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Identification and Prioritization of Green Lean Supply Chain Management Factors Using Fuzzy DEMATEL

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Abstract: Green–lean supply chain management (GLSCM) refers to strategically adopting and coordinating environmentally sustainable practices and lean concepts in supply chain operations. A considerable set of factors needs to be identified to implement GLSCM successfully. This study examined the factors influencing green lean supply chain management implementation in the Ready-made Garments Industries of Bangladesh through a literature review and discussions with field experts. The fuzzy decision-making trial and evaluation laboratory (fuzzy DEMATEL) approach is employed to analyze these factors to implement GLSCM effectively. This research identifies capacity utilization, green purchasing, and demand variation as the most influential factors in GLSCM, while quality improvement and the Kanban system are considered the least important factors. This study explored categorizing factors into the cause-and-effect group, the degree of interaction, and the interrelationship of the factors under consideration. The findings of this study may help managers develop an effective GLSCM system, hence increasing an organization's total profitability.

Keywords: supply chain; GSCM; LSCM; green lean; Fuzzy DEMATEL

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1. Introduction

Supply chain management should incorporate green and lean principles since it connects operational effectiveness with environmental sustainability. This connection allows businesses to streamline operations, reduce their environmental impact, and decrease waste. Organizations can increase resource efficiency, reduce carbon emissions, and improve sustainability by implementing environmentally friendly practices throughout the supply chain. Green–lean management, a new economic and environmental efficiency guideline, is an effective approach [1]. The present environmental situation emboldens manufacturing to minimize its harmful effect on the environment [2]. Based on this, the author made the case that management and production should be pushed to work toward reducing harmful environmental effects while upholding lean techniques. One of the most difficult problems in management research is combining supply chain operations with green and lean business concepts [3].

The application of green and lean strongly impacts supply chain management since it helps determine which processes are effective and which require some tweaking. Lean tools and environmental protection are powerful components for continuous development [4,5]. According to ref. [6], customer demand for eco-friendly products and services is increasing. Most industries want to make processes more efficient through sustainable initiatives because they must comply with environmental regulations while also meeting the demands of customers and other interested parties [7]. Lean management is a great technique for improving the quality of a product as well as reducing the cost of production [8,9]. Therefore, researchers are trying to understand the impact of the lean transformation of an industry during the last three decades [10]. Lean activities can be integrated at all levels of supply chain management. As a result, all supply chain activities will be optimized, which will make the supply chain effective. Such management will improve the quality of a product, reduce production costs, and make the supply chain more flexible [11]. Lean tools can integrate a supply chain's customers and external providers. Furthermore, lean production is the best strategy for maintaining the minimum amount of in-process inventory and finished product. In addition, a firm's operational performance can be improved using lean practices [12]. Therefore, many industries worldwide are trying to implement this strategy to improve their business performance [13]. Incorporating sustainable or environmental issues in business practices is essential to survive in a competitive market. In order to reduce the adverse effect on the environment, the impact of products or services needs to be measured in terms of pollution generated [14]. A "green" image can be spread globally by integrating the traditional supply chain with the environmental aspect. Green practices in the supply chain play an essential role in maintaining or retaining a competitive image and improving positive economic and environmental performance [15].

Green manufacturing advances by forcing the manufacturing process and technology to pollute rather than be used to reduce the negative environmental impact [2]. A green supply chain is designed to benefit from long-term competitiveness in all aspects [16]. Another study demonstrated that the green supply chain is still in its infancy, particularly in Bangladesh's textile sector [17]. Economic, environmental, and social factors must be considered when determining whether something is sustainable [18]. The implementation of the green–lean strategy is seen more in developed countries than in developing economies [2]. The insufficiency of metrics and assessments is a typical challenge or hurdle in implementing a green–lean supply chain strategy [19]. A fuzzy linguistic model illustrates and manages flexible information [20]. To address the interdependence of a group of attributes, DEMATEL is employed [21]. This study aims to develop a sustainable culture in the main area of the supply chain and to give a framework for decision-making based on the correlation of relevant factors and an industry-specific realistic scenario. This research uses the best-suited method Fuzzy DEMATEL to answer the following research questions:

- What are the factors that affect GLSCM performance?
- How can the interactions and interdependencies among these factors be identified?
- What are the cause-and-effect behavior of the factors that influence GLSCM performance?

The fuzzy DEMATEL technique is utilized to fulfill the study's purpose when making decisions in the face of uncertainty. The DEMATEL method is useful for establishing cause-and-effect relationships among complex factors in circumstances where the factors are interconnected, assessing the relative importance of various components and creating more informal links. There has not been much research on the interaction between operational performance and the environment, although some of it has been duplicated in earlier work [6]. Very little research has been done on the critical factors that will determine whether a green supply chain is successful [22]. Another study suggested that a set of elements or criteria needed to be developed and prioritized systematically in order to increase the effectiveness of the green supply chain [23].

This research makes a unique contribution by examining the interconnected factors of GLSCM and their correlation, interactions, and interdependencies that impact the overall performance of the supply chain. However, it is essential to recognize and analyze the interrelationship between green and lean supply chain management factors to improve supply chain performance and achieve sustainable goals. Even though little research has identified the factor's effects on performance measures of a green lean supply chain, no substantial study has been found in the literature investigating the impact and correlation of the factors on GLSCM performance measure. Identification, prioritization, interdependencies between the factors and implementation of GLSCM is still at the development stage.

The remainder of this paper is structured as follows. In Section 2, a review of the literature on lean practice, green practice, and their integration is presented. Section 3 provides an overview of the methodology, including the reliability and consistency analysis of the collected data, as well as the fuzzy DEMATEL methods with their corresponding steps and formulas. Numerical illustrations are provided in Section 4. Section 5 explains the results and serves as an evaluation of the calculations. Finally, Section 6 concludes the paper by discussing the study's implementation, providing managerial insights, addressing limitations, and suggesting future research directions.

2. Literature Review

The literature review examines relevant research on the integration of lean, green, and sustainable supply chain management concepts. The study provides the foundation for the current research, which utilizes the Fuzzy DEMATEL approach to identify and rank Green Lean factors. GLSCM is a strategy that blends the ideas of lean and green practices to build an environmentally responsible and sustainable supply chain. In order to eliminate waste, reduce carbon footprint, and improve overall efficiency and sustainability throughout the entire supply chain, GLSCM integrates lean methodologies with environmentally friendly behaviors. To accomplish ecologically sound supply chain operations, GLSCM also emphasizes eliminating non-value-adding processes, improving resource consumption, encouraging eco-friendly practices, and assuring social responsibility [24–26]. In another study, both internal and external influences drive supply chain lean and green techniques. It further asserts that for the supply chain to implement the green lean concept, it is important to fully comprehend the differences between green and lean implementation strategies. Finally, creating a lean environment serves as a catalyst for successful green implementation. Nowadays, keeping a green image, ecological balance and environmental sustainability in mind is a key concern for the researcher [27–29].

