

Identifying interrelationships of key success factors of third-party logistics service providers

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Abstract - To be more cost-effective as well as to maintain a sustainable competitive advantage, many enterprises tend to improve their business practices by having a strong relationship with third-party (3PL) logistics service providers. The main objectives of this paper are to determine the key success factors associated with the Sri Lankan 3PL industry and identify the interrelationships of these key success factors. A systematic literature review and expert opinions were used to identify the key success factors of the 3PL industry in Sri Lanka. In total 21 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. Q-sort technique was used to group key success factors into four categories. Decision-making trial and evaluation laboratory (DEMATEL) method was used to capture the interactive relationships among the key success factors of 3PL service providers, and the casual effect map analyzed. Data were collected through questionnaires from middle and senior-level managers of 3PL firms. A total of eleven experts in the 3PL industry participated in the data collection process. The result shows that organization strategy is a core success factor since it has both high prominence and high interrelationship. Management and process were classified as driving factors since they had a low prominence but a high interrelationship. However, human resources and customer orientation had high prominence but low relationship, which are influenced by other factors and cannot be directly improved. The findings may assist managers to formulate long-term flexible decision strategies in their 3PL firms.

Keywords - 3PL, DEMATEL, interrelationship, key success factors

I. INTRODUCTION

Over the last few decades, the global logistics industry has grown significantly. Planning, implementing and controlling transportation, warehousing, inventory management and control, order processing, information systems, and packaging are all common logistics management activities [1]. Third-party logistics (3PL) service providers are the companies that provide these logistics services. Reference [2] states that from a customer perspective, 3PL firms are considered as resource managers, problem solvers, transportation strategists, distribution strategists as well as supply chain strategists. The third-party logistics industry provides very important support for enterprises in different industries, and it also promotes the economic growth of a country. Because of that, the development of the 3PL industry is an essential factor that needs to be considered from a country perspective. Sri Lanka however, is lagging, even though our geographical location provides it a competitive edge.

With the increasing demand and technological advancement, it is a mandatory requirement to satisfy customers by fulfilling their needs to survive in the market.

Identifying key success factors for the industry, from both a customer and supplier perspective becomes fundamental for industry success. When it comes to the third-party logistics industry, service providers must set themselves apart by providing value-added services, focusing on key customer accounts that can generate high profits, achieve economies of scale, and improve service providers' ability to support international operations. Key success factors can provide significant support to achieve those goals in the 3PL industry.

Awareness of the key success factors will enable the companies to improve delivery performance, improve customer satisfaction, increase customer acquisition, optimize the relationship between suppliers and customers, improve profit and revenue growth, reduce overall logistics cost and improve the quality of logistics services provided. Countries like Germany, Sweden, Belgium, Austria, Japan identified those key success factors and developed a competitive edge over their rivals. Identifying the success factors in a developing country setting like Sri Lanka, would assist in developing the logistics services in the country and enable it to fully exploit the countries geographical location to service international trade worldwide.

Most of the studies have identified the priorities of the key success factors in the 3PL industry but very limited research has been done to identify the interrelationship of the key success factors in the 3PL industry. As Sri Lanka is lying on a key East-West trade route and located next to India, it is worthy for practitioners and investors to know about key success factors of third-party logistics provider companies in Sri Lanka. When the efficiency and effectiveness of service providers improve, it will create a smooth supply chain. Therefore, the clients can explore more business opportunities. This will create a win-win situation for both 3PL service providers and their clients.

II. LITERATURE REVIEW

A. Sri Lankan 3PL industry

The 3PL industries in European and Asian countries have been studied widely, but there is a limited number of studies focused on the Sri Lankan 3PL industry. Currently, 3PL services are in their nascent stage in Sri Lanka [3]. In World Bank's Logistics Performance Indicator ranking (LPI) for 2018, Sri Lanka is ranked 94th out of 160 whereas Germany is ranked at 1. With a score of 2.60 out of 5, Sri Lanka is classified as a partial performer [4] (for details, refer to Table I).

