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ANALYZING BARRIERS OF SUSTAINABLE CIRCULAR SUPPLY CHAIN MANAGEMENT IN THE TEXTILE SECTOR OF BANGLADESH : A FUZZY DEMATEL APPROACH

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Abstract

The use of a sustainable circular supply chain has brought about a revolutionary change in the world's textile industry. This has greatly influenced the development of the circular economy of the textile industry. The purpose of this study is to investigate the barriers to adoption of sustainable circular supply chain management (CSCM) in the textile industry of Bangladesh. Traditional operating models in this field have significantly hindered the effective implementation of CSCM. This study examines the challenges of implementing a sustainable circular supply chain in the textile industry. The goal is to provide a comprehensive understanding of the obstacles that must be overcome for a successful transition. His research uses the Fuzzy DEMATEL method to classify more complex obstacles. Implementation of CSCM. Known for analyzing complex systems with interconnected causal relationships, DEMATEL's approach has been enhanced by fuzzy technology. It transforms linguistic concepts into fuzzy numbers, capturing different experiences and perspectives, and helps create a clear structural model. The results of this study will provide the textile industry with valuable insights to help create strategies for effective CSCM implementation. A major challenge in implementing circular supply chains is reverting to traditional practices when obstacles arise. Therefore, this transition requires informed leadership and strong leadership. In addition to addressing these internal issues, the scope of lean implementation should be expanded. Our study is one of the first to systematically identify and assess barriers to CSCM adoption in the Bangladesh textile industry, contributing to the growing body of knowledge in the field.

Chapter 1

INTRODUCTION

1.1 Background

Sustainability has provoked a multitude of discussions and debates in the academic literature, including M. A. Moktadir, Ali, et al. (2018) . Sustainability has gained increasing attention in science, business, and politics over the past twenty years. In supply chain management, there has been a significant surge in research and development of sustainability-related frameworks, including green supply chains, closed-loop supply chains, reverse supply chains, sustainable supply chains (SSCs), and, more recently, circular supply chains (CSCs)(Debnath et al., 2023). The concept of circular supply chains aligns with the principles of the circular economy, suggesting a focus on recycling, reusing, and achieving zero waste within supply chain management. This entails the return or processing of used products or their components for repair, resale, refurbishment, or recycling, ultimately reducing waste and promoting sustainability. Circular supply chains are integral to the broader effort to minimize waste and adopt environmentally friendly practices in manufacturing and sales. Concerns about climate change and rising carbon emissions have prompted businesses to shift their business model from a linear economy to the Circular Economy (CE) model (Debnath et al., 2023)In addition to its positive environmental impact, the adoption of circular supply chains can also bring long-term economic benefits.

Textile industries are a major source of employment in Bangladesh. They are providing jobs to millions of people, mainly in the garments sector. Today, Bangladesh holds the second position in garment exporting while China remains the first for the last few decades(Vishwakarma et al., 2022a). Besides, ready-made garments (RMG) have been a major driver of economic growth in Bangladesh. The RMG industry in Bangladesh is considered one of the fastest-growing industries after the 1990s (Vishwakarma et al., 2022a). Additionally, the Generalized System of Preference (GSP) allowed Bangladesh to export RMG products to the European Union (EU) without any tariff, while the tariff rate on RMG products was 12.5% for all other countries (Mukhsin & Suryanto, 2022)This industry sector has attracted foreign investment in huge numbers. The RMG industry of Bangladesh exports a variety of RMG items for men, women, and kids, such as shirts, jackets, trousers, sweaters, t-shirts, etc. Among them, T-shirts (USD 5.6 billion) and trousers (USD 5.4 billion) have the highest export value (Saroha et al., 2022a). Bangladesh's RMG is concentrated mainly in two markets: the European Union (EU) and the United States of America (USA). These two markets comprise approximately 83% of Bangladesh's total RMG exports in 2020 (Lahane & Kant, 2021a)In Bangladesh, concerns about environmental sustainability and the ecological footprint of textile manufacturing have been raised, leading to increased awareness. The growth of the textile industry has played a pivotal role in the industrialisation of Bangladesh.Like no unmixed good in this world.

1.2 Problem Statement

Due to its intricate process, the textile industry is the biggest manufacturer that pollutes the environment, and this industry has been the main user of the Circular economy and its implementations(Malik et al. 2014), the textile industry is the second most polluting business globally because it is a supply chain that uses a lot of harmful materials that contaminate the air, water, and soil. The worldwide production of textile waste has increased, yet recycling or reusing textile items would cut down on fresh waste originating from virgin materials (Dolatabad et al., 2022)Furthermore, the textile industry utilizes a lot of water to finish the production process, as do all manufacturing procedures in the textile business uses a lot of water (Chhimwal et al., 2022)

Textile companies launch new items with short product life cycles, and this leads to less durable quality and more costs (Farooque et al., 2019). The consumption of textile items and the waste of textile products have been rising drastically. Currently, the textile industry in developing countries has to face the problems of waste production, environmental pollution, pollution and resource scarcity (M. A. Moktadir, Rahman, et al., 2018).To solve such problems of unsustainable development, CSC thus works as a dominant solution model in the previous take, make and lose model. CSC focuses on the triple bottom line of sustainable development (M. A. Moktadir, Rahman, et al., 2018)CSC works according to CE principles. Thus, manufacturing industries seeking to redesign their supply chain models using CE can achieve many significant benefits. Reverse logistics is an important part of CSC where used products are returned into the supply chain to add value. This has a significant economic impact, generating almost 2.20 billion euros in revenue through the effective implementation of e-waste recycling (Munny et al., 2019)The waste taken from the manufacturing process would be a significant input for another manufacturing process that encompasses raw material, harvesting, designing, yarn manufacturing, spinning, weaving, dyeing, stitching, and cutting (M. A. Rahman, 2022). It is obvious that today's linear economy cannot accomplish a sustainable manufacturing process; therefore, the circular economy obtained from a circular supply chain is especially needed for the textile industry (M. A. Rahman, 2022).However, it was suggested that textile companies transform their capabilities from a linear economy to a circular economy, there have been many barriers that companies encounter during this process. Therefore, this study focused on the barriers that prevent companies from adapting the Circular economy implementations.

While traditional supply chain management prioritizes effectiveness, affordability, and responsibility of operations, sustainable circular supply chain management also incorporates the pretensions of sustaining social and environmental values (Heinemann, 2022). This entails working on global problems including corruption, fair labour practices, deforestation, water security, and climate change. Encyclopedically, businesses have better working conditions, reduced waste, and reduced carbon emigration (Heinemann, 2022). They keep track of several enterprises that, for case, prioritize renewable energy, support recycling, or encourage lesser social responsibility among suppliers by assaying sustainability parameters in SCM systems(Forslund et al., 2022). While associations tend to concentrate on short-term earnings and ignore possible long-term earnings, SSCM can deliver the sustainability and profitability that enterprises want(M. A. Rahman, 2022)(M. A. Rahman, 2022). Not only will having a sustainable SC lower costs and emigration, but it'll also increase consumer fidelity and investor connections, maintain compliance issues, foster commercial societies, and boost profitability(Alam et al., 2023). The relinquishment of SSCM will be a ferocious process that calls for a series of ways to apply it in traditional cloth operations, but if these enormous conduct are taken, it'll help to achieve some of the relinquishment of SSCM will be a ferocious process that calls for a series of way to apply it in traditional cloth operations, but if these enormous conduct are taken, it'll help to achieve some of the Sustainable Development Goals(SDGs), which will ensure growth in the frugality, addition in society, and the preservation of the terrain(Debnath et al., 2023).of the Sustainable Development Goals(SDGs), which will ensure growth in the frugality, addition in society, and the preservation of the terrain(Lahane & Kant, 2021b).

Adaptation of CE applications requires all SC units to adapt them (Vishwakarma et al., 2022a). Processes in the circular supply chain (CSC) of a textile company the chain, such as collection, separation, classification and recycling, should be improved at the same time and should be used with as few harmful environmental effects as possible (Rashid et al., 2024). In CE, the entire SC and its processes should be adapted to sustainability based on the optimal use of all resources(Saeed & Kersten, 2019) . For these reasons, this study analyzed SC barriers to CE in the textile industry. noted the need to analyze certain economic sectors in different geographical contexts. It is important to understand the concept of CE in developing countries. Thus, several studies have been conducted and proposed possible frameworks for the implementation of CE in various fields of economies (Forslund et al., 2022). There too few studies have been carried out in the textile industry (M. A. Rahman, 2022)

RQ1. How can Circular supply chain barriers be identified within the complex structure of the textile industry according to Bangladesh's perspective?

RQ2. What are the interrelationships and dependencies among the identified barriers to the adoption of Circular Supply Chain Management (CSCM) in the textile industry of Bangladesh, considering the fuzzy nature of these relationships?

RQ 3. In what ways can the findings from a Fuzzy DEMATEL analysis inform the development of strategies and interventions to overcome the identified barriers and facilitate the successful implementation of Circular Supply Chain Management in the textile industry of Bangladesh?

