

Association for Information Systems AIS Electronic Library (AISeL)

ICEB 2017 Proceedings

International Conference on Electronic Business

Winter 12-4-2017

Measuring the Quality of Financial Electronic Payment System: Combined with Fuzzy AHP and Fuzzy TOPSIS

Li-Ru Chen

National Changhua University of Education, Taiwan, chen_907@yahoo.com.tw

Kai-Hao Liu

National Changhua University of Education, Taiwan, tw98@ms51.hinet.net

Fang-Pin Lai

National Chin-Yi University of Technology, Taiwan, lion0829@gmail.com

Shao-Shiun Chang

National Changhua University of Education, Taiwan, chess1mail@gmail.com

Kou-Yi Lee

National Chin-Yi University of Technology, Taiwan, kyli@ncut.edu.tw

Follow this and additional works at: <http://aisel.aisnet.org/iceb2017>

Recommended Citation

Chen, Li-Ru; Liu, Kai-Hao; Lai, Fang-Pin; Chang, Shao-Shiun; and Lee, Kou-Yi, "Measuring the Quality of Financial Electronic Payment System: Combined with Fuzzy AHP and Fuzzy TOPSIS" (2017). *ICEB 2017 Proceedings*. 21.
<http://aisel.aisnet.org/iceb2017/21>

This material is brought to you by the International Conference on Electronic Business at AIS Electronic Library (AISeL). It has been accepted for inclusion in ICEB 2017 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Measuring the Quality of Financial Electronic Payment System: Combined with Fuzzy AHP and Fuzzy TOPSIS

Li-Ru Chen, National Changhua University of Education, Taiwan, chen_907@yahoo.com.tw

Kai-Hao Liu, National Changhua University of Education, Taiwan, tw98@ms51.hinet.net

Fang-Pin Lai*, National Chin-Yi University of Technology, Taiwan, lion0829@gmail.com

Shao-Shiun Chang, National Changhua University of Education, Taiwan, chess1mail@gmail.com

Kou-Yi Lee, National Chin-Yi University of Technology, Taiwan, kyli@ncut.edu.tw

ABSTRACT

The study aims to apply Fuzzy AHP in TOPSIS to discuss the key factors that foster the success of current third-party online payment platforms. This study organized the quality measurements into four categories and eleven sub-categories. The AHP in TOPSIS is applied to calculate the weighted averages of all categories and sub-categories to measure the quality of third-party online payment platforms. This study finds that “safety quality” is the most emphasized category, “system quality” is the second, “communication quality” is the third, and “service quality” is the least emphasized.

Keywords: Fuzzy AHP, fuzzy TOPSIS, e-payment.

*Corresponding author

INTRODUCTION

In recent years, with the development of Internet technology, financial electronic payment system is growing (Remington & Dent, 2000). Not only the online payment can solve the physical path of time and labor problems, but also can provide an environment of safe, fast and a lot of convenient advantages (Jiang, Yang, & Jun, 2013; Ponte, Carvajal-Trujillo, & Escobar-Rodríguez, 2015). At present, financial electronic payment can be largely divided into internet banking (Martins, Oliveira, & Popovič, 2014), mobile payment (Slade, Dwivedi, Piercy, & Williams, 2015) and third-party online payment (Huang, Dai, & Liang, 2014; Roy & Venkateswaran, 2014).

In addition, with the network services provided by the function more and more complex (De Groot, Alkemade, Braat, Hein, & Willemen, 2010), internet service is open to the global environment. In fact, the security issues are also worthy of attention (Aderonke, 2010). So choose the appropriate network service evaluation criteria, taking into account the subjective and objective safety factors (Kim, Tao, Shin, & Kim, 2010), should be based on the user's security level requirements (Ramos-de-Luna, Montoro-Ríos, & Liébana-Cabanillas, 2016).

Owing to past researches in online e-payment were only for the choice of single-normative style (Koulayev, Rysman, Schuh, & Stavins, 2016), but in today's online trading environment, the decision-making problem faced by the user is complex and changeable (Lei, Yayla, & Kahai, 2017). That is to say, users often faced with the choice is not a single criterion can be used to solve (Oat, 2016). But rather to consider the various assessment criteria to which the same program belongs, and make the most appropriate choice (King, O'rourke, & DeLongis, 2014). In this way, multi-criteria decision-making (MCDM) become a method often used by decision makers (Zhang, 2016). Therefore, this study will apply multi-criteria decision-making method to assist financial electronic e-payment users in a number of possible options. According to the characteristics of each attribute of each program, make each program a sort of merit, then evaluate and select the ideal solution for the user.

Overall, this study will use the ideal solution similarity to prepare the order assessment adjustment method as a network service recommendation method (Nilashi & Ibrahim, 2014). To obtain reliable network service content satisfaction with trust range (Azmi *et al.*, 2016), and then use the hierarchical analysis method to obtain the user's feedback weight (Chaudhary & Uprety, 2016). That is to say, the establishment of a trusted electronic payment network service recommendation mechanism (Dahlberg, Guo, & Ondrus, 2015)

LITERATURE REVIEW

From the literature to explore the main criteria can be divided into system quality, communication quality, service quality and safety quality (Ye, Fu, & Law, 2016; Zhou, 2014). System quality can be divided into ease of use and response speed of the two sub-criteria (Mishra & Singh, 2015; Zhou, 2014). Communication quality can be divided into accuracy, immediacy and integrity of the three sub-criteria (Yang, Lu, Chau, & Gupta, 2017; Zhou, 2013, 2014). Service quality is divided into reliability, trust, user satisfaction three sub-criteria (Zhou, 2013). Security quality can be divided into network security, system security, transaction security three sub-criteria (Leone & Adams, 2016). Financial electronic payment program; mainly divided

#

into online banking, mobile payments and third party payments (Dahlberg, Mallat, Ondrus, & Zmijewska, 2008; M. Fisher, 2013; Herzberg, 2003).

In the field of e-commerce information system success model, known as the IS model (Delone & McLean, 2003; Iivari, 2005). It consists of six variables with relevant variables. The success factor of the proposed financial trading site is through many levels of the concept (Boselli, Cesarini, Mercorio, & Mezzanica, 2015; Rana, Dwivedi, Williams, & Weerakkody, 2015). Including system quality, user satisfaction, system usage, communication quality, service quality and net benefit (Delone & McLean, 2003; Rana *et al.*, 2015). Recently, users use the "web cloud computing service" (Garrison, Wakefield, & Kim, 2015) aware of the network security measures are not tight will cause loss or adverse consequences (Forsythe & Shi, 2003; Teneyuca, 2011). In order to prevent the insecurity of online transactions (Hong & Cha, 2013), set the secure socket layer (SSL) security credentials encryption mechanism (Manakshe, Jirkar, Wakhare, & Buram, 2014). So that third-party financial electronic payment agencies to access network consumer transactions to get better protection (Murdoch & Anderson, 2014). That is the safety of quality (Merkow & Breithaupt, 2014). The measure of communication quality includes the correctness of the information (Wang, Hahn, & Sutrave, 2016). Service quality is a measure of service consumer trust, user satisfaction, service reliability (Delone & McLean, 2003; Xu, Benbasat, & Cenfetelli, 2013). System quality measures ease of use and responsiveness (Koulayev *et al.*, 2016; Zhou, 2013). Safety quality is the safety of the measurement system and the security of the transaction and the security of the network (Zheng, Zhao, & Stylianou, 2013). Communication quality is defined as the ability to quickly feedback users using system information (Heath, 2014). Service quality is defined as the user can easily operate the system (Zhou, 2013). System quality is defined as accessibility and increased user convenience (Zhou, 2014), to improve support for the system (Sabherwal, Jeyaraj, & Chowa, 2006). In addition, based on financial electronic payment under the key factors, system quality, communication quality, service quality and safety quality, will affect the consumer and consumer's satisfaction (Fang *et al.*, 2014; Sabherwal *et al.*, 2006). Therefore, the system quality, communication quality, service quality and safety quality will be the key factors that affect the quality of financial electronic payment (Ming-Yen Teoh, Choy Chong, Lin, & Wei Chua, 2013). And then assess the importance of the payment system (Liébana-Cabanillas, Sánchez-Fernández, & Muñoz-Leiva, 2014).

