

Service performance evaluation of China expresses delivery companies based on a MCDM model

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Abstract

Multiple criteria decision making (MCDM) is used in various fields because of its advantages in qualitative and quantitative assessment of decision making. This paper applies best and worst method (BWM) and gray relational analysis (GRA) to evaluate service performance of private express delivery companies. Timeliness, reliability, economy, tangibility, service level and sustainability are determined as six dimensions that affect the performance of private delivery service. The weight of each dimension is calculated by BWM method. Five well-known private express delivery companies in China are selected as the case study. A gray relational analysis is used to sort the service performance of the five companies. The results can be used as a reference to improve companies' service performance in future.

Key words: *Multiple criteria decision (MCDM), BWM (Best and Worst Method), Grey relational analysis (GRA), service performance, China express delivery companies*

1 Introduction

With the development of e-commerce in recent years, private express delivery companies are being recognized and concerned gradually. According to the China Post Bureau disclosed information, 2016 national delivery service business volume accumulated to 31.28 billion, an increase of 51.4%, business income accumulated 397.44 billion RMB, an increase of 43.5%. At the same time, China's private express delivery companies are also facing a huge challenge, and its exposed a lot of problems which need to be solved, such as slow transport, damage or loss of goods, service staff bad attitude and other issues occurs in the service process.

A lot of research studies have been performed in different area from MCDM perspective with AHP, ANP, TOPSIS, VIKOR, DEMATEL and GRA and so on.

A MCDM problem consists of ranking the feasible alternatives and selecting the most desirable one(s) by considering multiple criteria, which are frequently in conflict with each other (Hatami-Marbini et al., 2013)¹. However, the traits of the objectives things appear fuzziness and uncertainty in real world, the criteria involved in the decision-making problem may not be suitable to express it in exact numeric value. Because of the expert's limited expertise about the problem domain, the performance for each alternative in the process of MCDM is sometimes completely unknown; a GRA method for MCDM with internal-valued fuzzy assessments can be implemented to solve the expertise subjective limitations².

So, it is better to choose linguistic variables to express the degree of the criteria value. Since linguistic variables are not directly mathematically operable, to cope with this difficulty, each linguistic variable is associated with a fuzzy number characterizing the meaning of each generic verbal term³.

However, seldom literature implement MCDM model to the field of express delivery. Therefore, the purpose of this study is intended to provide an empirical case in China express delivery companies to demonstrate how the MCDM methods combining BMW and GRA. This study proposes BWM method to achieve the weight for each weight, and GRA with internal-valued fuzzy assessments to get the service performance of each alternative. This study also ranks the priorities of dimensions and criteria to find the important factors in service performance of the express delivery in China.

The remainder of this paper is arranged as follows: we review the service performance literature in Section 2. A hybrid MCDM method with BWM and GRA for service performance of express delivery companies is introduced in Section 3. Data analysis and case study is illustrated in Section 4. Conclusion is presented in the Section 5.

2 Service performances in express delivery industry

2.1 Timeliness (D1)

Ding (2016) pointed out that timeliness is relation to the process of transporting goods, and this dimension is set from the perspective of the competition between companies⁴. Qi and Zheng (2013) argued that timeliness is more about customer's emotional experience during service process⁵. Based on this perspective, this paper set the timeliness as an important factor to influence the service performance in express delivery industry. Under the timeliness

dimension, there are four criteria: response time (D11), commitment to delivery time (D12), timely service hours (D13) and On-time delivery ratio (D14).

2.2 Reliability (D2)

Under the reliability dimension, there are three criteria: The safety of the goods (D21), delivery accuracy (D22), the stability of information services (D23) and the ability to resolve complaints (D24). Reliability is the basis of delivery service, express delivery companies should ensure that the goods in the transport process must safely and lossless (Rajesh & Ravi, 2015; Qi & Zheng, 2013)^{5, 6}. Rajesh & Ravi (2015) pointed out that safety as one of supplier's sustainability factor in selection best alternative⁶. Courier should deliver the right goods to the right customer in the right time, which called delivery accuracy. Customer are used to track the delivery schedule on the web, so the information notice must stable and reliable to ensure customer have satisfactory expectation. Patterson et.al (2013) pointed out that the damaging consequence of service failures for the development of successful and profitable customer relationship. The company must implement complaint resolution mechanisms to maintain the service reliability.

2.3 Cost (D3)

The rationality of price and cost-effective are the important factors which the customer to evaluate the courier companies. There are some evitable be an accident in service process, the need to assess the company's insurance and compensation in place. Meng & He (2015) set up a discount package service according to Members' welfare value-added and low-cost appreciation⁷. Based on the above analysis, there are four criteria under cost dimension: price rationality (D31), insurance and compensation (D32), cost-effective (D33) and discount package service (D34).

2.4 Service level (D4)

Service level is an important dimension to examine the quality of express delivery service. Service level refers to costumers' subjective impressions regarding the efficiency and effectiveness of the service delivery process as provided by a service company. (Chen and Chang, 2005; Chen, 2016)^{8, 9}. One of the reasons that hinder the development of China's private express is the difference in the quality of courier. The communication ability (D41),

professional knowledge (D42), service attitude (D43) and uniform dress (D44) of the courier and customer trust (D45) are considered under the service level.

