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Ranking of Best Practices of Logistics Service Providers using Fuzzy AHP

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Abstract

Due to globalization and increase in e-commerce businesses, the scope of Logistics Service Providers (LSPs) is expected to grow exponentially in India. In order to sustain and grow, LSPs need to provide quality services to organizations. The objective of this paper is to identify the best practices followed by Indian LSPs and to rate the identified best practices by using Fuzzy AHP methodology. The best practices are categorized into four major categories, that is strategic, operational, technical and societal on the basis of literature review and expert opinion. Further, twenty best practices were identified as sub- categories under above defined categories. The experts were asked to rate each of these twenty factors in terms of their importance. Further, a Fuzzy AHP approach was applied for prioritizing best practices. Based on priority weights, different categories can be ranked in descending order as Operational (0.45), Strategic (0.41), Technical (0.10) and Societal (0.03).The findings of the study shows that the top four prioritized factors among all the twenty factors are safe shipments, use of eco-friendly fleet, reduction in carbon emission and timely delivery. The study will enable the organizations to understand the strengths and practices used by Indian LSPs in order to provide better service quality and timely delivery to their committed shipments. The research will also help unorganized and budding LSPs to identify the factors on which they can improve and excel to fulfill the dynamic market needs.

Keywords: Logistics Service Providers, Service Quality, Best Practices, Fuzzy AHP methodology.

Introduction

Due to advancement in technology and significant developments in the Indian economy, the logistics sector is transforming to align with changing business requirements. Logistics is considered as the backbone of an economy and it contributes around 13% in GDP as against 7-8% in developed countries. In past few decades, the logistics sector has shown tremendous growth and at present, it has reached to around US $225 billion industry. The logistics sector will continue to show the robust growth of around 10-15% annually to match the pace of growth of the economy. The growth in Indian economy is bringing lots of opportunity for logistics sector to grow in terms of increase in volume handling, large traffic volume, and increase in network coverage. In India, Logistics sector is the interplay of infrastructure, technology and logistics service providers, which manages the efficient flow of goods from the point of origin to the point of consumption. Despite of few weaknesses, logistics sector is witnessing huge growth

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in retail, e-commerce and manufacturing sectors. Most of the organizations are taking support from logistics service providers in order to reduce cost and to provide efficient and timely services to the end customers. Logistics Service Providers (LSPs) or 3Pl provides various services including transportation, freight forwarding, warehousing, container services, shipping services, express cargo delivery and value added services etc. to manage all logistical activities in the entire supply chain smoothly. At present, organized logistics players are adopting latest techniques and technologies in order to meet increased and dynamic logistics requirements. Many best practices followed by LSPs to bring transparency, to enhance service quality and to improve collaboration and coordination among supply chain members.

In this paper, an attempt has been made to identify the best practices followed by Indian LSPs and rank them on the basis of their importance by Fuzzy AHP. The objective of the paper is to highlight the best practices adopted by logistics providers in order to serve end user with quality services. The paper is organized as follows. After introduction, literature review is discussed in Section-2. Section-3 deals with the model development and research methodology is discussed in Section-4. Section-5 contains findings and concluding remarks and implications of study in section-6.

Literature Review

From last three decades, many research has been done on logistics providers and logistical services provided by LSPs. Marasco (2008) analysed 152 articles published from 1989 to 2006 in 33 international journals. Busse and Wallenburg, (2011) provided comprehensive review of innovation practices of logistics management from 2001 to 2009. In general, outsourcing refers to giving some part of business to third party for the benefit of cost reduction and better customer services. Nowadays, Third party logistics (3PLs) become more important for logistics sector.

LSPs services are extended from transportation and warehousing into integrated logistics solutions in form of all shopping at one stop(Kumar et al.,2012). Sahay et al.(2006) found that the common logistics services in India are inbound and outbound transportation, warehousing activities, order fulfillment and fleet management. Gilaninia et al.(2011) and Fasanghari et al.(2008) highlighted the importance of information technology in effective coordination among all supply chain partners. Supply chain integration being an important component for increasing effectiveness and profitability of LSPs is discussed by many authors (Jayaram et al.(2010); Huang et al.,2014) Declining margins and a tougher competitive environment together are the main driving factors for the growth of 3PL (Tan et. al). Flexibility in service (Naim et. al, 2010), value added services (Soinio et al.,2012), optimal delivery time (Ulku and Bookbinber,2012) and network optimization (Basligil et al.,2011) are also found most frequently used outsourced logistics functions. Many studies exist in literature on latest logistics practices like innovation management (Busse and Wallenburg, 2011), green supply chain() and reverse logistics (Govindan et al.,2012).

Globalization has been a major reason for organizations to redesign their strategies, develop products to meet international market needs and enhance capability to reach globally (Kumar et al., 2012). This requirement gives full opportunity to logistics providers to come up with wide market reach and better connectivity with other nations. Many developed countries are in phase of well-established logistics providers handling all non-core activities whereas few are still in infancy phase (Tan et. al, 2014). Bhatnagar et al.(1999) have analysed that more than 50% of firms outsource shipment consolidation to logistics providers whereas around 40% outsourced order fulfillment, carrier selection and freight payment in Singapore. Logistics outsourcing practices are comparatively slower in North America and Latin America than Asia-Pacific Region and Western Europe (Kumar et al.,2012).

