FACTORS OF LOGISTICS SERVICE PROVIDERS EVALUATION AND SELECTION

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ABSTRACT

This study aims to identify and analyze the key factors influencing the decision-making process for the selection of logistics service providers (LSPs) via multiple-criteria decision analysis (MCDA). From a comprehensive literature review and empirical data gathered through surveys and interviews with supply chain managers across various factories in the Bien Hoa industrial zone, this research categorizes the evaluation criteria into five main factors: cost efficiency, service quality, capability, reliability, and sustainability and ethics. This paper also contributes to the logistics field by providing a structured framework for LSP evaluation that can be helful for LSPs in optimizing their supply chain decisions. The study's implications extend to enhancing logistical collaborations and promoting sustainable business practices within the global supply chain landscape.

1. INTRODUCTION

It is agreed that logistics service providers (LSPs) in today's globalized economy play a pivotal role in the supply chain networks of companies across various sectors (Balmer et al., 2020; Zailani et al., 2018). Besides, the effectiveness and efficiency of LSPs directly impact business operations (Chen et al., 2019), customer satisfaction (Jazairy & von Haartman, 2020), and market competitiveness (Liu et al., 2018). According to Sarabi and Darestani (2021), as supply chains become more complex and customer expectations rise, the need for comprehensive evaluation and strategic selection of LSPs becomes crucial. Thus, this research is motivated by the necessity to understand and systematize the factors that influence the selection of LSPs, aiming to provide businesses with a framework for making informed decisions that align with their operational goals and market demands.

Next, the expansion of global trade has increased the geographical dispersal of production and consumption, necessitating sophisticated logistics solutions. Cichosz et al. (2020) pointed out that companies are no longer confined to local or regional markets. Alternatively, they operate on a global scale, where the efficiency of transporting goods determines their ability to compete and thrive. Thence, addressing LSP selection factors is essential for businesses aiming to capitalize on global growth opportunities while managing risks effectively.

(Singh et al. 2022) argued that supply chains become more intricate, characterized by a multitude of interdependencies, so the role of LSPs becomes more critical than ever. It has been postualted that modern supply chains are not just about transporting goods from one place to another but involve managing complex inventories, thus providing value-added services (Laari et al., 2018), and ensuring real-time data flow across stakeholders (Vu et al., 2020). Hence, identifying LSPs selection factors can offer not only transportation solutions but also comprehensive logistics services for advanced supply chain practices (Gupta et al., 2023).

Additionally, the rapid advancement of technology, particularly in areas like artificial intelligence, blockchain, and the Internet of Things (IoT), has transformed logistics operations (Sureeyatanapas et al., 2018; Zailani et al., 2018). These technologies promise transparency (Prataviera et al., 2023), thus improving transaction efficiency, and reducing costs for firms (Świtała et al., 2018). However, they also require LSPs to continually adapt and innovate. Accordingly, evaluating LSPs based on their technological capabilities is increasingly becoming more important than it used to be.

Moreover, cost efficiency in an economically fluctuating environment remains a critical factor for businesses in maintaining profitability (Oláh et al., 2018). This research explores how economic pressures influesnce the prioritization of cost-related factors in the selection of LSPs. Besides, understanding the balance between cost and quality is crucial for businesses in achieving long-term sustainability in their operations. Dovbischuk (2022) also had a similar opinion.

To fill the literature gap, this paper aims to assess factors of logistics service providers (LSPs) evaluation and selection by the MCDA approach. In doing so, this paper first identifies main factors and subfactors affecting logistis firms' attitude in selecting their LSPs. Then, the MCDA techniques are used to calculate the weight of such factors and subfactors. Finally, some factories in the Bien Hoa industrial zones are empirical surveyd to verified the proposed research model.

2. METHODOLOGY

2.1. Identifying factors of LSPs evaluation and selection

Based on the literature review as noted earlier, this study identifies five main factors and twenty subfactors affecting logistis firms' attitude in selecting their LSPs, including cost efficiency, service quality, capability, reliability, and sustainability and ethics. Note that such factors and subfactors represent overall capacities of LSPs in delivering their services to their customers.

