Measuring Sustainability Performance of Logistics Service Providers using AHP

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Abstract

Many manufacturers and retailers often outsource their logistics functions to Logistics Service Providers (LSPs) to focus more on their core business process. Due to the competitiveness and the popularity of the sustainability concept, those organizations evaluate their prospective LSPs not only based on economic aspects like cost, service quality but also on social and environmental aspects as well. This paper proposes a model that can be used by organizations when evaluating and selecting LSPs based on their sustainability performance. Along with the traditional three dimensions of sustainability, a new dimension of Information Technology (IT) is incorporated into the model. A Composite Sustainability Performance Index (CSPI) is constructed using the Analytical Hierarchy Process (AHP) as a weighting method and linear aggregation method since multiple dimensions and indicators need to be incorporated when measuring sustainability performance. The proposed model is flexible as it depends on the sustainability requirements of the organization when selecting LSPs and their relative importance of the sustainability dimensions and indicators are up to the organization to decide. The proposed model is applied to an apparel manufacturing organization to evaluate and select their prospective LSPs.

Keywords

Analytic Hierarchy Process, Composite Index, Logistics Service Providers, Sustainability, Sustainability Indicators

1. Introduction

Logistics Service Providers (LSPs) which are also called 'Contract Logistics', 'Third-Part Logistics', 'Logistics Alliances', and 'Logistics Outsourcing' are firms that provide logistics services which are often integrated or bundled together for use by customers (Ali et al., 2019). The role of LSPs has changed over time from providing transportation services to a wide range of services including warehousing, inventory management, freight forwarding, cross-docking, technology management, etc. At present many manufacturers and retailers often outsource their logistics functions to logistics service providers as they want to focus more on their core business processes.

Today business organizations are more towards sustainability and sustainable development and focus on making themselves and their supply chain partners economically, socially, and environmentally sustainable. Due to the competitiveness and the popularity of the sustainability concept, those organizations evaluate their prospective LSPs not only based on economic performance like cost, service quality but also on social and environmental performance as well. Although there are studies on one or two dimensions of sustainability performance (Economic and Environmental to be precise), the studies which incorporate social dimension is still lagging (Qorri et al., 2018). Relatively few studies have done on the environmental sustainability of the logistics service providers (Evangelista et al., 2018) and often sustainability dimensions are addressed in isolation (Björklund & Forslund, 2019). Sustainability performance often incorporates multiple dimensions and indicators, and it is complex. Composites indices assist in aggregating all dimensions and indicators into a single measurement which will be easy to interpret, compare, and benchmark (Pandian, 2013; Singh et al., 2007).

The objective of this paper is to propose a model that can be used by organizations when evaluating their LSPs based on their sustainability performance and select the most suitable logistics service providers as the logistics partners. However, today business and technology are inseparable and LSPs heavily depend on the technology for their operations and they are bound to use technology sustainably. Over the coming years, companies expect to maintain their focus on sustainability while investing more on Information Technology (IT) resources. Organizations are looking forward to taking advantage of IT for their sustainability efforts involving IT at the early sage of sustainability initiatives (Oracle, 2009). But few studies have examined the role of IT in enabling firms to develop the capability to address the issues in TBL.

Hence it is important to incorporate the technology as a new dimension with the traditional three dimensions of the sustainability due to its contribution towards the firm's sustainability. Therefore, a newly included technological aspect is also considered in this research when evaluating sustainability performance, which was not addressed in previous literature. The proposed model is flexible as it depends on the sustainability requirements of a particular organization when selecting LSPs and their relative importance are up to the organization or the decision-maker to decide.

1.1 Objectives

Following are the objectives of the research conducted.

1.1.1 Identify the sustainability performance measures/indicators/criteria in logistics service providers
1.1.2 Construct a composite index to measure the sustainability performance of Logistics Service Providers

2. Literature Review

2.1 Sustainability and Logistics Service Providers

The economic dimension of sustainability is the aspect that is often evaluated in an organization. Studies that focus on measuring performance of supply chains or logistics service providers traditionally have focused on economic aspects of it with cost minimization (Profit maximization) and service level maximization (Varsei et al., 2014). Chardine-Baumann & Botta-Genoulaz (2014) in their model, covers the economic performance evaluation in five fields: Reliability, Responsiveness, Flexibility, Finance, and Quality. These five fields are further categorized into

subfields with an extensive review of the literature. Further this study highlights that the 'Finance' field was the field that was analyzed often.

