**Thesis Paper**
**on**

# Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh.


**Submitted by:**
Md. Tariful Islam Tuhin
Student ID: MSCM2401031020
Program: MBA in Supply Chain Management (MSCM)
Major: Supply Chain Management
Department of Business Administration
Sonargaon University (SU)


**Submitted to:**
Department of Business Administration
Faculty of Business
Sonargaon University (SU)

**Submitted for the partial fulfillment of Degree of MBA in Supply Chain Management (MSCM)**


**Sonargaon University (SU)**
147/1 Green Road, Panthapath, Tejgaon, Dhaka

**Submission Date: 03-January-2026**

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# Letter of Transmittal

**03-January-2026**

**Shahnaz Sharmin**
Lecturer
Department of Business Administration
Faculty of Business
Sonargaon University (SU)

Subject: Submission of Thesis Paper Titled **"Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh".**

Dear Madam,
It is my pleasure to submit the thesis paper titled "**Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh**" prepared in partial fulfillment of the requirements of the MBA in Supply Chain Management (MSCM) program at Sonargaon University (SU).

This research draws upon my professional experience and extensive secondary sources, offering insights into the structural challenges and improvement opportunities within Bangladesh's RMG import supply chain. I believe the findings will contribute meaningfully to both academic understanding and practical policy and industry applications.

I sincerely appreciate your continuous guidance, valuable feedback and encouragement throughout the research process. Your support has been instrumental in the successful completion of this thesis. I shall be pleased to provide any further clarification if required.

Thank you for your kind supervision and support.

Sincerely,

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**Md. Tariful Islam Tuhin**
ID: MSCM2401031020
Program: MBA in Supply Chain Management (MSCM)
Major: Supply Chain Management
Sonargaon University (SU)

# Declaration of Student

I hereby declare that the thesis titled "**Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh**" has been prepared by me as a partial requirement for the completion of the MBA in Supply Chain Management (MSCM) program at Sonargaon University (SU).

This thesis is an original work carried out under the guidance of **Shahnaz Sharmin**, Lecturer, Department of Business Administration, Sonargaon University. All sources of information used in this study have been properly acknowledged.

I further declare that this thesis has not been submitted, either in whole or in part to any other institution for the award of any degree or qualification.

Yours Sincerely

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**Md. Tariful Islam Tuhin**
ID: MSCM2401031020
Program: MBA in Supply Chain Management (MSCM)
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# Letter of Authorization

This is to certify that the thesis paper titled "**Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh**" has been prepared by **Md. Tariful Islam Tuhin**, bearing ID: MSCM2401031020, as a partial requirement for the completion of the MBA in Supply Chain Management (MSCM) program under the Department of Business Administration, Sonargaon University (SU).

The research has been carried out under my direct supervision and guidance. I hereby authorize the submission of this thesis for academic evaluation. I affirm that the work presented in this report is original and has been completed following the academic guidelines of Sonargaon University **(SU).**

This thesis or any part of its contents shall not be used for purposes other than academic requirements without prior permission from the Department or the undersigned.

I wish the student every success in his academic and professional endeavors.

---

**Shahnaz Sharmin**
Lecturer
Department of Business Administration
Faculty of Business
Sonargaon University (SU)

# Acknowledgment

At the outset, I express my sincere gratitude to the Almighty Allah for granting me the strength, patience, and perseverance to successfully complete this thesis.

I am deeply thankful to my respected supervisor, **Shahnaz Sharmin**, Lecturer, Department of Business Administration, Sonargaon University (SU), for her invaluable guidance, constructive feedback, and continuous encouragement throughout the research process. Her academic insight and supportive supervision played a vital role in shaping the quality and direction of this study.

I would like to acknowledge Han Apparels Limited for providing a professional environment that significantly enhanced my practical understanding of Supply Chain Management. My professional exposure within the organization enabled me to integrate theoretical knowledge with real-world supply chain practices, enriching the relevance of this research.I am particularly grateful to Md. Robiul Islam, General Manager (Head of Operations and Factory Management), Han Apparels Limited, for his expert guidance, strategic insights, and consistent support during the dissertation period. His leadership and professional advice greatly contributed to my learning and research development.I also extend my sincere appreciation to my colleagues at Han Apparels Limited for their cooperation, shared experiences, and support throughout this study.

Finally, I thank all individuals who directly or indirectly supported me in completing this academic endeavor. Their contributions were instrumental in the successful completion of this thesis.

# Abstract

This thesis investigates the critical supply chain vulnerabilities within the woven segment of Bangladesh's Ready-Made Garment (RMG) sector, which remains fundamentally dependent on imported raw materials. As the nation approaches graduation from Least Developed Country (LDC) status in 2026, the impending loss of preferential trade access threatens to exacerbate existing inefficiencies, placing the sector's cost competitiveness and long-term resilience at risk. The study aims to diagnose the systemic inefficiencies plaguing the import-dependent supply chain and to formulate strategic interventions for enhancement.

Adopting a mixed-methods case study approach, the research synthesizes quantitative survey data from 63 RMG firms, qualitative insights from 45 industry experts, field observations at key logistical nodes (Chattogram Port, bonded warehouses), and secondary data analysis. Findings identify pervasive bottlenecks including protracted customs clearance, chronic port congestion, limited digital integration, manual warehouse operations, and elevated logistics costs which are categorized into four core vulnerability areas: logistical, regulatory, technological, and structural import dependency.

In response, this thesis proposes the Resilient RMG Supply Chain 4.0 Model, a strategic framework advocating for digital transformation, regulatory streamlining, infrastructure modernization, and proactive risk mitigation, supported by tools such as an Import Substitution Priority Matrix. The study concludes that a coordinated agenda of policy reform and targeted investment is imperative to significantly enhance supply chain efficiency, mitigate the risks of import dependency, and secure Bangladesh's competitive position in the post LDC global apparel market.



**Keywords:** Bangladesh RMG, Supply Chain Efficiency, Import Dependency, LDC Graduation, Digital Transformation, Supply Chain Resilience, Industry 4.0, Logistics Optimization, Strategic Sourcing.

# Table of Contents

# List of Acronyms

| Acronym | Full Form |
|---|---|
| AEO | Authorized Economic Operator |
| API | Application Programming Interface |
| BKMEA | Bangladesh Knitwear Manufacturers and Exporters Association |
| BGMEA | Bangladesh Garment Manufacturers and Exporters Association |
| BIDA | Bangladesh Investment Development Authority |
| BDT | Bangladesh Taka |
| C&F | Clearing and Forwarding |
| ERP | Enterprise Resource Planning |
| FOB | Free on Board |
| FTT | Foreign Telegraphic Transfer |
| GVC | Global Value Chain |
| ICD | Inland Container Depot |
| IoT | Internet of Things |
| KPI | Key Performance Indicator |
| L/C | Letter of Credit |
| LDC | Least Developed Country |
| LPI | Logistics Performance Index |
| MFA | Multi-Fibre Arrangement |
| NBR | National Board of Revenue |
| NSW | National Single Window |
| PLC | Programmable Logic Controller |
| ROI | Return on Investment |
| UNCTAD | United Nations Conference on Trade and Development |
| UNESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| WEF | World Economic Forum |
| WMS | Warehouse Management System |
| PLI | Production Linked Incentive |
| RFID | Radio Frequency Identification |
| USD | United States Dollar |
| RMG | Ready-Made Garments |
| WTO | World Trade Organization |
| SCM | Supply Chain Management |

# Chapter 1: Introduction

## 1.1 Research Background and Context

### 1.1.1 The Rise of Bangladesh's RMG Sector

Ready-Made Garments (RMG) sector in Bangladesh represents one of the most remarkable economic success stories in the developing world. From its humble beginnings in the late 1970s with a few export-oriented factories, the sector has transformed into a global apparel powerhouse that has fundamentally reshaped Bangladesh's economic landscape and social fabric. The journey began in 1978 when Daewoo Corporation of South Korea partnered with Desh Limited of Bangladesh, marking the inception of the modern RMG industry. This collaboration provided the technical expertise, management know-how, and international market access that catalyzed the sector's exponential growth.