1.3 Objectives

Objective 1: Analyze Bangladesh's textile industry to identify circular supply chain challenges, considering regulatory, infrastructural, and socio-economic factors.

Objective 2: Gather stakeholder insights through qualitative methods to understand interrelationships among identified barriers to CSCM adoption in Bangladesh's textile sector.

Objective 3: Utilize Fuzzy DEMATEL to assess dependencies among barriers, informing targeted strategies for successful CSCM implementation in Bangladesh's textile industry.

1.4 Scopes of the Thesis

Looking at the barriers to circular supply chain management (CSCM) in the textile industry, this study theoretically improved the CSCM database in an attempt to address these RQs. The goal is to overcome obstacles and implement the right frames that make textile products possible. A new framework will be created to assess barriers, including questionnaires and the fuzzy DEMATEL technique will be presented (Saroha et al., 2022a). Questionnaires and literature were used to identify the significant barriers in the textile industry in Bangladesh(Saroha et al., 2022a). A DEMATEL model is presented to investigate significant interaction obstacles. The fuzzy DEMATEL technique was used in this study because it can map the barriers to impressive links of inaccurate information. In terms of practical implications, research and results can help textile manufacturers make an assessment of the company featuring (CSC) applications and making current systems competitive. The fuzzy DEMATEL model also helps industrial managers develop successful circular supply chain implementation strategies.(Saroha et al., 2022a)

Chapter 2

Literature Review

2.1 Sustainable Supply Chain

Feasible supply chain administration (SSCM) is all around adjusting natural, financial, and social contemplations all through the lifecycle of items green(Tumpa et al., 2019). It's not close to making items; it's approximately making them in a way that regards individuals and the planet. Governments, clients, and advertise weights are progressively pushing companies to embrace greener hones, making SSCM more vital than ever. This approach isn't almost about being "green" — it's around coordination maintainability into each viewpoint of how a company works(Tumpa et al., 2019).

SSCM is picking up footing among both commerce pioneers and analysts since it offers a way to address squeezing worldwide issues whereas too driving long-term financial benefits.(Munny et al., 2019) By considering natural impacts, social duty, and financial reasonability, companies can construct supply chains that are not as it were productive but moreover great for society and the environment.(Sodhi & Tang, 2011)

One of the key angles of SSCM is chance administration, including the relief of natural and social dangers.(Munny et al., 2019) It's not around maximizing benefits; it's moreover almost guaranteeing item security, securing the environment, and advancing great administration. SSCM sets yearning targets for lessening vitality utilization, expanding renewable vitality utilization, minimizing water utilization, and cutting down on squander era(Huq et al., 2014).

But supportability isn't close to the environment — it's too approximately individuals and financial matters(Siems et al., 2023). Later considers have highlighted the importance of considering social and financial variables nearby

natural ones(Khairul Akter et al., 2022a). This all encompassing approach to SSCM is vital for making supply chains that are really feasible and useful for everybody included(Dolatabad et al., 2022).

2.2 Circular Sustainable supply Chain

A circular supply chain is one that livelihoods materials and items as long as conceivable, instead of letting them go right away to waste. In a circular supply chain, makers reuse unrefined materials such as plastic, metal, cardboard, paper, steel, and glass. They repair and trade as of now had items(Karmaker et al., 2023)

2.3 A Brief Overview of the Bangladeshi Textile Industry

The material industry in Bangladesh is just like the beating heart of our economy. It's not fair a division; it's a powerhouse that fills our GDP, trade profit, and job showcase. We've been within the material diversion for a long time, and presently we're recognized universally as one of the best exporters of materials and pieces of clothing.(M. A. Moktadir, Rahman, et al., 2018)

What's fueled our industry's development? Well, we've got some pros up our sleeve. To begin with off, our labor costs are moo, making generation reasonable. Additionally, we've got a gigantic workforce, generally youthful and lively, prepared to roll up their sleeves and get the work done. And let's not disregard around those sweet exchange bargains we've secured, giving us an edge in worldwide markets. Gracious, and being so near to enormous markets like Europe and the US? That's a calculated dream come genuine.Presently, when it comes to making materials, we do it all. From turning yarn to weaving textures, weaving, coloring, printing – you title it, we've got it secured. Our industry is like a well-oiled machine, with companies dealing with each step of the method right here in our claim offices.(Salman et al., 2023)

But what truly puts us on the outline is our talent for making ready-made articles of clothing, or RMGs. They're our bread and butter, making up most of what we trade. And you know what? Our piece of clothing production lines are where the magic happens. They churn out clothing for a few of the greatest names within the worldwide design scene, much appreciated to their capacity to deliver on a gigantic scale, quick and at competitive costs.(Khairul Akter et al., 2022a)

Presently, it's not all daylight and rainbows. We've got our reasonable share of challenges as well. Laborer security, labor rights, natural concerns – they're all on our radar. We've had a few extreme minutes, with mishaps like fires and building collapses putting us beneath the magnifying lens. But hello, we're not ones to bashful absent from a challenge. We're venturing up our diversion, fixing controls, and making beyond any doubt our laborers are secure and treated decently.(Khairul Akter et al., 2022a; Vishwakarma et al., 2022)

In later a long time, we've been putting a greater center on maintainability. We're joining forces with activities just like the Agreement on Fire and Building Security and the Collusion for Bangladesh Specialist Security to raise the bar on work environment guidelines and natural hones.(Khairul Akter et al., 2022a) All in all, our material industry is like a phoenix rising from the fiery debris. We're advancing, adjusting, and always pushing forward. Beyond any doubt, we've got obstacles to hop, but we're not backing down. We're here to remain, driving our economy, making occupations, and putting Bangladesh on the map as a material powerhouse. (Salman et al., 2023)

2.4 Sustainable Supply Chain Management in Bangladesh in Textile Industry

Economical supply chain administration (SSCM) within the textile industry of Bangladesh may be a basic endeavor due to the sector's noteworthy commitment to the country's economy and its natural and social affect. Bangladesh is one of the world's biggest exporters of materials and pieces of clothing, bookkeeping for a considerable parcel of its GDP and business.(Huq et al., 2014)

In recent a long time, there has been developing acknowledgment of the have to be address supportability issues inside the material industry, especially concerning natural corruption, labor rights, and specialist security. SSCM hones in Bangladesh's material industry point to mitigate these challenges whereas cultivating financial development and social advancement.(M. A. Moktadir, Rahman, et al., 2018)

One of the essential centers of SSCM within the Bangladeshi material industry is decreasing natural contamination and asset depletion. Textile manufacturing forms regularly include noteworthy water and vitality utilization, as well as the discharge of unsafe chemicals and squander. SSCM activities look for to play down these impacts through the selection of cleaner generation strategies, resource-efficient advances, and wastewater treatment offices. Also, the advancement of eco-friendly materials, such as natural cotton and reused strands, is picking up footing to diminish the industry's carbon impression and reliance on limited assets.(Ni et al., 2020)

Additionally, SSCM in Bangladesh's material industry emphasizes the significance of guaranteeing fair labor hones and laborer security throughout the supply chain. Measures such as social compliance reviews, laborer preparing programs, and the usage of moral sourcing arrangements are basic components of SSCM endeavors to advance social obligation and engage specialists(A. Moktadir et al., 2018).

Moreover, collaboration and partnerships play a pivotal part in progressing SSCM in Bangladesh's material industry. Partners over the supply chain, counting producers, brands, government offices, non-governmental organizations (NGOs), and industry affiliations, must work together to drive economical hones and address systemic challenges. Activities such as industry-wide supportability frameworks, multi-stakeholder discoursed, and capacity-building programs encourage collective activity and information sharing to drive positive alter.(Awaysheh & Klassen, 2010)

In spite of advance made in actualizing SSCM hones, challenges stay, counting constrained mindfulness and capacity, compliance issues, and financial constraints. However, with proceeded commitment and collaboration, Bangladesh's material industry has the potential to ended up a worldwide pioneer in feasible supply chain administration, contributing to both natural stewardship and socio-economic advancement within the nation.(Karmaker et al., 2023)

2.5 Barriers of Sustainable Supply Chain

Obstructions in executing a circular economical supply chain are basically the obstacles or barricades that prevent businesses from successfully coordination hones pointed at advancing asset effectiveness, squander diminishment, and natural supportability over their supply chains. These boundaries can emerge from different components and can posture critical challenges to the selection and execution of circularity sandards (M. A. Moktadir, Ali, et al., 2018)

