Evaluation of cross border e-commerce user evaluation system for mobile terminals

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Abstract. A kind of construction way of user evaluation system for cross-border electronic commerce of mobile terminal based on fuzzy comprehensive evaluation of analytical hierarchical process was proposed pertinent to construction problem of user evaluation system for cross-boarder electronic commerce towards mobile terminal. Firstly, evaluation index of planning design quality for electronic commerce website was established based on six principles of model construction such as scientific rationality, authenticity, overall completeness, etc; secondly, index system of comprehensive evaluation was established to achieve all index weight through analysis of index system in analytical hierarchical process, and comprehensive judgment was conducted on proposed scheme according to principle of fuzzy comprehensive judgment. Finally, effectiveness of algorithm was verified through analysis of simulation experiment.

Key words. Analytical hierarchical process, Fuzzy comprehensive evaluation, Oriented terminal, Electronic commerce, User evaluation system.

1. Introduction

Trend of booming development of electronic commerce cannot be ignored since its emergence. Electronic commerce is a new kind of business operation mode[1] for buyers and sellers to conduct all kinds of trade activities based on application way of browser/server so as to realize commercial activity, transaction activity, financial activity and related comprehensive service activity in open network environment of Internet and global commercial trade activity. It has features such as serialization of transaction, cheap cost, globalization of market, virtualization of marketing, personalization of service and intensification of resource, etc, thus it is welcomed and relied increasingly and become important composition of modern service industry. Electronic commerce is evaluated as an industry with high human capital content,

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high technical content and high added-value; meanwhile, new technology, new type of business and new way contribute to its honor of "sunrise industry".

Analytical hierarchical process and fuzzy comprehensive evaluation method are both favored in comprehensive evaluation methods. Analytical hierarchical process is an evaluation method proposed by American famous operational research experts Shadan in 1970s and applied in design-making problems with complex structure and many decision-making principles which cannot be quantized easily, and it is a website evaluation method selected by current many scholars. Fuzzy comprehensive evaluation method established by American scientist Professor Zadeh in 1960s is an evaluation model and method designed for the fact that many economic phenomena in reality are with fuzziness and it is a method suitable for website evaluation; A model of theoretical system for website evaluation of evaluation decision-making for young consumers proposed by American scholar Denise E.Agosto in website evaluation method based on consumer behavior in combination of individual preference conception, limit of cognitive handling capacity and limit of objective targeting and content connection is a popular evaluation theory. Currently, foreign research literature is focused on empirical researches for evaluation of electronic commerce website relatively in perspective of literature of foreign many evaluation researches for electronic commerce website. For example, scholars like Sedena, Zhuang and Chen, etc are mainly devoted to discussion of sub-evaluation index, and research in this aspect is meticulous and perfect, but research literature pertinent evaluation method is few. Combination of theory and practice is emphasized in foreign countries, and the focus is on practice. If theory and practice are hardness and softness, then foreign literature is focused on "hardness".

A kind of construction way of user evaluation system for cross-border electronic commerce of mobile terminal based on fuzzy comprehensive evaluation of analytical hierarchical process was proposed pertinent to construction problem of user evaluation system for cross-boarder electronic commerce towards mobile terminal and effectiveness of algorithm was verified through analysis of simulation experiment.

2. Construction of index system of quality evaluation for e-commerce website

Evaluation of e-commerce website is actually a process of finding problems, analyzing problems and solving problems. Scope of e-commerce is very wide and it can be divided into many operation modes such as B2B, B2C, C2C, B2G, B2M (e-commerce between enterprise and seller as well as manager of corresponding products) according to different transaction objects. The following common nature of evaluation system will not change no matter how mode is different from each other:

(1) Scientific rationality. Evaluation method of e-commerce website shall be formulated strictly in science. It is a set of system and applicable evaluation system formulated after considering evaluated object. Evaluation index shall follow development process with super strong adaptability and forward-looking of development and guidance of reality.

(2) Authenticity. Evaluation system shall be in principle of justness, and evalua-

tion organization shall not have any non-reality relationship of third party with any evaluated website. It shall be true and transparent.

(3) Overall completeness. System used for evaluation shall be a set of detailed entirety. All functions shall be complete and evaluation layer shall be complete.

(4) Objectivity. Evaluation index of e-commerce website shall not be created without basis and it shall be real conforming to objective rule and applicable universally in big environment. It is refined, abstract and clear description of operation for website and essence shall be grasped in pertinence.