From the business and management perspective, the environmental dimension of the sustainability concept involves all activities and decisions needed to minimize environmental pollution caused by an organization. In the logistics sector the environmental concern has become a buzz topic due to many factors. Logistics and transport activities are the 2nd biggest contributor to GHSs (Greenhouse Gases) after electricity production. Demand for moving and delivering goods has grown exponentially in recent years and expected to grow in coming years which in turn will increase the demand for logistics services. Recent economic crisis and global warming has urged for more environmentally sustainable logistics services (Evangelista et al., 2018).

There are relatively few studies done on environmental sustainability in the logistics service industry. Evangelista et al. (2018)in its descriptive analysis of literature has identified that there is a need to develop research aimed at identifying standard metrics to be used to measure green 3PL's environmental performance. And it suggests that the future research should be aimed at developing models and applications that may quantify 3PL's environmental commitment and its impact on finance and operational performance. Further the analysis suggests that future research should better evaluate the efficiency of green measures by using alternative performance indicators as well.
Zhang et al. (2019) using an extensive review of literature identified that Triple Bottom Line (TBL) and Global Reporting Initiatives (GRI) applications are the two main models in measuring logistics environmental sustainability. Zhang et al. (2019) propose a set of environmental indicators for city logistics using the GRI model as the evaluation basis. The proposed set of indicators falls under five categories: Energy, transport and infrastructure, noise, congestion, and emissions, effluents, and waste.

Social sustainability of logistics service providers means to operate its services considering their impact on internal and external stakeholders (i.e. society and employees) in terms of welfare, safety, and wellness. Chardine-Baumann & Botta-Genoulaz (2014) includes the social dimension of sustainability to its analytical assessment model with five (5) five social fields/categories: Work conditions, human rights, social commitment, customer issues, best practices. Further the research categorizes the five fields into subfields/categories as well. The proposed composite index by Azevedo et al. (2017) also includes social dimension. The taken social performance measures are corruption risk and sourcing from local suppliers.

By using an extensive literature review Jung (2017) selected frequently adopted sustainability criteria with the help of industry experts. Study proposes price, service, and social sustainability as main criteria. Social sustainability criteria are sub categorized into philanthropy and average salary which are quantitative measures and management policy which is a qualitative measure. Management policy is further categorized into organizational learning/training process or programs, Human rights and participation, occupational health and safety and vehicle safety.
Although the definition of sustainability consists of three dimensions and the need of such research papers is high, sustainability dimensions are addressed in isolation and quantified indicators for social dimension are underdeveloped. Björklund & Forslund (2019) mentions the challenges when conducting sustainability logistics services including wide range of sustainability indicators, measuring and quantifying the indicators – Especially social dimension indicators, integrating sustainability dimensions, trade-offs between the dimensions, influence from the stakeholders, time perspective and contextual considerations.

2.2 Sustainability Performance Management and Evaluation

To be more competitive, organizations need to measure and manage their supply chain sustainability effectively and efficiently. Through measuring and evaluating sustainability performance organizations can identify the gaps and areas to be improved for further development. Many research studies have proposed metrics and models to measure sustainable supply chain performance.

Sustainability performance management approaches include environmental management standards like ISO 14001, international Reporting Standards (Global Reporting Incentive - GRI), SCOR model, Life Cycle Assessment, Multi Criteria Decision Making (MCDM) tools (AHP, ANP, DEA etc.), Rough Set Theory, Fuzzy Set approach, Composite indicators and conceptual models. Industry specific studies are sparsely present in the literature. Majority of the studies are focused on developing general models to access supply chain sustainability. Even Though there are studies with

all three dimensions of sustainability, still the social dimension is lagging. Math focused methods and tools used to measure sustainability is exponentially increasing. Majority of the studies focused on measuring the sustainability performance between suppliers and manufacturers (Qorri et al., 2018).

Through an extensive analysis of literature Taticchi et al. (2013) has found out that traditional research has focused on measuring supply chain performance in terms of cost, quality, speed, flexibility, and reliability referring to the economic dimensions of sustainability. Further, the analysis has found out that in the last decade a considerable amount of research was based on green supply chains or green logistics referring to environmental sustainability. But little research has shown social dimension performance of supply chains. It also highlights the importance of developing research models and models that are country and industry specific as the sustainability dimension impacts are context dependent and technology related.

