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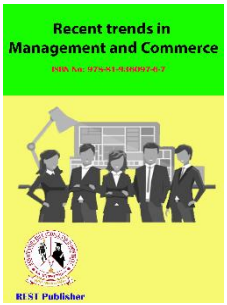

A Comprehensive Approach for Selecting Third-Party Logistics Providers

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Abstract: *The finest third-party logistics (3PL) supplier is a vital decision for businesses trying to streamline their supply chain operations. In order to free up time for businesses to concentrate on their core skills, third-party logistics providers offer a variety of services, such as distribution management, warehousing, and transportation. However, selecting the best 3PL supplier necessitates a rigorous assessment of variables including sector expertise, technical prowess, service quality, scalability, and cost-effectiveness. This introduction discusses the significance of choosing the best 3PL supplier and emphasizes important factors to take into account when making a choice. It is essential since there is a chance that third-party logistics (3PL) provider selection study may boost the supply chain's effectiveness and competitiveness. Firms may make selections that are tailored to their unique requirements by recognizing and assessing the elements that affect the choosing process. Proper 3PL selection may boost market response, save costs, expand the capacity of operations, and improve customer happiness. As a result, research in this field helps to create best practices and strategies that enhance supply chain management and promote entrepreneurship. A multi-criteria decision-making approach called The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is used to rank and choose the best option from a list of options. To determine how closely each alternative resembles the ideal answer, TOPSIS takes into account both positive and negative features. Based on the greatest distance from the inverse idealistic and the lowest distance to the positive ideal, the outcome score is calculated. This approach facilitates decision-making processes in a variety of contexts, such as project prioritization, supplier selection, and investment appraisal. Alternative parameters taken as 3PL-1, 3PL-2, 3PL-3, 3PL-4, 3PL-5. Evaluation parameters taken as Delivery Service (%), Quality of the Customer Experience (Quos), Coverage of the EU Territories (%), Flexibility, and Cost (EUR/km). From the result it is seen that 3PL-2 secures the first rank which is acquired by the TOPSIS method. To secure the first place on the table consistency will be the key factor which was maintained by 3PL-2*

Key words: *Outsourcing of logistics, third-party logistics, performance evaluation, many factors, and decision-making process.*

1. INTRODUCTION

Without broad foreign partnerships, it is getting more and harder for a company to compete in today's market. In order to simultaneously achieve cost reduction along the entire supply chain and a perceived increase in the value of goods and/or services, the concept of supply chain management evolved in this direction. It makes an effort to manage physical and information flows between all supply chain actors as effectively as possible [1]. As they transform their supply chain capabilities from an industrial to an information society fueled by technology, many businesses demonstrate an essential paradigm change. The "vertical to virtual integration trend" of the new millennium has ten key trends that have a high implementation potential. As supply chain partners work to create useful, efficient, and pertinent product or service solutions for end users, a significant change in logistics practices is anticipated. The disadvantage of vertical integration is that it necessitates a substantial financial investment and a complicated organizational structure. If a company is to succeed, it must connect the knowledge and synergy of its external supply chain partners Virtually integrating operations with

