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Full Length Research Paper

An empirical study on assessing brand equity for global shipping carrier-based logistics service providers

Ji-Feng Ding[1]*, Kuo-Liang Lee[2] and Shu-Chen Lin[2]

[1]Department of Aviation and Maritime Transportation Management, Chang Jung Christian University. No. 396, Sec. 1, Chang-Rong Rd., Gui-Ren, Tainan County 711, Taiwan.
[2]Department of Marketing and Distribution Management, Overseas Chinese University, Taichung, Taiwan.

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The main purpose of this paper is to apply a fuzzy multiple criteria decision-making (MCDM) model to assess brand equity (BE) for the global shipping carrier-based logistics service providers (GSLPs) from shippers' perspective in Taiwan shipping market. Firstly, some concepts and methods of the fuzzy set theory are applied to develop a fuzzy MCDM algorithm. For matching this assessing process, a hierarchical structure with five criteria, seventeen sub-criteria and three alternatives is constructed. Subsequently, the linguistic values are employed to appraise the fuzzy weights and fuzzy ratings. Furthermore, by combining the ideal and anti-ideal concepts, the highest BE company can be assessed. Finally, an empirical survey about three GSLPs in Taiwan shipping market is performed to appraise the systematic approach. The results of this study show that: (1) customer value is the most important criteria for BE from the shippers' perspective in Taiwan; (2) the top three key sub-criteria are high quality, multiplicity services and low cost, respectively; (3) the GSLP company A_2, the headquarter is located at Northwest Europe, is assessed as the highest BE company based on the results of the proposed fuzzy MCDM algorithm.

Key words: Brand equity, shipping, fuzzy multiple criteria decision-making (MCDM).

INTRODUCTION

Recently, much attention has been dedicated to the brand name (BN) and brand equity (BE), which portrays as a perceived and/or an increased value associated with the BN for customers. It is the value that customers perceive and recognize for goods and services caring such BN (Farquhar, 1990). The issue of brand is highly regarded by both industry and academia due to the fact that the highly reputed BNs would give owners the competitive edge and added value (Aaker, 1991, 1996; Barney, 2002; Fong, 2000; Liang et al., 2007a; Porter, 1980). Aaker (1991, 1996) and Porter (1980) emphasized that BE is the main source of gaining margins of profit and keeping competitive advantage for a business. Barney (2002) considered that positive reputation and BE impacted the advantage of differentiation of goods and services. Fong (2000) considered that BN is an important resource to a company and its competitive value depends on BE. Besides, high BE can also bring the advantage (Liang et al., 2007a) on better customer image, superior marketing place, lower marketing expenditures and switching cost. Furthermore, the BE has influenced the purchasing behavior in the marketing procedure. Barney (2002) had concluded that reputation of an associated BN is based on customers' experience of the goods supplied and services provided. If the goods and services exceed customer's expectation, it will create a positive reputation, along with the BE and therefore maintain a sustainable position of product superiority and differentiation for the enterprise. Therefore, the BN plays an important role when an enterprise engages the differentiation strategy for customer's value proposition and corporate reputation. The BN has become an important indicator for company differentiation in the shipping market. Emphasizing brand loyalty would be very important for the management of the BE. Establishing a BN implies that a

*Corresponding author. E-mail: jfding@mail.cjcu.edu.tw. Tel: +886-6-2785123 ext. 2263. Fax: +886-6-2785056.

series of value-added activities will be provided to the industry. The determinant factor of customer's purchasing policy is generally based on the overall evaluation of the company instead of the actual core services provided (Liu and Yang, 2001). As pointed out, core services represent about 70% of the total cost, but only have 30% of operational effectiveness. On the other hand, the non-core services, including BN, produce about 70% of operational effectiveness with only 30% of the total cost. Through the differentiation of BN, it can effectively upgrade services efficiency and added value. Establishing good BN is useful for market penetration and customer retention. It is also useful for profit enhancing due to the fact that it is practical in the market place to charge higher price for goods with better BN.

Due to the integrated solutions of shipping logistics services provided in the shipping chains, the global shipping carrier-based logistics service providers (GSLPs) are emerged and auxiliary to tackle these complicated shipping services for global container ocean carriers (GOCs) (Ding, 2010). The GSLPs used by shippers are growing rapidly in the recent years. Famous examples of GSLPs are Maersk Logistics, CMA-CGM Logistics, Evergreen Logistics, COSCO Logistics, NYK Logistics, YES Logistics, etc. In the shipping market, the BNs of GSLPs are attached to the GOCs, which have been playing up their own BNs to struggle for meeting shippers' requirements and getting shippers' satisfactions. Hence, the shippers have been considering the BN as an important criterion to consign to their shipments for GOCs and GSLPs. Since the BN has become an important criterion of consignments for shippers, hence, it is beneficial to upgrade its BE to be more competitive to its competitors for GOCs and GSLPs. It is a mutually interacting and beneficial process that the GSLPs make great effort to improve its BE while the shippers pay more attention on such equity. Therefore, it is helpful to the consignments by selecting a GSLP with high BE for the shippers.

