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Article

Computational analysis of the Logistics Supply Chain from a global trade perspective

Torky Althaqafi

College of Business, University of Jeddah, Jeddah 21589, Saudi Arabia; tmalthaqafi@uj.edu.sa

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Abstract: Global trade is based on coordinated factors, that means labor and products are moved from their point of origin to the point of use. Strategies have a significant impact on global trade because they enable the effective development of goods across international borders. The decision making is an important task for the development of Logistics Supply Chain (LSC) infrastructure and process. Decisions on supplier selection, production schedule, transportation routes, inventory levels, pricing strategies, and other issues need to be made. These decisions may have a big influence on customer service, profitability, operational efficiency, and overall competitiveness. The Artificial Intelligence (AI) approach of Fuzzy Preference Ranking Organization Method for Enrichment Evaluation (Fuzzy-Promethee-2) is used to assess the priority selection of the factors associated with the LSC and evaluate the importance in global trade. The role of AI is very useful compare to statistical analysis in terms of decision making. The computational analysis placed promotion of exports as the most important priority out of five selected attributes in LSC, with infrastructure development. The result suggests that LSC depends heavily on export promotion as the most significant attribute. Infrastructural development also appeared another factor influencing LSC. The foreign investment was ranked the lowest. The evaluated results are useful for the policy makers, supply chain managers and the logistics professionals associated with the supply chain management.

Keywords: supply chain management; global trade; artificial intelligence; Fuzzy-Promethee-2; LSC; logistics; trade practices

1. Introduction

The majority of the goods we regularly use cannot reach us without coordinated factors, such as the organization of administrations that deal with the development of products across or inside public boundaries, including transportation, warehousing, dissemination, expedited service, and much more (Agrawal et al., 2020). Furthermore, manufacturers use logistics to move keyboards and computer chips from far-off vendors via international value chains (Alharbi et al., 2024). Because of this, a country's competitiveness in export markets and its capacity to import the commodities it requires for production and consumption in a reliable and economical way are greatly influenced by the performance of the logistics sector. In terms of the environment, it is critical for decision-makers to understand that choices made at the corporate level impact supply chain operations both at the supply chain level and overall (Ramdani et al., 2009). In the powerful scene of global economy, coordinated factors organizations assume an imperative part that frequently stays concealed behind the scenes, yet their effect is sweeping and significant. These logistical powerhouses are the unsung heroes of economic growth, helping to optimize supply chain operations and facilitate the smooth movement of goods and services. The

crucial functions that make LSC driving force behind global trade continued economic expansion by examining their contributions to various sectors, influence on trade, and potential for further development.

The Logistics Performance Index (LPI) was created by the World Bank to assist economies in determining areas in which logistics could be improved (Shepherd and Sriklay, 2023). Production network unwavering quality is at the center of coordinated operations execution. The LPI gauges the degree of ease with which trustworthy links may be established within a supply chain, as well as the structural elements that enable this, including the standard of logistics services, infrastructure connected to commerce and transportation, and border regulations (Yuan et al., 2011; Gu Ho, 2022). As the global supply chain crisis nears its end in 2022, logistics experts are accustomed to producing LPI. Six categories were examined by logistics specialists in multiple country assessments: trade and transportation infrastructure; border and customs management; logistics service quality; timely shipments; traceability and tracking capabilities; and availability of international shipments at reasonable pricing. The associated areas are selected for the determining the priority of the LSC.

The key performance indicators reveal, unexpectedly, that industrialized nations experience longer delays at ports than emerging economies do (Alzahrani et al., 2021). The Russian invasion of Ukraine in Europe was at its worst, and the United States was still having problems with its marine supply line (Kirmani et al., 2019). It could likewise be that arising economies have been speedier to embrace state of the art arrangements, for example, another age of start to finish production network digitalization. The LSC can present difficulties for low and center pay nations where fundamental framework and power can be untrustworthy. The policy agenda includes infrastructural support, increasing capacity, and guaranteeing access to relevant technology. The building limit, access to relevant innovations, and supporting foundation of the strategy plan are all crucial (Ozturk and Acaravci, 2013; Stevens and Johnson, 2016). As countries and companies work to fortify value chains and modify them to trade patterns impacted by digital technology and climate change, the 2020 seem to be a period of transition (Buckley, 1985; Storey et al., 2006). The uncertainty is being exacerbated by efforts to relocate production of goods deemed essential to national security and rising geopolitical tensions (Alenezi et al., 2020; Çemberci et al., 2015). Effective LSC are more important than ever in the current trading environment. Logistics service decision-making has a direct impact on supply chain operations' efficacy and efficiency (Çolak et al., 2020). Making the correct decisions ensures that goods are delivered to the proper places in an efficient manner, at the right cost and quality. Many decisions in logistics, such how to allocate resources and buy things, are final and may have a big effect on how well everything works as a whole. Effective decision-making is therefore required to enhance operations and delight clients (Ghobakhloo et al., 2011). Decision making is an important phenomenon for evaluating the impact of factors associated with the LSC. Which factor of the LSC will affect the logistics supply more compare to other, the AI approach is very useful.