suppliers of goods and services creates an effective flow of internal and external activities, resolving the financial problems of vertical control while preserving many of the advantages.[3]. Even though 3PL providers account for a sizable portion of the global economy and are a topic of interest to supply chain management (SCM) scholars (Carter and Ellram 2003; Lai, Li, Wang and Zhao 2008; Marasco 2008), it is still challenging for them to understand their clients' expectations and identify the elements that influence their decision to choose one provider over another. By gaining a deeper understanding of the elements that influence the selection of a logistics service provider, we hope to address this problem. The approach we've taken may also be applied in other buyer-supplier partnerships where a significant barrier is a deeper understanding of how customers with diverse needs evaluate each service component differently when choosing a provider.[4].The logistics function is under more and more pressure as a result of the expansion of international markets and foreign sourcing. As a result, it has produced more intricate supply chains and increased the involvement of manufacturing and shipping managers in global logistics. Vendors are forced to use the services of a third party logistics (3PL) provider because they lack specialized understanding of the customs and architecture of the destination nations. 3PLs are "relationships between interfaces in the supply chains and third-party logistics providers, where logistics solutions can be provided, from basic to bespoke, in a shorter or longer term relationship, with a goal of productivity and efficiency," according to Bask (2001).."The ability of the 3PL to coordinate well allows them to find trustworthy partners or subcontractors and effectively handles the movement of commodities between partners," claims Voss (2003). However, it is getting more difficult to create and commercialize novel products [6]. Due to the development of information and communication technologies in the context of economic globalization, manufacturing companies changed from being "vertically integrated" to being "globally decentralized" in the 1990s [24]. In contrast, the logistics industry changed from being "in sourced" to "outsourced," then to "integrating" in the 2000s [25].Production and retail companies can boost their competitiveness by delegating logistical work to other renowned third party logistics (3PL) vendors, allowing them to focus on their core capabilities. According to data from the Korn/Ferry Institute, 65% of shippers used 3PLs more frequently in 2013. On-time delivery, warehouse services, and other demands and expectations of clients that are becoming more and more sophisticated may not be met by a single 3PL supplier. Fourth party logistics (4PL) providers have emerged as a result of the necessity for a 3PL provider to collaborate with IT service providers, corporate process management organizations, and other logistics businesses to provide integrated logistics services throughout the full supply chain. Production and retail companies can boost their ability to compete by delegating logistical work to other renowned third party logistics (3PL) vendors, allowing them to focus on their core capabilities. The Korn/Ferry Institute found that 65% of exporters increased their usage of 3PLs in 2013. A single 3PL provider might not be able to satisfy the increasingly complex demands and expectations of clients for on-time delivery, warehousing services, and other products. In order to deliver integrated logistics services across the whole supply chain, a 3PL provider must work in conjunction with IT service providers, corporate process management companies, and other logistics enterprises. Fourth party logistics (4PL) service providers have developed as a result of this. A 4PL is an aggregator that combines the resources, abilities, and technology of its own organization with those of other organizations in order to design, implement, and manage comprehensive supply chain solutions.. As an illustration, United Parcel Service, a well-known international package delivery firm, has established itself as a 4PL facilitator to effectively offer supply chain solutions to Cisco systems [7]. The organizational practice of contracting-out some or all logistics activities that were previously performed in-house has been referred to by terms like "logistics outsourcing," "logistics alliances," "third-party logistics (3PL)," "contract logistics," and "contract distribution" (Aertsen, 1993; Bowers ox, 1990; Lieb, 1992; Sink et al., 1996). Research has produced a variety of definitions that emphasise different elements of logistics outsourcing contracts, including the service being provided, the kinds and lengths of connections, the outcomes of how they function, the level of third-party control over the logistics process, and the position or role in the supply chain. According to the orientation (services supplied, kind and length of 3PL connections, performance outcomes, scope of 3PL responsibilities, and location in the supply chain), various definitions of 3PL are provided in Table 1.[8]. The 3PL is the subject of this investigation. As logistics concepts are adopted, these businesses are being compelled more and more to outsource their transport and logistics operations in order to concentrate on their core businesses. This has led to a rise in the need for logistics services, which in turn has created a market for specialized service providers known as 3PL providers that has been expanding globally over the past few decades. A specific authority that is not available inside the company's internal divisions is provided via outsourcing. Numerous factors can contribute to this influence, including economies of scale, process knowledge, cash availability, and access to pricey technologies. Businesses can lower their capital investment expenses and financial risks by outsourcing logistical-related operations. (Aghazadeh, 2003; Aktas & Ulengin, 2005)[9]. given the economy's rapid expansion, logistics are crucial to a variety of industries. Third Party Logistics (TPL) providers are increasingly growing and expanding swiftly as a crucial component of the contemporary economy in order to address the diverse and constantly changing demands of the firm and the client. The challenge of choosing a TPL supplier is challenging since several factors