However, experience showed (Aaker, 1991; Lassar et al., 1995) that it would be useful to maintain competitive advantage of encouraging high BE for GSLPs. On the other hand, selecting those with high BE would promote the shipments value for shippers. It was mentioned by Lassar et al. (1995) that in most cases, customer would be willing to pay a higher price for goods and services with good BE, in other words, it is highly related between BE and brand loyalty. Thus, under the competitive environment of the shipping market, the BE value among different GSLPs is gradually becoming an important issue of discussing how to manage and operate the BN for GSLPs, and how to select GSLPs of high BE for shippers in the future.

Since there are increasing scopes of logistics services with high competition of brand marketing among those GSLPs, evaluating the GSLPs with high BE is useful for smoothening the behavior of purchasing process to shippers. However, experience has shown that the assessing BE among GSLPs is not an easy matter. It involves a multitude of complex considerations and a decision-making tool is therefore crucial (Belton and Stewart, 2002). The assessment of BE among GSLPs poses a unique characteristic of multiple criteria decision-making (MCDM). The criteria are usually subjective in nature and often changing with the decision-making conditions, which creates the fuzzy and uncertain nature among the criteria and the important weights of the criteria. Further, there are situations in which information is incomplete or imprecise or views that are subjective or endowed with linguistic characteristics creating a fuzzy decision-making environment. The authors, therefore, adopt the fuzzy set theory (Zadeh, 1965), combing with MCDM method as an evaluation tool to improve the quality of the survey. In the light of this, a fuzzy MCDM approach is used to assess BE for GSLPs.

In summary, the aim of this paper is to develop a fuzzy MCDM model to improve the quality of decision-making in assessing BE for GSLPs from shippers' perspective in Taiwanese shipping market. The following section presents the research methodologies. The next section presents the proposed fuzzy MCDM algorithm. In the fourth section, an empirical survey is studied. Finally, some conclusions are made in the last section.

METHODOLOGY

Some of the research methodologies are briefly introduced in this section. These include the triangular fuzzy numbers and the algebraic operations, linguistic values, the graded mean integration representation (GMIR) method, and the distance measure approach, respectively.

Triangular fuzzy numbers and the algebraic operations

A fuzzy number *A* (Dubois and Prade, 1978) in real line $\Re$ is a triangular fuzzy number if its membership function $f_A : \Re \rightarrow [0, 1]$ is

$$f_A(x) = \begin{cases} (x-c)/(a-c), & c \le x \le a \\ (x-b)/(a-b), & a \le x \le b \\ 0, & otherwise \end{cases}$$

with $-\infty < c \le a \le b < \infty$. The triangular fuzzy number can be denoted by (c, a, b).

The extension principle (Zadeh, 1965) and the function principle (Chen, 1985) are employed to proceed with the algebraic operations of fuzzy numbers. In this paper, we used the Chen's function principle. Let $A_1 = (c_1, a_1, b_1)$ and $A_2 = (c_2, a_2, b_2)$ be fuzzy numbers, the algebraic operations of any two fuzzy numbers A_1 and A_2 can be expressed as;

(1) Fuzzy addition, ⊕:

$A_1 \oplus A_2 = (c_1 + c_2, a_1 + a_2, b_1 + b_2)$, where c_1, a_1, b_1, c_2, a_2, and b_2 are any real numbers.

(2) Fuzzy subtraction, ⊖:

$A_1 \ominus A_2 = (c_1 - b_2, a_1 - a_2, b_1 - c_2)$, where c_1, a_1, b_1, c_2, a_2, and b_2 are any real numbers.

(3) Fuzzy multiplication, ⊗ :

(i) $k \otimes A_2 = (kc_2, ka_2, kb_2), \quad k \in \Re, \ k \geq 0$;

(ii) $A_1 \otimes A_2 = (c_1c_2, a_1a_2, b_1b_2)$, where c_1, a_1, b_1, c_2, a_2 and b_2, are all nonzero positive real numbers.