A certain level of elements, with its level of the elements as an assessment benchmark, perform a pairwise comparison between the hierarchy elements (Schmoltdt, Kangas, Mendoza, & Pesonen, 2013), and the comparison between the various elements (Macharis, Springael, De Brucker, & Verbeke, 2004). The basic assessment scale used for hierarchical analysis is defined by verbal judgments ranking (Aminbakhsh, Gunduz, & Sonmez, 2013; Hummel, Bridges, & IJzerman, 2014), including "equally important", "slightly important", "quite important", "extremely important" and "absolutely important". Corresponding to the resulting numerical scale (numerical judgments) for (1,3,5,7,9), and the trade-off values (2, 4, 6, 8). The meaning and description of each scale are shown in Table 1:

Table 1: Hierarchical analysis method to assess the scale of the semantic table

Evaluation scale	Definition	Description
1 or (1: 1)	Equally important	The two elements are of the same importance
3 or (3: 1)	Slightly important	Experience to judge a little tendency to like a certain factor
5 or (5: 1)	Quite important	Experience judgment tends to prefer a factor
7 or (7: 1)	Very important	The actual display is very strongly inclined to like a certain factor
9 or (9: 1)	Absolutely important	Sufficient evidence certainly definitely likes an element
2, 4, 6, 8	Adjacent scale	Need to compromise

The selection of the scale is depending on the actual situation (Meade & Presley, 2002). But not more than nine scales for the principle (Satty, 2004). Otherwise it will cause the burden of the judg (Satty, 2004). A pairwise comparison matrix A is obtained by pairwise comparing the two factors. Due to pairs of reciprocal nature, if the ratio of the factor i to j is α_{ij} , the ratio of the element i to the element j is the reciprocal of the original ratio, that is, $1 / \alpha_{ij}$. Similarly, the lower triangular part of the pairing comparison matrix A is the reciprocal of the upper triangular part.

And in the questionnaire, for each sub-criteria attribute design, to compare the way in the 1-9 scale to the decision-makers and experts in various fields to fill. According to the results obtained from the questionnaire, will be able to establish the level of the pair of comparison matrix A:

$$[A] = [\alpha_{ij}] = \begin{bmatrix} 1 & \alpha_{12} & \dots & \alpha_{1n} \\ 1/\alpha_{12} & 1 & \dots & \alpha_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\alpha_{1n} & 1/\alpha_{2n} & \dots & 1 \end{bmatrix}$$

#

After the pairwise comparison matrix $[a_{ij}]$ is established, the weight $[w_{j \times 1}]$ of each level element can be obtained. Using the eigenvalue method commonly used in numerical analysis, the eigenvector or the dominant vector is calculated, and the relative weight between the elements is obtained. The calculation process will be described as follows:
Making sub-criteria pairs of comparison matrix A, such as (1):

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\ \vdots & \vdots & \cdots & \vdots \\ w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n \end{bmatrix} \quad (1)$$

Where $a_{ij} = w_i/w_j$, w_i, w_j is the weight of sub-criteria i and j. The pairwise comparison matrix A is a positive and negative matrix, and the elements in the matrix are positive and the reciprocal characteristics are as follows: (2) and (3)

$$a_{ij} = 1/a_{ji} \quad (2)$$

$$a_{ij} = a_{ik} / a_{jk} \quad (3)$$

The vector of the sub-criterion pairs A is multiplied by the weight of each criterion as shown in (4)

$$\bar{w} = (w_1, w_2, \dots, w_n)^t \quad (4)$$

Then obtained (5) and (6) :

$$A\bar{w} = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\ \vdots & \vdots & \cdots & \vdots \\ w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n \end{bmatrix} \cdot \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} \quad (5)$$

$$n \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} \quad (6)$$

$$(A-nI)\bar{w} = 0 \quad (7)$$

Because a_{ij} is the decision maker to compare the subjective judgment given by the comparison, with the real w_i/w_j value, there must be a certain degree of difference, so $A\bar{w} = n\bar{w}$ cannot be established. Thus, Saaty suggests replacing n with the largest eigenvalue λ_{\max} in the A matrix.

$$\text{That is } A\bar{w} = \lambda_{\max}\bar{w} \quad (8)$$

$$(A - \lambda_{\max}I)\bar{w} = 0 \quad (9)$$

The maximum eigenvalue of matrix A is calculated by (9), and the maximum eigenvector is the weight of each criterion. And the maximum eigenvalue of the calculation, Saaty proposed four approximation method, which in turn the normal value of the row vector method (10) can be obtained more accurate results.

$$w_i = \frac{1}{n} \sum_j \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad i, j = 1, 2, \dots, n \quad (10)$$

In order to confirm that the decision maker can achieve consistency before and after comparison, it is necessary to carry out the consistency test, make the consistency index (CI) and the consistency ratio (CR). Check according to the decision maker, the answer to the composition of the pair of comparison matrix is consistent matrix.

The main function and purpose of the consistency indicator is to determine whether the decision maker has made a reasonable judgment in the process of decision comparison. Whether it is consistent or whether there is any contradiction, etc., in order to correct the decision to avoid making bad decisions. Resulting in weight between the elements, the calculation produces an irrational phenomenon.

Consistency verification can also be used for the entire hierarchy, because the importance of each level is different, so to test whether the entire hierarchy is consistent. Therefore, Saaty (1980) suggested that when $C.I. \leq 0.1$, for the best acceptable error, if $C.I. \leq 0.2$ is also acceptable error, the test formula (11)

$$C.I. = \frac{\lambda_{max} - n}{n - 1} \quad (11)$$

Where n: evaluates the number of sub-criteria, λ_{max} is the largest eigenvalue of matrix A. If $\lambda_{max} = n$, then the pairwise comparison matrix A has consistency. When $C.I. = 0$, that before and after the judge is completely consistent; and $C.I. > 0$, it means that before and after the error is not consistent; $C.I. < 0$, said before and after the judge is not consistent, but still within the acceptable range.