are taken into account. Cost, reliability, customer service, and availability were the characteristics used by Shyer et al. (Shyer & Shih, 2006) to define logistics.. The unpredictability of the experts' judgments might be used in the process of choosing the TPL providers instead of taking into account these TPL provider criteria. The use of language variables in decision-making settings is quite useful when metrics for success cannot be expressed using precise numbers.. Older quantitative techniques find it challenging to adequately articulate the criteria for TPL selection, but the PLTS does a better job of doing so.[10].A privately held company known as a third party logistics provider, or 3PL, contracts with a primary producer, supplier, or consumer of a good or service to offer logistical services. Because the logistics provider engages in the supply chain at points between the producer and the consumer of a particular product but does not own the items, it is known as a third-party logistics provider. The 3PL service providers can either fully or partially handle the customer's logistical needs. Initially, carriers, storage facilities, or freight brokers were the 3PLs suppliers. Right now, they have broadened by providing a range of amenities and assuring a range of actions. The main 3PL providers regularly use their credit across the globe and have their own warehouses and transportation fleets. The activities that the buyer associated the 3PLs suppliers to are all listed in Table 1. These activities span a wide range, from highly narrow to very wide [11]. Due of the significant impact logistics has on economic growth, many businesses take it seriously. Third-party logistics (TPL) providers may offer professional services at cheaper rates than internal logistics, which is why some organizations opt to outsource their logistics to them. The choice of TPL providers has drawn the attention of researchers [1, 2]. The decision to select a TPL supplier is fundamentally an MCDM conundrum. When choosing a TPL provider, a number of factors must be taken into account, such as the cost of service, operational expertise in the sector, client happiness, and their public image. In this regard, MCDM models may be used to define techniques for choosing TPL providers[13].Third-party logistics providers (3PLs) provide specialized services to meet a range of transportation, distribution, inventory management, and warehousing demands, according to Jung et al. (2008).The effectiveness of these 3PLs has an impact on the business's service level. The finest 3PL to work with or a group of them to work with should be chosen based on a number of factors, including pricing. A few 3PLs have their own fleets of cars and warehouses. Additional capacity is required in responsive supply chains for more adaptability and distribution pace, with services being the most crucial sort of resource in this scenario. On the other side, decreasing costs is the most crucial element of supply chains that are cost-effective (Bozarth & Handfeld) [14]. Many scholars and practitioners in this subject have used and recommended various optimization techniques and methodologies. You may find a thorough and rapid overview of the 3PL oversight of services application and technique domains. Several 3PL provider selection frameworks have been used by several academics in the relevant field for decision analysis. It has been noted that hybrid techniques are more popular in recent years [15], despite the fact that several single deciding methods have been used to examine the 3PL provider selection problem.

2. TOPSIS METHOD

The current study suggests using M-TOPSIS; a brand-new modified synthetic evaluation method. This method includes the concept of a "optimized ideal reference point" and calculates the distances in the D+ D- plane between the alternative and this reference point. The original TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) served as its foundation. Several issues with the original TOPSIS technique, like the incidence of rank reversals and assessment failure, are addressed by the M-TOPSIS method. The optimized ideal reference point is a new feature of the M-TOPSIS technique that tries to offer a more logical framework for assessing alternatives. The simplicity of the M-TOPSIS approach is one of its benefits. The M-TOPSIS calculating process and its underlying notion are both clear-cut and simple to comprehend. Because of its ease of use, the strategy may be applied in practice and is available to decision-makers. The proposed M-TOPSIS method, which modifies the original TOPSIS method in various ways, provides a modified method of synthetic assessment. It is a potentially useful tool for decision-making in a variety of disciplines due to its simplicity and reasonable process.[1]The TOPSIS approach does have its drawbacks and limits, just like any other way of decision-making. .The following are some of the main criticisms of the TOPSIS strategy: When a criterion or alternative is added or withdrawn, the phenomenon of rank reversal describes how the order of options changes. This phenomenon is present in both the AHP (Analytic Hierarchy Process) and TOPSIS approaches. It suggests that when changes are made to the decision problem, the relative importance or weights of the criteria may not be consistently maintained. Disregard for the relative significance of distances: The two ideal solutions that TOPSIS aims to identify as a compromise are the Positive Ideal Solution (PIS) and the Negative Ideal Solution (NIS). However, the relative importance or weights of these two distances are not taken into account in the method's ranking calculation. This can cause the ranking results to be biased. The TOPSIS approach calculates the distances between alternatives and the ideal solutions using the Euclidean distance, disregarding correlation between criteria. The correlation between the criteria is not taken into account in the distance computation. As a result, the TOPSIS results may be impacted by information overlap or interdependence among criteria. These complaints draw attention to several TOPSIS approach weaknesses and point out potential areas for