The next section explains the related work on LSC and Fuzzy-Promethee-2 methodology applied in various sectors, further section elaborate the materials

associated with the LSC and the methodology of Fuzzy-Promethee-2 algorithm. Section 4; elaborate the data analysis of applied Fuzzy-Promethee-2 in LSC. Next section explains the outcome of the result and last explains the conclusion of the research article.

2. Literature review

The study of logistics exists at the center of contemporary commercial activity as a facilitator of supply chain, global commerce, and improved organizational productivity and customer satisfaction (Nadeem et al., 2022). The importance of the efficient logistic facilities for sustainable and balanced economic development of the countries: ports, railway, airports, dry ports, warehouses and storages, laboratories and testing centers, roads, and highways. These elements increase the flow of merchandise, eliminate congestion, promote export and import practices and foster the economic stability and growth (Nadeem, 2024). Logistics is the management of products movement from the point of origin to the point of consumption to meet consumer needs (Alenezi et al., 2020). Therefore, planned activities are closely related to transporting the appropriate product, to the appropriate customer, in the best possible quality and quantity, at the appropriate time, ingeniously, and affordably (Waller et al., 2013).

Yazdani and Graeml, (2014) mention the survey makes it possible for experts, social science graduate students, and workers seeking orientation on new LSC applications around the globe. This article presents several international LSC research findings, outlining contexts and views for the various studies to provide readers and scholars better insights into the state and prospects of international supply chain management. Additionally, this paper features the most fascinating works and draws attention to the less-studied countries and regions of the world. The outline also provides a prologue to professionals and administrators regarding the area of worldwide LSC.

Patki (2016) elaborate operations specialists and ordinary business practitioners have disagreed and become confused over the phrases “logistics” and “supply chain management.” For the two concepts, many traditional meanings have been put forward. Additionally, each phrase has varied applications across many sectors. A term’s long-term meaning in business is frequently determined by how widely it is used. It examines the two words’ establish the definition looks at the opinions of contemporary expert, and suggest a hierarchy for the relationship between strategies and production network (Patki et al., 2016). Pathak et al. (2024) establish blockchain technology has been seen to have some affinity with LSC as a solution to many problems affecting the field. This paper aims at discussing the relationship between blockchain and LSC practices and strategies. In the light of the specified focus, the study aims at providing a review of the literature to establish the extent to which blockchain technology can revolutionaries supply chain. To some extent, the company can enhance the levels of traceability and transparency by adopting blockchain and reach the goals with regard to the tracking of the items and operations. Furthermore, investment on blockchain technology increases data protection and accuracy, which have been major issues in LSC to increase

confidence among the stakeholders and to increase efficiency to deliver better performances and dependability. The study also discovered that blockchain can improve logistics and save expenses related to conventional supply chain procedures.

Kumar (2016) mention the development of generative AI has the potential to drastically change LSC. On the other hand, an academic debate looks at the connection between the possible downsides and the capabilities of this innovative technology. Negative effects on academic research integrity, dire predictions of widespread unemployment are frequent subjects of conversation (Carey, 2024). Nonetheless, due to the fluctuating public interest, there is relatively minimal research done on the connection between computer based intelligence and the operations and production network executive field. To compensate for this lack, this article introduces analysis of the execution problems and the outlook for the AI application in the LSC area.

A robust system is set up, and safety factor results are taken into consideration in the software development. The security is evaluated using the Fuzzy-Promethee-2 approach for examining security design. The gadgets are particularly suitable for fuzzy set guesses when it comes to proving subjective data. The Fuzzy-Promethee-2 technique is used to conduct the evaluation. This approach examines the impact of the system security parameters (Richey Jr. et al., 2023; Kuo et al., 2010).

Klein (2012) aims to produce software that is safe, multifunctional, and controlled. The demand for software security across different IT businesses is the main emphasis of this research. Security assessment is a crucial component of risk management procedures, serving as an analytical tool. The Fuzzy-Promethee-2 technique is employed to assess the influence of security considerations on safe software architecture. The impacts of the alternatives on the factors are compared using the Fuzzy-Promethee-2 approach. Generally speaking, leaders are in charge of rating various responses inside their specific context and evaluating them according to necessity. Fuzzy set theories are the finest instruments for producing results for modeling qualitative information because they can handle the imprecision that is frequently present in ranking alternatives (Lummus et al., 2001; Khan et al., 2021). The article discusses the suitability of the Fuzzy-Promethee-2 technique in this particular circumstance. The next sections elaborate the relationship of LSC factors and the approach to determine the most affecting factor of the LSC.

The decision making cases in LSC are dealing with high levels of uncertainty and risk, and the research concentrate on formally definable methods and deterministic models. The AI approach that deal with the uncertainty like probabilistic models, the use of scenarios and robust optimization techniques. Furthermore, it remains a global dilemma to handle complex interrelated systems, such as LSC, for the decision-makers. In many of the LSC decisions, there is a deficiency in the development and use of multi criteria decision making principles and practices which are related to supply chains. LSC as a field of research has many decision-making issues including AI implementation, real time data analytics, complexity, uncertainty and last but not the least sustainability challenges. Responding to these research gaps the research analysis resolve the importance of factors and attributes associated with the LSC, it would be beneficial to advancing

supply chain decision making hence increasing its effectiveness, adaptive, collaborative and resilient systems.

