

A Combined Approach of Analytic Hierarchy Process and Decision-Making Trial and Evaluation Laboratory Methods for Evaluating Key Success Factors of Third-Party Logistics Service Providers

Theruwanda Perera, Annista Wijayanayake and Ruwan Wickramarachchi

Department of Industrial Management

University of Kelaniya, Sri Lanka

pereradg_im15025@stu.kln.ac.lk , anni@kln.ac.lk , ruwan@kln.ac.lk

Abstract

This study aims to evaluate key success factors associated with the third-party logistics (3PL) service providers in Sri Lanka. This study used the systematic literature review and expert's opinion to identify the key success factors of third-party logistics industry in Sri Lanka. In total, 20 key success factors were obtained, and those key success factors were grouped into four categories as organization strategy, management and process, human resources and customer orientation. The study used the Q-sort technique to group key success factors into four categories and Analytic Hierarchy Process (AHP) to identify the priorities of the key success factors. Decision Making Trial and Evaluation Laboratory (DEMATEL) method used to identify the interrelationships among the key success factors in each category. The result shows that business expansion, technology and automation, internationalization of operations, management and leadership style are the most important key success factors in the Sri Lankan third-party logistics industry. The outcomes of this study can help managers/practitioners to formulate flexible decision strategies for better performance in their third-party logistics firms and experience a competitive advantage against the competitors.

Keywords

Key success factors, 3PL, AHP and DEMATEL.

1. Introduction

According to the Council of Supply Chain Management professionals, Third-Party Logistics (3PL) means a firm provides multiple logistics services for use by customers. Many companies seeking integrated logistics services tend to be partnered with large 3PL firms to reduce costs (Kersten and Koch, 2010), improve product quality (Bardhan et al., 2006), improve flexibility (Lau and Zhang, 2006). Logistics management activities typically include planning, implementing and controlling the transportation, warehousing, inventory management and control, order processing, information systems and packaging (Makmor et al., 2019).

Sri Lankan 3PL service providers also provide many services for their clients. However, this sector is also facing challenges in Sri Lanka such as poor infrastructure, insufficient use of technology and innovation, system incompatibility, limited-service offerings, lack of skilled workforce, lack of information sharing, high cost of operations and lack of trust. Compared to other countries, Sri Lanka has still not achieved the standard level of 3PL industry. Therefore, identifying the key success factors in 3PL industry is very important and it is necessary to prioritize those key success factors to increase the quality of the logistics enterprises' performances.

Many researchers have done their studies related to key success factors of 3PL industry in their countries. But there has been no comprehensive study that has focused on key success factors of 3PL industry in Sri Lanka. This will be the first study in Sri Lanka that focuses on key success factors in 3PL industry. Most of the studies have identified dependency relationships among key success factors and performance measures in 3PL industry but very limited researches have been done to identify the priorities of the key success factors in 3PL industry.

As Sri Lanka is lying on a key East-West trade route and set close to India, it is worthy for practitioners and investors to know about key success factors of third-party logistics provider companies in Sri Lanka. 3PL service providers can gain a competitive advantage by focusing on the key success factors and those key success factors can support enhancing service provider's capabilities to achieve their future goals in 3PL industry. This study results will be useful for academics to have a better understanding of the importance of key success factors and their execution in Sri Lanka. Moreover, this study results can be useful for some other countries in South Asia. That will create a more academic value for this study.

The objective of this study is to evaluate the key success factors in the Sri Lankan 3PL industry. There can be different views in different 3PL service providers when considering the key success factors. Therefore, need to identify the common key success factors accepted by the 3PL service providers.

1.1 Objectives

The objectives of this study are to prioritize the key success factors and identify the interrelationship among the key success factors of 3PL industry in Sri Lanka. The present research work uses a combined approach based on the Analytic Hierarchy Process (AHP) and the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method. The AHP method (Saaty, 1980) establishes the ranks of the key success factors according to the importance. On the other hand, the use of the DEMATEL method (Gabus and Fontela, 1972) helps in generating the interdependence between the key success factors by grouping them into cause-and-effect groups. The combined AHP and DEMATEL based approach can help managers to frame strategies to improve 3PL firms' performance.

2. Literature Review

2.1 Third-Party Logistics Industry in Sri Lanka

There has been substantial number of studies conducted of the 3PL industries in European and Asian countries but there are a limited number of studies under the Sri Lankan 3PL industry. Currently 3PL services are in their nascent stage in Sri Lanka. So, there should be more studies in the Sri Lankan 3PL industry to identify the key success factors and it will help 3PL service providers to increase their overall performance. The global logistics market reached a value of US\$ 4,730 billion in 2018 and projected to reach a value of US\$ 6,300 billion by 2024. According to the Sri Lankan government, logistics services contribute 2.5% of gross domestic product, which represents around US\$ 2 billion. The industry provides full-time direct employment to over 40,000 – 50,000 people. The size of the companies varies between 5 and 1000 employees. World Bank's Logistics Performance Indicator ranking (LPI) for 2018, Sri Lanka is ranked 94th out of 160. With a score of 2.60 out of 5, Sri Lanka is classified as a partial performer (Table 1). An in-depth analysis of LPI characteristics provides insights into opportunities as well as gaps in the current logistics industry.