Analyzing the barriers to lean encourages analyzing the interrelationship between performance measures of lean and green implementation in the supply chain. Sustainability in the supply chain is one approach to achieving long-term benefits through the integration of environmental and economic factors [30,31]. Chakraborty et al. (2023) conducted a study on internal factors of green supply chain management (GSCM) and proposed a theoretical model based on driving and dependence power. The authors utilized interpretative structural modeling (ISM) to incorporate industry experience into the evaluation process. Eight internally manageable factors were identified, with top management commitment being the most influential [32]. According to [33], to optimize the entire performance of a supply chain via green practices, the performance factors should be studied, and their interactions should be recognized and understood. The DEMATEL method, which makes this possible, is a path for successfully improving performance. The DEMATEL method is suggested as a means to achieve this, as it enables the evaluation of factors and the identification of causal relationships [34]. Caldera et al. [35] highlighted the need for research on how lean practices can contribute to environmental outcomes and promote sustainability in business processes. They emphasized the importance of integrating lean and green approaches to improve business performance [35,36]. The DEMATEL method is recommended for evaluating factors and understanding their causal relationships in the supply chain. The fuzzy DEMATEL method is useful in decision-making under uncertainty, especially for maintaining supply chain sustainability. Additionally, it allows for evaluating interdependencies and impacts among variables, representing the intricate relationships inside the green lean supply chain. Moreover, fuzzy DEMATEL offers a comprehensive evaluation framework that considers the factors' direct and indirect effects, identifying key drivers and facilitating effective decision-making for enhancing supply chain performance [36–38]. The fuzzy DEMATEL technique combines fuzzy set theory and DEMATEL to examine factor interdependencies. Fuzzy set theory manages uncertainty by giving linguistic concepts membership degrees, whereas DEMATEL looks at interactions between components. Fuzzy DEMATEL considers direct and indirect impacts to capture complex supply chain management dynamics. It uses fuzzy set theory to resolve data uncertainty and imprecision, allowing for accurate factor importance assessment [38,39].

The relationship between green and lean Is shown to address how they are related to performance factors and how they are related to the idiosyncratic system. Collaboration reduces the cost of partnering with one another and allows for faster customer service [40]. The balance between efficiency gained and eco-friendliness in operation can be achieved by installing green and lean initiatives simultaneously. Six streams of research can be carried out on the green and lean approach, namely: the compatibility of lean and green, their integration with other paradigms, their application in industry, indicators to measure their performance in an organization, and their impact on the performance of an organization [41]. According to refs. [42,43], very little research has been done on environmental sustainability in developing countries. As a result, they identify a research need for implementing green and lean processes in supply chains using performance metrics and resulting in supply chain improvement. One study mentioned that a company could implement green, lean, and global practices simultaneously. An integrated approach to environmental sustainability and increasing productivity is highly required for every industry because competition worldwide focuses on a company's green image. Moreover, combining lean and environmental sustainability allows for more efficient resource utilization [24,44].

Today's economic outlook is highly competitive, and companies in different sectors must take various measures to survive. Overall, creating an image of green and lean practices provides a globally positive impression that helps to improve environmental and operational performance simultaneously. Based on the research gap, this manifests a demand for assessing green lean supply chain management performance. This study will assist in deciding on the most critical criterion for enhancing the performance of a lean supply chain in a certain industry. The mentioned challenges motivated the authors to work on "green" and "lean" practices in SCM in developing countries.

This study aims to identify and analyze factors by reviewing the literature and gathering insights from a panel of five field experts and two academicians, as shown in Table 1. The mutual importance of these factors is examined using the fuzzy Decision-Making Trial and Evaluation Laboratory (fuzzy DEMATEL, a multi-criteria decision-making approach). Refer to the methodology Sections 3.1–3.3 for more comprehensive information.

Table 1. Green and Lean Factors in Literature.

Factors	**Description**	**References**
Eco-friendly Design (F1)	Designing the product and process that is environmentally friendly.	[45–52]
Supplier and customer collaboration (F2)	Collaboration between raw material supplier to manufacturer and manufacturer to the customer considering their impact on the environment.	[49–56]
Carbon management (F3)	Reducing the carbon emission.	
Green purchasing (F4)	Purchasing goods through the eco-friendly process.	
Demand variation (F5)	It results from the complexity of the supply chain and volatile market.	[47,50,55,57–60]
Collaboration between Supply chain (F6)	Good and long-term relationships among suppliers, manufacturers, chain, and customer.	
Kanban System (F7)	Use visual things to control the production and movement of the goods in the supply chain.	
Logistic Efficiency (F8)	Efficient movement of the goods between buyer and seller.	
Quality Improvement (F9)	Providing a quality product and better service to the customer.	
Information Technology (F10)	Enable the company to see the customer/user demand.	
Minimize lead time (F11)	Lead time is the time between order placed to receive the goods.	[61]
Capacity utilization (F12)	Utilizing the equipment and facility efficiently.	[62]
Customer satisfaction (F13)	Indicating all aspects that involve in fulfilling customer need in a right way serves the customer.	

Table 1. *Cont.*

Factors	Description	References
Minimize waste (F14)	Reducing waste is a non-value-added activity.	[63]
Recovery and reuse (F15)	Reuse of the waste after production and recovery of the product after use.	[4,46,49,56]

3. Research Methodology

3.1. Data Collection

The aim of this research is to assess the level of importance of factors in implementing a Green and Lean Supply Chain Management Performance. A comprehensive literature review was conducted to accomplish this objective, and discussions were held with experts from the RMG Industry located in Dhaka, Bangladesh. These companies aim to increase their worldwide impact on environmental performance so that they may gain various economic and ecological benefits in their business endeavors. The identified factors were selected based on their significant impact on the Supply Chain Performance of organizations. Additionally, extensive brainstorming sessions involving five industry experts and two academic experts were scheduled to reinforce and enhance the inputs obtained from the literature review. Industry experts considered the factors based on the Bangladeshi industry context, their capacity to be implemented in the sector, and their controllability in the group discussion. Since the process of industrialization depends on numerous factors, industry practices and cultures vary from region to region. This research considered both internal and external factors of the GLSCM focusing on lean and green together.

As a preliminary step, a questionnaire was created using a five-point Likert scale (ranging from 1 for least important to 5 for most important). This questionnaire was sent to 50 field experts to gather their opinions and assess the importance level and feasibility of the identified factors. To ensure the reliability of the questionnaire, a reliability analysis was conducted. Furthermore, to examine the consistency of the considered enablers, Kappa statistics were utilized. The opinions of 30 experts (20 from industry and 10 from academia) were collected through a questionnaire. These experts were asked to indicate the presence of fifteen factors across five perspectives: managerial, information, integration, production, and environment. The internal consistency of the enablers under these perspectives was evaluated by calculating the Kappa index value based on the collected opinions. The obtained Kappa index value falls within the significant range (0.21–0.40). This indicates that the identified set of factors is consistent and can be further analyzed.

After verifying the reliability and consistency of the identified factors, a fuzzy DEMATEL approach was employed for analysis. To facilitate this process, a questionnaire was developed using linguistic terms that ranged from "no influence" to "very high influence." This questionnaire was then discussed with 30 field experts who were requested to provide their opinions regarding the importance level of the factors under consideration. The fuzzy DEMATEL approach was implemented step by step to achieve the specific objective of the research. This approach enables the evaluation of interdependencies and influences among the factors, offering valuable insights into their relative significance and impact. Figure 1 depicts a representation of the process, providing an overview of the research approach.

