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Logistics Services Outsourcing Decision Making: a literature review and research agenda

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Abstract:

Logistics plays important role in any firm's supply chain. Outsourcing allows firms to focus on core business. Logistics outsourcing to third party logistics or logistics service providers (LSP) helps the companies to reduce costs, improve performance, sustainability, customer satisfaction and profitability. Logistics assessment and selection of LSP is a complex and important aspect of outsourcing decision. The purpose of this paper is to provide a review of logistics outsourcing literature to provide an insight to the trend, opportunities, criteria and techniques adopted in logistics outsourcing decision-making. This paper is based on literature review of 62 research articles published related to LSP evaluation and selection during 2010-2020. The analysis includes publications in journals, year, selection criteria and evaluation methods. It has been found that 44 major selection criteria have been used by different authors but most commonly used are: price, on-time delivery, service quality, reliability, flexibility, equipment and technology, customer relationship, while environmental and social criteria are rarely adopted. It is also observed that multi criteria decision making (MCDM) methods have been adopted by majority of researchers wherein Analytic Hierarchy Process (AHP), Technique for order of preference by similarity to ideal solution (TOPSIS) and their fuzzy variant are highly applied. Conclusion, implications for researchers and practitioners, limitations, and direction for future research are provided.

Key words:

Logistics services outsourcing, logistics service providers (LSP) selection, third party logistics service provider (3PL), 3PL selection criteria, 3PL selection techniques.

1. Introduction

Logistics is the management of material, service, capital and information flows and comprises of demand forecasting, purchasing, warehousing, storage, inventory control, packaging, material handling, traffic and transportation, order processing, customer service, service support, return handling, salvage and scrap disposal (Dey et al., 2011). Logistic services play important role for smooth flow of materials, information and money in a supply chain. Outsourcing logistics activities to LSP are mainly done to reduce cost and lead time and avoid heavy investment (Kumar and Singh, 2012). LSP is an external firm that manages, delivers and controls inventory, goods distribution, transportation, and customs clearance on behalf of the shippers (Hassini et al., 2012) and offer expertise, know-how, skills, infrastructure in terms of vehicle fleet, warehouses, geographical coverage that allow firms to achieve supply chain solutions at reduced total delivered costs. Outsourcing logistics and strategic alliances with LSP reduces costs; improve performance and customer satisfaction (Aguezzoul, 2014). Firms world over, are outsourcing logistic activities to LSP to reduce costs, overheads, supply chain complexities and enhance logistics capacity (Mitra, 2011), decreases the labour costs, excess inventories, number of warehouses, vehicles and

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shrinkage (Rajesh et al., 2013) and provides well-managed inventory and supply chain solutions to both manufacturer and the retailer. Expansion of the global supply chain by various firms led to the growth of logistics outsourcing (Singh et al., 2010). By hiring the services of LSP, many firms have benefitted in terms of operational efficiency, flexibility, and customer satisfaction improvement (Angkiriwang et al., 2014). In an empirical study, Adesunkanmi et al. (2022) found that logistics outsourcing had significant effect on productivity of manufacturing companies in the South-west Nigeria. In a survey of 49 drug manufacturers in UK, Ali et al. (2023) found quality and reliability improvement and logistics costs reduction as the most significant reasons for logistics outsourcing.

The process of evaluation and selection of LSP as a strategic business partner is a crucial step in logistics outsourcing (Jung, 2017). Though finding an appropriate LSP is challenging but careful evaluation and selection can lead to extraordinary result (Sahu et al., 2013).Various researchers have adopted a number of selection criteria and techniques for assessment and selection of LSP in the literature. Road transportation is causing more air pollution. Logistics industry remains unorganised and social sustainability remains neglected in developing countries. Due to globalization, economic slowdown and sustainability pressure, the manufacturing industry is facing greater challenges which will impact its competitiveness. Hence, the firms should rethink on how to evaluate and selection LSP. The evaluation and selection process of LSP involves multiple quantitative and qualitative criteria and alternative and thus viewed as a multi-criteria decision-making (MCDM) problem (Percin, 2009). Green supply chain practices adoption by LSP are mainly due environmental and cost efficiency issues (Centobelli et al., 2017). Logistics sector contribute to economic growth but significantly contribute to greenhouse effect and consume huge amounts of resources. Larson (2021) recommended the adoption of greater energy efficiency (and lower emissions) and social well-being in transportation. Logistics performance contributes to sustainable development in top Asian countries (Suki et al., 2021). Supply chain practices such as relationship with customers, postponement, level of information sharing, and information quality is found to have influences the environmental sustainability, whereas environmental sustainability had a significant direct effect on financial performance (Jum'a et al., 2021). Commercial organizations world over, are concerned about environmental impact of manufacturing and other activities (Vanalle et al., 2017). Sustainability innovation found a significant positive relationship on firm competitiveness. Firm competitiveness is found to have a positive significant relationship with operational, financial and environmental performance in Vietnamese SME sector (Le and Ikram, 2022). The sustainable logistics practices such as sustainable transportation, reverse logistics and management of waste, sustainable packaging and distribution, green monitoring and evaluation, and sustainable information sharing is found to have influence on environmental reputation and financial performance (Baah et al., 2021). A sustainable logistics management involves integration of economic, environmental and social thinking in traditional logistics management. Various MCDM methods, mathematical programming, and intelligent algorithm have been used for LSP evaluation and selection in the literature (Guarnieri et al., 2015). Few important logistics outsourcing review have been conducted from 2010 to 2020 as summarised in Table 1.