development. In order to solve some of these drawbacks and offer more reliable decision-making frameworks, researchers have created other variants of the TOPSIS technique, such as the modified TOPSIS (M-TOPSIS) mentioned above.[2]Among MCDM techniques, the TOPSIS method has grown significantly in popularity, and many academics have used and adapted it to address a variety of issues in several fields. The TOPSIS method's growing applications and development patterns mirror the general development trends of MCDM approaches in dealing with both straightforward and challenging decision-making issues. A comprehensive assessment is required to compile recent advancements in this field given the growing corpus of research on the TOPSIS approach and its different variants. While earlier studies have used TOPSIS and fuzzy TOPSIS for criteria identification, ranking, and evaluation, they might not be up to date with the most recent developments. Consequently, it is crucial to undertake a thorough investigation that takes into account recent advancements and new changes. While the current inquiry focuses on specific articles proposing improvements and adjustments to the TOPSIS approach, it is important to keep in mind that there may be additional pertinent research that have used the TOPSIS technique but are not covered in this specific investigation. In order to contribute to the ongoing progression in the field of MCDM, the paper's goal is to present an overview of recent innovations and improvements in the TOPSIS technique.[3]The TOPSIS method, which selects the greatest option from a group of alternatives based on how closely it resembles the perfect solution, is widely acknowledged as a well-liked Multiple Criteria Decision Making (MCDM) technique. There have been attempts to expand the TOPSIS approach, which was initially created to handle real-valued data, to accommodate interval data, where the ratings of alternatives with respect to criteria are expressed as intervals rather than precise numbers. The authors of the research suggest a novel direct approach to the interval extension of the TOPSIS method as a solution to this problem. This method stays clear of the heuristic presumptions and constraints that other approaches have. Through the use of this direct interval extension and numerical examples, the authors show that the final ranking of options can differ dramatically from the outcomes produced by currently used techniques. In conclusion, the research presents a novel way for incorporating interval data into the TOPSIS algorithm. In contrast to established techniques, this direct interval extension offers a unique viewpoint and evaluation of options by removing heuristic assumptions and restrictions. Heuristic methods are frequently used in interval extensions of the TOPSIS technique that establish positive and negative ideal solutions. Real values or intervals that are not reachable within the decision matrix are used to represent these ideal solutions. This, however, goes against the cornerstones of the conventional TOPSIS approach.[4]The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was first introduced by Hwang and Yoon in 1981 as a practical method for resolving multi-attribute decision-making problems with a constrained number of options. The fundamental idea of TOPSIS is to rank the alternatives according to how far away they are from the ideal and the undesirable answer, so determining the best option for making decisions. Because it is straightforward, simple to learn, and easy to incorporate with other approaches, TOPSIS has grown in popularity. It has been widely used in a variety of industries, including risk management, sustainable development, water resource management, and renewable energy. Numerous academics have recently expanded and improved the TOPSIS approach theoretically from various angles. In order to strengthen the theoretical basis of TOPSIS, some of these extensions entail combining fuzzy and grey number theory, swapping the Euclidean distance for vertical distance, or Mahalanobis distance. Choosing the attribute weights, which affects the final ranking of alternatives, is a crucial stage in the TOPSIS technique.[5]The TOPSIS approach has been used in a variety of areas of life. It has been applied to the management and decision-making of energy [3–7]. For clinic selection, disease diagnosis, and identification in medicine, TOPSIS has been used [2, 8–10]. For process optimization and equipment selection, TOPSIS has been used in engineering and industrial systems [11–16]. Risk assessment and environmental impact assessments have benefited from TOPSIS in the safety and environmental areas [17–22]. For process design and selection, chemical engineering has used TOPSIS [5, 23, 24]. Studies on water resources have used TOPSIS to manage water and allocate resources [5, 19, 23, 25]. In order to solve particular issues and incorporate fuzzy or ambiguous data, researchers have additionally expanded upon and modified the TOPSIS approach. While Zulqarnain et al. created a graphical model for clinic selection, Chen and Hwang proposed a novel model for TOPSIS [26]. For collective decision-making in a fuzzy context, Chen extended TOPSIS [28]. Numerous other researchers have also improved TOPSIS for making decisions in ambiguous situations [3, 4, 18, 19, 25, 29-35, 6, 8, 11-15, 17, and many more].The application of TOPSIS in decision-making has been further improved by the use of interval numbers and generalized interval-valued fuzzy soft matrices (IVFSM) [36, 37, 38–40]. As an illustration, TOPSIS with fuzzy data has been used to project the likelihood of success for pancreatic transplantation [8]. In order to enhance decision-making processes and overcome numerous issues brought on by ambiguity and complexity, TOPSIS has generally been widely used and extended in several sectors.[6]The literature research indicates that, with the exception of Triantaphyllou and Lin's fuzzy TOPSIS technique, the majority of the current TOPSIS algorithms produce choices with sharp relative closeness values. It is believed that relative closeness should be fuzzy when working with fuzzy weights and fuzzy ratings in order to reflect the whole spectrum of potential outcomes. Crisp relative closeness values don't represent the whole range of options