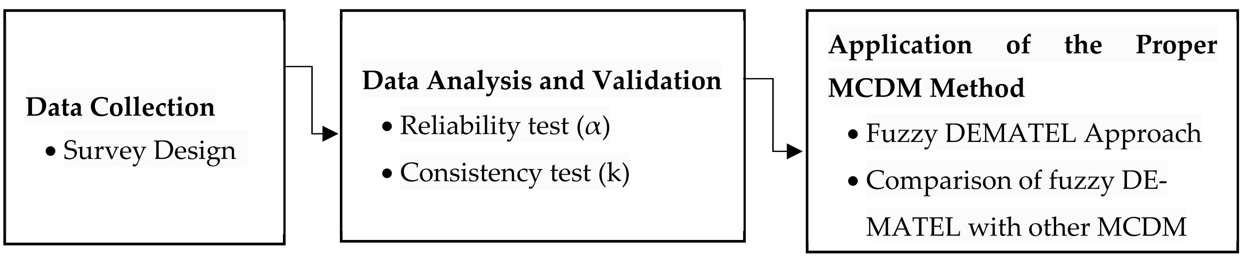

Figure 1. Overview of the Methodology.

3.2. Data Analysis and Validation

3.2.1. Reliability Analysis

To assess the feasibility of the considered factors, a questionnaire was distributed to 50 professionals and academics, and 30 responses were received. The response rate of 60% was deemed sufficient for analysis, following the guidelines of Malhotra and Grover (1998) [64]. The collected data were evaluated for reliability using Cronbach's alpha coefficient (α) in SPSS-23. The computed coefficient was found to be 0.884, which falls within the recommended range ($0.7 < \alpha < 0.95$) and indicates satisfactory internal consistency (Table 2). The mean and standard deviation of the responses were also calculated. These statistics provide an initial understanding of the importance level of the factors based on their mean values. For instance, F5, F6, F10, and F13 factors exhibited higher mean values compared to other factors. This suggests that these factors hold greater significance in establishing a better green lean supply chain performance.

Table 2. Reliability and item statistics.

Reliability Statistics				
Cronbach's Alpha			No. of Items	
0.884			15	
Item Statistics				
Factors	Mean	Std. Deviation	Corrected Item-Total Correlation	Respondents
F1	4.6333	0.49013	0.173	30
F2	4.4667	0.50742	0.258	30
F3	4.6333	0.49013	0.572	30
F4	4.7000	0.46609	0.210	30
F5	4.6000	0.49827	0.848	30
F6	4.4667	0.73030	0.832	30
F7	4.5000	0.62972	0.470	30
F8	4.2000	0.84690	0.758	30
F9	4.3333	0.71116	0.364	30
F10	4.5333	0.50742	0.835	30
F11	4.2667	0.73968	0.553	30
F12	4.7000	0.46609	0.537	30
F13	4.0000	0.83045	0.801	30
F14	3.7333	0.86834	0.548	30
F15	4.4667	0.73030	0.479	30

3.2.2. Check for Internal Consistency: Kappa Statistics

To evaluate the consistency of the considered factors across different perspectives, namely, the managerial perspective (P1), information perspective (P2), integration perspective (P3), and production perspective (P4), environmental perspective (P5) Kappa statistics developed by Cohen (1968) [65] were employed. The kappa index (k) is a measure of real and actual consensus and is the ratio of observed theoretical and chance agreement to agreement that goes beyond chance. Instead of being determined by chance, the contract is appraised quantitatively. As the identified factors can be categorized under these five perspectives, it was essential to assess the consistency of each factor within its corresponding perspective. Hence, Kappa statistics were utilized in this study to understand the nature of consistency for each factor under the respective perspective. Table 3 has been developed, and the number of experts involved in the existence of factors in the respective category is represented by the filled value in each cell. P_i and P_j represent the degree of involvement of experts for the ith barrier and the assignments percentage under the jth category, respectively.

Table 3. Summary of 30 experts under 5 perspectives.

Factors	Perspectives					Pi
	P1	P2	P3	P4	P5	
Eco-friendly Design (F1)	3	0	2	5	20	0.331034
Supplier and customer collaboration (F2)	22	3	4	1	0	0.413793
Carbon management (F3)	4	1	1	1	23	0.457471
Green purchasing (F4)	20	3	0	2	5	0.331034
Demand variation (F5)	5	3	5	17	0	0.227586
Collaboration between Supply chain (F6)	4	3	21	2	0	0.367816
Kanban System (F7)	1	7	3	20	0	0.355172
Logistic Efficiency (F8)	3	23	3	1	0	0.457471
Quality Improvement (F9)	2	0	3	22	3	0.409195
Information Technology (F10)	2	24	2	2	0	0.503448
Minimize lead time (F11)	3	2	5	20	0	0.331034
Capacity utilization (F12)	1	3	3	23	0	0.457471
Customer satisfaction (F13)	24	0	2	1	3	0.505747
Minimize waste (F14)	3	1	1	5	20	0.328736
Recovery and reuse (F15)	3	0	0	25	2	0.56092
Pj	0.222	0.162	0.122	0.326	0.168	K = 0.229

The value of kappa (k) is calculated as:

$$K = \frac{\text{Proportion of the observed agreement } - \text{ Chance agreement}}{1 - \text{ Chance agreement}} = 0.229$$

Table 4 provides the kappa value interpretation scale that suggested by Landis and Koch (1977) [66]. When 'k = 0.229' is examined, it is discovered that it pertains to establishing that all factors in their category are given fair consideration. In accordance with the work's methodology, additional analysis has been performed utilizing the fuzzy DEMATEL technique.

Table 4. Scale for interpretation of Kappa Statistics.

Values of K	<0	0.1–0.20	0.21–0.40	0.41–0.60	0.61–0.80	0.81–1.00
Interpretation	Poor	Slight	Fair	Moderate	Substantial	Perfect

3.3. Fuzzy DEMATEL Approach

DEMATEL is an efficient technique that focuses on assessing the interdependencies between elements and identifying the significant factors. Few approaches can find the factors' impact on GLSCM performance; hence, the DEMATEL method is chosen based on their relative importance [24,67]. Furthermore, it was mentioned that the DEMATEL technique's main advantage is that it shows how different variables interact and reveals how much one variable influences another and how much another variable influences another. DEMATEL method enables the factor to impact interdependently among other criteria or factors and helps establish a chart that illustrates the relevant link, which is used to evaluate and solve complicated problems concurrently with the connected problem. AHP, TOPSIS, and VIKOR could not establish causal links between variables; however, DEMATEL succeeded in doing so [68–70]. This model is very good at employing digraphs to represent the complex structure of causal links involving multiple elements. The matrices or digraphs represent the relationships between the factors, and the numerical expressions demonstrate the degree to which one criterion impacts another criterion. In the DEMATEL technique, the system comprises several criteria, such as F1, F2, F3, F4, and so on, and pair-wise comparisons are used to demonstrate the mathematical correlations. After establishing the relationships between the complex criteria, the subjective viewpoint is logically transformed into a linguistic term using the DEMATEL technique [5,71,72].