It can be seen from Table 1 that literature review article of 2019, 2020 focus on sustainability and challenges in logistics and there is no major literature reviews on logistics outsourcing in general since 2018. Hence, a review of logistics outsourcing for the period 2010-2020 is chosen. The study analyses the literature and tries to answer following research questions:

RQ1. How is the publication journal wise, year wise?

RQ2. What are the selection criteria adopted for logistics outsourcing decision making?

RQ3. What are the techniques and methods adopted for the logistics service provider's assessment and selection?

RQ4. What is the logistics outsourcing direction for future research?

An in-depth literature review has been carried to answer above questions. The paper is organized as follows. Section two covers the methodology; section three presents the review and analysis; section four provides discussion, and section five provides conclusion, proposed framework and direction for future research.

Table 1. Literature Reviews on LSP.

Author and Year	Published in Journal	Title	Objective
Aguezzoul (2014)	Omega	Third-party logistics Selection problem: A literature review on criteria and methods	Literature review of articles published during 1994-2013 on criteria and methods for 3PL selection.
Evangelista and Durst (2015)	Vine	Knowledge management in environmental Sustainability practices of third-party logistics service providers	Systematic review of 3PL knowledge management and sustainability practices.
Alkhatib, Darlington, & Nguyen, (2015)	Strategic Outsourcing: An International Journal	Logistics ServiceProviders (LSPs) evaluation and selection: Literature review and framework development	Literature review for a period 2008-2013 on logistics service provider selection and proposed a LSP evaluation and selection framework.
Konig & Spinler (2016)	International Journal of Logistics Management	The effect of logistics outsourcing on the supply chain vulnerability of shippers	Literature review and proposed a risk framework of logistics outsourcing impact on supply chain vulnerability.
Akbari (2018)	Benchmarking: An International Journal	Logistics outsourcing: a structured literature review	Literature review of logistics outsourcing from 1991 to 2016.
Ren et al. (2019)	International Journal of Environmental Research and Public health	A Systematic Literature Review of Green and Sustainable Logistics: Bibliometric Analysis, Research Trend and Knowledge Taxonomy.	Literature review of green and sustainable logistics from 1999 to 2019.
Premkumar, Gopinath & Mateen (2020)	International Journal of Logistics Research and Applications	Trends in third party logistics – the past, the present & the future	Systematic literature review of challenges faced by it in TPL services.

2. Methodology

The systematic literature review is the process to identify the articles and analyse for conclusions, and identify the gap for future research opportunities (Denyer & Tranfield, 2009). The literature review was carried out in following steps (Figure 1).

Step 1: Ten years from 2010-2020 is the range of investigation.

Step2: The articles were collected from EBSCO database and Google scholar.

Step3: The key words 'logistics service provider', 'logistics service provider selection', 'logistics partner outsourcing', 'logistics service', 'logistics outsourcing', 'third party logistics provider', 'third party logistics', '3PL', 'green logistics', 'sustainable logistics', 'triple bottom line sustainability' were searched in the above databases.

Step4: The paper not belonging to subject area were excluded. Papers related to logistics service provider assessment and selection was retained. This list was further refined by retaining papers published during 2010-2020. All the articles were classified and analysed to understand the progress in last ten years.

Step 5: In this final step, research gaps, findings and direction for future work were identified.