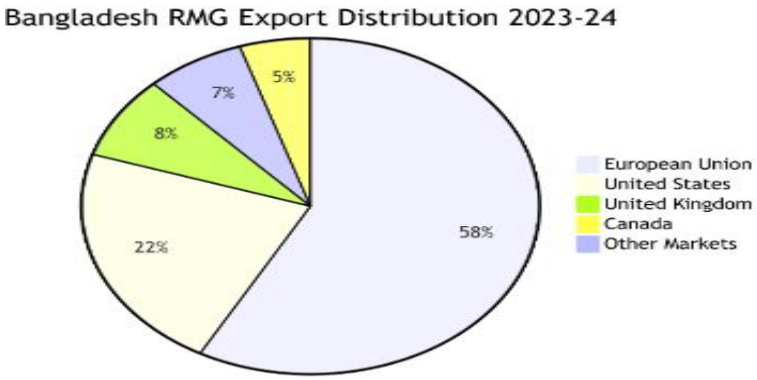
The sector's expansion has been nothing short of extraordinary, growing at an average annual rate of 15-18% over the past three decades. This growth trajectory has positioned Bangladesh as an indispensable player in global apparel value chains, with the sector evolving from basic cut-make-trim operations to increasingly sophisticated manufacturing capabilities. The Multi-Fibre Arrangement (MFA) phase-out in 2005, which many feared would devastate the industry, instead catalyzed a competitive consolidation that made Bangladeshi manufacturers more efficient and quality-conscious.

The RMG sector's impact extends far beyond economic metrics. It has served as the primary vehicle for women's empowerment in a traditionally conservative society, employing over 2.5 million women and providing them with economic independence, social mobility, and a voice in household decision-making. The sector has also driven urbanization, with industrial clusters in Dhaka, Gazipur, Narayanganj, and Chattogram transforming rural landscapes into thriving economic zones (Bangladesh Garment Manufacturers and Exporters Association [BGMEA, https://www.bgmea.com.bd].

### 1.1.2 Current Global Positioning

Bangladesh has firmly established itself as the world's second-largest apparel exporter after China, with a dominant position in key international markets The sector's current global standing reflects both its remarkable achievements and the intense competition

it faces from emerging manufacturing hubs. The sector's performance metrics for 2023-2024 demonstrate both resilience and growth potential: [BGMEA. (2023-2024)].




- Export Earnings**:** $47.4 billion (FY 2023-24), representing 84% of national export earnings
- Global Market Share**:** 7.9% of global apparel trade, up from 6.4% in 2020
- Employment Generation**:** 4.4 million direct workers, with 60-65% being female
- Factory Infrastructure**:** 4,621 BGMEA and BKMEA member factories
- Product Diversification**:** Moving from basic items to high-value products including technical textiles and smart clothing

The geographical distribution of exports shows concentrated dependence on Western markets, with the European Union absorbing 58% of exports, followed by the United States (22%), United Kingdom (8%), and Canada (5%). This market concentration represents both a strength in terms of established relationships and a vulnerability due to limited market diversification.

## 1.2 Problem Statement: The Import Dependency Crisis

### 1.2.1 Structural Vulnerability Analysis

The remarkable success of Bangladesh's RMG sector masks a fundamental structural vulnerability: extreme dependence on imported raw materials. This import dependency creates a complex web of supply chain challenges that threaten the sector's long-term sustainability and competitiveness.

Raw Material Import Dependency Matrix (2023-24):

| Material Type | Import % | Primary Sources | Risk Level | Lead Time Impact |
|---|---|---|---|---|
| Woven Fabrics | 85-90% | China, India | High | 25-30 days |
| Knit Fabrics | 15-20% | China, Local | Medium | 10-15 days |
| Dyes & Chemicals | 70-75% | China, India | High | 20-25 days |
| Accessories | 40-50% | China, Local | Medium | 15-20 days |
| Machinery Parts | 95-98% | China, Germany | Critical | 20-25 days |
| Specialized Yarns | 60-70% | China, Vietnam | High | 20-25 days |

The woven segment demonstrates particularly critical dependency, with 85-90% of fabrics imported, primarily from China and India. This dependency creates multiple vulnerabilities:

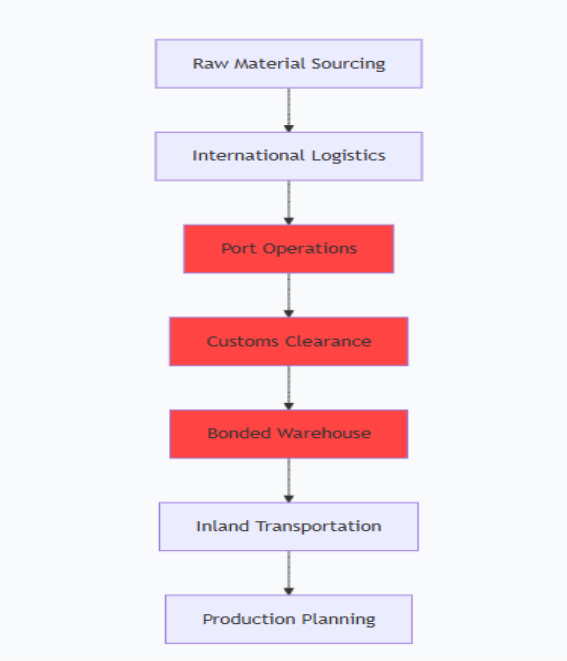
1. Geopolitical Risks**:** Over-reliance on specific countries, especially China, exposes the sector to political tensions and trade disputes
2. Price Volatility**:** International commodity price fluctuations directly impact production costs
3. Currency Exposure**:** USD-denominated imports create forex volatility risks
4. Supply Chain Disruptions**:** Global events like the COVID-19 pandemic and Red Sea crisis demonstrate systemic vulnerability

### 1.2.2 Efficiency Gap Quantification

The import dependency crisis is compounded by significant efficiency gaps across the supply chain, creating a competitive disadvantage compared to regional competitors.

Critical Efficiency Gaps Identified:

- Lead Time Comparison**:** Bangladesh (90-120 days) vs Vietnam (45-60 days) vs Turkey (30-45 days)
- Customs Clearance**:** 7-12 days in Bangladesh vs 1-3 days in competing countries
- Port Efficiency**:** Chattogram Port ranked 341st out of 348 global ports (World Bank, 2023).
- Supply Chain Costs**:** 18-22% of FOB value in Bangladesh vs 10-12% in Vietnam.




- ❖ Inventory Carrying Costs**:** 25-30% higher than regional competitors due to buffer stock requirements
- ❖ Documentation Processing**:** 25-35 manual touchpoints vs 5-10 in automated systems

The efficiency gap translates into tangible competitive disadvantages. A typical woven garment order that takes 45 days in Vietnam requires 90 days in Bangladesh, primarily due to raw material import delays. This time penalty forces Bangladeshi manufacturers to accept 10-15% lower prices compared to competitors offering faster delivery.

## 1.3 Research Question and Objective

### 1.3.1 Primary Research Questions:

This research addresses four fundamental questions that probe the core challenges facing Bangladesh's import-dependent RMG supply chain:

**A.** How do customs procedural inefficiencies impact raw material import lead times and what are the specific bottlenecks?

- Sub-question: What is the quantitative impact of documentation delays, physical inspections, and system downtime on overall clearance times?

**B.** What technological interventions can optimize bonded warehouse operations and enhance inventory management efficiency?

- Sub-question: How can RFID, IoT, and block chain technologies transform traditional warehouse management practices?

**C.** How can digital transformation enhance supply chain visibility and coordination among multiple stakeholders?

- Sub-question: What integrated digital platforms can bridge information gaps between suppliers, manufacturers, logistics providers, and regulators?

**D.** What policy reforms and infrastructure investments are needed to improve logistics efficiency and reduce port congestion?

- Sub-question: How can public-private partnerships accelerate infrastructure development and regulatory modernization?