However, when the problem becomes more complex, the elements to be compared will become more, and the order of the pairs of matrices will increase, so it will be more difficult to maintain consistency. Satty also proposes a Random Index (RI) to adjust the CI values of varying degrees to different levels. The resulting value is the Consistency Ratio (CR). If $CR \leq 0.1$, then the degree of agreement of the matrix is satisfactory, which means that the pair of scales have a certain degree of "reliability", see Table 2. The formula is as follows:

$$C.R. = \frac{C.I.}{R.I} \quad (12)$$

Table 2: Random Indicators for Consistency Verification

index	formula	Evaluation criteria
		$C.I. > 0$, said before and after the judge inconsistency
Consistency index (C.I.)	$C.I. = \frac{\lambda_{max} - n}{n - 1}$	$C.I. = 0$, said before and after the judge completely consistent $C.I. \leq 0.1$, indicating an allowable deviation
Consistency ratio (C.R.)	$C.R. = \frac{C.I.}{R.I}$, Which R.I. value to look up the table	$C.R. \leq 0.1$, Indicating consistency to an acceptable level

The pairwise comparison matrix can be followed by the order number n to correspond to the random index (R. I.), as shown in Table 3:

Table 3: Random Indicator Table

Order	1	2	3	4	5	6	7	8
R.I.	0.00	0.00	0.58	0.9	1.12	1.24	1.32	1.41
Order	9	10	11	12	13	14	15	
R.I.	1.45	1.49	1.51	1.48	1.56	1.57	1.58	

The weight of each criterion, multiplied by the performance of the program, the resulting product is the overall performance of the program, and finally the overall performance of the program sort, you can get the priority of the program, that is, clearly know each the importance of the element to the ultimate goal as a basis for decision making or assessment. Fundamentally, the main and sub-criteria are as shown in Tab. 4 and Tab. 5.

Table 4: Definition of primary and secondary criteria for the quality of financial electronic payment system

Main criteria	definition	The source of the literature
System quality	Evaluation of the information system itself, which includes ease of operation, time response, easy-to-use functions, flexibility of the system, ease of use, ease of access, ease of learning, and the degree of user's needs System characteristics, systems Precision, system reliability, system integration, system correctness, system efficiency, resource usage, response time and system response time.	(Delone & McLean, 2003)
Communication quality	The evaluation of the output of the communication system, including the correctness, completeness, timeliness, relevance, liquidity, clarity, comprehensibility, usefulness, reliability, up-to-date, objectivity and streamlining of the output data.	(Delone & McLean, 2003)
Service quality	Service quality, behavioral intention and financial performance. It is found that the quality of service will have a positive correlation with the intention of behavior. When the service quality is good, the behavior intention is the strongest, and the behavior intention will have an impact on the customer's behavior, and then the customer behavior will have an impact on the company's financial performance.	(Zeithaml, Berry, & Parasuraman, 1996)
Safety quality	When using the Internet Cloud Computing Service, the user is aware that if the network security is not tight, it will cause loss or adverse consequences.	(Jacoby & Kaplan, 1972) ; (Moore & Benbasat, 1991) ; (Heyen, Kasiraj, & Wolf, 1992)

Table 5: Definition of Quality Criteria for Financial Electronic Payment System

Sub-criteria	Definition	The source of the literature
Ease of use	Making it easier for users to get started.	(Benbasat, Cenfetelli, & Tan, 2007; L.-d. Chen, 2008)
Response speed	Users can make any requests for online transactions, and the site can quickly meet learners.	(Woldie, Hinson, Iddrisu, & Boateng,

		2008);(L.-d. Chen, 2008)
Accuracy	The correctness of the information provided by the Internet exchange.	(Nelson, Todd, & Wixom, 2005)
Immediate	In any case, the information presented must be up-to-date.	(Wixom & Todd, 2005)
Integrity	Online transactions provide all the information you need.	(Cooper, Brown, & Jones, 2004)
Reliability	The website is able to reliably and accurately implement the committed service capabilities.	(Wong, 2005); (LIU & LU, 2005)
Trust	Users are willing to accept the interaction provided by the online system pipeline.	(Ong, Lai, & Wang, 2004)
User satisfaction	The customer re-uses the product or service and is another presentation of satisfaction.	(Oliver, Rust, & Varki, 1997)
Network security	Personal protection of people on the Internet when the protection measures, including personal Internet privacy and security, the use of e-mail security, online chat friends and so on.	(Kang, Dabbish, Fruchter, & Kiesler, 2015; Yun, 2014)
system security	Information in the process, should ensure that the data security, system security for the use of the impact has been beyond the functional and performance requirements.	(Apvrille & Pourzandi, 2005); (McGraw, 2006)
Safety tradement	Internet transaction security requirements: 1. Confirmation of the identity of the user's electronic account 2. Data must be encrypted and decrypted Confidential data 3. Data integrity 4. The non-repudiation of the transaction information requirements.	(Kahn & Liñares-Zegarra, 2016)

The basic idea of the method is based on the use of Euclidean distance to evaluate the ideal solution and negative ideal (S.-M. Chen & Lee, 2010). The distance between the solutions and the relative proximity is used as the sort of the selection scheme. The distance principle is used to express the distance between the alternatives and the ideal solution. The result is high and the result is an effective way to solve the problem. In a limited program, evaluation, sorting based on decision attributes (Abo-Sinna & Amer, 2005).

Real-world problems, many of the projects are usually multi-criteria decision making (MCDM), and these programs are mutually exclusive, non-quantitative conditions, then multi-criteria decision-making method is used to deal with the real world (Ondrus, Lyytinen, & Pigneur, 2009; Tsai, Chou, & Leu, 2011). In the same scale and mutually exclusive conditions, and no one program can meet *all* the conditions to make it the best solution (Linck, Pousttchi, & Wiedemann, 2006). In this situation, the ideal solution to the optimal solution (TOPSIS) is particularly useful for dealing with such problems. (Masudin & Saputro, 2016).

The positive ideal solution (PIS) and negative ideal solution (NIS) are defined first in the evaluation process. The so-called ideal solution is the evaluation of the benefits of the program attributes of the largest value of the cost of the property of the assessment of the smallest value; On the other hand, the negative ideal solution is the minimum value of the alternatives, and the cost criterion is the largest. In the choice of the program, the distance from the ideal solution recently, the distance from the ideal solution is the best solution for the best solution.

From the previous studies, show that the ideal solution similarity preference order assessment method is a useful method to solve the best selection of the program (S. Chen, Li, & Tang, 2012; Ha, 2014). In addition, the preference order assessment method first uses the geometric mean calculation to integrate the opinions of many people, the basic idea can be explained in Figure 1. In the figure, two evaluation criteria C1 and C2 are used to explain, S is the sample space of n schemes, N is the negative ideal solution, and P is the ideal solution. When the A1 scheme is compared with the A2 scheme, the distance

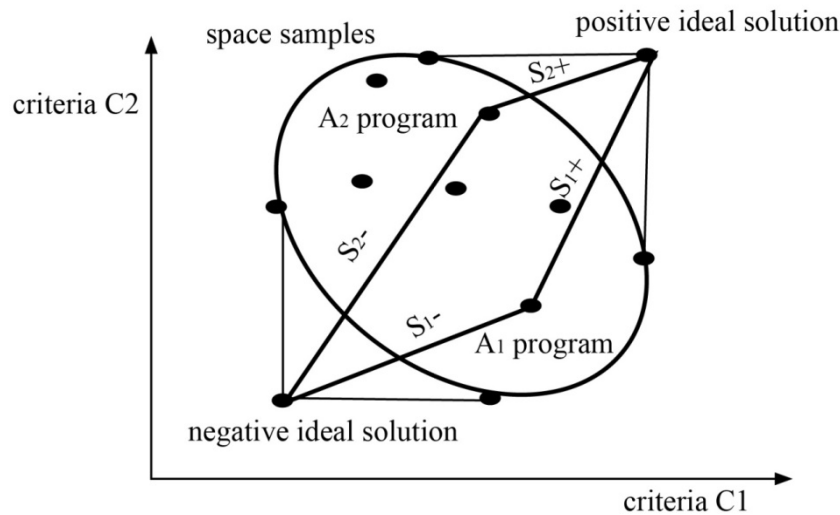


Figure 1: TOPSIS space concept map

between the A2 scheme and the ideal solution P is higher than that of the A1 scheme ($S_{2*} < S_{1*}$). While the A2 solution to the negative ideal solution N distance than the A1 program far ($S_{2-} > S_{1-}$). So A2 program better than A1 program, see figure 2

