

The Research on Service Quality Influencing Factors of the Logistics Enterprises Based on Gray Relative Analysis

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Abstract—The level of service quality management affects the market competitiveness of logistics enterprises to a large extent. In this paper, first of all, the authors have an introduction about some literatures and the importance of service management for logistics enterprises is overviewed briefly. Secondly, the authors build service quality evaluation system and establish 16 indexes of measuring the services management level of logistics enterprises. Finally, the authors analyze relational grade between evaluation factors and logistics enterprise service quality management based on the theory of gray relative analysis, and get a conclusion that service management of logistics enterprises should be focused on the preparation time before distribution and informatization level.

Index Terms—gray relative analysis, logistics enterprise, service quality, evaluation

I. INTRODUCTION

The logistics industry in the developed countries was known as "accelerator" of economic development. In recent years, tens of thousands of logistics enterprises emerged, which develop in rapid growth with the development of modern economy, quickly become a powerhouse in the field of circulation, and will also have more and more profound impact on the social and economic development.

Logistics service is defined based on the customer satisfaction. The importance of logistics service quality has long been recognized (Perrault and Russ, 1974) [1] because of the role that it plays in customer satisfaction. It is also confirmed that the relations between the logistics service quality and service performance is close. The improvement of logistics services quality helps to improve the customer satisfaction and loyalty, and also enlarge market share. A number of empirical studies early also provide strong support for the link between improvements in logistics service quality and improvements in customer satisfaction (Innis and La Londe 1994; Daugherty, Stank, and Ellinger 1998; Stank, Goldsby, and Vickery 1999;

Mentzer, Flint, and Hult 2001) [2]-[6]. It is a key to quality customer service and its performance has been shown to have a direct linkage with manufacturers'/suppliers' performance (Sharma, Scholar, & Sahay, 2004) [7].

The latest research of logistics service quality is the research results of Tennessee University in 2001. Through the survey to logistics enterprises and customers, they summed up nine indicators from the customer perspective, including information quality, order process, timeliness and so on. But the nine indicators ignore the logistics service process and service time, and the correlation among the various indicators. Keehung Lai (2004) [8] defines logistics enterprise service capacity as "the ability of creation and allocation of resources to meet the customer's logistics demand and the pursuit of better service performance." Mentzer, Myers and Meeshew Cheung (2004) [9] successively put forward two stage logistics service quality definition and customer orientated logistics service quality model based on service process. They also study the role of logistics service quality in global market segmentation. Jukka and Markku (2001)[10] use analytic hierarchy process (ahp) to study the third party logistics enterprise service quality evaluation, taking reliability, emergency power, order cycle, price and value-added service quality as evaluation indicators.

Many researchers attach more importance to service quality management and how to measure the service quality. Practically, which factors influencing service quality are more important in improving the service quality of logistics enterprises should be pay more attention. Kandampully (2003) [11] suggested that logistics industry should pay more attention to innovation in logistics service and the innovation in logistics can be implemented through technology, knowledge and relationship networks. Quinn and Hilmer (1994)[12] said that the service quality of logistics enterprise mainly reflect in the logistics enterprise service ability and customer satisfaction. Service ability should be the prior strategy choice logistics for enterprises to improving the service quality, and also the important characteristics to make the enterprise in market competition in a dominant position and to long-term prosperity. Daugherty and Stank, etc. (1998) [13] study that the relationship between logistics service capability, customer satisfaction, loyalty

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and the market share. They give 11 logistics service capability index from the point of logistics distribution. To meet their customers' logistics services requirements, many enterprise operators have to develop logistics service capabilities and improve their performance (Lai, 2004) [14]. Chin-Shan Lu identified (2010) [15] three critical logistics service capabilities influencing service quality in his paper based on factor analysis: innovation capability, customer response capability, and flexible operation capability.

Based on existing research, this paper also discusses which parts should be paid more attention by operators of logistics enterprise among given sixteen influencing factors based gray relative analysis.