2.2. Data collection

In order to verify the proposed research model, this paper selected a research sample from factories in the Bien Hoa industrial zones. Through two rounds of survey, the research team interviewed seventeen respondents to get information on factors and subfactors, as seen in

Table 1. The respondents' profile is seen in

Table 2.

Table 1. Factors and subfactors of LSPs selection

Factors	Subfactors	Codes
Cost efficiency (CE)	Freight rates	CE1
	Fuel charges	CE2
	Volume discounts	CE3
	Billing accuracy and flexibility	CE4
Service quality (SQ)	Timeliness	SQ1
	Damage control	SQ2
	Packaging and storage	SQ3
	Customer service	SQ4
Operating capability (OC)	Transportation modes	OC1
	Technological infrastructure	OC2
	Coverage area	OC3
	Handling special requirements	OC4
Reliability (RL)	Consistency	RL1
	Contingency management	RL2
	Risk management	RL3
	Financial stability	RL4
Sustainability and ethics (SE)	Environmental practices	SE1
	Ethical practices	SE2
	Corporate social responsibility (CSR)	SE3
	Compliance	SE4

Table 2. The sample's descriptive statistics

Features		Frequency	%
Types of firms	Multinational firms	6	35.29
	Domestic firms	9	52.94
	Joint-venture	2	11.76
Years of founding (years)	<3	2	11.76
	3-5	4	23.53
	6-9	7	41.18
	>9	4	23.53
Production areas	Consumer Goods	7	41.18
	Industrial goods	3	17.65
	Pharmaceuticals and chemicals	5	29.41
	Food and beverages	2	11.76

2.3. The MCDA approach

This paper adopts the MCDA approach to estimate the weight of factors and subfactor, as shown in

Table 1. The process for applying this method is as follows:

Step 1: Establish the fuzzy positive reciprocal matrix

Suppose we have $\tilde{A}$ a fuzzy positive reciprocal matrix with n factors as:

$$\tilde{A} = [\tilde{a}_{ij}]_{n\times n} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \dots \tilde{a}_{2n} \\ \vdots & \vdots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots 1 \end{bmatrix}$$

Where: $\tilde{a}_{ij}$ is a triangular fuzzy number (TFN) with some features:

$$\tilde{a}_{ij} = \begin{cases} [l_{ij},\ m_{ij},\ u_{ij}],\ \text{if } i > j \\ [1,\ 1,\ 1],\ \text{if } i = j \\ [\frac{1}{u_{ji}}, \frac{1}{m_{ji}}, \frac{1}{l_{ji}}],\ \text{if } i < j \end{cases} .$$

Step 2: Forming integrated FPRM

From the sample of t respondents, we can build t individual FPRM. Then integrated FPRMs can be constructed by:

$$[l_{ij}, m_{ij}, u_{ij}] = \left[\min_{1\le k\le t}\left(a_{ij}^{(k)}\right), \left(\prod_{k=1}^{t} a_{ij}^{(k)}\right)^{1/t}, \max_{1\le k\le t}\left(a_{ij}^{(k)}\right) \right]$$

$i = 1,2,...,n$, $j = 1,2,...,n$ and $k = 1,2,...,t$.

Note that experts rate the importance weight of factors and subfactors based the linguistic scale, as follows:

Table 3. Linguistic terms for the MCDA approach

Linguistic Term	Numerical Value	Description
Equal Importance	1	Both elements contribute equally to the objective.
Moderate Importance	3	One element is slightly more important than the other.
Strong Importance	5	One element is strongly more important than the other.
Very Strong Importance	7	One element is very strongly more important than the other.
Extreme Importance	9	One element is extremely more important than the other.
Intermediate Values	2, 4, 6, 8	Values used for compromises between the adjacent judgments.

