Critical Success Factors for Implementing Green Supply Chain Management in Electronics Industry: A Case Study

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Amit Banik

This Work is Dedicated to My Loving Parents and My Wife

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List of Abbreviations

CSFs	Critical Success Factors
DEMATEL	Decision Making Trial and Evaluation Laboratory
SCM	Supply Chain Management
GSCM	Green Supply Chain Management

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Abstract

Green supply chain management (GSCM) has emerged as a proactive approach to enhancing sustainable supply chain performance. This study explores critical success factors (CSFs) for implementing GSCM for an electronics manufacturing company from an emerging economy context. A total of 22 CSFs for GSCM implementation were selected based on literature review and opinions of 30 industrial managers from three electronics manufacturing industries. Among the 22 CSFs, 16 CSFs were finalized based on Pareto analysis. Then the Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach was used to capture the interactive relationships among the CSFs on the basis of developing a causal effect diagram. The findings reveal that top management commitment, government regulations and standards, pollution prevention and hazardous waste management, environment management certification (ISO 14000) are the CSFs for a successful implementation of GSCM. The prominence-causal graph indicates that top management commitment is paramount toward GSCM-implementation into existing supply chains followed by pollution prevention and hazardous waste management. This study can help industrial managers and supply chain practitioners to make strategic and tactical decisions regarding identification and successful implementation of GSCM practices in the electronics industries in emerging economies.

Chapter 1
Introduction

1.1 Introduction

Focusing on supply chain management (SCM) is getting increased importance to industrial managers for conducting business at a profit (Shukla, Garg, & Agarwal, 2013). A supply chain is an integrated network that consists of several supply chain agents, such as suppliers, plants, distribution centers, retailers and customers. These supply chain agents are organized efficiently to distribute products to customer nodes at right time, with right quantities and at right locations (Potkonjak, 2013). However, such a network has its harmful effect on the environment. Environmental bodies, government, and other stakeholders across the supply chain are aware of the ill-effects that the supply chain is causing to the environment if the supply chain is operated in a traditional fashion aiming to maximize economic benefits only. Therefore, traditional supply chains need to emphasize on environmental considerations (Rozar et al., 2015). When industrial managers consider environmental aspects in the design and operation of a supply chain, it can be termed as green supply chain (GSC).

GSC is important because as it brings competitive advantage to industries. GSC helps a company to achieve competitive advantage by integrating firm's innovative strategy (Melnyk & Tobias, 2014).

The implementation of GSCM generates several benefits to industries. GSCM maximizes firm environmental performance and minimizes waste generation. GSCM also helps a company improve its the eco-proficiency (Zhu, Sarkis, & Geng, 2005). Upon a successful implementation of GSCM, companies can enhance their economic and environmental performances and sustain their business successfully (Gandhi, Mangla, Kumar, & Kumar, 2015b). Based on the statistics over the past few years, it is seen that GSCM has played an important part in the building of good economic-environmental performances different stages in business (Phruksaphanrat, 2015) (Baresel-Bofinger et al., 2011).

Environmental sustainability is a critical issue in today's world and getting increased attention to academics and practitioners. Firms can perform better by adopting more advanced

and proactive environmental strategies. Sari (2017) revealed that environment-friendly initiatives help the firms to reduce energy and logistics costs and thus improve their operational and financial performance.

Industries operating in emerging economies are facing difficulties in incorporating green initiative in their traditional system. This occurs due to lack of expertise, their lack of knowledge or in the subject matter (Kubler et al., 2016). Therefore, for successful implementation of GSCM there is a need for appropriate knowledge regarding this and thus requires extensive research. In fact, there are various factors both internal and external which are responsible for the planning and implementation of GSCM concept. It may also consist of norms and regulations, globalization, supplier, competition, etc. (Gandhi et al., 2015b), (Gandhi et al., 2016), (Walker, Di Sisto, & McBain, 2008), (Bhool & Narwal, 2013). It is important for companies to know the critical factors needed to implement GSCM successfully. This study aims to investigate the critical factors for GSCM implementation in an emerging economy context.

1.2 Objectives with Specific Aims

This work aims to identify the critical factors that are important for implementation of GSCM in the electronics manufacturing industry. The specific objectives of this project are:

a) To identify critical success factors for green supply chain management implementation in the supply chain of an electronics manufacturing company.
b) To examine the contextual relationships among the critical success factors by using Decision Making Trial and Evaluation Laboratory (DEMATEL) technique.

1.3 Organization of the Thesis

This thesis is organized into 6 chapters as follows:

Chapter 1 contains an introduction. In this chapter, the motivation and objective to this study are discussed.

Chapter 2 offers the literature survey on the GSCM, CSFs related to it, the tool used to determine the CSFs, review on existing work and current practices in Bangladesh.

Chapter 3 describes the Research Framework. The DEMATEL method is used to obtain the required results.

Chapter 4 contains data collection and analysis. This chapter presents how the data were collected and applied using DEMATEL model.

Chapter 5 presents the results and discussion of findings. The validation, prioritize of critical factors are also described in this chapter. The conclusion and recommendation for further work are given in Chapter 6.

Chapter 2
Literature Review

2.1 Supply Chain Management

A supply chain is a network of facilities and activities which integrates from suppliers to the customer. The main stages of the supply chain are suppliers, manufacturing plant warehouse, retailers and customers. The drivers are transportation, facilities, inventory, sourcing, pricing etc. The main goal in designing SCN is the ability to meet customer demand and to minimize total network costs. Customer's satisfaction can also be improved by minimizing the total required delivering time production of the products to customers.

The investigated SCN problem involves a multi-stage stochastic network, where it takes the production and delivery times of the products into account. This makes it more applicable to real-world environments which have been detailed in. Costs and service levels can be better optimized by collaborative decision-making models. An increasing number of companies are now adopting make-to-order business models, a study for the problem of optimizing customer service levels and total distribution costs in an integrated production and distribution environment. Now-a-day supply chain works as an interrelating network of suppliers, manufacturers, distributors, and customers in competitive markets also satisfying customer demands. The main objective of the supply chain is to increase the profit. This can only be done if all the entities concerned about system optimization rather than their individual optimization. All the entities must be completely integrated so that information can be shared easily to handle fluctuating demand of the customers. The important concerns of the supply chains are inventory management, transportation, and logistics, facilities location and layout, the flow of information. In 21st century supply chain management (SCM) is a key strategy to improve competitive edge. The aim of efficiency is to optimize costs and quality and responsiveness aims to satisfy customer demands quickly.

The supply chain is the network of organizations which is an important management paradigm which continuously seeks for efficiency. Supply chain and logistics improve costs, produce value and deliver to the ultimate consumer efficiently (Christopher, 1992). The supply chain requires co-ordinations which manages a set of functions. An executive responsible for coordinating the entire process. Thus, it requires separate materials functions which reported to the

executive. Joint relationships with suppliers also occur across multiple tiers. The main objective of SCM is to manage the sourcing, flow, and control of materials and integrate them by participating all of a system."

2.2 Green Supply Chain Management

The emergence of green supply chain management (GSCM) is a buzz now-a-days and it started to take attention about a couple of decades ago, and now researchers further discover the knowledge's in this field. When researchers paid attention to the environmental concerns, the concept of the green supply chain was developed. The coordination of environmental, economic and social facets has been at the sustainable condition in today's management because of the successful implementation of the green supply chain. This has mainly led to the overall sustainability of an organization. Because of that, the Green Supply Chain Management (GSCM) has received great attention in the last decade and has naked huge opportunities for research in this area (Paul, Bhole, & Chaudhari, 2014).

The present supplier management literature mainly gives attention often to the end product producer, it directs suppliers and gives main attention to the relationship between local companies. Building competitive advantage and environmental risk management are two major motivations for the companies to implement GSCM. Literature has identified suppliers as an important stakeholder for a local company. Upstream supply chain members are accountable for poor environmental performance.

