

Logistics Service Quality Evaluation for E-Commerce Based on Extenics Theory

LI Qian^{1, a}

1 Neijiang Vocational and Technical College
Neijiang City 641100, China

^a Calla2015@163.com

Abstract — How to evaluate e-commerce logistics service quality research has not yet formed a complete and scientific theoretical system and method, the paper studies on this issue, using extension theory, the establishment of e-commerce logistics service quality evaluation model, an effective solution to the e-commerce logistics services quantitative evaluation of quality. In this paper extenics in primitive theory analysis method, through the expansion of e-commerce logistics service quality analysis, quality logistics services suited to e-commerce environment evaluation system, and the use of the nonlinear extenics extensive comprehensive evaluation establishes the evaluation model of e-commerce logistics service quality, effective solution to the evaluation of various indicators for different objects of the importance of different issues, has some practical value.

Keywords - E-Commerce, Logistics Service Quality Evaluation, Extenics Theory

I. INTRODUCTION

As the network continues to heat up and retail trade, e-commerce logistics market competition is extremely strong. Substantial growth in the size of the online retail market, where the market share of e-commerce gradually increased, has become the mainstay of e-commerce development. With the rapid development of e-commerce, enterprise quality of service consumers are increasingly high requirements, logistics service is considered to be one of the three main problems inhibiting the development of e-commerce, improve logistics service quality has gradually become e-business an important way to gain competitive advantage. So how to improve the market competitiveness of the enterprise has become a key problem. In this case, logistics service providers compete with quality characteristics of service attack, to compare the advantages of victory [1-3]. Visible, e-commerce logistics service quality is the business enterprise, the key logistics enterprises to maintain and enhance its market competitiveness. This article is based on this background topics, in-depth study of e-commerce and logistics service quality evaluation system and method for enterprises to improve the level of logistics services in the actual operation, to obtain a competitive advantage to provide important reference value.

Because of different industries have different characteristics, although studies on the evaluation of the quality of service are many, but the existing theory and experience does not fully apply to all industries and sectors, especially in logistics services for electronic commerce under the relevant study is not a lot, most of the research is focused on how to establish measurement model for the electricity supplier of logistics services, and this article focuses on the study of the electricity supplier logistics service quality evaluation model based on the establishment of e-commerce logistics service quality evaluation index system on evaluation model, and applied to a specific e-

commerce logistics service quality evaluation instance. This will be the quality of service and logistics service capacity of theories, combining the characteristics of e-commerce logistics services, the use of diamond thinking extenics, the feature electricity supplier of logistics services to expand the analysis to obtain under the influence of e-commerce environment logistics factors of quality of service, and to establish evaluation index system [4]. At the same time, the use of extenics in theory, for the index dynamic empowerment, and build e-commerce logistics service quality evaluation model. In order to verify the reliability and validity of the model, the paper selects representative Lynx Mall e-commerce sites as objects of applied research, evaluate their logistics services, and evaluate the results of a detailed analysis of how to improve the e-commerce logistics service quality guidelines direction. Therefore, the proposed theory has a certain value.

II. PROPOSED METHOD

The extenics theory describes matter elements in three elements: matter, character and corresponding character value. Matter element denotes logic cell of extenics theory [5]. It is assumed that three elements as a unity solve contradictory and incompatibility problems qualitatively and quantitatively. The symbol of the matter is defined as N , the character C , and the character value V . Therefore, the matter element is defined as $R = [N, c, v]$. The basic roadmap for the application of extenics is as follows: grading the evaluation target according to data value, constructing extenics model, setting the evaluation index into each rank set in turn for multiple index evaluation, and rating according to the comparison of correlation degree of evaluation results and each class set [6-8].

Define classical field

$$R_{0j} = (N_{0j}, C, V_{0ji}) = \begin{bmatrix} N_{0j} & c_1 & V_{0j1} \\ c_2 & V_{0j2} & \\ \dots & \dots & \\ c_n & V_{0jn} & \end{bmatrix} = \begin{bmatrix} N_{0j} & c_1 & \langle a_{0j1}, b_{0j1} \rangle \\ c_2 & \langle a_{0j2}, b_{0j2} \rangle & \\ \dots & \dots & \\ c_n & \langle a_{0jn}, b_{0jn} \rangle & \end{bmatrix} \quad (1)$$

where N_{0j} denotes the evaluated object, j ($j = 1, 2, 3, \dots, m$) is partition levels, C_i ($i = 1, 2, 3, \dots, n$) is the characters of the rank and N_{0j} is the effect degree. The characters here refer just to the evaluation indexes. $V_{0ji} = \langle a_{0ji}, b_{0ji} \rangle$ is a value scale of N_{0j} about character C_i , which is individual evaluation rank about the corresponding factors.