(4) Fuzzy division, ∅:

(i) $(A_1)^{-1} = (c_1, a_1, b_1)^{-1} = (1/b_1, 1/a_1, 1/c_1)$, where c_1, a_1, and b_1 are all positive real numbers or all negative real numbers.

(ii) $A_1 \varnothing A_2 = (c_1/b_2, \ a_1/a_2, \ b_1/c_2)$, where c_1, a_1, b_1, c_2, a_2, and b_2 are all nonzero positive real numbers.

Linguistic values

In fuzzy decision environments, two preference ratings can be used. They are fuzzy numbers and linguistic values characterized by fuzzy numbers (Zadeh, 1975, 1976). Depending on practical needs, decision makers (DMs) may apply one or both of them. In this paper, the weighting set and preference rating set are used to analytically express the linguistic values and describe how important of the involved criteria and sub-criteria, and how good or poor of alternatives against various sub-criteria are. The weighting set is defined as $W = \{VL, L, M, H, VH\}$ and rating set as $S = \{VP, P, F, G, VG\}$; where *VL*=Very Low, *L*=Low, *M*=Medium, *H*=High, *VH*=Very High, *VP*=Very Poor, *P*=Poor, *F*=Fair, *G*=Good, and *VG*=Very Good. Here, we define the linguistic values of *VL*=(0, 0, 0.3), *L*=(0, 0.2, 0.5), *M*=(0.3, 0.5, 0.7), *H*=(0.5, 0.8, 1), *VH*=(0.7, 1, 1), *VP*=(0, 0, 0.2), *P*=(0, 0.2, 0.4), *F*=(0.3, 0.5, 0.7), *G*=(0.6, 0.8, 1), and *VG*=(0.8, 1, 1).

GMIR method

To match the fuzzy MCDM algorithm developed in this paper, and to solve the problem powerfully, the GMIR method, proposed by Chen and Hsieh (2000), is employed to rank the final ratings of alternatives.

Let $A_i = (c_i, a_i, b_i), \ i = 1, 2, \ldots, n,$ be *n* triangular fuzzy numbers. By the GMIR method, the GMIR value $R(A_i)$ of A_i is

$$R(A_i) = (c_i + 4a_i + b_i)/6 \qquad (1)$$

Suppose $R(A_i)$ and $R(A_j)$ are the GMIR value of A_i and A_j, respectively.

We define: (i) $A_i > A_j \Leftrightarrow R(A_i) > R(A_j)$,

(ii) $A_i < A_j \Leftrightarrow R(A_i) < R(A_j)$, and

(iii) $A_i = A_j \Leftrightarrow R(A_i) = R(A_j)$.

Distance measure approach

Two famous distance measure approaches between two fuzzy numbers, that is, mean and geometrical distance measures, were introduced by Heilpern in 1997. However, Heilpern's method cannot satisfy some special cases between two fuzzy numbers. Hsieh and Chen (1999) had proposed the modified geometrical distance (MGD) approach to improve the drawback. To match the fuzzy MCDM algorithm developed in this paper, this MGD approach is used to measure the distance of two fuzzy numbers. That is, let $A_i = (c_i, a_i, b_i)$ and $A_j = (c_j, a_j, b_j)$ be fuzzy numbers. Then, the Hsieh and Chen's MGD value can be denoted by

$$\Omega_M(A_i, A_j) = \sqrt{\frac{1}{4}\left[(c_i - c_j)^2 + 2(a_i - a_j)^2 + (b_i - b_j)^2\right]} \qquad (2)$$

The proposed fuzzy MCDM algorithm

Five step-by-step descriptions of the fuzzy MCDM algorithm for evaluating BE are proposed in the following. They are (1) developing the hierarchical structure, (2) estimating fuzzy weights of all criteria and sub-criteria, and fuzzy ratings of all alternatives versus all sub-criteria, (3) calculating fuzzy ideal and anti-ideal solutions, (4) computing the distance of different alternatives versus the fuzzy ideal/anti-ideal solutions, and (5) calculating the relative closeness of different alternatives versus ideal solution, and finally ranking the alternatives.

Step 1. Developing the hierarchical structure

The concepts of hierarchical structure analysis with three distinct layers, that is, criteria layer, sub-criteria layer, and alternatives layer, are used in this paper. There are *k* criteria (represented as $C_t, t = 1, 2, \ldots, k$), $p_1 + \cdots + p_t + \cdots + p_k$ sub-criteria (represented as $SC_{11} \cdots SC_{1p_1} \cdots SC_{t1} \cdots SC_{tp_t} \cdots SC_{k1} \cdots SC_{kp_k}$), and *m* alternatives (represented as A_i, $i = 1, 2, \ldots, m$) in the hierarchical structure.