Assessment and collaboration are the two main facets of GSCM. This is found from traditional green supplier management. Information gathering is the main way to assess and monitor suppliers' environmental management and performance. Environmental performance improvement can be gained by the joint collaborative activities between companies and their supplier. Companies employ GSCM assessment and collaboration practices now-a-days for improvement. Companies can adopt collaborative practices when the direct relationship is established with sub-suppliers to help improve environmental performance. Green supply chain management practices are difficult to implement. Many difficulties may arise when companies approach their first tier and second-tier. To reduce the negative impact on total cost and environmental performance, companies should explore the enablers to improve environmental

performance. Researchers provided various approaches to implement green supply chain management practices, like "direct" (a company who has direct access to sub-suppliers), "indirect" (a company who uses its first-tier suppliers to manage sub-suppliers) and "working with third parties". Working with third parties means a company works with third parties like NGOs to manage sub-suppliers. Apple, Toyota, Dell, IBM and Honda never completely relinquish decisions about a product's components to top-tier suppliers and they often adopted the "direct" approach.

The definition of GSCM differs amongst author. Zhu et al. (2005) defined GSCM as an important and new concept for enterprises to achieve profit and market share objectives by reducing environmental risks and impacts while increasing their ecological efficiency. (Puviyarasu, 2016) defines that GSCM is an integration of supply-chain management with environmental thinking including PD, sourcing and manufacturing processes, delivering the final product to the customers. Islam et al, (2017) defines GSCM that it minimizes and eliminates the negative effects of the supply chain on the environment. Amron, (2018) addressed environmental measures to the whole supply chain. According to the study of Hervani, Helms and Sarkis (2005) GSCM consists of green procurement, green marketing, green manufacturing or materials management, and reverse logistics.

GSCM can also be defined as coordinating environmental concerns into the inter-organizational practices of SCM during a product's lifecycle (Islam et al., 2017a). Also, it can be said that Green Supply Chain Means consider environmental issues into SCM which includes manufacturing practices, product design, material sourcing, and selection, delivering finished products to the consumers (Mazaheri Asad, Shirani, & Mohammadi, 2016).

2.3 Critical Success Factors

Anthony (1974) utilized the concept of “critical success factor’’ in the design of a management control system. The characteristics, variables or conditions which have a huge impact on the firm success, competition and for those, the firms become properly sustained, maintained and managed, those are called critical success factors (CSF’s). It is an important to identify CSF’s for the eventual development of a firm’s strategy and also the integral part of the strategic planning process (Mohammad Reza, Asefeh, & Mohammad, 2010). Various alternatives are present such as what type of technology to introduce, who to partner with whom, what type of organizational

practice to be done when establishing a system. These alternatives are necessary for implementing an effective green supply chain and it is very difficult to take a decision to adopt these alternatives because such a decision depends on a number of elements and factors (Kant & Malviya, 2015). Such an approach helps the key decision maker to identify that information that is critical or important to the success of the business (Mohammad Reza et al., 2010). The positives aspects of the firms are more entitled to be the critical success factors. The profit impact of an activity or condition is usually the most significant factor for CSF identification as well as the determination of factor importance (Mohammad Reza et al., 2010). In doing the literature review, a variety of critical success factors were identified as discussed.

- **Stakeholder pressure**

Luoma and Meixell (2015) analyzed and found the way that stakeholder pressure influences green supply chain sustainability (GSCS). The authors opened the door for further investigation on this topic.

- **Waste disposal norm**

Johny C. Ho (2009) discussed the opportunities in green supply chain management. He focused on waste management. Hossain, Commission and Hossain (2012) investigated the paper industry in Bangladesh and emphasized solid waste disposal for greening the supply chain.

- **Environment management certification (ISO 14000)**

Hossain et al. (2012) linked environmental management systems with green supply chain management. Lodziensis (2017) discussed the role of environmental management concept in the supply chain.

- **Global competition factors**

Holt and Rao, (2005) answered the question of whether green supply chain leads to competitiveness and economic performance.

- **Pollution prevention and hazardous waste management**

Doshi et al., (2016) said that waste and emissions caused by the supply chain do huge environmental problems, which include global warming and acid rain. Therefore, pollution must be prevented and hazardous waste management system must be established.

- **Environment friendly packaging and transportation**

The role of transportation is always important in the supply chain. Singh and Bhardwaj (2011) investigated the role of logistics and transportation in green supply chain management. Battini et al., (2015) proposed sustainable packaging development for fresh food supply chains.

- **Top Management Commitment**

One of the most important factors is the top management commitment Sandberg and Abrahamsson, (2010) described the role of top management in supply chain management practices. From his article, it is clear that top management commitment is important for implementing GSCM.

- **Competencies for greener products and processes**

Chen et al., (2012) discussed a business strategy selection of green supply chain management via an analytic network process. He emphasized many factors i.e., greener products purchasing, following greener process etc.

- **Bargaining power through the supply chain**

Baron, Berman, and Wu, (2016) illustrated the power of bargaining within the supply chain and its implications in an industry. He showed how bargaining power effects supply chain management.

- **Application of advanced technology and IT tools**

Nair, Raju, and Anbudayashankar, (2009) discussed the importance of IT technology in industries. In their recent article, Mendoza-Fong et al., (2018) have presented the role of information and communication technology in green supply chain implementation and in enhancing the company's performance.

- **Government Regulations and Standards**

Government is the main body of a country. Therefore, the government should be aware of implementing GSCM. Nezakati, Fereidouni, and Rahman, (2016) evaluated the role of government in green supply chain management.

- **Reverse Logistics**

Mutingi, (2013) discussed the role of reverse logistics in GSCM based on system dynamics principles.

- **Development of trained and skilled manpower**

Heyns and Rose (2012) examined South African industries and identified the importance of trained and skilled manpower in the supply chain management.

- **Green infrastructure/policies/practice**

Sarkar (2012) mainly focused on green infrastructure. Saurav Negi (2016) studied the American multinational retailer Wal-Mart and they found that Wal-Mart practices green supply chain and follows green policies.

- **Collaboration with Suppliers**

Ramanathan, Bentley, and Pang, (2014) conducted a case study which is about the role of collaboration with suppliers, logistics in the UK green supply chains.

- **Recycling and Lifecycle management**

Tseng and Geng (2012) evaluated the green supply chain management using a life cycle assessment approach under uncertainty. Wibowo et al. (2017) analyzed the strategies needed to support sustainable construction in relation to supply chain management for materials.

2.4 Study Related to DEMATEL Method

DEMATEL means Decision-Making Trial and Evaluation Laboratory which is in research for solving complex and intertwined problem groups. It is capable of verifying interdependence between different variables and try to improve reflecting interrelationships between variables (Falatoonitoosi et al., 2013). This approach was modified to resolve the complex and intertwined problem groups (Kijewska, Torbacki, & Iwan, 2018), (Potdar, Routroy, & Behera, 2017), (López-Ospina et al., 2017), (Shen, Liu, & Tzeng, 2012). DEMATEL can confirm interdependence among criteria/variables and restrict the relations that reflect characteristics within a developmental trend (Kuan & Chen, 2014). DEMATEL method not only helps to find the importance of each factor with respect to one another but also finds the causal relationship between each factor (Hervani et al., 2005). It helps to find the relationships between elements in the system and defines the strength of their interrelationships (Shen et al., 2012), (K., R., K.E.K., & Ravi, 2018).

DEMATEL analyzes the factors by divided them into two categories. These are cause and effect group. DEMATEL illustrates the interrelationship between them by causal relationship diagram (Gandhi et al., 2015b). Causal relationship diagram is the final result of the DEMATEL

procedure (Falatoonitoosi et al., 2013). It can be used for gathering experts' knowledge and forming a structure model that allows the decision-makers to recognize the factors of greater influence (Seleem, Attia, & El-Assal, 2016). DEMATEL is a very popular method in Japan. It able to evaluate and formulate all intertwined cause and effect relationships in each structural model (Falatoonitoosi et al., 2013). In the multi-criteria decision making (MCDM) field, this method is applied to construct and visualize interrelations between criteria and sub-criteria (K. et al., 2018), (Sorooshian et al., 2012).