In order to start using the fuzzy DEMATEL method, the author first formed a committee, explained the purpose of our research to each member, and collected pertinent data. The following is a description of the step-by-step Fuzzy DEMATEL methods and solution approaches:

Step 1. A five-level linguistic measurement scale is used for pair-wise comparison based on relative influence, as shown in Table 5.

Table 5. Fuzzy linguistic scale.

Linguistic Variable	Influence Score	Triangular Fuzzy Numbers (TFN's)
Very high Influence	4	(0.7, 0.9, 1.0)
High Influence	3	(0.5, 0.7, 0.9)
Low Influence	2	(0.3, 0.5, 0.7)
Very low Influence	1	(0.1, 0.3, 0.5)
No Influence	0	(1, 1, 1)

Step 2. Expert opinion is collected using questionnaires for this research.

Step 3. After getting the Expert's input, the matrix is fuzzified according to the linguistic measurement scale in Table 5.

Step 4. Chang et al., (2011) [62] claimed centroid (center of gravity) is very popular for defuzzification into crisp value, but most of the research proposed using CFCS (converting fuzzy data into the crisp score) for defuzzification. The following Equation I and j indicate the factors where, i = 1, 2, 3, . . . , n and j = 1, 2, 3, . . . , n.

CFCS Normalization:

$$xr_{ij}^{n} = \left(r_{ij}^{n} - minl_{ij}^{n}\right) / \Delta_{min}^{max} \quad (1)$$

$$xm_{ij}^{n} = \left(m_{ij}^{n} - minl_{ij}^{n}\right) / \Delta_{min}^{max} \quad (2)$$

$$xl_{ij}^{n} = \left(l_{ij}^{n} - minl_{ij}^{n}\right) / \Delta_{min}^{max} \quad (3)$$

Calculating Is and rs:

$$xrs_{ij}^{n} = xr_{ij}^{n} / \left(1 + xr_{ij}^{n} - xm_{ij}^{n}\right) \quad (4)$$

$$xls_{ij}^{n} = xm_{ij}^{n} / \left(1 + xm_{ij}^{n} - xl_{ij}^{n}\right) \quad (5)$$

Total normalized crisp value:

$$x_{ij}^{n} = \left[xls_{ij}^{n}\left(1 - xls_{ij}^{n}\right) + xrs_{ij}^{n} \times xrs_{ij}^{n}\right] / \left(1 - xls_{ij}^{n} + xrs_{ij}^{n}\right) \quad (6)$$

Final crisp value:

$$Z_{ij}^{n} = minl_{ij}^{n} + x_{ij}^{n} \times \Delta_{min}^{max} \quad (7)$$

Integrating the crisp value for getting direct relation matrix:

$$Z_{ij}^{n} = \frac{1}{h}(z_{ij}^{1} + z_{ij}^{2} + \ldots + z_{ij}^{h}) \quad (8)$$

Step 5. Developing a direct relation matrix Z is an n*n matrix based on averaging the experts' input for each component in the matrix. Z is gained from Comparisons of pairs of factors based on the interactions and impacts between them. Z can be symbolized as Zij, which is defined as the level of influence of factor i on factor j. An average of the final crisp values of all experts is used to create the direct relation matrix for the Fuzzy DEMATEL approach based on formula (8).

Step 6. Normalizing the direct relation matrix that is X, $X = [X_{ij}]_{nxn}$ and $0 < X_{ij} < 1$, the formula for X is

$$X = K \times Z \quad (9)$$

$$K = \frac{1}{max_{l \leq i \leq n} \sum_{j=1}^{n} Z_{ij}} \quad (10)$$

Step 7. Calculating the total relation matrix that is T, is determined from the following formula where I refers to the identity matrix:

$$Z_{ij}^{n} = \frac{1}{h}\left(z_{ij}^{1} + z_{ij}^{2} + \cdots + z_{ij}^{h}\right) \quad (11)$$

Step 8. Now, determining the sum of row D and the sum of the column R from the total relation matrix T′ is

$$T = t_{ij}\,, where, \quad i, j = 1, 2, \ldots\ldots, n \quad (12)$$

$$D = \sum\nolimits_{j=1}^{n} t_{ij} \quad (13)$$

$$R = \sum\nolimits_{i=1}^{n} t_{ij} \quad (14)$$

Step 9. To construct a cause–effect diagram, (D + R) and (D − R) are calculated where (D + R) represents the horizontal axis and (D − R) represents the vertical axis in a cause–effect diagram.

Step 10. For depicting the interrelation among the criteria, the threshold value (a) is calculated (where N represents the total number of elements in the respective matrix) as follows:

$$a = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \left[t_{ij}\right]}{N} \quad (15)$$

4. Numerical Illustration and Analysis

After conducting factor reliability and consistency analyses, a questionnaire is developed based on a fuzzy linguistic scale (Table 5) and administered to 30 field experts through physical interviews, mailing, and group discussions. Detailed calculations are performed as described in Appendix A (Tables A1–A6). The expert opinions presented in Table A1 were fuzzified based on the fuzzy linguistic scale. The total relation matrix (Table A6) is obtained through step-by-step calculations using Equations (1) to (11). The fuzzified matrix is defuzzified using Equations (1) to (7), involving normalization, calculation of ls and rs values, total normalized crisp value, and final crisp value. The normalized matrix was derived by applying Equations (1) to (3) and left-side and right-side values were determined using Equations (4) and (5). Normalized crisp values are computed with Equation (6), while the final crisp values for each expert are obtained through Equation (7). The average direct relation matrix is calculated using Equation (8), and the direct relation matrix average was generated by averaging the final crisp values of all experts. The average matrix of direct relationships is presented in Table A5. Equations (9) and (10) are used for normalization, with the first value of K obtained by reciprocating the maximum value of each row in the direct relation matrix. Finally, the normalized matrix was obtained by multiplying K with each element in the matrix of direct relations, resulting in Table A6. The total relation matrix was determined using Equation (11).

After calculating the total relation matrix, it is required to calculate the sum of the row of the total relation matrix, D score, and the sum of the column R factor using Equations (13) and (14). Here, the D and R are calculated to get the importance rating (D + R) and interaction level (D − R) and the identity of each. The negative value of the D − R score of the factor falls into the effect group, and the positive value of the D − R score of the factor falls into the cause group. However, the overall ranking is based on the importance and interaction levels. The factor with a higher importance rating and interaction level placed first rank, as shown in Table 6.

Table 6. Ranking of the factor.