Table 1. Sri Lanka's LPI ranking and score

Parameter	Ranking (out of 160)	Score (out of 5.0)
Customs	79	2.58
Infrastructure	85	2.49
International shipments	112	2.51
Logistics competence	109	2.42
Tracking and tracing	78	2.79
Timeliness	122	2.79

Companies in pharmaceutical, manufacturing, textile, retail and FMCG sectors are heavily outsourcing their logistics requirements to 3PL service providers. Based on the scope of activities and capabilities, there are few major players in third-party logistics market in Sri Lanka such as Advantis 3PL Plus, DHL, John Keels Logistics and EFL. Though those companies put more effort to provide better 3PL service, currently 3PL market in Sri Lanka is facing many challenges. (Malkanthis and Jayamanna, 2016) stated that "While today world logistic industry is practicing 4PL, 5PL, and collaboration up to 7PL, within a short period, Sri Lanka is still grappling with 3PL, JIT (Just in Time), and

VMI (Vendor Managed Inventory).” Therefore, to meet the world competition there is a necessary requirement to identify the challenges that are hindering the growth of 3PL market in Sri Lanka to facilitate the growth of the industry.

2.2 Key Success Factors

Several studies have investigated the importance of key success factors on business performance in the 3PL industry. Key success factors are concerned with not only the success of a business entity but also its potential to deal with difficult business conditions (Pollard and Cater-Steel, 2009). Key success factors may be considered as a systematic set of activities that helps a firm to accomplish its organizational goal. A deeper relationship with customers is very important for the 3PL firms to build a broader range of service offerings, gain knowledge and obtain access to new markets (Cho et al., 2008). (Asthana and Dwivedi, 2020) stated that better understanding and proper communication between parties provide more accurate 3PL services and augment a strong relationship between relationship management and organizational effectiveness of the 3PL service provider with the 3PL service user.

Information Technology (IT) plays a vital role in managing modern-day complex supply chains. (Qureshi et al., 2008) suggested using information systems as one of the logistics enterprise's success factors. (Langley et al., 2009) have shown that “information technology is viewed as central to the overall performance and effectiveness of 3PL-customer relationship”. IT helps to reduce costs and errors through enhanced visibility, improved coordination, and data-driven automation. The reduction in lead time and waste translates into cost savings are some other advantages of using IT in the logistics industry. (Posey and Bari, 2009) suggested that the degree to which supply chain members' information systems are compatible with each other plays a significant role in information-processing capabilities. As an integrated service provider to many supply chain members, the IT capability of the 3PL firm can determine the overall competitiveness and success or failure of a supply chain.

IT is being extensively utilized in the industry of both China and the United States, but the US firms are investing more in IT as having a stronger IT focus. US firms are more aware of the significance of external IT alignment with their customers as well as internal IT advancement. The use of visibility tools (VT), Web-based communication technologies such as Web-based EDI (WEDI), transport management system (TMS), and warehouse management system (WMS) is relatively common in the US 3PL firms. Another interesting observation is that in comparison with 3PL firms in US and 3PL firms in China, US firms are more willing to invest in RFID which is still a more expensive technology than barcode (Lau, 2010). This study has found competitive advantages brought by IT utilization and they were grouped into three main categories in terms of cost, service variety, and service quality.

[Kersten and Koch, 2010] have found a positive influence of quality management on business success. The 3PL providers that emphasize service quality are more likely to be successful than competitors with an exclusive concern for costs. The results of this study have shown that service potential, process and outcome are three dimensions of logistics service quality. [Shaiq et. al., 2020] carried out research in Pakistan to determine how quality management practices 3PL service providers achieving integration competency in the service chain. Leadership, strategic planning, customer focus, knowledge management, human resource focus and process management used as the quality management dimensions. The results of this study identified the strategic planning, HR management focus and process management as the factors highly impacting the integration competency of 3PL service providers in Pakistan.

(Bianchini, 2018) stated that the cost of service, service level, level of professionalism, geographical location, specific references in the same sector, innovation capacity and collaboration with the customer are some key factors of the selection in 3PL service providers. (Asian et. al., 2019) have found that 3PL customers expect more focus on factors such as experience in the same industry, annual performance, customer service, creative management, availability of top management, service quality, flexibility, market knowledge from 3PL service providers. (Dieu Ho et. al., 2019) suggested several factors to improve warehouse operations. Improving the training process for both the old and new staff to better utilize warehouse facilities, and by having a fundamental knowledge of warehouse processes and steps is one factor.

(Vyas and Shah, 2016) have shown that breadth of services is positively related to revenue growth. But other factors such as industry focus, relationship with 3PL, investment in information systems, skilled logistics professionals and supply chain integration are not positively related to revenue growth of 3PL service providers. (Makmor et. al., 2019) mentioned that factors such as high level of management commitment towards any continuous improvement initiatives carried out, fostering the idea of skills improvement and acquisition of new knowledge among the staff and strong

financial resources are considered a must for Malaysian 3PL firms. These are the significant factors that need to have positive logistics performance in Malaysian 3PL firms.

One of the widely applied multi criteria decision making approach is Analytic Hierarchy Process (AHP). AHP is a rational framework for structuring a decision problem. It has been used in a wide range of decision-making situations to evaluate alternative courses of action and identify the one that is most desirable in view of the decision maker's preferences. [Gupta et. al., 2011] used the AHP method to prioritize the key growth strategies. [Hwang et. al., 2016] have used the AHP method to explore the relative importance of the 3PL selection criteria. [Bianchini, 2018] applied the two-phase AHP and TOPSIS method for the selection of 3PL service providers.

