Scientific and Social Research, 2024, Volume 6, Issue 12
https://ojs.bbwpublisher.com/index.php/SSR
Online ISSN: 2981-9946
Print ISSN: 2661-4332

Research on Logistics System Evaluation Based on Group Language Information in Mass Customization

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Abstract: In order to deal with the complexity of logistics system evaluation under mass customization environment, multiple heterogeneous evaluators often directly give the language information of logistics system evaluation, and a logistics system evaluation method based on group language information is proposed. In this method, firstly, the evaluator uses language information to represent the evaluation value of the key indicators of the logistics system in the mass customization environment, and then uses fuzzy language scale to transform the evaluation value. Secondly, the Generalized Induced Ordered Weighted Averaging (GIOWA) operator is used twice to aggregate the language information given by the evaluator with the weight of the indicator and the weight of the evaluator to obtain the comprehensive evaluation value of the member and the comprehensive evaluation value of the scheme. Finally, the comprehensive evaluation values of the scheme are sorted and the optimal scheme is obtained. This paper takes a computer enterprise to realize the mass customization model as an example to verify the effectiveness and practicability of the proposed method.

Keywords: Logistics system; Mass customization; Language information

Online publication: January 3, 2025

1. Introduction

Under the environment of mass production, the supply of commodities is becoming more and more abundant, and people are no longer satisfied with the homogeneity of products, but prefer personalized and diversified products. In order to meet the changing needs of customers, mass customization has also emerged in this case [1]. Mass customization is a large-scale production efficiency to meet the individual needs of different customers of the production model, the core is the diversification of product varieties and customization increased sharply, and as little as possible to increase the cost. The scope is the mass production of personalized customized products. Its

biggest advantage is to provide strategic advantages and economic value [2]. As a new production mode, the key issue of mass customization is to obtain high customer response, cost efficiency and production scale at the same time. Therefore, the realization of mass customization mode must choose the right logistics system, the choice of logistics system for enterprises to improve customer satisfaction, reduce costs and appropriate production scale has important practical significance. The evaluation of logistics system under mass customization environment is a multi-attribute decision problem, how to choose an effective decision analysis method has become a hot issue worthy of attention.

Generally, the evaluation of alternative solutions in mass customization environment usually contains more complex and uncertain factors, and simple digital scale usually cannot reflect the real situation [3]. In addition, the accurate value given after pound-to-pair comparison puts higher requirements on the evaluation members, and it is difficult to implement. In the operation process of fuzzy theory, the problem of defuzzification is involved, and the judgment information is inevitably lost. There are great differences between logistics system in mass customization environment and traditional logistics system. The use of Data Envelopment Analysis (DEA) method requires a large amount of historical data and market information, and it is difficult to collect light valuable information [4].

In reality, the evaluation of logistics system in mass customization environment has complexity and uncertainty, and most of this decision is a group decision. It is also affected by many factors such as the knowledge structure, experience and background of the evaluators, which will make the quantification of many indicators very difficult. People often give some language information directly in the evaluation, such as “good, average, poor” and other language forms for the information management level of the logistics system in the mass customization environment [5]. Using language information to directly represent the subjective and uncertain information in the evaluation can better reflect the uncertainty and fuzziness of the evaluation information. Therefore, the research on the evaluation of attribute values in the form of language variables has important theoretical and practical value.

Firstly, this paper invites experts to give language attribute values for the indicators of system evaluation, and uses fuzzy scale to make full use of the evaluation information. Then, the integrated operator is used to aggregate the evaluation information, index weight and evaluator weight to obtain the comprehensive evaluation value of members and the comprehensive evaluation value of schemes respectively, and the optimal scheme is obtained according to the comprehensive evaluation value of schemes. The purpose of this paper is to introduce the evaluation method based on group language into the hot issue of logistics system evaluation under mass customization environment, and apply it to the practice of mass customization in computer companies to improve the level of enterprises to meet customers’ personalized customization, and give a system scheme optimization strategy.

2. Logistics system evaluation methods

The evaluation process of logistics system under mass customization environment usually requires the participation of multiple evaluators to ensure the rationality of evaluation. In this paper, an evaluation method of logistics system based on group language information is proposed. The aggregation method is used to process language information, which effectively avoids the loss of decision information. In this method, GIOWA operator and fuzzy language scale are integrated into the evaluation process. Fuzzy language scale is used to represent and

process the language evaluation information of multiple evaluators on logistics system schemes. Based on this, the language evaluation matrix is constructed, and then the language information, index weights and personnel weights are gathered to finally select the best scheme.

(1) Step 1: The evaluation problem of logistics system in mass customization environment is selected on the basis of careful research, and key evaluation indicators are selected according to the logistics system and specific order requirements in mass customization environment. The evaluator gives the fuzzy language values of each scheme on different attributes, and obtains the evaluation matrix accordingly.