Factors	D Value	R Value	D + R Value	D − R Value	Identity	D + R Rank	D − R Rank	Final Rank
Eco-friendly Design (F1)	5.396	7.4259	12.822	−2.030	Effect	2	15	8
Supplier and customer collaboration (F2)	5.690	5.8675	11.557	−0.178	Effect	7	11	11
Carbon management (F3)	5.615	5.9811	11.596	−0.366	Effect	6	12	10
Green purchasing (F4)	6.565	5.9511	12.516	0.614	Cause	3	3	2
Demand variation (F5)	6.722	6.3496	13.072	0.373	Cause	1	7	3
Collaboration between Supply chain (F6)	5.752	5.2338	10.986	0.518	Cause	9	4	6
Kanban System (F7)	4.812	5.829	10.641	−1.017	Effect	12	13	14
Logistic Efficiency (F8)	5.432	5.3372	10.769	0.095	Cause	10	10	12
Quality Improvement (F9)	4.167	6.187	10.354	−2.020	Effect	14	14	15
Information Technology (F10)	6.249	5.9004	12.149	0.349	Cause	4	8	4
Minimize lead time (F11)	5.433	4.9908	10.424	0.442	Cause	13	5	9
Capacity utilization (F12)	6.621	5.0206	11.642	1.601	Cause	5	1	1
Customer satisfaction (F13)	5.658	5.3672	11.025	0.291	Cause	8	9	7
Minimize waste (F14)	5.089	4.7143	9.803	0.374	Cause	15	6	13
Recovery and reuse (F15)	5.802	4.8459	10.648	0.956	Cause	11	2	5

In this step, alpha (a) is calculated using Equation (15), the average of the total relation matrix, where the alpha value is 0.38. Three different categories of the effect of interaction among criteria, and this range of three types of effect in Table 7 is calculated according to [64]. Table 8 shows that the existing value is greater than the alpha value, indicating that the factors in the row are related to the factor in the column.

Table 7. Level of effect.

Effect Type	Range	Level	Effect Value
Strong effect ★	0.513 to 0.586	Maximum	0.586
Moderate effect ⬠	0.439 to 0.513	Average	0.439
		Higher	0.512
Weak effect ■	0.381 to 0.439	Minimum	0.381

Table 8. Interrelation between criteria (a = 0.38).

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	⬠	■	■	⬠	⬠	⬠	⬠	■	⬠	⬠	■	■	★	⬠	■
F2		■		⬠	■	■	■			■	■	■	⬠		
F3													⬠		

Table 8. *Cont.*

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F4				■			■		■				⬠		
F5													■		
F6					⬠	⬠	⬠	■	■	⬠	⬠	⬠	★		
F7	■			■	⬠	⬠	★	■	⬠	⬠	⬠	⬠	★	■	■
F8					⬠	■	■	■		■	⬠	■	⬠		
F9									■				⬠		
F10					⬠	⬠	⬠	■	⬠	⬠	⬠	⬠	★		
F11					■	■	■	■		■	⬠		⬠		
F12					■		■		■		■	⬠	⬠	■	
F13					■	■	■		■	■	■		⬠		
F14							■					■	⬠	■	
F15							■			■		■	⬠		■

5. Results and Discussion

Figure 2 provides a visual representation of the rankings of the factors based on the data presented in Table 6. Demand variation (F5) emerges as the most significant factor with the highest value of D + R, indicating a strong relationship with other factors and a high level of importance as determined from Table 5. The priority rating follows the order: F5 > F1 > F4 > F10 > F12 > F3 > F2 > F13 > F6 > F8 > F15 > F7 > F11 > F9 > F14. This suggests that the primary focus for RMG industries in Bangladesh should be on addressing demand variation (F5), followed by eco-friendly design (F1) and green purchasing (F4), following their priority order.

In Figure 3, the causal diagram depicts how the factors in the cause group influence the factors in the effect group. Analyzing the D-R values, it is observed that capacity utilization (F12) in the cause group has the highest D-R rating, indicating its significant influence within the effect group. Additionally, eco-friendly design (F1) is identified as the most important factor within the effect group. However, factor F2 shows the highest D-R value (−0.178) in the effect group. Hence, the ranking of the effect group's factors can be expressed as F1 > F3 > F2 > F7 > F9, indicating their respective levels of importance. Furthermore, the cause group exhibits positive D-R values, with capacity utilization (F12) having the highest D-R rating (1.601), making it the most influential factor within the cause group. The ranking of the cause group's influence on the effect group is as follows: F5 > F4 > F10 > F12 > F13 > F6 > F8 > F15 > F11 > F14. The top three causes are identified as demand variation (F5), green purchasing (F4), and information technology (F10), while the top three effects are eco-friendly design (F1), carbon management (F3), and supplier and customer collaboration (F2). After analyzing the interrelationship (Table 8) and utilizing the provided data, it is observed that eco-friendly design (F1) exhibits the highest interaction among all the criteria. On the other hand, demand variation (F5) shows negligible interaction with the other criteria. Considering the cause, effect, and interaction of the factors, the overall ranking can be expressed as follows: F12 > F4 > F5 > F10 > F15 > F6 > F13 > F1 > F11 > F3 > F2 > F8 > F14 > F7 > F9. These rankings and implications highlight the critical factors and their interrelationships in the context of green lean supply chain management.

They provide valuable insights for decision-makers in RMG industries in Bangladesh, aiding them in prioritizing their efforts and resources for maximum impact on supply chain performance and sustainability.

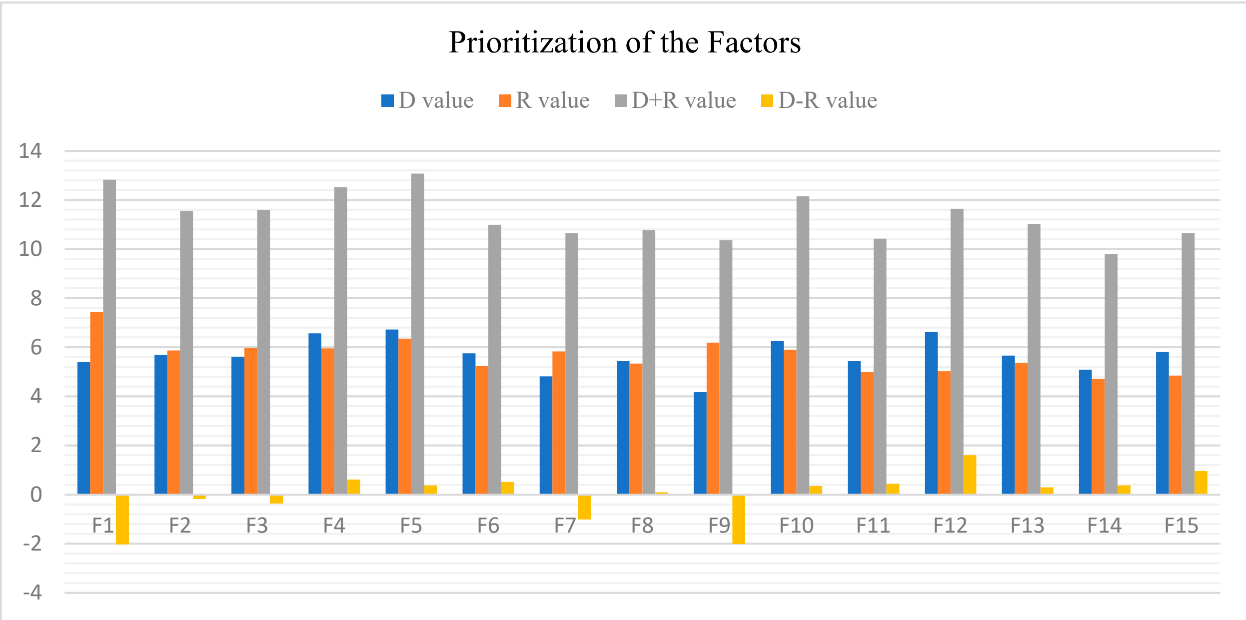

Figure 2. Prioritization of the Factors.