3. Materials and methods

The smooth movement of goods, materials, and products from one location to another is frequently used as a metric to determine a nation's economy's heartbeat (Almotiri et al., 2023). The logistics sector plays a crucial role in global trade, a vast and diverse nation in both demographic and geographic terms. The article focuses on understanding the importance of LSC and its impact on the world economy with a particular emphasis on the factors that boost LSC to offer better solutions for amplifying competency. Strategic operations management within LSC impacts several aspects of economic nature. Logistics has an influence on all organizational, operational and material requirements to shorten lead time, minimize cost of transportation, and manage inventory effectively enhancing production of goods hence productivity. LSC provides and maintains efficient communication links between suppliers, manufacturers, and consumers to encourage foreign exchange and economic expansion. The article also stresses that more effective supply chain management increases organizations' supply chain's ability to be more responsive to demand signals, flexibility in supply and demand volatility and innovation. Further, the company supports sustainability through effective utilisation of resources and avoiding wastage through the help of LSC. The article demonstrates that good LSC is not only of benefit to individual businesses but also crucial for the growth and development of national and global economies with the capability to create sustainable economies; the hierarchy diagram is shown in **Figure 1**:

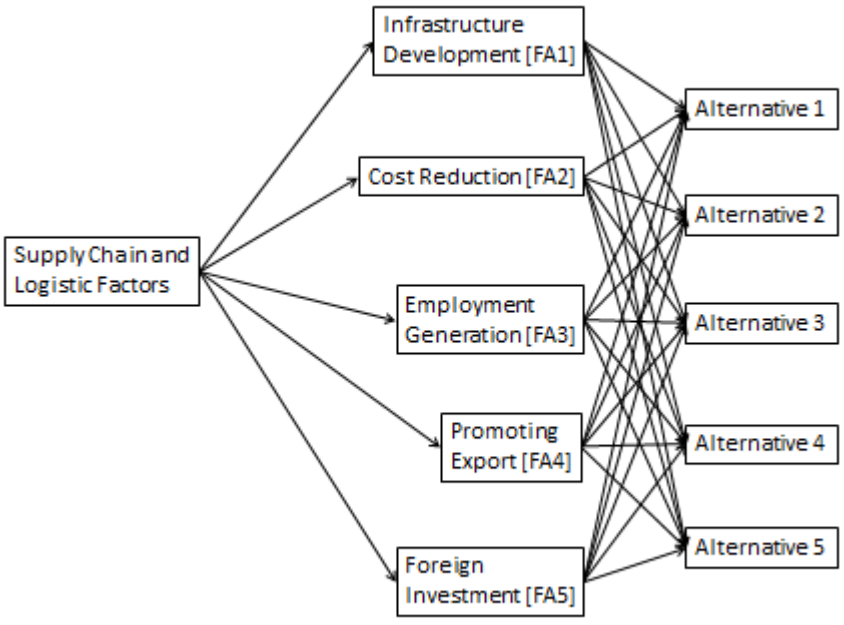

Figure 1. Hierarchy of the LSC factors and alternatives.

3.1. Infrastructure development [FA1]

Foundation Improvement is one of the vital manners by which coordinated factors organizations add to economic growth through framework advancement (Kirmani and Shankar, 2022). LSC businesses make investments in the construction of essential infrastructure, such as warehouses, transportation facilities, and technology systems, in order to effectively transport goods and services across the vast expanse of global trade. The logistics costs are reduced as well as LSC efficiency and improved by this investment (Kirmani et al., 2018). Global economic landscape gains strength and competitiveness as a result of improved infrastructure.

3.2. Cost reduction [FA2]

Cost Cutting in order to cut cost, logistic companies constantly look for better alternative of transportation routes (Vinodh and Jeya Girubha, 2012). Customers benefit as a result, as prices for goods rise as a result. The overall cost of living for the population is ultimately reduced as logistics providers work to cut transportation costs. In addition, lower prices boost export growth by making goods more competitive on the global market (Yazdani and Graeml, 2014).

3.3. Employment generation [FA3]

Global business generation has a significant number of jobs in the LSC. It provides drivers, warehouse workers, and administrative professionals with millions of direct and indirect jobs (Alqudsi-ghabra et al., 2011). The sector's significant contribution to economy can be seen in its positive effects on employment rates and overall living standards. Some organization as a major player in the logistics industry actively contributes to the creation of logistics related jobs (Althaqafi, 2023).

3.4. Promoting export [FA4]

Increasing exports to other nations are greatly facilitated by logistics companies (Alenezi et al., 2020). They assist businesses in gaining access to international markets, navigating regulatory requirements, and ensuring prompt product delivery (Althaqafi, 2020). This positive effect on trades straightforwardly adds to unfamiliar trade profit and generally financial development. The proficient development of merchandise made conceivable by coordinated factors suppliers fortifies presence in the worldwide exchange field (Althaqafi, 2023).

