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SERVICE CAPABILITY EVALUATION OF THIRD PARTY LOGISTICS ENTERPRISE IN E-COMMERCE ENVIRONMENT

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ABSTRACT

In the new E-commerce environment, it is necessary to evaluate the service capability of logistics enterprises. To this end, this paper deals with a new quantitative approach to the service capability evaluation of third party logistics enterprises. Firstly, based on the GQM (Goal Question Metric), a set of service capability evaluation index system of logistics enterprises is proposed. Secondly, based on the index system, the service capability evaluation model is built and the corresponding algorithm, i.e., Refining High Index (RHI) algorithm, is given. Finally, an example is used to show the application of the service capacity evaluation indexes, evaluation model and RHI algorithm, which provides quantitative references for service capability evaluation of logistics enterprises.

Keywords: *Service Capability, Quantitative Evaluation Model, Third Party Logistics Enterprise, Refining High Index Algorithm, E-Commerce*

1. INTRODUCTION

With the development of information technologies, E-commerce has developed rapidly and has become an important way for enterprises to win the competition in the market. On one hand, E-commerce has presented new opportunities to services of logistics enterprises. On the other hand, it also brought about challenges for logistics enterprises, because the service capability of the logistics enterprise is the core competitiveness of logistics enterprises and an important weapon to win in E-commerce environment. However, what does the service capability of the logistics enterprise embody? Furthermore, what should enterprises strengthen in their services to enhance core competition? These problems can be attributed to the service capability evaluation of third party logistics enterprises. So far, with the rapid development of E-commerce [1], the third-party logistics enterprises play a more and more important role, and logistics service capability evaluation has become an unavoidable issue in the development of the logistics industry. Therefore, this paper studies the service capability evaluation of third-party logistics enterprises in E-commerce environment.

Logistics service level is the comprehensive capacity of the third party logistics enterprises in cost control, quality management, flexibility, fast response, customer service, information service and development in the process of meeting customer needs, creating customer value and realizing the enterprise value [2-3]. So far, researches on logistics enterprise service have focused on: the study of logistics service concepts [4-5], logistics service factor analysis [6-7], logistics service evaluation [8] and so on. Among those various studies, methods on the evaluation of logistics service capabilities include TOPSIS approach, analytic hierarchy process approach, fuzzy comprehensive evaluation method [9] and so on. For example, reference [4] pointed out that logistics service capability is determined by factors such as EDI connection, transport, warehouse, and freight consolidation payments and so on. Reference [5] put forward four kinds of customer oriented service ability, which is related to logistics enterprise service performance level, relevance, reliability and flexibility. Reference [6] suggested that the logistics service capacity exists mainly in the supply chain distribution stages of logistics system, which is the external logistics capability by the final customer perception and evaluation. Reference [8] presented entropy weight-double base points method to evaluate the ability of logistics service. In conclusion, all of these studies can realize the evaluation on the service level of logistics enterprises to a certain extent, however, these

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studies mostly belong to the qualitative analysis and did not form a complete index system. What's more, evaluation methods in these studies depend on the index value. Therefore, it is necessary to carry out a systematic analysis and evaluation on the service capability of logistics enterprises in E-commerce environment.

This paper obtained the logistics service index system of the third party logistics enterprise in the E-commerce environment based on the GQM method, and established a service capacity evaluation model. Through the layer-by-layer analysis method, the service level of the third party logistics enterprise is evaluated. This provides quantitative basis for logistics service level evaluation and the choice on logistics enterprises.

2. LOGISTICS SERVICE LEVEL INDEX SYSTEM

2.1 GQM method

GQM is a widely used, object oriented metrics modeling method [10]. GQM method is proposed by Professor Victor Basisli of Maryland University in the mid 1980s, which is a goal-oriented method on software product and process measurement. And GQM method has been used in various fields, for example, Liu Xiaowen et. al. [11] applied GQM method for quantitatively research on IT governance measurement model and support system.