2.5 Current State and Practices in Bangladesh

GSCM is an emerging area of research in developing countries. The developing countries have traditionally been more focused on economic growth instead of green growth. They pay less attention and spend fewer resources on environmental issues, and their environmental problems are more severe than the developed countries (Azevedo et al., 2011). This emerging issue has become a new trend in Asia since Japan, Taiwan, and Korea are the heralds in terms of green electronic products (Hsu & Hu, 2008). GSCM is still a new sector in itself and has been under study and research in developing countries (Vijayvargy et al., 2017). In South-Asia, GSCM has been a topic in the research field mainly in India in automobile industries (All et al., 2017)(Luthra, Garg, & Haleem, 2015)(Islam et al., 2017b). A certain study on the implementation of GSCM in leather industry in Bangladesh has been conducted recently (Vijayvargy et al., 2017). Apart from this, to our knowledge, there hasn't been any significant study on the critical factors and its effect on the implementation of GSCM in the electronic industry or any other industrial sector in Bangladesh.

Chapter 3
Research Framework

This research aims to examine CSFs for implementing GSCM for an electronics manufacturing company. To examine the key CSFs, the DEMATEL method is used here. The proposed research comprises the following steps:

Step 1 *Identification of critical factors for an electronics company*

There are various factors based on which a company's performance can be evaluated. These factors depend on the type of product it produces or the services it provides. The list of factors is obtained from the statistical data of the respective company and also based on related literature reviews. The list of factors is given in **Table 4.1**.

Step 2 *Using DEMATEL determination of the factors essential for successful implementation of GSCM*

To analyze the multiple factors and their interrelationship, the DEMATEL approach is used.

Step 3 *Implementation of the acquired factors*

From the factors listed, the critical factors which are essential for the company to be able to implement GSCM successfully are found. These critical factors will then implement in the industry and the result will be recorded. Based on this the reliability of the factors can be evaluated.

The DEMATEL method is used to help find a reliable interrelationship between multiple factors which is otherwise difficult to determine. The following steps are involved in the determination of critical success factors using DEMATEL:

Step 1 *Making the direct-influenced matrix*

Using a scale of 0-9, the value of the relationship between the factors are determined with the help of the expert's opinion **(Table 4.3).** This is tabulated as a nxn matrix, where n= number of factors. Each scale value represents the amount of influence each factor has on the other.

Step 2 *Calculating the direct-influenced matrix normalized, (M)*

Normalized matrix is obtained by dividing each element in the direct relation matrix by the largest row sum of the average matrix.

Step 3 *Obtaining the total-relation matrix (T)*

Total relation matrix is obtained using the following equation:

T=$M(I-M)^{-1}$

Where,

T = total relation matrix

M = normalized matrix

I = identity matrix

Step 4 *A causal diagram*

The causal diagram is obtained using the net cause and effect values. $D_i + R_i$ And $D_i - R_i$ are calculated from the values in the total relation matrix.

Where,

D_i = Row values in T matrix

R_i = Column values in T matrix

$D_i + R_i$ = degree of importance

$D_i - R_i$ = net effect

The sum $D_i + R_i$ is called "Prominence'' and $D_i - R_i$ is called "Relation". The "prominence" proves the degree of importance and gives an index that shows the total effect both given and received by criterion i. "Relation" shows the net effect that criterion i donates to the system. If the value of $D_i - R_i$ is positive it is the cause factor and if $D_i - R_i$ is negative it is the effect factor. The flowchart of the research framework for CSFs is shown in **Fig. 3.1.**

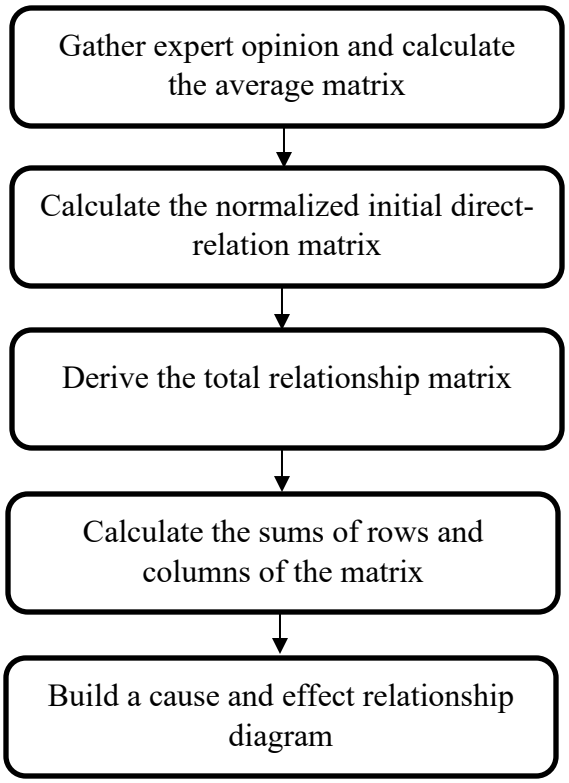

Fig. 3.1 Framework of Research for Investigating CSFs

Chapter 4

Data Collection and Analysis

4.1 Data Collection

The developed methodology has been tested by obtaining relevant data from previous literature review and an electronics manufacturing company of Bangladesh (X Industries Ltd.). The company profile is given in **Table A1 in Appendix A.** Initially, 22 Possible CSF's **(Table 4.1)** for implementing green supply chain were identified from the relevant literature, company's experienced person, company data **(Table A1 in Appendix A)** and 30 managers (**Table A2 in Appendix A**) from three companies including X Industries Ltd.

Table 4.1 Possible CSFs for implementing Green Supply Chain in X Industries Ltd.

Factor codes	Factor names
F1	Stakeholder pressure
F2	Waste disposal norm
F3	Environment management certification (ISO 14000)
F4	Global competition factors
F5	Pollution prevention & hazardous waste management
F6	Environment friendly packaging and transportation
F7	Top Management Commitment
F8	Competencies for greener products and processes
F9	Bargaining power through the supply chain
F10	Application of advanced technology and IT tools
F11	Government Regulations and Standards
F12	Reverse Logistics
F13	Development of trained and skilled manpower
F14	Green infrastructure/policies/practice
F15	Collaboration with Suppliers
F16	Recycling and Lifecycle management
F17	Development of trained and skilled manpower on green supply chain
F18	Environmental performance
F19	Establish an environmental risk management
F20	Green design and green marketing
F21	Clean production
F22	Green information technology

The selection criteria for the experts and the questionnaire are given in **Appendix B**. The feedback provided by the experts is summarized in **Table C1 in Appendix C**. After taking expert opinions, 16 factors from the initial 22 were selected following Pareto analysis. The Pareto chart is shown in **Fig.C1 in Appendix C**. The list of the selected CSFs are given in **Table 4.2**.

Table 4.2 Selected CSFs for X Industries Ltd.

Factor codes	Factor names
F1	Stakeholder pressure
F2	Waste disposal norm
F3	Environment management certification (ISO 14000)
F4	Global competition factors
F5	Pollution prevention and hazardous waste management
F6	Environment friendly packaging and transportation
F7	Top Management Commitment
F8	Competencies for greener products and processes
F9	Bargaining power through the supply chain
F10	Application of advanced technology and IT tools
F11	Government Regulations and Standards
F12	Reverse Logistics
F13	Development of trained and skilled manpower
F14	Green infrastructure/policies/practice
F15	Collaboration with Suppliers
F16	Recycling and Lifecycle management

In DEMATEL model, expert's opinion on the influence of each factor was obtained. The average direct relation matrix is formed, as given in **Table 4.4,** based on the ranking of each factor on a scale of 0-9 by various experts given in **Table 4.3**. The data obtained from each expert was averaged giving the average direct relationship matrix. Then this data was normalized to obtain the normalized matrix given in **Table 4.5**.