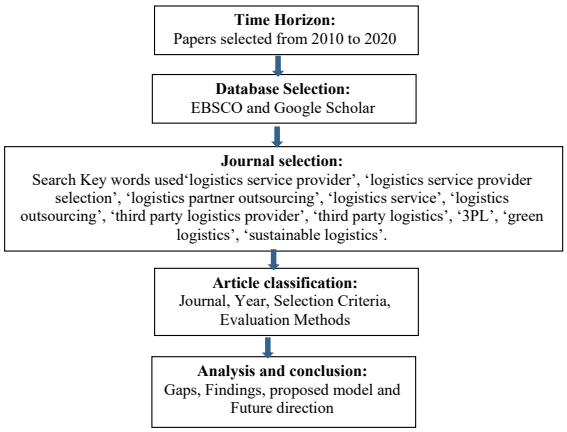

Figure 1. Literature Review Methodology.

3. Review and analysis

A review summary and discussions on the findings is presented in this section.

3.1. Distribution of Articles Publication Journal Wise

Though large number of articles on logistics outsourcing partner selection is available in the literature but few are with triple bottom line sustainability considerations. The articles on logistics services outsourcing published journal wise during 2010-2020 are shown in the Table 2. Only limited journals have published more than once. The Expert System with Application has published highest number of articles (5), followed by Benchmarking: An International Journal (4), Computers & Industrial Engineering (3) and Annals of Operations Research (3).

3.2. Distribution of articles publication year wise

A total of 62 articles on logistics outsourcing were published during the period from 2010 to 2020 as shown in Figure 2. The highest number of articles (8) published in the year 2015 and 2019 followed by 7 in 2014 and 2018.

Figure 2. Distribution of Articles Publication Year Wise.

3.3. Logistics outsourcing selection criteria

Various criteria have been proposed by various researchers for LSP evaluation and selection in the literature. The criteria have been classified as economic, environmental, and social sustainability criteria.

3.3.1. Economic criteria:

Li et al. (2012) adopted price, on-time delivery, product availability, service quality, reliability, flexibility, firm background, knowledge sharing and firm reputation. Falsini et al. (2012) considered reliability of quality, cost, speed of service, equipment, flexibility. Ho et al. (2012) identified flexibility, quality, cost, technology, delivery and risk. Kumar and Singh (2012) proposed logistics cost and service quality. Percin and Min (2013) adopted cost, service quality, flexibility, quick timely service, and reputation. Daim et al. (2013) used service cost, service level performance (on-time, reliability, and accuracy), expertise to respondents' industry, IT capability and integration, strong local presence, and global capability. Hsu et al. (2013) considered quality (customer's satisfaction, knowledge and skills, on time rate), compatibility (relationship, information sharing, flexibility), cost (cost savings, billing flexibility), and risk (information security, labor union, loss of management control). Li and Wan (2014) adopted economics, strategy, management, technology, quality. Liao and Kao (2014) considered information technology, customer relationship management, just-in-time, warehouses layout performance, forecasting methods, information sharing and trust, long-term trade relationship, service quality, order picking performance, customer relationship management and risk management. Guarnieri et al. (2015) adopted capacity, infrastructure, value added services, alliances with suppliers, logistics, and financial. Sharma and Kumar (2015) used on-time delivery, price, responsiveness, industry experience, capacity utilisation, asset ownership, logistics information system, technology integration, customer base, optimisation capability, financial growth rate, handling capability for special requirements, reputation, managerial staff level and international scope. Hwang et al. (2016) used performance (effectiveness, delivery, responsiveness, document accuracy, shipment error rate, safety), cost (price, value added service), service (asset/equipment, flexibility, capability, customer support service, capability of problem solving), quality assurance, information technology (system reliability), intangible (client relationship, financial stability, culture fit, customer orientation, experience, location, profitability, reputation, global scope). Bask et al. (2017) suggested price, lead time, reliability of service, transport mode. Sremac et al. (2018) proposed transportation cost, financial ability, reliability, vehicle fleet condition, professionalism of drivers, risk mitigation measures

Table 2. Articles Publication Journal Wise during 2010-2020.