GQM summarized the goals of the organization, broke them down into measurable indicators and made these indicators refined into measurable value, which is an object-oriented metrics, and also a scientific, logical way of thinking. Based on the specific needs of the project and the organization, GQM model are to provide software managers a model to achieve management goal, design a set of software measurement system, and apply a systematic approach to reduce and integrate the various targets of the software process and product models. The implementation process of GQM method is a top-down analysis process. And the model has a three-layer structure: Goals layer, Questions layer, Metric layer.

Goal layer: The definition of project goals under the specific environment is determined by many reasons, which may be about product, process and resource.

Question layer: A series of problems for evaluation goals should be proposed based on the relevant properties, and the selected problem should define a measure target instead of data without principles. Otherwise, it will cause the workload increase and data waste.

Metric layer: Whether these data are objective or subjective, data collection should be associated with each problem.

2.2 Index system of logistics services level

According to the GQM method, the service level index set of the third-party logistics enterprises in the E-commerce environment is obtained this paper, as shown in Table 1. And the basic operation capability indicator is taken as an example to show the sub index measurement shown in Table 2. Similarly, other sub- indicators can be obtained.

The service level index system of the third-party logistics enterprise in the E-commerce environment is shown in Figure 1, and the specific content of the index system is as follows:

(1)Basic operation capability. Third-party logistics enterprises in the E-commerce environment provide warehousing, packaging, processing, sorting, loading and unloading, handling and distribution, transportation and other basic services for customers. Combined with the characteristics of E-commerce operations such as operational tools of information technology, network, customer decentralization, demand fluctuation, small batch of orders, and the service equalization, the following indicators to measure the basic operation capability of the third-party logistics enterprises are put forward.

Storage capacity: The indicator can be measured through three indicators including the warehouse capacity, warehouse utilization rate, and inventory turnover rate.

Table 1 Description Of Sub-Goals

Sub-Goal	Description of the sub-index
Sub-Goal A: The basic operation capability	Describe the capability of infrastructure to meet the requirements of logistics service
Sub-Goal B: Customer Service Quality	Describe the capability of infrastructure to meet the requirements of customers
Sub-Goal C: Service charges	Describe the cost of providing logistics services
Sub-Goal D: Service time	Describe the time of providing logistics services
Sub-Goal E: Information service capacity	Describe the capability of information processing to provide logistics services

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Table 2 *The Metrics Of Sub-Goal A (The Capabilities Of Basis Operational)*

Criterion	Metric symbols	Question and metrics
Q1		Whether the warehouse is used effectively
M1		Warehouse utilization rate of
M1.1	n	Warehouse capacity
M1.2	m	Actual warehouse utilization area
Q2		Realization of the enterprise inventory assets
M2		inventory turnover level
M2.1	C	Average cost based on historical data
M2.2	MR	Average inventory balances based on historical data
Q3		
M3		Whether it can be quickly picked
M3.1	DR	Picking amount in unit time
M3.2		Picking quality
M3.2.1	CM	Picking error rate
Q4		Whether the communication with the transit point is smooth
M4	QR	The number of shipping courier to the transit station in unit time
Q5		Transport turnover speed
M5	TR	Transport turnover rate
Q6		Whether transportation tools are used effectively
M6		Utilization of transport equipment
M6.1	$T(IU)$	The number of transport equipment in the service
M6.2	$T(NIU)$	The number of transport equipment in the idle service

Sorting handling capacity: The indicator can be measured through three indicators including the total picking ability, picking ability, and picking quality.

Transport capacity: The indicator can be measured through three indicators including the number of express delivery to the transit station, transport turnover rate, utilization efficiency of transport equipment.

Distribution capacity: The indicator can be measured through five indicators including the distribution accuracy, distribution security, delivery timeliness, distribution economy, collaborative distribution capacity.

