Green Supplier Evaluation by Using the Weighted Produced Method

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Abstract: Green Supplier Evaluation is the industry standard among the most important challenges for the supply chain One is because it is environmentally friendly Very important for manufacturers. Supply Green Supplier Evaluation in Chain Management and Selection (GSES), Intensity of Competition, General Awareness and environmental issues in large measure due to is appreciated. Past to improve GSES numerous approaches over the decades are proposed. In recent years, in the green supply chain deciding the best for a company. Importantly, it is a strategic mission has changed. Green supply chain management Considers human toxicological effects and supply chain environmental concerns Management integrates. To improve supply chain performance, supplier All the environmental, social and Also consider economic factors want It is usually multi-objective or Includes criteria, green supplier The selection process is multi-criteria Decision making (MCDM) problem. In this study, Green Criteria for evaluating suppliers Package found and then WPM is used to evaluate Green suppliers selection.
Keywords: Green supply chain, Weighted Product Method**,** Technology, Economic and commercial.

1. Introduction

In recent years, many companies Trying to be environmentally friendly Necessary in any organization and Efficient in all business processes One of the processes that can be used is distribution are chain networks. [1]. Supplier selection is a sustainable supply chain Key to building partnerships is an operational task. Environmental, social and Economic dimensions are all well-rounded To be considered for sustainable supplier selection Should, it improve supply chain efficiency and One of the supplier selection process Part includes supplier evaluation and selection, It is supply chain and manufacturing and in the operations management literature It is an important issue [2]. In GSCM, to assess environmental effects or Coordinating and factory to upgrade Complex methods were used for the condition [3]. A huge one from environmental management To get the benefits, businesses are all Members also in green supply chain (GSC) should be coordinated Hence, "green delivery" policies and strategies As key success factors for business have changed because of their environment Public awareness against impacts has increased. A company's environment performance not only related with business's internal environmental efforts, but suppliers Affected By environmental performance and image [4]. With supply chain management philosophy Related competitive advantages suppliers and through strategic collaboration with service providers can be achieved. The success of the supply chain is its Depends on suppliers and thus, supplier selection .The problem has been an important research area is coming in recent years. Suppliers especially their contribution to the environment. An additional strategic dimension is taken into account Taken, it is for sustainable development, [5].

2. Green supply chain

The duties of GSCM include selecting and evaluating green suppliers, costing and buying materials, receiving and dispatching goods, and balancing supply and demand planning for manufacturing lines. Supplier purchases make up more than 60% of the overall income in the manufacturing sector. This demonstrates that suppliers are crucial to corporate operations. [6]. In order to remain competitive in the global market, businesses, particularly those in developing nations, must increase the efficacy of their green supply chain management initiatives. Due to the depletion of raw materials, rising pollution, and environmental deterioration, governments are, on the one hand, paying greater attention to environmental concerns and have enacted a number of environmental legislation. Additionally, a variety of consumer pressures make businesses more conscious of the negative effects of their operations on the environment. [7]. A green supply chain's success depends on the stakeholders' persistent and steadfast dedication. In other words, a company's green initiatives will have very little effect if its suppliers do not adopt green practises in their operations. As a result, a useful tool is required to rank suppliers according to how well they perform in terms of the environment. [8]. Green supplier selection is a crucial component of GSCM and a tactical choice that may enhance the performance and competitiveness of a manufacturing organisation. The success of manufacturers is directly impacted by the