and only provide one solution to a fuzzy MCDM situation. Although fuzzy relative proximity values are provided by Triantaphyllou and Lin's fuzzy TOPSIS approach, it is highlighted that these closeness values can be overstated and distorted due to the nature of fuzzy arithmetic operations. In Section 5, this problem will be shown with a numerical example. Therefore, a precise fuzzy TOPSIS approach that can handle fuzzy MCDM problems must be developed. The study suggests a fuzzy TOPSIS technique based on alpha level sets and the fuzzy extension concept to address this need. The suggested approach formulates the issue as a nonlinear programming (NLP) issue that can be handled with tools like LINGO or Microsoft Excel Solver.[7]The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method for multiple attribute decision making (MADM) was developed by Hwang and Yoon. The core idea of TOPSIS is to choose the option that is closest to the ideal solution on the positive side and farthest from the ideal solution on the negative side. The TOPSIS theory and its applications have been extensively studied in the literature. For instance, Lai et al. employed the TOPSIS concept to address problems with multiple-objective decision making (MODM). Abo-Sinna and Amer developed the TOPSIS approach to address challenging nonlinear programming problems with numerous goals. The VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) and TOPSIS methodologies were compared by Opricovic and Tzeng. A ranking strategy called VIKOR seeks to strike a balance between the opponent's regret and the majority's utility by maximizing the former while minimizing the latter. Also proposed was a multicriteria ranking index based on the idea of being close to the ideal answer. Jahanshahloo et al. developed an algorithmic strategy to extend TOPSIS for decision-making problems utilizing interval data. Yang and Hung investigated the potential applications of TOPSIS and fuzzy TOPSIS in the construction of plant architectures. The main difference between TOPSIS and fuzzy TOPSIS relates to the rating process.[8]The authors stress the importance of employing evaluation approaches appropriate for this activity in order to evaluate the competitiveness of the Chinese high-tech industry, which involves the mutual interference among evaluation indicators. In this field, the TOPSIS technique is recognized as a key tool for multiple criteria decision making (MCDM). The integrated programmed includes the goal weight, and the traditional TOPSIS method is well known for its completeness and simplicity in analyzing MCDM issues..Because it uses the Euclidean measure of distance to make decisions, the conventional TOPSIS technique reads the indicators as independent and does not account for their mutual disruption; the authors pay attention to this.

Third party logistics providers selection: A third-party logistics provider (3PL) should be carefully chosen. It is important to evaluate variables including pricing, reputation, service options, technical prowess, and a global reach. The optimum match for your business's unique demands is ensured by carrying out rigorous assessments, seeking sources, contrasting numerous suppliers, promoting effective and trustworthy chain of custody functions.

Delivery Service (%): Delivery service percentage is the proportion of times a business successfully provides clients with its goods or services within a given time limit. It is an important indicator that shows managerial efficiency, consumer approval, and general company success. A larger percentage of delivery services denote dependable and fast shipment, which promotes customer retention and a favorable business record.

Quos from Customer Experience: According to the client engagement viewpoint, quality of service (QoS) is defined as satisfying customers to the fullest extent possible in terms of product/service performance, responsiveness, dependability, and overall contentment. It entails providing outstanding customer service, rapid communication, personalized interactions, prompt issue resolution, and continually going above and beyond customer expectations in order to cultivate client devotion and vocal support.

Territorial Coverageof the EU (%): Territorial coverage of the EU refers to the percentage of geographic area within the European Union that is included in its jurisdiction. It represents the extent to which EU laws, regulations, and policies are applicable and enforced. The territorial coverage varies among EU member states and is a key aspect of European integration and governance.

Flexibility: Flexibility is the capacity to modify oneself in response to shifting conditions, needs, or requests. It entails making decisions and carrying out activities while being flexible, open-minded, and nimble. Organizations that are flexible are better equipped to deal with uncertainty, welcome creativity, modify their plans, and cater to changing client wants, which improves their ability to compete and durability.

Price (EUR/km):Price (EUR/km) is a unit of measurement that reflects a good or service's cost per mile. It is frequently employed in sectors including goods, logistics, and transportation. Organizations may make knowledgeable choices based on cost-effectiveness and earnings concerns thanks to the price per km, which aids in evaluating the economic viability and competitiveness of various solutions.

3. RESULT AND DISCUSSION

TABLE 1. The providers of third-party logistics services

	DATA SET				
	Delivery Service(%)	QoS from Customer Experience	Territorial Coverage of the EU(%)	Flexibility	Price(EUR/km)
3PL-1	99.98	9	88	9	0.95
3PL-2	99.95	10	92	10	0.92
3PL-3	99.9	10	75	9	0.99
3PL-4	98.98	8	85	8	0.9
3PL-5	99.97	8	95	10	1.2

Table 1 provides information about the performance of several third-party logistics (3PL) companies. It comprises criteria that allow for provider comparison and evaluation, such as delivery service, customer experience, territorial coverage, flexibility, and price.