(2)Customer service quality: The high quality of service not only enhances satisfaction of customers, but establishes a good image for E-commerce. Therefore, the indicator can be measured by the customer satisfaction, document accuracy, delivery error rate and other indicators as follows.

Customer satisfaction: The indicators can be measured by the ratio of customer complaints, resolution time of customer complaints, customer complaint resolution ratio, and customer concerned degree.

Document accuracy: The indicator can be measured by the accuracy of the recorded order information

Delivery error rate: The indicator can be measured by the accuracy degree of shipment.

Delivery flexibility: The indicator can be measured by the adaptability of the market demand on logistics enterprises.

Emergency logistics service capability: The indicator refers to the ability to meet the emergency needs of customers, which can be measured by the temporary storage capacity, temporary transportation capacity, and temporary distribution capacity.

Defense capability of the logistics risk: The indicator can be reflected by the capacity of defending against the threat, which may be caused by man-made or natural risks.

Personalized logistics service type: The indicator can be measured by the number of personalized logistics services in small batch and multiple varieties.

Feedback processing speed: The indicator can be measured by the proportion of the feedback questions which are timely solved and the total number of feedback problems.

(3)Service charge: Logistics activities have the operating costs, which mainly include the logistics management cost, information cost, inventory cost, transportation cost, distribution processing cost, and warehouse cost and so on. The indicators can be measured by the following indicators.

Logistics management cost: The indicator can be measured by labor costs of logistics management

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department, office expenses, and cost of consumed materials.

Information cost: It refers to the cost of collecting and processing information. The indicators can be divided into fixed costs and variable costs. Fixed costs can be measured by depreciation charges of fixed assets, daily maintenance fees, management fees, basic wage and variable costs can be measured by order processing costs and logistics information processing costs.

Inventory cost: It means the cost of the goods stored in the warehouse. The indicator can be measured by orders fees, purchase fees, custodial fees, overstock cost, and outdated product cost.

Transportation cost: The indicator can be measured by the transport personnel costs, the cost of transport equipment, transport energy consumption and other related logistics costs.

Distribution processing cost: The indicator can be measured by paying the processing fees of external circulation and the processing fees of its own equipment.

Warehouse cost: Warehouse cost plays an important part in the logistics cost. The indicator can be measured by the warehouse rent, manual operation fee, insurance premium, depreciation of machinery, and machine repair fee.

Maintenance fee: As all kinds of equipments and facilities need to be maintained in the fixed period, the indicator can be measured by a certain amount of maintenance fees in the process of logistics activities.

Packing charge: The indicator can be measured by packing expenses of the logistics activities in order to protect the goods.

Loading and unloading charge: The indicator can be measured by the cost in the loading, unloading and handling of logistics activities.

Return fee: The indicator can be measured by the cost of customer's returns or exchanges without satisfaction.

(4)Service time: In E-commerce environment, the more quickly goods arrives, the higher customer satisfaction is. The indicator can be measured by the average transportation time, average pick-up