(2) Step 2: GIOWA operator is used to aggregate the fuzzy language evaluation information in line *i* of the evaluation matrix by **Equation (1)**, and the comprehensive attribute evaluation value of each scheme given by the evaluator is obtained.

$$o_i^{(k)}(\boldsymbol{w}_a) = F_{GIOWA}\left\{(r_{i1}^{(k)}, G_1, \tilde{x}_{i1}^{(k)}), (r_{i2}^{(k)}, G_2, \tilde{x}_{i2}^{(k)}), \ldots, (r_{im}^{(h)}, G_m, \tilde{x}_{im}^{(k)})\right\} = \sum_{j=1}^{m} w_j l_{ij}^{(k)} \quad (1)$$

(3) Step 3: Again, GIOWA operator is used to aggregate the comprehensive attribute evaluation of the decision scheme given by the T-bit evaluator, and the comprehensive evaluation value of the logistics system scheme is obtained.

$$o_i(\boldsymbol{w}_b) = F_{GIOWA}\left\{(o_i^{(1)}(w_a), D_1, \tilde{x}_i^{(1)}), (o_i^{(2)}(w_a), D_2, \tilde{x}_i^{(2)}), \ldots, (o_i^{(T)}(w_a), D_t, \tilde{x}_i^{(k)})\right\} = \sum_{k=1}^{t} w_{bk} l_i^{(k)} \quad (2)$$

(4) Step 4: Based on the scheme comprehensive evaluation value, the scheme comprehensive evaluation value of the logistics system is arranged in the order from large to small, and the scheme is optimized accordingly.

The basic feature of this method is that the language evaluation information of evaluators is aggregated twice. The first time, the value of each evaluation index is aggregated according to the weight of the evaluation index of logistics system under mass customization environment, and the comprehensive evaluation value of members is obtained. For the second time, the comprehensive attribute evaluation value obtained in step 2 is used to gather again according to the impact degree of logistics system on multiple heterogeneous evaluators under mass customization environment, and finally the comprehensive evaluation value of the scheme is obtained. This method is suitable for group decision problems given by multiple heterogeneous evaluators with qualitative language information. In some evaluation processes, some evaluators are affected by personal feelings, knowledge structure and values, and will make too high or too low evaluation of some indicators. This method can fully take these aspects into account, prevent one-sided results as much as possible, and ensure the scientific and rational evaluation results.

3. Examples and analysis of results

U Computer Company is a well-known enterprise in China, and notebook computers are its main business. In the series of laptop products, customers have different appearance and configuration requirements. In the early stage, the main purpose of enterprises was to achieve the scale effect of production and ignored the personalized needs of customers for computers, which limited the market share of enterprises to a certain extent. Today, companies are trying to introduce a rationalized mass customization model, outsourcing the production of the original hardware, and focusing on intelligent assembly and appearance design. Customers can select and simulate the

assembly of each part, or submit orders according to the type recommended by the enterprise.

(1) Step 1: The third-party logistics enterprises draw up the logistics system improvement primary program according to the macro environment, development status and prospect of the company, and on this basis, adopt the methods of copywriting research, questionnaire and observation to repeatedly discuss the primary program, and the enterprise makes an expected evaluation of the operation effect of each program in the mass customization environment. The alternative scheme must not only meet the needs of customers, but also meet the objectives of the implementation of the enterprise mass customization mode. If a scheme cannot meet the requirements of enterprises or customers in one or more indicators, it needs to be removed from the alternative scheme. According to the above requirements, the project team selected 5 alternative schemes from the schemes submitted by the enterprises.

The enterprise project team fully weighs the different needs of various departments for the logistics system in the mass customization environment, and selects 5 evaluators from the company's strategic management, marketing department and production department to evaluate the indicators of each plan, and selects the best plan from the alternatives. Five evaluators gave language information evaluation values for each indicator, and the evaluation matrix was obtained according to them (**Table 1** to **Table 5**).

Table 1. Evaluation matrix given by D_1

	G_1	G_2	G_3	G_4	G_5	G_6
S_1	relatively good	very good	ordinary	very good	relatively good	good
S_2	very good	good	very good	good	relatively good	extremely good
S_3	good	relatively good	relatively good	ordinary	good	very good
S_4	good	very good	good	extremely good	very good	good
S_5	relatively good	relatively bad	good	relatively bad	ordinary	very good

Table 2. Evaluation matrix given by D_2

	G_1	G_2	G_3	G_4	G_5	G_6
S_1	good	relatively good	good	very good	relatively good	extremely good
S_2	very good	ordinary	relatively good	good	very good	good
S_3	relatively good	ordinary	good	ordinary	ordinary	very good
S_4	very good	relatively good	good	extremely good	very good	good
S_5	relatively good	good	very good	ordinary	good	very good