(5) User experience. Consumer experience is an important consideration factor for e-commerce enterprises to realize profit in this era of coming "Internet+", so it is advancement with times to merge user experience as consideration factor into evaluation system.

(6) Operability. Evaluation index shall be of easy achievement and evaluation system shall be of easy understanding. It shall also have the feature of universal applicability with strong realizability of operation. It shall be not a set of virtual evaluation system and it shall be implemented practically. Overall framework of index system can be seen in Table 1.

Table 1. User evaluation system of cross-boarder e-commerce towards mobile terminal

Target layer	Element layer F	Judgment layer Fi
Fuzzy comprehensive evaluation index system of e-commerce website	Function design F1 of website	Theme standout of navigation system f11
		Browse and access speed f12
		Link effectiveness of search engine f13
		Layer rationality of organization system f14
		Comprehensive rationality of search function f15
		Real-time richness of online interaction f16
	Filling content F2 of website	Comprehensiveness of related information of product (service) f21
		Content accuracy of product (service) f22
		Content practicability of product (service) f23
		Clarity of content, structure and logic for product (service) f24
		Correlation and potential replication of product (service) f25
		Content timeliness of product (service) f26
	Interface layout F3 of website	Function integrity of user interaction f31
		Aesthetics of design of text and style f32
		Design rationality of matching of image and multi-media f33
		Design aesthetics of network layout f34
		Feeling comfort of overall vision effect f35
		Theme standout of self-owned information of website f36
Fuzzy comprehensive evaluation index system of e-commerce website	Use performance F4 of website	Access flow statistic f41
		Conversion rate from access to ordering f42
		Quantity statistic of orders f43
		Summation statistics of order amount f44
		Statistics of customer evaluation f45
		Statistics of customer callback $f46$
	User experience F5 of website	Statistics of customer satisfaction degree f51
		Service level of personalized customer f52
		Completeness of consultancy service f53
		Customer loyalty f54
		Transaction credit and safety degree f55
		User promotion degree f56

3. Fuzzy comprehensive evaluation system based on AHP

3.1. Determining weight of all indexes

User evaluation system scheme of cross-border e-commerce towards mobile terminal is a decision-making process of multiple indexes, and rational evaluation index system shall be established as comprehensive evaluation standard. Indexes affecting user evaluation system evaluation of cross-border e-commerce towards mobile terminal can be divided into the following three types[3]:

(1) Economic index: factor X1 affecting total cost and this index includes fees of all processes in the process of user evaluation system of cross-border e-commerce towards mobile terminal, such as labor consumption, material consumption, etc.

(2) Index of reliability: this index mainly reflects difficulty level, condition safety, reliability, etc of scheme implementation, and it can be reflected with evaluation time X2.

(3) Technological economic index: it can be analyzed from dilution ratio X3, use ratio X4, effective ratio X5, and visual sense X6 of resource. So, established evaluation index set is: $U=\{X1, X2, X3, X4, X5, X6\}$.

Weight of all indexes shall be determined for fuzzy evaluation[4] in the next step for influence degree of all indexes on scheme optimization is different. Index weight calculation is conducted in AHP, and main steps are: constructing layer structure model, constructing judgment matrix, single order of hierarchy, consistency check, and overall ranking levels. There is no need to construct layer model and conduct overall ranking levels for index set to evaluate quality of methods has been determined.

3.2. Establishing judgment matrix through pair-wise comparison

Important degree bij of relativity is achieved through pair-wise comparison on all elements in index set to construct a judgment matrix B. bij shall be correctly selected according to comparison scale, but selection is mainly decided by deep understanding of analytical personnel on evaluated schemes and familiarity degree on user evaluation system of cross-border e-commerce towards mobile terminal. Value[5] of importance degree of pair-wise comparison is shown in Table 2.