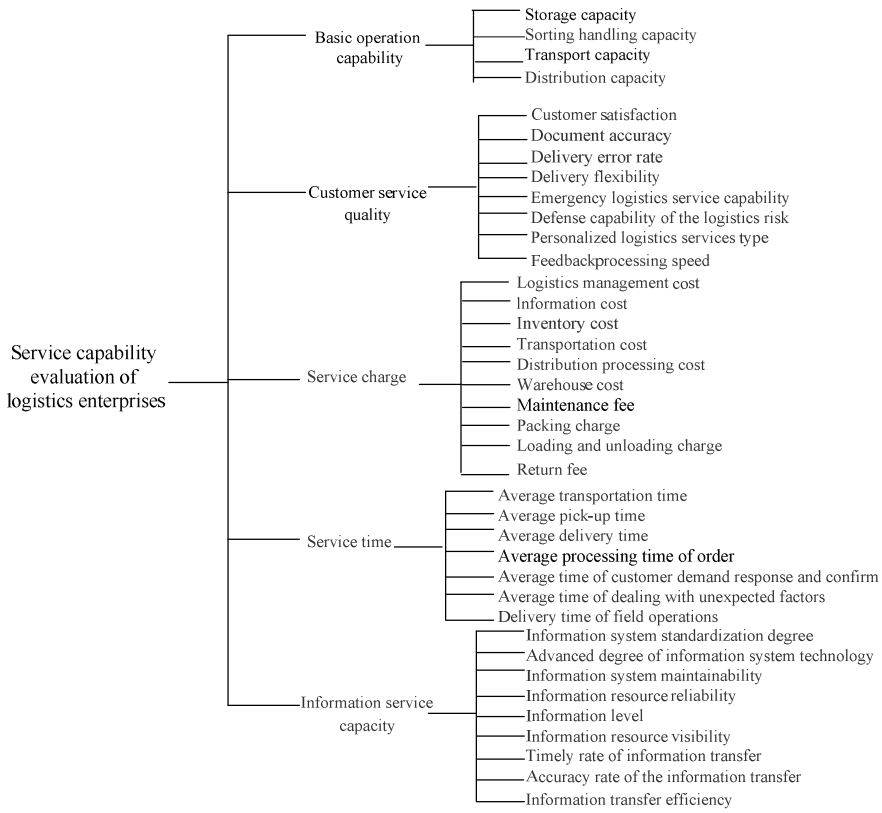

Figure 1 *The Services Level Index System Of Third-Party Logistics Enterprises In The E-Commerce Environment*

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time, average delivery time, average processing time of order, average time of customer demand response and confirm, average time of dealing with unexpected factors, and delivery time of operations.

Average transportation time: The indicator can be measured by the average transportation time of goods from collection of transit station in sellers' city to the transit point of purchaser's city.

Average pick-up time: The indicator can be measured by the average time of the commodity packed to the city of transit point.

Average delivery time: The indicator can be measured by the average period of goods or services to reach the agreed place and complete the business.

Average processing time of order: The indicator can be measured by the average time from the receipt of the order until the completion of the order.

Average time of customer demand response and confirm: The indicator can be measured by the average time of finding customers demand, negotiating orders, and accepting customer orders.

Average time of dealing with unexpected factors: The indicator can be measured by the average time of logistics enterprises to cope with a variety of unexpected situation.

Delivery time of operations: The indicator can be measured by the required time of goods or services to reach the agreed place until the business completed.

(5)Information service capacity: Compared with the traditional retail business activities, E-commerce operations are based on the Internet and Web technology. To enhance rapid response ability, logistics enterprises in E-commerce environment need higher capacity of information service. The indicator can be measured by the degree of information systems standardization, advanced degree of information systems technology, information system maintainability, information system reliability, information resource visibility, accuracy rate of the information transfer, information transfer efficiency and so on.

Information systems standardization degree: Logistics information system is to collect, process, analyze and transfer the flow of information in the process of logistics services, whose degree of standardization has a great impact on business performance. The indicator can be reflected through information flow management level of the third-party logistics enterprises in the process of logistics services.

Advanced degree of information system technology: The indicator can be reflected through the use of bar code technology, network technology, identification technology, advanced logistics technology in the third-party logistics enterprises, which reflects the information level, but also is an important symbol of the modernization of logistics enterprises.

Information system maintainability: The indicator can be reflected by information systems' adaption to the changing environment, the performance of timely maintenance or determining the systems' error, and the required effort to correct errors.

Information resource reliability: The indicator can be measured by the number of faults in the unit time or the proportion of the time to failure in the working time.

Information level: The indicator can be reflected by the satisfaction of business leaders, managers, business personnel system and other respects.

Information resource visibility: The indicator can be reflected by the real-time, full visibility of information in the entire supply chain.

Timely rate of information transfer: The indicator can be measured by the ratio between the number of in time, correct transmission and that of total information transmission.