S. No.	Year	Journals	No. of Papers published
1	2010	Environmental Research Journal	1
2	2010	International Journal of Physical Distribution & Logistics Management	1
3	2010, 2012	International Journal of Production Economics	2
4	2010, 2012, 2017	Journal of Modelling in Management	3
5	2011	International Journal of Applied Logistics	1
6	2011	Management Research Review	1
7	2011	Transportation Research Part C: Emerging Technologies	1
8	2011, 2012, 2013, 2014, 2015	Expert System with Application	5
9	2012	Computers & Operations Research	1
10	2012, 2015	International Journal of Production Research	2
11	2013	International Journal of Business Excellence	1
12	2013, 2020	International Journal of Logistic Systems and Management	2
13	2013, 2020	International Journal of Logistics Research & Applications	2
14	2013	Journal of Manufacturing Technology Management	1
15	2013, 2015, 2015 2018	Benchmarking: An International Journal	4
16	2014	Engineering Economics	1
17	2014	Journal of Industrial Engineering	1
18	2014	Journal of Military and Information Science	1
19	2014	Omega	1
20	2014	Procedia engineering	1
21	2014, 2019, 2020	Computers & Industrial Engineering	3
22	2015	International Journal of Shipping and Transport Logistics	1
23	2015	Proceedings of Fourth International Conference on Soft Computing for Problem Solving Springer India	1
24	2015, 2015	Journal of Cleaner Production	2
25	2016	Industrial Management & Data Systems	1
26	2016	Journal of Testing and Evaluation	1
27	2016	Supply Chain Management: An International Journal	1
28	2017	The International Journal of Advanced Manufacturing Technology	1
29	2017	Transport	1
30	2017, 2019	Sustainability.	2
31	2018, 2019	Annals of Operations Research	**3**
32	2018	Procedia CIRP	1
33	2018	Symmetry	1
34	2018	Technological and Economic Development of Economy	1
35	2018, 2018	Applied Soft Computing	2
36	2019	International Journal of Integrated Supply Management	1
37	2019	Neural Computing and Applications	1
38	2019	Proceedings of the Thirteenth International Conference on Management Science and Engineering Management. ICMSEM 2019	1
39	2019	International Journal of Environmental Research and Public health	1
40	2020	Decision Making: Applications in Management and Engineering	1
41	2020	Environment, Development and Sustainability	1
42	2020	Gazi University Journal of Science	1

and damage compensation. Govindan et al. (2019) adopted cost of service, financial position, asset ownership, optimisation capabilities, reputation and market position, experience in similar industry, geographic location. Roy et al. (2019) adopted cost of service, reputation and market position, delivery reliability, technological expertise, geographic location. Sinani et al. (2020) used transportation cost, financial ability, professionalism of drivers, and risk mitigation measures. Garg and Sharma (2020) adopted outsourcing cost, resource capacity, service delivery, technical capacity, firm performance and reputation.

3.3.2. Environmental criteria

Falsini et al. (2012) adopted environmental safeguard, operators' safety. Guarnieri et al. (2015) adopted environmental practices. Bask et al. (2017) proposed environment friendly service and ISO 14000 certification. Govindan et al. (2019) adopted environmental criteria such as environmental protection policies, green distribution and transportation network, green warehouse building, green initiative participation, and ISO 14000 compliance. Roy et al. (2019) adopted resource consumption, ISO 14000 compliance, green transportation, environment protection, emission and waste generation. Garg and Sharma (2020) used green purchasing, energy efficiency, reverse logistics, emission minimisation, ISO 14000 certification, green practices.

3.3.3. Social criteria:

Falsini et al. (2012) used operators' safety. Hsu et al. (2013) adopted labour union. Hwang et al. (2016) proposed labour relations. Govindan et al. (2019) adopted worker's health and safety, staff training, compatibility with sustainable goals, local community influence, ILO laws compliance. Roy et al. (2019) proposed health and safety, staff training, labour equity, local community influence, and ILO compliance. Garg and Sharma (2020) adopted safety, health and working condition, equity and fair wages, community support.

A summary of important criteria for LSP selection from the literature provided in the Table 3.

3.4. Logistics service provider evaluation technique

Various MCDM techniques and mathematical models have been used by various researchers in the literature for the evaluation and selection of suitable LSP. A single, hybrid, fuzzy, sustainable MCDM techniques and mathematical models have been applied for LSP selection. Majority articles demonstrate application of hybrid model.

3.4.1. Single model

For global logistics provider selection, Bhatti et al. (2010) applied AHP while Daim et al. (2013) adopted AHP for 3PL evaluation. Momeni et al. (2015) proposed multi objective additive network DEA model for selection of the most appropriate 3PL providers. Hwang et al. (2016) applied AHP to rank 3PL selection criteria.