As aforementioned, the GSLPs are operated by GOCs due to the total solutions can be integrated in the shipping market. In our case, three famous GSLPs operated in Taiwan, that is, named A_1, A_2, and A_3, which are subsidiary companies of the top 20 GOCs in word in 2009. The headquarters of these three GSLPs are located at North-east Asia, Northwest Europe, and East Asia, respectively. They are selected after a preliminary screening for further evaluation and therefore three GSLP companies are represented as the evaluation alternatives.

While interview with executive managers of shippers (exporters and importers) in Taiwan, the criteria and sub-criteria of assessing

BE have been discussed and made known in academic and management publications and related literature review (Aaker, 1991, 1996; Chen and Horng, 1999; Ding and Tu, 2006; Ding, 2009, 2010; Keller, 1998; Liang, 2007a, 2007b; Martin and Brown, 1990; Park and Srinivasan, 1994). In this paper, five criteria and eighteen sub-criteria are suggested and their code names are shown in parentheses. All criteria and sub-criteria are subjective:

1. Brand loyalty (C_1). This criterion includes three sub-criteria, that is, customer satisfaction (C_{11}), customer loyalty (C_{12}), and channel relationship (C_{13}).
2. Brand association (C_2). This criterion includes three sub-criteria, that is, leader brand (C_{21}), enterprise image (C_{22}), and differentiation among GSLPs (C_{23}).
3. Brand fame (C_3). This criterion includes four sub-criteria, that is, well-known and popular brand (C_{31}), positive felling of shippers (C_{32}), good reputation (C_{33}), and total solutions of solving problems (C_{34}).
4. Customer value (C_4). This criterion includes four sub-criteria, that is, multiplicity services (C_{41}), high quality (C_{42}), low cost (C_{43}), and short handling time (C_{44}).
5. Market evaluation (C_5). This criterion includes four sub-criteria, that is, market share (C_{51}), freight and price (C_{52}), adequate activities of warehouse, distribution and transportation (C_{53}), and information technology (IT) and communication capability (C_{54}).

Step 2. Estimating fuzzy weights of all criteria and sub-criteria, and fuzzy ratings of all alternatives versus all sub-criteria

The arithmetic mean method is used to obtain the average fuzzy weights of all criteria and sub-criteria, as well as the fuzzy ratings of alternatives versus all subjective sub-criteria in this paper. The linguistic values of the weighting and rating sets are assisted in obtaining the fuzzy weights and fuzzy ratings. This is done as follows.

Let $W_t^h = (c_t^h, a_t^h, b_t^h),\ \ t = 1, 2, \ldots, k;\ \ h = 1, 2, \ldots, n,$ be the weight given to criterion C_t by the h^{th} DM. Then, the average fuzzy weight of C_t can be represented as

$$W_t = 1/n \otimes \left(W_t^1 \oplus W_t^2 \oplus \cdots \oplus W_t^n\right) = (c_t, a_t, b_t), \quad (3)$$

where, $c_t = 1/n \sum_{h=1}^{n} c_t^h,\ a_t = 1/n \sum_{h=1}^{n} a_t^h,\ b_t = 1/n \sum_{h=1}^{n} b_t^h$

Let $W_{tj}^h = (c_{tj}^h, a_{tj}^h, b_{tj}^h),\ t = 1, 2, \ldots, k;\ \ j = 1, 2, \ldots, p_t;$ $h = 1, 2, \ldots, n,$ be the weight given to sub-criterion SC_{tj} by the h^{th} DM. Then, the average fuzzy weight of SC_{tj} can be represented as

$$W_{tj} = 1/n \otimes \left(W_{tj}^1 \oplus W_{tj}^2 \oplus \cdots \oplus W_{tj}^n\right) = (c_{tj}, a_{tj}, b_{tj}),$$

where $c_{tj} = 1/n \sum_{h=1}^{n} c_{tj}^h,\ a_{tj} = 1/n \sum_{h=1}^{n} a_{tj}^h,\ b_{tj} = 1/n \sum_{h=1}^{n} b_{tj}^h$. (4)