Accuracy rate of the information transfer: The indicator can be measured by the ratio between the number of accurate transmission and that of total information transmission.

Information transfer efficiency: The indicator can be reflected by the ability of the third-party logistics enterprise to distinguish information and the customer information needs, which can be measured by the ratio between the effective information transmission and that of total information transmission.

3. SERVICE LEVEL EVALUATION OF THE THIRD-PARTY LOGISTICS ENTERPRISE

3.1 Evaluation model

According to the service level evaluation index system of the third-party logistics enterprise, this paper proposes a new evaluation model of logistics service level, the main content is shown in Figure 2.

(1)Left wall: It consists of index layers, which includes the basic operation capability, customer service quality and so on.

(2)Roof: It consists of refined indicators, which are refined by the indicator layer.

(3)Room: It consists of the relationship matrix between the index layer and its refined indicators,

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the standard value of the refined indicators and the actual value of the enterprise.

(4)Basement: It consists of the importance degree, service level index and criterion layer, which corresponds to the index layer.

3.2 Evaluation algorithm

According to the above logistics service level evaluation index system and evaluation model, this paper utilizes the refined high-level indicator (RHI) algorithm to evaluate the logistics service level. The specific steps are as follows:

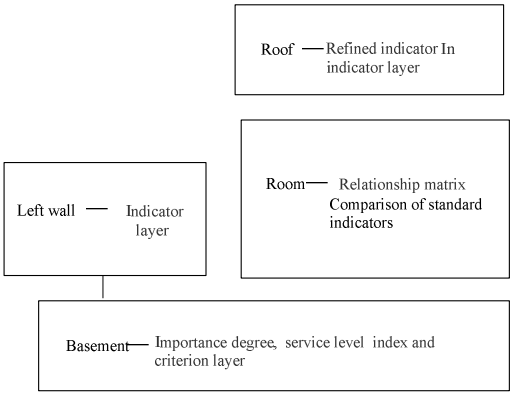

Figure 2 Service Level Evaluation Model

Algorithm 1: RHI algorithm for third-party logistics service level evaluation in E-commerce environment.

Step1：Build left wall. Assume that an important degree of each index layer corresponding indicator $k_i\left(i=1,2,\cdots m\right)$ has five levels, and the importance degree gradually increases from level 1 to level 5.

Step2: Build the roof. The roof primarily consists of the refined indicators in each indicator layer.

Step3: Construct the room. Assume that there are six levels $r_{ij}\left(i=1,2,\cdots,m;\ j=1,2,\cdots,n\right)$ of the relationship between each indicator layer and the refined indicators. The relation degree increases gradually from level 1 to level 6. However, the standard value of refined indicators and the actual value of the enterprise can be obtained through the investigation.

Step4: Clear the relationship between the refined indicators (Evaluation indicators at the same level have mutual independence).

Step5: Calculate the importance scores h_j and important degree h_j' of refined indicators. The equation of the importance scores h_j and important degree h_j' of refined indicators is as follows:

$$h_j=\sum_{i=1}^{m}k_i r_{ij}\qquad\left(j=1,2,\cdots,n\right)$$

$$h_j'=\frac{h_j}{\sum_{j=1}^{n}h_j}\qquad\left(j=1,2,\cdots,n\right)$$

The greater the value of h_j' is, the more important the refined indicator j is.

Step6: Obtain the service level $w_j\left(j=1,2,\cdots,n\right)$ of each refined indicators, which can be measured by the ratio between the gap of the current index value and the standard value.

$$w_j=1-\left|\frac{\text{Gap}}{\text{Standard value}}\times 100\%\right|$$

Step7: Calculate service level index R_j of the refined index. According to the service level and the importance degree of the refined indicators, the calculation formula is as follows:

$$R_j=\sum_{j=1}^{n}w_j h_j'$$

Step8: Calculate service level of the criterion layer index (Weighted Average Service Value, which is credited as WASV).

$$WASV=\sum_{j=1}^{n}R_j$$

Step9: After calculating the service level of the criterion layer index, goto Step 1. According to the above steps, we can obtain the final service level index of logistics enterprises.