RESEARCH DESIGN

The hierarchical analysis is a set of decision-making methods (Saaty, 1990) developed by Saaty (1977). In the case of contingency planning for the US Department of Defense, which is mainly used in the case of uncertainty and decision-making issues with multiple evaluation sub-criteria, the complexity of the problem one by one simplified (Asokan, Janson, Steiner, & Waidner, 1997). The theory of hierarchical analysis is simple and practical (Kadambi, Li, & Karp, 2009). As a result, since its inception, it has been used in priority order decisions, planning resources, allocations, forecasts and portfolios (A. S. Fisher & Kaplan, 2000). As the theory of hierarchical analysis is clear and simple, easy to operate, and can accommodate a number of experts and decision-making advice, widely used by academics and practitioners, the scope of its application is quite extensive (Bhushan & Rai, 2007).

When using hierarchical analysis, the target problem must be described first, and then the possible influencing factors can be identified and the hierarchical structure (Lee & Kozar, 2006). Using the two factors into pairs to compare the advantages and disadvantages between the two factors, and thus the establishment of pairs of comparison matrix, the use of matrix eigenvalues and eigenvector calculation, obtained the weight of each attribute and the program. And finally through the comprehensive evaluation of the way to obtain the best program sort (Neofytides & Baig, 2009). In order to confirm that the decision maker is able to achieve consistency before and after making the comparison, it is necessary to carry out the consistency test. To check whether the pairwise comparison matrices formed by the answers answered by the decision maker are consistent matrices, Saaty (1980) suggests that when $CI \leq 0.1$, the best acceptable error, if $CI \leq 0.2$, is also acceptable error.

This study evaluates the research framework of the sub-criteria of the financial electronic payment system, based on the successful model of the information system proposed by DeLon and McLean (2003), and develops the main criteria for evaluating the online financial electronic payment system through the relevant literature (Tajuddin, 2015). The first layer is the system quality, information quality, service quality and net benefit of the four parts of the study will be net benefits into safety quality, each part of the subdivision down, and its overall distinction is divided into three levels, such as Figure 2 shows.

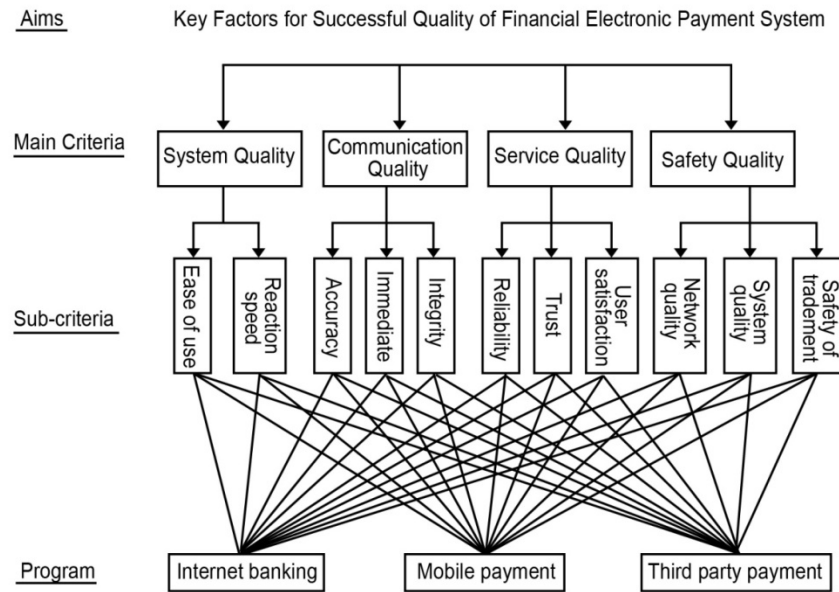


Figure 2: Research architecture

TOPSIS calculus is to first define the ideal solution (PIS) and negative ideal solution (NIS) (Mahmoodzadeh, Shahrabi, Pariazar, & Zaeri, 2007). Its purpose is to find the distance from the "ideal solution" the closest distance, and from the "negative ideal solution" farthest away from the program. The so-called ideal solution refers to the alternative method, the benefit of the largest surface or the smallest cost of the sub-standard value; negative ideal solution is the smallest benefit or cost of the largest sub-standard value. The TOPSIS proposed by Hwang and Yoon is the best solution for finding the nearest distance to the "positive ideal solution (PIS) and the distance from the" ideal solution " (Yoon & Hwang, 1995). It can be used for different problems, in the calculation of the program's PIS and NIS the best distance (Lai, Liu, & Hwang, 1994). According to the development of Minkowski's L_p metric, for different issues using different distance calculation, the calculation steps such as columns:

The decision-making problem m alternatives, n evaluation sub-criteria, converted into matrix x , that is x_{ij} has been presented the order of the relationship between the various programs

(A). $(x_{ij})_{m \times n}$:

(B). Let the original matrix $(x_{ij})_{m \times n}$ Normalized to $R = (r_{ij})_{m \times n}$

$$\text{which is } r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, \quad i = 1, 2, \dots, m, \quad j = 1, 2, \dots, n$$

(C). Determine the weight, after the experts specify the weight w_j

The establishment of weighted decision matrix $t_{ij} = r_{ij} \cdot w_j$,

$i = 1, 2, \dots, m, j = 1, 2, \dots, n$, among them $\sum_{j=1}^n w_j = 1$, w_j for the j sub-criteria.

(D). to determine the worst choice (A_w) and the best choice (A_b)

$$A_w = \{(\max(t_{ij} | i = 1, 2, \dots, m) | j \in J_-), (\min(t_{ij} | i = 1, 2, \dots, m) | j \in J_+)\} \equiv \{t_{wj} | j = 1, 2, \dots, n\}$$

$$A_b = \{(\min(t_{ij} | i = 1, 2, \dots, m) | j \in J_-), (\max(t_{ij} | i = 1, 2, \dots, m) | j \in J_+)\} \equiv \{t_{bj} | j = 1, 2, \dots, n\}$$

among them, $J_+ = \{j = 1, 2, \dots, n | j \text{ associated with standards that have a positive impact}\}$, $J_- = \{j = 1, 2, \dots, n | j \text{ associated with standards that have a negative impact}\}$.

(E). Calculate the separation measure d_{w_i} and d_{b_i}

$$d_{w_i} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{wj})^2}, \quad i = 1, 2, \dots, m,$$

#

$$d_{ib} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{bj})^2}, i = 1, 2, \dots, m,$$

(F). Calculate the relative proximity of the best choice. $s_{iv} = d_{iv}/(d_{iv} + d_{ib}), 0 \leq s_{iv} \leq 1, i = 1, 2, \dots, m$

(G). According to $s_{iv} (i = 1, 2, \dots, m)$, sort the order of size, choose the best solution.

