GRA-AHP BASED APPROACH FOR SELECTION OF GREEN LOGISTICS SUPPLIER: A CASE STUDY OF AN INDIAN PAPER INDUSTRY

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ABSTRACT

Green Supplier selection is becoming an important issue in supply chain management. In recent years, determining the obtaining green supplier in the supply chain has become a key management consideration. However, these decisions usually involve several factors or criteria, and it is often necessary to eliminate among possibly conflicting factors. Thus, the multiple criteria decision making (MCDM) becomes a very useful and important approach to solve this kind of problem. Considering both tangible and intangible criteria, this study proposes integrated Grey Relational Analysis and Analytical Hierarchy Process (AHP) approach to solve the Green Logistics Supplier Selection problem. The advantage of this method is that it allows decision makers to set multiple aspiration levels for supplier selection problems. The model proposed is illustrated by an example in a paper industry. This is a first of its kind study based on a medium size Indian paper industry.

KEYWORDS: GRA-AHP, MCDM, Logistics

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INTRODUCTION

As businesses move towards increased global competitiveness, the tactical issues surrounding supply management progressively demands the attention of firms for cost reduction, improved quality, better customer service and continuousness of supply which significantly elevates supply chain management stature within organizations (Spekman, 1981; Freeman & Cavinato, 1990; Cavinato 1991; Monezka, 1992; Watts et al., 1992; Heberling, 1993; Gadde & Hakansson, 1994; Carter & Narasimhan, 1996 and Ferguson et al., 1996). Customer pressure encourages companies to implement green practices in their processes and respond with in-kind performance enhancement. An investment in cleaner technologies not only improves the environmental performance but also creates competitive edge and enhances economic performance.

Many companies are investing to adopt green practices including P&G (Procter & Gamble), Unilever, and Engro Corporation. Recently, General Motors also invests \$2.5 billion for adopting green practices in their business. Nowadays, Indian government is also very serious about the environment. According to a report by the organization for economic Co-operation and development, air pollution could cause 6-9 million premature deaths by 2060, with the biggest mortality rate spike forecasted in India. It is also very likely to cost 1% of the global GDP, around \$2.6 trillion annually, in terms of sick days, medical costs and condensed agricultural output, the report added. Organizations are also taking part in making the production processes and logistics as green as possible. As a result, Green Supply Chain Management (GSCM) turns out to be a new systematic environmental approach in supply chain management and has been repeatedly accepted and practiced by forward-thinking organization.

This paper is organized as follows. In section 2, the GRA-AHP approach is discussed. Subsequently, in section 3, paper industry case study is discussed. In the section 4, proposed decision support system steps are explained. The section 5 evaluates green logistics suppliers. In the section 6, managerial implications of the model discussed. Finally, section 7 discusses conclusion & future research directions.

GRA-AHP-TOPSIS METHOD

Analytic Hierarchy Process (AHP), since its development, has been a tool used by the hands of decision makers and academics; and it has become one of the most widely used multiple criteria decision-making technique. Many highly recognized works have been published based on AHP: they include usage of AHP in different fields such as planning, selecting the best alternative, resource allocation, resolving conflict, optimization, and numerical extensions of AHP. Bibliographic review of the multiple criteria decision-making tools undertaken by Steuer [118] is also important. AHP is a multiple criterion decision-making tool that uses eigen value approach to the pair – wise comparisons. It also provides a methodology to calibrate the numeric scale for the calculation of quantitative as well qualitative performances of the attributes. The scale ranges from 1/9 for “least important than”, to 1 for “equal”, and to 9 for “absolutely more valued than” covering the entire spectrum of the comparison.

The Grey System Theory was proposed by Deng in the year 1982 has been proven to be useful for dealing with poor, partially complete, and uncertain information. The grey relational analysis that is based on the grey system theory by Deng can be used to solve the complex interrelationships among more than one performance characteristics effectively. Through the grey relational analysis, a grey relational grade is calculated to evaluate the multiple performance characteristics. As a result, optimization of the these complex performance factors can be converted into optimization by a single grey relational grade.

In the grey relational analysis, the experimental results are first normalized to the range between zero and one, which is also called the grey relational generating. Next, the grey relational coefficient is derived from the normalized experimental results to express the association between the desired and actual experimental results. Then, the grey relational grade is computed by averaging the grey relational coefficient agreeing to each performance characteristic. The overall evaluation of the multiple performance characteristics is based on the grey relational grade. As a result, optimization of the complex multiple performance characteristics can be converted into optimization of a single grey relational grade. Ideal level of the process parameters is the level with the highest grey relational grade.