No	Context	Barriers	Descriptions	Reference
1	Managerial	Absence of provider's top administration responsibility	The dedication of the upper management raises the bar for performance and productivity. The entire performance of the organization will impacted by the decisions that senior management make about strategy. If senior management is not committed to pursuing sustainability in SC operations, it will be difficult to do so	(M. A. Rahman, 2022; Tumpa et al., 2019)
2		Absence of coordination and trust	The primary obstacle to coordination is the fact that misaligned goals lead to distinct SC phases optimizing local aims instead of the chain's overall profits. Other contributing reasons are incentives for the sales team, inefficient processes that lead to lengthy lead times for restocking, and a lack of information sharing. These all contribute to a head purchasing and a distrusted environment that makes collaboration difficult.	(Farooque et al., 2019; Forslund et al., 2022)
3		Insufficient awareness and advancements from suppliers offering eco-friendly packages	Suppliers are essential in advancing SSCM since they offer eco-friendly packaging. Businesses find it difficult to apply SSCM since suppliers don't know how to create packaging that is environmentally favorable.	(Lahane & Kant, 2022)
4		Market Demand and Consumer Behavior	Need of buyer mindfulness or request for feasible items and administrations may discourage businesses from contributing in circular activities, as they may see constrained showcase openings or hesitance to pay a premium for economical choices.	(Lahane & Kant, 2021)
5		Legal and Liability Issues	Concerns over lawful liabilities, especially related to item guarantees, mental property rights, and risk for reused or remanufactured items, may discourage businesses from grasping circular models	(Salman et al., 2023)
6	Technical	Technology Readiness and Infrastructure	Lacking mechanical capabilities and foundation for reusing, remanufacturing, and asset recuperation can restrain the	(Luthra et al., 2022)

			achievability and adaptability of circular supply chain arrangements	
7		Limited Access to Expertise and Resources	Little and medium-sized endeavors (SMEs) or businesses in creating districts may need get to to the mastery, assets, and systems required to embrace circular hones viably.	(Lahane & Kant, 2021)
8		Institutional Support and Governance	Insufficient organization bolster or administration structures at nearby, national, or universal levels may prevent the scaling up of circular activities and collaboration among partners	(Lahane & Kant, 2021)
9		Infrastructure and Logistic Constraints	Challenges related to framework impediments, such as lacking squander collection and reusing offices or wasteful transportation systems, can prevent the viable usage of circular hones	(Lahane & Kant, 2022)
10		Complexity of Supply Chains	Supply chains are regularly complex and interconnected, making it challenging to recognize openings for circularity and arrange endeavors over numerous partners and geographies	(Sodhi & Tang, 2011)
11		Lack of Collaboration	Constrained collaboration and information sharing among supply chain accomplices can prevent endeavors to execute circular hones, as fruitful circularity regularly requires participation and coordination over the esteem chain.	(Boström et al., 2015)
12		Quality and Performance Standards	Assembly quality and execution guidelines for reused or remanufactured items can be challenging, especially on the off chance that they don't coordinate the quality of virgin materials or confront skepticism from clients.	(Khairul Akter et al., 2022b)
13		Infrastructure and Logistic Constraints	Challenges related to framework confinements, such as lacking squander collection and reusing offices or wasteful transportation systems, can ruin the viable execution of circular hones.	(Chowdhury et al., 2023)
14		Insufficient skilled manpower	Lack of knowledgeable and experienced workers with the necessary skills to	(BUGS ANTOCHEVIZ, 2018)

			successfully adopt sustainable circular supply chain practices	
15	Financial	Initial Cost and Investment	Actualizing circular hones frequently requires noteworthy forthright venture in innovation, framework, and representative preparing, which can hinder organizations, particularly littler ones with constrained assets.	(Saroha et al., 2022b)
16		Resistance to Change	Resistance from partners inside the organization, counting workers, administration, and shareholders, can block the selection of circular hones due to fear of disturbance or newness with modern approaches	(Leonas, 2017)
17		Fragmented Value Chains	In businesses with divided esteem chains, such as gadgets or materials, planning circular activities among various providers, producers, and wholesalers can be troublesome due to contrasting needs and capabilities.	(Kiefhaber, 2018)
18		Financial Incentives and Business Models	Constrained budgetary motivating forces or reasonable trade models for circular supply chain hones may debilitate speculation in maintainability, especially in the event that the benefits are not promptly clear or quantifiable.	(Heinemann, 2022)
19		Insufficient training	Absence of thorough training programs to teach employees about circular supply chain concepts and practices	(Awaysheh & Klassen, 2010; T. Rahman et al., 2020)
20		Inadequate plant This factory layout & maintenance	This identifies problems with maintenance procedures and manufacturing layouts that impede lean efficiency.	(Mott et al., 2022)

2.6 Research gaps and contributions of the study

Distinguished basic boundaries to executing maintainability hones within the attire and material division utilizing ISM, fuzzy MICMAC, and DEMATEL strategies, highlighting communication crevices, execution boundaries, need of instruction, capacity limitations, and invert coordinations as key challenges, helping industry experts and supervisors

(Vishwakarma et al., 2022) Recognizes and analyzes circular supply chain boundaries within the material industry, proposing a system and uncovering causal connections utilizing the Fuzzy-DEMATEL strategy, with key discoveries highlighting issues such as lacking reusing foundation and resistance to circular economy models. (Kazancoglu et al., 2022) Distinguishes challenges and openings in actualizing circular economy hones inside the material and clothing industry in Bangladesh, Vietnam, and India, emphasizing the require for collective industry, administrative, and shopper endeavors nearby activities such as information sharing and marketization of squander reusing for fruitful usage. (Saha et al., 2022) Utilizes a multi-criteria decision-making approach to prioritize basic victory variables for actualizing green supply chain administration in Bangladesh's attire fabricating industry, highlighting 'demand from buyers', 'economic and assess benefits', and 'government regulations' as key components. (Debnath et al., 2023) Proposes a half breed approach utilizing dark Explanatory Arrange Prepare (ANP) to address challenges in executing Keen Squander Administration Frameworks (SWMS) within the material industry of rising economies, with a center on Bangladesh, emphasizing proficient squander recuperation observing and control as a basic step towards accomplishing a zero-waste circular economy. (Chowdhury et al., 2023) (Chowdhury, N. R., Paul, S. K., Sarker, T., & Shi, Y. (2023). Implementing smart waste management system for a sustainable circular economy in the textile industry. International Journal of Production Economics, 262, 108876.) The investigate crevice alludes to the lost or unexplored regions inside existing writing or information in a specific field or subject. Recognizing inquire about holes is fundamental for researchers and analysts to characterize the scope of their work and contribute to the progression of information by tending to these holes.(Ahmed et al., 2018) Here's an case of a inquire about crevice related to the circular, maintainable supply chain within the material industry in Bangladesh. Whereas there's developing intrigued and attention towards actualizing circular and feasible hones within the material industry around the world, there remains a noteworthy inquire about hole with respect to the particular challenges and openings for such activities inside the setting of Bangladesh. In spite of being one of the world's biggest article of clothing exporters, the nation faces interesting socio-economic, infrastructural, and natural imperatives that require custom fitted approaches to circularity and maintainability . Identification of practices on its own does not give a clear enough understanding. To develop full understanding, all practices should be modelled into a framework to appreciate the inter-relationships among them. (Berberoglu, Y., Kazancoglu, Y., & Sagnak, M. (2023). Circularity assessment of logistics activities for green business performance management. *Business Strategy and the Environment*, *32*(7), 4734-4749.).In most studies, researchers have ignored the possibility of some vagueness in human judgement; this could have been ruled out by using fuzzy set theory with the selected methodology. (Yadav, G., Luthra, S., Jakhar, S. K., Mangla, S. K., & Rai, D. P. (2020). A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case. *Journal of Cleaner Production*, *254*, 120112.) Many studies have focused on the importance and priority of finding out factors; very little attention has been paid to the mutual relations and level of effects of one factor on another; the fuzzy-DEMATEL technique could have been employed. (Saroha, M., Garg, D., & Luthra, S. (2022). Identification and analysis of circular supply chain management practices for sustainability: a fuzzy-DEMATEL approach. *International Journal of Productivity and Performance Management*, *71*(3), 722-747.)Understanding the existing infrastructural confinements and mechanical availability for actualizing circular hones, such as reusing offices, squander administration frameworks, and renewable vitality selection, is pivotal for concocting attainable and compelling procedures. (Kovač, A., Paranos, M., & Marciuš, D. (2021). Hydrogen in energy transition: A review. *International Journal of Hydrogen Energy*, *46*(16), 10016-10035.) Inquire about looking at the achievability and viability of actualizing traceability and straightforwardness instruments all through the material supply chain in Bangladesh is restricted. Understanding the obstructions to and potential benefits of improving straightforwardness, such as made strides laborer conditions, natural affect decrease, and customer believe, is basic. (Khan, M. A., Hossain, M. E., Shahaab, A., & Khan, I. (2022). ShrimpChain: A blockchain-based transparent and traceable framework to enhance the export potentiality of Bangladeshi shrimp. *Smart Agricultural Technology*, *2*, 100041.)