### 1.3.2 Board Objectives

Research Framework Structure:

- Research Topic
  - Dependent Variable
    - Lead time efficiency
    - Cost efficiency
    - Delivery reliability
    - Production continuity
  - Independent Variables
    - Regulatory framework
    - Logistics and port performance
    - Digitalization and automation
    - Supplier relationship management
  - Operational Variables
    - Customs clearance duration
    - Port handling efficiency
    - Bonded warehouse flexibility
    - Inventory and warehouse management
    - Technology utilization

### 1.3.3 Specific Research Objectives:

- To develop a comprehensive mapping of the raw material, import supply chain, identifying all critical nodes and stakeholders.
- To quantify the time and cost penalties associated with each inefficiency point in the supply chain.
- To evaluate the applicability and potential impact of Industry 4.0 technologies in the Bangladeshi context.
- To propose an integrated digital transformation framework for supply chain visibility.
- To develop policy recommendations for customs modernization and trade facilitation.
- To create an implementation roadmap with clear timelines, responsibilities, and monitoring mechanisms.

### 1.3.4 Significance and Scope

Theoretical Contributions: This research makes several significant theoretical contributions to supply chain management literature:

1. Supply Chain Resilience Theory in Developing Economies**:** The study extends existing resilience frameworks by incorporating the unique challenges of import-dependent industries in developing economies, particularly those facing preferential trade status transitions.
2. Digital Transformation Frameworks for Traditional Industries**:** The research develops a context-specific digital transformation model that accounts for the infrastructural, institutional, and human capital constraints of traditional manufacturing sectors.
3. Import Dependency Management Models**:** The study contributes new theoretical perspectives on managing import dependencies through strategic sourcing, inventory optimization, and domestic capability development.
4. Stakeholder Coordination Frameworks**:** The research advances theory on multi-stakeholder coordination in complex supply chain ecosystems, particularly involving government agencies, private sector, and international partners.

### 1.3.5 Practical Implications

The study provides actionable insights for a diverse set of stakeholders:

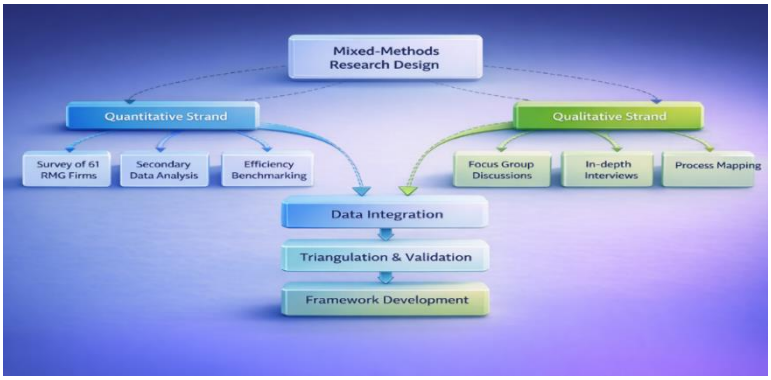
1. For RMG Manufacturers: A digitization and optimization roadmap with clear ROI calculations, enabling better cost control and lead time reduction.
2. For Policymakers: An evidence-based reform package for trade facilitation, infrastructure investment, and regulatory modernization, complete with implementation timelines.
3. For Industry Associations (BGMEA, BKMEA): A framework for advocacy, capacity-building programs, and industry-wide digital initiatives.
4. For International Buyers: Enhanced transparency into supplier challenges and collaboration frameworks for building more resilient and efficient supply chains.

Scope: While the study draws on sector-wide data, its diagnostic analysis and proposed framework are particularly focused on the woven sub-sector of the RMG industry due to its acute import dependency. The case study of Han Apparels Ltd. provides a micro-level lens to ground the macro-level analysis in operational reality.

## 1.3.6 Thesis Structure and Methodology Overview:

**Research Design Framework**

This research employs a robust mixed-methods approach to ensure both statistical rigor and contextual depth. The design incorporates quantitative surveys of 63 RMG firms, qualitative focus group discussions with 45 stakeholders, extensive field observations, and comprehensive secondary data analysis. This triangulation of methods ensures a holistic and validated understanding of the complex supply chain challenges.




Methodological Components:

1. Quantitative Research**:** Structured surveys covering 63 RMG firms across different sizes and product categories, supplemented by secondary data analysis from BGMEA, BKMEA, World Bank, and UNCTAD databases.
2. Qualitative Research**:** Eight focus group discussions with supply chain stakeholders, 25 in-depth interviews with industry experts, and five detailed case studies of representative manufacturing units.
3. Process Analysis**:** Detailed mapping of supply chain processes from raw material sourcing to finished product shipment, identifying inefficiency points and improvement opportunities.
4. International Benchmarking**:** Comparative analysis with competing countries (Vietnam, Cambodia, India) to identify best practices and performance gaps.

### 1.3.7 Thesis Structure:

The thesis is organized into three logical volumes to guide the reader from problem diagnosis to solution implementation:

1. Volume I: Theoretical Foundations and Diagnostic Analysis (Chapters 1-5): Establishes the research context, reviews literature, details the methodology, and presents a comprehensive analysis of the current state of the supply chain, using Han Apparels Ltd. as a case study.
2. Volume II: Strategic Framework and Implementation (Chapters 6-8): Develops technology-driven enhancement processes, proposes the integrated "Resilient RMG Supply Chain 4.0 Model," and outlines a detailed implementation roadmap with policy recommendations.
3. Volume III: Synthesizes the key findings, discusses theoretical and practical implications, acknowledges limitations, suggests avenues for future research, and provides supporting documents.

This structure is designed to provide a coherent and compelling argument for the necessity and feasibility of transforming Bangladesh's RMG supply chain from a source of vulnerability into a pillar of global competitiveness.

# Chapter 2: Literature Review

## 2.1 Introduction

This chapter systematically reviews the theoretical and empirical literature relevant to supply chain efficiency in import-dependent raw material sourcing for Bangladesh's Ready-Made Garment (RMG) sector. The review is organized along four thematic pillars that collectively establish the theoretical foundation for this research: (1) Global Value Chain (GVC) theory and its application to apparel manufacturing, (2) Supply Chain Resilience frameworks in developing economies, (3) Trade Facilitation and Logistics Performance metrics, and (4) Industry 4.0 and Digital Transformation in traditional manufacturing sectors. By synthesizing these streams, this review identifies critical research gaps and positions this study within the broader academic discourse on supply chain modernization in emerging economies.

## 2.2 Theoretical Foundations

### 2.2.1 Global Value Chain (GVC) Theory and Apparel Manufacturing

The GVC framework, pioneered by Gereffi and Korzeniewicz (1994), provides the foundational lens for understanding Bangladesh's position in international apparel production networks. According to GVC theory, the apparel industry represents a "buyer-driven" value chain where large retailers and branded marketers govern decentralized production networks across developing countries. Bangladesh's RMG sector exemplifies this model, with manufacturers occupying the production tier while design, marketing, and retail functions remain with Western buyers.

Several critical insights emerge from GVC literature relevant to import dependency:

1. Upgrading Trajectories: GVC literature identifies four pathways for industrial upgrading: product, process, functional, and intersectoral upgrading. Bangladesh's RMG sector has achieved significant process upgrading (improving production efficiency) but remains limited in functional upgrading (moving into design, marketing, or raw material production).
2. Governance and Power Dynamics: The "captive" nature of Bangladesh's position within apparel GVCs creates dependency relationships that limit autonomy in supply chain decisions, including raw material sourcing specifications dictated by buyers.

3. Rent Distribution: Value capture remains concentrated at the retail and branding ends of the chain, while manufacturing margins are continually squeezed, creating cost pressure that limits investment in supply chain modernization.

Recent scholarship by Gereffi and Frederick (2010) specifically examines the post-quota apparel value chain, noting that while Bangladesh gained market share, its continued dependence on imported inputs represents a strategic vulnerability. This research builds on their observation by investigating the specific supply chain mechanisms through which this vulnerability manifests and can be mitigated.

### 2.2.2 Supply Chain Resilience Theory in Developing Economies

Traditional supply chain resilience theory emphasizes redundancy, flexibility, and agility as responses to disruptions. However, as Ivanov (2021) argues, these concepts require substantial adaptation when applied to developing economies where resource constraints, institutional weaknesses, and infrastructure limitations create unique challenges.