Decision making trial and evaluation laboratory (DEMATEL) is considered as an effective method for the identification of cause-effect chain components of a complex system. It deals with evaluating interdependent relationships among factors and finding the critical ones through a visual structural model. [Govindan and Chaudhuri, 2016] analyzed the interrelationships between risks faced by 3PL service providers in relation to one of its customers using DEMATEL method. [Alinejad et. al., 2018] used the AHP and DEMATEL methods to prioritize the key success factors of the 3PL industry in Iran. [Kaur et. al., 2015] also used AHP and DEMATEL methods with some other multi criteria decision making techniques for supplier selection. Most of the past literature used either AHP or DEMATEL method to make multicriteria decisions.

3. Methods

3.1 Proposed Research Framework

Key success factors were identified with the literature review and expert's opinion. After identifying the key success factors Q-sort technique used to categorize the key success factors into groups. AHP has been used to create a model and prioritize the key success factors. One of the widely applied multi-criteria decision-making approaches is the Analytic Hierarchy Process (AHP). AHP is a rational framework for structuring a decision problem. At the same time, the DEMATEL method assists decision-makers to understand the interactions between factors by means of a causal relationship diagram (Figure 1).

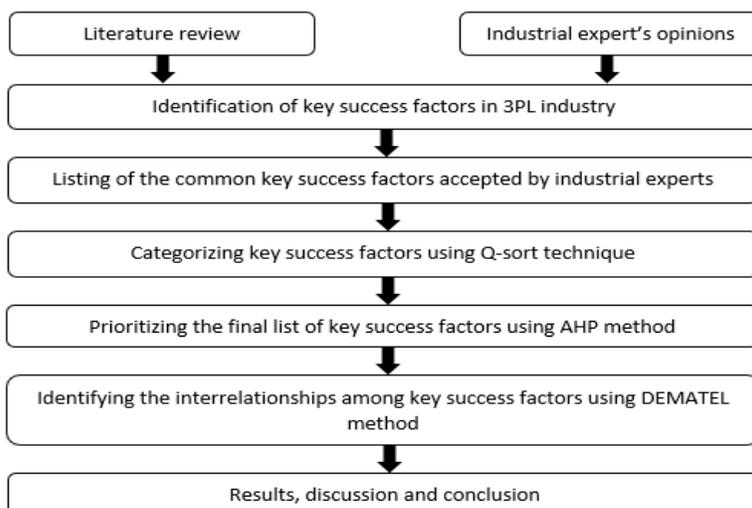


Figure 1. Proposed framework

One objective of this study is to identify the key success factors in 3PL industry. First, literature review has been conducted to identify the studies that have been done related to key success factors in 3PL industry. Then, interviews were conducted with the experts in Sri Lankan 3PL industry to identify more key success factors. Finally, 20 important key success factors were determined through the inputs of the experts in 3PL industry. Those 20 key success factors were categorized into four groups using Q-sort technique (Table 2).

Table 2. Key success factors

Data Sources Key Success Factors	(Alinejad et al., 2018)	(Mothilal et al., 2012)	(Gupta et al., 2011)	(Rajesh et al., 2011)	(Vyas and Shah, 2016)	Expert' s Opinion
Business expansion	×		×	×		×
Internationalization of operations	×		×			×
Technology and automation	×		×	×		×
Management and leadership style	×			×		×
Breadth of service offerings	×	×	×	×	×	×
Experience as a 3PL service provider	×		×	×		×
Trust worthiness of employees	×		×	×		×
Skilled and professional workforce	×	×	×	×	×	×
Retention of skilled workforce						×
Long term relationship with customers	×	×		×	×	×
Quick response for customer complaints	×					
Focus on specific industries	×	×	×		×	
Infrastructure availability for business opportunities						×
Information systems	×	×	×	×	×	×
Supply chain integration	×	×	×	×	×	
Continuous improvements						×
Tracking KPIs						×
Compliance with safety and security regulations						×
Quick response for customer inquiries	×					
Ability to penetrate business opportunities						×

3.2 AHP

AHP originally developed by Thomas Saaty and it is a very effective technique to handle the complexity in decision making. AHP models the decision-making problem as a hierarchy in a top-down approach. AHP has been applied to various research areas, including choice decision, prioritization and evaluation, resource allocation, benchmarking, quality management, public policy, healthcare and strategic planning (Hwang et al., 2016).

Compare to other decision-making techniques, AHP has two unique features. First, AHP provides a comprehensive structure to combine the intuitive rational and irrational values during the decision-making process. Second, AHP enables the decision maker to judge the consistency in the decision-making process (Wu and Tsai, 2012). AHP and ANP are the most popular methods used to solve decision problems. As compared to ANP, simplicity is the benefit of the AHP method because AHP requires less pairwise comparisons.

The basic steps of AHP are summarized below (Gandhi et al., 2016).

- 1) Structuring the problem hierarchically including the goal, criteria, sub criteria and a set of alternatives but it is not necessary to have all four levels for every AHP models. It depends on the requirements of the researcher who do the study. With a hierarchical structure, a complicated and complex problem is converted to a hierarchical system of elements.
- 2) Constructing a set of pairwise comparison matrices. This step includes collection of data to form the pairwise assessments among factors. These comparison matrices demonstrate the judgment of decision-maker about the priority of elements. For deriving judgment of the decision-maker and establishing the comparison matrices, the scale that was suggested by Saaty for AHP can be used (Table 3). Geometric mean is used to consolidate different experts' judgements to a single value in pairwise comparison matrix.