Chapter 3

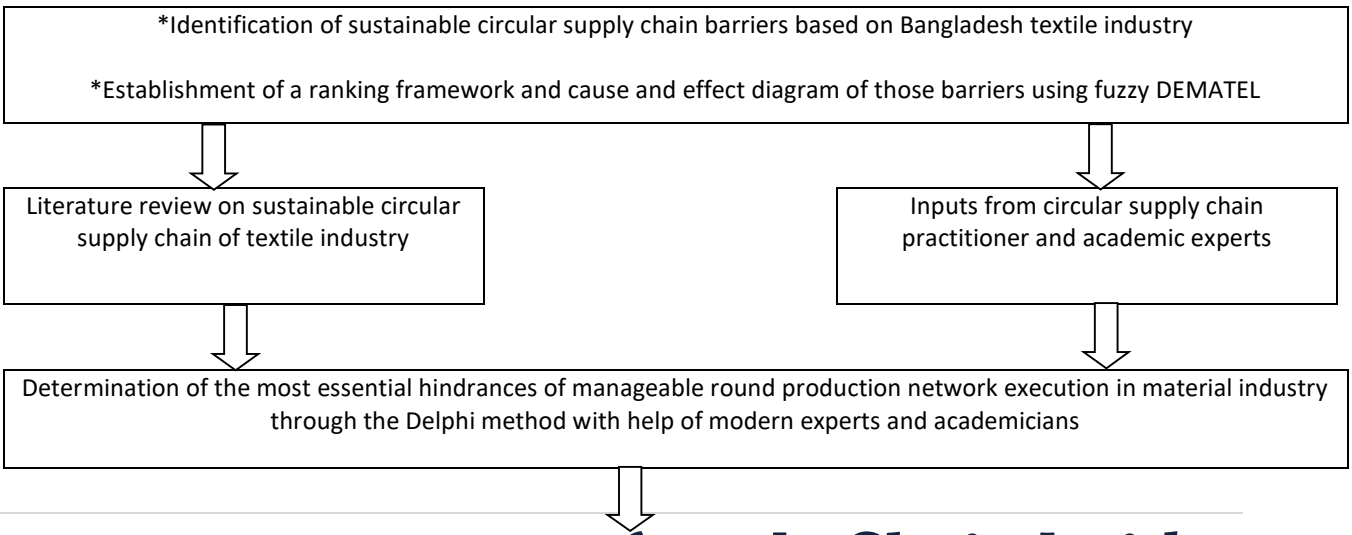
METHODOLOGY

3.1 Proposed Research Methodology

The DEMATEL strategy was once connected in 1973 by the Geneva Inquire about Center of the Battelle Dedication Organized. The DEMATEL procedure may be a more progressed way to make and look at a auxiliary demonstrate for analyzing the intuitive between impacts among complicated criteria (Han and Deng, 2018). Be that as it may, it is difficult to isolated complex factors when making choices in a fluffy circumstance. Within the current work, a fuzzy DEMATEL strategy is connected to produce a more exact investigation. The material industry of Bangladesh, like numerous businesses, includes complex and interrelated variables that influence the selection of economical circular supply chain (SCSC). DEMATEL is especially suited for analyzing complex frameworks with numerous interconnected factors (Jodlbauer & Tripathi, 2023). It permits us to examine the cause-and-effect connections among obstructions, giving bits of knowledge into how each obstruction impacts others. This can be profitable when managing with complicated issues such as (CSC) selection. Fuzzy DEMATEL expands the conventional DEMATEL strategy by pleasing fuzzy rationale (Ahmed et al., 2021). In real-world scenarios, information and connections are regularly loose and questionable. Fuzzy DEMATEL can handle this fluffiness successfully, permitting for a more practical representation of the framework beneath think about. FAHP, Fluffy VIKOR, and BWM strategies may not offer the same level of adaptability in taking care of fluffy information (Kushwaha and Talib, 2020;Raut et al., 2019;Bouzon et al., 2016;Prakash and Barua, 2015). Fuzzy DEMATEL has been effectively connected in various considers including complex decision-making issues, counting those related to obstructions and deterrents (Ponnambalam et al., 2023;). Its viability in uncovering covered up connections and dependencies among factors makes it a reasonable choice for

our investigate setting. For the analysis of intricate causal interactions among several factors, the decision-making trial and evaluation laboratory (DEMATEL) technique is most appropriate (Hsu et al., 2013;). A structural modelling technique called DEMATEL may create a digraph to show how different components are interdependent and have cause-and-effect linkages (Su et al., 2015). To assist in determining their causal links, all of the factors—which in this case are obstacles to SSCM—are separated into cause and effect groups according to the DEMATEL technique.

3.2 Flowchart of The Current Research:



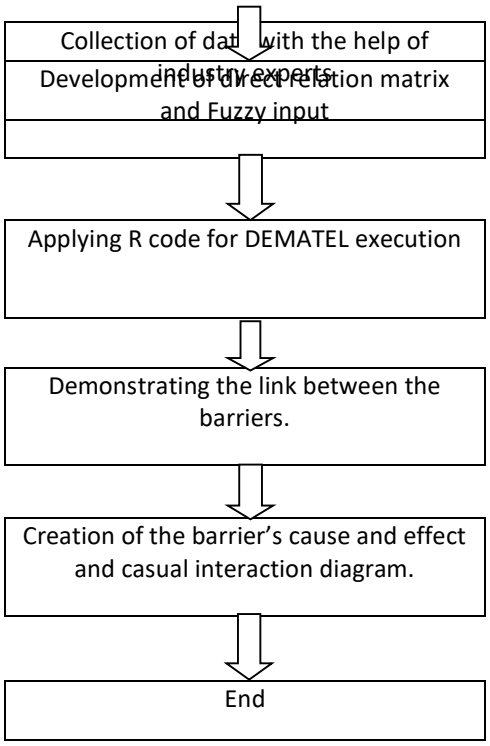


Figure 1. Flowchart of the current research

3.1 Study design, Data collection and Validation

Fuzzy DEMATEL is used in this study to identify the most important motivations for implementing a sustainable circular supply chain. The data collection procedure used three different ways to obtain expert feedback. Initially, the questionnaire (attached) was sent to 15 experts via a Google form. The aim was to strengthen and improve the significant barriers identified. A group of 15 experts from various backgrounds, both from industry and academia, was selected during data validation of our study using a purposive sampling method. Purposive sampling, a non-probability sampling method, involves the deliberate selection of specific respondents based on characteristics or characteristics related to research objectives (Moktadir et al., 2018). To preserve the privacy of these experts, their names will not be published in this study. Carefully selected people were actively

and directly involved in the furniture industry. The experts were selected on the condition that they are familiar with the circular supply chain and have at least six years of experience in the textile industry of Bangladesh. The selection criteria of these experts were carefully applied during the panel sessions to allow them to provide insight into the implementation of a sustainable circular supply chain. The criteria for selecting the expert included: i) expertise in implementing SCSC, ii) adequate understanding of the circular supply chain concept, iii) knowledge of the textile industry in Bangladesh. The resulting panel of experts included professors and industry leaders with a collective experience of more than ten years in the field of sustainable circular supply chain. Table 3 gives an overview of the profiles of the experts who participated in the study. Table 4 presents the final barriers for the textile industry developed by experts.

Table 3. Profiles of experts

Experts	Size of industry	Experience level	Professional role
1	Medium	10 years	Industrial Engineer, Researcher, Usama textile
2	Large	10 years	Manager, Snow tex.
3	Large	9 years	Head of procurement, DBL group
4	Medium	7 years	Manager, Mohammadi group
5	Large	8 years	Senior industrial officer, Taipei Bangla fabrics ltd
6	Medium	7 years	Researcher, AB textiles
7	Large	9 years	Operation specialist, standard group
8	Medium	6 years	Head of procurement, epyllion group
9	Small	5 years	Manufacturing director, Noman group
10	Large	9 years	Manufacturing director, envoy textiles
11	Medium	8 years	Manager, Sinha group
12	Large	10 years	Manager, Hamim group
13	-	7 years	Assistant professor, Ahsanullah university of science and technology
14	-	6 years	Assistant professor, Ahsanullah university of science and technology
15	-	10 years	Professor, Dhaka University

After a careful evaluation process and thorough consideration of expert recommendations, a total of thirteen (13) key barriers were identified to fulfill the scope of this study. Initially, the experts looked at the wider context of the implementation of a sustainable circular supply chain and consolidated the 20 barriers identified in the literature review into 14 of the initial list. In the next round, the experts refined the list of obstacles, focusing mainly on cognitive and human obstacles. psychological factors and finally 13 barriers are selected. These barriers are presented in Table 4, presented by an expert panel using the Delphi technique. This study uses a three-step Delphi methodology to identify important barriers affecting the sustainable use of CSC. Figure 2 (accepted from H. M. Taqi et al., 2023) describes the steps of the three-stage Delphi method. The figure illustrates how a comprehensive literature review is used to initially identify significant barrier.