3.5. Foreign investment [FA5]

Investing from abroad foreign investment in logistics sector has increased due to the different country's expanding economy (Althaqafi, 2023). New technologies, expertise, and significant investments have been brought to the global market by a number of foreign logistics companies. This modernizes the business as well as fortifies worldwide ties and monetary collaboration, subsequently helping global economy. Global economic growth is aided by the logistics industry becoming a gateway for foreign investment.

4. Methodology: Fuzzy Promethee-2

AI is complementary to the Fuzzy-Promethee-2 method, which improves decision making in environments of uncertainty and complexity. The uncertainty and vagueness in human preferences are efficiently handled in fuzzy-promethee-2 by use of the fuzzy logic. AI can complement this by deriving the utilisation of fuzzy membership functions and preference structures from the expert opinion and history to reduce imprecision. This makes it possible to have a combined view of the different possible actions as well as ways of sizing up the different options available in a quantitative as well as qualitative capacity. The combined application of AI with the Fuzzy-Promethee-2 enhances constructive flexibility for decision making especially in other areas like supply chain, project assessment and resource allocation. Fuzzy-Promethee-2 cannot process data from real-world human decision contexts. The unpredictable nature of human judgment is addressed with the fuzzy idea. The order of etymology determines the Three-sided fuzzy Number (TFN). In this sense, the scale TFN arrangement is represented by the numbers on the force level of interest. TFN is denoted as (l, m, u) in **Table 1** below. **Table 1**'s scale illustrates how experts allocated impressions to the components influencing the traits in a comprehensible manner. The values of TFN have been examined via the link between factors and alternatives. The framework of the assessment is shown in **Figure 2**.

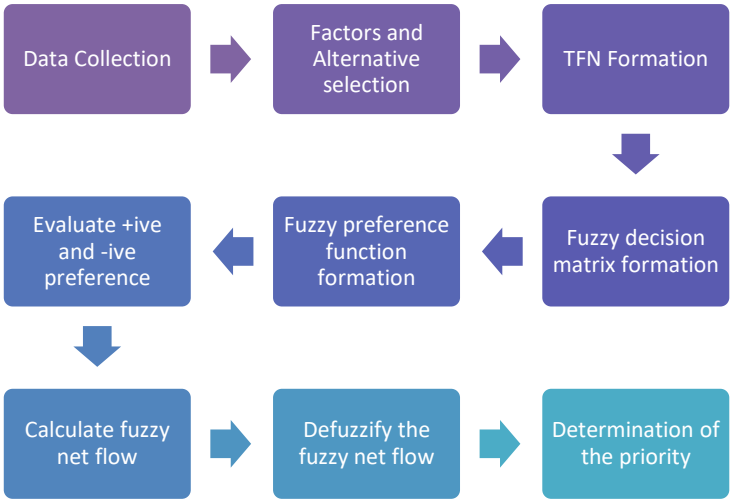

Figure 2. Research framework.

This paper discusses the applicability of AI method called fuzzy-Promethee-2 to categorise the factors that its effect on LSC to the highest extent. The AI methodology of performance and development assessment of LSC employs data and experts' opinions. The AHP, based on insight from industrialists, professionals, and researchers, is used to establish priority selection. Moreover, the data is backed by an augmenting synthetic data vault (Schoenherr, 2009; Althaqafi, 2020) for augmentation of resilience in addition to dependability. This type of approach makes it easier to understand key aspects influencing LSC by encouraging effective evaluation, planning, and optimization of the complex supply chains. The Fuzzy-Promethee-2 technique has the following seven steps:

Stage-1

The pairwise examination grid to the Three-sided fuzzy framework M is made use of **Table 1**. An elective organization of FA other option and C is chosen in order to survey the portion of the element (Patki, 2016). Every basis's weight and kind are chosen.

Stage-2

Make the assessment matrix more uniform. Based on arbitrary and instantaneous rules, this standardization should be possible (Gkioulos and Chowdhury, 2021). The average arithmetic d_{ij} is evaluated using the equation. Here, d_{ij}^{k}, k^{th} is the number of decision makers, and a fuzzy TFN member indicates the weight of the k^{th} decision maker over the i^{th} condition over the j^{th} condition.

$$Minimum\ Rij = \frac{[Xij - (Yij)\ ]}{[(Xij) + (Yij)\ \ ]} \tag{1}$$

$$Maximum\ Rij = \frac{[(Xij) + Yij]}{[(Xij) - (Yij)]} \tag{2}$$

where $i = \ 1, 2, 3 \ldots . m$ and $j = 1, 2, 3 \ldots . . n$.