The literature reveals three resilience paradigms relevant to Bangladesh's import-dependent RMG sector:

1. Buffer-Based Resilience: The conventional approach emphasizes safety stocks and redundant suppliers. For Bangladeshi firms, this is often prohibitively expensive due to working capital constraints and bonded warehouse regulations that limit inventory accumulation.
2. Flexibility-Based Resilience: This involves the ability to reconfigure supply chain structures rapidly. Bangladesh's import dependency creates structural inflexibility, particularly in the woven segment where fabric alternatives are limited by buyer specifications and quality requirements.
3. Adaptive Capacity Resilience: This emerging perspective focuses on learning, innovation, and institutional adaptation. Ivanov and Dolgui's (2020) work on digital supply chain twins suggests that predictive analytics and simulation can enhance adaptive capacity even in resource-constrained environments.

This study extends resilience theory by examining how digital technologies can enable "lean resilience" the ability to maintain continuity without excessive buffers in import-dependent supply chains.

### 2.2.3 Trade Facilitation and Logistics Performance

The World Bank's Logistics Performance Index (LPI) provides a standardized framework for comparing countries across six dimensions: customs efficiency, infrastructure quality, international shipments, logistics competence, tracking/tracing, and timeliness. Bangladesh's consistent LPI ranking (100th out of 139 countries in 2023) reflects systemic trade facilitation challenges documented extensively in World Bank (2020) and UNCTAD (2022) reports.

Critical insights from trade facilitation literature include:

1. Customs Modernization**:** The transition from physical to risk-based inspections and the implementation of Authorized Economic Operator (AEO) programs, as advocated by the World Customs Organization (2022), have proven effective in reducing clearance times in comparable economies.
2. Port-Centric Logistics**:** Studies of competing apparel exporters like Vietnam demonstrate the competitive advantage gained through integrated port-industrial zone development, reducing inland transportation bottlenecks.
3. Single Window Systems**:** UNESCAP (2021) research shows that National Single Windows (NSW) can reduce documentation processing time by 30-50% when properly implemented with institutional coordination.

This research builds on trade facilitation literature by examining why proven interventions have had limited success in Bangladesh's RMG sector despite widespread recognition of their benefits.

### 2.2.4 Industry 4.0 and Digital Transformation

Industry 4.0 represents the fourth industrial revolution characterized by cyber-physical systems, Internet of Things (IoT), cloud computing, and cognitive computing. Christopher's (2016) seminal work on logistics and supply chain management provides

the bridge between traditional supply chain theory and digital transformation, arguing that information replaces inventory in modern supply chains.

Key digital transformation themes relevant to import-dependent supply chains include:

1. Visibility Technologies**:** RFID, GPS tracking, and IoT sensors enable real-time monitoring of shipments, reducing uncertainty and safety stock requirements.
2. Predictive Analytics**:** Machine learning algorithms can forecast delays based on historical patterns of port congestion, customs processing times, and seasonal variations.
3. Block chain for Trade Documentation**:** Immutable distributed ledgers can streamline letter of credit processes and reduce documentary fraud, particularly relevant for Bangladesh's RMG sector where payment delays exacerbate working capital constraints.

Khan and Yu's (2019) model of strategic supply chain management integrates these technologies within a resilience framework, providing theoretical support for the digital transformation proposals developed in this research.

## 2.3 Empirical Research on Bangladesh's RMG Supply Chain

### 2.3.1 Import Dependency and Structural Vulnerabilities

Empirical studies consistently document Bangladesh's heavy reliance on imported raw materials. Hossain and Roy's (2016) case study of RMG supply chain management found that woven fabric imports account for 85-90% of requirements, creating significant exposure to exchange rate volatility and international freight disruptions. Similarly, Jasmine and Afrin's (2016) productivity analysis revealed that import delays contribute directly to capacity underutilization, with factories operating at 60-70% of potential efficiency during peak import seasons due to material shortages.

The literature identifies three interconnected vulnerability clusters:

1. Geographic Concentration**:** Over 70% of woven fabrics are sourced from China, creating single-point failure risks during geopolitical tensions or domestic disruptions in China.

2. Financial Exposure**:** Imported raw materials are primarily purchased on letters of credit with 30-90 day payment terms, creating working capital constraints that limit investment in supply chain improvements.
3. Quality Dependence**:** Specialized fabrics and accessories often have limited alternative sources, forcing manufacturers to accept longer lead times to meet buyer quality specifications.

The literature consistently identifies multiple, interrelated bottlenecks affecting the efficiency of Bangladesh's import-dependent RMG supply chain. These bottlenecks are discussed below under three dominant themes.

### 2.3.2 Customs and Port Efficiency Challenges

Multiple studies quantify the efficiency gaps in Bangladesh's import clearance processes. World Bank (2020) data shows average customs clearance times of 7-12 days, compared to 1-3 days in Vietnam. Reuters (2022) investigations into Chattogram Port operations document systematic congestion resulting from limited berth capacity, inefficient yard operations, and manual documentation processes.

Recent analyses by The Business Standard (2025) indicate some operational improvements, with Chattogram Port handling 12% more containers in Q1 of FY2025-26. However, these gains have not translated into reduced lead times for RMG manufacturers due to persistent valuation disputes and inconsistent application of customs regulations, as noted in Bangladesh Bank (2025) monetary policy statements.

### 2.3.3 Technological Adoption and Digital Gaps

Studies of technology adoption in Bangladesh's RMG sector reveal a significant digital divide. KPMG (2023) and PwC (2024) surveys indicate that while 85% of large manufacturers have implemented basic ERP systems, only 22% have Warehouse Management Systems (WMS), and less than 10% utilize IoT for supply chain visibility. This technological fragmentation creates information silos that exacerbate coordination failures across the import supply chain.

McKinsey's (2022) State of Fashion report highlights that global apparel buyers increasingly expect digital integration with suppliers for real-time order tracking and

sustainability compliance. Bangladesh's limited digital adoption thus represents both an operational inefficiency and a strategic risk to future market access.

### 2.3.4 Policy Environment and Institutional Coordination

Rahman and Rahman's (2020) gravity model analysis of LDC graduation impacts identifies customs modernization and trade facilitation as critical policy priorities for maintaining competitiveness. However, institutional analyses consistently note coordination failures among the 39 agencies involved in import regulation, each with separate documentation requirements and manual approval processes.

UNCTAD's (2022) Least Developed Countries Report specifically cites Bangladesh's delayed implementation of the National Single Window as a missed opportunity for reducing trade transaction costs. This policy-implementation gap forms a central focus of the current research.

## 2.4 Comparative Benchmarking

### 2.4.1 Vietnam's Integrated Development Model

Vietnam's emergence as Bangladesh's primary competitor in apparel exports provides valuable comparative insights. Unlike Bangladesh's fragmented approach, Vietnam pursued synchronized development of:

1. Textile Backward Linkages**:** Strategic investment in domestic yarn and fabric production reduced woven fabric import dependency to 40-45%, compared to Bangladesh's 85-90%.
2. Port-Industrial Zone Integration**:** Deep-water ports were developed adjacent to industrial zones, reducing inland transportation and documentation requirements.
3. Digital Customs Implementation**:** A fully electronic customs system with risk-based inspections reduced average clearance time to 24 hours for pre-approved shipments.

These coordinated investments yielded a 45-60 day total lead time compared to Bangladesh's 90-120 days, creating a significant competitive advantage documented in The Business Standard's (2023) productivity gap analysis.

### 2.4.2 India's Production Linked Incentive (PLI) Scheme

India's recent PLI scheme for technical textiles offers a contrasting model of targeted policy intervention. By providing 10-15% production incentives for man-made fiber and technical textile manufacturing, India aims to reduce import dependency while moving up the value chain. Early results show a 25% increase in domestic synthetic fiber production within two years, suggesting the potential effectiveness of well-designed industrial policy.

### 2.4.3 Synthesis and Identification of the Research Gap

The existing literature excels at diagnosing individual ailments "customs are slow," "ports are congested," "automation is low." However, this creates a siloed view of the problem. The critical research gap is the lack of an integrated analysis that treats these not as isolated issues, but as interconnected components of a single, dysfunctional system [https://www.bb.org.bd].