Figure 2: Steps of the three-stage Delphi technique (adopted from H. M. Taqi et al., 2023)

"Source: Figure courtesy of H. M. Taqi et al., 2023"

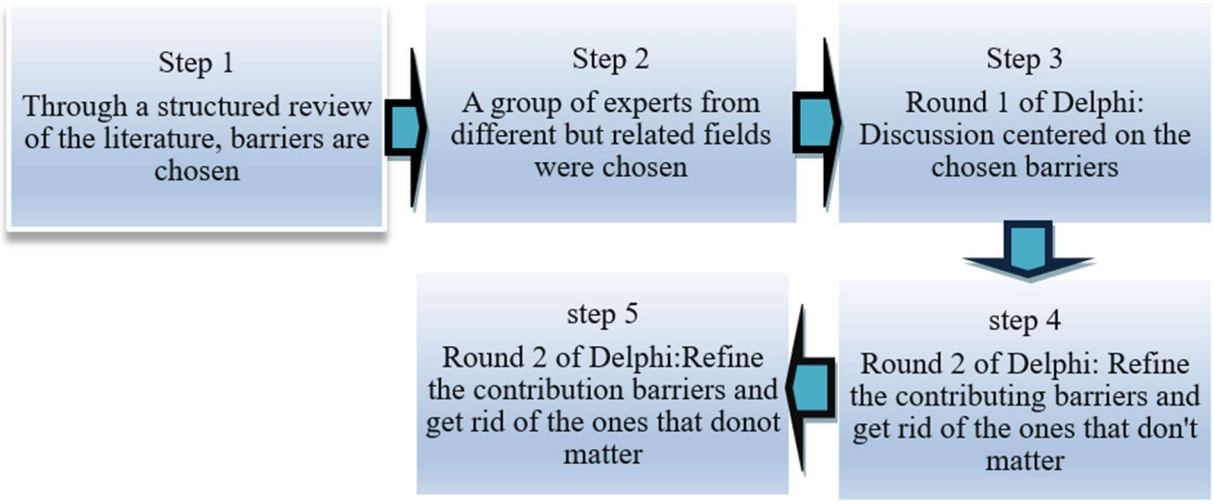


Table 4. The list of final barriers developed from experts' input

code	Barriers
A1	Absence of coordination and trust
A2	Market Demand and Consumer Behavior
A3	Fragmented value chain
A4	Technology Readiness and Infrastructure
A5	Limited Access to Expertise and Resources
A6	Complexity of Supply Chains
A7	Lack of Collaboration
A8	Infrastructure and Logistic Constraint
A9	Insufficient skilled manpower
A10	Resistance to Change
A11	Financial Incentives and Business Models
A12	Inadequate plant of factory layout & maintenance

A13	Insufficient training

3.2 Fuzzy DEMATEL Method

Fuzzy DEMATEL technique includes 7 basic steps;

Step 1: Objectives and Evaluation criteria with respect to them are determined.

Step 2: Decision makers are questioned to determine their judgments about the relationship between criteria. Since human judgments on evaluation criteria include uncertainty, five linguistic terms "Very high influence, High influence, Low influence, Very low influence, No influence" are determined. Then these linguistic terms are expressed as positive triangular fuzzy numbers as shown in Table 5. The answers of decision makers in terms of linguistic terms are converted to triangular fuzzy numbers.

Table 5. Fuzzy linguistic scale

Linguistic terms	**Triangular Fuzzy Numbers**
No influence(N)	(0.00,0.00,0.25)
Very low influence (VL)	(0.00,0.25,0.50)
Low influence (L)	(0.25,0.50,0.75)
High influence (H)	(0.50,0.75,1.00)
Very high influence (VH)	(0.75,1.00,1.00)

"Source: Table courtesy of Kumar et al (2023)"

Step 3: Let O is the k. evaluators' fuzzy decision matrix about the criteria expressed in terms

$$\tilde{}k$$

of fuzzy triangular numbers. O

j=1 ij

˜ (k) (k) (k) (k) $Yabc$

˜k

is normalized as follows

k=1, 2, ..., p (1)

(2)

(3)

Step 4: In this step, average value of p evaluators normalized fuzzy decision matrix is found.

0 $\tilde{o}k$ ... $\tilde{o}k$ 12 ln

$\tilde{o}$ (1) $\oplus$ $\tilde{o}$ (2) $\oplus$ ... $\oplus$ $\tilde{o}$ (p)

O= p (4)

˜

˜ $\tilde{o}$ 1 1 $\tilde{o}$ 1 1 ... $\tilde{o}$ l n $\sum$ p $\tilde{o}$ ( )

Ok=$\tilde{o}$21 $\tilde{o}$22 ... o2 ; $\tilde{o}ij$= k=1 ij (5) .....⋱.... p

$\tilde{o}n$1 $\tilde{o}n$2 ... $\tilde{o}nn$

Step 5: After finding initial direct relation matrix and normalizing it, Total relation fuzzy matrix˜

(T) is defined as follows;˜˜−1

"Source:

T= O. (I − O) (6)

Step 6: In this step D and R are calculated. D is the sum of the row and R is the sum of the

column of T. Then D and R a

re defuzzified separately. Best Nonfuzzy Performance (BNP) value was used as a defuzzification procedure. The BNP value can be found using the following equation;

BNP =((U −L)+(M −L))/3+L (7) ij ij ij ij ij ij

BNP represents the defuzzified value of D and R. We call defuzzified value of D and R as D ij

and R respectively.

In order to determine causal relationships between Critical success factors, D + R and D - R are calculated. While D + R represents degree of central role (how much importance the criteria have), D - R shows the degree of relation. Relation divides the criteria in to cause and effect group. If D - R is positive then criteria belong to cause group. If D - R is negative then criteria belong to effect group.

Step 7: Causal diagram is constructed. In this diagram the horizontal axis represents D - R while vertical axis represents D + R. In this diagram, Criteria above the horizontal axis mean that they belong to cause group. Criteria below the horizontal axis mean that they belong to effect group.

4.1 Results of the study

This segment summarizes the results of using the fuzzy DEMATEL method to understand the relationships between barriers to circular supply chain implementation in the textile industry of Bangladesh. An expert group consisting of academic and industrial experts was formed to investigate the interrelationships of aspects related to the purpose of the study (stage 1). The direct correlation matrix T is formed based on the responses of the experts according to Table 6. According to the linguistic variable (step 2), the research examines the following reactions to the human logic variable: no influence, very low influence, low influence, high influence and very high influence. The language scale is presented in Table 5.

Table 6. Direct-relationship matrix T

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
A1	0	VH	L	VL	L	H	VH	VH	L	VH	VL	L	H
A2	H	0	VH	L	L	VL	H	VH	L	H	VL	VH	L
A3	H	VH	0	VL	VL	H	H	L	L	L	VH	VL	H
A4	VH	H	L	0	VL	VL	H	VH	H	H	VL	L	VH
A5	VL	VL	VH	L	0	H	VH	H	H	VH	VH	VH	VH
A6	L	VH	L	H	VH	0	L	VH	L	H	H	VH	VH
A7	VH	VL	H	L	VH	VH	0	H	H	VH	VH	H	L
A8	VL	VL	H	VH	VL	H	H	0	H	L	L	VH	L
A9	L	VH	VH	H	VH	L	L	VL	0	H	H	VH	VH
A10	H	VL	VL	L	VH	VH	VH	VL	VH	0	VH	VH	VH
A11	VH	L	VL	H	VL	VH	H	VL	VL	H	0	H	VL
A12	L	VH	VL	VH	VL	VH	L	H	H	VH	VL	0	H
A13	H	L	VH	H	VL	VL	VH	H	H	VH	VL	L	0

In the study, triangular fuzzy numbers are calculated using a method where the fuzzy data is converted to a crisp score value (CFCS). Questions will be removed to get the correct number. The original direct relationship

matrix F is calculated using the logistic method to obtain the original direct relationship matrix F shown in Table 7 (step 3).

Table 7. Initial direct- relation matrix F

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
A1	0	0.97	0.50	0.25	0.50	0.75	0.97	0.97	0.50	0.97	0.25	0.50	0.75
A2	0.75	0	0.97	0.50	0.50	0.25	0.75	0.97	0.50	0.75	0.25	0.97	0.50
A3	0.75	0.97	0	0.25	0.25	0.75	0.75	0.50	0.50	0.50	0.97	0.25	0.75
A4	0.97	0.75	0.50	0	0.25	0.25	0.75	0.97	0.75	0.75	0.25	0.50	0.97
A5	0.25	0.25	0.97	0.50	0	0.75	0.97	0.75	0.75	0.97	0.97	0.97	0.97
A6	0.50	0.97	0.50	0.75	0.97	0	0.50	0.97	0.50	0.75	0.75	0.97	0.97
A7	0.97	0.25	0.75	0.50	0.97	0.97	0	0.75	0.75	0.97	0.97	0.75	0.50
A8	0.25	0.25	0.75	0.97	0.25	0.75	0.75	0	0.75	0.50	0.50	0.97	0.50
A9	0.50	0.97	0.97	0.75	0.97	0.50	0.50	0.25	0	0.75	0.75	0.97	0.97
A10	0.75	0.25	0.25	0.50	0.97	0.97	0.97	0.25	0.97	0	0.97	0.97	0.97
A11	0.97	0.50	0.25	0.75	0.25	0.97	0.75	0.25	0.25	0.75	0	0.75	0.25
A12	0.50	0.97	0.25	0.97	0.25	0.97	0.50	0.75	0.75	0.97	0.25	0	0.75
A13	0.75	0.50	0.97	0.75	0.25	0.25	0.97	0.75	0.75	0.97	0.25	0.50	0

Using the formula (in step 4), the factor creates a generalized direct correlation matrix S, whose main diagonal elements are all between 1 and 0. As shown in the generalized direct correlation matrix in Table 8.