In this study, we focus on scholars who are engaged in electronic payment related research and industry, those who frequently use financial electronic payment. Respondents showed a total number of 15 e-payment experts. The questionnaire was issued a total of 15, recycling 15 questionnaires. Table 6 shows the demographic of the respondents.

Table 6: Demographics of the respondents

Characteristics	Frequency	Percent (%)
Gender		
Male	13	86.6%
Female	2	13.4%
Age		
20-29	6	40.0%
30-39	3	20.0%
>=40	6	40.0%
Education level		
College	5	33.3%
Graduate	10	66.7%
Occupation		
Business	2	13.3%
Information	5	33.3%
Manufacturing	1	6.66%
Service	1	6.66%
Self-employed	2	13.3%
Student	3	20.0%
Others	1	6.66%
Professional license		
Yes	13	86.6%
No	2	13.4%
Working years		
Less than five years	3	20.0%
More than five years, less than ten years	3	20.0%
More than a decade	8	60.0

DATA ANALYSIS

Based on the hierarchical structure analysis and questionnaire data, the evaluation structure of the financial electronic payment system quality is constructed. The weight of the main and sub-criteria is developed, and the preference order of the sub-criteria is evaluated by TOPSIS. Then the key success factors of electronic payment quality are discussed. The analysis steps are listed below.

Hierarchical Analysis e-Payment System

First perform a consistency check. Using the Choice Maker software for operation analysis, the Consistency Ratio (CR) must be less than 0.1 to meet the logical consistency requirements. Through the consistency test, the weight value obtained by it is meaningful. The CR values of the overall level presented in Table 6 are less than 0.1, indicating that the overall hierarchy is consistent, and that the weight of each criterion is calculated and evaluated by information compiled by 10 experts and 5-bit system users are available. Table 7 shows the consistency ratio for each level.

Table 7: CR values for each level

Level	average value	CR (Min-Max) value
System quality, communication quality, service quality, safety quality	0.025392	0.0045~0.068
Ease of use, response speed (sub-criteria)	0.023408	0.0013~0.0634
Accuracy, immediacy, completeness	0.013908	0.0013~0.1699
Reliability, trust, user satisfaction (sub-criteria)	0.012508	0.0013~0.0318

Table 7: CR values for each level

Network security, system security, transaction security (sub-criteria)	0.000250	0.0005~0.0008
------------------------------------------------------------------------	----------	---------------

Continue to process the questionnaire data from 10 experts and 5 system users. Find the overall level and the first layer, the second layer of the main, sub-criteria. In addition, the overall level of view, the first assessment criteria for the 11 assessment sub-criteria, which were most subject to expert and attention, were in the order of transaction safety (10.22%). On behalf of the data in the system within the process, should ensure the safety of information. Ease of use (7.77%), meaning the convenience of the user for financial electronic payment systems. Response speed (7.22%), refers to the other side of the response speed. System security (5.98%), refers to the privacy of the network security, the use of e-mail security, network community communication security. Trust (5.22%), which is based on the user's positive expectations, is willing to accept the online system pipeline provided by the online interaction.

The above criteria, ease of use and response speed are the criteria for the evaluation of the quality of the main criteria. System security and network security belong to the safety quality of the assessment criteria. Trust is the quality of service. It can be seen that the higher the relative importance of the sub-criteria, the higher the importance of the main criteria. In addition, the importance of the 11 evaluation sub-criteria, the quality of the system and the quality of the bottom of the sub-criteria have a high proportion, so users and experts believe that the quality of security and system quality is the impact of electronic financial payment system quality Key factors. Table 8 shows the overall level assessment of the main and sub-criteria weight values and sorting.

Table 8: Overall level assessment of the main and sub-criteria weight values and sorting

Aims	Main-criteria	Sub-criteria	Sub-criteria weight	Complex weight	Sorting	
Key Factors of Quality of Financial Electronic Payment System	System quality (24.49%)	Ease of use	40.82%	7.77%	2	
		Response speed	22.79%	7.22%	3	
		Information accuracy	20.47%	4.82%	7	
	Information quality (23.18%)	Immediate	22.90%	4.19%	8	
		Integrity	27.62%	4.05%	9	
		Service quality (20.07%)	reliability	18.36%	2.72%	10
	Service quality (20.07%)	Trust	Trust	28.15%	5.28%	5
			User satisfaction	18.05%	2.68%	11
		Safety quality (32.26%)	Network security	37.93%	5.02%	6
			system security	20.61%	5.98%	4
	Safety of tradement	Safety of tradement	53.73%	10.22%	1	

From the establishment of the four main criteria, 11 sub-criteria of the financial electronic payment system priority factors priority, From the establishment of the four main criteria, 11 sub-criteria of the financial electronic payment system priority factors priority, as a program for the selection of electronic payment system. By the various factors given to the priority value of the three programs point of view, the weight of each part is not the same.

According to the comprehensive value of each criterion, it is found that the financial electronic payment system scheme is the third party payment, the third is the Internet bank, the action payment is slightly less favored by the users and experts. Table 9 Shown the impact of financial electronic payment of key factors in the selection of the overall priorities and complex weight value.

Table 9: Weight of the financial electronic payment system

Sub-criteria	Complex weight	Internet banking	Mobile payment	Third party payment
Ease of use	0.078	90	89	93
Response speed	0.072	90	90	89
Accuracy	0.048	88	87	91
Immediate	0.042	90	89	90
Integrity	0.041	91	90	93
Reliability	0.027	93	89	93
Trust	0.053	90	88	91
User satisfaction	0.027	89	89	93
Network security	0.050	91	90	94

Table 9: Weight of the financial electronic payment system

system security	0.059	90	89	93
Safety of tradement	0.102	89	88	92
Average		54.306	53.671	55.46
Competitiveness		2	3	1

TOPSIS method to use the final ranking of the advantages, the main reason is that this method is suitable for the theme of this study, in practice is not difficult and easy to understand. TOPSIS requires two basic prerequisites, the weight of the attribute is known, the monotonically increasing or monotonically decreasing property (Garg & Narahari, 2009). Just for the operation of financial electronic payment system quality of the key factors have the characteristics. Thus, the decision matrix after normalization of the vector is obtained via the preceding steps, as shown in Table 10.

Table 10: Decision Matrix for Financial e-Payment System Guidelines

Program / main criteria	System quality	Communication quality	Service quality	Safety quality
Internet banking	0.2441	0.2051	0.2053	0.3453
Mobile payment	0.2641	0.2083	0.20513	0.3423
Third party payment weights	0.2782	0.2086	0.2181	0.2951
the ideal	0.2585	0.2441	0.2331	0.2643
the worst	0.2653	0.2370	0.2137	0.2840
	0.2482	0.2552	0.2651	0.2315

Go to the next step in the TOPSIS method is to determine the positive ideal solution (PIS) and the negative ideal solution (NIS). And calculate the distance between the solution and the ideal solution and the negative ideal solution, so that the scheme to be selected is the closest to the ideal solution, and the distance from the negative ideal solution farthest. Therefore, the ideal solution and the negative ideal solution are calculated for each criterion, as shown in Table 11 and Table 12.