The mathematics of GRA is calculated from space theory. The purpose of grey relational analysis is to measure the relative impact of the compared series on the reference series. In other words, the calculation of GRA reveals the relationship between two discrete series in a Grey space.

The MCDM approach based on GRA-AHP is explained in the following steps:

AHP

- Step 1: Generation and normalization of pairwise matrix using the following equation for normalization.

$$N_{ij} = \frac{c_{ij}}{\sum_{i=1}^n c_{ij}} \quad (1)$$

- Step 2: Calculation of weights of each criterion by taking average of each row of pairwise matrix. A weight matrix is generated.
- Step 3: Consistency analysis by multiplying pairwise matrix and weight matrix using equation 2.

$$\begin{bmatrix} C_{11} & \dots & C_{1n} \\ \vdots & \ddots & \vdots \\ C_{mj} & \dots & C_{mn} \end{bmatrix} * \begin{bmatrix} W_{11} \\ W_{12} \\ \vdots \\ W_{m1} \end{bmatrix} = \begin{bmatrix} V_{11} \\ V_{12} \\ \vdots \\ V_{m1} \end{bmatrix} \quad (2)$$

- Step 4: Then the consistency vector is obtained. To do this, the weighted sum vector is divided by corresponding. The following formula is used to do the same.

$$C_{vij} = \frac{1}{w_{ij}} \quad (3)$$

- Step 5: The consistency is calculated by using the eigenvalue, λ_{max} , to calculate the consistency index, CI. Consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value in Table 2. The CR is acceptable if it is lower than 0.10. Or else the decision matrix is inconsistent.

$$\lambda_{max} = \frac{\sum_{i=1}^m C_{vij}}{m} \quad (4)$$

$$CI = \frac{\lambda_{max} - m}{m - 1} \quad (5)$$

$$CR = \frac{CI}{Random Index} \quad (6)$$

GRA

- Step 6: Generation and normalization of decision matrix using following equation:

$$X_{ij} = \frac{X_{ij} - (X_{ij})_{min}}{(X_{ij})_{max} - (X_{ij})_{min}} \quad (7)$$

- Step 7: Then the Grey Relational Coefficient is calculated using following equation.

$$C(N_{0j}, N_{ij}) = \frac{\nabla_{min} + \rho \nabla_{max}}{\nabla_{ij} + \rho \nabla_{max}} \quad (8)$$

Where, $\nabla_{ij} = |N_{0j} - N_{ij}|$; $\nabla_{min} = \min(\nabla_{ij}, i = 1, 2, 3, \dots, m, j = 1, 2, 3, \dots, n)$;

$\nabla_{max} = \max(\nabla_{ij}, i = 1, 2, 3, \dots, m, j = 1, 2, 3, \dots, n)$

- Step 8: Grey Relational Grade is calculated using eq. 9. It is actually the multiplication of Grey relation Coefficient Matrix and Weight Vector.

$$G(x_0, x_i) = \sum_{j=1}^n W_j, \quad \{\text{For } i = 1, 2, 3, \dots, m\} \quad (9)$$

w_j is the weight for attributes, $j = 1, 2, 3, \dots, n$. and moreover $\sum_{j=1}^n W_j = 1$

- A set of alternatives can be preference ranked in descending order of G_i . In this, larger index values indicate better performance of the alternatives.

PROBLEM DESCRIPTION

An Indian paper industry (company A) is chosen for this study. Company XYZ has approximately 600 employees per shift; they make corrugated boxes for many multinational companies in India. Products such as television sets, refrigerators, fruits, etc. are kept in these boxes by these companies. The company is one of the leaders in its product segment in North Indian region.

This company has proposed changes in the structure of the final product in order to make it greener, free of harmful chemicals, recyclable, and to lower its electricity consumption. These changes also meet the requirements of environmental law and the needs of their customers. The company is also committed to product life cycle (LCA) analysis of the product. The LCA conducts a series of waste disposal, waste disposal, and waste disposal, and this invention allows the company to evaluate its use of such resources and implement mitigation measures.