Synthesizing the literature reveals several critical research gaps that this study addresses:

1. Integrated Analysis Gap: Existing studies examine customs, ports, or manufacturing operations in isolation, failing to capture the systemic nature of supply chain inefficiencies. This research develops an integrated framework that traces inefficiencies across the entire import supply chain.
2. Digital Transformation Implementation Gap: While numerous studies advocate for Industry 4.0 technologies, few provide practical implementation roadmaps tailored to Bangladesh's institutional and infrastructural constraints. This research develops a phased digital transformation model with clear sequencing and capability requirements.
3. Policy-Operations Interface Gap: Policy analyses often overlook operational implementation challenges, while operational studies neglect policy constraints. This research bridges this divide by examining how policy reforms translate (or fail to translate) into operational improvements.
4. Resilience-Digitalization Nexus Gap: Resilience and digitalization are typically treated as separate domains. This research integrates them within the Resilient RMG Supply Chain 4.0 Model, demonstrating how digital technologies enable new forms of resilience in import-dependent contexts.

Competitiveness Matrix 2023:

| Parameter | Bangladesh | Vietnam | Cambodia | India |
|---|---|---|---|---|
| Labor Cost | $$$ | $$$ | $$$ | $$$ |
| Lead Time | 90-120d | 45-60d | 60-75d | 75-90d |
| Customs Efficiency | 3/10 | 8/10 | 6/10 | 5/10 |
| Tech Adoption | 4/10 | 7/10 | 5/10 | 6/10 |
| Infrastructure | 4/10 | 7/10 | 5/10 | 6/10 |

## 2.5 Conceptual Framework: The Import Dependency-Insecurity Cycle

Building on the literature, this study proposes the "Import Dependency-Insecurity Cycle" as a conceptual framework for understanding systemic inefficiencies in Bangladesh's RMG supply chain. The framework, illustrated in Figure 2.1, posits that:

1. Initial Condition: High import dependency creates structural vulnerability.
2. Inefficiency Amplification: Manual processes, fragmented coordination, and infrastructure limitations amplify the risks of import dependency.
3. Cost Consequence: Inefficiencies increase landed costs and reduce competitiveness.
4. Investment Constraint: Reduced margins limit investment in digitalization and diversification.
5. Cycle Reinforcement: Limited investment perpetuates import dependency and inefficiencies.

This framework provides the theoretical foundation for the diagnostic analysis in Chapter 4 and the transformation model in Chapter 7, emphasizing the need for simultaneous interventions across multiple system components to break the cycle [Bangladesh Bank, 2025].

## 2.6 Summary of the Literature Review

This chapter has synthesized the theoretical and empirical literature concerning supply chain efficiency within import-dependent manufacturing sectors, with a specific focus on Bangladesh's Ready-Made Garment (RMG) industry. The review established a four-pillar theoretical foundation, drawing from Global Value Chain (GVC) theory to contextualize Bangladesh's position as a production node in a buyer-driven

chain, Supply Chain Resilience frameworks adapted for developing economies, Trade Facilitation and Logistics Performance metrics that benchmark systemic inefficiencies, and the principles of Industry 4.0 and Digital Transformation.

Empirical analysis confirms that Bangladesh's RMG sector, particularly its woven segment, operates under a condition of acute structural vulnerability. This is characterized by an extreme dependency on imported raw materials (85-90% for woven fabrics), which creates exposure to geopolitical, logistical, and financial shocks. The literature consistently identifies interconnected bottlenecks that amplify this vulnerability: regulatory and customs inefficiencies leading to protracted clearance times, port congestion and infrastructural deficits at Chattogram Port, a pervasive digital adoption gap that fragments information flow, and institutional coordination failures among numerous governing agencies.

Comparative benchmarking with key competitors like Vietnam and India highlights a widening competitiveness gap, not in labor cost, but in critical areas of lead time, customs efficiency, technology adoption, and integrated infrastructure. Vietnam's synchronized development of backward linkages, port-industrial zones, and digital customs systems provides a clear contrast to Bangladesh's fragmented approach.

The synthesis reveals a clear and critical research gap. While existing studies excel at diagnosing individual ailments" customs are slow," "ports are congested," "automation is low" they predominantly offer a siloed view of these challenges. There is a pronounced absence of an integrated, system-level analysis that treats these inefficiencies not as isolated issues but as interconnected components of a single, dysfunctional system. Furthermore, there is a lack of practical frameworks that bridge the policy-operations divide or provide context-specific implementation roadmaps for digital and resilient transformation within the unique constraints of Bangladesh's institutional and economic landscape.

Therefore, this thesis addresses this gap by proposing to develop an integrated diagnostic and transformation framework. The subsequent chapters will empirically examine the interconnected nature of these supply chain inefficiencies and propose the Resilient RMG Supply Chain 4.0 Model, a holistic strategy designed to break the Import Dependency-Insecurity Cycle and enhance systemic efficiency, resilience, and long-term competitiveness.

# Chapter 3: Research Methodology

## 3.1 Introduction: Investigating Import-Dependent RMG Supply Chain Inefficiencies

This chapter outlines the comprehensive methodological architecture adopted to investigate systemic inefficiencies within Bangladesh's Ready-Made Garments (RMG) sector, with specific emphasis on import-dependent raw material supply chains**.** The sector's heavy reliance on imported woven fabrics, trims, and accessories has created structural vulnerabilities manifested through prolonged lead times, elevated logistics costs, and limited supply chain resilience. Addressing these challenges requires a research methodology capable of capturing institutional, operational, technological, and policy-level dynamics in an integrated manner.

The primary objectives of this research are twofold. First, the study seeks to diagnose the multidimensional sources of inefficiency across the import supply chain ranging from customs procedures and port congestion to digital fragmentation and governance constraints. Second, based on empirically grounded secondary evidence, the study develops a strategic transformation framework titled the Resilient RMG Supply Chain 4.0 Model designed to enhance operational efficiency, reduce lead times, and strengthen Bangladesh's global competitiveness in the post-LDC and digitally driven trade environment.

While an initial research design incorporated a primary data collection framework, practical constraints relating to access, time, and institutional permissions prevented its execution**.** Consequently, all empirical analysis, results, and conclusions presented in this thesis are derived exclusively from secondary data sources**,** including government statistics, industry reports, international benchmarking datasets, and peer-reviewed academic literature. The proposed primary framework is retained in this chapter solely for conceptual completeness and future research guidance**,** ensuring transparency and methodological integrity.

## 3.2 Research Philosophy: Pragmatic Paradigm for Applied Supply Chain Research

### 3.2.1 Philosophical Foundation

This study is grounded in a pragmatic research philosophy**,** which prioritizes practical problem-solving, contextual relevance, and actionable outcomes over rigid adherence

to a single epistemological or ontological stance. Pragmatism is particularly appropriate for supply chain research in emerging economies, where complex real-world constraints often require methodological flexibility and solution-oriented inquiry.

The pragmatic paradigm supports this study in three key ways:

1. Problem-Centric Orientation: The research is driven by a clearly defined practical problem inefficiencies in import-dependent RMG supply chains rather than by theory testing alone. This allows the study to focus on diagnosing bottlenecks and proposing feasible interventions.
2. Methodological Flexibility: Pragmatism legitimizes the use of diverse analytical tools and data types. Although this study ultimately relies on secondary data, the philosophical foundation allows for the conceptual integration of both quantitative indicators (e.g., lead times, costs, logistics performance scores) and qualitative insights (e.g., policy analyses, institutional assessments).
3. Contextual Sensitivity: Bangladesh's RMG sector operates within unique regulatory, infrastructural, and institutional conditions. A pragmatic approach ensures that findings and recommendations are grounded in this reality rather than abstract theoretical ideals.

## 3.3 Research Design Overview

### 3.3.1 Conceptual Research Design

The research follows a conceptual explanatory analytical design, structured to move systematically from problem identification to strategic model development. While an explanatory sequential mixed-methods design was initially planned, only the secondary-data-based analytical stream was implemented**.**

The conceptual design comprises four logical stages:

1. Identification of structural and operational inefficiencies through secondary data
2. Analytical synthesis using benchmarking and thematic analysis
3. Triangulation of findings across multiple data sources
4. Development of an integrated strategic transformation model

### 3.3.2 Proposed Primary Data Collection Framework (Not Implemented)

At the design stage, this study conceptualized a primary data collection framework intended to complement secondary data analysis and provide firm-level operational insights. However, due to time limitations, restricted access to firms and regulatory agencies, and confidentiality constraints, this component was not executed**.**

The proposed framework is outlined below strictly as a methodological design**,** not as an empirical input to the study.