Table 11: Ideal solution for the quality of financial e-payment systems

Idea Solution	Ideal solution	PIS		
Program / main criteria	System quality	Communication quality	Service quality	Safety quality
Internet banking	0.0982	0.1204	0.0652	0.1868
Mobile payment	0.0504	0.1140	0.0452	0.1258
Third party payment	0.1686	0.1340	0.0852	0.2172

#

Table 12: Ideal solution for the quality of financial electronic payment systems

Worst Solution	Negative ideal solution NIS			
Program / main criteria	System quality	Communication quality	Service quality	Safety quality
Internet banking	0.0725	0.1365	0.0728	0.0885
Mobile payment	0.0951	0.1568	0.0852	0.0986
Third party payment	0.0523	0.1227	0.0530	0.0752

And then seek their distance with the ideal solution (S^+) and the distance of the ideal solution (S^-). Calculate the separation measure for each scheme from the ideal solution (d_i^+) and the separation measure of the negative ideal solution (d_i^-). And obtain the relative degree of closeness (C_i) of each scheme to the ideal solution, it can be sorted according to the size of this value, and the financial electronic payment system scheme is close to the ideal solution, as shown in Table 13.

Table 13: Relative proximity of financial e-payment ideal solutions

Program	d_i^+	d_i^-	C_i (Proximity)	result - rank
Internet banking	0.2118	0.2832	0.5721	2

#

Mobile payment	0.2906	0.1754	0.3763	3
Third party payment	0.0983	0.2999	0.7532	1

Consolidate the results of the evaluation of the criteria, the advantages of the three programs sort the results, followed by third-party payment, Internet banking, mobile payments are slightly less for the financial users and test experts favor. From the relative solution with the ideal solution that, accurate analysis of the key factors that affect the success of electronic payments.

CONCLUSION

The aim of this paper is to develop a hierarchy framework in assessing the key success factors of the quality of financial electronic payment systems. Compare the relative weight values with AHP in TOPSIS, it is clearly understand the impact of the criteria on the quality of electronic payments. Through this dual assessment model, it can more thoroughly assess the impact of the guidelines, and further provide a gradual increase in the use of electronic payment system. Also it is an important reference and substantive recommendations to the financial electronic payment providers.

In addition, the users and experts agree that the safety quality should be considered as the first consideration for the quality of the financial electronic payment system, and its weight value (32.26%) accounts for a very high proportion. Therefore, the security quality of the underlying level of the two criteria included in the overall level of ranking, accounting for the top six, namely, transaction security and network security.

Furthermore, the system quality of the underlying level included in the ease of use and response speed, the overall level of ranking is the top three. And in the quality of information and service quality, which contains the underlying criteria is biased towards the technical aspects of the system and service level. The results show that the weight values of the two and its underlying criteria are relatively low, but they are still necessary to evaluate the sub-criteria. This phenomenon represents the user's electronic payment behavior first to pay attention to security, and then consider the ease of payment operations.

However, the results of the study found that each evaluation sub-criteria have its importance, but users and experts believe that the financial quality of electronic payment and system quality should be emphasized and attention, and the transaction is easy and easy to operate Users are critical of the use of the system and are satisfied.

Suggestion

Review the financial electronic payment system quality assessment results, for the future development of electronic trading environment, the researchers made a number of reminds and recommendations. The first user level, a comprehensive assessment of the results of the guidelines, the majority of users for the transaction security, ease of use and response speed requirements may be due to work or mission requirements, the required level of quality differently.

The hierarchical structure and assessment of the criteria, the establishment of the assessment model, not only to provide a general electronic payment system and the main functional reference, and financial electronic payment system suppliers will be different with the needs of users, the relevant assessment criteria can also be for the reference, the evaluation results for the system provider can provide substantive advice.

The development of financial electronic payment market will be more and more vigorous. If the specific areas of electronic payment assessment should be based on the objectives of the field, the project and the scope of a detailed consideration, the assessment model will be more in line with specific needs. Researchers can refer to the evaluation model of this study, on the one hand to improve the degree of discrimination, on the other hand to accurately assess the true characteristics of the field for more valuable research. Future study may change survey type from cross-sectional to longitudinal. For example, time series or panel data analysis.

REFERENCES

- [1] Abo-Sinna, M. A., & Amer, A. H. (2005). Extensions of TOPSIS for multi-objective large-scale nonlinear programming problems. *Applied Mathematics and Computation*, 162(1), 243-256.
- [2] Aderonke, A. A. (2010). An empirical investigation of the level of users' acceptance of e-banking in Nigeria. *Journal of Internet Banking and Commerce*, 15(1), 1-13.
- [3] Aminbakhsh, S., Gunduz, M., & Sonmez, R. (2013). Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. *Journal of Safety Research*, 46, 99-105.
- [4] Apvrille, A., & Pourzandi, M. (2005). Secure software development by example. *IEEE Security & Privacy*, 3(4), 10-17.
- [5] Asokan, N., Janson, P. A., Steiner, M., & Waidner, M. (1997). The state of the art in electronic payment systems. *Computer*, 30(9), 28-35.
- [6] Azmi, A., Azmi, A., Ang, Y. D., Talib, S. A., & Talib, S. A. (2016). Trust and justice in the adoption of a welfare e-payment system. *Transforming Government: People, Process and Policy*, 10(3), 391-410.
- [7] Benbasat, I., Cenfetelli, R., & Tan, C.-W. (2007). Understanding the antecedents and consequences of e-government service quality: an empirical investigation. In *Proceedings of the Twenty Eighth International Conference on Information Systems* (Paper 39). ICIS, Montreal, Quebec, Canada, December 9-12.