Stage-3

Examine the changes in implications between the alternatives with and without various options for every standard. Here, the decision is still up in the air pairwise. Each condition's fuzzy load is obtained using the mathematical mean measurements.

$$d_j(a, b) = \ g_j(a) - \ g_j(b) \tag{3}$$

Stage-4

The Fuzzy-Promethee-2 approach provides access to six tendency limitations. We applied the conventional inclination work in this instance. This system is reduced to 1 since it cannot become more sophisticated. If the qualities are more than zero after evaluation, $d > 0$ is lost.

$$P(d) = \{0\ d \leq 0\ d\ d > 0 \tag{4}$$

Stage-5

To assesses the tendency accumulated esteem if the loads of w_j satisfy. Techniques for de-fuzzification are used once the weight rules have been evaluated. The non-fuzzy value of M is obtained from the conditional value of the fuzzy number w.

$$\{\pi(a, b) = \sum_{j=1}^{k} P_j(a, b) w_j\ \pi(b, a) = \sum_{j=1}^{k} P_j(b, a) w_j \tag{5}$$

$$\sum_{j=1}^{k} w_j = 1$$

Step-6

Each choice is linked to the other via compute streams that outperform the other. Transferring to the a^{th} alternatives from the dominant (positive) stream and establish negative flow for the alternative a^{th} choices in the Equations (6) and (7).

$$\phi^{+}(a) = \frac{1}{n-1}\sum_{x\epsilon A} \Pi\,(a,x) \tag{6}$$

$$\phi^{-}(a) = \frac{1}{n-1}\sum_{x\epsilon A} \Pi\,(a,x) \tag{7}$$

The weighing approach described by the scientist Yu et al. (2016) is cited in the ensuing advancements. After getting each value of N_i, the global weighting of the criterion is computed by multiplying the local weight by weight-related within the same dimension. Promethee-II is not designed to manage verified human-choice climate data. The soft thinking method is used to solve the shortcomings that arise from human judgment. The Triangular Fuzzy Number (TFN) is not entirely established using the phonetic technique. As a result, the AHP power levels of interest numbers have moved to the TFN scale. TFN(l, m, u) is listed below in **Table 1**. When professionals etched the pieces, the characteristics were changed quantitatively.

Table 1. Triangular fuzzy scale.

Values	Definition	TFN
8	The range is distributed between best to poor	7.0, 8.0, 9.0
6		5.0, 6.0, 7.0
4		3.0, 4.0, 5.0
2		1.0, 2.0, 3.0
9		9.0, 9.0, 9.0
7		6.0, 7.0, 8.0
5		4.0, 5.0, 6.0
3		2.0, 3.0, 4.0
1		1.0, 1.0, 1.0

5. Results

Table 2, last part displays the average option value, **Table 3** displays the average value for each option, with Equations (1) and (2) denoting the lowest and greatest values, respectively and shown in **Figure** 3.

Table 2. TFN value of alternatives.

	FA1	FA2	FA3	FA4	FA5
FA1	1.00000	9.00000	1.00000	4.00000	2.00000
FA2	0.11000	1.00000	3.00000	0.33000	0.20000
FA3	1.00000	0.33000	1.00000	5.00000	0.16700
FA4	0.25000	3.000001	0.20000	1.00000	7.00000
FA5	0.50000	5.00000	6.00000	0.14000	1.00000

Table 3. Average value of alternative.

Attributes	FA1	FA2	FA3	FA4	FA5	Average Value
FA1	0.47300	0.40500	0.39100	0.60100	0.28500	0.43200
FA2	0.09400	0.08100	0.04300	0.06600	0.21400	0.09900
FA3	0.15600	0.24300	0.13100	0.06600	0.21400	0.16200
FA4	0.15600	0.02430	0.39200	0.20000	0.21400	0.24100
FA5	0.11800	0.02600	0.04300	0.06600	0.07100	0.06500

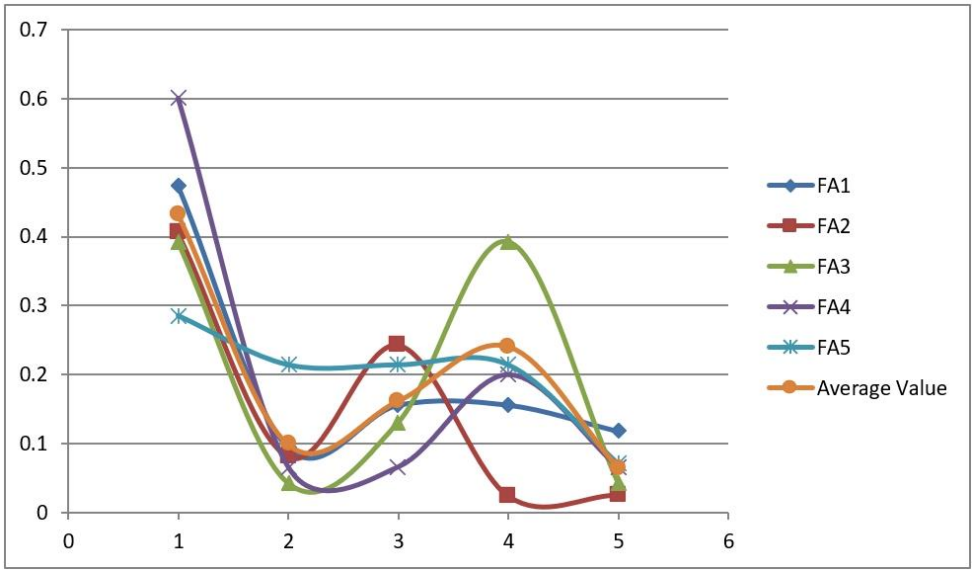

Figure 3. Average weight of the attribute.