Colicchia et al. (2013) proposes a model for environmental sustainability assessment by analyzing the literature which consists of seven macro areas and these seven macro areas are divided into two as inter-organizational and intra-organizational environmental practices. Distribution strategies and transport execution, warehousing and green building, reverse logistics, packaging management and internal management belong to the intra-organizational practices in the context of the logistics industry while collaboration with customers and external collaborations are belong to inter-organizational environmental practices. Study found that logistics service providers have adapted many sustainability initiatives related to distribution and transportation activities while initiatives related to internal management are less. Internal management initiatives include environmental compliance and auditing programs, environmental performance measuring and monitoring, use of green IT, promotion of environmental awareness among managers, incentives and benefits for green behaviors and development of formal environmental sustainability standards of the company. It also highlights the lack of standard methodology for measuring the environmental impact and the need of developing effective performance measurement systems. With the case study conducted, Colicchia et al. (2013) found that the main driver for the environmental sustainability initiatives for logistics service providers is customers. Case study also revealed that the government rules and regulations are also an important driver, but it is often considered as a barrier by the logistics service providers.

There are many tools to assess Supply Chain Management practices like Odette ENALOG, Efficient Consumer Response (ECR), Oliver Wight Class A Checklist for Business Excellence and SCOR model. Among them, the most sustainability-oriented model is the SCOR model. The SCOR model has become more matured with GREENSCOR, but still, it lacks the integration of all three dimensions of sustainability.

Schöggl et al. (2016) proposes the ASSC model (Assessment of Sustainability in Supply Chains Model) that allows qualitative and quantitative indicators to be employed in assessing environmental and social dimensions. It also allows the aggregation of relevant indicators into KPIs (Key Performance Indicators) with respect to specific aspects of sustainability. The proposed ASSC model and the aggregation method is stable, but the content or the sustainability indicators used are adoptable which will be able to reflect the dynamics of sustainable development.

Jung (2017) has used Analytical Hierarchy Process (AHP) for its sustainability performance evaluation model due to its ease of use and applicability in real world scenarios. For further preciseness fuzzy theory has been incorporated into the AHP to overcome the high degree of fuzziness and uncertainty of the answer. The proposed model was used to evaluate three 3PL providers of an e-commerce company. Also, the study has proved that by changing the relative position of the criteria/sub criteria in the proposed model, decision makers can determine the effect of such a change. Although the results show that the proposed model is a good and viable alternative to evaluate the social sustainability of 3PL providers, the exclusion of the environmental dimension in the model is the major drawback.

Oršič et al. (2019) proposes the Green Innovative model, 3PL GIF (Third Party Logistics Green Innovative Model) based on social, economic, and environmental indicators. 3PL GIF checks the implementation of the business policies in all three dimensions of sustainability and helps the logistics service providers by altering them to use quality standards, measure them and continuously improve them. 3PL GIF provides an easy comparison between organizations and helps to identify lacking fields. 3PL GIF compare the progress in sustainable development between organizations and can be applied to a logistics company of any size.

2.3 Composite Indices

Chardine-Baumann & Botta-Genoulaz (2014) proposes a characterization model of sustainability based on fifteen [15] fields and sixty-seven [67] sub fields which are drawn from the literature on above mentioned supply chain management practices. The proposed model includes the rarely spoken social dimension and an analytical assessment model based on composite index as well.

Research conducted by Azevedo et al. (2017) proposes a sustainability assessment tool consisting of indicators that represent economic, environmental, and social performance and aggregates them into a composite index. It also implies the importance of the selected sustainable supply chain indicators being measurable and verifiable. Delphi technique which is extracting unbiased information from a panel of experts is used to obtain weighted economic, social, and environmental indicators. To aggregate the indicators to construct a composite index, a linear additive aggregation technique called Simple Additive Weighting (SAW) method was used. The proposed sustainability model helps in assessing the sustainability based on three sub-indices for each sustainability dimension and the company sustainability index is composed as a function of these three sustainability sub-indices. Using the proposed index, ranking of the supply chains can be done based on sustainability and it helps to identify on which dimension the company has performed worst.

Singh et al. (2007) proposes a Composite Sustainability Performance Index (CSPI) that is specific for steel industry by using five [5] dimensions of sustainability namely: economic, environmental, social, organizational governance and technical aspects. Analytical hierarchy process (AHP) was used to determine the wights of criteria and sub criteria. CSPI was constructed by evaluating and aggregating sub-indices.