Step 3: Build geometric means for matrixes

For the i^{th} AC ($i = 1,2,\dots,n$) in the matrix $\tilde{A}$, its geometric means $\tilde{g}_i$ may be computed, as follows:

$$\tilde{g}_i = \left(\prod_{j=1}^{n} \tilde{a}_{ij}\right)^{1/n} = \left[\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n}, \left(\prod_{j=1}^{n} m_{ij}\right)^{1/n}, \left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}\right],\ i = 1,2,\dots,n$$

And:

$$\sum_{i=1}^{n}(\tilde{g}_i) = \left[\sum_{i=1}^{n}\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n},\ \sum_{i=1}^{n}\left(\prod_{j=1}^{n} m_{ij}\right)^{1/n},\ \sum_{i=1}^{n}\left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}\right]$$

Then, the weight $\tilde{w}_i$ for the i^{th} factor ($i = 1, 2, \dots, n$) can then be obtained as:

$$\tilde{w}_i = \tilde{g}_i / \sum_{i=1}^{n} \tilde{g}_i = \left[\frac{\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}}, \frac{\left(\prod_{j=1}^{n} m_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} m_{ij}\right)^{1/n}}, \frac{\left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n}} \right],\ i = 1,2,\dots,n$$

Step 4: Defuzzification

Let $\tilde{w}_i = [l_i^w, m_i^w, u_i^w]$, where:

$$\left[\frac{\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}}, \frac{\left(\prod_{j=1}^{n} m_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} m_{ij}\right)^{1/n}}, \frac{\left(\prod_{j=1}^{n} u_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} l_{ij}\right)^{1/n}}\right], i = 1,2,\ldots,n$$

The Buckley's index (1981) of the $\tilde{w}_i$, $i = 1,2,\ldots,n$, is defined as:

$$w_i = \left[l_i^w \times \left(m_i^w\right)^2 \times u_i^w\right]^{\frac{1}{4}}, \ i = 1,2,\ldots,n$$

Step 5: Normalization:

Normalizing the w_i ($i = 1,2..,n$), the crisp weight ω_i of the i^{th} factor can then be found as:

$$\omega_i = w_i / \sum_{i=1}^{n} w_i, \ i = 1,2,\ldots,n$$

Step 6: The FPRM's consistency

This paper adopts the formula developed by Wang and Lin (2017) to test FPRM's consistency, as follows:

Let $\tilde{A} = \left(\tilde{a}_{ij}\right) = \left(a_{ij}^L, a_{ij}^M, a_{ij}^U\right)_{n\times n}$ be the integrated FPRM, then its geometric consistency index $\left(GCI\right)$ is defined as:

$$GCI\left(\tilde{A}\right) = \max\left\{\frac{2}{(n-1)(n-2)}\sum_{i<j}\left(\log a_{ij}^M - \frac{1}{n}\sum_{k=1}^{n}\log a_{ik}^M + \log a_{kj}^M\right)^2; \frac{1}{2(n-1)(n-2)}\sum_{i<j}\left[\log a_{ij}^L + \log a_{ij}^U - \frac{1}{n}\sum_{k=1}^{n}\left(\log a_{ik}^L + \log a_{ik}^U + \log a_{kj}^L + \log a_{kj}^U\right)\right]^2\right\}$$

Note that the GCI thresholds is as follows:

$$GCI = \begin{cases} 0.3147 & \text{if } n = 3 \\ 0.3562 & \text{if } n = 4 \\ 0.3700 & \text{if } n > 5 \end{cases}$$

3. FINDINGS AND DISCUSSION

3.1. The weight of factors and subfactors

Table **4** exhibits empirical results for factors and subfactors. Some discussion is as follows:

The weight of cost efficiency is 21.96%, which is second-most important among five factors in the sample. This factor is divided into four sub-factors. The most significant sub-factor is CE4 with a global weight of 9.25%, which suggests it's the most critical aspect within the cost efficiency category. CE2 also carries significant weight at 5.90%. This distribution indicates a prioritization of certain cost factors (likely reflecting elements such as volume discounts or billing accuracy) over more basic elements like CE1 (3.11%).

The weight of service quality weigh is 28.38%, which is most important in the sample. This is the highest weighted factor, indicating its paramount importance in logistics provider selection. Service quality is often regarded as the most important factor in selecting LSPs due to several critical impacting a company's operations (Liu et al., 2018), customer satisfaction (Sarabi & Darestani, 2021), and overall competitiveness (Cichosz et al., 2020). On top of that, Singh et al. (2022) argued that high service quality is not just about meeting current needs but also about preparing for future challenges and opportunities, making it an indispensable criterion in SLP selection.