Table 4.3 Linguistic variables for the importance weight of each factor (Khaled et al., 2011)

Linguistic variables	Numbers
No influence	0
Very low influence	1
Low influence	2
Medium low influence	3
Medium influence	4
Fair influence	5
Medium-high influence	6
High influence	7
Very high influence	8
Extreme influence	9

Table 4.4 Average Direct Relation Matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	0	6	6	5	3	4	3	5	7	8	5	9	2	3	7	8
F2	8	0	8	4	5	8	6	4	2	3	5	8	9	6	5	2
F3	9	6	0	8	9	8	5	7	8	5	6	2	1	7	9	4
F4	7	8	5	0	2	9	6	3	2	4	8	6	7	2	5	8
F5	5	7	5	6	0	7	9	6	7	4	3	5	9	4	8	6
F6	7	5	7	6	5	0	2	5	6	5	6	2	6	9	6	5
F7	8	7	6	7	7	8	0	9	9	9	9	8	7	7	7	7
F8	5	3	5	5	8	5	7	0	4	8	4	4	6	6	3	5
F9	2	1	2	4	5	2	5	6	0	5	6	6	4	4	4	1
F10	9	5	7	9	7	1	6	3	7	0	2	4	6	5	6	2
F11	8	9	8	2	6	9	4	9	6	6	0	2	5	2	8	9
F12	6	8	5	6	2	8	8	2	4	3	3	0	2	5	2	6
F13	4	5	2	8	5	7	9	9	2	4	2	7	0	8	3	2
F14	5	3	6	7	3	2	2	8	3	8	1	8	4	0	7	5
F15	7	4	4	3	7	3	3	2	5	7	6	6	8	3	0	2
F16	6	6	9	7	5	2	5	3	6	6	2	2	7	2	8	0

Table 4.5 Normalized Matrix (M)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	0	0.052	0.052	0.043	0.026	0.035	0.026	0.043	0.061	0.070	0.043	0.078	0.017	0.026	0.061	0.070
F2	0.070	0	0.070	0.035	0.043	0.070	0.052	0.035	0.017	0.026	0.043	0.070	0.078	0.052	0.043	0.017
F3	0.078	0.052	0	0.070	0.078	0.070	0.043	0.061	0.070	0.043	0.052	0.017	0.009	0.061	0.078	0.035
F4	0.061	0.070	0.043	0	0.017	0.078	0.052	0.026	0.017	0.035	0.070	0.052	0.061	0.017	0.043	0.070
F5	0.043	0.061	0.043	0.052	0	0.061	0.078	0.052	0.061	0.035	0.026	0.043	0.078	0.035	0.070	0.052
F6	0.061	0.043	0.061	0.052	0.043	0	0.017	0.043	0.052	0.043	0.052	0.017	0.052	0.078	0.052	0.043
F7	0.070	0.061	0.052	0.061	0.061	0.070	0	0.078	0.078	0.078	0.078	0.070	0.061	0.061	0.061	0.061
F8	0.043	0.026	0.043	0.043	0.070	0.043	0.061	0	0.035	0.070	0.035	0.035	0.052	0.052	0.026	0.043
F9	0.017	0.009	0.017	0.035	0.043	0.017	0.043	0.052	0	0.043	0.052	0.052	0.035	0.035	0.035	0.009
F10	0.078	0.043	0.061	0.078	0.061	0.009	0.052	0.026	0.061	0	0.017	0.035	0.052	0.043	0.052	0.017
F11	0.070	0.078	0.070	0.017	0.052	0.078	0.035	0.078	0.052	0.052	0	0.017	0.043	0.017	0.070	0.078
F12	0.052	0.070	0.043	0.052	0.017	0.070	0.070	0.017	0.035	0.026	0.026	0	0.017	0.043	0.017	0.052
F13	0.035	0.043	0.017	0.070	0.043	0.061	0.078	0.078	0.017	0.035	0.017	0.061	0	0.070	0.026	0.017
F14	0.043	0.026	0.052	0.061	0.026	0.017	0.017	0.070	0.026	0.070	0.009	0.070	0.035	0	0.061	0.043
F15	0.061	0.035	0.035	0.026	0.061	0.026	0.026	0.017	0.043	0.061	0.052	0.052	0.070	0.026	0	0.017
F16	0.052	0.052	0.078	0.061	0.043	0.017	0.043	0.026	0.052	0.052	0.017	0.017	0.061	0.017	0.070	0

Table 4.6 Total Relation Matrix (T)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	0.125	0.158	0.161	0.155	0.129	0.140	0.130	0.143	0.160	0.175	0.132	0.176	0.125	0.120	0.171	0.159
F2	0.197	0.115	0.181	0.154	0.149	0.182	0.159	0.146	0.125	0.142	0.137	0.176	0.185	0.153	0.161	0.118
F3	0.219	0.175	0.129	0.196	0.194	0.190	0.161	0.179	0.186	0.172	0.157	0.140	0.137	0.168	0.208	0.145
F4	0.189	0.180	0.159	0.118	0.125	0.188	0.157	0.135	0.124	0.148	0.161	0.157	0.170	0.118	0.161	0.165
F5	0.183	0.180	0.166	0.179	0.118	0.182	0.193	0.170	0.173	0.160	0.130	0.162	0.198	0.145	0.194	0.155
F6	0.184	0.150	0.169	0.165	0.146	0.108	0.122	0.149	0.153	0.155	0.140	0.124	0.159	0.171	0.167	0.137
F7	0.241	0.210	0.205	0.217	0.203	0.217	0.148	0.221	0.218	0.230	0.200	0.212	0.210	0.193	0.218	0.191
F8	0.166	0.133	0.151	0.156	0.168	0.149	0.162	0.105	0.136	0.176	0.122	0.137	0.157	0.146	0.140	0.136
F9	0.108	0.089	0.097	0.116	0.117	0.097	0.119	0.127	0.074	0.123	0.115	0.126	0.112	0.103	0.116	0.079
F10	0.197	0.149	0.165	0.187	0.159	0.118	0.154	0.130	0.159	0.110	0.109	0.141	0.156	0.136	0.163	0.112
F11	0.211	0.197	0.195	0.149	0.172	0.197	0.154	0.194	0.170	0.179	0.105	0.137	0.168	0.130	0.199	0.181

Table 4.6 Total Relation Matrix (T) (continued)

	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**	**F12**	**F13**	**F14**	**F15**	**F16**
F12	0.163	0.164	0.143	0.152	0.109	0.164	0.157	0.111	0.126	0.125	0.109	0.094	0.114	0.129	0.121	0.136
F13	0.156	0.148	0.126	0.178	0.141	0.166	0.177	0.177	0.116	0.143	0.107	0.162	0.107	0.162	0.136	0.112
F14	0.153	0.122	0.147	0.160	0.117	0.113	0.112	0.155	0.116	0.164	0.089	0.159	0.129	0.085	0.158	0.125
F15	0.167	0.130	0.129	0.126	0.148	0.121	0.119	0.111	0.132	0.154	0.128	0.143	0.160	0.110	0.100	0.100
F16	0.170	0.153	0.178	0.167	0.142	0.122	0.143	0.126	0.148	0.155	0.106	0.119	0.161	0.109	0.176	0.088

Using the normalized matrix and inverse of the identity matrix of the normalized matrix the total relation matrix was obtained and is given in **Table 4.6**.

Chapter 5
Results and Finding

5.1 Results and Discussion

The DEMATEL method is applied based on the expert opinion found as shown in **Table 4.4**. The total relation matrix is obtained and based on this matrix, the effects that success factors exert (D_i) and receive (R_i) are calculated. The value of ($D_i + R_i$) gives the degree of importance of that success factors while subtracting them ($D_i - R_i$) gives the net effect. **Table 5.1** represents the values of D_i, R_i, ($D_i + R_i$) and ($D_i - R_i$) for all success factors.