In Sri Lanka, though 3PL service providers and their customers maintain a good relationship, the level of satisfaction, and trust towards service providers are not considered high. Cost, lack of control, lack of coordination

and lack of cooperation, lack of skills and knowledge, lack of industry knowledge, and trade union activities are the factors that affect the growth of the 3PL market in Sri Lanka [3]. This study also identifies future issues in the Sri Lankan 3PL sector, such as reducing delivery lead times, adopting new technology, managing the number of order channels multiplied by the number of delivery alternatives, and dealing with overstocks due to online sales, among others.

When examining the 3PL industry's global context, they gravitate toward innovative technical services. Sri Lanka should also concentrate on improving the quality of these new applications to attract more customers and raise the country's GDP. Otherwise, they will not be able to compete in the market since a competitor will gain a competitive advantage over them [5]. Reference [6] stated that before the 3PL industry in Sri Lanka gets disrupted with the labour shortage issues and the dynamic customer demands, firms have to focus on technology adoptions to survive within industries.

TABLE I. SRI LANKA'S LPI RANK AND SCORE

| Parameter | Germany (score out of 5) | Sri Lanka (score out of 5) |
|-------------------------|-----------------------------|-------------------------------|
| Customs | 4.09 | 2.58 |
| Infrastructure | 4.37 | 2.49 |
| International shipments | 3.86 | 2.51 |
| Logistics competence | 4.31 | 2.42 |
| Tracking and tracing | 4.24 | 2.79 |
| Timeliness | 4.39 | 2.79 |
| Overall LPI score | 4.2 | 2.6 |
| LPI rank | 1 | 94 |

Reference [7] investigated how information technology, supply chain security, and green supply chain practices affect the amount of interaction between users and providers of third-party logistics services. Reference [8] mentioned that several 3PL providers in Sri Lanka have taken steps to establish their own modest to large-scale Information Communication Technology (ICT) solutions for their business processes. The usefulness of a Warehouse Management System (WMS) in facilitating warehouse best practices is also highlighted in this study.

B. 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 [9]. Reference [10] claimed that a stronger association between relationship management and organizational success of the 3PL service provider and the 3PL service user is enhanced by greater understanding and proper communication between parties.

Cloud technology applications in the logistics industry have been explored in some research. Reference [11] provided a smart model that uses agent technology and cloud computing to make data collection and flow easier, as well as provide better and less expensive access to logistics management systems. The cloud platform is also mentioned in reference

[12] as a crucial foundation for logistics network optimization. The internet of things technology development patterns in warehouse operations were explored in reference [13] using four main criteria. Those were the rapid development of RFID technology in warehousing, the integrated application of sensing technology, the AGV (Automated Guided Vehicle) integration into the warehouse, and IoT will be in sync.

Improving and better understanding of efficiency and innovation-based strategies can gain a competitive advantage in the 3PL industry. Reference [14] has shown that improvement and process innovation are mostly pushed forward by industry-focused 3PL providers. This study clearly defines the importance of industry specialization and it can also facilitate the development of best practices to improve internal processes. Business process re-engineering companies outperformed non-business process re-engineering companies in the logistics industry, not only in information processing, technology applications, organizational structure, and coordination but also in all major logistics operations [15].

Reference [16] conducted in Pakistan to determine how quality management practices 3PL service providers achieving integration competency in the service chain. Quality management components include leadership, strategic planning, customer focus, knowledge management, human resource emphasis, and process management. Strategic planning, HR management focus, and process management were identified as characteristics that have a significant impact on the integration competency of 3PL service providers in Pakistan, according to the findings of this study. Surprisingly, the impact of leadership, customer focus, and knowledge management were not significant. Management and leadership, internationalization, and staff competence were regarded as the most essential and critical success characteristics of logistics provider organizations in Iran [17].

Reference [18] also classified key success factors of the 3PL industry in India. Most Indian 3PL service providers give importance to cost reduction as the most important success factor. The information technology system is also critical to the company's performance. The organization can quickly and efficiently share and convey information with the end-user if it focuses more on this component. This can also increase the speed and accuracy of the process, resulting in higher client satisfaction. This would increase profit while also improving the company's brand image. Reference [19] 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.

3PL clients demand 3PL service providers place a greater emphasis on elements such as industry experience, annual performance, customer service, creative management, top management availability, service quality, flexibility, and market understanding [20]. Several criteria were proposed to improving warehouse operations. Improving the training process for both existing and new employees to better utilize warehouse resources is one key, as it is having a basic understanding of warehouse operations and steps [21]. From the standpoint of global organizations and local firms, leadership, logistics, business, and information and

communication technology are the four competency categories [22].