2.5 Tangibility (D5)

Technical equipment (D51), distribution network and information network (D52), research and development (D53) are the three criteria under the tangibility dimension. Handling equipment, storage equipment, motor transport, payment equipment and so on is very important technical equipment for delivery express.

In this paper, we put research and development into the tangibility dimension.

2.6 Sustainability (D6)

Based on the express industry's sustainable development, this article focuses on environmental pollution treatment during service process. Social responsibility is very important to enhance the sustainable development of courier companies, and environment concerns reflect the corporate sense of social responsibility. Under the sustainability dimension, environmental concerns (D61) and environmental pollution treatment during service process (D62) are two important criteria.

3 Combined MCDM model

3.1 Best and worst method (BWM)

BWM is a comparison-based MCDM method that compares the best criterion to the other criteria, and all the other criteria to the worst criteria (Rezaei, 2015)¹³. It uses only two vectors instead of a full pairwise comparison matrix, which makes it an excellent method when data collection is costly with respect to time and money (Rezaei, 2015)⁶. The purpose is to find the optimal weight through model construction using the comparison system.

3.2 Grey relation analysis (GRA)

GRA method could solve a lot of uncertainty and ambiguities generated from inaccurate decision (Deng, 1989; Lin and Chen, 1999; Rajesh & Ravi, 2015).^{5, 11-13}

4 Case study

4.1 Application of BWM to evaluate weights of the criteria

The BWM method has been described in detail in last chapter, and we would apply BWM to the service performance evaluation of private express companies in China. 6 dimensions and 22 criteria which obtained by experts and decision-makers are considered to assess service performance (Table 1).

Decision-makers will determine the best and the worst dimension and criteria during the 6 dimensions and 22 criteria. Using BWM method which proposed in chapter 3. The comparison result of the Best-to-Others or Others-to-Worst are represented by the linguistic scales varying from very unimportant (1) to very important (7).

Questionnaires are filled by 8 experts and decision-makers, and the Best-to-Others vector and the Others-to-Worst vector are calculated as followed:

Table1 - Comparisons between dimensions

BO	Timeliness	Reliability	Cost	Service level	Tangibility	Sustainability
Best dimension:	5	1	5	4.625	5.25	6.375
Reliability						
OW						Worst dimension: Sustainability
Timeliness						4.75
Reliability						6.375
Cost						4.375
Service level						4.75
Tangibility						4.125
Sustainability						1

The weight of each criterion could be calculated by the linear equation. The dimensions weight are following: $w_1=0.1193$, $w_2=0.4661$, $w_3=0.1193$, $w_4=0.1290$, $w_5=0.1137$, $w_6=0.0526$. The weights of each criteria are as follows, $w_{11}=0.009$, $w_{12}=0.017$, $w_{13}=0.023$, $w_{14}=0.070$, $w_{21}=0.279$, $w_{22}=0.068$, $w_{23}=0.037$, $w_{24}=0.083$, $w_{31}=0.069$, $w_{32}=0.020$, $w_{33}=0.021$, $w_{34}=0.009$, $w_{41}=0.016$, $w_{42}=0.018$, $w_{43}=0.023$, $w_{44}=0.064$, $w_{45}=0.008$, $w_{51}=0.075$, $w_{52}=0.012$, $w_{53}=0.027$, $w_{61}=0.044$, $w_{62}=0.009$.

4.2 Application of GRA to evaluate the service performance

This paper selected five private express delivery companies in China: Shen Tong (S1), S.F.(S2), YTO(S3), ZTO(S4) and Yunda(S5). This paper rates the performance of companies on corresponding attributes in linguistic scales varying from Very Poor to Very Good.

The grey possibility values obtained using equations 16-19 (step 9). $P(S_1 < S^{\max})=0.7720$, $P(S_2 < S^{\max})=0.6526$, $P(S_3 < S^{\max})=0.8742$, $P(S_4 < S^{\max})=0.9253$, $P(S_5 < S^{\max})=0.9351$. The smaller the likelihood of grey relevancy, the closer it is to an ideal courier company. In this paper, the service performance rank of the five companies is: $S_2 > S_1 > S_3 > S_4 > S_5$. The result display that S.F. performances best among the five companies.

4.3 Result and discussion

In the choice of express company, customer needs to consider the implementation of the individual criteria of the courier companies. This paper makes a sort of the completion of the individual criteria of the five express companies. If the on-time delivery ratio is the focus of the customer's attention, then the customer will use SF as his best choice, because the priority of the indicator is: $S_2 > S_1 > S_3 = S_4 = S_5$.

5 Conclusions

The development of China's private express is gradually on the right track, and the dimensions and criteria which proposed in the paper can give some suggestion and development tacit to decision-makers. During the 6 dimensions which involved in this paper, the responsibility is the best dimension. On this premise, the diversification of service products, the improvement of the overall quality of service personnel, the development of the ecological environment is the future direction of private express need to work hard.

First of all, in order to improve service reliability, express service enterprises should be as soon as possible to strengthen technical and equipment investment, change the business model, and only in this way can we promote the overall service level of the industry. Second, the express service industry needs to make a detailed market division, carry out differentiated marketing in the competition process, form its own competitive advantage, diversify the service products and increase the number of service packages. Third, transport and delivery may result in the process of environmental pollution, shall formulate a series of measures of prevention, treatment and post treatment system of things, so that the sustainable development of express service company.

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