3.4.2. Hybrid model

The integrated or hybrid models have used for LSP assessment and selection in the literature. Akman and Baynal (2014) used AHP and TOPSIS. Bianchini (2018) adopted AHP and TOPSIS for 3PL selection in an Italian biscuit company. Aggarwal (2019) applied AHP-DEA for 3PL selection. Sharma and Kumar (2015) proposed Quality function deployment (QFD) and Taguchi loss function for 3PL selection. Roy et al. (2019) proposed interval-valued fuzzy-rough number (IVFRN) based FARE-MABAC model for sustainable LSP selection in a food manufacturing company. Özcan and Ahıskalı (2020) used AHP, TOPSIS and Goal Programming for selection and order allocation among 3PL.

3.4.3. Fuzzy model

Fuzzy extension of various MCDM models have been proposed for LSP selection. Li et al. (2012) proposed fuzzy AHP-fuzzy TOPSIS for LSP selection for a tire manufacturing company. Kumar and Singh (2012) used fuzzy AHP-TOPSIS; Ho et al. (2012) applied QFD-fuzzy AHP; Hsu et al. (2013) demonstrated Grey DEMATEL-ANP; Bali and Eroglu (2014) and Alkhatib et al. (2015a) applied fuzzy DEMATEL-fuzzy TOPSIS. Datta et al. (2013) developed fuzzy appropriateness index (FAI) for evaluation and selection of third-party logistics.

Table 3. Summary of important criteria for LSP selection from the literature.

Type	S.No.	Criteria	Li et al. (2012)	Falsini et al. (2012)	Ho et al. (2012)	Kumar and Singh (2012)	Daim et al. (2012)	Percin and Min (2013)	Hsu et al. (2013)	Li and Wan (2014)	Liao and Kao (2014)	Guarnieri et al. (2015)	Sharma & Kumar (2015)	Hwang et al. (2016)	Bask et al. (2017)	Sremac et al. (2018)	Bianchini et al. (2018)	Govindan et al. (2019)	Roy et al. (2019)	Sinani et al. (2020)	Garg & Sharma (2020)	Ozcan and Ahiskali (2020)
Economic	1	Price/ Cost	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x
	2	On-time delivery/Delivery	x		x		x	x	x				x		x						x	x
	3	Responsiveness											x									x
	4	Service quality	x		x	x		x		x	x			x								x
	5	Reliability	x	x			x								x				x			
	6	Capacity and capability										x		x							x	
	7	Flexibility	x	x	x			x	x				x	x								
	8	Equipment & technology		x	x					x		X		x					x		x	
	9	IT capability and integration					x				x			x								
	10	Information sharing & trust							x		x											
	11	Financial/Financial stability										x		x		x		x		x	x	
	12	Firm Reputation	x					x					x	x							x	x
	13	Strategic Alliance										x					x					x
	14	Geographic location												x			x	x	x			
	15	Value added service										x		x								
	16	Customer Relationship							x		x			x								
	17	Risk/ risk management			x				x		x				x	x				x		
Environ-mental	18	Environmental safeguard and practices		x								x			x			x	x		x	
	19	Green transportation																x	x		x	
	20	ISO 14000 compliance																x	x		x	
Social	21	Worker health and safety																x	x		x	
	22	Labour union and labour relations							x					x							x	

Yayla et al. (2015) applied fuzzy AHP-TOPSIS in a confectionary company. Sahu et al. (2015) developed a fuzzy appraisement module using interval-valued fuzzy numbers (IVFNs) in Indian automobile parts manufacturing company. Ghorabaee et al. (2017) proposed IT2FS based CRITIC-WASPAS method for 3PL evaluation; Ecer (2018) applied fuzzy AHP-EDAS (Evaluation based on Distance from average solution) method. Sremac et al. (2018) adopted rough dombi aggregator based SWARA-WASPAS for 3PL selection for transportation of dangerous goods. Chen et al. (2018) used fuzzy axiomatic design, extended regret aversion/rejoice preference for criteria weight determination and expected perceived utility for LSP selection for omni-channel environment and compared the result with TOPSIS. Singh et al. (2018) used fuzzy AHP-fuzzy TOPSIS for 3PL selection in a cold chain. For 3PL selection, Jovčić et al. (2019) proposed fuzzy AHP-fuzzy TOPSIS method. Wen et al. (2019) proposed hesitant fuzzy linguistic based CoCoSo (combined compromise solution) method for selection of third-party logistics service providers in supply chain finance. Pamucar et al. (2019) suggested interval rough number (IRN) based BWM for criteria weight and IRN-WASPAS and IRN-MABAC method for ranking 3PL. Govindan et al. (2019) applied fuzzy AHP and TOPSIS for selection of forward and reverse LSP. Sinani et al. (2020) proposed rough number based Dombi-Hamy Mean (RNDHM) operator to rank 3PL. Yadav et al. (2020) applied F-AHP for 3PL selection in IoT based Agricultural supply chain.