Existing literature suggests that best practices followed by LSPs are inclined more by top management. The new ideas, new policies and innovation are usually initiated by senior management of an organization and finally turned into applicable strategies. Hoek et al. (2008) suggested that the other peer departments must be internally aligned with supply chain partners to improve the efficiency of the entire process. Ellinger et al. (2007) examined the market orientation and the development practices followed by manpower also influences the performance of logistics service providers. Network Planning and enhancing the existing network, network distribution management by hub and spoke systems are the important components of strategic planning (Zapfel and Wasner, 2002). The management always prefers to audit all the processes to maintain control and transparency in system. LSPs need to maintain confidentiality of the entire customer data used in transactions so top management gives high importance to this concern. As operational best practices, the prime focus of LSPs is to deliver the safe shipments in committed time (Stank et al., 2003).

The best practices are broadly categorized into four categories- strategic, operational, technical and societal. The sub-categories taken under each category is defined in table 1 along with corresponding references.

Table 1: Literature Review on Best Practices followed by LSPs

Best Practices	Definition/meaning	References
Organizational		Hoek (2008); Ellinger (2007)
Manpower Management	Managing human resources which involved in all logistics operations	Tezuka (2011); Jayaram et al.(2010); Juga et al.(2010), Wong et al.(2010); Hamdan et al.(2008); Sahay et al.(2006); Aghazadeh (2003); Becker (1996)
Network Planning and Enhancement	Planning of maintaining existing network and enhancing new dimensions as required for expansion of business	Gunasekaran et al. (2016); Soinio et al.(2012) ; Basligil et al.(2011); Gilaninia et al.(2011); Kayakutlu et al.(2011); Ellinger et al.(2008); Zapfel et al.(2002)
Audit & Control	Process to cross check the correctness of the functioning of all processes in the organisation	Gilmour (1999); Comyn-Wattiau & Akoka (1996)
Data Confidentiality	Keeping all records and data transactions w ith appropriate security measures	Jothimani & Sarmah (2014); Tweddle (2008); Farmer(1988)
Innovation & Customized Solutions	Trying out new ways to provide services along with serving customer needs in tailor -made fashion	Yeung et al.(2012); Busse and Wallenburg (2011); Huo et al.(2008); Ghobadian(1994); Farmer(1988)

Operational		Stank et al. (2003); Yeung (2006)
Safe Shipments	Ability to deliver products safely	Markovic (2006), Stank et al.(2003); Mentzer et al.(2001; Philip and Hazlett (1997); Ghobadian et al.(1994); Vandamme et al.(1993); Parasuraman et al.(1985, 1988)
Timely delivery	Ability to deliver goods on time	Kumar et al.(2012) ; Ulku et al.(2012); Yeung et al.(2012); Busse et al.(2011); Juga et al.(2010) ; Huo et al.(2008);Sahay et al.(2006); Millen et al.(1998).
Resource Optimization	Optimum use of all available limited resources to LSPs	Forslund (2012); Tezuka(2011); Jayaram et al.(2010); Naim etal.(2010); Sahay et al.(2006); Aghazadeh(2003)
Efficient Route Planning	Planning of route for efficient movement of fleet	Ravi (2014); Ulku et al.(2012); Basligil et al.(2011); Ellinger et al.(2008); Zapfel et al.(2002)
Inventory Replenishment	Adopting various ways to refill the inventory of customer at earliest	Swenseth & Godfrey (2002); Sahay et al.(2006); Waller et al.(1999)
Technical		Forslund (2012); Lai et al. (2007); Wang Fu (2006); Bharadwaj (2000)
Use of Warehouse Management Software	Usage of IT and software for warehouse management	Ketikidis et al. (2008); Doerr et al. (2006)
Data handling and extraction	Managing data handling and extraction of data through data mining tools	Evangelista et al.(2013); Kumar & Kumar (2014)
Tracking and Tracing of shipments	Using GPS technology to track and trace the exact location of pipeline shipment	Kumar & Kumar (2014); Shamsuzzoha, & Helo (2011); Hillbrand & Schoech (2007)
Use of Internet & (Electronic Data Interchange) EDI Systems	Access to internet and adoption of EDI systems for increasing transparency of processes	Evangelista et al.(2013); Gilaninia et al.(2011); Sakun(2011; Tezuka(2011); Wong et al.(2010); Fasanghari et al.(2008); ,Jharkharia et al.(2005)
Bar-Coding & RFID Systems	Techniques which helps in tracking the product or items	Ketikidis et al. (2008); Doerr et al. (2006); Gaukler & Seifert (2007)

Societal		Centobelli (2017); Mani et al. (2016)
Use of eco-friendly fleet	Usage of more green and environment friendly fleet to reduce the pollution level in environment	Colicchia et al. (2013); Lieb & Lieb (2010); LaGuardia & Srinivasan (2011)
Use of renewable energy sources	Usage of those sources which can be naturally replenish	Huang et al.(2014); Ulku et al.(2012); Tezuka (2011); Naim et al.(2010)
Use of reusable and recyclable packaging	Repeated usage of packaging either in same form or another form as recycled one	Govindan et al. (2012); LaGuardia & Srinivasan, (2011); Lieb & Lieb (2010); Sahay et al.(2006)
Reduction in Carbon emission	Step to reduce carbon emission in environment b y modifying transport and facility usage	Kim et al. (2009); Hua et al., (2011); Elheddhli & Merrick (2012)
Initiatives towards CSR	Organizations activities for society and environment as a	Juntunen et al.(2014); Colicchia et al. (2013); Lieb