#

- [8] Bhushan, N., & Rai, K. (2007). *Strategic Decision Making: Applying the Analytic Hierarchy Process*. Springer Science & Business Media.
- [9] Boselli, R., Cesarini, M., Mercorio, F., & Mezzananza, M. (2015). Applying the AHP to smart mobility services: A case study. In *International Conference on Data Management Technologies and Applications* (pp. 354-361). IRIS, July 20-22.
- [10] Chaudhary, A., & Upreti, I. (2016). Analysis of telecom service quality factors with analytic hierarchy process and fuzzy extent analysis: A case of public sector unit. *International Journal of Business and Systems Research*, 10(2-4), 162-185.
- [11] Chen, L.-d. (2008). A model of consumer acceptance of mobile payment. *International Journal of Mobile Communications*, 6(1), 32-52.
- [12] Chen, S.-M., & Lee, L.-W. (2010). Fuzzy multiple attributes group decision-making based on the interval type-2 TOPSIS method. *Expert Systems with Applications*, 37(4), 2790-2798.
- [13] Chen, S., Li, R., & Tang, B. (2012). Group-buying website evaluation based on combination of TOPSIS, entropy weight and FAHP. *Journal of Convergence Information Technology*, 7(7), 130-139.
- [14] Cooper, W. P., Brown, P. C., & Jones, C. D. (2004). Methods and systems for transferring funds. U.S. Patent No. 6,736,314. Washington, DC: U.S. Patent and Trademark Office.
- [15] Dahlberg, T., Guo, J., & Ondrus, J. (2015). A critical review of mobile payment research. *Electronic Commerce Research and Applications*, 14(5), 265-284.
- [16] Dahlberg, T., Mallat, N., Ondrus, J., & Zmijewska, A. (2008). Past, present and future of mobile payments research: A literature review. *Electronic Commerce Research and Applications*, 7(2), 165-181.
- [17] De Groot, R. S., Alkemade, R., Braat, L., Hein, L., & Willemsen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological complexity*, 7(3), 260-272.
- [18] DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems*, 19(4), 9-30.
- [19] Fang, Y., Qureshi, I., Sun, H., McCole, P., Ramsey, E., & Lim, K. H. (2014). Trust, satisfaction, and online repurchase intention: The moderating role of perceived effectiveness of e-commerce institutional mechanisms. *MIS Quarterly*, 38(2), 407-427.
- [20] Fisher, A. S., & Kaplan, S. J. (2000). Method for supplying automatic status updates using electronic mail. U.S. Patent No. 6,047,264. Washington, DC: U.S. Patent and Trademark Office.
- [21] Fisher, M. (2013). Conducting an online payment transaction using an NFC enabled mobile communication device. U.S. Patent No. 8,352,323. Washington, DC: U.S. Patent and Trademark Office.
- [22] Forsythe, S. M., & Shi, B. (2003). Consumer patronage and risk perceptions in Internet shopping. *Journal of Business Research*, 56(11), 867-875.
- [23] Garg, D., & Narahari, Y. (2009). An optimal mechanism for sponsored search auctions on the web and comparison with other mechanisms. *IEEE Transactions on Automation Science and Engineering*, 6(4), 641-657.
- [24] Garrison, G., Wakefield, R. L., & Kim, S. (2015). The effects of IT capabilities and delivery model on cloud computing success and firm performance for cloud supported processes and operations. *International Journal of Information Management*, 35(4), 377-393.
- [25] Ha, N. P. N. (2014). The analysis of impacts of service quality on customer satisfaction and customer loyalty: The case of Galaxy cinemas (Doctoral dissertation, International University HCMC, Vietnam).
- [26] Heath, S. (2014). System and method for using global location information, 2D and 3D mapping, social media, and user behavior and information for a consumer feedback social media analytics platform for providing analytic measurements data of online consumer feedback for global brand products or services of past, present or future customers, users, and/or target markets. U.S. Patent No. 8,909,771. Washington, DC: U.S. Patent and Trademark Office.
- [27] Herzberg, A. (2003). Payments and banking with mobile personal devices. *Communications of the ACM*, 46(5), 53-58.
- [28] Heyen, J. G., Kasiraj, C., & Wolf, T. J. (1992). System using independent attribute lists to show status of shared mail object among respective users: Google Patents.
- [29] Hong, I. B., & Cha, H. S. (2013). The mediating role of consumer trust in an online merchant in predicting purchase intention. *International Journal of Information Management*, 33(6), 927-939.
- [30] Huang, X., Dai, X., & Liang, W. (2014). BulaPay: a novel web service based third-party payment system for e-commerce. *Electronic Commerce Research*, 14(4), 611-633.
- [31] Hummel, J. M., Bridges, J. F., & IJzerman, M. J. (2014). Group decision making with the analytic hierarchy process in benefit-risk assessment: a tutorial. *The Patient-Patient-Centered Outcomes Research*, 7(2), 129-140.
- [32] Iivari, J. (2005). An empirical test of the DeLone-McLean model of information system success. *ACM Sigmis Database*, 36(2), 8-27.
- [33] Jacoby, J., & Kaplan, L. B. (1972). *The components of perceived risk*. Paper presented at the SV-Proceedings of the third annual conference of the association for consumer research.
- [34] Jiang, L., Yang, Z., & Jun, M. (2013). Measuring consumer perceptions of online shopping convenience. *Journal of Service Management*, 24(2), 191-214.
- [35] Kadambi, K. S., Li, J., & Karp, A. H. (2009). Near-field communication-based secure mobile payment service. *Proceedings of the 11th international Conference on Electronic Commerce*, Taipei, Taiwan, August 12 - 15), 142-151.
- [36] Kahn, C. M., & Liñares-Zegarra, J. M. (2016). Identity theft and consumer payment choice: Does security really matter?. *Journal of Financial Services Research*, 50(1), 121-159.

#

- [37] Kang, R., Dabbish, L., Fruchter, N., & Kiesler, S. (2015). *my data just goes everywhere:” user mental models of the internet and implications for privacy and security*. Paper presented at the Symposium on Usable Privacy and Security (SOUPS).
- [38] Kim, C., Tao, W., Shin, N., & Kim, K.-S. (2010). An empirical study of customers’ perceptions of security and trust in e-payment systems. *Electronic Commerce Research and Applications*, 9(1), 84-95.
- [39] King, D. B., O’rourke, N., & DeLongis, A. (2014). Social media recruitment and online data collection: A beginner’s guide and best practices for accessing low-prevalence and hard-to-reach populations. *Canadian Psychology/Psychologie canadienne*, 55(4), 240.
- [40] Koulayev, S., Rysman, M., Schuh, S., & Stavins, J. (2016). Explaining adoption and use of payment instruments by US consumers. *The RAND Journal of Economics*, 47(2), 293-325.
- [41] Lai, Y.-J., Liu, T.-Y., & Hwang, C.-L. (1994). Topsis for MODM. *European journal of operational research*, 76(3), 486-500.
- [42] Lee, Y., & Kozar, K. A. (2006). Investigating the effect of website quality on e-business success: An analytic hierarchy process (AHP) approach. *Decision Support Systems*, 42(3), 1383-1401.
- [43] Lei, Y., Yayla, A. A., & Kahai, S. (2017). Guiding the Herd: The Effect of Reference Groups in Crowdfunding Decision Making. *Proceedings of the 50th Hawaii International Conference on System Sciences*, Big Island, Hawaii, USA, January 4-7.
- [44] Leone, R. M., & Adams, R. J. (2016). Safety standards: implementing fall prevention interventions and sustaining lower fall rates by promoting the culture of safety on an inpatient rehabilitation unit. *Rehabilitation Nursing*, 41(1), 26-32.
- [45] Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. (2014). Antecedents of the adoption of the new mobile payment systems: The moderating effect of age. *Computers in Human Behavior*, 35), 464-478.
- [46] Linck, K., Pousttchi, K., & Wiedemann, D. G. (2006). Security issues in mobile payment from the customer viewpoint.
- [47] Liu, C.Y., & Lu, J.P. (2005). On logistics mode of enterprises with B2C e-commerce. *Logistics Technology*, 1, 76-79.
- [48] Macharis, C., Springael, J., De Brucker, K., & Verbeke, A. (2004). PROMETHEE and AHP: The design of operational synergies in multicriteria analysis.: Strengthening PROMETHEE with ideas of AHP. *European Journal of Operational Research*, 153(2), 307-317.
- [49] Mahmoodzadeh, S., Shahrabi, J., Pariazar, M., & Zaeri, M. (2007). Project selection by using fuzzy AHP and TOPSIS technique. *International Journal of Human and Social Sciences*, 1(3), 135-140.
- [50] Manakshe, A. R., Jirkar, S., Wakhare, P., & Buram, V. (2014). Analysis of secure electronic transmission (SET) system for electronic transactions. *International Journal of Research in Advent Technology*, 2(3), 12-15.
- [51] Martins, C., Oliveira, T., & Popovič, A. (2014). Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application. *International Journal of Information Management*, 34(1), 1-13.
- [52] Masudin, I., & Saputro, T. (2016) *Evaluation of B2C website based on the usability factors by using fuzzy AHP & hierarchical fuzzy TOPSIS.* #n *IOP Conference Series: Materials Science and Engineering 114*(1) Paper 012091. IOP Publishing.
- [53] McGraw, G. (2006). *Software Security: Building Security In*. Upper Saddle River, NJ: Addison-Wesley Professional.
- [54] Meade, L. M., & Presley, A. (2002). R&D project selection using the analytic network process. *IEEE transactions on Engineering Management*, 49(1), 59-66.
- [55] Merkow, M. S., & Breithaupt, J. (2014) *Information Security: Principles and Practices*. Indianapolis, IN: Pearson Education.
- [56] Ming-Yen Teoh, W., Choy Chong, S., Lin, B., & Wei Chua, J. (2013). Factors affecting consumers’ perception of electronic payment: an empirical analysis. *Internet Research*, 23(4), 465-485.
- [57] Mishra, V., & Singh, V. (2015). Selection of appropriate electronic banking channel alternative: Critical analysis using analytical hierarchy process. *International Journal of Bank Marketing*, 33(3), 223-242.
- [58] Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192-222.
- [59] Murdoch, S. J., & Anderson, R. (2014). Security protocols and evidence: Where many payment systems fail. In *International Conference on Financial Cryptography and Data Security* (pp. 21-32). Springer, Berlin, Heidelberg.
- [60] Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: An empirical examination within the context of data warehousing. *Journal of Management Information Systems*, 21(4), 199-235.
- [61] Neofytides, C. L., & Baig, A. A. (2009) Method for requesting and receiving an online payment through a payment enabler system. U.S. Patent No. 7,587,342. Washington, DC: U.S. Patent and Trademark Office.
- [62] Nilashi, M., & Ibrahim, O. B. (2014). A model for detecting customer level intentions to purchase in B2C websites using TOPSIS and fuzzy logic rule-based system. *Arabian Journal for Science and Engineering*, 39(3), 1907-1922.
- [63] Oat, E. (2016). Integrating payment solutions to online marketplaces.
- [64] Oliver, R. L., Rust, R. T., & Varki, S. (1997). Customer delight: Foundations, findings, and managerial insight. *Journal of Retailing*, 73(3), 311-336.
- [65] Ondrus, J., Lyytinen, K., & Pigneur, Y. (2009). Why mobile payments fail? Towards a dynamic and multi-perspective explanation. In *Proceedings of the 42nd Hawaii International Conference on the System Sciences* (pp. 1-10). HICSS, Waikoloa, Hawaii, USA, January 05-09.
- [66] Ong, C.-S., Lai, J.-Y., & Wang, Y.-S. (2004). Factors affecting engineers’ acceptance of asynchronous e-learning systems in high-tech companies. *Information & management*, 41(6), 795-804.