II. SERVICE QUALITY INFLUENCING FACTORS OF THE LOGISTICS ENTERPRISES

The evaluation of the level of the service management for the logistics enterprise shall be based on the evaluation of its quality of service, and to some extent the quality level of the service reflected by the enterprise can represent its service management level. Their relationship is shown in Fig. 1.

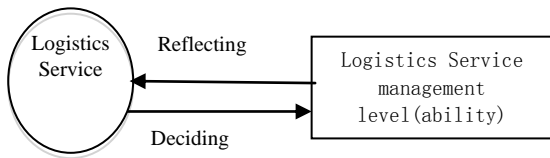


Figure 1. The relationship between service quality and service management level

This article will mainly study the measure of the level of service management of the logistics enterprises through the study of factors influencing the level of its logistics services quality. Therefore, in order to build an evaluation system for the quality of service for the logistics enterprises, indexes are designed as shown in Table I, totally 5 classes and 16 specific indexes.

The reliability of the logistics service evaluates whether the enterprise fulfilled its service promises reliably and accurately. Reliable service means that services can be achieved on time without mistakes, which is obviously desired by customers. The writers select three indexes to assess the reliability of logistics services, including whether the staff achieves the task accurately, whether the enterprise fulfilled its promises accurately, as well as solutions took by the enterprise after errors.

The response speed of the logistics service evaluates whether the enterprise is well ready to help the customers and whether provides fast and efficient services. Clearly, customers' waiting, especially waiting for no reason, will cause unnecessary negative impact to the customers' perceived product quality. From receiving the customer order, the logistic enterprise should enter the efficient service stage, including the preparation for the distribution, distribution process efficiency and after-sales service when problems.

The security conditions of services reflect the staff's ability to achieve the services. The writer uses three

indexes to assess the service guarantee, including the professional knowledge of the service personal, whether the enterprise established relevant rules and regulations specialized for services, as well as whether communicate with the customers effectively during the service.

The service attitudes of the staff reflect whether the staff put themselves in customers' position and pay special attention to customers. Hereon, the writer sets the following indexes to evaluate the service attitude of the logistics enterprises, that is, whether the staff sincerely care about the customers, and whether provide customers with personalized service, as well as whether be polite to and respect the customers.

Hardware conditions of the logistics enterprises refer to the facilities and equipment. Hardware conditions are the basis that the logistics enterprise provides customers with qualified logistics services. Its evaluation indexes include the following aspects: the informatization level, facility level, vehicle quantities and storage equipment.

III. GRAY CORRELATION GRADE BETWEEN EACH FACTORS AND SERVICE QUALITY MANAGEMENT

As a multi-factor statistical analysis method, GRA is to describe the size and order of strength between the factors by means of relational grade based on the sample data. If the sample data reflect the two factors out changes in the trend (direction, size, speed, etc.) are basically the same, then the correlation grade between them is larger, In contrast, a smaller correlation.

The model is as follows:

Suppose that X_0 is reference series, and X_i compared Series. They are

$$X_0 = \{X_0(k), k = 1, 2, \dots, n\}$$

$$X_i = \{X_i(k), k = 1, 2, \dots, n\} (i = 1, 2, \dots, m)$$

$$r_{oi} = \frac{\min \min |X_0(k) - X_i(k)| + \rho \max \max |X_0(k) - X_i(k)|}{|X_0(k) - X_i(k)| + \rho \max \max |X_0(k) - X_i(k)|}$$

Correlation grade is defined as

$$r_i = 1/n \sum_{k=1}^n r_{oi}(k)$$

We can calculate the relation grade between the evaluation index and service management level of distribution enterprise. Calculation steps are as follows.

Step1: Define total score of logistics service management for several logistics enterprises as sequence, second-level indicators as subsequence x_i .