Proposed Framework

As in literature review, the existing literature in best Practices has been studied. A model is proposed to understand the hierarchy of best practices usually followed by Indian LSPs (Figure 1). Almost all well-established and well known LSPs practice their operations in best possible way to ensure successful fulfillment of all commitments made to customer. At strategic level, the top management of the organization is directly involved in taking major decisions related to manpower management, network planning and enhancement, audit and control of all ongoing processes, maintaining data confidentiality and identifies new innovative and customized solutions to satisfy the customer needs in possible efficient manner. At operational level, the best practices adopted by LSPs are more focused towards the satisfactory end delivery of the services to the customer. Their preferences for delivering the best of the service quality are planning of safe shipments, timely and accurate delivery, optimizing resources efficiently, managing inventory and efficient route planning. At technical level, this is almost mandatory for LSPs to make use of latest software and tools to keep updated their customers with basic requirements of tracking and tracing of goods, warehouse management, data handling and extraction etc. The best practices followed by LSPs to make their systems technically robust are use of warehouse management systems software, use of Bar-coding and RFID technology, use of GSM-GPS technology and internet and EDI systems to make their system transparent and convenient. At societal level, almost all LSPs contributing towards Corporate Social Responsibility (CSR) in the form of making use of renewable energy resources, increasing use of eco-friendly fleet and reusable and recyclable packaging materials. Moreover, they are also giving importance to use of solar panels, tree plantation and rain water harvesting especially at their warehouses and open areas.

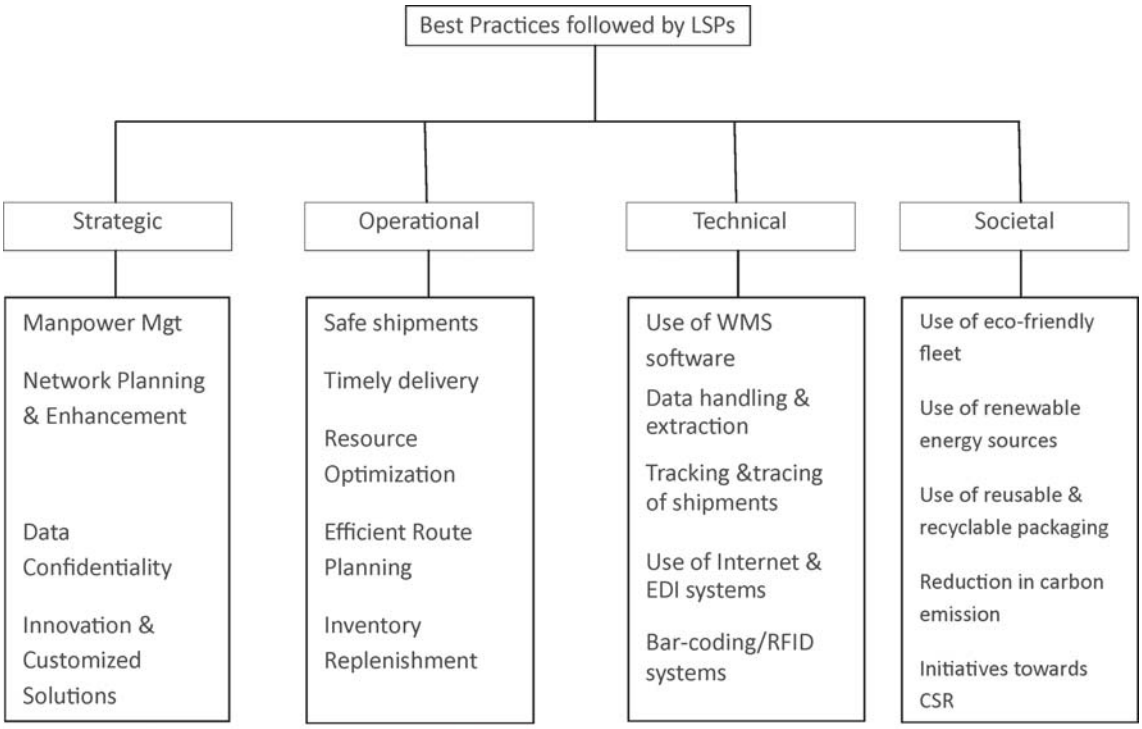

Figure 1: Proposed Model for Best Practices followed by LSPs

Research Methodology

In literature, there are various methods available for ranking best practices of LSPs. Multiple Criteria Decision Making (MCDM) is considered to be one of the most effective tools. It is widely used for dealing with unstructured problems with multiple conflicting objectives (Lee and Eom, 1990). Many approaches like Analytical Hierarchy Process (AHP), TOPSIS, Data Envelopment Analysis (DEA), DEMATEL and Interpretive Structural Modeling (ISM) etc. have been developed for solving MCDM problems (Tyagi et al., 2015). These approaches measures the alternative ratings based on the preferences or weights given by decision makers to each alternative in precise and crisp manner. In this paper, identified best practices are prioritized by using Fuzzy AHP.

Fuzzy Analytical Hierarchy Process

AHP give better results when we deal with crisp information decision applications (exact and ordinary data) but to handle uncertainties associated with the data, an additional integration of fuzzy theory is required. The advantage of Fuzzy AHP over AHP is to capture uncertain imprecise judgment of experts in pair-wise comparison and can be better applicable in dealing complexities with 3PL selection. Proposed hierarchical framework (Figure 1) will be used for applying fuzzy AHP. Linguistics scales for importance weight of each factor is given in table 2.