In India, in accordance with the rules of Solid Wastage Management (SWM), 2016, by the Union Ministry of Environmental, Forests and Climate Change (MoEF & CC), all companies present in the sector are now required to take responsibility for their post-purchase products. The impact on the product and the environment. Thanks to the mandate of the Indian government, companies recognize that offering greener products not only meets the needs of customers but also requires finding the right green suppliers to improve the management of their package.

Because of this new context in India, the company's owner seeks a way to identify and to select suppliers who will support the company's adoption of GSCM practices. Among all the present suppliers of the company, 4 major suppliers have been identified as candidates for company A.

According to the principles of feasibility, systematic independence, hierarchy, comparability, dynamics, flexibility and completeness, this research designs 13 green supplier evaluation criteria. From the previous studies and green supplier strategy assessment, and by referring to the supplier selection decision criteria in previous studies, discarded redundant criteria and combined similar criteria. During the process of selecting criteria, in addition to the traditional decision criteria for green supplier selection, in the process of understanding the company's actual operating conditions and requirements on its suppliers, we learned that the raw materials or parts provided by previous suppliers did not have good after-sales service, and the company often had to deal with defective products by itself. Because of this, sometimes damage to the environment was inflicted. So, in order to realize the sustainable development of the company, a criterion of after-sales service was added after the discussion of experts.

Therefore, the final list consists of 13 criteria. These are ISO 14001 Certification (C1), Green Logistics (C2), Commitment of Senior Management to GSCM (C3), Green Purchasing (C4), Product Designs that Avoid/Reduce Toxic/Hazardous Material Use (C5), Product Designs that Reduce/Reuse/Recycle/Reclaim Materials, Components, Or Energy (C6), Compliance with Legal Environmental Requirements as Prescribed By Government of India (C7), Green Packing and Labelling (C8), Waste Management and Pollution Prevention Systems (C9), Willingness to Work with Clients to make the Supply Chain Greener (C10), Green Technologies for Manufacturing (C11), Green Warehousing (C12), After-Sales Services (C13).

According to the purpose of the company, we prepared questionnaires to evaluate 4 suppliers, sent the questionnaire to the academic expert group for content analysis and improvement and chose three experienced senior management personnel of the panel (the selected decision makers not only have a deep understanding of the company's

business strategy and operation strategy, but also are familiar with the company's procurement strategy, supplier selection process and procurement performance results).

The pairwise analysis of all the criteria was done by all three experts. To avoid inconsistency, a final pairwise matrix was generated by taking the average of the pairwise matrix of the three experts.

DECISION SUPPORT SYSTEM FOR SELECTION OF GREEN LOGISTICS SUPPLIERS

The proposed decision support system required for the assessment of Selection of Green Logistics Suppliers in two steps: (i) Initial screening of the providers by a team of concerned managers from industry and (ii) GRA-AHP based decision support system for the final evaluation of the suppliers. Often, the initial screening of the suppliers is an easy task but the final selection from the list of short-listed suppliers is a difficult task. In this section, we present a methodology for the initial screening of the providers. Later, these selected providers would be ranked by the GRA-AHP based approach.

The steps of decision support methodology are enlisted as follows:

- Formation of a team of senior managers & consultants.
- Identification of potential green logistics suppliers in the business environment.
- Identification of criterions based on literature review.
- Preparation of decision matrix and pairwise matrix with the assistance of industry experts and researchers.
- Final selection using GRA- AHP approach and agreement of services offered by the service providers.

GRA-AHP based decision modeling methodology, which is discussed in the next section of the paper, is recommended for the final selection of a green supplier.

EVALUATION OF GREEN LOGISTICS SUPPLIER SELECTION USING GRA-AHP APPROACH

Implementation of GRA-AHP-TOPSIS model and analysis are explained in the following 8 steps:

- **Step 1:** Generation and normalization of pairwise matrix using the equation 1 for normalization. The Table 1 shows the pairwise matrix generated along with the column sum at the bottom. Table 2 shows the Normalized matrix generated for the pairwise matrix.
- **Step 2:** Calculation of weights of each criterion by taking average of each row of pair wise matrix. A weight matrix is generated. Table 3 shows the calculated weights of the respective criterions. Figure 1 demonstrates pictorially.
- **Step 3:** Consistency analysis by multiplying pair wise matrix and weight matrix using equation 2. Weight sum vector generated is shown in Table 4.
- **Step 4:** Then the consistency vector is obtained using equation 3. The consistency vector table generated is shown in Table 5.
- **Step 5:** The consistency is determined by using the eigenvalue, $\lambda_{\max}$, using equations 4, 5 and 6.