The average values from **Table 3** are multiplied by the comparative values of the options in **Table 4** derived from Equation (5). We assessed the preference value.

Table 4. Preference value of alternative.

Weights	0.43100	0.09000	0.16000	0.24000	0.06000
D(FA1-FA2)	1.00000	0.85000	1.00000	1.00000	0.34000
D(FA1-FA3)	−0.83000	0.43000	0.75000	1.00000	0.34000
D(FA1-FA4)	−0.83000	0.43000	0.00000	−0.75000	0.34000
D(FA1-FA5)	−0.93000	1.00000	1.00000	1.00000	1.00000
D(FA2-FA1)	1.00000	−0.86000	−1.00000	−1.00000	−0.34000
D(FA2-FA3)	0.17000	−0.42000	−0.25000	0.00000	0.00000
D(FA2-FA4)	0.17000	−0.42000	−1.00000	−0.25000	0.00000
D(FA2-FA5)	0.07000	0.14300	0.00000	0.00000	0.66000
D(FA3-FA1)	0.83300	0.57000	−0.75000	−1.00000	−0.34000
D(FA3-FA2)	−0.16000	0.43000	0.25000	0.00000	0.00000
D(FA3-FA4)	0.00000	0.00000	−0.75000	0.25000	0.00000
D(FA3-FA5)	−0.09000	0.57000	−0.25000	0.00000	0.66000
D(FA4-FA1)	0.83300	−0.43000	0.00000	−0.75000	−0.34000
D(FA4-FA2)	−0.16000	0.43000	1.00000	0.25000	0.00000
D(FA4-FA3)	000000	0.00000	0.75000	0.25000	0.00000

Table 4. (*Continued*).

Weights	**0.43100**	**0.09000**	**0.16000**	**0.24000**	**0.06000**
D(FA4-FA5)	−0.09000	0.57000	1.00000	0.25000	0.66000
D(FA5-FA1)	0.93000	−1.00000	−1.00000	−1.00000	−1.00000
D(FA5-FA2)	−0.07000	−0.86000	0.00000	0.00000	−0.66000
D(FA5-FA3)	0.10000	−0.57000	−0.25000	0.00000	−0.66000
D(FA5-FA4)	0.10000	−0.57000	−1.00000	−0.25000	−0.66000

The evaluation was conducted using Fuzzy-Promethee-2's Equation (5) and Step 7. Below is the revised table. The evaluation is displayed in **Table 5**.

Table 5. Aggregated preference value.

D(FA1-FA2)	0.43000	0.07000	0.16000	0.24000	0.02000	0.92000
D(FA1-FA3)	0.00000	0.03000	0.12000	0.024000	0.02000	0.41000
D(FA1-FA4)	0.00000	0.03000	0.00000	0.00000	0.02000	0.05000
D(FA1-FA5)	0.00000	0.09000	0.16000	0.024000	0.06000	0.05500
D(FA2-FA1)	0.43000	0.00000	0.00000	0.00000	0.00000	0.04300
D(FA2-FA3)	0.07000	0.00000	0.00000	0.00000	0.00000	0.07000
D(FA2-FA4)	0.07000	0.00000	0.00000	0.00000	0.00000	0.07000
D(FA2-FA5)	0.03000	0.01000	0.00000	0.00000	0.22000	0.26000
D(FA3-FA1)	0.39000	0.05000	0.00000	0.00000	0.00000	0.44000
D(FA3-FA2)	0.00000	0.03000	0.04000	0.00000	0.00000	0.07000
D(FA3-FA4)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D(FA3-FA5)	0.00000	0.05000	0.00000	0.00000	0.22000	0.27000
D(FA4-FA1)	0.39000	0.00000	0.00000	0.00000	0.00000	0.03900
D(FA4-FA2)	0.00000	0.03000	0.16000	0.06000	0.00000	0.25000
D(FA4-FA3)	0.00000	0.00000	0.12000	0.06000	0.00000	0.18000
D(FA4-FA5)	0.00000	0.05000	0.16000	0.06000	0.22000	0.49000
D(FA5-FA1)	0.39000	0.00000	0.00000	0.00000	0.00000	0.39000
D(FA5-FA2)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D(FA5-FA3)	0.04000	0.00000	0.00000	0.00000	0.00000	0.04000
D(FA5-FA4)	0.04000	0.00000	0.00000	0.00000	0.00000	0.04000

Table 6. Leaving and entering the outranking flow.