Table 8. Generalized direct relation matrix S

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
A1	0.000	0.101	0.052	0.026	0.052	0.078	0.101	0.101	0.052	0.101	0.026	0.052	0.078

A2	0.078	0.000	0.101	0.052	0.052	0.026	0.078	0.101	0.052	0.078	0.026	0.101	0.052
A3	0.078	0.101	0.000	0.026	0.026	0.078	0.078	0.052	0.052	0.052	0.101	0.026	0.078
A4	0.101	0.078	0.052	0.000	0.026	0.026	0.078	0.101	0.078	0.078	0.026	0.052	0.101
A5	0.026	0.026	0.101	0.052	0.000	0.078	0.101	0.078	0.078	0.101	0.101	0.101	0.101
A6	0.052	0.101	0.052	0.078	0.101	0.000	0.052	0.101	0.052	0.078	0.078	0.101	0.101
A7	0.101	0.026	0.078	0.052	0.101	0.101	0.000	0.078	0.078	0.101	0.101	0.078	0.052
A8	0.026	0.026	0.078	0.101	0.026	0.078	0.078	0.000	0.078	0.052	0.052	0.101	0.052
A9	0.052	0.101	0.101	0.078	0.101	0.052	0.052	0.026	0.000	0.078	0.078	0.101	0.101
A10	0.078	0.026	0.026	0.052	0.101	0.101	0.101	0.026	0.101	0.000	0.101	0.101	0.101
A11	0.101	0.052	0.026	0.078	0.026	0.101	0.078	0.026	0.026	0.078	0.000	0.078	0.026
A12	0.052	0.101	0.026	0.101	0.026	0.101	0.052	0.078	0.078	0.101	0.026	0.000	0.078
A13	0.078	0.052	0.101	0.078	0.026	0.026	0.101	0.078	0.078	0.101	0.026	0.052	0.000

Applying the equation to the generalized direct relationship matrix gives the total relationship matrix M. Table 9 shows the general relationship matrix (step 5). In the sum relation matrix M, the sum of the rows and the sum of the columns are represented separately as D and R (step 6). Following the DEMATEL method, the matrix is found using R code.

Table 9. Total Relation Matrix M

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	0.336	0.410	0.373	0.346	0.332	0.421	0.476	0.436	0.384	0.495	0.332	0.434	0.445
C2	0.395	0.309	0.400	0.355	0.315	0.362	0.440	0.422	0.371	0.459	0.318	0.457	0.407
C3	0.380	0.383	0.290	0.313	0.278	0.386	0.419	0.359	0.346	0.413	0.366	0.371	0.405
C4	0.417	0.381	0.361	0.306	0.294	0.358	0.442	0.423	0.394	0.460	0.315	0.415	0.450
C5	0.409	0.389	0.453	0.413	0.315	0.469	0.525	0.456	0.450	0.548	0.441	0.523	0.514
C6	0.428	0.453	0.412	0.435	0.403	0.390	0.483	0.481	0.426	0.528	0.413	0.524	0.512
C7	0.475	0.394	0.435	0.413	0.413	0.493	0.437	0.461	0.451	0.553	0.443	0.509	0.477
C8	0.335	0.322	0.362	0.385	0.279	0.388	0.418	0.312	0.376	0.416	0.326	0.438	0.390
C9	0.422	0.447	0.446	0.422	0.397	0.430	0.472	0.404	0.366	0.517	0.407	0.510	0.503
C10	0.448	0.385	0.383	0.407	0.407	0.482	0.518	0.408	0.463	0.453	0.433	0.519	0.509
C11	0.385	0.328	0.296	0.346	0.269	0.393	0.401	0.325	0.312	0.421	0.259	0.400	0.348

C12	0.386	0.414	0.347	0.413	0.307	0.434	0.431	0.417	0.407	0.494	0.326	0.383	0.447
C13	0.401	0.360	0.402	0.378	0.297	0.363	0.463	0.402	0.396	0.481	0.322	0.415	0.361

We can also know the value of D, R, D-R, D-R using R code. Here D and R show us the relationship between them. Table 10 shows the results (step 7). Here we rank the barriers (D+R) based on the values representing the degree of centrality given in Table 10. The order is given in Table 11.

Table 10. Relationship between Criteria

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
D	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.220155	5.040112
R	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398	5.217398
D+R	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755	10.43755
D-R	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757	0.002757

Table 11. Ranking Framework of the barrier

Barriers	D+R	Ranking
(A10) Resistance to change	12.053527	1
(A7) Lack of collaboration	11.880063	2
(A6) Complexity of supply chain	11.256286	3
(A12) Inadequate plant of factory layout and maintenance	11.101429	4
(A9) Insufficient skilled man power	10.885644	5

(A13) In sufficient training	10.808931	6
(A1) Absence of coordination and trust.	10.437553	7
(A5) Limited access to Expertise and re sources	10.209067	8
(A8) Infrastructure and logistic constraint	10.05231	9
(A2) Market demand and consumer behavior	9.982696	10
(A4) Technology readiness and infrastructure	9.948272	11
(A3) Fragmented value chain	9.667341	12
(A11) Financial incentives and business model.	9.184679	13

Table 10 shows us what (D-R) is worth. Both positive and negative values can be found there. These values fall into two categories: cause group and effective group. Values with (D-R) <0 are referred to as effective group values. Positive values that fall within the cause group are the remaining values.

(D+R) degree of central role ranking shows in Table 11. From that table, A (10) Resistance to change placed at first with the value of 12.053527, A (7) Lack of collaboration placed at 2nd with a value of 11.880063. The following A (6) complexity of supply chain have value of 11.256286. These 3 criteria have close value that refers that these 3 criteria are the main barriers in term of implement circular supply chain in textile industry. Then A (9), A (13), A (1), A (5) have the closest value. Mentioned four criteria have also eloquent influence on the textile industry's adoption of sustainable circular supply chain. A (8), A (2), A (4), A(3)have value of 10.05231, 9.982696, 9.948272, 9.667341 these four criteria impact on the industry ranked third. A (11) has the lowest value of 9.184679 which have the lowest influence.

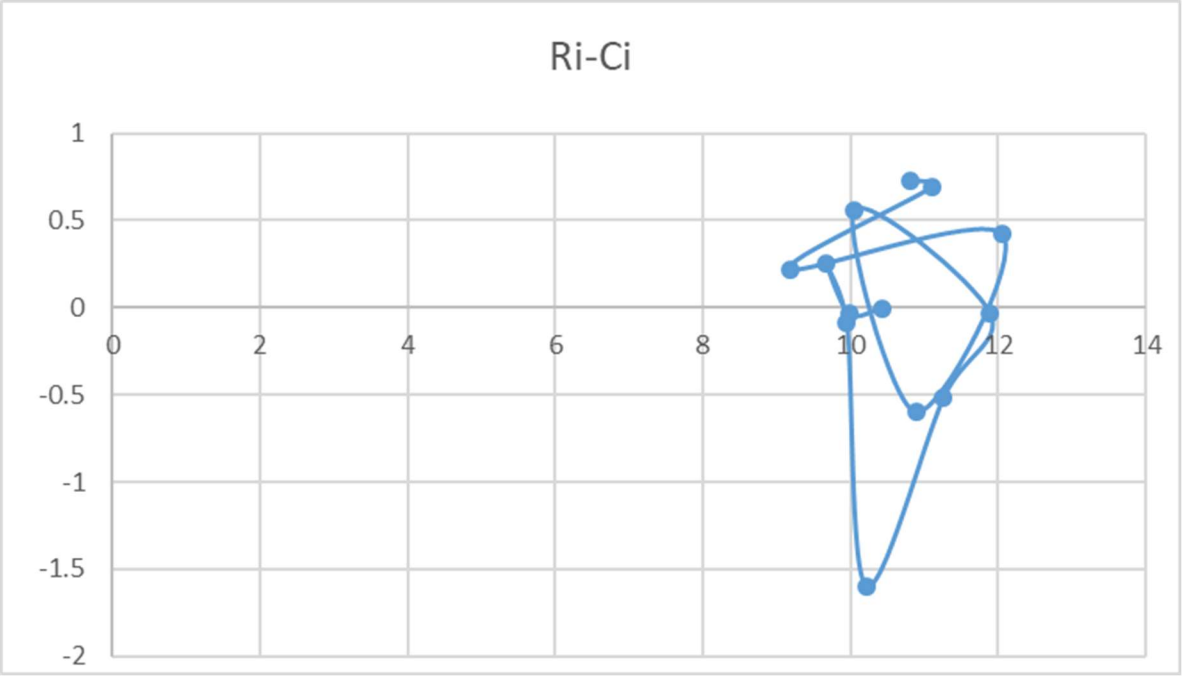


Figure 3. Casual Diagram of (D-R) vs (D+R)