The breadth of services is positively related to revenue growth [23]. 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 the revenue growth of 3PL service providers. Malaysian 3PL enterprises must have a high level of management commitment to any continuous improvement projects, support the idea of skills improvement and acquisition of new information among employees, and have sufficient financial resources [24]. These are the significant factors that need to have positive logistics performance in Malaysian 3PL firms.

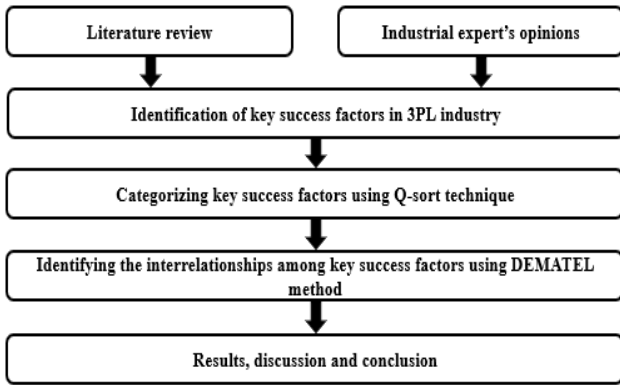


Fig 1. Flow diagram of the process of the methodology

The most significant characteristics for success as a 3PL provider are internationalization, industry focus or expertise, investment in information systems, availability of trained personnel, and supply chain integration [25]. The breadth of services, industry focus, relationship with 3PLs, investment in information systems, skilled logistic professionals, and supply chain integration were identified as key success factors [26]. These factors were considered for this study.

Decision-making trial and evaluation laboratory (DEMATEL) method is a useful tool for identifying cause-effect chain components in a complicated system. It deals with using a visual structural model to evaluate interdependent interactions among components and identify the key ones. The interrelationships between risks faced by 3PL service providers to one of its customers using the DEMATEL method were analyzed [27]. The AHP and DEMATEL methods were used to prioritize the key success factors of the 3PL industry in Iran, while other studies used AHP and DEMATEL methods with some other multi-criteria decision-making techniques for supplier selection [28]. Most of the past literature used either AHP or DEMATEL method to make multicriteria decisions.

III. METHODOLOGY

A. Proposed research framework

Through a thorough literature review, several prominent key success factors in the 3PL industry were identified. Thereafter, through interviews with experts in the 3PL industry, the list was revised which included the addition of success factors unique to the Sri Lankan context. The main objective of this study is to identify the interrelationships among the key success factors, hence a quantitative research approach was used. After identifying the key success factors

Q-sort technique was used to categorize the key success factors into four groups, namely organization strategy, management and process, human resources, and customer orientation. The identified key success factors were divided into those categories by using the data collection approach in the Q-sort technique. When compared to the general Likert scale, the “Q-sort table” is more effective to get the data from a small sample. Then the DEMATEL method enabled the decision-makers to understand the interactions between factors using a causal relationship diagram (Fig. 1).

B. 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 analyse the interactions between factors by categorizing them into cause and effect groups. The procedure of the DEMATEL method can be summarized by the following steps [29].

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 $X_k = [x_{kij}]$, 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:

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

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 the following equation in which all elements should lie between 1 and 0.

$$S = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}} \quad (2)$$

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 [30].

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5) Dividing factors into four quadrants according to their locations in digraph by calculating the mean of $(r+c)$ as in Fig. 2.

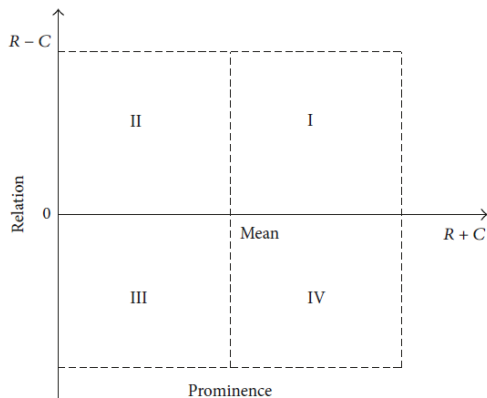


Fig. 2. Four quadrant digraph

Because they have high prominence and relation, the elements in quadrant I are defined as core factors or interconnected givers; the factors in quadrant II are characterized as driving factors or autonomous givers because they have low prominence but high relation. Quadrant III factors have low prominence and relation, and are relatively disconnected from the system (referred to as independent factors or autonomous receivers); quadrant IV factors have high prominence but low relation (referred to as impact factors or intertwined receivers), and are influenced by other factors and cannot be improved directly [29].