$$\lambda_{\max} = \frac{(14.78+13+8+14.85+4.64+14.92+14.64+15.83+15+15.2+14.63+16.4+14.47+10.7+15.30801+15.4459)}{11} = 14.848$$

$$CI = \left(\frac{14.848 - 13}{13 - 1} \right) = 0.154$$

$$CR = \frac{0.154}{1.56} = 0.0987,$$

Which is less than 0.1, hence the results are consistent. The value 1.56 is given by taken for 13 criterions.

Table 1: Pairwise Matrix

CRITERIA	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	1.00	0.20	0.33	1.00	0.33	1.00	0.20	0.14	0.20	0.20	0.33	0.33	0.33
C2	5.00	1.00	0.33	1.00	0.20	1.00	0.20	0.20	0.20	0.33	0.20	0.14	0.33
C3	3.00	3.00	1.00	5.00	3.00	3.00	1.00	1.00	1.00	1.00	3.00	0.20	3.00
C4	1.00	1.00	0.20	1.00	0.20	0.33	0.14	0.14	0.33	0.20	0.33	0.14	0.33
C5	3.00	5.00	0.33	5.00	1.00	3.00	0.33	0.33	0.33	1.00	3.00	1.00	0.20
C6	1.00	1.00	0.33	3.00	0.33	1.00	0.20	0.14	0.33	0.20	0.33	0.20	1.00
C7	5.00	5.00	1.00	7.00	3.00	5.00	1.00	1.00	3.00	1.00	5.00	3.00	5.00
C8	7.00	5.00	1.00	7.00	3.00	7.00	1.00	1.00	3.00	3.00	5.00	3.00	1.00
C9	5.00	5.00	1.00	3.00	3.00	3.00	0.33	0.33	1.00	3.00	3.00	1.00	1.00
C10	5.00	3.00	1.00	5.00	1.00	5.00	1.00	0.33	0.33	1.00	3.00	1.00	1.00
C11	3.00	5.00	0.33	3.00	0.33	3.00	0.20	0.20	0.33	0.33	1.00	0.20	0.33
C12	3.00	7.00	5.00	7.00	1.00	5.00	0.33	0.33	1.00	1.00	5.00	1.00	1.00
C13	3.00	3.00	0.33	3.00	5.00	1.00	0.20	1.00	1.00	1.00	3.00	1.00	1.00
COLUMN SUM	45.00	44.20	12.20	51.01	21.40	38.34	6.14	6.16	12.07	13.27	32.20	12.22	15.53

Table 2: Normalized Matrix

CRITERIA	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	0.0222	0.0045	0.0273	0.0196	0.0156	0.0261	0.0326	0.0232	0.0166	0.0151	0.0103	0.0273	0.0215
C2	0.1111	0.0226	0.0273	0.0196	0.0093	0.0261	0.0326	0.0325	0.0166	0.0251	0.0062	0.0117	0.0215
C3	0.0667	0.0679	0.0820	0.0980	0.1402	0.0783	0.1628	0.1623	0.0829	0.0754	0.0932	0.0164	0.1931
C4	0.0222	0.0226	0.0164	0.0196	0.0093	0.0087	0.0233	0.0232	0.0276	0.0151	0.0103	0.0117	0.0215
C5	0.0667	0.1131	0.0273	0.0980	0.0467	0.0783	0.0542	0.0540	0.0276	0.0754	0.0932	0.0818	0.0129
C6	0.0222	0.0226	0.0273	0.0588	0.0156	0.0261	0.0326	0.0232	0.0276	0.0151	0.0103	0.0164	0.0644
C7	0.1111	0.1131	0.0820	0.1373	0.1402	0.1304	0.1628	0.1623	0.2487	0.0754	0.1553	0.2455	0.3219
C8	0.1556	0.1131	0.0820	0.1373	0.1402	0.1827	0.1628	0.1623	0.2487	0.2261	0.1553	0.2455	0.0644
C9	0.1111	0.1131	0.0820	0.0588	0.1402	0.0783	0.0542	0.0540	0.0829	0.2261	0.0932	0.0818	0.0644
C10	0.1111	0.0679	0.0820	0.0980	0.0467	0.1304	0.1628	0.0541	0.0276	0.0754	0.0932	0.0818	0.0644
C11	0.0667	0.1131	0.0273	0.0588	0.0156	0.0783	0.0326	0.0325	0.0276	0.0251	0.0311	0.0164	0.0215
C12	0.0667	0.1584	0.4099	0.1373	0.0467	0.1304	0.0542	0.0540	0.0829	0.0754	0.1553	0.0818	0.0644
C13	0.0667	0.0679	0.0273	0.0588	0.2337	0.0261	0.0326	0.1623	0.0829	0.0754	0.0932	0.0818	0.0644