Table 5.1 Result of DEMATEL

	D_i	R_i	$D_i + R_i$	$D_i - R_i$
F1	2.358032	2.828611	5.186643	-0.47058
F2	2.480033	2.453018	4.933051	0.027015
F3	2.757523	2.499337	5.25686	0.258187
F4	2.45593	2.57309	5.02902	-0.11716
F5	2.688339	2.3394	5.027739	0.348938
F6	2.400281	2.455056	4.855337	-0.05478
F7	3.334545	2.368316	5.702861	0.966229
F8	2.341149	2.377716	4.718865	-0.03657
F9	1.718082	2.315739	4.033821	-0.59766
F10	2.344638	2.511946	4.856585	-0.16731
F11	2.736177	2.047483	4.78366	0.688694
F12	2.116821	2.365172	4.481994	-0.24835
F13	2.313143	2.448389	4.761532	-0.13525
F14	2.103657	2.178395	4.282053	-0.07474
F15	2.07817	2.588879	4.667049	-0.51071
F16	2.261592	2.137565	4.399157	0.124026

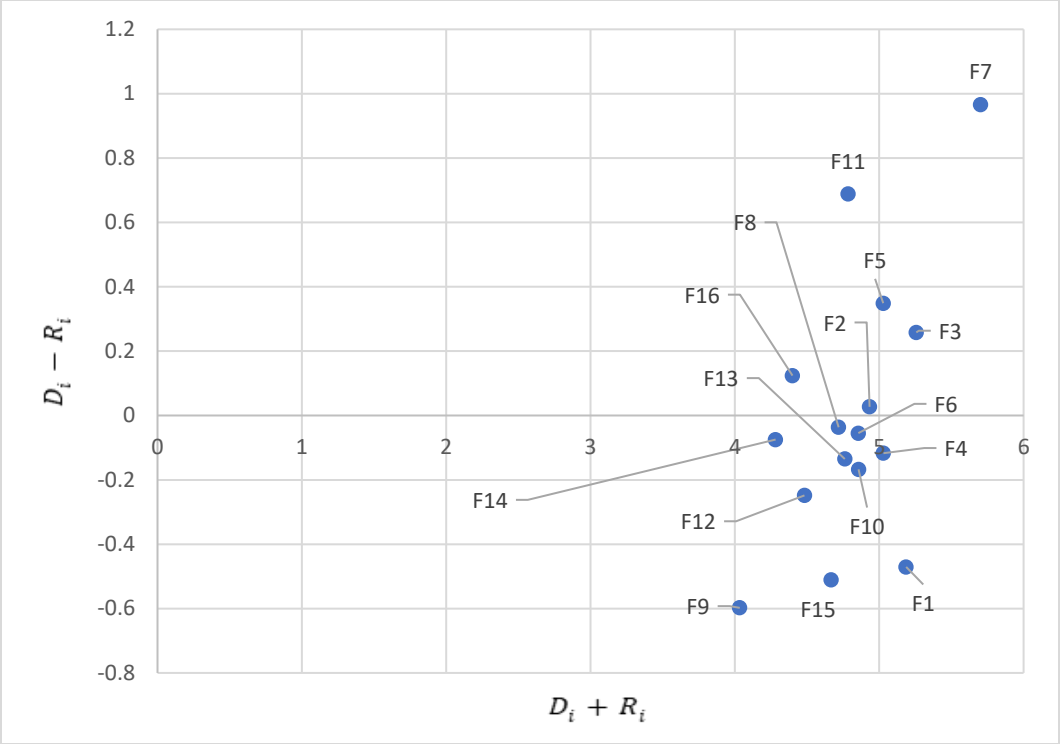

Fig. 5.1 Causal Relationship Diagram

The rows and columns of total relation matrix were tabulated to obtain the degree of importance and net effect. **Fig. 5.1** presents the causal diagram of the success factors: it represents $(D_i - R_i)$ with respect to $(D_i + R_i)$.

The factors having a positive net effect are categorized as cause factor and factors having a negative net effect are categorized as effect factor as shown in **Table 5.2**. In the cause and effect diagram shown in **Fig. 5.1,** factors at the top are cause factors and factors at the bottom are effect factors.

Fig. 5.2 illustrates the success factors in descending order, it is observed that F7: "Top Management Commitment" has the highest given value, while F9: "Bargaining power through supply chain" has the lowest given value.

Table 5.2 Cause and Effect Factors

Cause	Effect
1. Top Management Commitment 2. Government Regulations and Standards 3. Pollution prevention and hazardous waste management 4. Environment management certification (ISO 14000) 5. Recycling and Lifecycle management 6. Waste disposal norm	1. Competencies for greener products and processes 2. Environment friendly packaging and transportation 3. Green infrastructure/policies/practice 4. Global competition factors 5. Development of trained and skilled manpower 6. Application of advanced technology and IT tools 7. Reverse Logistics 8. Stakeholder pressure 9. Collaboration with Suppliers 10. Bargaining power through the supply chain

5.2 Analysis of Critical Success Factors

The critical success factors of X Industries Ltd. could be identified and prioritized by observing both **Fig. 5.1** and **Fig. 5.2**. Among all the factors in the cause group, the following have the highest given impact (D_i): Top Management Commitment (F7), Government Regulations and Standards (F11), Pollution prevention and hazardous waste management (F5), Environment management certification (ISO 14000) (F3). Therefore, these four factors can be considered as the most critical success factors. As shown in **Fig 5.1,** these factors form a cluster of great net-effect and degree of importance. These cause factors have higher given impact, so more attention should be exerted to strengthen them in order to enhance the effect factors, as a result, i.e., improving these four factors can easily enhance others. Although factors in the effect group tend to be easily influenced by other factors, however, these group factors do not have a direct impact on the system. But still make a significant contribution. Therefore, these factors need to be discussed to find out their contribution in overall manner (Gandhi, Mangla, Kumar, & Kumar, 2015b).

Hoejmose et al., (2012) showed the role of trust and top management in Business to Business (B2B) and Business to Consumers (B2C) markets to implements the green supply chain management.

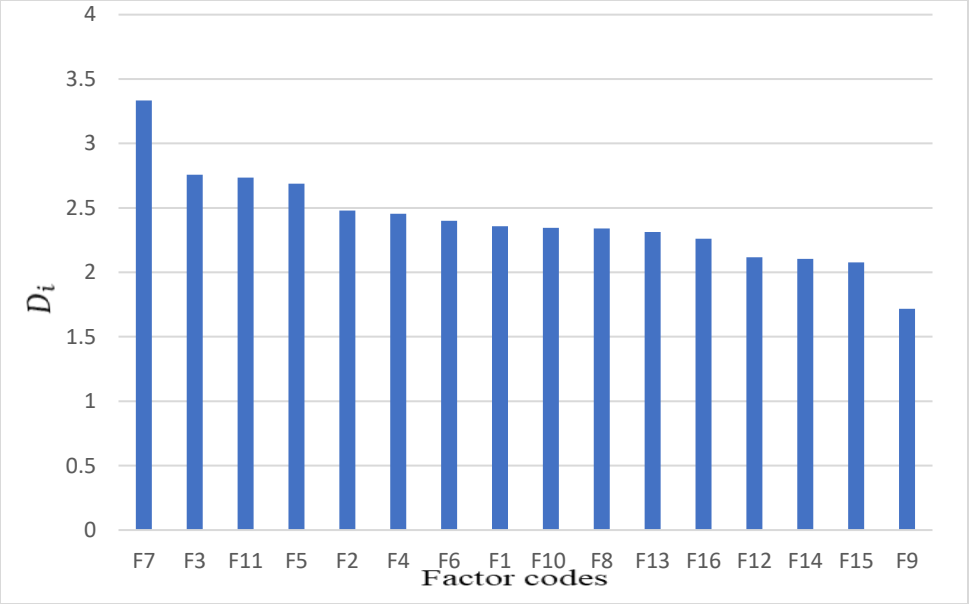

Fig. 5.2 Ranking of Success Factors Based on Given Impact (D_i)

Nezakati et al., (2016) also evaluated and emphasized government role in green supply chain management through different theories. Nawrocka, Brorson, & Lindhqvist, (2009) focused on the role of ISO 14001 in environmental supply management practices in Swedish companies and showed the importance of it. Factors namely waste disposal norm (F2), Competencies for greener products and processes (F8), Environment friendly packaging and transportation (F6), Green infrastructure/policies/practice (F14), Global competition factors (F4), Development of trained and skilled manpower (F13), Application of advanced technology and IT tools (F10), Reverse Logistics (F12) are subsequent important factors. Factors (F9) and (F15) have a negative net effect and a low degree of importance. Chen et al., (2012) designated green supply chain management strategies to effectively direct business functions and activities in the electronics industry. He mainly focused on green product and processes. Singh, Singh, & Bhardwaj (2011) studied the courier service industry in India and showed the role of logistics and transportation in GSCM. Hu & Hsu (2010) investigated an electrical and electronics industries in Taiwan and found supplier management, product recycling, organization involvement and life cycle management as critical factors. Moktadir, Rahman, & Ali (2017) found that the top management commitment is the most important success factor for implementing GSCM in the footwear industry of Bangladesh.

