results. This framework could be developed as the weight of efficient to allocate the rank of different e-commerce website in the future studies.

References

[1] X. Yu, S. Guo, J. Guo, X. Huang, Rank B2C e-commerce websites in e-alliance based on AHP and fuzzy TOPSIS, Expert Systems with Applications, vol. 38, pp. 3550-3557, 2011.

[2] W.-Y. Chiu, G.-H. Tzeng, H.-L. Li, A new hybrid MCDM model combining DANP with VIKOR to improve e-store business, Knowledge-Based Systems, vol. 37, pp. 48-61, 2013.

[3] K. Liu, X. Luo, L. Zhang, Evaluation of China's B2C e-commerce website: An analysis of factors that influence online buying decision, International Journal of Multimedia and Ubiquitous Engineering. vol. 11 (3), pp. 143-156, 2016.

[4] A.R. Ashraf, N. Thongpapanl, S. Spyropoulou, The connection and disconnection between e-commerce businesses and their customers: Exploring the role of engagement, perceived usefulness, and perceived ease-of-use, Electronic Commerce Research and Applications. vol. 20, pp. 69-86, 2016.

[5] J.-H. Wu, T.-L. Hisa, Analysis of E-commerce innovation and impact: a hypercube model, Electronic Commerce Research and Applications, vol. 3, pp. 389-404, 2005.

[6] X.B. Yu, S.S. Guo, J. Guo, X.R. Huang, Rank B2C e-commerce websites in e-alliance based on AHP and fuzzy TOPSIS, Expert Systems with Applications. vol. 38 (4), pp. 3550-3557, 2011.

[7] G. Acampora, D. Alghazzawi, H. Hagras, A. Vitiello, An interval type-2 fuzzy logic based framework for reputation management in Peer-to-Peer e-commerce, Information Sciences. vol. 333, pp. 88-107, 2016.

[8] Q. Liu, S. Huang, L. Zhang, The influence of information cascades on online purchase behaviors of search and experience products, Electronic Commerce Research. vol. 16 (4),) pp. 53-580, 2016.

[9] C.-C. Sun, G.T. Lin, Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites, Expert Systems with Applications, vol. 36, pp. 11764-11771, 2009.

[10] J. Santos, E-service quality: a model of virtual service quality dimensions, Managing service quality, vol. 13, pp. 233-246, 2003.

[11] C.C. Sun, G.T.R. Lin, Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites, Expert Systems with Applications. vol. 36 (9), pp. 11764-11771, 2009.

IEEE Office - SEET Complex, Federal University of Technology, Owerri, Nigeria, https://aeuso.org
EISSN: 2305-0543, PISSN: 2411-6173

[12] H.J. Wen, B. Lim, H.L. Huang, Measuring e-commerce efficiency: a data envelopment analysis (DEA) approach, Industrial Management & Data Systems, vol. 103, pp. 703-710, 2003.

[13] Y.-C. Chiu, J.Z. Shyu, G.-H. Tzeng, Fuzzy MCDM for evaluating the e-commerce strategy, International Journal of Computer Applications in Technology, vol. 19, pp. 12-22, 2004.

[14] J. Santos, E-service quality: a model of virtual service quality dimensions, Managing service quality, 13, pp. 233-246, 2003.

[15] G.R. Heim, J.M. Field, Process drivers of e-service quality: analysis of data from an online rating site, Journal of Operations Management, vol. 25, pp. 962-984, 2007.

[16] W. Zuo, Q. Huang, C. Fan, Z. Zhang, Quality management of B2C e-commerce service based on human factors engineering, Electronic Commerce Research and Applications, vol. 12, pp. 309-320, 2013.

[17] A. Parasuraman, V.A. Zeithaml, L.L. Berry, Servqual, Journal of retailing, vol. 64, pp. 12-37, 1988.

[18] A. Awasthi, S.S. Chauhan, H. Omrani, A. Panahi, A hybrid approach based on SERVQUAL and fuzzy TOPSIS for evaluating transportation service quality, Computers & Industrial Engineering, vol. 61, pp. 637-646, 2011.

[19] A. Parasuraman, V.A. Zeithaml, A. Malhotra, ES-QUAL a multiple-item scale for assessing electronic service quality, Journal of service research, vol. 7, pp. 213-233, 2005.

[20] D. Kang, W. Jang, Y. Park, Evaluation of e-commerce websites using fuzzyhierarchical TOPSIS based on E-S-QUAL, vol. 42, pp. 53-65, 2016.

[21] J. Wu, F. Chiclana, H. Fujita, E. Herrera-Viedma, A visual interaction consensus model for social network group decision making with trust propagation, Knowledge-Based Systems. vol. 122, pp. 39-50, 2017.

[22] S. Aggarwal, A. Bishnoi, Neutrosophic trust evaluation model in B2C e-Commerce, Hybrid Soft Computing Approaches. vol. 611, pp. 405-427, 2016.

[23] E.T. Loiacono, R.T. Director-Watson, Webqual (tm): a web site quality instrument, University of Georgia, 2000.

[24] Saaty, T, L.: Decision Making With Dependence and Feedback: The Analytic Network Process." RWS Publisher, Pittsburgh, PA, 2001.

IEEE Office - SEET Complex, Federal University of Technology, Owerri, Nigeria, https://aeuso.org
EISSN: 2305-0543, PISSN: 2411-6173