In 2017, in its study, Gan et al. (2017) has stated the importance of 'Sustainability Indices (SI)' in sustainability research and practice and mentioned that the weighting and aggregation of index components is a critical step in sustainability assessment. Weighting of sustainability indices reflect the relative importance of the different dimensions of the sustainability performance of an organization. Further it reflects the trade-off ratios among dimensions if they are substitutable. Aggregation reflects the substitutability of different dimensions. Therefore, inappropriate weighting and aggregation may often lead to misinterpretation of the information. Weighting indicators can be categorized into three [3] as equal weighting, static based weighting, and public/expert opinion-based weighting. Aggregation methods integrate weighted components into a single composite index. Widely used aggregation methods are additive aggregation methods, multiplication aggregation methods and non- compensating aggregation methods. When it comes to weighting methods, most of the studies (46.88%) adopted equal weighting methods. 21.88% adopted statistical based weighting methods and only 23.95% adopted expert opinion-based methods. Although most of the researchers used an equal weight approach due to its simplicity and straightforwardness, it gives no insight of relationships between indicators and often has the risk of double weighting. Each weighting and aggregation method has its own pros and cons. But the selection of the approach is based on the purpose of developing or the using SIs, particular spatial or temporal scales at which the SIs are to be applied and specific type of sustainability that the SIs are used to assess.

2.4 Summary of the literature reviewed

Many of the research has used Triple Bottom Line (TBL) as the basis of their models and already existing models and standards like Global Reporting Incentives (GRI) and ISO standards (ISO 26000, ISO 14000) as the basis of the selection of sustainability indicators. Below Table 1 consists of the sources of the selected indicators used by the past literature reviewed by the author. Sources are mainly categorized into Trible Bottom Line (TBL), Global Reporting Incentives (GRI), ISO standards, Past literature, and models.

Table 1: Indicator selection and sources of past literature

Source	Authors
TBL	(Azevedo et al., 2017), (Salvado et al., 2015)
GRI	(Azevedo et al., 2017), (Chardine-Baumann & Botta-Genoulaz, 2014), (Salvado et al., 2015), (Singh et al., 2007), (Varsei et al., 2014), (Zhang at el., 2019)
ISO Standards	(Chardine-Baumann & Botta-Genoulaz, 2014), (Oršič et al., 2019), (Salvado et al., 2015)
Past Literature and existing models	(Chardine-Baumann & Botta-Genoulaz, 2014), (Jung, 2017), (Singh et al., 2007), (Varsei et al., 2014)

Following Table 2 illustrated the various proposed models by the past literature considered in this study including the sustainability dimensions and the output.

Table 2: Sustainability dimensions and the respective models used in the literature review

Authors	**Sustainability Dimension**			**Output**
	Economic	Environment	Social	
(Colicchia et al., 2013)	–	√	–	Conceptual Model
(Chardine-Baumann & Botta-Genoulaz, 2014)	√	√	√	Analytical Assessment Model
(Varsei et al., 2014)	√	√	√	Multidimensional Model
(Ahi & Searcy, 2015)	√	√	√	Mathematical Model
(Santiteerakul et al., 2015)	√	√	√	Conceptual Model
(Azevedo et al., 2017)	√	√	√	Composite Index
(Schöggl et al., 2016)	√	√	√	Conceptual Model (ASSC Model)
(Haddach et al., 2017)	√	√	√	Composite Index
(Jung, 2017)	√	–	√	Multi-Criteria Evaluation Model using Fuzzy AHP
(Badiezadeh et al., 2018)	√	√	–	Network Data Envelopment Analysis (NDEA) Model
(Qorri et al., 2018)	√	√	√	Conceptual Model
(Oršič et al., 2019)	√	√	√	3rd Party Logistics Green Logistics Model (3PL GIF) Index

According to the above summary table (Table 2) past literature on evaluating the sustainability performance of LSPs and supply chain as a whole cover different combinations of sustainability dimensions and indicators and the methodologies or models used by researchers vary from one another.