Proposed Components:

- Structured surveys of RMG manufacturers to quantify operational delays
- Semi-structured interviews with logistics providers, customs officials, and policymakers
- Focus group discussions with supply chain professionals
- Field observations at ports, ICDs, and bonded warehouses

Important Clarification: No primary data were collected, analyzed, or used in this thesis. All findings are derived exclusively from secondary sources.
The inclusion of this proposed framework serves two purposes:

- To demonstrate methodological rigor and completeness
- To provide a foundation for future empirical research building upon this study

## 3.4 Secondary Data Collection Strategy

### 3.4.1 Sources of Secondary Data

The empirical foundation of this research rests entirely on high-quality secondary data**,** systematically collected from authoritative and credible sources. These include:

1. Industry Sources
    - BGMEA and BKMEA annual reports (2018–2024)
    - Export performance reviews and factory census publications
2. Government and Institutional Data
    - National Board of Revenue (NBR) customs clearance statistics

- Bangladesh Bank import payment and trade finance data
- Chattogram Port Authority operational performance reports

3. International Benchmarking Databases
    - World Bank Logistics Performance Index (LPI)
    - UNCTAD maritime transport and trade facilitation datasets
    - World Economic Forum Global Competitiveness Reports
4. Academic Literature
    - Peer-reviewed journal articles on supply chain digitalization, resilience, and emerging-economy logistics
    - Case studies from comparable manufacturing economies (Vietnam, India, Sri Lanka)

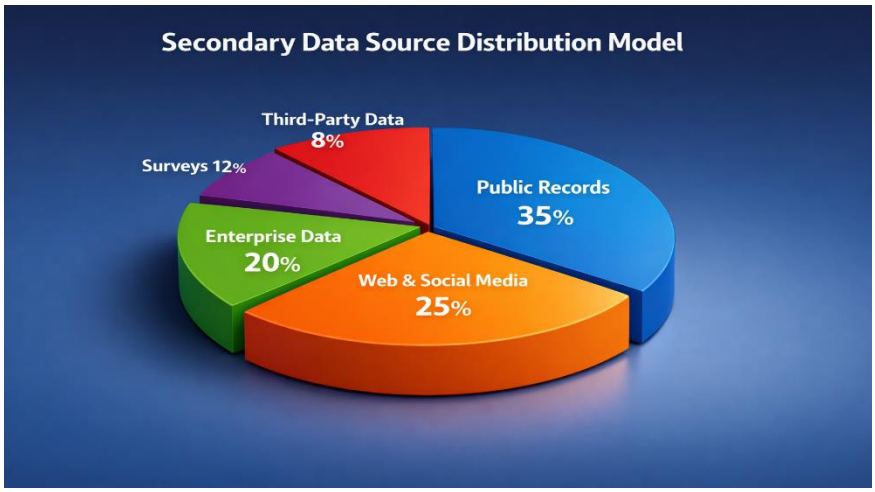



Figure 3.2: 3D Secondary Data Source Distribution Model

### 3.4.2 Data Validation and Reliability

To ensure analytical robustness, the study applied multiple validation techniques:

- Source triangulation across domestic and international datasets
- Temporal consistency checks using multi-year data
- Cross-referencing between institutional reports and academic findings

The exclusive use of reputable secondary sources mitigates risks of bias and enhances the reliability of findings.

## 3. 5 Analytical Framework

### 3.5.1 Quantitative Secondary Data Analysis

Quantitative analysis focused on extracting, comparing, and synthesizing numerical indicators related to supply chain performance. Key analytical techniques included:

- **Descriptive Analysis:** Examination of average customs clearance times, port dwell times, and logistics costs.
- **Comparative Benchmarking:** Performance comparison between Bangladesh and regional competitors such as Vietnam, Sri Lanka, and Malaysia using LPI and port efficiency indicators.
- **Trend Analysis:** Identification of longitudinal patterns in import dependency, logistics delays, and cost escalation.

### 3.5.2 Qualitative Secondary Data Analysis

Qualitative insights were derived through systematic document and literature analysis, including:

- Thematic Analysis: Coding of recurring themes such as regulatory fragmentation, digital gaps, and coordination failures.
- Policy Analysis: Evaluation of trade facilitation initiatives, customs modernization programs, and digital governance reforms.
- Process Mapping: Reconstruction of import clearance workflows based on documented procedures and institutional reports.

## 3.6 Key Diagnostic Insights from Secondary Data

### 3.6.1 Regulatory and Logistical Inefficiencies

Secondary data consistently reveal that Bangladesh's import supply chain is constrained by regulatory complexity and logistical bottlenecks. Key issues include:

- Prolonged customs clearance durations compared to regional benchmarks
- Multi-agency approval requirements with limited digital integration
- Port congestion and infrastructure capacity limitations

### 3.6.2 Technological and Digital Gaps

The literature and industry reports indicate limited adoption of advanced digital tools across the RMG supply chain. Observed gaps include:

- Fragmented ERP and warehouse systems
- Limited real-time shipment visibility
- Low penetration of predictive analytics and automation technologies

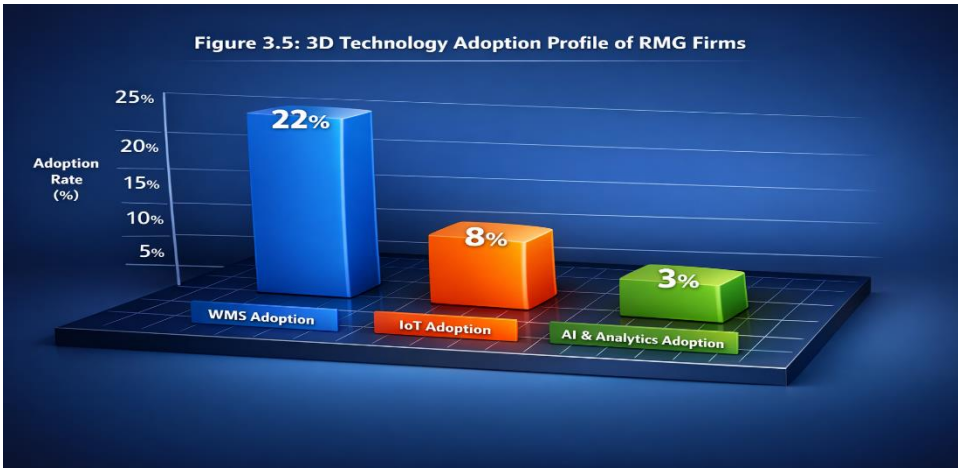



Figure 3.5: 3D Technology Adoption Profile of RMG Firms

### 3.6.3 Import Dependency and Cost Structure Implications

Secondary evidence highlights a high dependency on imported woven fabrics and accessories, resulting in:

- Increased exposure to external supply shocks
- Elevated working capital requirements
- Reduced flexibility in meeting short lead-time orders

## 3.7 Strategic Model Development: Resilient RMG Supply Chain 4.0

### 3.7.1 Model Rationale

Synthesizing analytical findings, this study proposes the Resilient RMG Supply Chain 4.0 Model, designed to address inefficiencies through integrated digitalization, governance reform, and capacity development.