performance of their suppliers since suppliers offer the raw materials, services, and completed commodities that are used as inputs in supply chains. Therefore, to help businesses enhance their social reputation, ensure company continuity, and save costs, rigorous supplier evaluation and selection are necessary [9]. The decision-making process is significantly impacted by the expert opinions' subjectivity and methodological constraints. Additionally, time-consuming pair wise comparisons and univariate tests are needed for several popular techniques like AHP, ANP, and DANP [10]. Traditionally, supplier assessment policies have taken into account economic factors including cost, quality, flexibility, technology, and delivery. Environmental and social characteristics, such as environmental commitment, recyclable packaging, social responsibility, ethical concerns, legal compliance, and dedication to employee health and safety, should also be taken into account when evaluating and choosing suppliers in a sustainable manner. [11]. As a cross-functional strategy, supply chain management is in charge of handling tasks including controlling the storage and flow of raw materials inside and outside the organisation, processing raw materials, and completing items before shipping them to their final destination. Investigators are interested in a number of aspects for this aim, including product design, inventory control, network reorganisation, distribution strategy, and evaluation of green suppliers. Among these concerns, selecting the finest green supplier and assessing their performance is crucial for the management of a company to be successful. [12]. Green packaging, green production, green distribution, reverse logistics, and green procurement can all be considered as parts of a green supply chain. The practise of purchasing goods, services, and building projects that have a lower overall environmental effect than other similar products, services, and projects is known as green procurement. [13]. Today's supply chain management practises seek to utilise fewer, more dependable suppliers and to preserve long-term relationships with them. Managers must now, however, get goods and services from vendors that can offer cheap prices, excellent quality, quick turnaround times, and at the same time, a strong focus on environmental responsibility [14].Because of the complex nature of the system and environment, many algorithm techniques and technologies can be merged in actual applications in accordance with changes in the corporate strategic objectives, system reaction capabilities, and values of the green supplier assessment indicator. The assessment indication will be more thorough if the full green supply chain is brought to completion. [15]. A successful and competitive supply chain must take supplier selection and evaluation (SSE) into account. Quantitative research abounds, and supplier selection techniques may easily be divided into qualitative and quantitative categories. [16]. Companies should establish supplier performance evaluation indices based on their own attributes, needs, and experiences in order to find compatible suppliers since different organisations have different organisational cultures and attributes and place a different emphasis on particular performance evaluation indices. [17]. One of the main topics of the literature on procurement and supply management is procurement process models, where supplier assessment is crucial. They may stress that purchasing is a decision-making process or characterise it as a linear or circular process. [18, 19]. When choosing suitable suppliers and lowering procurement costs, the procurement department is crucial to industries. Therefore, a major determining aspect in the purchase process is supplier selection. The task of the buying department is to compile a list of potential suppliers, assess each one's performance, and then choose the best one. [20].

3. Weighted Product Method

Operational research is a field that uses a variety of methodologies. Additionally, it is known as "Multi-Criteria Decision Making" (MCDM). In this case, judgments are decided by taking into account numerous factors as opposed to only one. Benefit criterion and cost criteria are two different categories of criteria. [21]. Similar to the weighted sum approach is the weighted product method. The primary distinction is that this approach uses multiplication rather than addition. Several ratios, one for each criterion, are multiplied to compare one possibility to the others. Each ratio is increased by the amount of the related criterion's relative weight. [22]. For instance, TOPSIS may be used to evaluate providers, rank qualities or criteria, and calculate optimal generation. WP is used in the meantime to determine the attribute weights and predict the best generation for a certain day. [23]. When evaluating multiple alternatives for a set of attributes or criteria where each attribute is independent of the others and when determining whether new employees will accept such approaches, the weighted product method is used. There will undoubtedly be a large number of candidates who are differently abled or who enrol with different abilities and are then chosen based on a set of criteria established by the institution or institution during recruitment, so appropriate methods are required to handle such situations. [24]. One of the most popular strategies in MCDM is the WPM method. Due to shorter computing durations, this strategy is more effective than others at addressing the problem. In highly subjective situations, WPM is straightforward and simple to apply. WPM is utilised in a variety of contexts, including selecting the best route, evaluating online operations, manufacturing, and choosing project managers. [25].
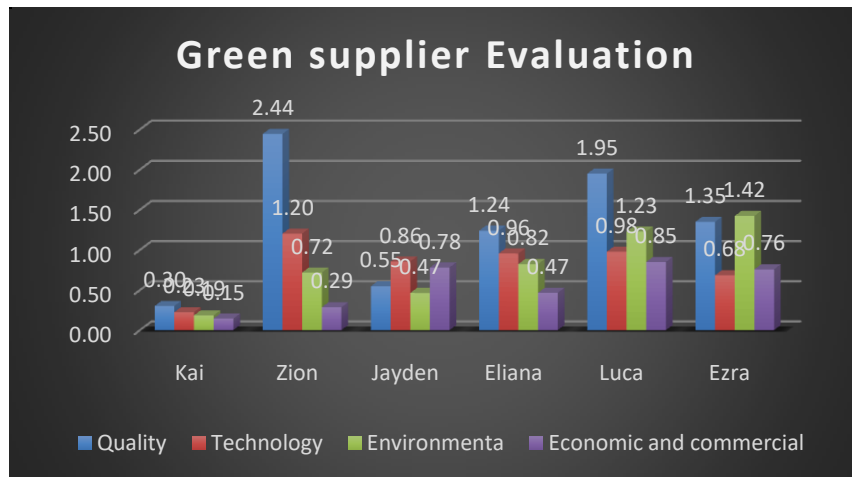
4. Analysis and Discussion