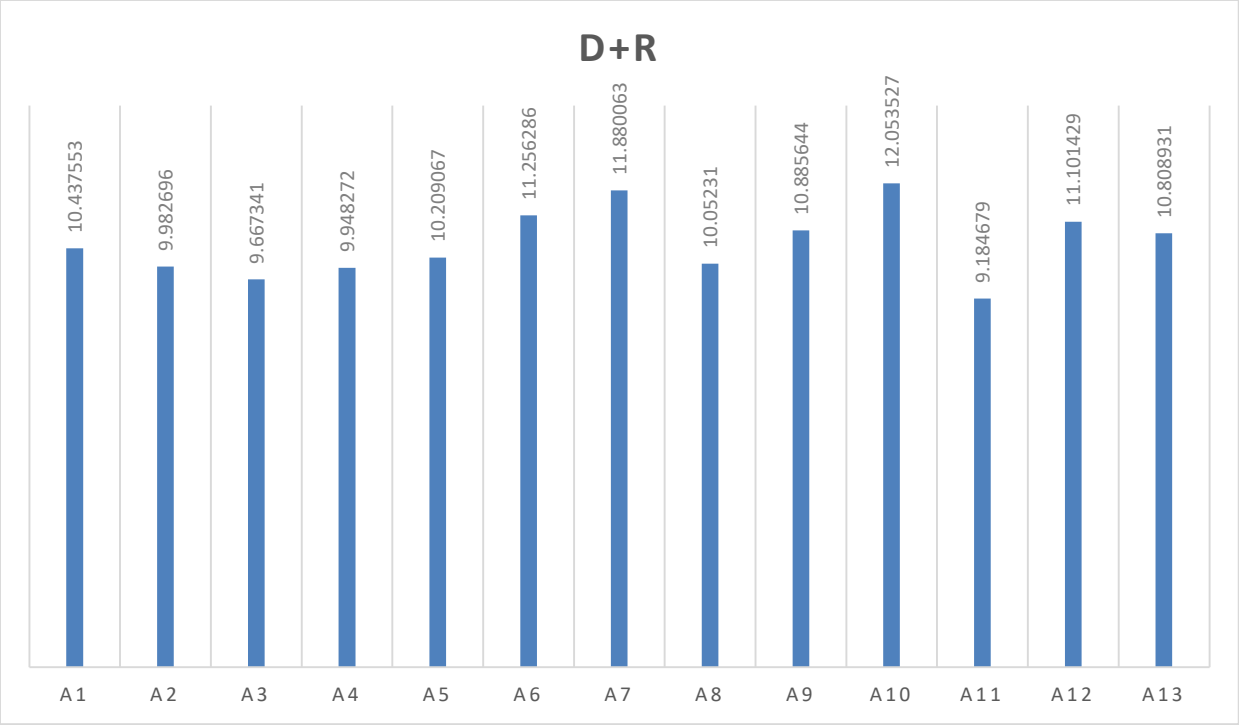
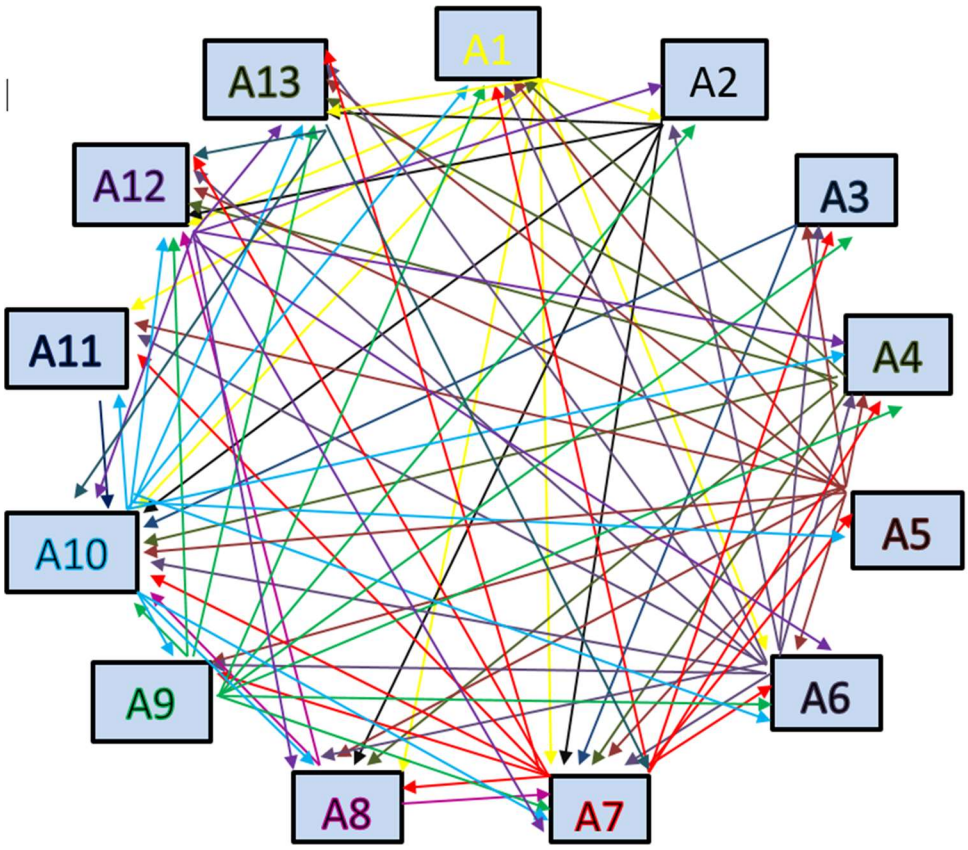


Figure 4. Bar charts of ranking.



NOTE: Above mentioned A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12 are the barriers.

Figure 5. Casual interaction diagram of total relation matrixa

The causal interactions diagram in Figure 5 provides a visual depiction of the interrelationships among the obstacles impeding the adoption of sustainable circular supply chains in Bangladesh's textile sector. It offers a foundation for tactical planning and judgement calls meant to enhance the adoption procedure. This diagram can help industrial managers understand key components, how they relate to one another, and their respective strengths. Through a thorough analysis of Figure 5, managers can enhance the adoption of sustainable CSC within their sector by making well-informed decisions, allocating resources efficiently, and prioritising initiatives.

4.2 Validation of results

In this section of the study, industry practitioners assisted in further validating the causal diagrams and rating of the barriers. To validate the research findings, twelve industry managers participated in three phases of focus group talks. The participants were chosen based on their years of professional experience, present association with an organisation, and area of competence. Participants were specifically selected based on their awareness of the principles of the circular supply chain, their current employment in a manufacturing organisation, and their minimum of 5 years of work experience. The participants were given the rating of sustainable circular supply chain hurdles in the first phase for validation. Following the conversation, everyone agreed on how to prioritise the obstacles. In the subsequent stage, the participants were requested to confirm the obstacles within the framework of the obstacles. This measure was implemented to guarantee the precise categorisation of the obstacles detected during the initial stage. The participants were then shown the causal diagram and the diagram of causal interactions. The participants were questioned regarding the appropriateness of the barriers in the context of Bangladesh's textile industry, as well as the direct and indirect linkages between the barriers. According to the participants, the barriers' direct and indirect links are suitable and meaningful in the given situation. Overall, this phase offered a better knowledge of the connections between the barriers and assisted in validating and refining the ones that had been identified.

Chapter 3

Discussion and Implication of the study

5.1 Discussion of the findings

The findings of the Sustainable Circular Supply Chain (SCSC) study are very important for the textile industry in Bangladesh. Just as Industry 4.0 (I4.0) technologies have transformed manufacturing, the adoption of sustainable circular supply chain practices can transform how the textile industry operates. However, understanding the barriers to SCSM adoption and their impact is essential to managing this change. This study sheds light on the barriers to SCSC adoption and analyzes their impact on the industry's journey towards efficiency and sustainability. Our study contributes to the growing body of research on SCSC implementation, particularly in the context of the textile industry in Bangladesh. By comparing our results with existing studies, we can draw attention to the peculiarities and significance of the study. Our study stands out as one of the few initiatives to investigate barriers to SCSC adoption in the textile industry of Bangladesh.