Table 3. Significance of scores in AHP

Verbal judgement	Numerical rating
Extremely preferred	9
Very strongly to extremely preferred	8
Very strongly preferred	7
Strongly to very strongly preferred	6
Strongly preferred	5
Moderately to strongly preferred	4
Moderately preferred	3
Equally to moderately preferred	2
Equally preferred	1

- 3) Normalizing the decision matrix. For that, all the values in the column are divided by sum of the respective column. Then weights are calculated by averaging the values in each row. Based on the attained importance weights, the priority for the respective criterion is obtained.
- 4) Calculating the consistency ratio (CR) to ensure the consistency of pairwise assessments. The formulation of CR is:

$$CR = CI / RI$$

The consistency index (CI) = $(\lambda_{\max} - n) / (n - 1)$, λ_{\max} gives the maximum average value and value of the random index (RI) can be selected from depending on the value of n (Table 4).

Table 4. Random consistency index

Order of matrix (n)	1	2	3	4	5	6	7	8	9	10
Random index (RI)	0.00	0.00	0.52	0.89	1.11	1.25	1.32	1.41	1.45	1.49

3.3 DEMATEL

DEMATEL method was developed by the Geneva Research Centre of the Battelle Memorial Institute to visualize the structure of complicated causal relationships through matrixes or digraphs. DEMATEL is a well-known method that is used to analyze the interactions between factors by categorizing them into cause and effect groups. The procedure of DEMATEL method can be summarized by the following steps (Si et al., 2019).

- 1) Calculating the direct relation matrix. To obtain the direct influence between any two factors, use the inputs of the decision makers. Decision makers are asked to indicate the direct influence that one factor has on another factor, using an integer scale of “no influence (0),” “low influence (1),” “medium influence (2),” “high influence (3),” and “very high influence (4)”. The notation of x_{ij} represents the degree to which the respondent believes factor i affects factor j . For $i = j$, all principal diagonal elements are equal to zero. For each respondent, an $n \times n$ non-negative matrix can be established as $X^k = [x_{ij}^k]$, where k is the number of respondents with $1 \leq k \leq H$, and n is the number of factors. Thus, $X^1, X^2, X^3, \dots, X^H$ are the matrices from H respondents. To summarize all opinions from H respondents, the average matrix $A = [a_{ij}]$ is constructed as follows:

$$a_{ij} = \frac{1}{H} \sum_{k=1}^H x_{ij}^k$$

- 2) Calculating the normalized direct-relation matrix, where normalization of direct-relation matrix D is performed by $D = A \times S$ with the assistance of following equation in which all elements should lie between 1 and 0.

$$S = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}}$$

- 3) Calculating total relation matrix T , where T is defined as $T = D(I - D)^{-1}$ where I is the identity matrix. Let $[r_i]_{n \times 1}$ and $[c_j]_{1 \times n}$ be the vectors representing the sum of rows and sum of columns of the total relation

matrix. When $j = i$, the sum $(r_i + c_j)$ illustrates the total effects given and received by factor i . $(r_i + c_j)$ represents the degree of importance for factor i in the entire system. On the other hand, the difference $(r_i - c_j)$ indicates the net effect that factor i contributes to the system. If the value $(r_i - c_j)$ is positive, then, factor i is a net cause, while factor i is a net receiver if the value $(r_i - c_j)$ is negative (Wu and Tsai, 2012).

- 4) Computing the threshold value to obtain the causal digraph. The overall value in matrix T reflects how one factor influences other factors, it is necessary for a decision maker to set up a threshold value to filter out some negligible effects. Only the effects greater than the threshold value are chosen and depicted in causal digraph. The causal digraph can be acquired by mapping the dataset of $(r + c, r - c)$. Generally, threshold value calculates by taking the average of the values of each element in matrix T.

4. Data Collection

Previous studies of the same interest, research articles, journals and books were used to identify the key success factors in 3PL industry. The identified key success factors were further filtered through expert opinions based on an industry based past records. Through the experts many key success factors were identified which were not in the literature review (Figure 2). The target population for this study is all the 3PL companies in Sri Lanka. Considering the time and cost constraints, convenience sampling, which is a non-probability sampling method, is the sampling technique that was used in this study.

Interviews and the questionnaires were used as the data gathering instrument for collecting primary data. In the process of data collection mainly executives, middle and senior level managers of four 3PL firms who got more than five years of experience in 3PL industry were interviewed and their opinions were compared with literature review. Totally, 36 experts in 3PL industry were participated for data collection process. Those selected experts were highly skilled professionals in their domain having good experience. The initial discussions with experts in 3PL industry have been really helpful in determining main criteria and sub criteria in the AHP model. The questionnaires were systematically prepared to evaluate the key success factors.