WPM of the green supplier evaluation alternate parameters is Kai, Zion, Jayden, Eliana, Luca, and Ezra. Evaluation parameters are Quality, Technology, Environmental, Economic and commercial. Here Quality and technology are beneficial parameters. Environmental, Economic and commercial are non-beneficial parameters.

TABLE 1. Green supplier Selection

	Quality	Technology	Environmental	Economic and commercial
Kai	0.30	0.23	0.19	0.15
Zion	2.44	1.20	0.72	0.29
Jayden	0.55	0.86	0.47	0.78
Eliana	1.24	0.96	0.82	0.47
Luca	1.95	0.98	1.23	0.85

| Ezra | 1.35 | 0.68 | 1.42 | 0.76 |

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FIGURE 1. Green supplier Evaluation

Figure 1 illustrates WPM of the green supplier evaluation alternate parameters are Kai, Zion, Jayden, Eliana, Luca, and Ezra. Evaluation parameters are Quality, Technology, Environmental, Economic and commercial.

TABLE 2. Performance Value

Kai	0.1236	0.187	1	1
Zion	1	1	0.25766	0.5105
Jayden	0.2242	0.7116	0.397849	0.1867
Eliana	0.5074	0.7947	0.224515	0.3126
Luca	0.7979	0.813	0.150407	0.1718
Ezra	0.5524	0.5686	0.130007	0.1926

Table 2Normalized Data shows the informational set for Quality, Technology, Environmental, Economic and commercial.

TABLE 3. Weight Distributed

Kai	0.25	0.25	0.25	0.25
Zion	0.25	0.25	0.25	0.25
Jayden	0.25	0.25	0.25	0.25
Eliana	0.25	0.25	0.25	0.25
Luca	0.25	0.25	0.25	0.25
Ezra	0.25	0.25	0.25	0.25

Table 3 Weight shows the informational set for the weight all same value 0.25.

TABLE 4. Weighted Normalized data

Kai	0.5929	0.6576	1	1
Zion	1	1	0.7125	0.8453
Jayden	0.6881	0.9184	0.7942	0.6573
Eliana	0.844	0.9442	0.6884	0.7478
Luca	0.9451	0.9496	0.6228	0.6438
Ezra	0.8621	0.8684	0.6005	0.6625

Table 4shows the green supplier evaluation in weighted normalized decision matrix of alternate parameters are Kai, Zion, Jayden, Eliana, Luca, and Ezra. Evaluation parameters are Quality, Technology, Environmental, Economic and commercial.

TABLE 5. Preference score

	Preference Score	Rank
Kai	0.3899	3
Zion	0.6022	1
Jayden	0.3299	5
Eliana	0.4102	2
Luca	0.3598	4
Ezra	0.2978	6

Table 5 Rank shows the informational set for Rank of the taken alternate parameters. Here Zion is Rank 1 and Eliana is rank 2 while Ezra is last rank. Kai is 3rd rank and Luca, Jayden are fourth, fifth rank respectively.
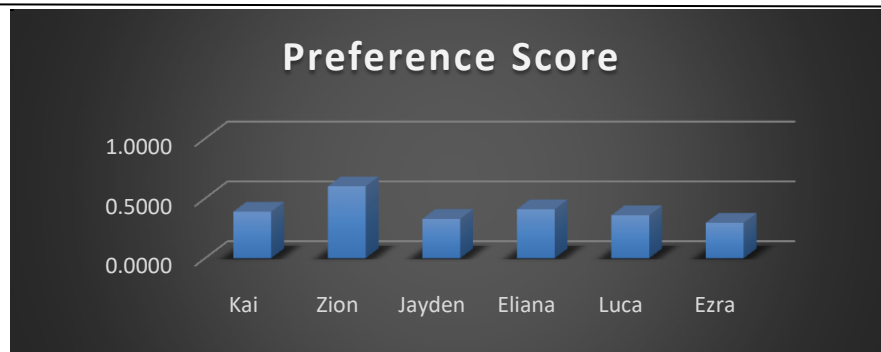
FIGURE 2. Preference score