Although Stakeholder pressure (F1) has a negative net effect, they have a high degree of importance. Factors having high degree of importance and high net effect are considered as critical

success factors. Thus, Top Management Commitment (F7), Government Regulations and Standards (F11), Pollution prevention and hazardous waste management (F5), Environment management certification (ISO 14000) (F3) are the critical factors for successful implementation of green supply chain management in the X Industries Ltd.

The type of technology used for the manufacturing process determines if it will affect the environment in terms of pollution and fuel consumption. The technology used should be cost-effective. The raw materials and parts for the electronic products are bought from suppliers. Therefore, it is important that the supplier to the company have the green factor in their products. To implement GSCM in the company, it is of vital importance to make sure that the company is able to make a profit using GSCM initiative. Competitiveness among companies is a common scenario that helps a company in building GSCM and try to better itself from its competitor. Once a company starts to establish GSCM into its supply chain system, other companies will be motivated to follow GSCM practices to make sure they are in level with them.

5.3 Validation of Results

The results of the DEMATEL analysis were discussed with the CEO of X Industries Ltd. He agreed with the findings and said that it would be helpful for his company. Finally, it was shared with a validation group (not including the expert team involved in the study) consisting of the head of the SCM, Y Industries Ltd. and to the head of the SCM, Z Industries Ltd., for their insights and comments. Validation was done considering industrial insights and it ensures that the results are satisfied. The validation team agreed with the findings and the head of Supply Chain of Y Industries Ltd. also commented that it was insightful for him.

During the meeting with the validation team, they said top management has plan to implement GSC in their company. If top management is supportive, everything is possible. The team especially emphasized on globalization. Most of the electronics parts are imported from abroad. If they follow GSC culture then their customers can be motivated to buy their products. Validation team agreed with almost every factor. They said that "Environment friendly packaging and transportation" can be given more importance and it can be considered as a cause rather than effect.

5.3.1 Prioritization of Critical Factors and Further Validation

For prioritization of critical factors, $D_i - R_i$ values are used. The values of $D_i - R_i$ are sorted by largest to smallest and hence the position of each factor is found in **Table 5.3**. For further validation, the threshold limit was calculated for identifying the most important interrelationships. This threshold limit is denoted by h. The threshold is calculated by taking the mean and standard deviation of the values from the Total Relationship Matrix (T) **(Table 4.6),** and added one standard deviation to the mean. From T (**Table 4.6**), it is found that, the mean of T is 0.15034418816 and the standard deviation is 0.021975142. Therefore, Threshold limit h= 0.17231933028. All the relationships meeting or exceeding the threshold value are bold in the Total Relation Matrix (T) (**Table 5.4**). Then these strongest dyadic relationships are plotted (**Fig.5.3**). Two-way significant relationships are represented by bold solid lines, whereas one-way relationships are represented by different colored lines.

Table 5.3 Prioritization of Critical Factors

Priority	Factors	$D_i - R_i$
1st	F7	0.966229
2nd	F11	0.688694
3rd	F5	0.348938
4th	F3	0.258187
5th	F16	0.124026
6th	F2	0.027015
7th	F8	-0.03657
8th	F6	-0.05478
9th	F14	-0.07474
10th	F4	-0.11716
11th	F13	-0.13525
12th	F10	-0.16731
13th	F12	-0.24835
14th	F1	-0.47058
15th	F15	-0.51071
16th	F9	-0.59766

Table 5.4 Total Relation Matrix with Threshold Value

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	0.125	0.158	0.161	0.155	0.129	0.140	0.130	0.143	0.160	**0.175**	0.132	**0.176**	0.125	0.120	0.171	0.159
F2	**0.197**	0.115	**0.181**	0.154	0.149	**0.182**	0.159	0.146	0.125	0.142	0.137	**0.176**	**0.185**	0.153	0.161	0.118
F3	**0.219**	**0.175**	0.129	**0.196**	**0.194**	**0.190**	0.161	**0.179**	**0.186**	0.172	0.157	0.140	0.137	0.168	**0.208**	0.145
F4	**0.189**	**0.180**	0.159	0.118	0.125	**0.188**	0.157	0.135	0.124	0.148	0.161	0.157	0.170	0.118	0.161	0.165
F5	**0.183**	**0.180**	0.166	**0.179**	0.118	**0.182**	**0.193**	0.170	**0.173**	0.160	0.130	0.162	**0.198**	0.145	**0.194**	0.155
F6	**0.184**	0.150	0.169	0.165	0.146	0.108	0.122	0.149	0.153	0.155	0.140	0.124	0.159	0.171	0.167	0.137
F7	**0.241**	**0.210**	**0.205**	**0.217**	**0.203**	**0.217**	0.148	**0.221**	**0.218**	**0.230**	**0.200**	**0.212**	**0.210**	**0.193**	**0.218**	**0.191**
F8	0.166	0.133	0.151	0.156	0.168	0.149	0.162	0.105	0.136	**0.176**	0.122	0.137	0.157	0.146	0.140	0.136
F9	0.108	0.089	0.097	0.116	0.117	0.097	0.119	0.127	0.074	0.123	0.115	0.126	0.112	0.103	0.116	0.079
F10	**0.197**	0.149	0.165	**0.187**	0.159	0.118	0.154	0.130	0.159	0.110	0.109	0.141	0.156	0.136	0.163	0.112
F11	**0.211**	**0.197**	**0.195**	0.149	0.172	**0.197**	0.154	**0.194**	0.170	**0.179**	0.105	0.137	0.168	0.130	**0.199**	**0.181**
F12	0.163	0.164	0.143	0.152	0.109	0.164	0.157	0.111	0.126	0.125	0.109	0.094	0.114	0.129	0.121	0.136
F13	0.156	0.148	0.126	**0.178**	0.141	0.166	**0.177**	**0.177**	0.116	0.143	0.107	0.162	0.107	0.162	0.136	0.112
F14	0.153	0.122	0.147	0.160	0.117	0.113	0.112	0.155	0.116	0.164	0.089	0.159	0.129	0.085	0.158	0.125
F15	0.167	0.130	0.129	0.126	0.148	0.121	0.119	0.111	0.132	0.154	0.128	0.143	0.160	0.110	0.100	0.100
F16	0.170	0.153	**0.178**	0.167	0.142	0.122	0.143	0.126	0.148	0.155	0.106	0.119	0.161	0.109	**0.176**	0.088

These results generate interesting insights. From the **Fig. 5.3,** it is seen that among the cause factors only "Top Management Commitment" (F7) and "Pollution prevention and hazardous waste management" (F5) have two-way significant relationships with each other. From **Table 5.4,** it is noticed that factor "F7" has crossed the threshold value for all other factors. Therefore, it is considered as the most critical factor. Then factor F11 gets the second priority; F5 gets the 3rd priority and F3 gets the 4th priority. From **Table 5.4,** it is also found that factors F9, F12, F14, F15 have not crossed the threshold value. Therefore, they are considered as effect factors. Factors F1, F4, F6, F8, F10 and F13 have very negligible influence over other factors, so these are also considered as effect factors.