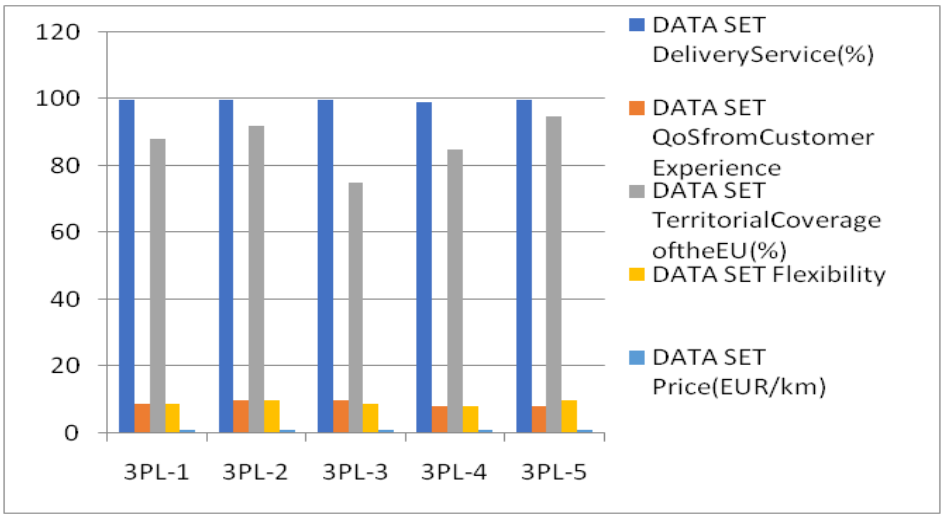

Figure 1. Third party logistics provider's selection

The data from Table 1 is represented graphically in Figure 1, where all aspects are essentially equal, concluding that all 3PLs are engaged in healthy rivalry.

Table 2. Normalized data

	Normalized data				
	Delivery Service(%)	QoS from Customer Experience	Territorial Coverage of the EU(%)	Flexibility	Price(EUR/km)
3PL-1	0.4482	0.4450	0.4509	0.4361	0.4257
3PL-2	0.4481	0.4945	0.4714	0.4845	0.4123
3PL-3	0.4479	0.4945	0.3843	0.4361	0.4437
3PL-4	0.4437	0.3956	0.4356	0.3876	0.4033
3PL-5	0.4482	0.3956	0.4868	0.4845	0.5378

The performance of several third-party logistics (3PL) providers across various criteria is presented in Table 2 using normalized data. The values represent each provider's comparative performance in terms of service delivery, customer satisfaction, geographic coverage, adaptability, and cost.

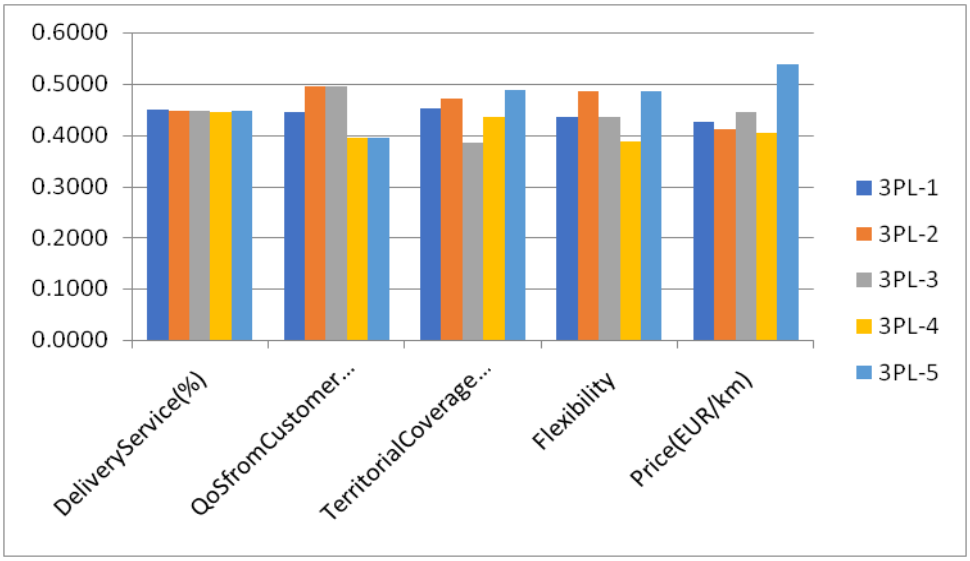

Figure 2. Normalized data

Figure 2 shows us the graphical representation of the table 2 where delivery service %is almost same for all the 3PLs, 3PL 2 and 3 stands on top with almost equal QoS from customer experience, and when it comes to other aspects 3PL-5 stands on the top.