Among four subfactors of this factor, SQ4 stands out with a very high weight of 12.18%, signaling that this sub-factor, which related to customer service (Chen et al., 2019) or delivery accuracy (Laari et al., 2018), is extremely critical. Besides, SQ1 also has a substantial impact at 5.33%.

The weight of operating capability is 16.45%. Its subfactors reflects operational aspects with OC4 being exceptionally dominant at 8.76%. This suggests that whatever OC4 represents (likely a crucial operational parameter like technological capability or geographical coverage) is highly valued.

Reliability has the weight of 12.76%. More specifically, RL4 (5.55%) is the most crucial reliability measure, indicating its central role in assessing LSP reliability. This might include aspects like consistency and risk management.

Sustainability and ethics have the weight of 20.45%. This factor is significantly weighted, with a particular emphasis on SE2 (6.28%) and SE4 (8.37%). These might include critical ethical considerations like corporate social responsibility and environmental impact, reflecting a growing trend towards sustainability in logistics.

Table 4. The weight of factors and subfactors

Factors	Global weight (%)	Sub-factors	Local weight (%)	Global weights (%)
Cost efficiency (CE)	21.96	CE1	14.18	3.11
		CE2	26.88	5.90
		CE3	16.80	3.69
		CE4	42.13	9.25
Service quality (SQ)	28.38	SQ1	18.78	5.33
		SQ2	13.68	3.88
		SQ3	24.62	6.99
		SQ4	42.92	12.18
Operating capability (OC)	16.45	OC1	10.66	1.75
		OC2	11.75	1.93
		OC3	24.33	4.00
		OC4	53.26	8.76
Reliability (RL)	12.76	RL1	21.60	2.76
		RL2	12.79	1.63
		RL3	22.12	2.82
		RL4	43.49	5.55
Sustainability and ethics (SE)	20.45	SE1	17.34	3.55
		SE2	30.70	6.28
		SE3	11.05	2.26
		SE4	40.91	8.37

The weights reflect a balanced approach to evaluating logistics service providers, emphasizing service quality and ethical practices along with cost. The high weights on certain sub-factors like SQ4, OC4, and SE4 suggest a nuanced preference towards logistics providers who excel in delivering exceptional service quality, robust operational capabilities, and strong ethical standards. This model facilitates a comprehensive and detailed assessment, enabling businesses to make informed choices based on a broad spectrum of relevant criteria.

3.2. Operating performance of LSPs

Table 5 displays the operating performance of the logistics service providers, including THO, CEY, MLP, JKO, and ADN based on the five factors and twenty subfactor. Here, we can examine how each provider scores across various sub-factors and compare their overall performance relative to each other.

Table 5 also lists sub-factors across several categories: cost efficiency (CE), service quality (SQ), operating capability (OC), reliability (RL), and sustainability and ethics (SE). Each sub-factor has a global weight, indicating its importance in the overall evaluation.

Particularly, JKO demonstrates strong reliability, especially in RL1 and RL2. THO is also strong in RL3 and RL4, showing a balanced performance across reliability metrics. In the meantime, CEY demonstrates strong performance in SE1 and SE2, indicating a focus on sustainability and ethics. JKO scores well in SE4, showing strength in this critical sub-factor. Overall performance of LSPs is THO (23.52%), CEY (22.12%), MLP (22.27%), JKO(18.37%), ADN (13.72%).