Define segment field

$$R_p = (P, C, V_p) = \begin{bmatrix} P & c_1 & V_{p1} \\ c_2 & V_{p2} & \\ \dots & \dots & \\ c_n & V_{pn} & \end{bmatrix} = \begin{bmatrix} N_{0j} & c_1 & \langle a_{p1}, b_{p1} \rangle \\ c_2 & \langle a_{p2}, b_{p2} \rangle & \\ \dots & \dots & \\ c_n & \langle a_{pn}, b_{pn} \rangle & \end{bmatrix} \quad (2)$$

where P refers to the set of every rank about the evaluation of matter; $V_{pi} = \langle a_{pi}, b_{pi} \rangle$ is the value scale of P about C_i , which represents P 's segment field.

Define evaluation of a matter element

For the evaluation of an object P , the collected data or analysis results of a matter element thus obtained is assigned the expected evaluation of the matter element R .

where P is an evaluated object, C_i is the factor of effect degree, and V_i is P 's value about the factor C_i .

Define the correlation of each rank about evaluation index

The correlation of each index V_i about each rank j is as follows:

$$K_{0j}(v_i) = \begin{cases} \frac{\rho(v_i, V_{0ji})}{\rho(v_i, V_{pi}) - \rho(v_i, V_{0ji})} & \rho(v_i, V_{pi}) - \rho(v_i, V_{0ji}) \neq 0 \\ \frac{-\rho(v_i, V_{0ji})}{|V_{0ji}|} & \rho(v_i, V_{pi}) - \rho(v_i, V_{0ji}) = 0 \end{cases} \quad (3)$$

$$\rho(v_i, V_{0ji}) = \left| v_i - \frac{a_{0ji} + b_{0ji}}{2} \right| - \frac{b_{0ji} - a_{0ji}}{2}$$

$$\rho(v_i, V_{pi}) = \left| v_i - \frac{a_{pi} + b_{pi}}{2} \right| - \frac{b_{pi} - a_{pi}}{2}$$

where $K_{0j}(v_i)$ is the dependent degree of No. i index value V_i ; V_{0ji} refers to the value field of No. i index subjected to No. j rank; $V_{0ji} = \langle a_{0ji}, b_{0ji} \rangle$ is the distance between No. i index value v_i and the classical field of No. j effect degree grade. $\rho(v_i, V_{0ji})$ is the distance between V_i and V_{0ji} .

The correlation of each evaluating object P about each evaluating rank j is defined as follows:

$$K_{0j}(P) = \sum_{i=1}^m a_i K_{0j}(v_i) \quad (4)$$

In the above formula, a_i is the index C_i 's weight coefficient, and $\sum_{i=1}^n a_i = 1$

The extension evaluation rank

If $K_{jmax}(P) = \max_{j \in \{1, 2, 3, \dots, m\}} K_{0j}(P)$, the evaluation P belongs to rank j^* .

$$\bar{K}_{0j}(P) = \frac{K_{0j}(P) - \min_j K_{0j}(P)}{\max_j K_{0j}(P) - \min_j K_{0j}(P)} \quad (5)$$

$$j^* = \frac{\sum_{j=1}^m j \times \bar{K}_{0j}(P)}{\sum_{j=1}^m \bar{K}_{0j}(P)} \quad (6)$$

j^* is termed rank variable characteristic value of P , and the degree towards another rank can be seen from j^* .

III. E-COMMERCE LOGISTICS SERVICE PROCESSES

E-commerce transaction is ultimately transferred to the buyer to physical products customers, but e-commerce transactions are ordering on a virtual network market, starting from the customer to confirm the order, in the form of ownership of the goods is transferred from the business flow of business-to-customer, but tangible physical goods did not happen quickly transfer, e-commerce cannot be as instantaneous physical movement of goods as a traditional transaction, must rely on the corresponding logistics activities, according to the order logistics needs of customers relying on the physical goods in an appropriate way, way transfer occurs only when commodity completely transferred to the hands of consumers, business-to-customer service until the end [9]. Therefore, the logistics support is an important part of e-commerce commerce transactions. Commerce logistics service quality research based on quality of service and related logistics service quality based on the theory, according to the theory of the foregoing, the e-commerce logistics service quality is defined as: consumer e-commerce website after the actual purchase behavior, customer Satisfaction merchants provide logistics services, this level of satisfaction is perceived by the gap between expectations and actual customer service and logistics reflected [10-12]. Customer evaluation of logistics service quality not only to consider the results of the service, but also to the whole process of service, therefore, study commerce logistics service quality, we must first understand the specific process of e-commerce logistics services, as shown in figure 1.