	FA1	**FA2**	**FA3**	**FA4**	**FA5**	**φ +**
FA1	-	0.92000	0.41000	0.05000	0.55000	0.48300
FA2	0.43000	-	0.07000	0.07000	0.26000	0.20700
FA3	0.44000	0.07000	-	0.00000	0.07000	0.19500
FA4	0.39000	0.25000	0.18000	-	0.49000	0.32700
FA5	0.39000	0.00000	0.04000	0.04000	-	0.11700
φ −	0.41200	0.31000	0.17500	0.04000	0.39200	-

Since the options and choices are related, we evaluated the ath elective's outclassing stream, which is shown in **Table 6**. To ascertain this, Equations (6) and (7) were employed.

The ranking of alternative form Equation (8) is shown in **Table 7**.

Table 7. Outranking flow of alternative.

Alternatives	φ +	φ −	φ (Total)	Rank
Infrastructure Development [FA1]	0.483	0.412	0.071	2
Cost Reduction [FA2]	0.207	0.31	0.032	3
Employment Generation [FA3]	0.195	0.175	0.02	4
Promoting Export [FA4]	0.327	0.04	0.287	1
Foreign Investment [FA5]	0.117	0.392	−0.275	5

The ranking **Table 7** shows the methodology of Fuzzy-Promethee-2 used to evaluate the value and calculate the alternative of the LSC and its bar graph is shown in **Figure 4**. LSC plays a significant role in export promotion. For economic growth to be sustainable and distributed around the world, trade logistics infrastructure such as ports, railroads, airports with dry ports, storage infrastructure, and labs and testing facilities are essential. LSC is the management of the flow of products from their place of origin to their point of consumption in order to meet consumer demands. Therefore, the delivery of the appropriate goods in the best possible quality and quantity to the right customer at the right time, expertly, and at the right cost is closely linked to planned exercises. The AI approach Fuzzy-Promethee-2 evaluates and validate the results with the outcome of the analysis. Promoting export has got the highest rank with the score of 0.287, preceded by infrastructure development (0.071) and so on with least score of foreign investment (−0.275). The result of the analysis is useful for business development in the different sector.

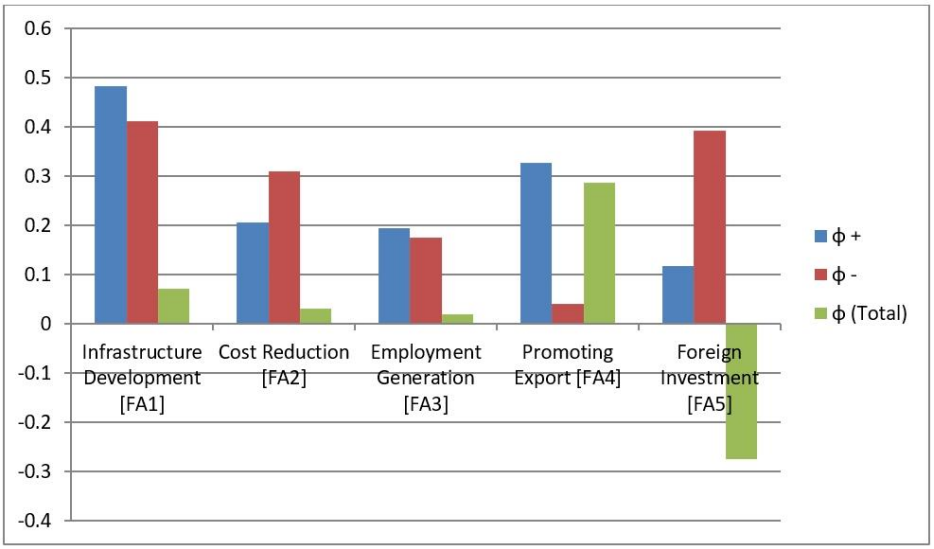

Figure 4. Priority of the alternatives.

The fuzzy promethee-2 technique is highly appropriate for the decision making situations characterized by complexity, ambiguity and multi-criterion. The fuzzy

logic as well as the Promethee-2 approaches has been merged to enhance the performance of the decision makers who crave for the application of the analyses to situations where the facts are not always precise or the preferences are vague. There are many decisions that are made in practice where uncertainty exists in the sense that the relevant information is never complete or is unclear. The Fuzzy Promethee-2 does permit a decision maker to act upon fuzzy data while drawing conclusions. Such methodology becomes particularly useful in other situations in which the relevant facts are not easily available, such as customers' preferences, market predictions, or risk assessments. Whenever decision making is pursued, it often involves consideration of various conflicting criteria. In cases of more complicated than normal decision environments, conventional techniques may not readily provide the most optimal solution, especially in cases where several different variables and criteria need to be accounted at the same time. Fuzzy Promethee-2 helps to resolve decision making in ranking and ordering of alternatives by dividing the decision problem into simple and sequential steps.

6. Discussion

In **Table 8** contains our quantitative discussion of the significance of Promethee-2 ranking method. The comparison shows that the Fuzzy-Promethee-2 methodology offers acceptable and accurate judgments in contrast to the other ranking system. The method of preference comparison is shown in **Figure 5**. The Fuzzy-Promethee-2 approach yields the exact assessed value when compared to the other method. The business organizations are utilizing the outcome infrastructure development as a top priority proceeded by export promotion, while developing LSC.