3.4.4. Mathematical programming model

Hybrid model including mathematical techniques have also been proposed for LSP selection. Falsini et al. (2012) applied a combined AHP, DEA and Linear Programming (LP) method. A combined QFD, fuzzy-linear regression and multi-objective programming (MOP) model proposed by Percin and Min (2013) for Turkish auto part manufacturers. To minimize cost and maximize performance of outsourced services to 3PL in closed-loop supply chain, Garg et al. (2015) applied a fuzzy bi-objective mixed integer linear programming (MILP) model. Haldar et al. (2017) used an integrated DEA-TOPSIS-LP model for selection and work distribution among 3PL firms. Zhou et al. (2019) adopted a mathematical model based simulations to verify the proposed LSP selection model in cloud manufacturing. Wang et al. (2020) utilized multi objective programming (MOP) and genetic algorithm for LSP selection and order allocation.

3.4.5. Sustainable model

Sustainability considerations have also been used in 3PL evaluation and selection. Celik et al. (2016) used IT2FS-ELECTRE (Et ChoixTraduisant la REalité) method to evaluate green 3PL service providers. Bask et al. (2017) used environmental sustainability criteria in 3PL selection while Jung (2017) applied fuzzy AHP considering social sustainability. For a food manufacturing company, Roy et al. (2019) used economic, environmental and social criteria and IVFRN-FARE (factor relationship) and IVFRN-MABAC (multi-attributive border approximation area comparison) models for selection of third-party logistics provider. Garg and Sharma (2020) applied BWM and VIKOR method for Sustainable outsourcing partner selection in electronics company in India.

3.4.6. Reverse logistics evaluation model

Few studies have focused on reverse logistics provider (RL) evaluation and selection. Azadi and Saen (2011) proposed chance-constrained DEA for third-party reverse logistics provider (3PLRL) selection for dual-role factors. Jayant et al. (2014) proposed a TOPSIS-AHP approach for RL selection in mobile phone industry. Zarbakhshnia et al. (2018) proposed fuzzy SWARA-fuzzy COPRAS considering sustainability, while Mavi et al. (2017) adopted fuzzy SWARA- fuzzy MOORA method for 3PLRL selection.

3.4.7. Inter-relationship model

Liou & Chuang (2010) proposed DEMATEL for dependent relationships among criteria, ANP to determine the criteria relative weights and VIKOR for outsourcing partner selection.

Some studies are related to finding inter-relationship among 3PL selection criteria. Govindan et al. (2016) proposed grey DEMATEL to develop inter-relationship 3PL selection criteria.

A summary of techniques and models adopted for LSP assessment and selection in the literature is shown in Table 4.

Table 4. Techniques adopted for Logistics Service Providers assessment and selection.

Methods/Techniques	AHP	Fuzzy AHP	TOPSIS	Fuzzy TOPSIS	EDAS	IT2FS ELECTRE	SWARA	Fuzzy/ Rough SWARA	BWM Rough	FARE Fuzzy	Fuzzy CRITIC	COPRAS Fuzzy	Fuzzy MOORA	WASPAS Fuzzy/ Rough	HF-CoCoSo	MABAC fuzzy	ANP	VIKOR	DEMATEL/fuzzy/Grey	DEA/ Chance constrained DEA	QFD	Taghuchi Loss Function	LP	Integer Programming/MILP/Goal Programming	MOP	IVFN based assessment	Fuzzy appropriateness index (FAI)	Mathematical model and simulation	Fuzzy AD, extended regret aversion/rejoice preference	Genetic Algorithm
Bhatti et al. (2010)	x																													
Azadi and Saen (2011)																				**x**										
Falsini et al. (2012)	x																			**x**			**x**							
Ho et al. (2012)		x																			**x**									
Li et al. (2012)		x		x																										
Kumar and Singh (2012)		x		x																										
Percin and Min (2013)																					**x**				**x**					
Daim et al. (2013)	x																													
Datta et al. (2013)																											**x**			
Hsu et al. (2013)																	x		x											
Akman and Baynal (2014)	x		x																											
Bali and Eroglu (2014)		x																	x											
Jayant et al. (2014)	x		x																											
Momeni et al. (2015)																				**x**										
Sahu et al. (2015)																										**x**				
Yayla et al. (2015)		x		x																										
Alkhatib et al. (2015)				x															x											
Garg et al. (2015)																								**x**						
Sharma & Kumar (2015)																					**x**	**x**								
Celik et al. (2016)						x																								
Hwang et al. (2016)	x																													
Govindan et al. (2016)																			x											
Ghorabaee et al. (2017)											x			x																