Due to the competitiveness and the popularity of the sustainability concept, organizations evaluate their prospective LSPs not only based on economic performance like cost, service quality but also on social and environmental performance as well. Although there are studies on one or two dimensions of sustainability performance (Economic and Environmental to be precise), it is evident from the literature review that the studies which incorporate social dimension is still lagging (Qorri et al., 2018). Relatively few studies have done on the environmental sustainability of the logistics service providers (Evangelista et al., 2018) and often sustainability dimensions are addressed in isolation (Björklund & Forslund, 2019).

Over the coming years, companies expect to maintain their focus on sustainability while deploying more on Information Technology (IT) resources. Organizations are looking forward to taking advantage of IT for their sustainability efforts involving IT at the early sage of sustainability initiatives. Further the study implies that it is

important because with the IT, collection and analysis of data and its best practices will improve while reducing the fragmentation of the sustainability efforts. Further IT will help in creating transparent systems and reporting tools to help organizations to track the progress in sustainability initiatives (Oracle, 2009). Few studies have examined the role of IT in enabling firms to develop the capability to address the issues in TBL. Dao et al. (2011) has focus on the role of different IT resources and the integration of those IT resources with Supply Chain Management (SCM) and Human Resource Management (HRM). The study highlights that IT resources with the integration of SCM resources and HRM resources enables the sustainability capabilities which in turn results in sustainability values in the firms and competitive advantage. Hence it is important to incorporate the technology as a new dimension with the traditional three dimensions of the sustainability due to its contribution towards the firm's sustainability.

In general, the research focused on evaluation all three dimensions of the sustainability are rare to find. Although many studies have done on the areas of logistics outsourcing and logistics strategies there are relatively few studies on environmental sustainability. Majority of the studies measure the sustainability performance of the upstream supply chain and studies on sustainability performance of logistics service providers are minimum (Qorri et al., 2018). Both quantitative and quantitative approaches have been used in evaluating and measuring sustainability performance. Mathematical models are used under the quantitative approach (Haddach et al., 2017). Widely used qualitative approaches are AHP, ANP, Fuzzy Set Approach, Balance Score Card and DEA (Qorri et al., 2018).

Therefore, there is a need to develop research aimed at identifying standard metrics to measure LSP's environmental performance (Evangelista et al., 2018; Sweeney et al., 2018.).

3. Methodology

Sustainability performance indicators for LSPs under each dimension are identified with the literature review, Global Reporting Incentives (GRI), and expert opinions. Analytic Hierarchy Process (AHP) has been used to create a model and give relative importance for each dimension/indicator and then the sub-dimensions or sub-indicators under each dimension are compared. Weighted and evaluated indicators are then aggregated using linear additive aggregation to construct the CSPI based on which the LSPs can be evaluated.

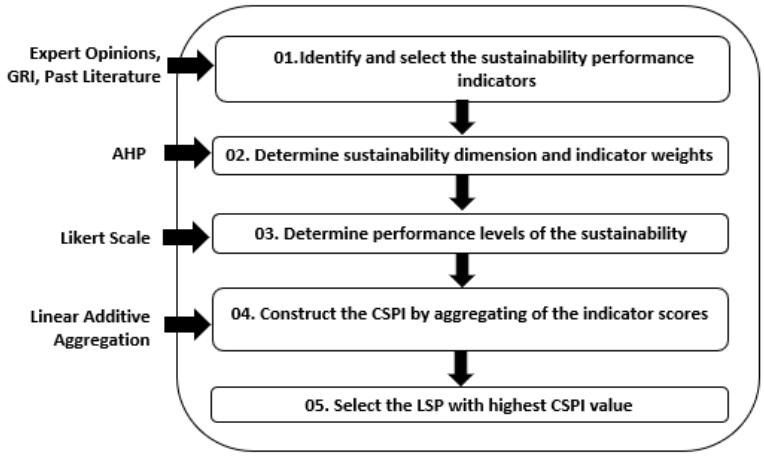

Figure 1: Flow diagram of the methodology process

The decision hierarchy is a graphical representation of the decision goal, the main objectives, the criteria/attributes, sub criteria and alternatives. This hierarchic frame and decomposition represent a summary of the selection of the best LSP. Here the sustainability performance indicators are considered as attributes/criteria and for clarity of the presentation the links to and from sub criteria are given in codes. The alternatives, LSP are considered as LSP_1, LSP_2…. LSP_n.. Application of AHP assessing the best LSP is given below in Figure 2.