The findings of the research were taken together with the traditional approach of Promethee-2 in which, both studies the rank of promoting the exports was the highest and the foreign investment rank was the least. The quantitative rates obtained by both the methodologies show the degree of closeness of the results, showing that the fuzzy method gives broad yet slightly different views from the classical approach. These conclusions are important for LSC organizations, managers and decision makers, since they clarify under which circumstances the export promotion strategy should be preferred above the foreign direct investment strategy. Such evaluations of the decisions made enable the stakeholders to create and improve the LSC in ways that match both the national and corporate objectives much better. The reference analysis also confirms the strength of the both fuzzy and classical Promethee-2 approaches in making key decisions in the area of LSC.

Table 8. Comparison with Promethee-2 methodology.

Alternatives	**Promethee-2**	**Fuzzy-Promethee-2**
Infrastructure Development [FA1]	0.083	0.071
Cost Reduction [FA2]	0.196	0.032
Employment Generation [FA3]	0.392	0.020
Promoting Export [FA4]	0.611	0.287
Foreign Investment [FA5]	-0.121	-0.275

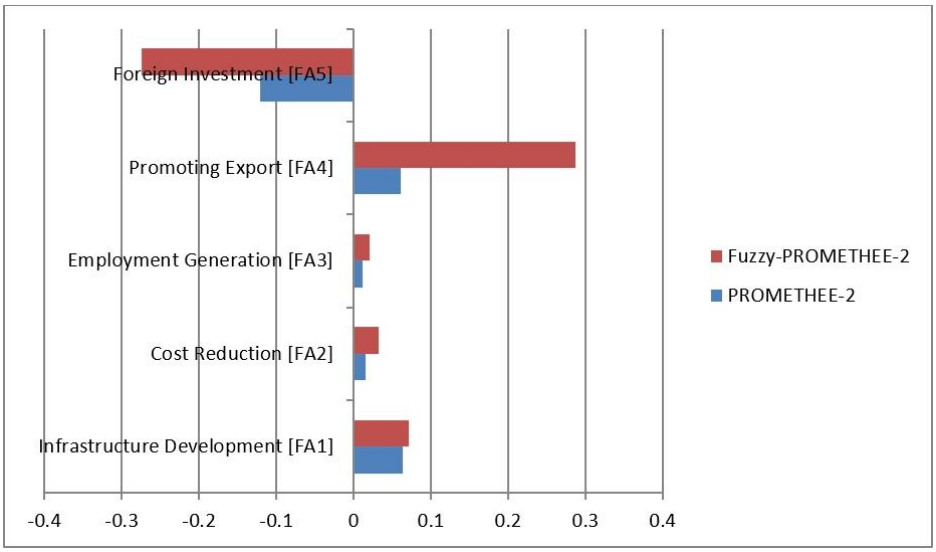

Figure 5. Graphical representation of the comparison with classical Promethee-2 approach.

7. Conclusions

The study applied Fuzzy-Promethee-2 techniques to estimate the LSC factors. For estimating any decision making problems Fuzzy-Promethee-2 is an effective approach. Both the impact and the features of LSC are assessed. The focus also arranges the evaluation of essential components in relation to their weights. By using Fuzzy-Promethee-2, the last step ranks the options according to significance. In relation to LSC, the available metrics were: Promoting Export [FA4] > Infrastructure Development [FA1] > Cost Reduction [FA2] > Employment Generation [FA3] > Foreign Investment [FA5] rank on the basis of expert opinion and synthetic data vault. Results show that alternative (Promoting Export [FA4]) provides ideal impact on LSC with maximum user satisfaction. This research provides guidelines for LSC employee, policy makers and developers to design LSC that provide maximum growth in the global trade. This research article is investigating the impact of LSC in the global trade perspective. The outcomes of the assessment will help the specialists in incorporating legitimate LSC growth and development.

The limitations of this analysis should be kept in mind for consideration in future similar evaluations. One main method of analysis can be noted as having a limitation concerning on data collection. Since data are critical for advancement, they become crucial; however, using them can be hodustic and complex. However, given these constraints, it is still possible to some extent to draw constructive knowledge from this study and contribute to the development of LSC. Future assessments can avoid the data challenge by employing better approaches to data gathering, employing more contemporary data analytical models, or by merely restricting their data search to only important data areas aligned to the research objectives. The future research can endeavour to build on the current study and come up with enriched understandings of LSC development. Thirdly, it is also possible that this analysis failed to detect some other even modifiable dependent factors with regards to LSC. The findings exemplify where each of the LSC factors affects the supply chain, as well as the preferred characteristics for effective LSC. This research

reveals the key attribute of LSC for the practitioner; the findings are enhanced by simulations and analyses. In addition, better data collection and analytical techniques used in subsequent studies will refine the results and better help supply chain managers make mechanical adjustments to improve their operations.

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