Although previous studies discussed the adoption of SCSC in different contexts such as manufacturing and service sectors (Ponnambalam et al., 2023; Robertsone et al., 2022; Leite et al., 2022; Mathiyazhagan et al., 2022), none of them did so . specially made focused on the textile industry of Bangladesh. This particularity is crucial because different industries often face unique challenges when implementing CSC. Therefore, our study fills a critical gap in the literature by shedding light on industry-specific barriers. As in the broader SCSC studies, we identify a complex interdependence between CSC acceptance criteria in the textile industry. Using the Fuzzy DEMATEL method allows us to better understand these complexities. By examining the causal relationships between different factors, we can determine which criteria have the greatest influence and which are more sensitive to external influences. Contrary to general CSC studies, our research the textile industry in Bangladesh shows that the three main barriers are "Resistance to change", "Insufficient training" and "Inadequate factory layout and maintenance". This differs from studies in other fields (Abu et al., 2022; Qureshi et al., 2022) where the importance of barriers can vary. These unique findings highlight the domain-specific nature of CSC challenges and emphasize the importance of tailoring strategies to address these specific barriers. Our study provides practical insights how the textile industry in Bangladesh can overcome barriers to CSC adoption. The focus on insufficient education highlights the need for expert guidance during the transition. In addition, addressing the "complexity of supply chains" and "infrastructure and logistics constraints" are crucial. These findings guide industry players to create targeted strategies that demonstrate the real relevance of our research. In conclusion, our study bridges the gap in the literature by addressing barriers to CSC adoption in the textile industry of Bangladesh. Using established CSC concepts, our research provides domain-specific insights that can guide strategies for successful implementation. The authors noted that results do not change significantly under different conditions. This shows how reliable our model is. There are three main obstacles affecting the adoption of CSC in the textile industry of Bangladesh. They are "Resistance to change", "Insufficient training" and "Inadequate facilities layout and maintenance". These three barriers also affect

other barriers. However, the technique used in this study allowed them to be combined, creating a framework that all involved decision makers can use to identify and understand the cause-effect relationships between groups of decision criteria. By comparing our results with existing research, we highlight the uniqueness of our contribution and highlight the need for industry-specific approaches to CSC implementation. This research lays the groundwork for further research on the circular supply chain in emerging markets where such knowledge is critical for industries striving for economic growth and competitiveness.

5.2 Theorical Implications

The results of this study contribute to understanding barriers and their interactions from a practitioner's perspective. With the help of our methodology, it is possible to prioritize obstacles and direct attention to them in the right order. Before implementing a circular supply chain, a company must ensure that management is committed and has the knowledge and skills to provide appropriate training to the employees it recruits. Another major barrier to adoption is resistance to change and lack of awareness of its benefits. The biggest problem with circular supply chain implementation is the tendency to fall back into old routines when obstacles arise. Therefore, experienced inspiration and guidance are necessary during the transition phase. Along with solving these internal problems, the implementation of the circular supply chain must be expanded. Despite the fact that this research mainly uses case studies from the textile industry, the technology created can also be applied to other industries. As a result, overcoming several related difficulties can be significantly attributed to the structural framework provided in this study. The implementation of sustainable circular supply chain practices can directly contribute to the achievement of SDGs such as: 12 (Responsible consumption and production), 8 (Decent work and economic growth), 13 (Climate action), 9 (Industrial innovation and infrastructure), because it improves and completes production processes, taking into account the impact of the environment, workplace and natural resources. The already available literature on circular supply chain application derives various theoretical insights from this study such as:

- We highlight the main obstacles facing the textile sector in implementing sustainable CSC in emerging markets.
- Use the Fuzzy DEMATEL technique to estimate and rank the most important obstacles.
- To gain a deep understanding of how the implementation of a sustainable circular supply chain can affect productivity and reduce the negative impact on the furniture business
- To lay the foundation for further in-depth research to give a decision. -makers with a better understanding of the barriers to adopting a sustainable circular supply chain in many other industries.

5.3 Practical Implications

The above explanation illustrates research findings to help the textile industry understand the most important and least important barriers and their relationship. With this understanding, managers can better identify obstacles to implementing a circular supply chain. The study would be of interest to actors in the sustainable circular supply chain because it could be applied in organizations to focus on the interaction of barriers to an effective implementation of CSCM. If these barriers were better understood and understood by manufacturers, researchers and policy makers, they could remove significant barriers to the implementation of circular supply chain projects. Researchers in various fields of industrial management can also follow the observations and discussions of the results. Managers use the analysis as a starting point to advance their sustainability initiatives in their manufacturing organizations. By focusing on the biggest obstacles, the study

can help managers of manufacturing organizations to use their resources as efficiently as possible. They can choose which barrier to focus on first, considering how this study analyzes the barriers and shows the hierarchical relationships between them. Since circular supply chain utilization and resource management are at the top of all barriers, managers and decision makers should focus on these issues first. This research provides valuable practical knowledge to stakeholders in the textile industry. The results provide practical guidance for industry players, making our research directly relevant to real challenges. The practical implications are given below.

Vanquishing resistance to the circular supply chain: Since the biggest obstacle is “abandoning CSC practices”, it is important to focus on change management and employee engagement strategies .Implementation of circular supply chain practices should include training and workforce involvement in the process to reduce resistance.

Improve Plant Arrangement and Maintenance: "Negligent plant arrangement and maintenance" is another major obstacle. Manufacturers must prioritize investments in facility improvements, layout optimization and regular maintenance to create an environment conducive to sustainable circular supply chain manufacturing.

Emphasizing Management Training: Government-sponsored programs can provide training and resources for change management, emphasizing the importance of employee involvement in the transition to sustainable practices.

5.4 Policy Implications

Integrated industry support: Policymakers can encourage textile producers to collaborate and strengthen their operations by offering incentives, tax credits or subsidies for joint ventures or mergers that promote efficiency and competitiveness.

Development of Real Estate Infrastructure: Politicians should support the development of infrastructure in the textile industry, including incentives to improve manufacturing facilities and ensure regular maintenance to increase efficiency.

Attaining coordination and trust: Achieving coordination and trust in Bangladesh's textile industry for a sustainable circular supply chain involves engaging stakeholders, setting shared goals, providing education, ensuring transparency through technology, offering financial incentives, and conducting regular audits. Long-term relationships and effective conflict resolution are also essential.

Solving supply chain complexity: For supply chain complexity reduction, streamline processes, localize suppliers, and implement industry standards. Integrate digital tools for better management, foster stakeholder collaboration, and adopt modular designs. Optimize resource use, provide training on efficient practices, and advocate for supportive government policies.

Enhancing manpower capabilities: To increase skilled manpower it is better to partner with educational institutions to develop relevant curricula, and provide continuous professional development opportunities. Promote industry certifications, incentivize skill acquisition, and leverage government and NGO support for training initiatives. Engage in public-private partnerships to ensure a steady pipeline of skilled workers and encourage knowledge sharing through industry forums and workshops.

Resolving technology readiness and infrastructure: To address technology readiness and infrastructure challenges for sustainable circular supply chain implementation in Bangladesh's textile industry we have to focus on investment in appropriate technology solutions tailored to the sector's needs. This involves collaborating with technology providers to develop affordable and scalable solutions suitable for local conditions. Additionally, upgrade existing infrastructure, such as transportation networks and waste management systems, to support circularity. Foster public-private partnerships to share the burden of investment and ensure the widespread adoption of technology and infrastructure upgrades.

By prioritizing these practical and policy implications based on three key barriers, Bangladesh's textile industry can systematically address the challenges it faces in adopting sustainable circular supply chain production practices, thereby increasing productivity and competitiveness. This research can benefit companies by helping them prioritize circular supply chain implementation based on the performance metrics they see as most strategically important to improve.

Chapter 4

Conclusion and future scopes of the study

In conclusion, this study provided valuable insights into the challenges and opportunities associated with adopting a sustainable circular supply chain in the textile industry of Bangladesh. Using DEMATEL's technique, we discovered a nuanced understanding of the obstacles facing this industry. The results of the study show that there are many administrative, technical and financial barriers in the textile industry in Bangladesh that make it difficult to implement a circular supply chain. This study revealed several managerial, technical and financial barriers that make the implementation of circular supply chain practices in the textile industry of Bangladesh a challenging endeavour. In particular, both implementers and non-implementers (CSCM) identified financial constraints as the main barrier. This highlights the critical importance of finance in implementing a sustainable circular supply chain. In addition, lack of expertise and knowledge emerged as a major barrier, highlighting the need for training and capacity development in sustainable circular supply chain methods. These findings increased our understanding of the lack of circular supply chain implementation in the textile business of Bangladesh. It was shown that due to limited resources and capital, the textile industry

cannot use all circular supply chain tools and methods simultaneously. In addition, the importance of correcting management errors and improving specific production processes, design and operation is emphasized.

To remove these barriers and promote the effective implementation of circular supply chain principles, it is imperative that the textile industry in Bangladesh and relevant stakeholders take conscious steps. These measures include increasing management expertise, improving quality control mechanisms, investing in research and development, and correcting structural inefficiencies.

Although this study provides valuable information, it acknowledges certain limitations. The authors derived some barriers from expert opinion, which leaves room for further research to explore the barriers in more depth. Although the authors used the Fuzzy DEMATEL approach to improve the acceptance of the results, other criteria classification methods (eg fuzzy AHP, fuzzy TISM, fuzzy VIKOR, etc.) must be investigated in future work. The future world of science in this field is promising. This could include a deeper study of the barriers affecting circular supply chain implementation in the textile industry. In addition, exploring alternative fuzzy fusion methods can provide deeper insights. Future research should also focus on achievement strategies tailored to the broader industry ecosystem and perspectives of different industries. This study contributes to the growing body of knowledge on circular supply chain adoption in the textile sector of Bangladesh. It highlights industry-specific challenges and provides valuable information for both practitioners and policy makers. Further research in this area has great potential to improve circular supply chain implementation and improve the competitiveness of the industry worldwide.

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