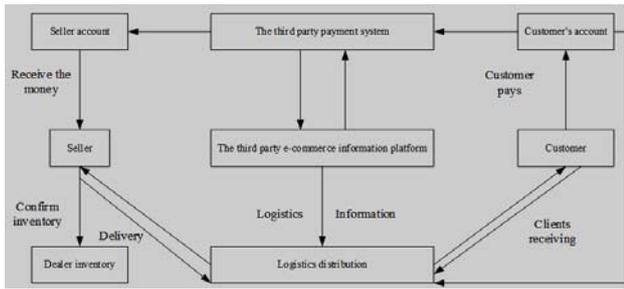


Figure 1. Process for e-commerce logistics service.

In the e-commerce environment of logistics services, the whole process is in accordance with e-commerce features unified management and scheduling information, in accordance with the needs of the customer orders, the logistics center sorting, distribution and final goods with a good selection of suitable logistics Mode goods forwarded to the customer, and the process of logistics information through e-commerce platform for feedback information to consumers. In addition, the logistics services also include collect payment, assume refunds and other related value-added logistics services. Commerce logistics processes As shown, jobs are generally divided into physical and virtual job in two parts. The biggest difference between e-commerce logistics and logistics in the traditional sense is that the virtual processes, virtual work under the supervision of the whole process of information, including information from the extract stream of orders, produce goods tracking number, accept the cargo tracking requests, feedback cargo tracking information, send pay a single billing information, feedback return information and a series of operations. The physical processes are generally the same as with traditional logistics processes, including warehousing, picking, picking, packing, sub-put, with group, distribution, sale and return and other steps. In the actual process of logistics services, real jobs and imaginary body work are inseparable, physical work in driving virtual operations carried out under the feedback information entity virtual job, it can be said, e-commerce is "with actual situation" of the product.

Choose effective logistics approach is key to enhancing the quality of logistics services. From the ecosystem of e-commerce logistics point of view, for businesses choose the logistics model can be summarized in three categories, one for the financial strength of large enterprises, can choose self-built logistics system and third-party logistics and win-win model. Such enterprises in the country have their own sales network, and need to be upgraded to be able to form its own distribution network, its own logistics system to complete the logistics companies and distribution centers all over the room, and completed by the third-party logistics companies Distributor last kilometer of the center between the consumer and distribution. The second category is the business with the rest of the logistics enterprises to establish a regional logistics alliance, most of the logistics enterprise network is limited to certain areas, through cooperation with the advantage of logistics enterprises set up regional logistics alliance, we can actively respond to the rapidly changing market demands, risk-sharing and common profits. The third

category by the merchant directly to a third party logistics outsourcing logistics companies to complete logistics services. Although e-commerce logistics service e-commerce businesses because of the situation, using the logistic model and customer requirements differ, but the impact of e-commerce ultimate consumer perception of logistics service quality factors and the evaluation methods are the same. Therefore, the evaluation system and evaluation methods herein, the logistics service quality for the establishment of e-commerce logistics model for the use of different e-commerce logistics services are applicable.

IV. CONSTRUCTION OF EVALUATION SYSTEM

The departure divergent expansion characteristic motif, summarized from e-commerce logistics services for the transparency of their own property, completeness, reliability, timeliness, economy and empathy dimensions, thus as e-commerce logistics service quality evaluation level indicators index system, will feature the corresponding primitives as respective secondary index, index system shown in Figure 2, a detailed analysis the following aspects.

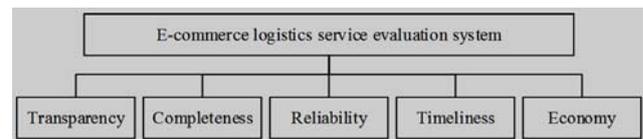


Figure 2.E-commerce logistics service evaluation Index system.