Let X = {x1, x2… xn} be an object set, and U = {u1, u2… um} be a goal set. According to the method of Chang (1992) extent analysis, each object is taken and extent analysis for each goal gi, is performed, respectively. Therefore, M-extent analysis values for each object can be obtained and are represented as follows:

$$M_{g_i}^1, M_{g_i}^2, \ldots, M_{g_i}^m, \quad i = 1,2, \ldots, n, \qquad \ldots(1)$$

Where, all the $M_{g_i}^j \ (j = 1,2, \ldots \ldots m)$ are triangular fuzzy numbers represented by (l, m, u), l,m and u is the least possible, most likely and largest possible. The steps of the fuzzy AHP (Chang, 1996) are as follows:

Step 1: The value of fuzzy synthetic extent with respect to the i^{th} object is defined as

$$S_i = \sum_{j=1}^{m} M_{g_i}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j\right]^{-1} \qquad \ldots(2)$$

To obtain $\sum_{j=1}^{m} M_{gi}^{j}$ perform the fuzzy addition operation of M-extent analysis values for a particular matrix such that

$$\sum_{j=i}^{m} M_{g_i}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right) \qquad \ldots(3)$$

and to obtain $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$, perform the fuzzy addition operation of $M_{g_i}^j \ (j = 1,2, \ldots \ldots m)$ values such that

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \qquad \ldots(4)$$

The inverse of the vector in "equation (2)" can be computed as,

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \qquad \ldots(5)$$

Table 2: Linguistic variable for importance weight of each factor

Linguistic variable	Triangular Fuzzy Numbers
Equally Important	(1,1,1)
Weakly Important	(2/3, 1, 3/2)
Fairly Important	(3/2, 2, 5/2)
Strongly Important	(5/2, 3, 7/2)
Absolutely Important	(7/2, 4, 9/2)

Source: Singh & Sharma (2014)

Step 2: The degree of possibility of $M_2 = (1_2, m_2, u_2) \geq M_1 = (l_1, m_l, u_l)$ is defined as

…(6)

and can be equivalently expressed as follows:

$$V(M_2 \geq M_1) = \text{hgt}(M1 \cap M2) = \mu_{M_2}(d)$$

$$= \begin{cases} 1, & \text{if } m_2 \geq m_1, \\ 0, & \text{if } l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \text{otherwise,} \end{cases} \quad \ldots(7)$$

Where, d is the ordinate of the highest intersection point D between and shown in figure 2. l M_2 M_1

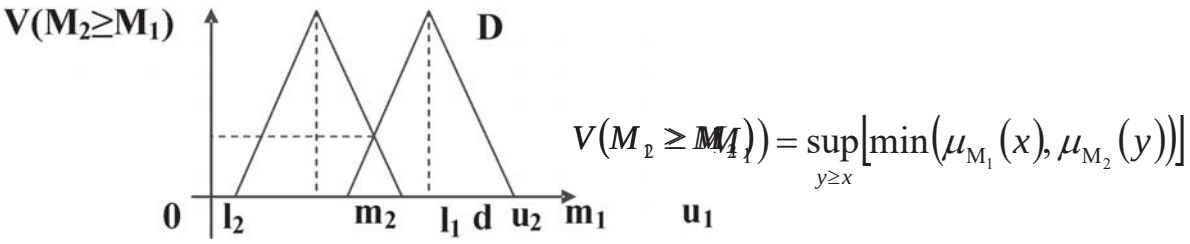

Figure 2: The interaction between triangular fuzzy numbers, M_1 and M_2

To compare M_1 and M_2, we need both the values of and .

Step 3: The degree possibility for a convex fuzzy number to be greater than k, convex fuzzy numbers M_i (i=1, 2,….., k) can be defined as

$$V(M \geq M_1, M_2, \ldots, M_k) = V[(M \geq M_1) \text{and} (M \geq M_2) \text{and} \ldots \text{and} (M \geq M_k)]$$

$$= \min V(M \geq M_i), i = 1,2,3, \ldots, k \quad \ldots(8)$$

Assume that, $d'(A_i) = \min V(S \geq S_k)$ …(9)

for, k=1,2,…..,n and k≠1. Now the weight vector can be given by the following formulae,

$$W' = \{d'(A_1), d'(A_2), \ldots, d'(A_n)\}^T, \quad \ldots(10)$$

Where Ai (i=1, 2, 3….., n) are n elements.

Step 4: Via normalization, the normalized weight vectors are given as,

$$W' = \{d(A_1), d(A_2), \ldots, d(A_n)\}^T,$$

Where "W" is a non- fuzzy number

Step 5: Integrate the opinions of decision makers and apply geometric average to combine the fuzzy weights of decision makers.

Findings of the Study

Fuzzy AHP approach is used to rank the best practices followed by Indian logistics service providers. The inputs on the best practices followed by Indian LSPs have been taken from two experts. The experts are working with well-established Indian logistics companies and they provide their insights on the best practices followed by Indian logistics service providers in general. Expert-1 is senior operation manager in leading Logistics Company with experience of more than 10 years. Expert-2 is supply chain head in well known Indian logistics company with 15 years of experience.

Pair-wise comparison of all the factors at each level is done on a linguistic scale as shown in table 2. By using Equation (1-2), the pair-wise comparison matrices of major criteria and sub criteria are developed and shown in table 3. The final individual and global weights are evaluated by using (3-10) equations by applying Fuzzy AHP method and as shown in table 4.