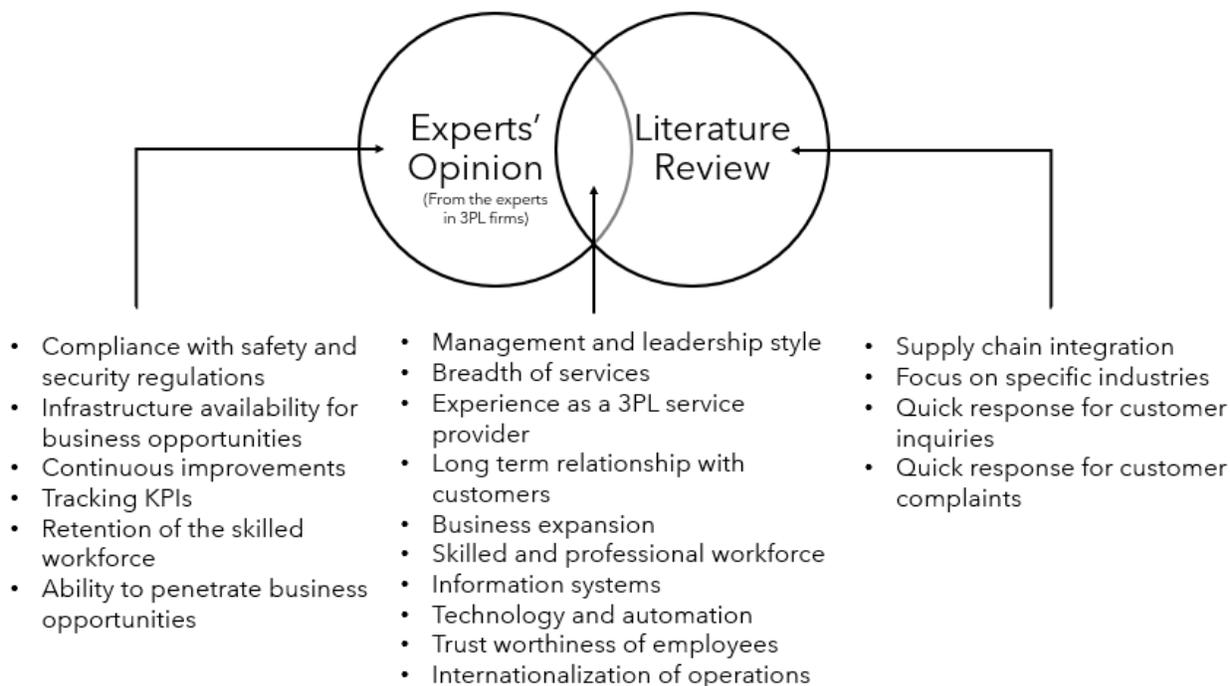


Figure 2. Identification of the key success factors

5. Results and Discussion

5.1 Numerical Results

AHP application: determining the priorities of the key success factors

Experts in 3PL industry were interviewed and collected the data through questionnaires. The main source of collecting the data needed for this study was the experts in 3PL industry. Convenience sampling, which is a non-probability sampling method, is the sampling technique that was used in this study. In the process of data collection mainly executives, middle and senior-level managers of four 3PL firms were interviewed and their opinions were compared with the literature review. Totally, 36 experts in 3PL industry have participated in the data collection process. Those selected experts were highly skilled professionals in their domain having a good experience.

The four main categories of the key success factors considered here are organization strategy, management and process, human resources and customer orientation (Alinejad et al., 2018). Those four categories worked as the main criteria of the AHP model in this study (Figure 3). AHP model proposed with the goal of prioritizing the key success factors. Experts were asked to scale the factors on a nine-point Likert Scale and those inputs were used to do the pairwise comparison in AHP.