Table 3. Weights

	weights				
	Delivery Service(%)	QoS from Customer Experience	Territorial Coverage of the EU(%)	Flexibility	Price(EUR/km)
3PL-1	0.20	0.20	0.20	0.20	0.20
3PL-2	0.20	0.20	0.20	0.20	0.20
3PL-3	0.20	0.20	0.20	0.20	0.20
3PL-4	0.20	0.20	0.20	0.20	0.20
3PL-5	0.20	0.20	0.20	0.20	0.20

The weights of the 3PLs, which are equally taken, are displayed in Table 3.

Table 4. Weighted normalized decision matrix

	weighted normalized decision matrix				
	Delivery Service(%)	QoS from Customer Experience	Territorial Coverage of the EU(%)	Flexibility	Price(EUR/km)
3PL-1	0.0896	0.0890	0.0902	0.0872	0.0851
3PL-2	0.0896	0.0989	0.0943	0.0969	0.0825
3PL-3	0.0896	0.0989	0.0769	0.0872	0.0887
3PL-4	0.0887	0.0791	0.0871	0.0775	0.0807
3PL-5	0.0896	0.0791	0.0974	0.0969	0.1076

Table 4 shows the weighted normalized decision matrix of 3PLs for delivery service(%) except 3PL-4 all the other 3PLs have the same value, respectively in all the aspects 3PL-2 and 5 have the higher values overall and 2PL-4 have the least values comparatively.

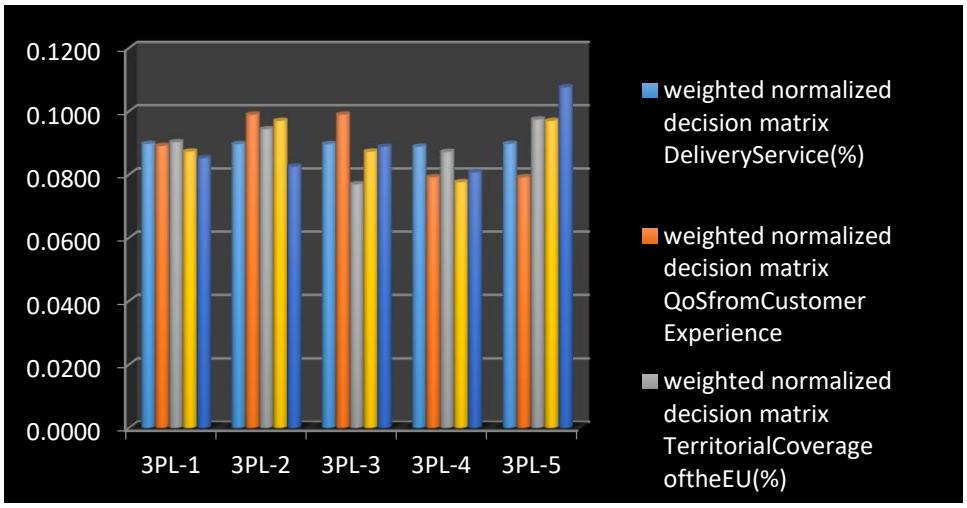

Figure 3. Weighted normalized decision matrix

Figure 3 shows us the domination of 3PL-2 and 5 in almost all the matrices and 3PL-4 is lagging behind compared to other 3PLs and this is obtained by using TOPSIS method

Table 5. Values of SI Plus, SI Negative, CI

	SI Plus	Si Negative	Ci
3PL-1	0.0162	0.0295	0.6454
3PL-2	0.0036	0.0412	0.9206
3PL-3	0.0241	0.0290	0.5464
3PL-4	0.0295	0.0288	0.4934
3PL-5	0.0334	0.0282	0.4581

According to the TOPSIS approach, Table 5 displays the SI plus, SI negative, and CI values for the alternative 3PL-1, 3PL-2, 3PL-3, 3PL-4, and 3PL-5.