Step 2: Set the equalization of the original data by

$$\bar{x}(k) = \frac{x_i(k)}{x_i}$$

Step3: Get the Difference sequence by

$$\Delta_{oi}(k) = |x_0(k) - x_i(k)| (i = 1, 2, \dots, 16; k = 1, 2, \dots, 5)$$

Step 4: Get the Maximum and minimum values of the sequence by

TABLE I. THE EVALUATION INDEX SYSTEM FOR THE QUALITY OF SERVICE OF THE LOGISTICS ENTERPRISES

Primary indexes	Secondary indexes	Index explanation	Variable name
Reliability of the logistics services	Provide the necessary services accurately	Reflecting the error rate of the service provided by the enterprise	X_1
	The enterprise fulfilled its promises accurately	Reflecting the fulfilled rate of the service provided by the enterprise	X_2
Response speed of the logistics Services	Solutions taken by the enterprise after errors preparation time before distribution	Reflecting the quality of after-sales services of the enterprise	X_3
		Reflecting the response ability	X_4
	Distribution time	Reflecting the distribution efficiency of the enterprise	X_5
	Whether the after-sales services are in time	Reflecting the quality of after-sales services of the enterprise	X_6
Security conditions of the logistics services	Professional knowledge of the service personal	Reflecting the service personnel's working ability of the enterprise	X_7
	Rules and regulations for service management	Reflecting the attention degree on standardizing services	X_8
The service attitudes of the staff	Communicate with the customers effectively	Reflecting the service methods of the enterprise	X_9
	The staff sincerely care about the customers	Reflecting the attention degree of the enterprise to the customers	X_{10}
	Provide customers with personalized service	Reflecting the quality of the value-added service to customers	X_{11}
Hardware conditions of logistics enterprises	Be polite to and respect the customers	Reflecting the basic literacy of the employee	X_{12}
	Informatization level	Reflecting enterprise modernization level	X_{13}
	Facility level	Reflecting the service ability of logistics enterprises	X_{14}
	Vehicle quantities	Reflecting the service ability of logistics enterprises	X_{15}
	Storage equipment	Reflecting the service ability of logistics enterprises	X_{16}

$$\Delta_{\max} = \max_i \max_k |x_0(k) - x_i(k)|$$

$$\Delta_{\min} = \min_i \min_k |x_0(k) - x_i(k)|$$

Step 5: Get the relation coefficient by

$$r_{0i} = \frac{\Delta_{\min} + \rho \Delta_{\max}}{\Delta_{0i}(k) + \rho \Delta_{\max}}$$

Step 6: Get the relation grade by

$$r_i = 1/n \sum_{k=1}^n r_{0i}(k)$$

During the course of this study, the writer chose five typical logistics enterprises' indexes as research objects, designed the responsive questionnaires for the level of the total service management and each evaluation index of the enterprise, as well as carried out researches, and obtained the relevant data, as shown in Table II. (Specific research process is omitted herein)

By far, by the above formula, we can find relational grade between the logistics service quality and service management of logistics enterprises. And in accordance with the results the relationship between service level and service management level of logistics enterprises can be analyzed. The result is as shown in Table III.

In the table, we also list the order of the indexes according to the degree of the grey relation. On the sort results, the top five are "Informatization level", "preparation time before distribution", "Vehicle quantities", "Distribution time" and "Provide the necessary services accurately". The analysis results are broadly consistent with our expectations.

"Informatization level" reflects enterprise modernization level. The study found that the enterprises that supply higher service quality perceived by customers usually make use of the high level of logistics information. A high level of logistics information platform can support the enterprise's efficient logistics services. Therefore, the logistics enterprises in a certain scale should strengthen the construction of logistics informationization level.

"Preparation time before distribution" reflects the response ability. In the survey, we found that the logistics enterprise whose logistic services are better have a high work efficiency in preparing each orde. On the contrary, it takes a too much time for the enterprise whose logistics service level is worse to prepare each order from receiving orders to the distribution. Therefore, in order to improve the logistics enterprise service ability and perceived customer service level, the logistics enterprises need to improve order preparation time.

"Vehicle quantities" are the foundation for logistics enterprise to carry out efficient logistics service. The enterprises should undertake the corresponding order quantity according to their distribution ability. If the enterprise blindly pursue order quantity but not timely carry out logistics service, the customer satisfaction will be very low. Therefore, for some enterprise, in order to improving logistics service quality, they can improve its distribution ability or appropriate order intake.