Table 3: Pair-wise Comparison Matrix of the Major Criteria and Sub Criteria

Table 3(a): Pair-wise Comparison Matrix of the Major Criteria

	Strategic	Operational	Technical	Societal
Strategic	(1,1,1)	(1.5,2,2.5)	(1.5,2,2.5)	(0.667,1,1.5)
Operational	(0.4,0.5,0.667)	(1,1,1)	(2.5,3,3.5)	(1.5,2,2.5)
Technical	(0.286,0.334,0.4)	(0.286,0.334,0.4)	(1,1,1)	(1.5,2,2.5)
Societal	(0.667,1,1.5)	(0.4,0.5,0.667)	(0.4,0.5,0.667)	(1,1,1)

The weight vector from this table is calculated as $W_{BP} = (0.41,0.45,0.10,0.03)^T$

Table 3(b): Pair wise comparison matrix of sub factors with respect to Strategic

	Manpower Mgt	Network Plan & Enhancement	Audit & control	Data Confidentiality	Innovation & customized sol
Manpower Mgt	(1,1,1)	(1,1,1)	(0.667,1,1.5)	(0.667,1,1.5)	(2.5,3,3.5)
Network Plan & Enhancement	(1,1,1)	(1,1,1)	(1.5,2,2.5)	(1.5,2,2.5)	(1.5,2,2.5)
Audit & control	(0.667,1,1.5)	(0.4,0.5,0.667)	(1,1,1)	(0.667,1,1.5)	(1.5,2,2.5)
Data Confidentiality	(0.667,1,1.5)	(0.667,1,1.5)	(0.667,1,1.5)	(1,1,1)	(0.667,1,1.5)
Innovation & customized sol	(0.286,0.334,0.4)	(0.4,0.5,0.667)	(0.4,0.5,0.667)	(0.667,1,1.5)	(1,1,1)

The weight vector from this table is calculated as $Ws = (0.28,0.31,0.23,0.18,0.01)^T$

Table 3©: Pair wise comparison matrix of sub factors with respect to Operational

	Timely Delivery	Safe Shipments	Resource Optimization	Effective Route Planning	Inventory Replenishment
Timely Delivery	(1,1,1)	(1,1,1)	(1.5,2,2.5)	(0.667,1,1.5)	(2.5,3,3.5)
Safe Shipments	(1,1,1)	(1,1,1)	(3.5,4,4.5)	(1.5,2,2.5)	(3.5,4,4.5)
Resource Optimization	(0.4,0.5,0.667)	(0.223,0.25,0.286)	(1,1,1)	(3.5,4,4.5)	(0.667,1,1.5)
Effective Route Planning	(0.667,1,1.5)	(0.4,0.5,0.667)	(0.223,0.25,0.286)	(1,1,1)	(3.5,4,4.5)
Inventory Replenishment	(0.286,0.334,0,4)	(0.223,0.25,0.286)	(0.667,1,1.5)	(0.223,0.25,0.286)	(1,1,1)

The weight vector from this table is calculated as $W_O = (0.28,0.44,0.26,0.02,0)^T$

Table 3(d): Pair wise comparison matrix of sub factors with respect to Technical

	Use of WMS Software	Data handling & extraction	Tracking & tracing	Use of Internet & EDI	Bar-coding & RFID systems
Use of WMS Software	(1,1,1)	(0.667,1,1.5)	(1.5,2,2.5)	(0.667,1,1.5)	(1.5,2,2.5)
Data handling & extraction	(0.667,1,1.5)	(1,1,1)	(0.667,1,1.5)	(2.5,3,3.5)	(1,1,1)
Tracking & tracing	(0.4,0.5,0.667)	(0.667,1,1.5)	(1,1,1)	(0.667,1,1.5)	(2.5,3,3.5)
Use of Internet & EDI	(0.667,1,1.5)	(0.286,0.334,0.4)	(0.667,1,1.5)	(1,1,1)	(3.5,4,4.5)
Bar-coding & RFID systems	(0.4,0.5,0.667)	(1,1,1)	(0.286,0.334,0.4	(0.224,0.25,0.286)	(1,1,1)

The weight vector from this table is calculated as $W_T = (0.26,0.25,0.22,0.27,0)^T$

Table 3(e): Pair wise comparison matrix of sub factors with respect to Societal

	Use of eco-friendly fleet	Use of renewable energy resources	Use of reusable and recyclable packaging	Reduction in carbon emission	Initiatives towards CSR
Use of eco-friendly fleet	(1,1,1)	(2.5,3,3.5)	(1,1,1)	(3.5,4,4.5)	(0.286, 0.34,0.4)
Use of renewable energy resources	(0.286, 0.34,0.4)	(1,1,1)	(1,1,1)	(3.5,4,4.5)	(0.4,0.5,0.667)
Use of reusable					

and recyclable packaging	(1,1,1)	(1,1,1)	(1,1,1)	(3.5,4,4.5)	(0.4,0.5,0.667)
Reduction in carbon emission	(0.223, 0.25,0.286)	(0.223,0.25,0.286)	(0.223,0.25, 0.286)	(1,1,1)	(0.286, 0.34,0.4)
Initiatives towards CSR	(2.5,3,3.5)	(1.5,2,2.5)	(1.5,2,2.5)	(2.5,3,3.5)	(1,1,1)

The weight vector from this table is calculated as $W_{C4} = (0.51,0.05,0.43)^T$

Table 5: Global Weight of the Main and Sub-Factors for Selection of Best 3PL

S.No.	Factors	Individual wt.	Global wt.
1	**Strategic**	**0.41**	**0.41**
	● Manpower Management	0.28	0.116
	● Network Planning & Enhancement	0.31	0.127
	● Audit & Control	0.23	0.095
	● Data Confidentiality	0.18	0.072
	● Innovation & Customized Solutions	0.01	0.005
	Operational	**0.45**	**0.45**
	● Timely Delivery	0.28	0.125
	● Safe Shipments	0.44	0.202
	● Resource Optimization	0.26	0.116
	● Effective Route Planning	0.02	0.011
	● Inventory Replenishment	0.00	0.00
3	**Technical**	**0.10**	**0.10**
	● Use of WMS Software	0.26	0.027
	● Data handling and Extraction	0.25	0.026
	● Tracking & tracing of shipments	0.22	0.023
	● Use of Internet & EDI	0.27	0.028
	● Bar-coding & RFID Systems	0.00	0.00
4	**Societal**	**0.03**	**0.13**
	● Use of eco-friendly fleet	0.44	0.014
	● Use of renewable energy resources	0.06	0.002
	● Use of reusable and recyclable packaging	0.07	0.002
	● Initiatives towards CSR	0.00	0.000