Table 2. Table of pair-wise comparison of importance degree

Value of importance degree	Definition
1	Quality (importance) of Pi and Pj are equal.
3	Pi is slightly better (more important) than Pj
5	Pi is better (more important) than Pj
7	Pi is much better (more important) than Pj
9	Pi is extremely better (more important) than Pj
2, 4, 6, 8	It is mid-value of above pair-wise neighboring degree

3.3. Single hierarchical arrangement

Eigenvector W corresponding to maximum eigenvalue λ max of judgment matrix B is solved, and component of eigenvector W is right quality value of corresponding element. Eigenvector of judgment matrix is solved through computer, and the main steps[6] are:

(1) Take a initial vector $W0$ of the same order as judgment matrix B;

(2) Calculating $Wk+1=B\cdot Wk$, $k = 0, 1, 2\ldots$;

(3) Set $\beta = \sum\limits_{i=1}^{n} W_i^{k+1}$;

(4) Precision ε is offered, and calculation shall be stopped when $|W_i^{k+1} - W_i^k| < \varepsilon$ is set up for all $i = 1, 2, \ldots, n$, and then W=Wk+1 is the wanted eigenvector;

(5) Calculation of maximum eigenvalue: $\lambda_{\max} = \sum\limits_{i=1}^{n} \frac{W_i^{k+1}}{n\bullet W_{ik}}$, and n is order of the matrix.

3.4. Consistency inspection of judgment matrix

Judgment matrix is established on the basis of scoring of pair-wise comparison, and $b_{ij} = b_{ik}/b_{jk}$(I, j, k=1, 2, ..., n if pair-wise scoring has objective consistency; it cannot be totally consistent generally due to one-sidedness of human judgment, so certain deviation is allowed. But deviation shall not be large, so deviation degree inspection, namely consistency inspection[7] shall be conducted. The method is as follows:

(1) Consistency index is: $CI = \frac{\lambda_{max}-n}{n-1}$; obviously, $\lambda_{max} = n$ when judgment matrix has total consistency, so CI=0.

(2) Average random consistency index RI. Average random consistency index is as follows in Table 3 through simulation of judgment matrix of different orders in random constitution.

Table 3. RI value of random consistency index

Order	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

(3) Definition of randomness ratio CR is CR=CI/RI. Judgment matrix is of satisfied consistency to conduct single ranking when CR<0.1; or score shall be re-modified until the requirement is reached.

3.5. Fuzzy comprehensive judgment

Fuzzy comprehensive evaluation is a kind of method[8] of comprehensively evaluating objects in multi-layer and multi-factor occasions and a decision-making method of relatively comprehensive and objective evaluation on objects affected by multi-factors in fuzzy mathematical principle on the basis of fuzzy set. It is involved in four elements: factor set U, prepared object set P for selection, judgment matrix R

and weight distribution vector W. Overall judgment process can be concluded into the following steps:

(1) Determination of factor set U and prepared object set P for selection. Prepared object for selection is namely scheme set in the evaluation, and it can be indicated as if there are n evaluation schemes:

P={P1, P2, ..., Pn}

Factor set is evaluation factor set of evaluation scheme, namely evaluation index set. It can be indicated as if there are m indexes:

U={X1, X2, ..., Xm}

(2) Finding out judgment matrix. $R = U \times P \to [0,1], r_{ij} = R(X_i, P_j) \in [0,1]$ is characteristic index of scheme Pj on factor Xi.

(3) Establishing weight set W of all indexes in factor set U. Weight set W can be calculated in the principle of AHP. Weight set $W = \{W1, W2, ..., Wm\}$ refers to importance and influence degree for all determined schemes, and it shall be satisfied that $0 < W_k < 1, \sum_{k=1}^{m} W_k = 1$.

(4) Determining fuzzy transformation, namely deciding corresponding rule to $\otimes$ for $B = W \otimes R$.

(5) Judgment result $B=(b1, b2, ..., bn)$ can be achieved according to defined fuzzy transformation rule, namely

$$B = (a_1, a_2 \ldots a_n) \otimes \begin{pmatrix} r_{11} & r_{12} & \ldots & r_{1m} \\ r_{21} & r_{22} & \ldots & r_{2m} \\ \ldots & \ldots & \ldots & \ldots \\ r_{n1} & r_{n2} & \ldots & r_{nm} \end{pmatrix}.$$

Rank order of corresponding evaluation object can be achieved from all value in $B=(b1, b2, ..., bn)$, thus optimal scheme can be determined.

4. Empirical analyses

It can be verified through empirical research whether reality of index system is scientific and reasonable and whether it can be ruler to evaluate e-commerce website more completely. Representative UGO website of e-commerce of TV shopping transformation is selected for website evaluation to verify usability and operability value of evaluation index system established hereinbefore.