IV. DATA COLLECTION

Previous studies of the same interest, research articles, journals, and books were used to identify the key success factors in the 3PL industry. The identified key success factors were further filtered through expert opinions based on industry-based records. Interviews and questionnaires were used as the data gathering instruments for collecting primary data. Interviews were done with the industry experts including middle and senior managers in 3PL companies. Finally, twenty-one important key successes were determined through the inputs of the experts in the 3PL industry.

Those twenty-one key success factors were categorized into four groups using the Q-sort technique as in Fig. 3. Six experts in the 3PL industry were interviewed and collected data using a “Q-sort table” to identify the main category of each key success factor. Then each key success factor received an average value under each main category. Based on the highest average value of each key success factor, those were assigned to relevant main categories. The selected experts have more than seven years of experience in the 3PL industry and four of them were managers and the rest of them were senior executives in their 3PL companies [31].

The target population for this study was all the 3PL companies in Sri Lanka. The non-probability sampling methods of convenience sampling were applied to collect the data from the respondents. Hence it is difficult to gather data from individuals unless you are personally or mutually known to them, this method of sampling was selected to collect the data from experts in the 3PL industry. 11 experts in the 3PL industry participated in the data collection process. Those selected experts were highly skilled professionals in their domain having a good experience.

V. RESULTS AND DISCUSSION

To determine the interdependence between the listed key success factors of the 3PL industry in Sri Lanka, the DEMATEL method was used. It helped to evaluate the interrelationship among the key success factors in terms of the causal effect map. According to the procedure of the DEMATEL method firstly for the main factors, the normalized initial direct-relation matrix (D) was formed. Next, the total relation matrix (T) was calculated. The threshold value of the key factors was then calculated using the total relation matrix. It not only aided in the differentiation of the structure but also in the construction of a causal effect map. The causal impact map aids in the comprehension of the structure by identifying the influence of one success factor over another and filtering out unimportant effects.

Table II provides the direct and indirect effects of the four main key success factors. The values in the $(r+c)$ column express the degree of relationship of each factor with other factors. The factor which has the highest $(r+c)$ value indicates, it has more relationship with other factors. Here it is the organization strategy. Generally, the type of relationships among these four main factors can be taken by the $(r-c)$ values. Based on the $(r-c)$ value factors can be divided into cause-and-effect groups. If the $(r-c)$ value is positive, then that factor belongs to the cause group. If $(r-c)$ value is negative, then that factor belongs to the effect group. Organization strategy, management, and process are in the cause group. Human resources and customer orientation are the factors in the effect group. These factors in the cause group can influence other factors. The mean $(r+c)$ value is 28.8425