Transparency means that consumers get to experience rapid process of e-commerce logistics services, timely and accurate logistics information, as far as possible eliminate information service providers and consumers asymmetry between the important information related to the transaction back to the customers, customer logistics information clear in mind. Corresponding indicators: exhaustive, goods information integrity guidance notes, and whether information has ordered prompt delivery schedule.

Completeness refers to e-commerce merchants to provide ordering system fully functional, enabling consumers to implement quick and easy operation, flexible way of logistics services offered to meet the different requirements of customers, along with measures to improve the reasonable handle emergencies. Corresponding indicators include: ease of operation processes, diversity of payment, receipt mode diversity, diversity of return service, completeness of action.

Staff Reliability refers to the ability of logistics services offered by e-commerce merchants can be trusted, which provides logistics services to comply with the commitment in the service process, to ensure customer satisfaction providing proper logistics services to protect customer privacy and security, make customer service the whole process a pleasant experience. The corresponding indicators include: the accuracy of order processing, will disclose transaction information, whether personal data can be transmitted intact security, accuracy goods, goods, whether proper packaging.

Timeliness refers to the time and speed of e-commerce merchants to provide logistics services, timely and effective

status customers solve problems and meet the needs of the customer raised. Corresponding indicators include timeliness order response, order release cycle, answer response rate, the agreed delivery time, error processing speed.

Economy refers to the need to pay the cost of logistics services, logistics services not only to consider their own costs, but also consider the costs associated with the cost of the services being paid, in addition to the time the return service, logistics costs borne by businesses is whether the customer great concern. Corresponding indicators include: logistics price, service cost, return service charges.

V. COMMERCE LOGISTICS SERVICE QUALITY EVALUATION MODEL BASED ON THE EXTENICS THEORY

In order to comprehensive and objective evaluation of logistics service quality, the use of primitive extenics theory and expand analytical method starting from different aspects of e-commerce logistics service quality attributes, the perspective of logistics service quality are described and analyzed, and the establishment of a multi-index evaluation system. Commerce logistics service quality evaluation based on topological theory first be evaluated to determine the conditions of evaluation and measure objects that determine the evaluation index system; the second step, to collect relevant data and index data with different units of measurement were measure treatment; the third step, the index system to determine the weights of each indicator; the fourth step, the mathematical model of comprehensive evaluation, comprehensive evaluation index calculation or comprehensive evaluation scores; and finally, based on the evaluation index or score can single Evaluation of objects grade evaluation or sorting a plurality of evaluation units, leading to the conclusion. This article preclude the use of non-linear extension comprehensive evaluation method, which built on the basis of the extension set theory, be used to evaluate an object, including the pros and cons of things, methods and strategies.

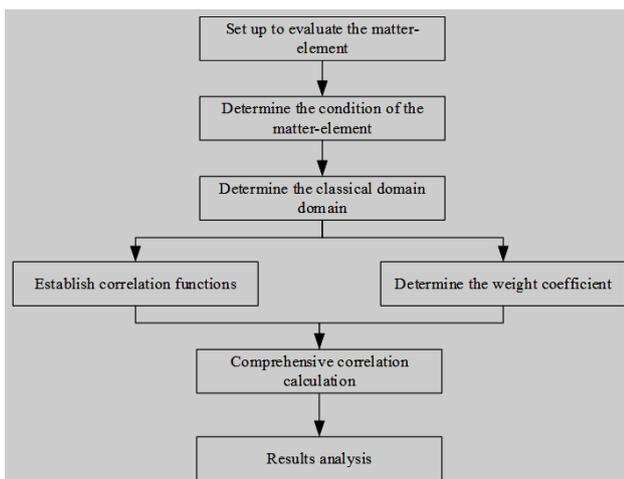


Figure 3. Process of nonlinear extenics evolution method.

It is through the establishment of multi-index Matter - element model to describe the contradictions, to establish

indicators to evaluate the correlation function object qualitative and quantitative analysis, to measure the relationship between the elements and the set value by the size of the correlation function, and thus the evaluation object Comprehensive reasonable evaluation, comprehensive evaluation method of nonlinear extension of the evaluation process shown in Figure 3.

VI. CASE STUDY

Determine drought evaluation indices of logistics service evaluation.

The five representative indices [3-4] which are used to estimate the degree of logistics service evaluation are introduced. And the measured values are shown from the Table I.