Let $S_{itj}^h = (c_{itj}^h, a_{itj}^h, b_{itj}^h),\ i = 1, 2, \ldots, m;\ \ t = 1, 2, \ldots, k;$ $j = 1, 2, \ldots, p_t;\ h = 1, 2, \ldots, n,$ be the rating assigned to alternative A_i by the h^{th} DM for sub-criterion SC_{tj}. Then, the average fuzzy rating of alternative A_i can be represented as

$$S_{itj} = 1/n \otimes \left(S_{itj}^1 \oplus S_{itj}^2 \oplus \cdots \oplus S_{itj}^n\right) = (c_{itj}, a_{itj}, b_{itj}),$$

where, $c_{itj} = 1/n \sum_{h=1}^{n} c_{itj}^h,\quad a_{itj} = 1/n \sum_{h=1}^{n} a_{itj}^h,$

$$b_{itj} = 1/n \sum_{h=1}^{n} b_{itj}^h . \quad (5)$$

Step 3. Calculating fuzzy ideal and anti-ideal solutions

The fuzzy MCDM algorithm based on the ideal and anti-ideal concepts (Liang, 1999) is used in this paper. The logic of ideal and anti-ideal solutions is based on the concept of relative closeness in compliance with the shorter (longer) the distance of alternative *i* to ideal (anti-ideal), the higher the priority can be ranked.

Firstly, to ensure compatibility between fuzzy ratings of subjecttively positive criteria (or sub-criteria) and negative criteria (or sub-criteria), the average fuzzy superiority values must be converted to dimensionless indices. The fuzzy ideal values with minimum values in negative sub-criteria or maximum values in positive sub-criteria should have the maximum rating. Based on the principle stated as above, let $\alpha_{tj} = \max_i \{b_{itj}\},\ \ \beta_{tj} = \min_i \{c_{itj}\}$ then the normalized average fuzzy superiority value N_{itj}^a of alternative A_i for sub-criterion SC_{tj} can be defined as:

(1) For the positive sub-criterion SC_{tj} (the sub-criteria that have positive contribution to the objective, e.g., benefit sub-criterion):

$$N_{itj}^a = (p_{itj}, q_{itj}, r_{itj}) = \left(\frac{c_{itj}}{\alpha_{tj}}, \frac{a_{itj}}{\alpha_{tj}}, \frac{b_{itj}}{\alpha_{tj}}\right) \quad (6)$$

(2) For the negative sub-criterion SC_{tj} (the sub-criteria that have negative contribution to the objective, e.g., cost sub-criterion):

$$N_{itj}^a = (p_{itj}, q_{itj}, r_{itj}) = \left(\frac{\beta_{tj}}{b_{itj}}, \frac{\beta_{tj}}{a_{itj}}, \frac{\beta_{tj}}{c_{itj}}\right) \quad (7)$$

Subsequently, by using the GMIR method, the GMIR values can be express as $R(N_{itj}^a)$. The fuzzy ideal value FI_{tj}^+ and fuzzy anti-ideal value FAI_{tj}^- of each sub-criterion above the alternatives layer can be judged and determined by comparing with these GMIR values $R(N_{itj}^a)$. Then,

(a) $R(N_{xtj}^{a}) = \max_{i} R(N_{itj}^{a})$, then the fuzzy ideal value

$$FI_{tj}^{+} = N_{xtj}^{a} ,, \quad (8)$$

(b) if $R(N_{ytj}^{a}) = \min_{i} R(N_{itj}^{a})$, then the fuzzy anti-ideal value

$$FAI_{tj}^{-} = N_{ytj}^{a} . \quad (9)$$

Finally, we integrate the fuzzy ideal/anti-ideal values into the fuzzy ideal/anti-ideal solutions. Define the fuzzy ideal solution I^{+} and fuzzy anti-ideal solution AI^{-} as;

$$I^{+} = (FI_{11}^{+}, FI_{12}^{+}, \ldots, FI_{t1}^{+}, \ldots, FI_{tp_t}^{+}, \ldots, FI_{k1}^{+}, \ldots, FI_{kp_k}^{+}) \text{, and}$$
$$AI^{-} = (FAI_{11}^{-}, FAI_{12}^{-}, \ldots, FAI_{t1}^{-}, \ldots, FAI_{tp_t}^{-}, \ldots, FAI_{k1}^{-}, \ldots, FAI_{kp_k}^{-}) \quad (10)$$

Step 4. Computing the distance of different alternatives versus the fuzzy ideal/anti-ideal solutions

As mentioned in Step 2, let W_t and W_{tj}, $t = 1, 2, \ldots, k;\quad j = 1, 2, \ldots, p_t$, are the average fuzzy weights of criteria C_t and sub-criteria SC_{tj}, respectively. Here the normalized integration weights of the sub-criteria SC_{tj} can be obtained by using the GMIR method - the Equation (1) - and denoted by;

$$\omega_{tj}^{*} = \frac{R(W_t)}{\sum_{t=1}^{k} R(W_t)} \times \frac{R(W_{tj})}{\sum_{j=1}^{p_t} R(W_{tj})} ,\ 0 \le \omega_{tj}^{*} \le 1, \quad \sum \omega_{tj}^{*} = 1. \quad (11)$$