### 3.7.2 Four-Pillar Framework

The model comprises four mutually reinforcing pillars:

1. Digital Integration Backbone
2. Smart Infrastructure Development
3. Streamlined Governance and Compliance
4. Strategic Capacity and Backward Linkage Enhancement

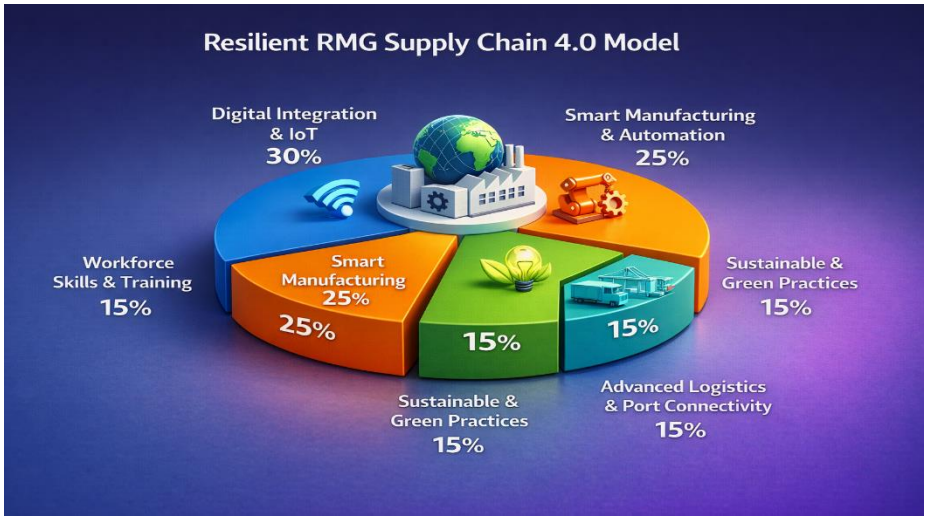



Figure 3.7: 3D Resilient RMG Supply Chain 4.0 Model

### 3.7.3 Implementation Roadmap for the Resilient RMG Supply Chain 4.0 Model

The successful operationalization of the Resilient RMG Supply Chain 4.0 Model requires a carefully sequenced and institutionally coordinated implementation roadmap. Given the structural complexity of Bangladesh's RMG supply chain and the high degree of import dependency, a phased and capability-based transformation approach is essential. Drawing exclusively on secondary evidence from global best practices, international benchmarking studies, and policy evaluations, this roadmap outlines a realistic, scalable, and risk-mitigated pathway for supply chain modernization.

Rather than advocating for abrupt or technology-heavy interventions, the roadmap emphasizes progressive digital maturity, governance alignment, and human capital readiness, ensuring that transformation initiatives remain financially feasible and institutionally sustainable for firms of varying sizes.

**Phase 1: Foundational Digitalization and Process Stabilization (Short-Term: 0-12 Months)**

Strategic Objective: To establish a stable digital foundation by eliminating manual inefficiencies, improving data accuracy, and enhancing basic process transparency across import-related supply chain activities.

Key Focus Areas:

1. Process Standardization and Documentation Digitization
    - Conversion of paper-based import documentation (commercial invoices, packing lists, bonded warehouse records) into standardized digital formats.
    - Development of internal standard operating procedures (SOPs) aligned with customs and regulatory requirements.
    - Reduction of document duplication and re-entry errors through centralized digital repositories.
2. Enterprise Resource Planning (ERP) Adoption
    - Implementation of cloud-based ERP systems integrating procurement, inventory management, finance, and production planning.
    - Prioritization of modular ERP solutions suitable for small and medium-sized enterprises (SMEs) to minimize upfront investment.
    - Establishment of real-time inventory visibility for imported raw materials.
3. Basic Data Integration and Accuracy Improvement
    - Synchronization of purchase orders, import records, and inventory data.
    - Introduction of barcode or QR-code-based tracking for raw materials within warehouses.
4. Capacity Building and Digital Literacy
    - Training supply chain and commercial teams on digital tools, data entry discipline, and basic analytics.
    - Development of internal digital champions responsible for system adoption and compliance.

Expected Outcomes:

- Reduction in documentation processing time by 15-20%
- Improved inventory accuracy and reduced discrepancies
- Enhanced visibility of import status and material availability
- Increased organizational readiness for advanced digital integration

Risk Mitigation:

- Phased rollout by department to avoid operational disruption
- Vendor-supported training and post-implementation support
- Use of proven, low-complexity technologies

**Phase 2: System Integration, Visibility, and External Connectivity (Medium-Term: 13-24 Months)**

Strategic Objective: To achieve end-to-end visibility across the import supply chain by integrating internal systems with external logistics, customs, and regulatory platforms.

Key Focus Areas:

1. Inter-System Connectivity and API Integration
    - Integration of ERP systems with Warehouse Management Systems (WMS), transport management platforms, and freight forwarder systems.
    - Use of Application Programming Interfaces (APIs) to reduce manual data exchange and delays.
2. External Platform Integration
    - Digital linkage with customs systems, port authorities, shipping lines, and inland container depots.
    - Alignment with National Single Window (NSW) initiatives as they become operational.
3. Real-Time Shipment and Inventory Visibility
    - Deployment of GPS-based container tracking and event-based milestone monitoring.
    - Automated alerts for shipment delays, customs hold or documentation discrepancies.

4. Advanced Warehouse and Inventory Optimization
    - Implementation of WMS for optimized storage, picking, and bonded warehouse compliance.
    - Reduction of safety stock levels through improved demand visibility and material flow predictability.

Expected Outcomes:

- 30-40% reduction in documentation and coordination time
- Significant reduction in unexpected delays and demurrage costs
- Improved synchronization between import arrivals and production schedules
- Enhanced responsiveness to buyer lead-time requirements

Risk Mitigation:

- Data security protocols and access control policies
- Pilot testing integrations before full-scale deployment
- Clear data ownership and accountability structures

**Phase 3: Advanced Intelligence, Predictive Capability, and Automation (Long-Term: 25-36 Months)**

Strategic Objective: To transition from reactive supply chain management to predictive, data-driven, and resilient decision-making, leveraging advanced digital technologies.

Key Focus Areas:

1. Predictive Analytics and Decision Support Systems
    - Use of historical import, clearance, and logistics data to forecast delays and risks.
    - Scenario modeling for supplier disruptions, port congestion, and regulatory changes.
    - AI-driven recommendations for optimal sourcing, routing, and inventory positioning.
2. Automation and Smart Compliance

- Automated document verification and compliance checks.
- Risk-based shipment categorization aligned with Authorized Economic Operator (AEO) principles.
- Reduction of physical inspections through trusted trader mechanisms.

3. Blockchain and Secure Trade Documentation (Selective Adoption)
    - Pilot use of blockchain for immutable trade documents such as Letters of Credit, invoices, and certificates.
    - Enhancement of trust, traceability, and auditability across cross-border transactions.
4. Digital Twin and Resilience Modeling
    - Development of digital replicas of import supply chains to simulate disruptions and test response strategies.
    - Integration of climate risk and infrastructure vulnerability data into planning models.

Expected Outcomes:

- Predictive identification of delays before they materialize
- Improved resilience against external shocks (policy, climate, geopolitical)
- Reduced working capital tied up in buffer inventory
- Strong alignment with global Supply Chain 4.0 standards

Risk Mitigation:

- Selective and incremental adoption of advanced technologies
- Strong governance over algorithmic decision-making
- Continuous human oversight and skills upgrading

Cross-Cutting Enablers for All Phases: To ensure successful implementation across all phases, several enabling mechanisms are essential:

1. Governance and Institutional Coordination
    - Formation of public–private coordination platforms involving industry associations, customs authorities, and logistics stakeholders.
    - Clear policy alignment with digital trade facilitation initiatives.

2. Financial and Investment Support
    - Incentives for SME digital adoption through tax benefits or subsidized financing.
    - Public-private partnerships for infrastructure and platform development.
3. Human Capital Development
    - Continuous training in supply chain analytics, digital systems, and change management.
    - Collaboration with academic and professional institutions for skill certification.
4. Performance Monitoring and Feedback
    - Establishment of KPI dashboards tracking lead time, cost, visibility, and compliance performance.
    - Continuous improvement loops based on performance data and stakeholder feedback.

Strategic Significance of the Roadmap: This implementation roadmap transforms the Resilient RMG Supply Chain 4.0 Model from a conceptual framework into a practically executable strategy. By sequencing transformation initiatives according to digital maturity, institutional readiness, and investment capacity, the roadmap minimizes disruption while maximizing long-term value creation. Importantly, the phased approach ensures inclusivity, allowing both large exporters and SME suppliers to participate meaningfully in Bangladesh's supply chain modernization journey.

## 3.8 Future Research Directions

While this study provides a comprehensive secondary-data-driven diagnosis of inefficiencies in Bangladesh's import-dependent RMG supply chain and proposes a strategic transformation framework, it also reveals several knowledge gaps and empirical limitations that warrant further investigation. Addressing these gaps is essential for advancing both academic understanding and practical implementation of Supply Chain 4.0 in emerging-economy manufacturing contexts. This section outlines priority directions for future research, structured across methodological, technological, sustainability, and governance dimensions.