TABLE I. MEASURED VALUES OF LOGISTICS SERVICE EVALUATION INDICES

Transparency	Timeliness	Reliability	Timeliness	Economy
-70	3.6	-77	0.6	80

The evaluation levels are divided into normal, mild, moderate, severe and serious groups. And the Table II lists the standard intervals of all indices about the different grades.

TABLE II. STANDARD INTERVALS OF INDICES ABOUT THE DIFFERENT GRADES

Grade	Transparency	Timeliness	Reliability	Timeliness	Economy
normal	[-20,0]	[0.5,1]	[-10,0]	[0,0.2]	[0,5]
mild	[-30,-20]	[1,1.5]	[-30,-10]	[0.2,0.4]	[5,20]
moderate	[-50,-30]	[1.5,2.5]	[-50,-30]	[0.4,0.6]	[20,30]
severe	[-80,-50]	[2.5,3]	[-80,-50]	[0.6,0.8]	[30,50]
serious	[-100,-80]	[3,20]	[-100,-80]	[0.8,1]	[50,100]

Determine the assessed matter-element. For building land ranking assessment, the mean values observed can be described as the following matter-element.

$$R = (N, c, v) = \begin{bmatrix} N & c_1 & v_1 \\ & c_2 & v_2 \\ & c_3 & v_3 \\ & c_4 & v_4 \\ & c_5 & v_5 \end{bmatrix}$$

where N is the grade of logistics service evaluation; C_j refers to the evaluation index; V_i presents the mean value observed in characteristic.

Determine the classical field and segmental field and matter-element model. According to the description of Table

I and Table II, the classical field R_o of drought indices can be written as:

$$R_o = \begin{bmatrix} N & N_{o1} & N_{o2} & N_{o3} & N_{o4} & N_{o5} \\ c_1 & [-20,0] & [-30,-20] & [-50,-30] & [-80,-50] & [-100,-80] \\ c_2 & [0.5,1] & [1,1.5] & [1.5,2.5] & [2.5,3] & [3,20] \\ c_3 & [-10,0] & [-30,-10] & [-50,-30] & [-80,-50] & [-100,-80] \\ c_4 & [0,0.2] & [0.2,0.4] & [0.4,0.6] & [0.6,0.8] & [0.8,1] \\ c_5 & [0,5] & [5,20] & [20,30] & [30,50] & [50,100] \end{bmatrix}$$

$$R = (P, c, v) = \begin{bmatrix} P & c_1 & -70 \\ & c_2 & 3.6 \\ & c_3 & -77 \\ & c_4 & 0.60 \\ & c_5 & 80 \end{bmatrix}$$

while the segmental field R_p can be written as:

$$R_p = (N_p, c, v_p) = \begin{bmatrix} N_p & c_1 & [-100,0] \\ & c_2 & [0.5,20] \\ & c_3 & [-100,0] \\ & c_4 & [0,1] \\ & c_5 & [0,100] \end{bmatrix}$$

Then the evaluated matter-element model R will be:

calculate the weights of indices. Actually, if the grade which the datum of index belongs to is higher, it will be unfriendly to the drought conditions. So the index C should be endowed greater weight. Therefore, the index weight vector is

$$\omega = (0.25, 0.15, 0.18, 0.16, 0.26)$$

Since the smaller the data of drought index, crop water shortage degree and drought area percent are, the more weaken the Dalian City's drought condition should be within certain scope. Thus the simple dependent functions which the optimization point x_0 is the left end point of interval $0 \leq X$ are established for the three indices. Similarly, for the precipitation anomaly percent index and water anomaly percent index, the simple dependent functions which the optimization point x_0 is the right end point of interval $0 \leq X$ are established. Then the dependent degrees of all indices about the different grades are calculated, and the synthesis dependent degrees can be obtained on the basis of weight as shown in Table III.

TABLE III. CALCULATION FOR THE DEPENDENT DEGREE AND SYNTHESIS DEPENDENT DEGREE

degree	dependent degree					synthesis dependent degree Kt(P)
	C1	c2	C3	C4	C5	
I	-0.625	-0.45614	-0.74444	-0.5	-0.78947	-0.64393
II	-0.57143	-0.40385	-0.67143	-0.33333	-0.75	-0.57262
III	-0.4	-0.2619	-0.54	0	-0.71429	-0.4222
IV	0.2	-0.16216	0.06	0.33333	-0.6	-0.06619
V	-0.25	0.84103	-0.11538	-0.33333	0.4	0.09355

From the calculation results in Table III, the synthesis dependent degree of the case building is [-0.62301 - 0.54601 -0.38324 -0.03377 0.10846]. It is obviously that the fifth component of the vector is the maximum and positive number which means the logistics service evaluation is the V. But it is not very serious, because the positive number is smaller. Then the final grade index is calculated is $t^* = 4.23201$. It has once again proven the results above. And some efforts should be made to alleviate the conditions.