TABLE II. THE DIRECT AND INDIRECT EFFECTS OF FOUR 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 |

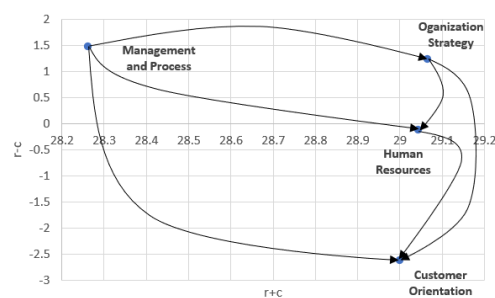


Fig. 4. The digraph of the main factors

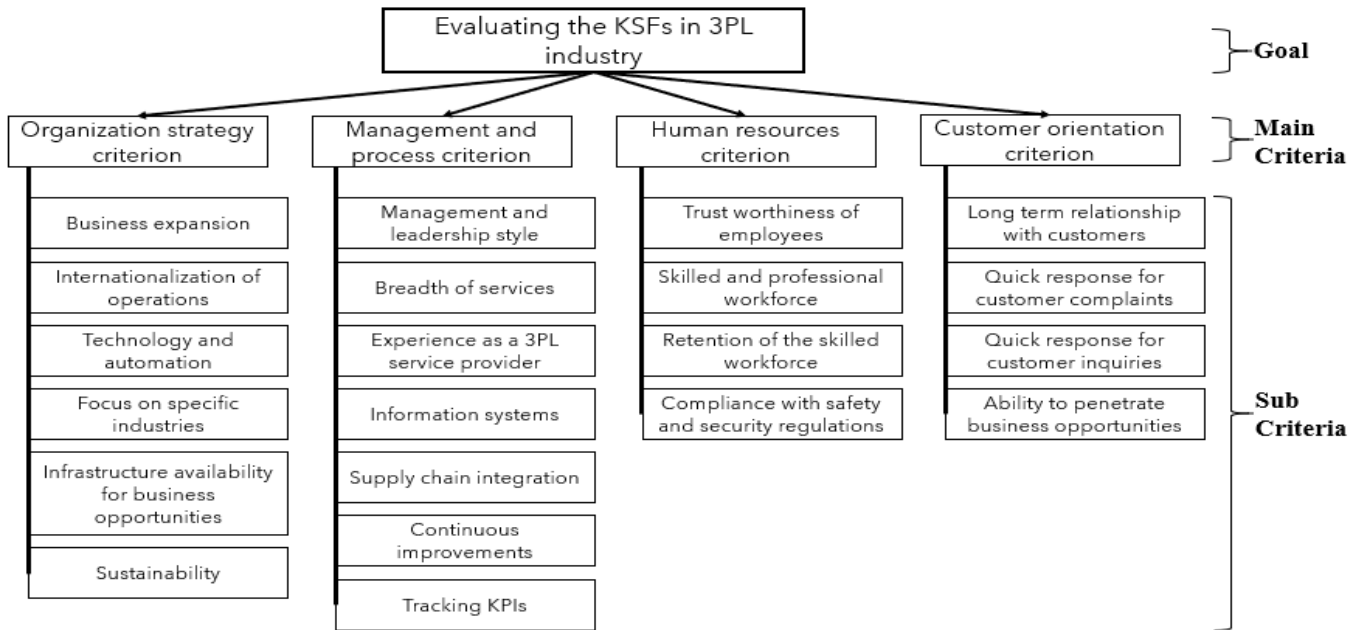


Fig. 3: Main and subkey success factors

By observing Fig. 4, organization strategy can consider as a core factor since it has high prominence and relation; the management and process factor can consider as a driving factor because it has a low prominence but high relation; the human resources and customer orientation have high prominence but low relation, which are impacted by other factors and cannot be directly improved. The threshold value that is considered to draw the digraph of the main criteria is 3.6053. It is necessary to set up a threshold value to filter out some negligible effects among factors.

Table III shows, technology, and automation, infrastructure availability for business opportunities, and sustainability which are in the cause group based on (r-c) values. Business expansion, internationalization of operations, and focus on specific industries are in effect group. The mean (r+c) value is 23.1002. Fig. 5, shows that technology and automation is the only core factor since it has high prominence and relation. Infrastructure availability for business opportunities and sustainability are the factor which considers as driving factors because it has a low prominence but high relation. Focus on specific industries has low prominence, relation and it is relatively disconnected from the system. The business expansion and internationalization of operations have high prominence but low relation, which are being influenced by other factors and cannot be directly improved. The threshold value that is considered to draw the digraph of the organization strategy factors is 1.9250 [31].

TABLE III. THE DIRECT AND INDIRECT EFFECTS OF ORGANIZATION STRATEGY FACTORS

| Organization Strategy Factors | r+c | r-c |
|--|---------|---------|
| Business Expansion (OS1) | 23.9560 | -0.9900 |
| Internationalization of Operations (OS2) | 24.9506 | -0.9543 |
| Technology and Automation (OS3) | 23.9220 | 0.8298 |
| Focus on Specific Industries (OS4) | 22.6404 | -0.5701 |
| Infrastructure Availability for Business Opportunities (OS5) | 21.5743 | 1.4686 |
| Sustainability (OS6) | 21.5580 | 0.2161 |