Table 3. Evaluation matrix given by D_3

	G_1	G_2	G_3	G_4	G_5	G_6
S_1	good	very good	relatively good	good	ordinary	very good
S_2	extremely good	good	relatively bad	relatively good	relatively good	good
S_3	relatively good	relatively bad	good	relatively bad	ordinary	very good
S_4	relatively good	relatively good	very good	ordinary	very good	relatively good
S_5	very good	relatively bad	relatively good	ordinary	relatively bad	good

Table 4. Evaluation matrix given by D_4

	G_1	G_2	G_3	G_4	G_5	G_6
S_1	good	relatively good	extremely good	very good	good	relatively good
S_2	very good	relatively bad	very good	good	extremely good	relatively good
S_3	very good	relatively good	good	relatively bad	ordinary	relatively good
S_4	relatively good	very good	good	very good	relatively good	extremely good
S_5	relatively good	ordinary	relatively bad	ordinary	relatively good	relatively good

Table 5. Evaluation matrix given by D_5

	G_1	G_2	G_3	G_4	G_5	G_6
S_1	very good	relatively good	very good	ordinary	very good	relatively good
S_2	relatively good	ordinary	very good	relatively good	good	relatively bad
S_3	relatively good	very good	ordinary	relatively bad	very good	relatively good
S_4	very good	relatively good	very good	good	extremely good	ordinary
S_5	very good	relatively good	good	extremely good	relatively good	ordinary

(2) Step 2: The index weight vector obtained by Analytic Hierarchy Process (AHP) method is $w_a = (0.30,\ 0.20,\ 0.10,\ 0.15,\ 0.10,\ 0.15)$. According to GIOWA operator, the language evaluation information of the evaluation matrix is aggregated, so that the comprehensive evaluation value of the members of the logistics system scheme can be obtained (**Table 1** to **Table 6**).

Table 6. The comprehensive evaluation value of the members

	S_1	S_2	S_3	S_4	S_5
D_1	good	very good	good	very good	relatively good
D_2	very good	good	relatively good	very good	good
D_3	good	good	relatively good	good	relatively good
D_4	very good	good	relatively good	good	ordinary
D_5	good	relatively good	good	very good	good

(3) Step 3: Mass customization implementation needs to improve the logistics system, and there are differences in the needs of different departments for the logistics system, system improvement will have different impacts on various departments of the enterprise, the project team uses the Delphi method to determine the weight of different department evaluators according to historical data $w_b = (0.3,\ 0.2,\ 0.3,\ 0.1,\ 0.1)$. Again, GIOWA operator is used to aggregate the comprehensive information evaluation value of 5 evaluators, and the comprehensive evaluation value of logistics system is obtained.

$o_1(\boldsymbol{w}_b) = \text{good},\ o_2(\boldsymbol{w}_b) = \text{good}, o_3(\boldsymbol{w}_b) = \text{relatively good},\ o_4(\boldsymbol{w}_b) = \text{very good},\ o_5(\boldsymbol{w}_b) = \text{relatively good}.$

(4) Step 4: According to the comprehensive evaluation value of the scheme, the alternative schemes are

sorted as $S_4 \succ S_1 = S_2 \succ S_3 = S_5$, and the best scheme is finally obtained.

4. Conclusion

Language information was used to evaluate the factors that cannot be quantified in the selection of logistics system under mass customization environment, and establish an evaluation matrix based on language information. The evaluators participating in the selection of logistics system under mass customization environment are treated differently, and the importance of the evaluators participating in the evaluation is different. The GIOWA operator was used twice to aggregate the language information, index weight and evaluator weight in the evaluation matrix, obtain the comprehensive evaluation value of the member and the comprehensive evaluation value of the scheme in turn, and select and determine the optimal scheme on this basis.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Shadkam E, 2022, Cuckoo Optimization Algorithm in Reverse Logistics: A Network Design for COVID-19 Waste Management. Waste Management & Research, 40(4): 458–469.

[2] Wang ZQ, Chen ZS, Garg H, et al., 2022, An Integrated Quality-Function-Deployment and Stochastic-Dominance-Based Decision-Making Approach for Prioritizing Product Concept Alternatives. Complex & Intelligent Systems, 8(3): 2541–2556.

[3] Wang H, Xin YJ, Deveci M, et al., 2024, Leveraging Online Reviews and Expert Opinions for Electric Vehicle Type Prioritization. Computers & Industrial Engineering, 197(11): 110579.

[4] Mouschoutzi M, Ponis ST, 2022, A Comprehensive Literature Review on Spare Parts Logistics Management in the Maritime Industry. The Asian Journal of Shipping and Logistics, 38(2): 71–83.

[5] Chen ZS, Zhu Z, Wang XJ, et al., 2023, Multiobjective Optimization-Based Collective Opinion Generation with Fairness Concern. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 53(9): 5729–5741.