Table 3: Weights of Criteria

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Sum of rows	0.2618	0.3622	1.3190	0.2315	0.8292	0.3621	2.0859	2.0760	1.2401	1.0954	0.5463	1.5174	1.0729
Weight	0.0201	0.0279	0.1015	0.0178	0.0638	0.0279	0.1605	0.1597	0.0954	0.0843	0.0420	0.1167	0.0825

Table 4: Weighted Sum Vector

CRITERIA	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
WSV	0.2976	0.3846	1.5063	0.2607	0.9518	0.4077	2.4604	2.3949	1.4499	1.2329	0.6085	1.7863	1.2748

Figure 1: Priorities and Weights of Criteria.

Table 5: Consistency Vector

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
CV	14.7811	13.8040	14.8452	14.6383	14.9226	14.6368	15.3335	14.9973	15.1992	14.6316	14.4791	15.3030	15.4459

- **Step 6:** Generation and normalization of decision matrix using equation 7, which is shown in Table 6.

Table 6: Decision Matrix

Alternative	Attributes/Criteria												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
GLS1	9.00	7.00	8.00	8.00	7.00	6.00	7.00	6.00	8.00	8.00	8.00	9.00	8.00
GLS2	7.00	8.00	6.00	8.00	6.00	8.00	9.00	8.00	6.00	7.00	9.00	9.00	9.00
GLS3	5.00	6.00	7.00	9.00	8.00	6.00	8.00	9.00	7.00	9.00	9.00	9.00	7.00
GLS4	8.00	5.00	8.00	8.00	9.00	5.00	8.00	9.00	5.00	7.00	8.00	7.00	6.00
GLS5	7.00	6.00	7.00	5.00	6.00	7.00	6.00	7.00	5.00	3.00	7.00	9.00	7.00
MAX-MIN	4.00	3.00	2.00	4.00	3.00	3.00	3.00	3.00	3.00	6.00	2.00	2.00	3.00
MIN	5.00	5.00	6.00	5.00	6.00	5.00	6.00	6.00	5.00	3.00	7.00	7.00	6.00

- **Step 7:** Then the Grey Relational Coefficient is calculated using equation 8, as shown in Table 7.

Table 7: Grey Relation Generation

Alternatives	Attributes/Criteria												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
GLS1	0.80	0.50	0.33	0.75	0.25	0.33	0.25	0.00	0.60	2.50	0.17	0.29	0.40
GLS2	0.67	0.60	0.00	0.75	0.00	0.60	0.50	0.40	0.33	4.00	0.29	0.29	0.50
GLS3	0.00	0.33	0.20	0.80	0.40	0.33	0.40	0.50	0.50	2.00	0.29	0.29	0.25
GLS4	0.75	0.00	0.33	0.75	0.50	0.00	0.40	0.50	0.00	4.00	0.17	0.00	0.00
GLS5	0.67	0.33	0.20	0.00	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.29	0.25
Reference	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
$\nabla_{\min}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\nabla_{\max}$	0.80	0.60	0.33	0.80	0.50	0.60	0.50	0.50	0.60	4.00	0.29	0.29	0.50
ρ	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

- **Step 8:** Finally, Grey Relational Grade is calculated using eq. 9, as shown in Table 8. Figure 2 demonstrates pictorially.

Table 8: Grey Relational Grades and Priorities

Alternatives	Grey Relational Grade	Priorities
GLS1	0.8663	3
GLS2	0.8780	2
GLS3	0.9197	1
GLS4	0.8315	4
GLS5	0.7984	5

Figure 2: GRA Relational Grades of Alternatives.