#

- [67] Ponte, E. B., Carvajal-Trujillo, E., & Escobar-Rodríguez, T. (2015). Influence of trust and perceived value on the intention to purchase travel online: Integrating the effects of assurance on trust antecedents. *Tourism Management*, 47, 286-302.
- [68] Ramos-de-Luna, I., Montoro-Ríos, F., & Liébana-Cabanillas, F. (2016). Determinants of the intention to use NFC technology as a payment system: An acceptance model approach. *Information Systems and e-Business Management*, 14(2), 293-314.
- [69] Rana, N. P., Dwivedi, Y. K., Williams, M. D., & Weerakkody, V. (2015). Investigating success of an e-government initiative: validation of an integrated IS success model. *Information Systems Frontiers*, 17(1), 127-142.
- [70] Remington, D. B., & Dent, W. T. (2000). Electronic bill presentment and payment system. U.S. Patent No. 6,070,150. Washington, DC: U.S. Patent and Trademark Office.
- [71] Roy, S., & Venkateswaran, P. (2014). Online payment system using steganography and visual cryptography. *Proceedings of 2014 IEEE Students' Conference on Electronics and Computer Science* (pp. 1-5). IEEE, Bhopal, India, March 1-2.
- [72] Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, 48(1), 9-26.
- [73] Sabherwal, R., Jeyaraj, A., & Chowa, C. (2006). Information system success: Individual and organizational determinants. *Management Science*, 52(12), 1849-1864.
- [74] Satty, T. L. (2004). Decision making—the analytic hierarchy and network processes (AHP/ANP). *Journal of Systems Science and Systems Engineering*, 13(1), 1-35.
- [75] Schmoldt, D., Kangas, J., Mendoza, G. A., & Pesonen, M. (2013). *The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making* (Vol. 3). Springer Science & Business Media, B.V.
- [76] Slade, E. L., Dwivedi, Y. K., Piercy, N. C., & Williams, M. D. (2015). Modeling consumers' adoption intentions of remote mobile payments in the United Kingdom: extending UTAUT with innovativeness, risk, and trust. *Psychology & Marketing*, 32(8), 860-873.
- [77] Tajuddin, M. (2015). Modification of DeLon and McLean model in the success of information system for good university governance. *TOJET: The Turkish Online Journal of Educational Technology*, 14(4), 113-123.
- [78] Teneyuca, D. (2011). Internet cloud security: The illusion of inclusion. *Information Security Technical Report*, 16(3), 102-107.
- [79] Tsai, W.-H., Chou, W.-C., & Leu, J.-D. (2011). An effectiveness evaluation model for the web-based marketing of the airline industry. *Expert Systems with Applications*, 38(12), 15499-15516.
- [80] Wang, Y., Hahn, C., & Sutrave, K. (2016). Mobile payment security, threats, and challenges. *Proceedings of the 2016 Second International Conference on Mobile and Secure Services* (pp. 1-5). IEEE, Gainesville, FL, USA, February 26-27.
- [81] Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*, 16(1), 85-102.
- [82] Woldie, A., Hinson, R., Iddrisu, H., & Boateng, R. (2008). Internet banking: An initial look at Ghanaian bank consumer perceptions. *Banks and Bank Systems*, 3(3), 35-46.
- [83] Wong, A. (2005). E-commerce business methodologies for supply and demand chain management. U.S. Patent Application No 11/260,776, Washington, DC: U.S. Patent and Trademark Office.
- [84] Xu, J. D., Benbasat, I., & Cenfetelli, R. T. (2013). Integrating service quality with system and information quality: An empirical test in the e-service context. *Mis Quarterly*, 37(3), 777-794.
- [85] Yang, S., Lu, Y., Chau, P. Y., & Gupta, S. (2017). Role of channel integration on the service quality, satisfaction, and repurchase intention in a multi-channel (online-cum-mobile) retail environment. *International Journal of Mobile Communications*, 15(1), 1-25.
- [86] Ye, B. H., Fu, H., & Law, R. (2016). Use of impact-range performance and asymmetry analyses to improve OTA website quality. *Journal of Hospitality and Tourism Management*, 26, 9-17.
- [87] Yoon, K. P., & Hwang, C.-L. (1995) *Multiple Attribute Decision Making: An Introduction* (Vol. 104). Los Angeles: Sage publications.
- [88] Yun, H. (2014). Online payment network security risk and prevention technology research. *Network Security Technology & Application*, 4, Paper 079.
- [89] Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, 60(2), 31-46.
- [90] Zhang, Y. (2016). Model for multiple attribute decision making with hesitant triangular fuzzy information and its applications. *Journal of Intelligent & Fuzzy Systems*, 30(3), 1691-1696.
- [91] Zheng, Y., Zhao, K., & Stylianou, A. (2013). The impacts of information quality and system quality on users' continuance intention in information-exchange virtual communities: An empirical investigation. *Decision Support Systems*, 56, 513-524.
- [92] Zhou, T. (2013). An empirical examination of continuance intention of mobile payment services. *Decision Support Systems*, 54(2), 1085-1091.
- [93] Zhou, T. (2014). Understanding the determinants of mobile payment continuance usage. *Industrial Management & Data Systems*, 114(6), 936-948. .