Results show that priority weight differs for all criteria. Based on priority weights, different categories can be ranked in descending order as Operational (0.45), Strategic (0.41), Technical (0.10) and Societal (0.03). The most important best practices are followed under operational category. Under operations category, safe shipments (0.44) and timely delivery (0.28) are two important sub factors that are basically inbuilt operational practices required to serve customers. Resource Optimization (0.26) is also an important concern area where LSPs try to optimize their limited resources. After operational, second priority should be given to Strategic. At strategic level, the major sub factor is Network Planning and Enhancement with priority weight of 0.31 followed by manpower management (0.28) and audit and control (0.23) as shown in Table 4. In today's market conditions deviating from traditional to digital, logistics service providers are extensively working towards the enhancement of network from domestic to global and simultaneously, emphasizing on manpower management to train them as per increasing market requirements. The weight for data confidentiality is 0.18 which shows that top management gives high importance to the security and safety of customer's data. Innovation and customized solutions (0.005) has less weightage as compared as to other sub factors. It reflects that LSPs give little importance to innovation rather than serving customers in usual way.

In Technical, Use of Internet and EDI (0.27) and use of WMS (0.26) are the two important sub factors required for smooth communication between different supply chain partners. Common software's like Electronic Data Interchange (EDI) and Warehouse Management software (WMS) brings transparency and reduces inventory integration in entire supply chain. These findings have emphasized on the increasing importance of communication by logistics providers to remain competitive in dynamic market conditions. Also, in order to serve across boundaries specifically in era of e-commerce, competency of logistics provider can act as a competitive advantage to the firm. Data handling and extraction (0.25) followed by tracking and tracing of shipments (0.22) are also required sub factors of technical category. It helps in providing all essential information related to data and exact positioning of the shipments to the customers.

Societal is the fourth important category. In this category, use of eco friendly fleet (0.44) and reduction in carbon emission (0.44) are perceived to be most important sub factor of Societal, followed by use of reusable and recyclable packaging (0.07) and use of renewable energy sources (0.06). These results clearly show that LSPs have started contributing towards society but not at very large scale. LSPs are adopting best practices to serve customers in best possible manner but still in learning phase.

Concluding Remarks and Implications of the Study

Logistics service providers are contributing hugely in successful execution of all processes of organizations. At the same time, they are also trying to give best of their services to fulfill their customer expectations. The best practices followed by Indian logistics service providers are categorized into strategic, operational, technical and societal on the basis of literature review and expert opinion. Further, twenty best practices were identified as sub- categories under above defined categories. The experts rated these sub factors on the basis of their importance and further prioritized by using Fuzzy AHP methodology. Operational (0.45), Strategic (0.41), Technical (0.10) and Societal (0.03) are the ranking of main categories. Safe shipments are the most important obvious best practice that is needed to be strictly followed by LSPs. Although LSPs focus comparatively less to society but still use of eco-friendly fleet is also considered as one of the important best practice followed by LSPs. The importance of network planning an enhancement reflects the need of increase in existing distribution network and to serve more customers. Timely delivery and manpower management are two prioritized best practices where LSPs need to give more emphasis to be more successful. Delivering shipments on time and

managing manpower to deliver best of the services are vital requirements of LSPs in order to make customer satisfied.

Innovations and customized solutions, effective route planning, inventory replenishment, bar coding and initiatives towards CSR activities are still in infancy stage. Large logistics players have initiated these practices but small players are in planning state and if implemented, not at very big scale. These best practices can further be implemented and brings improvement in services of LSPs. The study will enable the organizations to understand the capabilities and practices used by Indian LSPs in order to provide better service quality and timely delivery of their committed shipments. The research will also help unorganized and budding LSPs to identify the factors on which they can work to improve and excel to fulfill the dynamic market needs.