VII. CONCLUSION

In this paper, based on the extenics theory, combining the characteristics of e-commerce logistics services, the establishment of evaluation index system, constructing mathematical evaluation model, we propose a method for quantitative evaluation of e-commerce logistics service quality. By rhombus thinking, binding motif extenics theory and expand analytical methods to establish matter element model to evaluate the object, using a plurality of features on the expansion element analysis was used to build e-

commerce logistics service quality evaluation three index system, the first layer that is the target layer for e-logistics service quality, and the second, three for the two indicators layer, level indicators are transparency, completeness, reliability, timeliness, economy and empathy, two indicators are lower index level indicators, a total composed by the indicators. Using the extenics theory to establish the index system, it is the first innovation of this paper. The process of e-commerce logistics service quality evaluation index value of empowerment, we use a simple correlation function method extenics theory, this approach avoids the interference of human factors evaluation results, taking into account the index data will fall into the rating scale the impact of the index weight, to solve the same index in different evaluation objects in different issues of importance, so that the right of each index is more reasonable, more convincing, so that the final results of the evaluation more objective. This is the second innovation of this paper. E-commerce logistics service quality established quantitative evaluation model, using a comprehensive evaluation extenics theory, the nonlinear extension comprehensive evaluation method can

evaluate the quality of service for e-commerce logistics quantify discussion to solve the Evaluation of the quantification and practical issues, and to establish a reliable mathematical model for the evaluation of e-commerce logistics service quality, in order to solve other evaluation question provides a theoretical reference.

REFERENCES

- [1] Kersten W, Koch J. The effect of quality management on the service quality and business success of logistics service providers[J]. *International Journal of Quality & Reliability Management*, 2010, 27(2): 185-200.
- [2] Zheng G, Zhu N, Tian Z, et al. Application of a trapezoidal fuzzy AHP method for work safety evaluation and early warning rating of hot and humid environments[J]. *Safety Science*, 2012, 50(2): 228-239.
- [3] Juga J, Juntunen J, Grant D B. Service quality and its relation to satisfaction and loyalty in logistics outsourcing relationships[J]. *Managing Service Quality: An International Journal*, 2010, 20(6): 496-510.
- [4] Chou C C, Liu L J, Huang S F, et al. An evaluation of airline service quality using the fuzzy weighted SERVQUAL method[J]. *Applied Soft Computing*, 2011, 11(2): 2117-2128.
- [5] Baki B, Sahin Basfirinci C, Murat AR I, et al. An application of integrating SERVQUAL and Kano's model into QFD for logistics services: A case study from Turkey[J]. *Asia Pacific Journal of Marketing and Logistics*, 2009, 21(1): 106-126.
- [6] Liu H T, Wang W K. An integrated fuzzy approach for provider evaluation and selection in third-party logistics[J]. *Expert Systems with Applications*, 2009, 36(3): 4387-4398.
- [7] Zheng G, Jing Y, Huang H, et al. Application of life cycle assessment (LCA) and extenics theory for building energy conservation assessment[J]. *Energy*, 2009, 34(11): 1870-1879.
- [8] Shan W, Zhang Q. Extension theory and its application in evaluation of independent innovation capability[J]. *Kybernetes*, 2009, 38(3/4): 457-467.
- [9] Huang Y K, Kuo Y W, Xu S W. Applying importance-performance analysis to evaluate logistics service quality for online shopping among retailing delivery[J]. *International Journal of Electronic BusinessManagement*, 2009, 7(2): 128.
- [10] Yun R, Lu Y, Filip P. Application of extension evaluation method in development of novel eco-friendly brake materials[J]. *SAE International Journal of Materials and Manufacturing*, 2009, 2(2009-01-3019): 1-7.
- [11] Chen S H. Establishment of a performance-evaluation model for service quality in the banking industry[J]. *The Service Industries Journal*, 2009, 29(2): 235-247.
- [12] McIvor R. How the transaction cost and resource-based theories of the firm inform outsourcing evaluation[J]. *Journal of operations management*, 2009, 27(1): 45-63.