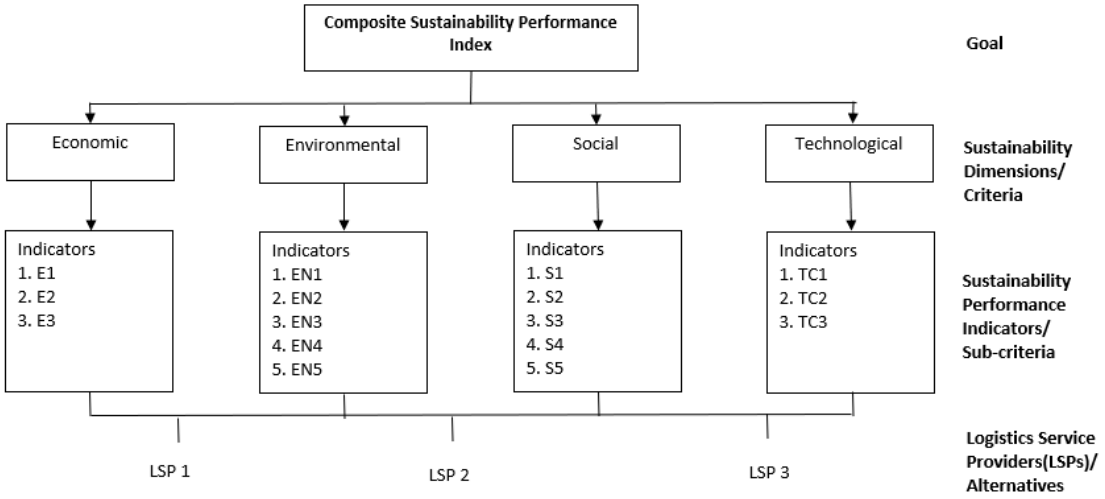

Figure 2: Application of AHP in assessing the sustainability performance of LSPs

4. Data Collection

As the initial step the sustainability performance indicators (sub-criteria) for LSP were identified with the help of literature review, Global Reporting Incentives (GRI), and expert opinions. Opinions on sustainability performance indicators were extracted from the logistics service industry experts through interviews (Table 1). Ten (10) industry experts from five leading 3PL service providers and a leading apparel manufacturing firm in Sri Lanka. The number and the types of indicators selected depend on the requirement of the organization which provides the flexibility for the proposed model.

Table 3: Selected Sustainability Performance Indicators with their sources

No.	Economic dimension	Environmental dimension	Social dimension	Technological dimension
1.	E1 - Direct economic Values generated and distributed (GRI 201-1)	EN1 - Adhering to Environmental laws and regulations (GRI 307-1)	S1 - Number of incidents of corruption reported and investigated (GRI 205-1)	TC1 - Use of IT for route and load optimization (Oracle, 2009)
2.	E2 - Market Share (Oršič et al., 2019)	EN2 - Directing waste for reuse/recycle or other recovery operations (GRI 306-4)	S2 - Incorporation of minorities in the workforce (GRI 405-1)	TC2 - Digital Reporting and Archiving of Important Documents (Oracle, 2009)
3.	E3 - R&D Expenditure (Salvado et al., 2015)	EN3 - Controlling GHG emissions (GRI 305-5)	S3 - Incorporation of women in the workforce (GRI 405-1)	TC3 - Use of Compatible Management Information Systems (MIS) (Dao et al., 2011)
4.		EN4 - Directing wastewater for recycling/reuse or other recovery operations (GRI 303-3)	S4 - Investments in local community development programs (GRI 413)	
5.		EN5 - Controlling energy consumption through conservation and efficiency initiatives (GRI 302-4)	S5 - No of accidents and work-related ill health reported (GRI 403-1)	

The proposed methodology was applied to an apparel organization which uses multiple LSPs. Questionnaires were given to the logistics experts in the organization to determine the relative importance of four selected dimensions and sustainability performance indicators. By the results of the questionnaire, weights of the dimensions of sustainability and sustainability performance indicators were determined using AHP based pairwise comparison using "PriEsT" software.

Performance levels of each sustainability performance indicator of prospective LSPs of the selected organization were taken through a 9-point Likert Scale as it is difficult to get quantitative figures from the organizations. Finally using linear additive aggregation, final weights, and the performance level scores were aggregated together to form the CSPI of each prospective LSP (Table 3).

5. Results and Discussion

5.1 Results

The final weight of each indicator was calculated by multiplying the indicator (sub-criteria) weight by the relevant dimension (criteria) weight as shown in Table 4.