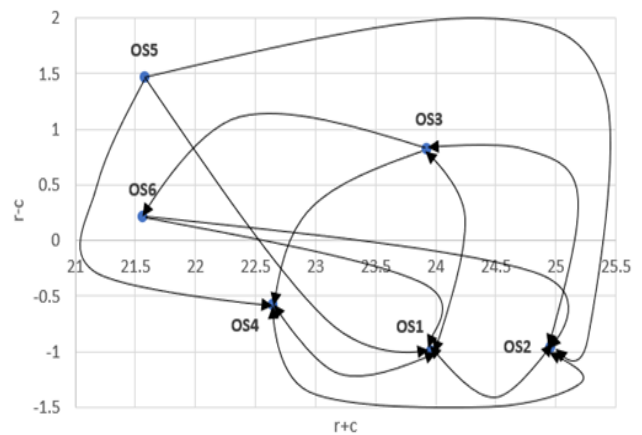


Fig 5. The digraph of the organization strategy factors

TABLE IV. THE DIRECT AND INDIRECT EFFECTS OF MANAGEMENT AND PROCESS FACTORS

| Management and Process Factors | r+c | r-c |
|--|--------|---------|
| Management and Leadership Style (MP1) | 7.0208 | 3.2107 |
| Breadth of Service Offerings (MP2) | 8.8385 | 0.7119 |
| Experience as a 3PL Service Provider (MP3) | 6.6339 | 2.6094 |
| Information Systems (MP4) | 9.5557 | -1.5012 |
| Supply Chain Integration (MP5) | 9.4050 | -0.2228 |
| Continuous Improvements (MP6) | 9.2848 | -2.8169 |
| Tracking KPIs (MP7) | 9.5422 | -1.9911 |

Table IV shows, management and leadership style, breadth of service offerings, and experience as a 3PL service provider which are identified as the key success factors in the cause group. Information systems, supply chain integration, continuous improvements, and tracking KPIs are the key success factors in the effect group. The mean (r+c) value is 8.6116. Fig. 6, shows that breadth of service offerings is a core factor since it has high prominence and relation. 3PL service providers should be more considerate about this factor to gain the benefit in the long run. Management and leadership style and experience as a 3PL service provider are

the factors which consider as driving factors because it has a low prominence but high relation. Under this main factor, there is no disconnected sub factor in the system. Information systems, supply chain integration, continuous improvements, and tracking KPIs have high prominence but low relation, which are impacted by other factors and cannot be directly improved. The threshold value that is considered to draw the digraph of the management and process factors is 0.6151.

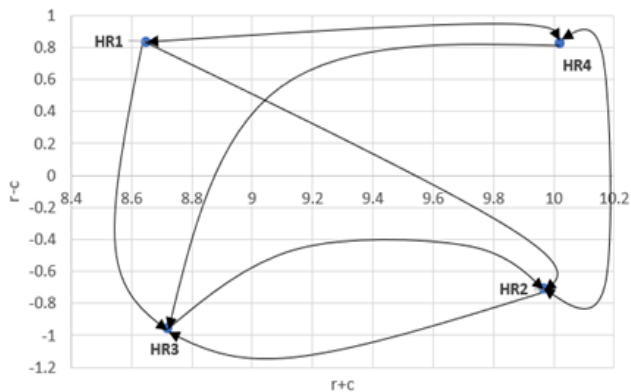


Fig 6. The digraph of the management and process factors

As in Table V, trustworthiness of employees and compliance with safety and security regulations are in the cause group. Skilled and professional workforce and retention of skilled workforce are the factors in effect group. The mean (r+c) value is 9.3383. Compliance with safety and security regulations is the core factor and trustworthiness of employees is the driving factor under this main factor. Therefore, managers need to put direct effort into compliance with safety and security regulations and need to build up the trustworthiness of employees (Fig. 7). Retention of the skilled workforce shows a disconnection from other factors since it has low prominence and relation. The skilled and professional workforce is the only impact factor that is impacted by other factors. The threshold value that is considered to draw the digraph of the human resources factors is 1.1672.