"Distribution efficiency" refers to how long the goods are in the way. The length of time of the distribution directly affects the logistics service timely. The reasonable planning of distribution route is an effective means of improving delivery time. Before distributing, logistics

enterprises should overall plan distribution route according to the daily business.

TABLE II. EVALUATION SCORES OF FIVE LOGISTICS ENTERPRISES

Primary indexes	Secondary indexes	A	B	C	D	E
Reliability of the logistics services	Provide the necessary services accurately	80	65	75	86	76
	The enterprise fulfilled its promises accurately	90	80	95	100	90
	Solutions taken by the enterprise after errors preparation time before distribution	70	65	90	80	90
Response speed of the logistics Services	Distribution time	90	70	70	70	71
	Whether the after-sales services are in time	80	80	85	80	80
Security conditions of the logistics services	Professional knowledge of the service personal	80	60	80	75	65
	Rules and regulations for service management	60	80	85	77	82
	Communicate with the customers effectively	80	80	100	100	95
The service attitudes of the staff	The staff sincerely care about the customers	90	100	100	90	88
	Provide customers with personalized service	70	70	90	90	80
	Be polite to and respect the customers.	100	80	80	82	82
Hardware conditions of logistics enterprises	Informatization level	90	75	90	87	83
	Facility level	90	66	80	80	82
	Vehicle quantities	70	80	80	78	75
	Storage equipment	80	90	90	85	80
		90	100	100	95	92

TABLE III. RELATIONAL GRADES BETWEEN EVALUATION INDEXES AND SERVICE QUALITY MANAGEMENT LEVEL OF FIVE ENTERPRISES

Evaluation indexes	Relation coefficient					Relation grade	Ordering	
	A	B	C	D	E			
Reliability of the logistics services	Provide the necessary services accurately	0.58455	0.64736	0.91762	0.64777	0.77759	0.714983	5
	The enterprise fulfilled its promises accurately	0.54946	0.50260	0.47476	0.94548	0.60841	0.616148	11
	Solutions taken by the enterprise after errors preparation time before distribution	0.53077	0.75955	0.66785	0.45218	0.66391	0.614857	12
Response speed of the logistics Services	Distribution time	0.59154	0.63900	0.66135	0.99179	0.60684	0.784710	2
	Whether the after-sales services are in time	0.78426	0.52981	0.68527	0.62401	0.91012	0.722811	4
Security conditions of the logistics services	Professional knowledge of the service personal	0.99157	0.44505	0.96155	0.85384	0.47500	0.605851	13
	Rules and regulations for service management	0.85282	0.41118	0.63768	0.47860	0.95147	0.666356	8
	Communicate with the customers effectively	0.62686	0.55946	0.55987	0.77982	0.76207	0.657619	9
The service attitudes of the staff	The staff sincerely care about the customers	0.50430	0.46809	0.71508	0.49982	0.58202	0.553867	15
	Provide customers with personalized service	0.97792	0.98086	0.91216	0.71251	0.74005	0.698108	7
	Be polite to and respect the customers.	0.45970	0.45778	0.40710	0.58735	0.83418	0.549228	16
Hardware conditions of logistics enterprises	Informatization level	0.67214	0.56572	0.66499	0.99999	0.81572	0.597591	14
	Facility level	0.73893	0.50999	0.49308	0.65604	0.80890	0.80139	1
	Vehicle quantities	0.61999	0.33400	0.60724	0.70755	0.76045	0.706698	6
	Storage equipment	0.91314	0.46289	0.81090	0.73906	0.67891	0.740984	3
		0.56361	0.51321	0.62223	0.60755	0.68133	0.643718	10

“Providing the necessary services accurately” reflects the reliability of the services provided by the enterprise. If companies can not accurately provide the necessary services to customers, and often in short supply or with too high error rate in goods delivery, then, there is no doubt that the services quality of the enterprise will not be too high, and the level of service management will not be high too.