Family living goods is the core of UGO, and it is devoted to forging domestic leading family TV shopping enterprise! UGO was founded in September in 2008 upon approval of State Administration of Radio, TV and Film and it is professional TV shopping channel covering the whole nation. It has covered places such as Beijing, Tianjin, Hebei, Henan, Shanxi, Shandong, Jiangsu, Zhejiang, Sichuan, Guangdong, Guangxi, Jiangxi, Hainan, Liaoning, Jilin, Heilongjiang, Anhui, Hunan, Hubei, Fujian, Inner Mongolia, etc. It has covered more than 220 cities for about 85 million families, and it is family shopping channel covering many areas and families in China.

4.1. Construction of dynamic fuzzy weight set and comment weight set of UGO website

Index system matrix is:

$$
F = \begin{bmatrix} F_{1n} \\ F_{2n} \\ F_{3n} \\ F_{4n} \\ F5n \end{bmatrix} = \begin{bmatrix} f_{11}, f_{12}, f_{13}, f_{14}, f_{15}, f_{16} \\ f_{21}, f_{22}, f_{23}, f_{24}, f_{25}, f_{26} \\ f_{31}, f_{32}, f_{33}, f_{34}, f_{35}, f_{36} \\ f_{41}, f_{42}, f_{43}, f_{44}, f_{45}, f_{46} \\ f_{51}, f_{52}, f_{53}, f_{54}, f_{55}, f_{56} \end{bmatrix}.
$$

Weight of W on F is:

$$
W = (w_1, w_2, w_3, w_4, w_5) = (0.24, 0.22, 0.15, 0.19, 0.20).
$$

E= [good, preferably good, ordinary, worse, bad]=[90, 75, 60, 45, 30] (4-3)
Analysis is conducted on design index module of website function

$B1 = W1 * R1$

$$
= (0.16, 0.16, 0.24, 0.17, 0.15, 0.12) * \begin{bmatrix} 0.5 & 0.2 & 0.1 & 0.16 & 0.04 & 0 \\ 0.4 & 0.3 & 0.1 & 0.1 & 0.1 & 0 \\ 0.7 & 0.1 & 0.12 & 0.08 & 0 & 0 \\ 0.36 & 0.44 & 0.4 & 0.1 & 0 & 0 \\ 0.1 & 0.4 & 0.24 & 0.16 & 0.1 & 0 \\ 0.12 & 0.14 & 0.56 & 0.1 & 0.08 & 0 \end{bmatrix}
$$

$$
= (0.4026, 0.2556, 0.215, 0.0978, 0.047, 0).
$$

The result of $B1 = (0.4026, 0.2556, 0.215, 0.0978, 0.047, 0)$ upon unitary calculation indicates 40.26% of the people think function design of UGO website is good; 25.56% think it is preferably good; 21.5% think it is ordinary; 9.78% think it is worse; the rest 4.7% think it is bad among 50 users investigated.

4.2. Analysis on design index module of website function

The result of $B1 = (0.4026, 0.2556, 0.215, 0.0978, 0.047, 0)$ upon unitary calculation indicates 37.42% of the people think function design of UGO website is good; 33.82% think it is preferably good; 16.48% think it is ordinary; 4.08% think it is

worse; the rest 8.2% think it is bad among 50 users investigated.

$$B2 = W2 * R2$$

$$= (0.22, 0.17, 0.16, 0.12, 0.18, 0.15) * \begin{bmatrix} 0.76 & 0.2 & 0.04 & 0 & 0 & 0 \\ 0.58 & 0.3 & 0.12 & 0 & 0 & 0 \\ 0.34 & 0.26 & 0.24 & 0 & 0.16 & 0 \\ 0.3 & 0.23 & 0.48 & 0.04 & 0.16 & 0 \\ 0.1 & 0.64 & 0.22 & 0 & 0.04 & 0 \\ 0.08 & 0.48 & 0 & 0.24 & 0.2 & 0 \end{bmatrix}$$

$$= (0.3742, 0.3382, 0.1648, 0.0408, 0.082, 0) .$$

5. Conclusions

A kind of construction way of user evaluation system for cross-border electronic commerce of mobile terminal based on fuzzy comprehensive evaluation of analytical hierarchical process was proposed in this thesis. Quality evaluation index of planning and design for e-commerce website was established and comprehensive evaluation index system was established in AHP method to realize effective construction of evaluation system model of e-commerce user.

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