Then, compute the distance of different alternatives versus I^{+} and AI^{-} which were denoted by D_i^{+} and D_i^{-}, respectively. Define

$$D_i^{+} = \sqrt{\sum_{t=1}^{k} \sum_{j=1}^{p_t} \left[(\omega_{tj}^{*})^2 \times (\Omega_M (FI_{tj}^{+}, N_{itj}^{a}))^2 \right]},$$
$$i = 1, 2, \ldots, m, \quad (12)$$

$$D_i^{-} = \sqrt{\sum_{t=1}^{k} \sum_{j=1}^{p_t} \left[(\omega_{tj}^{*})^2 \times (\Omega_M (FAI_{tj}^{-}, N_{itj}^{a}))^2 \right]}$$
$$,\ i = 1, 2, \ldots, m, \quad (13)$$

where $\Omega_M(\bullet)$ can be obtained by using the Equation (2).

Step 5. Calculating the relative closeness of different alternatives versus ideal solution, and finally ranking the alternatives

The relative closeness (that is, the relative approximation value) of different alternatives A_i versus fuzzy ideal solution I^{+} can be calculated, which can be denoted as

$$RC_i^{*} = \frac{D_i^{-}}{D_i^{+} + D_i^{-}} , \quad (14)$$

where $0 \le RC_i^{*} \le 1,\ i = 1, 2, \ldots, m$.

Suppose alternative A_i is an ideal solution (that is, $D_i^{+} = 0$), then $RC_i^{*} = 1$. Otherwise, if A_i is an anti-ideal solution (that is, $D_i^{-} = 0$), then $RC_i^{*} = 0$. The nearer the value RC_i^{*} close to 1 implies a closer alternative A_i come near the ideal solution. That is, the maximum value of RC_i^{*}, then the all alternatives can be ranked. Finally, the best alternative can be selected.

Empirical survey

In this section, an empirical survey of assessing BE for GSLPs from shippers' perspective in Taiwanese shipping market is carried out to demonstrate the computational process as described above.

Data collection of questionnaires

In this step, five criteria, eighteen sub-criteria with three alternatives were used to design the questionnaire, and to obtain information on the importance weights of criteria and sub-criteria, as well as on the appropriateness of three alternatives versus various eighteen sub-criteria. We used 1,500 exporters and importers in Taiwan as the population, recorded in the '*Directory of Excellent Exporters and Importers in 2007, Taiwan (ROC)*' (Ministry of Economic Affairs (Taiwan), 2008). The questionnaire was filled in by the export/import department of each company on May to November in 2009. In addition, the surveys were repeatedly completed through phone calls and over-and-over in-person interviews by the authors. The reliability, that is, Cronbach alpha, of the questionnaire was 0.837. Finally, a total of 319 valid responses were collected, from the 1,500 exporters and importers, which represents 21.27% of the total population.

RESULTS

We use the linguistic weighting set *W* and rating set *S* to evaluate the importance weights of all criteria and sub-criteria, as well as the appropriateness ratings of three alternatives versus eighteen sub-criteria. To sum up the results surveyed in the valid 319 questionnaires, the importance weights and appropriateness ratings are shown in Tables 1 and 2, respectively.

According to Tables 1 and 2, we use the Equations (6)-(13) to obtain the distance of three companies versus fuzzy ideal/anti-ideal solutions, respectively. Then, by using the Equation (14), the relative closeness of three companies versus fuzzy ideal solutions can be calculated. Finally, the highest BE of three companies can be determined. The results can be shown in Table 3. We can see that the ranking order of relative closeness for the three alternatives is A_2, A_3, and A_1, respectively. The

Table 1. Average fuzzy weights of five criteria and eighteen sub-criteria.