(Table 4 continues in the next page)

(Table 4 continues from the previous page)

Methods/Techniques	AHP	Fuzzy AHP	TOPSIS	Fuzzy TOPSIS	EDAS	IT2FS ELECTRE	SWARA	Fuzzy/ Rough SWARA	BWM Rough	FARE Fuzzy	Fuzzy CRITIC	COPRAS Fuzzy	Fuzzy MOORA	WASPAS Fuzzy/ Rough	HF-CoCoSo	MABAC fuzzy	ANP	VIKOR	DEMATEL/fuzzy/Grey	DEA/ Chance constrained DEA	QFD	Taghuchi Loss Function	LP	Integer Programming/MILP/Goal Programming	MOP	IVFN based assessment	Fuzzy appropriateness index (FAI)	Mathematical model and simulation	Fuzzy AD, extended regret aversion/rejoice preference	Genetic Algorithm
Bhatti et al. (2010)	x																													
Jung (2017)		x																												
Haldar et al. (2017)			x																	**x**			**x**							
Mavi et al. (2017)								x					x																	
Ecer (2018)		x			x																									
Zarbakhshnia et al. (2018)								x				x																		
Chen et al. (2018)																													**x**	
Sremac et al. (2018)								x					x																	
Singh et al. (2018)		x		x																										
Bianchini (2018)	x		x																											
Wen et al. (2019)															x															
Aggarwal (2019)	x																			**x**										
Jovčić et al. (2019)		x		x																										
Pamucar et al. (2019)									x					x		x														
Zhou et al. (2019)																												**x**		
Roy et al. (2019)										x						x														
Govindan et al. (2019)		x	x																											
Sinani et al. (2020)		x																			**x**									
Garg and Sharma (2020)										x								x												
Özcan & Ahıskalı (2020)																	x		**x**					**x**						
Yadav et al. (2020)		x																												
Wang et al. (2020)																									x					x

4. Discussion and proposed framework

The LSP evaluation and selection process is a strategic decision associated with uncertainty, ambiguity and complexity. Based review and analysis of the literature on logistics outsourcing, following conclusion can be made.

- Forty-four criteria have been proposed by various researchers for logistics outsourcing provider evaluation. The criteria are not clustered in most papers. They could be broadly clustered into economic, operational, agile, resilient, environmental and social sustainable criteria.

- Important selection criteria adopted are cost of service, on-time delivery and responsiveness, service quality, reliability, capacity and capability, flexibility, Equipment and technology, IT capability and information sharing, financial stability, firm reputation, strategic alliance geographic location, value added services, customer relationship, and risk management.

- Environmental and social sustainability criteria have rarely been applied in few studies. Due to global pressure and awareness, there is increasing trend to use them. Important environmental criteria are environmental safeguard & practices, green transportation, and ISO 14000 compliance. Social sustainable criteria are such as working hours, working environment, and occupational health, risk and safety should be used in LSP evaluation.

- Most of the papers demonstrated application of MDCM methods. The AHP, TOPSIS and their fuzzy variant are highly used techniques for assessment and selection of LSP.

- Fuzzy variant of MCDM methods have been found to be applied most. Triangular fuzzy, Intuitionistic fuzzy, Grey and Rough numbers have been utilised.

- Mathematical programming such as linear programming or mixed integer linear programming technique has also been used in combination with other MCDM methods in few papers.

- A limited number of articles exhibiting application of MCDM techniques on reverse logistics provider selection also found in the literature.

- Dependence relationship between criteria has been studied using DEMATEL or its fuzzy variant.

5. Conclusion and future research

The literature review on logistics outsourcing covered the articles published during past 10 years (2010-2020) and has answered all four research questions stated above. The analysis covered the number of publications journal wise and year wise, trends in adoption of criteria and evaluation techniques. Review further, highlighted the logistics outsourcing trends over the period, research gaps, and direction for the future research. The result indicates that the selection criteria are varying from author to author. Economic and operational criteria are widely used but the environmental and social sustainability criteria adoption increasing slowly. The agility, resilience and risk criteria are mostly neglected. Predominantly, MCDM methods have been applied, where AHP, TOPSIS and their fuzzy variant have found greater application in comparison to other methods. A comparative analysis of various methods is lacking in the literature. It is difficult to say which method is better suited in terms of accuracy and robustness in LSP selection.