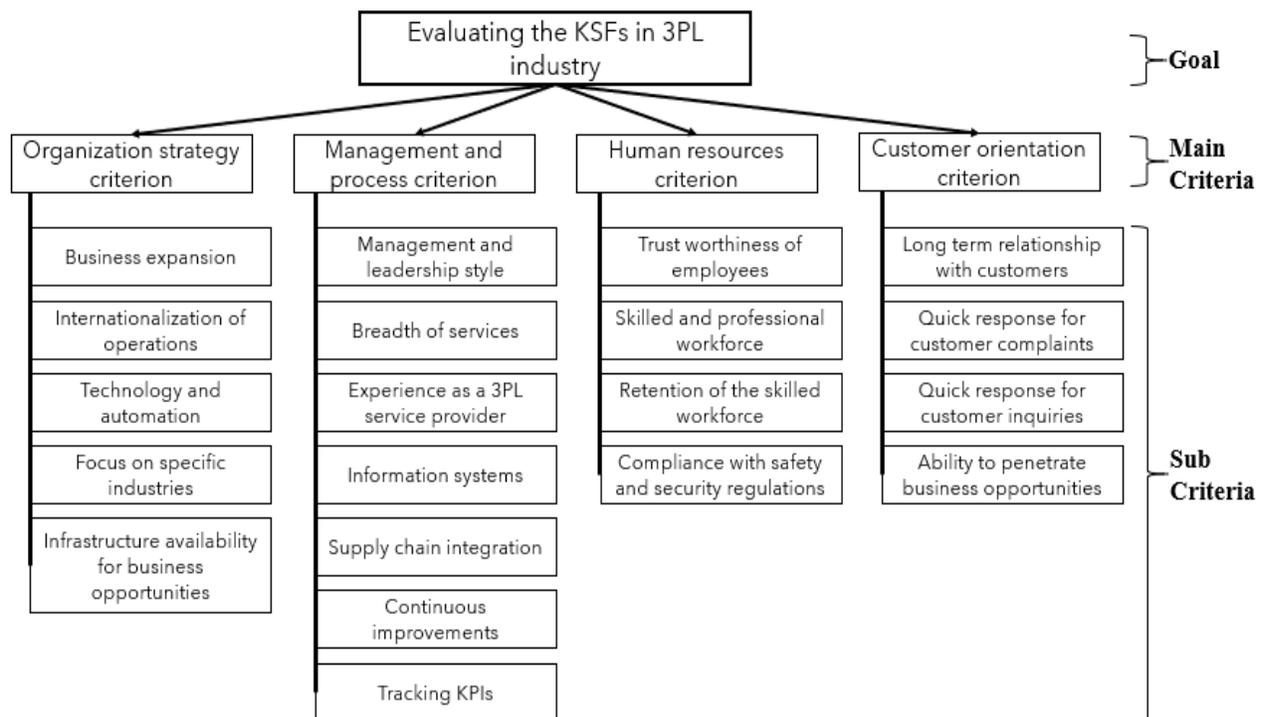


Figure 3. AHP model

The incompatibility rate of all pairwise comparison matrices is less than 0.1 and depicts the compatibility of matrices. Based on the pairwise comparison weights of the main criteria were determined. Then again local weights of sub-criteria under each main criterion were determined. The global priority of each key success factor is calculated by multiplying its local weight with its corresponding weight along the hierarchy (Table 5).

Table 5. Final weights of key success factors

Main Factors	Local Weights	Sub Factors	Local Weights	Global Weights
Organization Strategy	0.288	Business expansion	0.238	0.069
		Internationalization of operations	0.219	0.063
		Technology and automation	0.221	0.064
		Focus on specific industries	0.143	0.041
		Infrastructure availability for business opportunities	0.179	0.052
Management and process	0.36	Management and leadership style	0.175	0.063
		Breadth of service offerings	0.103	0.037
		Experience as a 3PL service provider	0.098	0.035
		Information systems	0.163	0.059
		Supply chain integration	0.134	0.048
		Continuous improvements	0.167	0.060
		Tracking KPIs	0.161	0.058
Human resources	0.144	Trust worthiness of employees	0.271	0.039
		Skilled and professional workforce	0.225	0.032
		Retention of skilled workforce	0.218	0.031
		Compliance with safety and security regulations	0.287	0.041
Customer orientation	0.208	Long term relationship with customers	0.281	0.058
		Quick response for customer complaints	0.244	0.051
		Quick response for customer inquiries	0.229	0.048
		Ability to penetrate business opportunities	0.246	0.051

According to the results, most important four key success factors identified in Sri Lankan 3PL industry are business expansion, technology and automation, internationalization of operations, management and leadership style (Table 5). In past literature internationalization of operations is also identified as most important key success factor of 3PL industry [Alinejad et. al., 2018]. But compare to previous studies Sri Lankan 3PL industry is currently paying more attention into technology and automation which will definitely enable the 3PL companies to take the competitive advantage. However, it is evident that more attention should be paid to business expansion, internationalization of operations, management and leadership style. That will pave the 3PL service providers with a roadmap to improve their performance.

DEMATEL application: determining the interrelationships among the key success factors

Table 6. Direct-indirect influence matrix (Main Factors)

Main Factors	r+c	r-c
Organization Strategy	29.0657	1.2463
Management and Process	28.2621	1.4809
Human Resources	29.0439	-0.1059
Customer Orientation	28.9987	-2.6213

(Table 6) provides the direct and indirect effects of the four main key success factors. Generally, the type of relationships among these four main factors can be taken by the (r-c) values. Organization strategy and management and process are in the cause group. Human resources and customer orientation are the factors in the effect group. By observing (Figure 4), organization strategy can be the most important main factor that need to consider. Compare to the other factors, organization strategy shows more relationships with other three factors. The threshold value that considered to draw the digraph of the main criteria was 3.6053.

5.2 Graphical Results

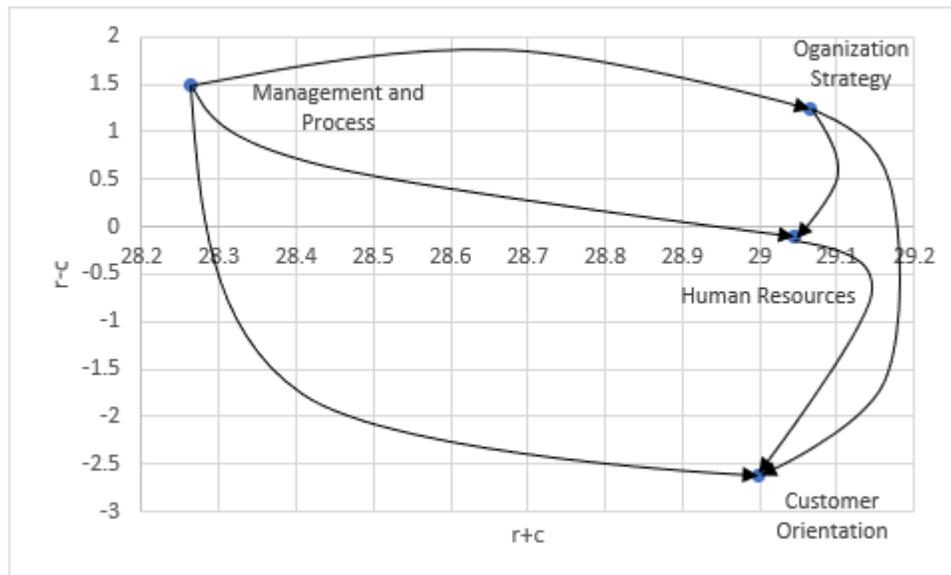


Figure 4. The digraph of the main criteria

6. Conclusion

This study set out to investigate the importance and the interrelationships of the key success factors of 3PL industry in Sri Lanka. The study was able to investigate 20 key success factors using AHP and DEMATEL method. AHP does not consider the indirect effects for each criterion and assumes that criteria are independent. Therefore, the importance of key success factors calculated by AHP can be viewed as short-term improvement opportunity. In the other hand results of the DEMATEL application can use to make long-term improvement opportunities. These results would help managers in 3PL industry to develop strategies for effective supply chain management.