In addition, some of the indicators in the table can not be fully quantified, and five grades of A, B, C, D, E is used to evaluate them. A——quite satisfied with the conditions; B——satisfied with the conditions; C——somewhat satisfied with the conditions; D——narrowly satisfied with the condition; E——hardly satisfied with the conditions, which is conducive to the quantitative evaluation of service level indicators.

4. EXAMPLE

To show the logistics service evaluation method, this paper takes logistics service of a certain logistics enterprise as an example to show the application of evaluation index system, evaluation

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	Basic operation capability	Customer service quality	Service charges	Service time	Information service capacity
Importance scores	5	7	3	7	5
Importance degree	0.1852	0.2593	0.111	0.2593	0.1852
Level Index	0.7835	0.7513	0.6347	0.7635	0.7623
Index of logistics service capability	0.1451	0.1948	0.0705	0.1980	0.1421
The final index of logistics service capability is 0.7505					

Figure 4 *Logistics Service Level Of An Enterprise*

model and algorithm. Firstly, the relevant departments in the enterprise are investigated to obtain data. Then, based on the data, the importance score and a relationship degree are determined, and the evaluation model is established. Finally, based on RHI algorithm, the index of the enterprise logistics service level is obtained.

Basic operation capability evaluation is taken as an example to show the calculation of the criteria layer indicators, as shown in Figure 3. In the same way, other value of the layer indicators can be calculated, and the results are as shown in Table 3.

Table 3 Values Of Criterion Layer

Index	Basic operation capability	Customer service quality	Service charge	Service time	Information service capacity
Value	0.8424	0.7513	0.7374	0.7635	0.7623

		Warehouse capacity to meet demand	Warehouse to use effectively	Inventory turnover level	Total Picking ability	Picking ability	Picking quality	Ability of shipping courier to the transit station	Rate of transport turnover	Transportation tools to use effectively	Timely accuracy of distribution
Importance scores		5	7	7	5	3	5	3	1	3	7
Standard indicators		A	100%	A	80%	A	B	B	C	B	A
Corporate indicators		B	80%	A	50%	B	B	C	C	C	B
Results	Importance degree	0.1087	0.1522	0.1522	0.1087	0.0652	0.1087	0.0652	00217	0.0652	0.1522
	Index of refined indicators	0.7143	0.8	1	0.6250	0.7143	1	0.6	1	0.6	0.7143
	Basic operation capability index of refined indicators	0.0776	0.1217	0.1522	0.0679	0.0466	0.1087	0.0391	0.0217	0.0391	0.1087
The total is: Index of basic Operational capability is 0.7835											

Figure 3 Basic Operation Capability Of Logistics Service Enterprise

According to the service level index of the criterion layer, the service level index of the logistics enterprise can be obtained, as shown in Figure 4.

By the combination of quantitative and qualitative evaluation, the service level index of the logistics enterprise can be obtained, that is, 0.7505. This means the good probability of the logistics enterprise service level is 75.05%, which is acceptable. At the same time, the index of the basic operation capability is the highest in Figure 5, which shows that the basic operation capability this enterprise is relatively successful and better in the industry, and other aspects of the service level should be enhanced.

5. CONCLUSION

The rapid development of E-commerce means both opportunities and challenge for logistics enterprise. However, how to improve the logistics enterprise service capability thus to enhance the competition, becomes the arduous task for logistics enterprises. This paper presents a set of service capability evaluation index system of logistics enterprises in the E-commerce environment, and realizes the enterprise logistics service level evaluation. This enriched the theory of logistics enterprise service capability evaluation, and laid the foundation for the enterprise to win the market competition in E-commerce environment.

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