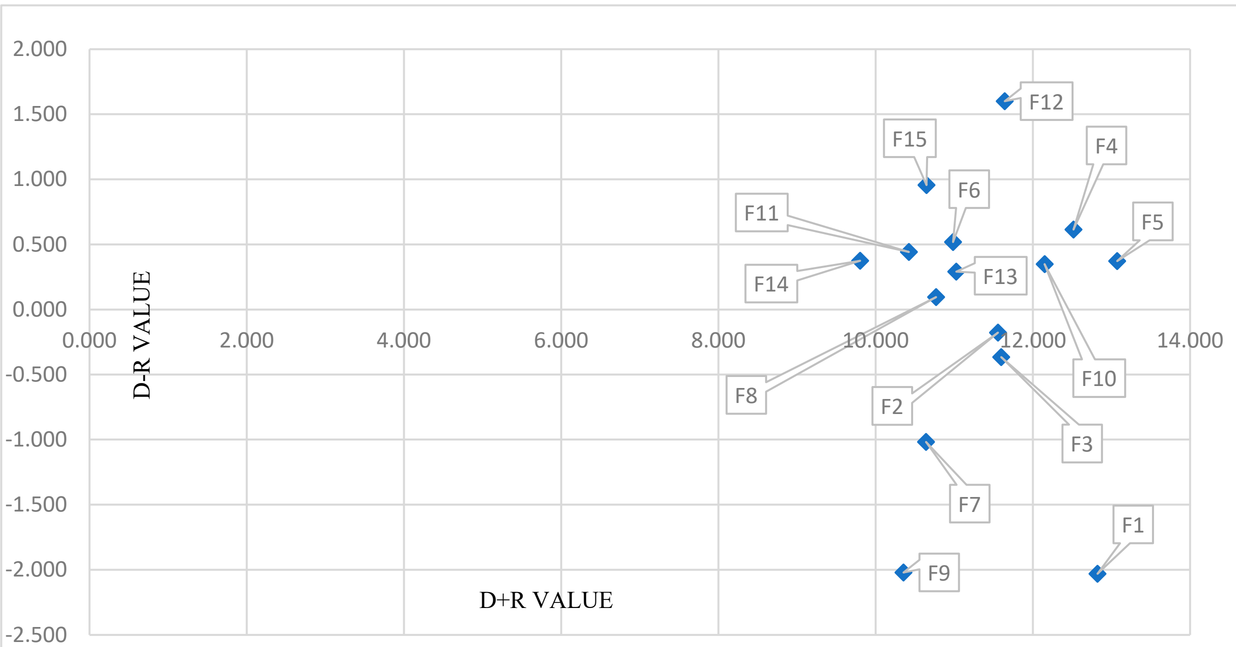

Figure 3. Cause and Effect Diagram.

6. Conclusions

The research objective is fulfilled through the application of the fuzzy DEMATEL method, which analyzes a group of fifteen factors. This method, based on fuzzy set theory, reduces ambiguity in decision-making. The study reveals that effective capacity utilization (F12) is the most important factor and exhibits the highest level of interaction with other factors, resulting in the ranking: F12 > F4 > F5 > F10 > F6. These factors have a greater influence on the specific research purpose as they exhibit higher interaction levels and belong to the cause group, as indicated by their D-R ratings. Table 6 identifies five major cause factors (F5, F4, F10, F12, F6) and three major effect factors (F1, F3, F2) based on their overall rankings within each group. It is crucial to focus on improving the effect group (F1, F2, F3, F7, F9) since the cause group easily influences it. So, the effect group should be improved in the order of F1 > F3 > F2, paying more attention to these factors. Considering this, improvements in F1, F2, and F3 should be prioritized by focusing on F1, F4, F5, F6, and F10. In summary, to enhance the performance of Green Lean supply chain management in Bangladesh, companies should prioritize F5, F4, F10, F12, F6, F15, and F13. The study's findings provide valuable insights for managers in managing and selecting factors to improve the performance of Green Lean supply chain management.

6.1. Implementation of the Study

Establishing a strong reputation for implementing green and lean factors/methods is beneficial for enhancing operational and environmental performance while reducing uncertainty in decision-making. According to the rankings, the utilization of proper capacity (F12) exhibits the highest level of interaction among all criteria related to implementation. Green purchasing holds the second-highest level of interaction among the implementation elements. Before developing a plan, the management team needs to determine the schedule and approach to be used. Initially, priority should be given to establishing a demand variation system, as it ranks higher in the priority list compared to increasing customer satisfaction. This is because customer satisfaction processes are influenced by effective demand variation. The implementation of an advanced IT system takes precedence over supply chain collaboration, as the advanced use of Information Technology (IT) holds a higher ranking. This is because the advanced use of IT influences supply chain collaboration. Effective collaboration within the supply chain is only possible when advanced IT utilization and GLSCM implementation is in place.

6.2. Managerial and Environmental Implications

The findings of this research should be taken into consideration when aiming to enhance the performance of the supply chain from a green–lean perspective. Unlike previous studies that focused solely on the application of green–lean processes, this study reveals the integration, linkage, and relationships between green and lean methods. The identified factors and their interdependencies provide valuable insights for managers to effectively allocate resources and address ambiguity in decision-making. This research serves as a guideline for improving supply chain management performance by integrating green and lean practices and identifying the most significant factors for success. Key factors highlighted in this study include demand variation, green purchasing, proper capacity utilization, waste minimization, recovery, and reuse. The managerial team can benefit from these findings by better understanding upcoming challenges and identifying areas that require attention and action. Organizations can successfully reduce their greenhouse gas emissions and environmental impact by giving priority to aspects like eco-friendly design, green purchasing, and carbon management. By implementing these ideas, supply chains can be made more environmentally friendly while using fewer resources, producing less waste, and overall improving environmental conditions.

6.3. Practical Recommendations for Managers and Decision-Makers

Managers and decision-makers can improve their supply chains' effectiveness by implementing realistic recommendations based on the factors they have prioritized. To improve customer satisfaction and reduce stock-outs, they should concentrate on resolving demand fluctuation (F5) by utilizing techniques like demand forecasting and responsive production planning. Emphasizing eco-friendly design (F1) principles can lessen the ecological impact and encourage environmental responsibility. These principles include incorporating sustainable materials and energy-efficient methods. Establishing alliances with environmentally conscious suppliers, performing audits, and promoting green procurement practices are all part of prioritizing green purchasing (F4). By utilizing information technology (F10) solutions, inventory control may be improved, supply chain visibility can be increased, and real-time data sharing can be made possible for effective decision-making. By integrating these variables into their strategy, managers can achieve sustainable goals, enhance supply chain performance, and gain a competitive advantage.