Table 4: Final weights of sustainability performance indicators

Dimension	Indicator	Indicator Weight	Dimension Weight	Final Weight
Economic	E1	0.6946	0.5498	0.3819
	E2	0.1548	0.5498	0.0851
	E3	0.1504	0.5498	0.0827
Environment	EN1	0.5094	0.2748	0.1400
	EN2	0.2532	0.2748	0.0696
	EN3	0.1244	0.2748	0.0342
	EN4	0.0698	0.2748	0.0192
	EN5	0.0414	0.2748	0.0114
Social	S1	0.4528	0.1202	0.0544
	S2	0.2348	0.1202	0.0282
	S3	0.151	0.1202	0.0182
	S4	0.1012	0.1202	0.0122
	S5	0.0582	0.1202	0.0070
Technology	TC1	0.715	0.0554	0.0396
	TC2	0.213	0.0554	0.0118
	TC3	0.0716	0.0554	0.0040
				1.0000

Here three (3) LSP were considered and using AHP calculated the CSPI value which were given in the following Table 5.

Table 5: CSPI calculations of 3 LSPs

			LSP 1		LSP 2		LSP 3	
	Indicator	**Final Weight**	**Performance Level**	**Indicator Weights**	**Performance Level**	**Indicator Weights**	**Performance Level**	**Indicator Weights**
Economic	E1	0.3819	4	1.5276	3	1.1457	3	1.1457
	E2	0.0851	4	0.3404	3	0.2553	3	0.2553
	E3	0.0827	3	0.2481	4	0.3308	4	0.3308
Environment	EN1	0.1400	4	0.5599	3	0.4199	3	0.4199
	EN2	0.0696	3	0.2087	3	0.2087	4	0.2783
	EN3	0.0342	3	0.1026	4	0.1367	4	0.1367
	EN4	0.0192	3	0.0575	4	0.0767	4	0.0767
	EN5	0.0114	4	0.0455	3	0.0341	3	0.0341
Social	S1	0.0544	3	0.1633	3	0.1633	4	0.2177
	S2	0.0282	3	0.0847	3	0.0847	4	0.1129
	S3	0.0182	4	0.0726	4	0.0726	4	0.0726
	S4	0.0122	4	0.0487	4	0.0487	3	0.0365
	S5	0.0070	3	0.0210	3	0.0210	3	0.0210
Technology	TC1	0.0396	4	0.1584	3	0.1188	3	0.1188
	TC2	0.0118	3	0.0354	3	0.0354	3	0.0354
	TC3	0.0040	3	0.0119	3	0.0119	3	0.0119
				3.6863		**3.1644**		**3.3044**

According to the results, the most important and least important sustainability dimensions and the sustainability performance indicators of the organization can be identified. The prospective LSP with the highest CSPI can be selected as the best alternative.

The following are the results of the calculations done for the data collected from the apparel manufacturing organization. According to the results, highest importance is given to the economic dimension (0.5498) by the decision makers, then to environmental (0.2748), then social (0.1202) and least to technology dimension (0.0554). CSPI values are 3.6863, 3.1644, 3.3044 for LSP 1, LSP 2, LSP 3, respectively. Among them, the highest values were obtained by LSP 1 which is 3.6863 and it is the best selection among the three alternatives. The reason LSP 1 got the highest CSPI is, it has performed best in the highly weighted sustainability performance indicators by the organization.

Due to the difficulty in the collection of actual figures or quantitative values for the performance levels of sustainability, performance indicators were measured using a 9-point Likert Scale for constructing CSPI which made the results subjective. This requires future studies to collect the real quantitative indicator values of the prospective LSPs when using the model to get a more accurate outcome.

6. Conclusion

This paper proposes a model (CSPI) to evaluate the logistics service providers based on their sustainability performance. The proposed CSPI is a flexible one as it provides the opportunity to the organization to select its prospective logistics partners based on their requirements and priorities of the different sustainability dimensions and indicators. The criteria used to select the LSP is different from company to company. These models enable such options and provide the flexibility to select to criteria and sub criteria accordingly. The relative importance of the dimensions and sustainability indicators was determined through AHP pair-wise comparison. Linear additive

aggregation was used to aggregate the weighted scores of the indicators into the CSPI. The logistics service provider with the highest CSPI is selected as the best sustainability performer.

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