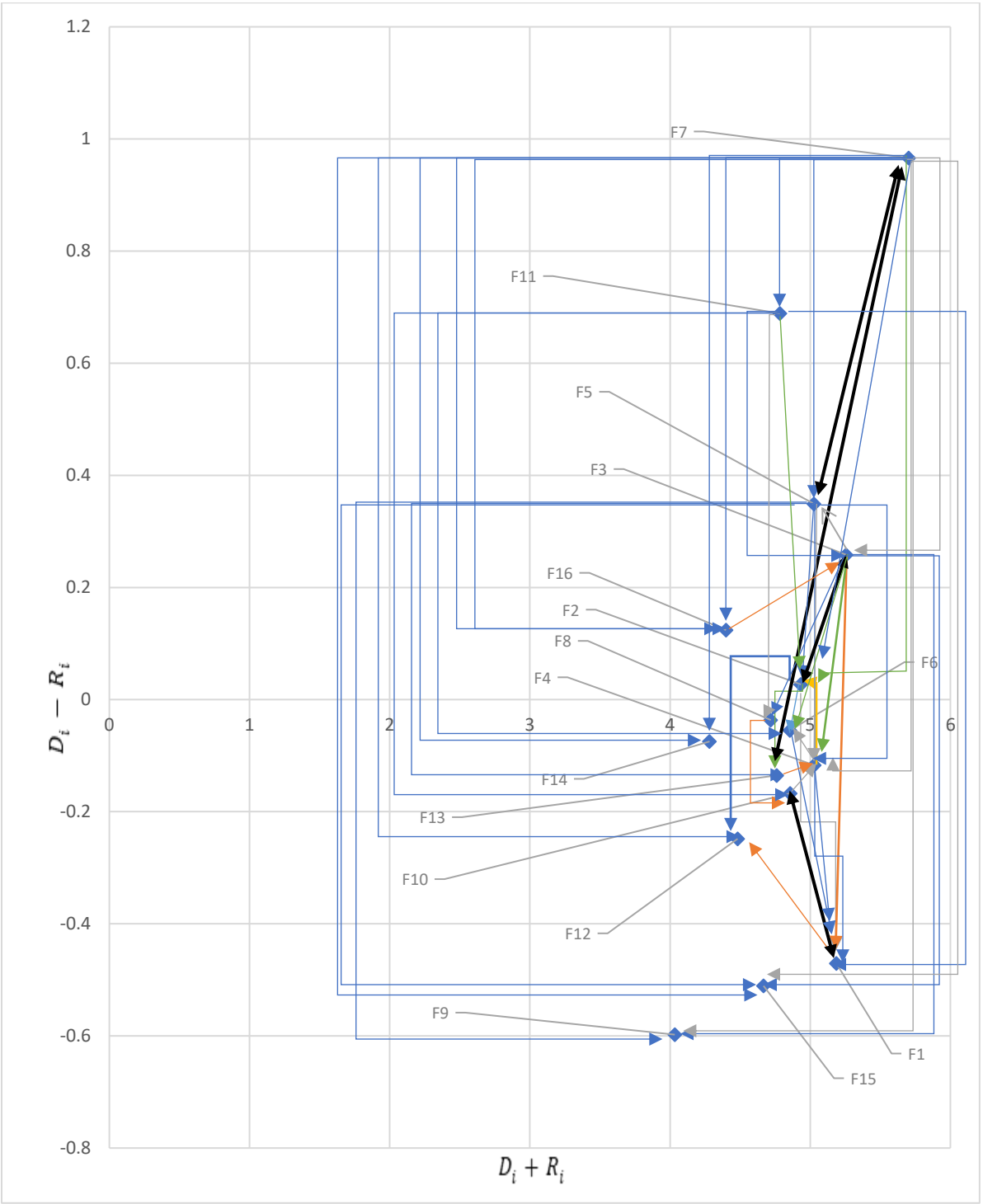

Fig. 5.3 The prominence-causal DEMATEL graph

Chapter 6
Conclusions and Recommendations

6.1 Conclusions

In recent years, environmental and sustainable issues have become the major concerns for business organizations, governments and international bodies. Thus, business organizations are struggling to become more sustainable. GSCM can reduce the bad impact of industrial activity without sacrificing quality, cost, paradigm shift, reliability, performance or energy utilization efficiency. It is also going from end-of-pipe control to meet not only leading to overall economic profit but also minimizing ecological damage. This area is still challenging for everyone. There is still more yet to discover and thus there is a need for wider research. There are various critical factors either external or internal which may be associated with an organizational supply chain. These are responsible to plan and implement GSCM concepts. It is one of the most important strategic decisions to practice the non-environment friendly practices and to ensure sustainability in business. A huge emphasis has been given to adopting GSCM in developed nations. Further, with the current technology, it is becoming important for Bangladeshi industries to implement GSCM to reduce environmental impacts and maximize economic gains. Implementing GSCM is difficult to achieve because of the existence of many critical factors. In this study, a systematic way is followed to deal with this problem, which is to evaluate the CSFs in the implementation of GSCM to improve the ecological–economic performance of the business.

The aim of this work is to propose a structural framework to evaluate the CSFs in greening the supply chain by using DEMATEL approach. The DEMATEL method helps to establish interactive relationships among the factors by dividing them into cause and effect group factors. After received inputs from the experts, total 16 common GSCM implementation CSFs were selected. The research outcome reveals that the main factors are Top Management Commitment (F7), Government Regulations and Standards (F11), Pollution prevention and hazardous waste management (F5), Environment management certification (ISO 14000) (F3). So top management should be helpful and show enough commitment to implement GSCM. It is also important to follow government laws and regulation. Moreover, pollution prevention and hazardous waste management must be active and concern about Environment management certification (ISO

14000). As the cause group factors have a tendency to directly affect the system, the company should work on these factors to improve the overall green supply chain performance.

This study can help industrial managers not only to obtain the interactive relationships among key factors to GSCM but also to prioritize them. With the key insights of this research, industrial managers can develop strategies for efficiently managing their supply chains.

6.2 Recommendation

This research has evaluated the critical success factors for an electronics manufacturing company of Bangladesh using the DEMATEL method. Other methods such as Fuzzy-DEMATEL, Fuzzy-based total interpretive structural equation mode (Fuzzy ISM) can also be used to evaluate the critical success factors.

This study is based on one specific type of company i.e., an electronics company. The CSFs will vary depending on the type of company and industry. Thus, more research is required for examining CSFs in an emerging economy's context like Bangladesh.

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Appendix A

Table A1: Profile of the X Industries Ltd.

Factory	Chandra, Kaliakoir, Gazipur.
Company Type	Manufacturing, Consumer Electronics.
Total worker	12000+
No. of Production lines	7 lines
Products	Refrigerators, Freezers, Air- Conditioners & Compressors.
Production Capacity	3.00 million refrigerator/year, 0.30 million Air-conditioner/year and 0.50 million Compressor/year.
Production Process	Tube Bending, Thermoforming, Roll Forming, Foaming, Welding, Gas Charging, Testing, Finishing & Packaging.
Machineries	Thermoforming, Channel Extrusion, ABS/HIPS Sheet Extrusion, Magnetic Strip Extrusion, PP Hollow Sheet Extrusion, VMC, 5 axis VMC, Ultrasonic Welding, Injection Molding, Styrofoam Making, Hi Speed Power Press, Fin Press, Corrugation.
Export Market	Nepal, Bhutan, Myanmar, Maldives, UAE, Qatar, Nigeria and West Africa.