In addition, on calculated integrated correlation degree, 16 indexes selected by the writer are more than 0.5, which

indicate that the selected indexes have significant impacts to evaluate the quality of service of the logistics enterprises.

IV. CONCLUSION

Service management of logistics enterprises involves multiple systems, and there are many relevant factors. To strengthen service management and improve service quality to enhance the competitiveness enterprises is of

great practical significance for logistics enterprises. From the results of the analysis of this article, the various elements have a significant effect on service management of logistics enterprises, but to improve the informatization level, preparation time before distribution, vehicle quantities, and distribution time and provide the necessary services accurately is undoubtedly the most important. The analysis results are broadly consistent with our expectations. In the course of improving services management level, managers should only control effectively the key points of affecting logistics enterprise service quality according to its own reality, it is to be achieved to improve the competitiveness of logistics enterprises and to achieve rapid and sustainable development.

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REFERENCES

[1] D. P. William and F. Russ, "Physical distribution service: A neglected aspect of marketing management," *MSU Business Topics*, vol. 22, pp. 37-45, Feb 1974.

[2] E. I. David and B. J. La Londe, "Customer service: The key to customer satisfaction, customer loyalty, and market share," *Journal of Business Logistics*, vol. 15, pp.1-27, Jan 1994.

[3] J. D. Patricia, T. P. Stank, and A. E. Ellinger, "Leveraging logistics/distribution capabilities: The impact of logistics service on market share," *Journal of Business Logistics*, vol. 19, pp. 35-51, Feb. 1998.

[4] P. S. Theodore, T. J. Goldsby, and S. K. Vickery, "Effect of service supplier performance on satisfaction and loyalty of store managers in the fast food industry," *Journal of Operations Management*, vol. 17, pp. 429-447, Feb 1999.

[5] T. M. John, D. J. Elint, and T. M. Hult, "Logistics service quality as a segment-customized process," *Journal of Marketing*, vol. 65, pp. 82-104, Apr. 2001.

[6] M. Rafiq, "Measuring customers' perceptions of logistics service quality of 3PL service providers," *Journal of business logistics*, vol. 28, pp. 159-175, Feb. 2007.

[7] D. Sharma, R. Scholar, and B. S. Sahay, "Modeling distributor performance index using the system dynamics approach," *Asia Pacific Journal of Marketing and Logistics*, vol. 16, pp. 37-67, Mar 2003.

[8] K. H. Lai, "Service capability and performance of logistics service providers," *Transportation Research Part E*, vol. 40, pp. 471-482, Oct 2004.

[9] J. T. Mentzer, M. B. Myers, and M. S. Cheung, "Global market segmentation for logistics services," *Industrial Marketing Management*, vol. 33, pp. 314-326, Jan 2004.

[10] J. KaKorpela, A. Lehmusvaara, and M. Tuminen, "An analytic approach to supply chain development," *International Journal of Production Economics*, vol. 71, pp. 213-219, Jan 2001.

[11] R. L. Chapman, C. Soosay, and J. Kandampully, "Innovation in logistic services and the new business model: A conceptual framework," *International Journal of Physical Distribution & Logistics Management*, vol. 33, no. 7, pp. 630-650, July 2003.

[12] Q. J. Brian and G. H. Frederick, "Strategic outsourcing," *Sloan Management Review*, vol. 35, pp. 361-374, April, Summer 1994.

[13] J. D. Patricia, T. P. Stank, and A. E. Ellinger, "Leveraging logistics/distribution capabilities: The impact of logistics service on market share," *Journal of Business Logistics*, vol. 19, pp. 153-162, Feb 1998.

[14] K. H. Lai, "Service capability and performance of logistics service provider," *Transportation Research - Part E Logistics and Transportation Review*, vol. 40, pp. 385-399, May 2004.

[15] C. Y. Lin, "Influencing factors on the Innovation in logistics technologies for logistics service providers in Taiwan," *Journal of American Academy of Business*, vol. 9, pp. 257-263, Sept 2006.



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