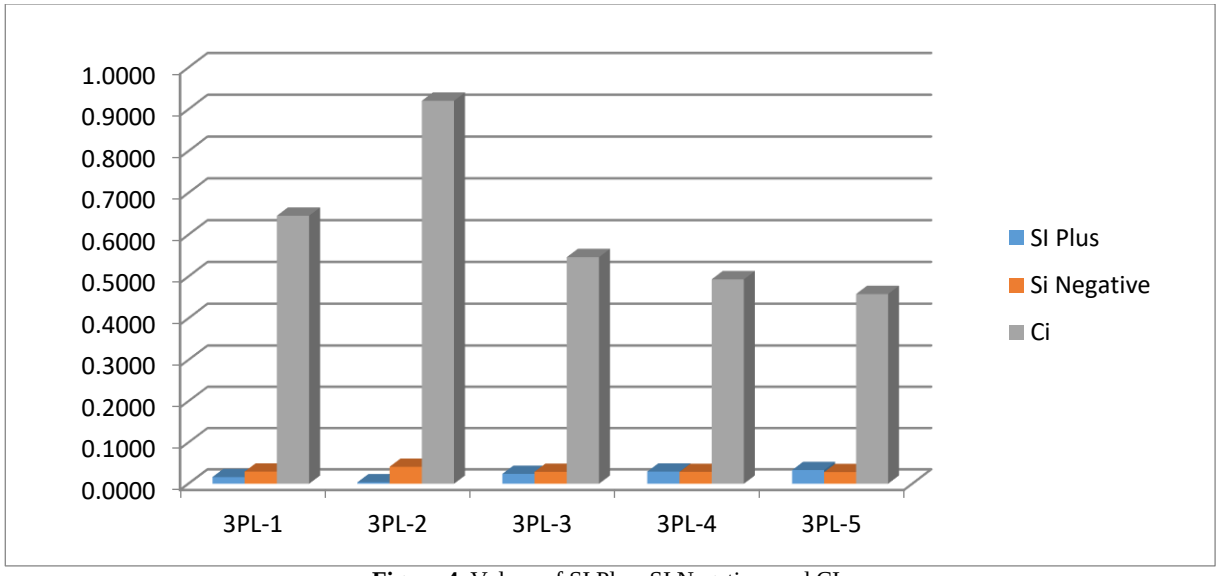

Figure 4 . Values of SI Plus, SI Negative, and CI

Figure 4 shows us the values of SI plus, SI negative, and CI. It is clearly visible that 3PL-2 is the dominant among all the 3PLs and 3PL-5 has the least values and this is analyzed by TOPSIS method.

Table 6. Rankings

3PL-1	2
3PL-2	1
3PL-3	3
3PL-4	4
3PL-5	5

Table 6shows the rankings of the 3PLs by using TOPSIS Method. 3PL-2 got the first rank and 3PL-5 got the last rank.3PL-1 is second rank, 3PL-3 is third rank and 3PL-4 is fourth rank.

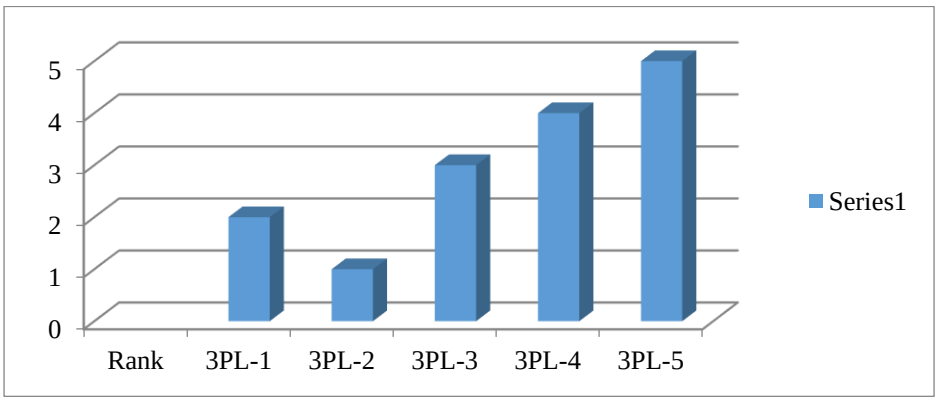

Figure 5. Rankings

Figure 5 shows the ranking of 3PLs where 3PL-2 stands at the first position followed by 3PL-1 and 3PL-3 at second and third slots and then comes 3PL-4 and 3PL-5, by using TOPSIS methodology.

4. CONCLUSION

For companies looking to optimize their supply chain operations, choosing third-party logistics (3PL) suppliers is a crucial choice. To make an informed decision, a number of things should be taken into account. First and foremost, it's important to evaluate the 3PL provider's experience and industry understanding to make sure they have the skills and knowledge needed to handle particular goods or sectors. For smooth communication and data sharing, it is crucial to assess their technological infrastructure and integration capabilities. Additionally, taking into account the provider's geographic coverage and distribution network may help assess how well they can reach their target audiences. Evaluations of additional elements including price, service level agreements, and scalability are also necessary.. The choice of a 3PL provider that complements the organization's objectives, values, and operational needs can be aided by a thorough assessment procedure that includes requests for bids, site visits, and customer references. A wise decision will increase the effectiveness of the supply chain, customer happiness, and overall business performance. Furthermore, verifying the 3PL's dependability and level of customer service quality by checking client references, industry certifications, and performance data. Businesses may choose a 3PL supplier with confidence by undertaking a thorough assessment process that takes into account these elements. This will eventually improve supply chain efficiency, customer happiness, and overall business performance.

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