Table A2: Industry Experts

Companies	Experts	Affiliation
X Industries Ltd.	Expert 1	Chief Executive Officer
	Expert 2	Sr. Deputy Operative Director, SCM
	Expert 3	Sr. Additional Director, SCM
	Expert 4	Additional Director, SCM
	Expert 5	Sr. Deputy Director, SCM
	Expert 6	Deputy Director, SCM
	Expert 7	Sr. Asst. Director, SCM
	Expert 8	Asst. Director, SCM
	Expert 9	Sr. AGM, SCM
	Expert 10	AGM, SCM
Y Industries Ltd.	Expert 11	MD & CEO
	Expert 12	Head of SCM
	Expert 13	In-Charge, Sourcing & Procurement
	Expert 14	In-Charge, Planning & Inventory
	Expert 15	In-Charge, Logistics & Distribution
	Expert 16	Manager, Distribution
	Expert 17	Asst. Manager, Sourcing
	Expert 18	Asst. Manager, Commercial
	Expert 19	Executive, Commercial & Logistics
	Expert 20	Executive, SCM
Z Industries Ltd.	Expert 21	Managing Director
	Expert 22	Executive Director
	Expert 23	Head of SCM
	Expert 24	Sr. Manager, SCM
	Expert 25	Manager, SCM
	Expert 26	Dy. Manager, SCM
	Expert 27	Asst. Manager, SCM
	Expert 28	Sr. Executive, SCM
	Expert 29	Executive, SCM
	Expert 30	Executive, SCM

Appendix B

DEMATEL Method Questionnaire

Designation:

Company:

Years of Experience:

We are trying to identify the critical success factors for implementing Green Supply Chain Management (GSCM) in Electronics Industry.

[This is an editable PDF, just click on the Yes or No option and save is. Then please send it back]

Critical success factors to implement Green Supply Chain Management (GSCM)

01. Do you think stakeholder pressure is a critical success factor for implementing GSCM?

☐ Yes ☐ No

02. Do you think waste disposal norm is a critical success factor for implementing GSCM?

☐ Yes ☐ No

03. Do you think environment management certification (ISO 14000) is a critical success factor for implementing GSCM?

☐ Yes ☐ No

04. Do you think global competition factors is a critical success factor for implementing GSCM?

☐ Yes ☐ No

05. Do you think pollution prevention and hazardous waste management is a critical success factor for implementing GSCM?

☐ Yes ☐ No

06. Do you think environment friendly packaging and transportation is a critical success factor for implementing GSCM?

☐ Yes ☐ No

07. Do you think top management commitment is a critical success factor for implementing GSCM?

☐ Yes ☐ No

08. Do you think competencies for greener products and processes is a critical success factor for implementing GSCM?

☐ Yes ☐ No

09. Do you think bargaining power through the supply is a critical success factor for implementing GSCM?

☐ Yes ☐ No

10. Do you think application of advanced technology and IT tools is a critical success factor for implementing GSCM?

☐ Yes ☐ No

11. Do you think government regulations and standards is a critical success factor for implementing GSCM?

☐ Yes ☐ No

12. Do you think reverse logistics is a critical success factor for implementing GSCM?

☐ Yes ☐ No

13. Do you think development of trained and skilled manpower is a critical success factor for implementing GSCM?

☐ Yes ☐ No

14. Do you think green infrastructure/policies/practice is a critical success factor for implementing GSCM?

☐ Yes ☐ No

15. Do you think collaboration with suppliers is a critical success factor for implementing GSCM?

☐ Yes ☐ No

16. Do you think recycling and lifecycle management is a critical success factor for implementing GSCM?

☐ Yes ☐ No

17. Do you think development of trained and skilled manpower on green supply chain is a critical success factor for implementing GSCM?

☐ Yes ☐ No

18. Do you think environmental performance is a critical success factor for implementing GSCM?

☐ Yes ☐ No

19. Do you think establish an environmental risk management is a critical success factor for implementing GSCM?

☐ Yes ☐ No

20. Do you think green design and green marketing is a critical success factor for implementing GSCM?

☐ Yes ☐ No

21. Do you think clean production is a critical success factor for implementing GSCM?

☐ Yes ☐ No

22. Do you think green information technology is a critical success factor for implementing GSCM?

☐ Yes ☐ No

Appendix C

Table C1: Experts' feedback on critical success factors for implementing Green Supply Chain Management (GSCM)

Man-agers	Factors																				
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22
E1	•	•	•		•		•	•			•		•	•		•						
E2	•		•	•		•	•		•	•	•	•			•							
E3		•	•		•		•	•					•			•						•
E4			•	•	•	•	•				•			•		•					•	
E5		•	•		•		•			•		•			•					•		
E6		•			•		•	•			•		•			•		•				
E7			•	•	•	•	•									•						
E8	•	•	•		•		•	•	•		•	•		•	•	•						
E9	•		•		•	•	•			•	•					•						
E10					•	•	•	•			•			•		•						
E11	•	•	•				•	•			•		•			•						
E12			•	•	•		•		•		•	•		•	•	•						
E13		•	•		•	•	•	•			•		•				•					
E14			•	•		•	•				•			•		•						
E15	•			•	•	•	•			•	•											
E16		•	•			•	•	•			•					•			•			
E17		•	•		•		•	•			•	•	•									
E18			•	•	•	•	•			•	•			•		•						
E19	•	•			•	•	•	•			•											•
E20		•	•		•		•			•	•		•	•		•						
E21				•	•	•	•	•			•		•	•		•						
E22		•		•	•		•	•		•	•			•								
E23		•	•		•		•				•		•	•		•						
E24			•	•		•	•	•	•		•	•			•	•						
E25		•	•		•		•	•	•		•	•	•		•	•						
E26		•		•	•		•	•		•			•	•				•				
E27			•	•		•	•			•	•		•	•		•						
E28	•	•	•		•		•		•		•	•			•	•						
E29		•			•	•	•	•		•	•	•	•									
E30		•	•		•		•		•		•			•	•		•					

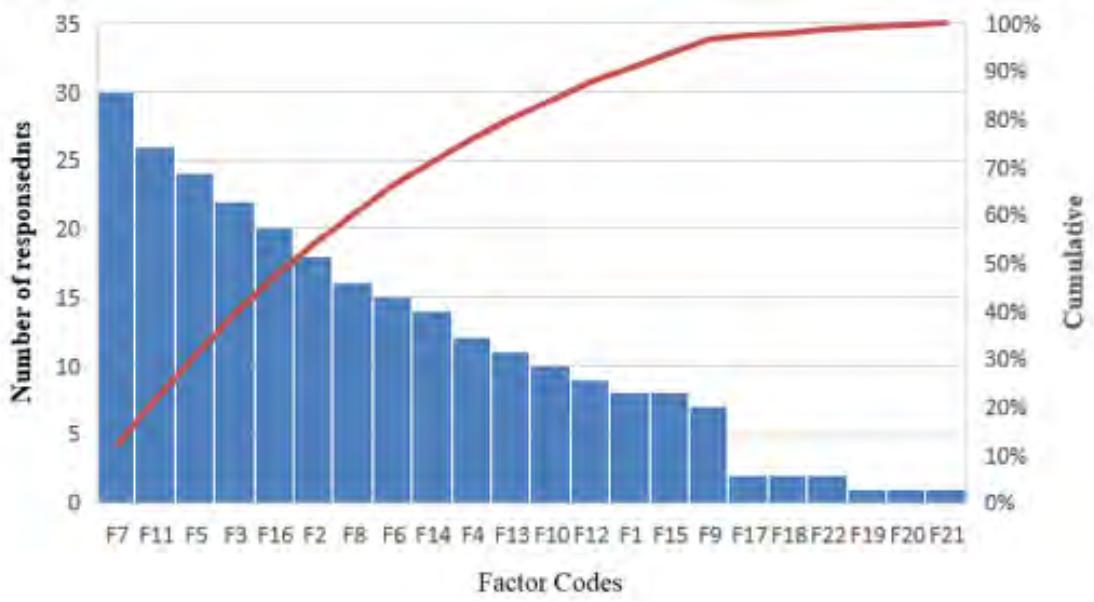

Fig. C1: Experts' feedback on critical success factors for implementing Green Supply Chain Management (GSCM)