Figure 2 shows preference score for given alternate and evaluation parameters.
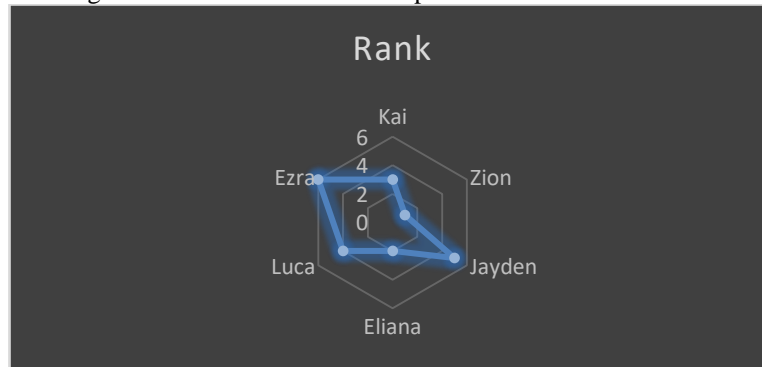
FIGURE 3. Rank

Figure 3 Rank illustrates the informational set for Rank of the taken alternate parameters. Here Zion is Rank 1 and Eliana is rank 2 while Ezra is last rank. Kai is 3rd rank and Luca, Jayden are fourth, fifth rank respectively.

5. Conclusion

A supply chain management system can be established using resources like money, components, processes, and information flows, but government regulations and environment Due to public awareness of security, Businesses today have to survive in the global market if you believe, you have to solve environmental problems. In this regard, green supply chain management (GSCM) businesses profitability and market share Arises as a means to achieve goals, at the same time it reduces the environmental impact and improve environmental performance. To meet customer needs Companies in their supply chain management Add environmental and social factors Methods must be developed. Rethinking the procurement and supply chain in novel ways is a key approach to adopt responsible GSCM, and checking that the provider of the products effectively includes green criteria may be the first step in this process. A good green supplier selection approach may assist minimize environmental and legal risks and boost a company's competitiveness in a dynamic, competitive, and regulated market. The selection of suppliers is a crucial process in corporate procurement. The assessment procedure becomes an MCDM challenge when choosing a suitable provider among several competing criteria. In other words, as those actions are essential to effective sustainable development, companies should make it a routine part of their business to identify and reduce environmental burdens.

Reference

1. TorabzadehKhorasani, Sasan. "Green supplier evaluation by using the integrated fuzzy AHP model and fuzzy copras." Process Integration and Optimization for Sustainability 2, no. 1 (2018): 17-25.
2. Govindan, Kannan, SivakumarRajendran, Joseph Sarkis, and ParasuramaMurugesan. "Multi criteria decision making approaches for green supplier evaluation and selection: a literature review." Journal of cleaner production 98 (2015): 66-83.
3. Zhang, Li-Jun, Ran Liu, Hu-Chen Liu, and Hua Shi. "Green supplier evaluation and selections: a state-of-the-art literature review of models, methods, and applications." Mathematical Problems in Engineering 2020 (2020).
4. Liao, Chin-Nung, Yan-Kai Fu, and Li-Chun Wu. "Integrated FAHP, ARAS-F and MSGP methods for green supplier evaluation and selection." Technological and Economic Development of Economy 22, no. 5 (2016): 651-669.
5. Büyüközkan, Gülçin. "An integrated fuzzy multi-criteria group decision-making approach for green supplier evaluation." International Journal of Production Research 50, no. 11 (2012): 2892-2909.
6. Liou, James JH, Mu-Hsin Chang, Huai-Wei Lo, and Min-Hsi Hsu. "Application of an MCDM model with data mining techniques for green supplier evaluation and selection." Applied Soft Computing 109 (2021): 107534.
7. Wang, Ke-Qin, Hu-Chen Liu, Liping Liu, and Jia Huang. "Green supplier evaluation and selection using cloud model theory and the QUALIFLEX method." Sustainability 9, no. 5 (2017): 688.