TABLE V. THE DIRECT AND INDIRECT EFFECTS OF HUMAN RESOURCES FACTORS

| Human Resources Factors | r+c | r-c |
|---|---------|---------|
| Trust Worthiness of Employees (HR1) | 8.6473 | 0.8350 |
| Skilled and Professional Workforce (HR2) | 9.9651 | -0.7089 |
| Retention of Skilled Workforce (HR3) | 8.7211 | -0.9555 |
| Compliance with Safety and Security Regulations (HR4) | 10.0198 | 0.8295 |

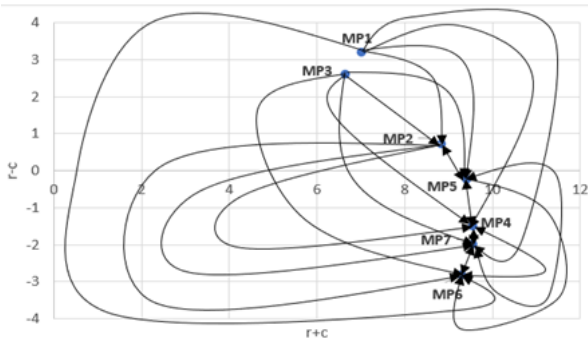


Fig 7. The digraph of the human resources factors

According to the (r-c) values in Table VI, long-term relationships with customers, quick response for customer complaints, and quick response for customer inquiries are in the cause group. The ability to penetrate business opportunities is the only key success factor in the effect group. The mean (r+c) value is 4.8481. Regarding the customer orientation main factor, long term relationship with customers is the only core factor. Quick response for customer complaints and quick response for customer inquiries are the driving factors. As shown in this digraph, the ability to penetrate the business opportunities factor has disconnected from other factors and stands as an independent factor. The threshold value that is considered to draw the digraph of the customer orientation factors is 0.6060 (Fig. 8).

TABLE VI. THE DIRECT AND INDIRECT EFFECTS OF CUSTOMER ORIENTATION FACTORS

| Customer Orientation Factors | r+c | r-c |
|---|--------|---------|
| Long Term Relationship with Customers (CO1) | 5.8417 | 0.4511 |
| Quick Response for Customer Complaints (CO2) | 4.8322 | 0.6108 |
| Quick Response for Customer Inquiries (CO3) | 4.4897 | 0.6831 |
| Ability to Penetrate Business Opportunities (CO4) | 4.2288 | -1.7450 |

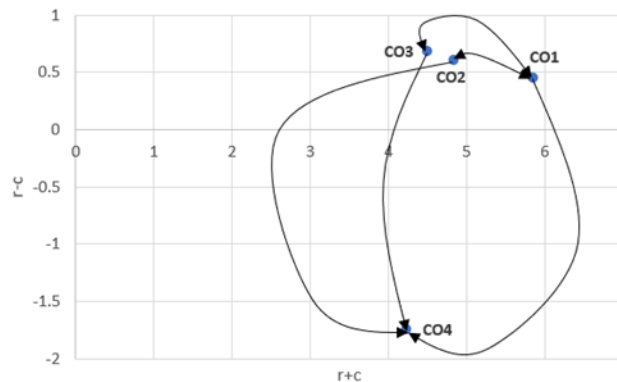


Fig 8. The digraph of the customer orientation factors

VI. CONCLUSION

This study set out to investigate the interrelationships of the key success factors of the 3PL industry in Sri Lanka. The study was able to investigate 21 key success factors using the DEMATEL method. The results of the DEMATEL application can be used to make long-term improvement opportunities in 3PL companies. These results would help managers in the 3PL industry to develop strategies for the effective supply chain management.

The result shows that organization strategy is a core factor since it has high prominence and relation; the management and process factor is a driving factor because it has a low prominence but high relation; the human resources and customer orientation have high prominence but low relation, which are impacted by other factors and cannot be directly improved. Therefore, managers need to focus more on main factors such as organizational strategy and management and process to increase the performance of the 3PL companies. Also, it is important to focus on subkey success factors which act as core factors and driving factors under each main factor. That will be useful for the management to develop long-term strategies for the companies.

The model proposed in the study has limitations. For example, the results of the DEMATEL method are highly dependent on the judgments of the experts. Great care was taken in finalizing the key success factors but cannot rule out errors due to human biases or judgment. Though a generalized model is developed here in this research, a particular company in the 3PL industry could select the criteria and sub-criteria according to their requirements and interest and develop a model that applies to their interest. The results of the DEMATEL could be dynamically adjusted according to adjust to new key success factors that may arise in the 3PL industry. This study is limited to the key success factors which were considered from the experts' opinion, may be improved by including the opinions of both the 3PL service providers and the customers

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