The result shows that business expansion, technology and automation, internationalization of operations, management and leadership style are the most important key success factors in the Sri Lankan 3PL industry. These factors explain that most of the Sri Lankan 3PL service providers are currently in the growth stage of the 3PL industry and these key success factors will lead them to reach the maturity level. Therefore, managers need to focus more on these factors to increase the performance of the 3PL companies. Also, it is important to focus on key success factors which are in the organization strategy because organization strategy shows more relationships with other main criteria. That will be useful for the management to develop long term strategies for the companies.

The model proposed in this work has its own limitations. For example, this AHP model is highly dependent on the judgements of the experts. Great care was taken in finalizing the key success factors but still there could be some errors due to human biasness or judgment. Though a generalized model is developed here in this research, a particular company in 3PL industry could select the criteria and sub criteria according to their requirements and interest and develop a model that is applicable to their interest. The results of the AHP and DEMATEL could be changed according the new key success factors come in to the 3PL industry. In this study only considered the key success factors from the 3PL service providers perspective but in future studies it is better to consider both 3PL service providers and their client's opinion.

References

Alinejad, E. A., Pishvae, M. S. and Naeini, A. B., Key success factors for logistics provider enterprises: an empirical investigation in Iran, *Kybernetes*, vol. 47, no. 3, pp. 426-440, 2018.

- Asian, S., Pool, J. K., Nazarpour, A. and Tabaeian, R. A., On the importance of service performance and customer satisfaction in third-party logistics selection, *Benchmarking: An International Journal*, vol. 26, no. 5, pp. 1550-1564, 2019.
- Asthana, S. and Dwivedi, A., Performance measurement of India-based third-party logistics sector: an empirical study of user versus provider perspectives, *Production Planning & Control*, vol. 31, no. 2, pp. 259-272, 2020.
- Bardhan, I., Whitaker, J. and Mithas, S., Information technology, production process outsourcing, and manufacturing plant performance, *Journal of Management Information Systems*, vol. 23, no. 2, pp. 13-40, 2006.
- Bianchini, A., 3PL provider selection by AHP and TOPSIS methodology, *Benchmarking: An International Journal*, vol. 25, no. 1, pp. 235-252, 2018.
- Cho, J.J.K., Ozment, J. and Sink, H., Logistics capability, logistics outsourcing and firm performance in an e-commerce market, *International Journal of Physical Distribution & Logistics Management*, vol. 38, no. 5, pp. 336-359, 2008.
- Dieu Ho, T. H., Daniel, J., Nadeem, S. M., Garza-Reyes, J. A. and Kumar, V., Improving the Reliability of Warehouse Operations in the 3PL Industry: An Australian 3PL Case Study, *Proceedings of the 2018 International Conference of the Production and Operations Management Society (POMS)*, Kandy, Sri Lanka, pp. 1-8, December 2018.
- Gandhi, S., Mangla, S. K., Kumar, P. and Kumar, D., A combined approach using AHP and DEMATEL for evaluating success factors in implementation of green supply chain management in Indian manufacturing industries, *International Journal of Logistics Research and Applications*, vol. 19, no. 6, pp. 537-561, 2016.
- Govindan, K. and Chaudhuri, A., Interrelationships of risks faced by third party logistics service providers: A DEMATEL based approach, *Transportation research part E: logistics and transportation review*, vol. 90, pp. 177-195, 2016.
- Gupta, O. K., Ali, S. S. and Dubey, R., Third Party Logistics: Key Success factors and growth Strategies, *International Journal of Strategic Decision Sciences*, vol. 2, no. 4, pp. 29-60, 2011.
- Hwang, B. N., Chen, T. T. and Lin, J. T., 3PL selection criteria in integrated circuit manufacturing industry in Taiwan, *Supply Chain Management: An International Journal*, vol.21, no. 1, pp. 103-124, 2016
- Kaur, H., Singh, S. P. and Glardon, R., An Integer Linear Program for Integrated Supplier Selection: A Sustainable Flexible Framework, *Global Journal of Flexible Systems Management*, vol. 17, no. 2, pp. 113-134, 2015.
- Kersten, W. and Koch, J., The effect of quality management on the service quality and business success of logistics service providers, *International Journal of Quality & Reliability Management*, vol. 27, no. 2, pp. 185-200, 2010.
- Langley Jr., C.J., Albright, D., Morton, J., Wereldsma, D., Alf, M., Swaminathan, S., Smith, G., Murphy, J., Deakins, T.A., Hoemmken, S. and Peters, K., The State of Logistics Outsourcing, *Third-Party Logistics: Results and Findings of the 14th Annual Study*, Atlanta, 2009.
- Laosirihongtong, T., Adebajo, D., Samaranyake, P., Subramanian, N. and Boon-itt, S., Prioritizing warehouse performance measures in contemporary supply chains, *International Journal of Productivity and Performance Management*, vol. 67, no. 9, pp. 1703-1726, 2018.
- Lau, K.H. and Zhang, J., Drivers and obstacles of outsourcing practices in China, *International Journal of Physical Distribution & Logistics Management*, vol. 36, no. 10, pp. 776-792, 2006.
- Lau, K. H., IT Alignment in the 3PL Industry: A Comparative Study, *Software Services for e-World - 10th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society*, I3E 2010, Buenos Aires, Argentina, pp. 260-271, November 2010.
- Makmor, M. F. bin M., Saludin, M. N. bin, and Saad, M. binti., Best Practices Among 3rd Party Logistics (3PL) Firms in Malaysia towards Logistics Performance, *International Journal of Academic Research Business and Social Sciences*, vol. 9, no. 5, pp. 394-405, 2019
- Malkanthe, M. A. A. and Jayamanna, J. M. D. J. N., EXPLORATION OF FACTORS HINDERING THE GROWTH OF 3PL MARKET IN SRI LANKA, *Academy for Global Business Advancement (AGBA)*, 13th World Congress, Indonesia, 2016
- Mothilal, S., Gunasekaran, A., Nachiappan, S. P. and Jayaram, J., Key success factors and their performance implications in the Indian third-party logistics (3PL) industry, *International Journal of Production Research*, vol. 50, no. 9, pp. 2407-2422, 2012
- Pollard, C. and Cater-Steel, A., Justifications, strategies, and critical success factors in successful ITIL implementations in US and Australian companies: an exploratory study, *Information Systems Management*, vol. 26, no. 2, pp. 164-175, 2009.