5.1. Implication for research and practice

The review considered the logistics outsourcing publication over the past 10 years and analysed articles published journal wise, year wise, selection criteria adopted and the techniques applied for LSP selection. This contributes to the logistics outsourcing literature. It has also provided understanding of environmental and social sustainability issues in the logistics service industry. The manager and professionals can use the proposed model which would enhance agility, economic and operational efficiency, environmental and social sustainability of supply chain.

5.2. Limitations and future research

The study was focused on logistics outsourcing evaluation and selection only. It has not covered other aspects of outsourcing such as impact of outsourcing

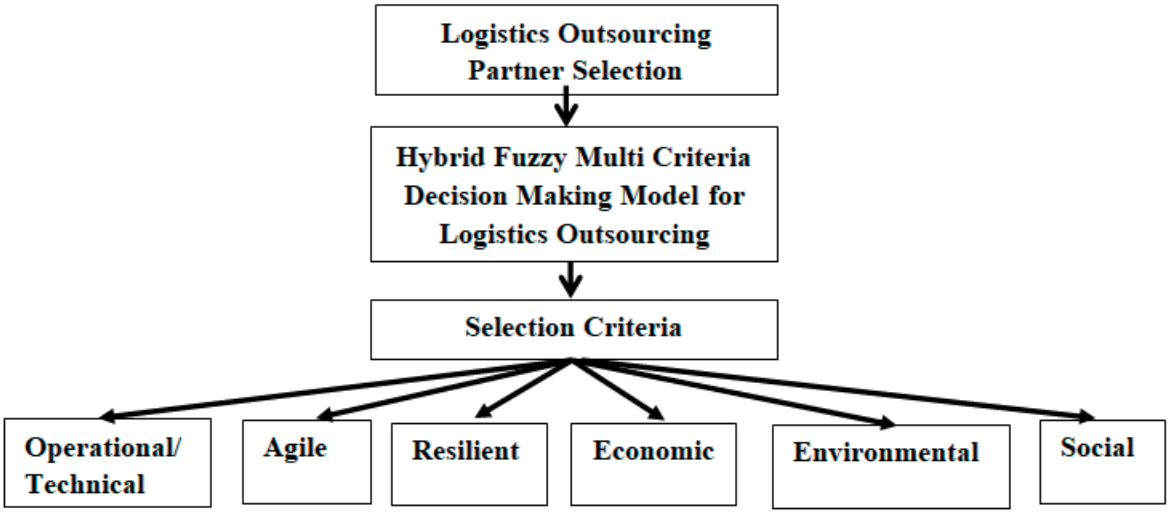

Figure 3. Proposed Hybrid Fuzzy MCDM Model for Logistics Outsourcing Partner Selection.

on performance of LSP, sustainability adoption impact on LSP profitability and client satisfaction etc. The number of papers included in this study is from EBSCO and Google Scholar, which might have not covered all peer-reviewed publications. Even though, a reasonable representation of the research on logistics outsourcing decisions has been provided in this research, future studies may cover wider databases. Sustainability initiatives by the LSP should become differentiator with the competitors in the industry and at the same time manufacturers should give due importance to sustainable LSP operations in their outsourcing decisions. It is recommended that future studies LSP evaluation and selection should incorporate number of environmental criteria such as environmental safeguard, vehicle energy efficiency, warehouse energy efficiency, eco-design packaging, recycling packaging materials and waste reduction, reverse logistics, and social criteria such as working hours, working environment, occupational safety and health in addition to economic and operational efficiency criteria in outsourcing decisions so as to contribute to sustainable development. A hybrid fuzzy MCDM model for LSP selection is proposed for future research, which should include criteria such as operational and technical, agile, resilient, economic, environmental and social sustainability as depicted in Figure 3. The proposed model will meet logistics operational/technical requirements as well as enhance logistics agility, resilience and sustainability. The fuzzy variant of MCDM methods would resolve the subjectivity and ambiguity involved in subjective ratings by group of decision makers in LSP selection process.

Future study should also analyse causal relationships among criteria using Ism, TISM, DEMATEL, fuzzy cognitive mapping (FCM) to understand the cause and effect criteria so that managers can focus more on cause criteria. A comparison of deterministic verses fuzzy model as well as one method with others should also be carried out to observe the robustness and accuracy of the method and its general applicability.

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