Criteria / Sub-criterion	Fuzzy weight	GMIR value
C_1	(0.121, 0.337, 0.601)	0.345
C_2	(0.118, 0.336, 0.599)	0.343
C_3	(0.242, 0.483, 0.710)	0.481
C_4	(0.443, 0.713, 0.864)	0.693
C_5	(0.266, 0.506, 0.724)	0.503
C_{11}	(0.439, 0.707, 0.857)	0.687
C_{12}	(0.429, 0.697, 0.852)	0.678
C_{13}	(0.419, 0.687, 0.846)	0.669
C_{21}	(0.445, 0.716, 0.865)	0.696
C_{22}	(0.465, 0.740, 0.882)	0.718
C_{23}	(0.449, 0.720, 0.867)	0.670
C_{31}	(0.50, 0.781, 0.909)	0.755
C_{32}	(0.486, 0.765, 0.90)	0.741
C_{33}	(0.506, 0.789, 0.917)	0.763
C_{34}	(0.441, 0.710, 0.862)	0.691
C_{41}	(0.580, 0.872, 0.965)	0.839
C_{42}	(0.621, 0.912, 0.960)	0.871
C_{43}	(0.554, 0.835, 0.916)	0.802
C_{44}	(0.522, 0.799, 0.891)	0.768
C_{51}	(0.475, 0.743, 0.857)	0.717
C_{52}	(0.548, 0.829, 0.909)	0.796
C_{53}	(0.506, 0.781, 0.887)	0.753
C_{54}	(0.508, 0.783, 0.889)	0.755

Table 2. Average fuzzy ratings of three alternatives versus eighteen sub-criteria.

Sub-criteria	A_1	A_2	A_3
C_{11}	(0.569, 0.769, 0.870)	(0.636, 0.839, 0.901)	(0.259, 0.459, 0.648)
C_{12}	(0.736, 0.936, 0.958)	(0.639, 0.839, 0.859)	(0.231, 0.431, 0.626)
C_{13}	(0.555, 0.755, 0.877)	(0.682, 0.882, 0.924)	(0.261, 0.461, 0.650)
C_{21}	(0.257, 0.457, 0.648)	(0.665, 0.865, 0.916)	(0.575, 0.775, 0.897)
C_{22}	(0.232, 0.432, 0.628)	(0.679, 0.879, 0.922)	(0.554, 0.754, 0.869)
C_{23}	(0.278, 0.478, 0.667)	(0.658, 0.858, 0.910)	(0.540, 0.740, 0.861)
C_{31}	(0.229, 0.429, 0.621)	(0.575, 0.775, 0.851)	(0.548, 0.748, 0.857)
C_{32}	(0.241, 0.441, 0.635)	(0.703, 0.903, 0.940)	(0.514, 0.714, 0.841)
C_{33}	(0.271, 0.471, 0.661)	(0.710, 0.910, 0.938)	(0.521, 0.721, 0.848)
C_{34}	(0.256, 0.456, 0.647)	(0.705, 0.905, 0.935)	(0.554, 0.754, 0.865)
C_{41}	(0.246, 0.446, 0.639)	(0.709, 0.909, 0.939)	(,0.524 ,0.724)0.850
C_{42}	(0.272, 0.472, 0.661)	(0.715, 0.915, 0.942)	(0.557, 0.757, 0.866)
C_{43}	(0.259, 0.459, 0.649)	(0.709, 0.909, 0.938)	(0.531, 0.731, 0.852)
C_{44}	(0.247, 0.447, 0.639)	(0.741, 0.941, 0.961)	(0.535, 0.735, 0.853)
C_{51}	(0.250, 0.450, 0.642)	(0.740, 0.940, 0.961)	(0.556, 0.756, 0.867)
C_{52}	(0.262, 0.462, 0.653)	(0.661, 0.861, 0.905)	(0.522, 0.722, 0.847)
C_{53}	(0.261, 0.461, 0.653)	(0.716, 0.916, 0.946)	(0.525, 0.725, 0.858)
C_{54}	(0.266, 0.466, 0.657)	(0.652, 0.852, 0.899)	(0.563, 0.763, 0.879)

The optimal selection is obviously company A_2, which is the highest BE company from the shippers' perspective based on the proposed fuzzy MCDM algorithms. Therefore, it can recommend that company A_2 is the most

Table 3. The distance, relative closeness, and ranking order of three companies.

Company	D_i^+	D_i^-	RC_i^*	Ranking
A_1	0.09805	0.03204	0.2463	3
A_2	0.00454	0.10353	0.9580	1
A_3	0.05043	0.06486	0.5626	2

BE for GSLPs based on the shippers' perspective in Taiwan.

DISCUSSION

The BE has gradually been becoming an important indicator for business and marketing management. The brand for GSLPs actually has been influenced the shippers' purchasing behavior in the shipping procedure, and therefore, eventually affected the service providers' subsistence. It would be beneficial to provide high BE with perceived value and reputation for the shippers. On the other hand, it is expected that the GSLPs would keep competitive advantage when they offer highly equity for their customers, and thus, this will affect the choice behavior of shipments. Since it would be preferred to select those with high BE of providing consignment value for the shippers; on the other hand, it would be prioritized to select those meeting shippers' requirements for the service providers in the shipping market. Hence, it is important to assess the priority of BE for both shippers and service providers. Since the topic is essential to study, in light of this, the main purpose of this paper is to employ a systematic approach - fuzzy MCDM model - to empirically assess BE for three famous GSLPs in Taiwan shipping market.