8. Liou, James JH, Mu-Hsin Chang, Huai-Wei Lo, and Min-Hsi Hsu. "Application of an MCDM model with data mining techniques for green supplier evaluation and selection." Applied Soft Computing 109 (2021): 107534.

9. Xu, Xue-Guo, Hua Shi, Li-Jun Zhang, and Hu-Chen Liu. "Green supplier evaluation and selection with an extended MABAC method under the heterogeneous information environment." Sustainability 11, no. 23 (2019): 6616.

10. Liou, James JH, Yen-Ching Chuang, EdmundasKazimieras Zavadskas, and Gwo-HshiungTzeng. "Data-driven hybrid multiple attribute decision-making model for green supplier evaluation and performance improvement." Journal of Cleaner Production 241 (2019): 118321.

11. Yan, G. E. "Research on green suppliers' evaluation based on AHP & genetic algorithm." In 2009 International Conference on Signal Processing Systems, pp. 615-619. IEEE, 2009.

12. Van, LuuHuu, Vincent F. Yu, LuuQuocDat, Canh Chi Dung, Shuo-Yan Chou, and Nguyen Viet Loc. "New integrated quality function deployment approach based on interval neutrosophic set for green supplier evaluation and selection." Sustainability 10, no. 3 (2018): 838.

13. Gitinavard, Hossein, Hamid Ghaderi, and Mir SamanPishvaee. "Green supplier evaluation in manufacturing systems: a novel interval-valued hesitant fuzzy group outranking approach." Soft Computing 22, no. 19 (2018): 6441-6460.

14. Akcan, Serap, and Mehmet Ali Taş. "Green supplier evaluation with SWARA-TOPSIS integrated method to reduce ecological risk factors." Environmental monitoring and assessment 191, no. 12 (2019): 1-22.

15. Hashemi, Seyed Hamid, Amir Karimi, and MadjidTavana. "An integrated green supplier selection approach with analytic network process and improved Grey relational analysis." International Journal of Production Economics 159 (2015): 178-191.

16. Freeman, James, and Tao Chen. "Green supplier selection using an AHP-Entropy-TOPSIS framework." Supply Chain Management: An International Journal (2015).

17. Chung, Chih-Chao, Li-Chung Chao, and Shi-Jer Lou. "The establishment of a green supplier selection and guidance mechanism with the ANP and IPA." Sustainability 8, no. 3 (2016): 259.

18. Wątróbski, Jarosław, and WojciechSałabun. "Green supplier selection framework based on multi-criteria decision-analysis approach." In International Conference on Sustainable Design and Manufacturing, pp. 361-371. Springer, Cham, 2016.

19. Dobos, Imre, and GyöngyiVörösmarty. "Evaluating green suppliers: improving supplier performance with DEA in the presence of incomplete data." Central European Journal of Operations Research 27, no. 2 (2019): 483-495.

20. Pitchipoo, Pandian, Ponnusamy Venkumar, and SivaprakasamRajakarunakaran. "Fuzzy hybrid decision model for supplier evaluation and selection." International Journal of Production Research 51, no. 13 (2013): 3903-3919.

21. Das, Bijoy, SumanSankarBhunia, Sarbani Roy, and Nandini Mukherjee. "Multi criteria routing in wireless sensor network using weighted product model and relative rating." In 2015 Applications and Innovations in Mobile Computing (AIMoC), pp. 132-136. IEEE, 2015.

22. Mateo, José Ramón San Cristóbal. "Weighted sum method and weighted product method." In Multi criteria analysis in the renewable energy industry, pp. 19-22. Springer, London, 2012.

23. Fitriasari, Novi Sofia, SyifaAfifahFitriani, and Rosa ArianiSukamto. "Comparison of weighted product method and technique for order preference by similarity to ideal solution method: Complexity and accuracy." In 2017 3rd International Conference on Science in Information Technology (ICSITech), pp. 453-458. IEEE, 2017.

24. Khairina, Dyna Marisa, Muhammad ReskiAsrian, and HelizaRahmaniaHatta. "Decision support system for new employee recruitment using weighted product method." In 2016 3rd International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE), pp. 297-301. IEEE, 2016.

25. Boltürk, Eda, Ali Karaşan, and CengizKahraman. "Simple additive weighting and weighted product methods using neutrosophic sets." In Fuzzy multi-criteria decision-making using neutrosophic sets, pp. 647-676. Springer, Cham, 2019.