Table 5. Operating performance of LSPs

Sub-factors	**Global weights (%)**	**LSPs**				
		THO	CEY	MLP	JKO	ADN
CE1	3.11	19.72	27.68	15.66	34.88	2.06
CE2	5.90	18.52	11.53	29.19	15.51	25.25
CE3	3.69	20.40	15.07	30.93	26.10	7.49
CE4	9.25	36.33	11.00	22.38	24.74	5.55
SQ1	5.33	30.08	29.27	21.14	14.74	4.77
SQ2	3.88	33.36	10.15	29.01	18.00	9.48
SQ3	6.99	22.50	34.67	10.50	17.95	14.39
SQ4	12.18	16.07	31.28	36.34	10.66	5.65
OC1	1.75	25.96	29.02	23.49	7.69	13.84
OC2	1.93	9.64	10.70	28.04	28.67	22.96
OC3	4.00	25.21	10.54	16.45	28.31	19.49
OC4	8.76	20.67	27.28	22.65	12.50	16.90
RL1	2.76	30.59	14.12	16.78	31.44	7.06
RL2	1.63	33.67	7.02	12.22	36.30	10.78
RL3	2.82	32.94	10.86	27.56	10.42	18.22
RL4	5.55	33.13	14.73	11.03	13.79	27.33
SE1	3.55	30.67	31.63	17.92	9.45	10.32
SE2	6.28	19.97	36.34	16.03	8.97	18.70
SE3	2.26	20.52	16.21	32.56	18.20	12.51
SE4	8.37	10.10	22.55	16.78	27.95	22.62
Mean		23.52	22.12	22.27	18.37	13.72

To sum up, THO shows the highest overall performance with a mean score of 23.52%, indicating strong capabilities across several factors, particularly in service quality and cost efficiency. CEY and MLP are close behind, each excelling in different sub-factors such as operating capability and sustainability. JKO, while strong in reliability and certain aspects of sustainability, scores lower overall. ADN lags behind the others, suggesting room for improvement across most evaluated factors.

These insights provide a comprehensive understanding of how each logistics service provider performs relative to the others based on critical factors and sub-factors, enabling businesses to make informed decisions based on their priorities and needs.

4. CONCLUSION

It has been posited that the evaluation and selection of Logistics Service Providers (LSPs) are pivotal to the success of supply chain operations in competitive and globalized business environment nowadays (Balmer et al., 2020; Gultekin et al., 2022; Wen et al., 2019). Yet, factors of LSPs selection from firms' perspective is yet well-undocumented. Accordingly, this study has systematically examined the multifaceted factors influencing the decision-making process for choosing LSPs. By identifying key evaluation criteria such as cost efficiency, service quality, operating capability, reliability, and sustainability and ethics, this paper provides a comprehensive framework for businesses to assess potential logistics partners effectively.

It is argued that cost efficiency remains a fundamental consideration, as logistics costs significantly impact overall profitability. Factors such as freight rates, billing accuracy, and volume discounts must be weighed carefully to ensure cost-effective logistics solutions. However, this study highlights that cost alone is not the sole determinant of an effective logistics partnership.

Service quality emerged as the most critical factor, underscoring the importance of timeliness, damage control, and customer service in fostering strong supplier relationships. The ability of LSPs to consistently meet and exceed service expectations can enhance customer satisfaction and brand reputation, providing a competitive advantage in the market. In the meantime, operating capability and reliability are equally important in evaluating LSPs. Qin et al. (2020) argued that a provider’s ability to offer diverse transportation modes, manage complex logistics operations, and ensure the timely delivery of goods is essential for maintaining smooth supply chain operations. Additionally, reliability in terms of consistent performance and effective risk management is crucial in mitigating disruptions and enhancing supply chain resilience.

In addition, sustainability and ethics have recently gained prominence in the selection of LSPs. It is evident that businesses strive to meet environmental standards and social responsibilities (Mathauer & Hofmann, 2019); so, the ethical practices and sustainability initiatives of logistics providers play a significant role in their selection (Hohenstein, 2022). The findings of this study have significant implications for practitioners in the logistics field. Particularly, by understanding the relative importance of these factors and sub-factors, port companies can develop tailored evaluation criteria aligning with their strategic objectives. Moreover, this framework can be adapted to different industries and geographic contexts, providing flexibility in its application.

According to Jazairy and von Haartman (2020), the selection of LSPs should be approached as a strategic decision that balances cost considerations with service quality, capability, reliability, and ethical practices. We know that supply chains are continuing to evolve; thus, businesses adopting a comprehensive and dynamic approach to evaluating logistics partners will be better positioned to thrive in the complex and rapidly changing global market. Thus, it is highly recommended that future research could explore the integration of emerging technologies, such as artificial intelligence and blockchain, in enhancing the evaluation and selection process of LSPs, further contributing to the advancement of logistics management.

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