References

- Aghazadeh, S.M.(2003), "How to choose an effective third party logistics provider", Management Research News, 26, 7, 50 - 58.
- Basligil, H., Kara, S.S., Alcan, P., Ozkan, B. and Caglar, E. G. (2011), "A distribution network optimization problem for third party logistics service providers", Expert Systems with Applications, 38, 12730–12738.
- Bhatnagar, R., Sohal, A.S. and Millen, R. (1999), "Third party logistics services: a Singapore perspective", International Journal of Physical distribution and Logistics Management, 29, 9, 569-587.
- Busse, Christian and Wallenburg, C. M. (2011), "Innovation management of logistics service providers Foundations, Review, and Research agenda", International Journal of Physical Distribution & Logistics Management, 41, 2, 187-218.
- Centobelli, P., Cerchione, R., & Esposito, E. (2017), "Environmental sustainability in the service industry of transportation and logistics service providers: Systematic literature review and research directions" Transportation Research Part D: Transport and Environment, 53, 454-470.
- Chang, D. Y. (1996), "Application of extend analysis method on Fuzzy AHP", European Journal of Operational Research, 96, 343–350.
- Colicchia, C., Marchet, G., Melacini, M., & Perotti, S. (2013), "Building environmental sustainability: empirical evidence from Logistics Service Providers", Journal of Cleaner Production, 59, 197-209.
- Comyn-Wattiau, I., and J. Akoka. "Logistics information system auditing using expert system technology." Expert Systems with Applications 11, no. 4 (1996): 463-473.
- Dey, A., LaGuardia, P., & Srinivasan, M. (2011), " Building sustainability in logistics operations: a research agenda", Management Research Review, 34, 11, 1237-1259.
- Doerr, K. H., Gates, W. R., & Mutty, J. E. (2006). A hybrid approach to the valuation of RFID/MEMS technology applied to ordnance inventory. International Journal of Production Economics, 103(2), 726-741.
- Elhedhli, S., & Merrick, R. (2012). Green supply chain network design to reduce carbon emissions. Transportation Research Part D: Transport and Environment, 17(5), 370-379.
- Ellinger, A.E., Ketchen, D.J., Hult T.M., Elmadag, A.B. and Richey, R.G. (2008), "Market orientation, employee development practices, and performance in logistics service provider firms", Industrial Marketing Management, 37, 353-366.
- Evangelista, P., Mckinnon, A. and Sweeney, E. (2013), "Technology adoption in small and medium-sized logistics providers", Industrial Management and Data Systems,.113, 7, 967-989.
- Farmer, J.H. (1988), "A Conceptual Model of service quality", International Journal of Operations and Production Management, 8, 6, 19-29.
- Fasanghari, M., Roudsari, F.H. and Chaharsooghi, S.K. (2008), "Assessing the Impact of Information Technology on Supply Chain Management", World Applied Sciences Journal 4, 1, 87-93.
- Forslund, H. (2012), "Performance management in supply chains: logistics service providers' perspective", International Journal of Physical Distribution & Logistics Management, 42, 3, 296-31.

- Gaukler, G., & Seifert, R. (2007), "Applications of RFID in supply chains", Trends in supply chain design and management, 29-48.
- Ghobadian, A., Speller, S. and Jones, M. (1994), "Service Quality", International Journal of Quality & Reliability Management, 11, 9, 43-66.
- Gilaninia, S., Mousavian, S.J., Tayebi, F., Panah, M.P., Ashouri, S., Touhidi, R., Nobahar, R., Azizi, N. and Seighalani, F. Z. (2011), "The Impact of Information Technology Application on supply Chain Performance", Interdisciplinary Journal of Contemporary Research in Business, 3, 8.
- Gilmour, P. (1999). A strategic audit framework to improve supply chain performance. Journal of business & industrial marketing, 14(5/6), 355-366.
- Govindan,Kannan, Palaniappan,Murugesan, Zhu,Qinghua, Kannan,Devika (2012)," Analysis of third party reverse logistics provider using interpretive structural modeling", International Journal of Production Economics ,140 ,204–211.
- Gunasekaran, A., Dubey, R. and Singh, S.P. (2016), "Flexible Sustainable Supply Chain Network Design: Current Trends, Opportunities and Future", Global Journal of Flexible Systems Management, 17, 2, 109–112.
- Hamdan, A. and Rogers, K.J. (2008), "Evaluating the efficiency of 3PL logistics operations", International Journal of Production Economics, 113, 235-244.
- Hillbrand, C., and Schoech, R. (2007), "Shipment localization kit: An automated approach for tracking and tracing general cargo", Management of Mobile Business, 2007 ICMB 2007. International Conference, IEEE, 46-50.
- Hoek, R. V., Ellinger, A. E. and Johnson, M. (2008), "Great divides: internal alignment between logistics and peer functions", The International Journal of Logistics Management, 19, 2, 110 – 129.
- Hua, G., Cheng, T. C. E., & Wang, S. (2011). Managing carbon footprints in inventory management. International Journal of Production Economics, 132(2), 178-185.
- Huang, M. C., Yen, G.F. and Liu, T.C. (2014), "Reexamining supply chain integration and the supplier's performance relationships under uncertainty", Supply Chain Management: An International Journal, 19, 1, 64-78.
- Huo, B., Selen, W., Yeung, J.H and Zhao, X. (2008), "Understanding drivers of performance in the 3PL industry in HongKong", International Journal of Operations & Production Management, 28, 8, 772-800.
- Jayaram, J. and Tan, K.C. (2010), "Supply chain integration with third-party logistics providers", International Journal of Production Economics, 125, 262–271.
- Jharkharia S. and Shankar R. (2005), "IT-enablement of supply chains: understanding the barriers", The Journal of Enterprise Information Management, 18, 1, 11-27.
- Jothimani, D., & Sarmah, S. P. (2014). Supply chain performance measurement for third party logistics. Benchmarking: An International Journal, 21(6), 944-963.
- Juga, J., Juntunen, J. and Grant, D.B. (2010), "Service quality and its relation to satisfaction and loyalty in logistics outsourcing relationships" Managing Service Quality, 2, 6, 496-510.
- Juntunen, J., Juntunen, M. and Juga, J. (2015), "Latent classes of service quality, logistics cost and loyalty", International Journal of Logistics: Research and Applications, 18, 5, 442-458.
- Kayakutlu, G. and Buyukozkan, G. (2011), "Assessing performance factors for a 3PL in a value chain", International Journal of Production Economics, 131, 441-452.
- Ketikidis, P. H., Koh, S. C. L., Dimitriadis, N., Gunasekaran, A., & Kehajova, M. (2008). The use of information systems for logistics and supply chain management in South East Europe: Current status and future direction. Omega, 36(4), 592-599.
- Kim, N., Janic, M., & Van Wee, B. (2009). Trade-off between carbon dioxide emissions and logistics costs based on multiobjective optimization. Transportation Research Record: Journal of the Transportation Research Board, (2139), 107-116.