Higher the Grade higher will be the priority to the alternative. As shown in Table 8. Here, after the application of GRA, we got the priorities order $GLS\ 3 > GLS\ 2 > GLS\ 1 > GLS\ 4 > GLS\ 5$. It is clear here that these results must be seen in the light of the business environment of paper industry and the inputs provided by a team of experts in the pair-wise comparison of the attributes.

DISCUSSIONS AND MANAGERIAL IMPLICATIONS

The proposed hybrid model in the present research has found out several significant attributes for evaluation of green logistics suppliers for a paper industry. It was found that among all the criteria evaluated, the criteria with maximum weight age is C8, i.e. Commitment of Senior Management To GSCM. This was followed by Waste Management and Pollution Prevention (C8), Product designs that reduce, reuse, recycle, or reclaim materials, components, or energy (C12), Compliance with legal environmental requirements and auditing programs (C3), Green Logistics (C9), Product designs that avoid or reduce toxic or hazardous material use (C13), Green Packing and Labelling (C10), ISO 14001 Certification (C5), Green Purchasing (C11), Green Manufacturing Technologies (C6), Willingness to Work with clients for making the supply chain greener (C2), After Sales Services (C1) and Green Warehousing (C4) respectively. C7 and C8 scored very close to each other after the results, This means that both Commitment of Senior Management to GSCM and Waste Management and Pollution Prevention of the suppliers will play a crucial role in selection of the supplier in Paper Industry. Also, Product designs that reduce, reuse, recycle, or reclaim materials, components, or energy (C12) and Compliance with legal environmental requirements and auditing programs (C3), the next two criteria scored comparable values. So, for the Corresponding company and corresponding industry, these two factors also play a crucial role in the selection of the suppliers. We have seen that our consistency ratio is 0.0987 which is less than 0.1 but is very close to 0.1 which indicates that the priorities are quite sensitive.

After that we used Grey Relational Analysis to form a decision matrix for criteria and alternatives (Green Logistics Suppliers) and calculate Grey Relational Grades to find out which Green Logistics Supplier is closest to the ideal requirements. After the application of GRA, we got the priorities order as GLS 3 > GLS 2 > GLS 1 > GLS 4 > GLS5.

This study may provide support to management and consultants for making strategic decisions in selection of green suppliers for the paper industry in an Indian context. The developed model provide flexibility in accommodating new attributes according to industry needs time to time for sound decision making.

Table 9: Criteria List and Resulting Weights

Code	Criteria	Weight	Percentage Share	Rank
C1	After Sales Services	0.2976	2.01	12
C2	Willingness to Work with Clients for Making the Supply Chain Greener	0.3846	2.79	10
C3	Compliance with Legal Environmental Requirements and Auditing Programs	1.5063	10.15	4
C4	Green Warehousing	0.2607	1.78	13
C5	Iso 14001 Certification	0.9518	6.38	8
C6	Green Manufacturing Technologies	0.4077	2.79	11
C7	Commitment of Senior Management To GSCM	2.4604	16.05	1
C8	Waste Management and Pollution Prevention	2.3949	15.97	2
C9	Green Logistics	1.4499	9.54	5
C10	Green Packing and Labelling	1.2329	8.43	6
C11	Green Purchasing	0.6085	4.20	9
C12	Product Designs That Reduce, Reuse, Recycle, Or Reclaim Materials, Components, Or Energy	1.7863	11.67	3
C13	Product Designs That Avoid or Reduce Toxic or Hazardous Material Use	1.2748	8.25	7

CONCLUSIONS AND FUTURE SCOPE

The research provides substantive support to the Indian supply chain management literature and fresh insights about the SC relationship that exists in Indian small-scale industries such as paper industry, bottling industry, etc. There is always a scope for further improvement in the research model, especially in the decision-making models, as no decision is 100 percent accurate, so a comparative study may be conducted by using other multi-criteria decision-making methods to validate the results obtained by present method. ATOPSIS approach may be used by contemplation of the interactions between criteria and the results could be compared by using TOPSIS or GRA MCDM. The criteria were specifically selected for the supplier of an Indian paper industry. If a different industry is selected, some of the criteria may get redundant and may be required to be replaced. Also, the weights of the same criteria may vary as the pairwise matrix will be generated by the industry specific experts. So, a different industry can be researched in the future. Microsoft Excel has been used for calculation purpose in this work. Tailored software may be developed to reduce computational speed and simplification of calculations.

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