6.4. Limitations and Future Directions

While the findings of this analysis provide valuable insights into the specific industry and region under study, several limitations must be acknowledged. First, the generalizability of the results to other sectors or regions may be limited. The factors and their prioritization could vary in different industries or geographic contexts, considering variations in supply chain practices, customer preferences, and regulatory environments. Second, the fuzzy DEMATEL approach relies on expert opinions and subjective assessments, introducing potential biases and variability into the results. The weighting and scoring of factors are based on the experts' perceptions, which may differ among individuals. Obtaining diverse expert opinions and ensuring transparency in the decision-making process can help mitigate these biases. Third, the availability and quality of data used in the study can impact the accuracy and reliability of the results. Data limitations, such as incomplete or outdated information, may affect the rankings and relationships between factors. Future research should aim to gather more comprehensive and up-to-date data to enhance the robustness of the analysis. Furthermore, this study does not consider the dynamic nature of industries and markets. The identified criteria and their priorities may change over time due to evolving technologies, market trends, or regulatory frameworks. Conducting longitudinal studies would capture these changes and provide a more accurate understanding of the evolving importance of green and lean supply chain management factors.

To address these limitations and enhance future research, it is recommended to incorporate sub-criteria within the analysis. Breaking down the factors into specific components can yield more accurate and actionable insights. Additionally, considering the influence of external factors, such as regulations, market trends, and technological advancements, on the identified factors and their prioritization is crucial for a comprehensive understanding of green and lean supply chain management. Moreover, developing decision support systems or tools based on the study's findings can assist managers in effectively implementing green and lean supply chain management techniques. These tools can provide real-time data analysis, scenario modeling, and decision-making support to optimize supply-chain processes and align with sustainability goals.

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Appendix A

See Tables A1–A6.

Table A1. Direct relation matrix based on expert opinion.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0	3	4	4	1	3	3	2	3	3	1	2	3	4	4
F2	4	0	3	4	1	3	2	2	1	2	1	2	2	4	4
F3	3	2	0	3	1	1	1	1	2	1	1	1	2	2	2
F4	4	4	4	0	1	1	3	1	2	2	2	1	1	3	4
F5	2	1	1	1	0	2	2	1	1	1	2	1	3	1	1
F6	2	2	1	1	3	0	3	1	3	4	3	2	3	1	1
F7	3	2	3	2	3	3	0	4	2	3	3	3	4	3	2
F8	2	2	1	3	3	3	3	0	2	4	4	2	3	2	1
F9	2	1	2	2	3	3	3	1	0	3	1	2	4	2	2
F10	1	2	1	1	3	3	2	3	3	0	3	2	4	1	1
F11	1	1	1	1	3	3	2	3	2	4	0	3	4	1	1
F12	3	1	3	3	3	2	3	2	2	2	2	0	2	4	4
F13	2	1	1	1	3	4	3	3	4	3	3	2	0	1	1
F14	3	2	4	4	1	2	3	1	2	1	1	3	2	0	4
F15	3	3	4	3	1	2	3	1	2	2	1	3	2	4	0

Table A2. Normalized crisp value.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0.72	0.44	0.64	0.64	0	0.44	0.44	0.22	0.44	0.44	0	0.22	0.44	0.64	0.64
F2	0.64	0.72	0.44	0.64	0	0.44	0.22	0.22	0	0.22	0	0.22	0.22	0.64	0.64
F3	0.44	0.22	0.72	0.44	0	0	0	0	0.22	0	0	0	0.22	0.22	0.22
F4	0.64	0.64	0.64	0.72	0	0	0.44	0	0.22	0.22	0.22	0	0	0.44	0.64
F5	0.22	0	0	0	0.72	0.22	0.22	0	0	0	0.22	0	0.44	0	0
F6	0.22	0.22	0	0	0.44	0.72	0.44	0	0.44	0.64	0.44	0.22	0.44	0	0
F7	0.44	0.22	0.44	0.22	0.44	0.44	0.72	0.64	0.22	0.44	0.44	0.44	0.64	0.44	0.22
F8	0.22	0.22	0	0.44	0.44	0.44	0.44	0.72	0.22	0.64	0.64	0.22	0.44	0.22	0
F9	0.22	0	0.22	0.22	0.44	0.44	0.44	0	0.72	0.44	0	0.22	0.64	0.22	0.22
F10	0	0.22	0	0	0.44	0.44	0.22	0.44	0.44	0.72	0.44	0.22	0.64	0	0
F11	0	0	0	0	0.44	0.44	0.22	0.44	0.22	0.64	0.72	0.44	0.64	0	0
F12	0.44	0	0.44	0.44	0.44	0.22	0.44	0.22	0.22	0.22	0.22	0.72	0.22	0.64	0.64
F13	0.22	0	0	0	0.44	0.64	0.44	0.44	0.64	0.44	0.44	0.22	0.72	0	0
F14	0.44	0.22	0.64	0.64	0	0.22	0.44	0	0.22	0	0	0.44	0.22	0.72	0.64
F15	0.44	0.44	0.64	0.44	0	0.22	0.44	0	0.22	0.22	0	0.44	0.22	0.64	0.72

Table A3. Final crisp value.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0.75	0.5	0.68	0.68	0.1	0.5	0.5	0.3	0.5	0.5	0.1	0.3	0.5	0.68	0.68
F2	0.68	0.75	0.5	0.68	0.1	0.5	0.3	0.3	0.1	0.3	0.1	0.3	0.3	0.68	0.68
F3	0.5	0.3	0.75	0.5	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.3	0.3	0.3
F4	0.68	0.68	0.68	0.75	0.1	0.1	0.5	0.1	0.3	0.3	0.3	0.1	0.1	0.5	0.68

Table A3. *Cont.*

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F5	0.3	0.1	0.1	0.1	0.75	0.3	0.3	0.1	0.1	0.1	0.3	0.1	0.5	0.1	0.1
F6	0.3	0.3	0.1	0.1	0.5	0.75	0.5	0.1	0.5	0.68	0.5	0.3	0.5	0.1	0.1
F7	0.5	0.3	0.5	0.3	0.5	0.5	0.75	0.68	0.3	0.5	0.5	0.5	0.68	0.5	0.3
F8	0.3	0.3	0.1	0.5	0.5	0.5	0.5	0.75	0.3	0.68	0.68	0.3	0.5	0.3	0.1
F9	0.3	0.1	0.3	0.3	0.5	0.5	0.5	0.1	0.75	0.5	0.1	0.3	0.68	0.3	0.3
F10	0.1	0.3	0.1	0.1	0.5	0.5	0.3	0.5	0.5	0.75	0.5	0.3	0.68	0.1	0.1
F11	0.1	0.1	0.1	0.1	0.5	0.5	0.3	0.5	0.3	0.68	0.75	0.5	0.68	0.1	0.1
F12	0.5	0.1	0.5	0.5	0.5	0.3	0.5	0.3	0.3	0.3	0.3	0.75	0.3	0.68	0.68
F13	0.3	0.1	0.1	0.1	0.5	0.68	0.5	0.5	0.68	0.5	0.5	0.3	0.75	0.1	0.1
F14	0.5	0.3	0.68	0.68	0.1	0.3	0.5	0.1	0.3	0.1	0.1	0.5	0.3	0.75	0.68
F15	0.5	0.5	0.68	0.5	0.1	0.3	0.5	0.1	0.3	0.3	0.1	0.5	0.3	0.68	0.75