- Kumar, R., & Kumar, H. (2014), " Availability and handling of data received through GPS device: In tracking a vehicle"Advance Computing Conference (IACC), 2014 IEEE International, 245-249.
- Kumar, P. and Singh, R. K. (2012), "A fuzzy AHP and TOPSIS methodology to evaluate 3PL in a supply chain", Journal of Modeling in Management, 7, 3,287-303.
- Lee, S. M., and Eom, H. B. (1990), "Multiple-criteria decision support systems: the powerful tool for attacking complex, unstructured decisions", Systemic Practice and Action Research, 3, 1, 51-65.
- Lieb, K. J., & Lieb, R. C. (2010), "Environmental sustainability in the third-party logistics (3PL) industry", International Journal of Physical Distribution & Logistics Management, 40, 7, 524-533.
- Mani, V., Agrawal, R. and Sharma, V. (2016), "Impediments to Social Sustainability Adoption in the Supply Chain: An ISM and MICMAC Analysis in Indian Manufacturing Industries", Global Journal of Flexible Systems Management, 17, 2, 135–156.
- Marasco, A. (2008), "Third-party logistics: A literature review", International Journal of Production Economics, 113, 127–147.
- Mentzer, J.T., Flint, D. J. and Hult, G. T. (2001), "Logistics service quality as a segment-customized process", Journal of Marketing, 65, 82-104.
- Millen, R., Sohal, A. and Moss, S. (1999), "Quality management in the logistics function: an empirical study", International Journal of Quality & Reliability Management, 16, 2, 166-180.
- Naim, M., Aryee, G. and Potter, A. (2010), "Determining a logistics provider's flexibility capability", International Journal of Production Economies, 127, 39-45.
- Parasuraman, A., Zeithaml, V.A. and Berry, L. L. (1985), "A conceptual model of service quality and its implications for future research", Journal of Marketing, 49, 3, 41-50.
- Parasuraman, A., Zeithaml, V.A. and Berry, L. L. (1988), "SERVQUAL: A Multiple-Item Scale for measuring consumer perceptions of service quality", Journal of Retailing, 64 1, 12-37.
- Philip, G. and Hazlett, S. A. (2001), "Evaluating the service quality of information services using a new P-C-P attributes model", International Journal of Quality and Reliability Management,18, 9, 900-916.
- Ravi, V. (2014), "Reverse Logistics Operations in Automobile Industry: A Case Study Using SAP-LAP", Global Journal of Flexible Systems Management,15, 4, 295–303.
- Sahay, B.S. and Mohan, R. (2006), "3PL practices: an Indian perspective", International Journal of Physical Distribution & Logistics Management, 36, 9, 666-689.
- Sakun, Boon-itt (2011),"Achieving Product Quality Performance: The Roles of Supply Chain Integration and Information Technology", International Journal of Innovation Management and Technology, Vol.2, No.5, October 2011.
- Shamsuzzoha, A., & Helo, P. T. (2011), "Real-time tracking and tracing system: Potentials for the logistics network", Proceedings of the 2011 international conference on industrial engineering and operations management, 22-24.
- Soinio,Juho,Tanskanen, Kari and Finne, Max(2012), "How logistics-service providers can develop value-added services for SMEs: a dyadic perspective", The International Journal of Logistics Management , 23, 1, 31-49.
- Stank, T.P., Goldsby, T. J., Vickery, S. K. and Savitskie, K.(2003), "Logistics service performance estimating its influence on market share", Journal of Business Logistics, 24, 1, 27-35.
- Swenseth, S. R., & Godfrey, M. R. (2002). Incorporating transportation costs into inventory replenishment decisions. International Journal of Production Economics, 77(2), 113-130.
- Tan, A. W. K., Yifei, Z, Zhang, D. and Hilmola, O. P (2014)," State of third party logistics providers in China", Industrial Management & Data Systems, 114, 9,1322-1343.
- Tezuka, K. (2011), "Rationale for utilizing 3PL in supply chain management: A shippers' economic perspective", IATSS Research, 35, 1, 24–29.
- Tweddle, D. (2008), "Logistics, security and compliance: The part to be played by authorized economic operators (AEOs) and data management", World Customs Journal, 2, 1, 101-105.

- Tyagi, M., Kimar, P. and Kumar, D. (2015), "Assessment of Critical Enablers for Flexible Supply Chain Performance Measurement System Using Fuzzy DEMATEL Approach",Global Journal of Flexible Systems Management, 16, 2, 115–132.
- Ulku, M. Ali and Bookbinder, James H.(2012)," Optimal quoting of delivery time by a third party logistics provider: The impact of shipment consolidation and temporal pricing schemes",European Journal of Operational Research, 221 (2012) 110–117.
- Wang, Y. M. and, Elhag, T. M. S. (2006), "On the normalization of interval and fuzzy weights", Fuzzy Sets and Systems, 157, 2456–2471.
- Waller, M., Johnson, M. E., & Davis, T. (1999). Vendor-managed inventory in the retail supply chain. Journal of business logistics, 20(1), 183.
- Wong, C. Y. and Karia, N. (2010), "Explaining the competitive advantage of logistics service providers: A resource-based view approach," International Journal of Production Economics,128, 51–67 .
- Yeung, K., Zhou, H., Honggeng ,A., Yeung, C. L. and. Cheng, T. C. E. (2012), "The impact of third –party logistics providers' capabilities on exporters' performance", International Journal of Production Economies , 135, 741-753.
- Zapfel, G. and Wsaner, M. (2002), "Planning and optimization of hub-and-spoke transportation networks of cooperative third-party logistics providers", International Journal of Production Economics, 78, 207-220.