- Posey, C., Bari, A., Information sharing and supply chain performance: understanding complexity, compatibility, and processing, *International Journal of Information Systems & Supply Chain Management*, vol. 2, no. 3, pp. 67-76, 2009.
- Qureshi, M. N., Kumar, D. and Kumar, P., An integrated model to identify and classify the key criteria and their role in the assessment of 3PL services providers, *Asia Pacific Journal of Marketing and Logistics*, vol. 20, no. 2, pp. 227-249. 2008.
- Rajesh, R., Pugazhendhi, S., Ganesh, K., Yves, D., Koh, S. C. L. and Muralidharan C., Perceptions of service providers and customers of key success factors of third-party logistics relationships – an empirical study, *International Journal of Logistics Research and Applications*, vol. 14, no. 4, pp. 221-250, 2011.
- Sangka, B. K., Rahman, S., Yadlapalli, A. and Jie, F., Managerial competencies of 3PL providers, *The International Journal of Logistics Management*, vol. 30, no. 4, pp. 1054-1077, 2019.
- Shaiq, M., Alwi, S. K. K., Shaikh, S. and Zaman, Z., Quality Management as Driver of Vertical Integration in Service Chain: A Study of 3rd Party Logistics Industry, *OPERATIONS AND SUPPLY CHAIN MANAGEMENT*, vol. 13, no. 3, pp. 244 - 255, 2020.
- Si, S. L., You, X. Y., Liu, H. C. and Zhang, P., DEMATEL Technique: A Systematic Review of the State-of-the-Art Literature on Methodologies and Applications, *Mathematical Problems in Engineering*, 2018.
- Vyas, R. and Shah, T., ADOPTION OF 3PL PRACTICES IN SAURASHTRA REGION: IMPACT AND INFLUENCE OF KEY SUCCESS FACTORS ON REVENUE GROWTH, *International Journal of Current Multidisciplinary Studies*, vol. 2, no. 5, pp. 273-278. 2016
- Wu, H. H. and Tsai, Y. N., An integrated approach of AHP and DEMATEL methods in evaluating the criteria of auto spare parts industry, *International Journal of Systems Science*, vol. 43, no. 11, pp. 2114-2124, 2012.

Biographies

Theruwanda Perera is an undergraduate at the Department of Industrial Management, University of Kelaniya, Sri Lanka reading for BSc in Management & Information Technology and currently working as a supply chain intern in Nestle, Sri Lanka. He is also a member of the British Computer Society (BCS) Sri Lanka. He has industrial experience as an intern for Advantis 3PL Plus PLC for over a period of 6 months, where he obtained the exposure to the warehouse management and lean tools.

Annista Wijayanayake received her Doctor of Engineering and Master of Engineering in Industrial Engineering and Management, specializing in Financial Engineering from Tokyo Institute of Technology Japan, respectively in 2001 and 1998. Currently she is serving as a Senior Lecturer at the Department of Industrial Management, University of Kelaniya- Sri Lanka. She had served as a honorary Research Fellow at Royal Melbourne Institute of Technology (RMIT) Australia in 2004 and as a lecturer, at the Faculty of Economics and Business and Faculty of Information Technology Monash University-Australia from 20017-2019. Also, she had served as an Academic Advisor for B.Sc. in Management and Information Technology degree program, University of Kelaniya from 2003-2008. She won many international awards for her research and teachings. She received the academic excellence award for her Master's degree by research by Tokyo Foundation- Japan for Inbound Students. She also received the 2019 teaching excellence award from the Department of Econometrics and Business Statistics - Monash University for her teachings. She had worked as the co-investigator of international research on unnatural deaths among women and girls in Sri Lanka, which is funded by United Nation Population fund. Her research has been featured in prestigious journals such as Mathematical Programming, International Journal of Theoretical and Applied Finance, Journal of Global Optimization and in many International Conference Proceedings

Ruwan Wickramarachchi is a Senior lecturer and the head of the Department of Industrial Management, University of Kelaniya. He holds BSc in Industrial Management from the University of Kelaniya and MPhil in Management studies (specialized in Information systems) from the University of Cambridge, United Kingdom. He received his PhD in distributed simulation from the Sheffield Hallam University, United Kingdom.