Firstly, to facilitate the main issue for assessing BE, a fuzzy MCDM algorithm is constructed to apply some concepts and methods of using the fuzzy set theory. The key methodologies include the employment of Zadeh's fuzzy set and linguistic values, Chen and Hsieh's GMIR method, and Hsieh and Chen's MGD approach. As for the proposed fuzzy MCDM algorithm, a hierarchical structure is developed. Then, the linguistic values are employed to appraise the fuzzy weights of all criteria and sub-criteria, as well as the fuzzy ratings of all alternatives versus all sub-criteria. Moreover, the authors combined the ideal and anti-ideal concepts, the highest BE company will be ultimately ranked by this proposed fuzzy MCDM model.

Secondly, the systematic appraisal approach using this fuzzy MCDM algorithm is performed to assess the empirical survey. This study of assessing BE for three GSLPs in Taiwan shipping market is utilized to demonstrate the computational process of the fuzzy MCDM algorithm. For matching this evaluation problem, a hierarchical structure of assessing BE is developed with five criteria, eighteen sub-criteria and three GSLPs. Then, a questionnaire is designed to survey. We used 1,500 exporters and importers in Taiwan as the population. A total of 319 questionnaires or 21.27% of the total population were checked for validity. The results of empirical survey are summarized as follows.

Thirdly, overall speaking, we can calculate the integrated weight 29.3% of the criteria of customer value. Following the integrated weights of the other four criteria (market evaluation, brand fame, brand loyalty, and brand association) are 21.3, 20.3, 14.6, and 14.5% respectively. Hence, customer value, ranking first, is the most important criteria influencing the BE from the shippers' perspective in Taiwan. Market evaluation, brand fame, and brand loyalty are ranked in the second, third, and fourth places. Brand association is the lowest ranked. It is worth to point out that customer value is the key element and the most important asset of BE. Customer value can be seen as the most criteria attached on the BE according to high value of high service and quality, as well as low cost and handling time for shippers. Thus, a reputed brand of service provider is created by a high percentage of providing customer value of shippers.

Fourthly, following will be extensively expressed the key attribute of the five dimensions. (a) For brand loyalty, customer satisfaction is the key attribute. Experience show customer satisfaction will affect customer retention and loyalty, and therefore, meeting customer needs is a great vital for obtaining customer satisfaction to eventually gain BE for shippers. (b) For brand association, enterprise image is the key attribute. Good and excellent image embedded on the skull and brain will influence the positive habit of purchasing behavior and eventually affect BE for shippers. (c) For brand fame, good reputation is the key attribute. Good reputation is referred by many researchers that it will impact the margins and competitive advantage and eventually affect BE for shippers. (d) For customer value, high quality is the key attribute. The quality would be paid close attention on customer value by shippers. High customer value would be influenced by providing high quality, which would affect BE for shippers. (e) For market evaluation, freight and price is the key attribute. In the shipping market, freight and price are critical factors influencing the choice decision of evaluating different GSLPs. An acceptable freight and price to shippers may be gained more market share and finally affected the BE for shippers.

Fifthly, the top three key sub-criteria are high quality, multiplicity services, and low cost, respectively. The weights of these five key sub-criteria are all above 7%. They are all located on the dimension of customer value. However, the lowest weights of seven ones are, below 5%, total solutions of solving problems, leader brand, differentiation among GSLPs, channel relationship, customer loyalty, enterprise image, and customer satisfaction, respectively. These attributes are almost located on the dimensions of brand loyalty and brand association due to the fact that these two dimensions have low weights. We can see just one dimension of customer value, total weights as 29.3%, is bigger than the above two ones, totally as 29.1%. Therefore, six lowest weights are appeared on these two dimensions.

Finally, among three GSLPs operated in Taiwan, the company A_2 - the headquarters is located at Northwest Europe - is determined as the highest BE company from the shippers' perspective based on the results of the proposed fuzzy MCDM algorithm. Hence, it can recommend that company A_2 is the most BE for GSLPs based on the shippers' perspective in Taiwan. Furthermore, this paper with its methodologies developed can be employed as a practical tool for business application. The proposed model not only release the limitation of crisp values, but also facilitate its implementation as a computer-based decision support system for assessing BE of liner and tramp shipping companies in a fuzzy environment.

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