Table A4. Average direct relation Matrix.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0.75	0.44	0.55	0.64	0.28	0.34	0.52	0.35	0.52	0.41	0.21	0.32	0.53	0.6	0.52
F2	0.38	0.75	0.35	0.42	0.39	0.56	0.44	0.3	0.3	0.3	0.28	0.45	0.48	0.32	0.35
F3	0.47	0.47	0.75	0.49	0.28	0.2	0.24	0.15	0.41	0.27	0.23	0.25	0.43	0.36	0.36
F4	0.55	0.43	0.5	0.77	0.24	0.17	0.41	0.21	0.38	0.33	0.32	0.35	0.38	0.36	0.52
F5	0.19	0.18	0.1	0.2	0.79	0.38	0.33	0.24	0.3	0.32	0.46	0.25	0.48	0.16	0.16
F6	0.3	0.41	0.19	0.23	0.52	0.77	0.55	0.38	0.38	0.6	0.64	0.52	0.53	0.3	0.27
F7	0.39	0.32	0.35	0.42	0.38	0.52	0.75	0.49	0.38	0.41	0.5	0.62	0.63	0.52	0.38
F8	0.19	0.36	0.13	0.25	0.57	0.56	0.47	0.75	0.3	0.52	0.69	0.46	0.35	0.3	0.16
F9	0.19	0.21	0.19	0.25	0.44	0.34	0.36	0.24	0.75	0.47	0.24	0.21	0.67	0.3	0.3
F10	0.33	0.35	0.27	0.29	0.59	0.56	0.52	0.55	0.52	0.75	0.56	0.51	0.56	0.24	0.24
F11	0.19	0.3	0.27	0.26	0.53	0.54	0.38	0.58	0.29	0.55	0.79	0.3	0.67	0.13	0.21
F12	0.38	0.19	0.33	0.34	0.5	0.26	0.41	0.49	0.35	0.27	0.38	0.79	0.31	0.63	0.46
F13	0.3	0.3	0.19	0.2	0.46	0.56	0.38	0.35	0.55	0.44	0.54	0.21	0.76	0.27	0.24
F14	0.44	0.27	0.43	0.5	0.5	0.28	0.53	0.19	0.35	0.24	0.15	0.56	0.41	0.75	0.49
F15	0.44	0.27	0.49	0.5	0.27	0.22	0.44	0.21	0.38	0.38	0.21	0.43	0.35	0.52	0.75

Table A5. Normalized direct relation matrix.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0.106	0.062	0.078	0.091	0.040	0.048	0.074	0.050	0.074	0.058	0.030	0.045	0.075	0.085	0.074
F2	0.054	0.106	0.050	0.059	0.055	0.079	0.062	0.042	0.042	0.042	0.040	0.064	0.068	0.045	0.050
F3	0.067	0.067	0.106	0.069	0.040	0.028	0.034	0.021	0.058	0.038	0.033	0.035	0.061	0.051	0.051
F4	0.078	0.061	0.071	0.109	0.034	0.024	0.058	0.030	0.054	0.047	0.045	0.050	0.054	0.051	0.074
F5	0.027	0.025	0.014	0.028	0.112	0.054	0.047	0.034	0.042	0.045	0.065	0.035	0.068	0.023	0.023
F6	0.042	0.058	0.027	0.033	0.074	0.109	0.078	0.054	0.054	0.085	0.091	0.074	0.075	0.042	0.038
F7	0.055	0.045	0.050	0.059	0.054	0.074	0.106	0.069	0.054	0.058	0.071	0.088	0.089	0.074	0.054
F8	0.027	0.051	0.018	0.035	0.081	0.079	0.067	0.106	0.042	0.074	0.098	0.065	0.050	0.042	0.023

Table A5. *Cont.*

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F9	0.027	0.030	0.027	0.035	0.064	0.048	0.051	0.034	0.106	0.067	0.034	0.030	0.095	0.042	0.042
F10	0.047	0.050	0.038	0.041	0.084	0.079	0.074	0.078	0.074	0.106	0.079	0.072	0.079	0.034	0.034
F11	0.027	0.042	0.038	0.037	0.075	0.076	0.054	0.082	0.041	0.078	0.112	0.042	0.095	0.018	0.030
F12	0.054	0.027	0.047	0.048	0.071	0.037	0.058	0.069	0.050	0.038	0.054	0.112	0.044	0.089	0.065
F13	0.042	0.042	0.027	0.028	0.065	0.079	0.054	0.050	0.078	0.062	0.076	0.030	0.108	0.038	0.034
F14	0.062	0.038	0.061	0.071	0.071	0.040	0.075	0.027	0.050	0.034	0.021	0.079	0.058	0.106	0.069
F15	0.062	0.038	0.069	0.071	0.038	0.031	0.062	0.030	0.054	0.054	0.030	0.061	0.050	0.074	0.106

Table A6. Total relation matrix.

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	0.444	0.385	0.396	0.446	0.442	0.441	0.495	0.392	0.464	0.449	0.418	0.433	0.562	0.444	0.410
F2	0.342	0.387	0.320	0.461	0.408	0.425	0.427	0.341	0.352	0.382	0.381	0.400	0.488	0.352	0.336
F3	0.323	0.313	0.350	0.339	0.344	0.324	0.350	0.279	0.353	0.333	0.326	0.333	0.498	0.320	0.304
F4	0.368	0.338	0.360	0.415	0.376	0.357	0.416	0.321	0.387	0.379	0.377	0.379	0.468	0.356	0.362
F5	0.230	0.225	0.202	0.240	0.377	0.308	0.310	0.255	0.286	0.296	0.321	0.277	0.378	0.238	0.224
F6	0.351	0.359	0.313	0.354	0.467	0.492	0.476	0.386	0.419	0.462	0.474	0.442	0.540	0.371	0.345
F7	0.391	0.369	0.365	0.412	0.469	0.479	0.535	0.424	0.447	0.459	0.476	0.483	0.586	0.435	0.389
F8	0.307	0.327	0.279	0.331	0.445	0.433	0.433	0.416	0.376	0.421	0.454	0.404	0.482	0.343	0.301
F9	0.263	0.260	0.247	0.284	0.371	0.339	0.355	0.286	0.392	0.355	0.324	0.308	0.453	0.295	0.279
F10	0.370	0.366	0.339	0.379	0.499	0.481	0.491	0.427	0.459	0.502	0.481	0.458	0.580	0.379	0.355
F11	0.300	0.313	0.294	0.323	0.430	0.422	0.410	0.383	0.370	0.418	0.460	0.370	0.513	0.308	0.302
F12	0.340	0.297	0.314	0.347	0.432	0.373	0.419	0.367	0.381	0.373	0.391	0.448	0.458	0.397	0.351
F13	0.307	0.301	0.273	0.305	0.405	0.410	0.397	0.336	0.395	0.388	0.407	0.343	0.512	0.320	0.297
F14	0.340	0.301	0.324	0.363	0.350	0.360	0.421	0.306	0.369	0.352	0.338	0.402	0.454	0.405	0.348
F15	0.345	0.306	0.337	0.368	0.373	0.257	0.414	0.315	0.379	0.380	0.353	0.387	0.454	0.375	0.389

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