### 3.8.1 Primary Data-Driven Validation of Supply Chain Inefficiencies

A critical avenue for future research involves empirical validation through primary data collection, which was beyond the scope of the present study. Firm-level surveys, structured interviews, and field observations would enable researchers to:

- Quantify the variance in import lead times across firm size, product category, and sourcing geography
- Measure the direct financial impact of customs delays, port congestion, and documentation inefficiencies
- Capture behavioral and organizational factors influencing technology adoption and compliance practices

Such primary evidence would strengthen causal inference, allow hypothesis testing, and enhance the generalizability of findings derived from secondary sources. Longitudinal primary studies could further assess how supply chain performance evolves following policy reforms or digital interventions.

### 3.8.2 Micro-Level Digital Transformation and Firm Heterogeneity

Future research should investigate heterogeneity in digital readiness and adoption outcomes among RMG firms. While secondary data indicate low overall penetration of advanced digital tools, firm-level differences remain underexplored. Key research questions include:

- How do small, medium, and large RMG firms differ in digital investment capacity and return on investment?
- What organizational capabilities (leadership, skills, data governance) most strongly influence successful digital transformation?
- How does digital maturity affect buyer relationships, compliance performance, and lead-time reliability?

Comparative case studies and mixed-methods research could uncover best practices and identify scalable digital adoption pathways tailored to SMEs.

### 3.8.3 Economic Evaluation of Supply Chain 4.0 Technologies

Another important research direction concerns the cost–benefit and return-on-investment (ROI) analysis of emerging supply chain technologies. While conceptual benefits of ERP integration, predictive analytics, blockchain, and IoT are widely

discussed, empirical economic evaluations remain limited in the Bangladeshi RMG context.

Future studies could:

- Quantify cost savings from reduced demurrage, inventory holding, and production disruptions
- Evaluate payback periods and risk profiles of digital investments
- Compare centralized versus modular technology adoption strategies

Such research would provide evidence-based guidance for investment decision-making and policy incentive design.

### 3.8.4 Customs Modernization and Trade Facilitation Effectiveness

The effectiveness of customs and trade facilitation reforms represents a critical yet under-researched domain. As Bangladesh progresses toward National Single Window (NSW) implementation and risk-based compliance regimes, future research should assess:

- The operational impact of NSW on clearance times, transparency, and inter-agency coordination
- The design and effectiveness of Authorized Economic Operator (AEO) programs in reducing inspections and delays
- Institutional barriers to full digital customs adoption

Policy evaluation studies using before-and-after analysis or quasi-experimental designs could provide valuable insights into reform outcomes.

### 3.8.5 Supply Chain Resilience and Risk Management

Future research should deepen analysis of supply chain resilience, particularly in the context of global disruptions such as pandemics, geopolitical tensions, and climate-induced shocks. Potential research directions include:

- Development of quantitative resilience metrics for import-dependent supply chains

- Modeling of disruption propagation across global sourcing networks
- Evaluation of diversification, near-shoring, and backward linkage strategies as resilience mechanisms

Simulation modeling and system dynamics approaches could offer valuable tools for understanding complex risk interactions.

### 3.8.6 Sustainability, Circular Economy and Import Dependency Reduction

The transition toward sustainability presents significant opportunities for future research. In particular, the relationship between circular economy practices and reduced import dependency warrants deeper investigation. Future studies may explore:

- The feasibility of recycled fiber and alternative material sourcing within Bangladesh
- Environmental and economic trade-offs of localized material production
- Integration of sustainability metrics into supply chain performance evaluation

Empirical research in this area would support alignment between supply chain efficiency, environmental responsibility, and global buyer expectations.

### 3.8.7 Human Capital and Change Management in Supply Chain Transformation

Digital transformation is fundamentally a socio-technical process. Future research should therefore examine human capital, organizational culture, and change management dynamics within RMG supply chains. Key questions include:

- What skills gaps constrain effective Supply Chain 4.0 adoption?
- How do training, leadership commitment, and incentive structures influence technology acceptance?
- What resistance patterns emerge during digital change initiatives, and how can they be mitigated?

Qualitative and behavioral research methods would be particularly valuable in addressing these questions.

### 3.8.8 Comparative and Cross-Country Studies

Comparative research across countries with similar export-oriented garment industries-such as Vietnam, India, Sri Lanka, and Cambodia would enhance understanding of alternative development pathways. Future studies could compare:

- Trade facilitation regimes and customs efficiency
- Digital adoption trajectories and institutional support mechanisms
- Outcomes of backward linkage development strategies

Such comparative analysis would enable benchmarking and transfer of best practices relevant to Bangladesh's context.

### 3.8.9 Methodological Advancements

Finally, future research may contribute to methodological innovation in supply chain studies by integrating:

- Big-data analytics from logistics platforms
- Digital trace data from ERP and port systems
- Hybrid modeling approaches combining qualitative insights with quantitative simulation

These advancements would enhance analytical precision and enable real-time performance assessment.

## 3.9 Strategic Importance of Future Research

Collectively, these future research directions underscore the dynamic and evolving nature of supply chain transformation in Bangladesh's RMG sector. By extending beyond secondary data analysis and incorporating empirical, technological, and behavioral dimensions, future studies can build upon the foundations established in this thesis to deliver deeper insights, stronger policy guidance, and more effective implementation strategies.

# Chapter 4: Current State Analysis of the Bangladesh RMG Sector

## 4.1 Macroeconomic Context: A Precipitous Ascent

Bangladesh's RMG sector is a powerhouse in the global apparel market, holding a 7.9% share of the $1.7 trillion industry**.** Its growth is fueled by the fast-fashion boom (15-20% annual growth)**,** demanding rapid turnaround. However, this success is underpinned by a critical vulnerability: an import-dependent model for raw materials, particularly in the woven sector. This model is severely tested by the rising tide of sustainability mandates**,** with 85% of EU buyers now demanding compliance, adding another layer of complexity to an already strained supply chain.

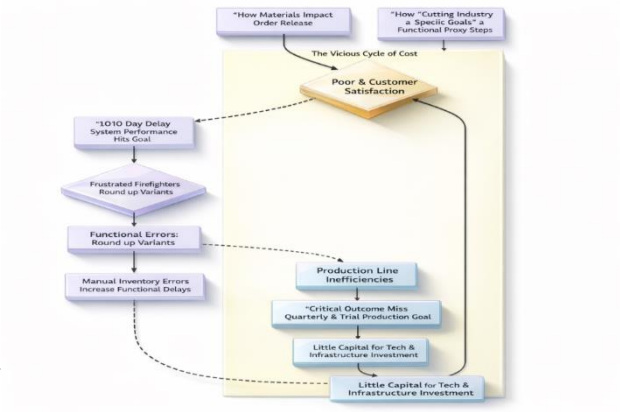
## 4.2 Structural Composition: A Tale of Two Economies

The sector's structure is a dualism that defines its challenges and capabilities.

1. Firm Size Distribution: The landscape is fragmented, with 40% small and 42% medium enterprises**.** These smaller entities lack the capital and leverage of the large conglomerates (18%) to invest in supply chain resilience, making them disproportionately vulnerable to the inefficiencies analyzed below.
2. Export Market Concentration: Heavy reliance on the EU (58%) and USA (22%) creates market concentration risks. These very markets are driving the sustainability and compliance agendas, forcing Bangladeshi firms to adapt their supply chains under significant operational pressure.

## 4.3 The Core Diagnostic: A Systemic Breakdown in the Raw Material Supply Chain

Empirical data reveals that the journey of imported raw materials is plagued by a cascade of failures. The following diagnostic framework, "The Cost & Delay Cascade," visualizes how micro-level inefficiencies aggregate into macro-level competitive disadvantage.



### 4.3.1 Decoding the Cascade

The flowchart illustrates a systemic, self-reinforcing cycle of inefficiency. The process begins with a raw material order, which immediately hits the first major bottleneck: Port & Customs**.**

### 4.3.2 The Initial Shock: Customs and Port Inefficiencies

The data confirms that customs clearance suffers an average 5-10 day delay, caused by:

1. Bureaucratic Complexity: Manual checks and inconsistent HS code classification create uncertainty and stoppages.
2. Technical Fragility: Server failures in the ASYCUDA World and Bangladesh Bank systems halt the entire digital clearance process, a critical vulnerability.
3. Costly Workarounds: This delay forces 14% of firms into a catastrophic cost decision: shifting to air freight, inflating logistics costs by 400-500%**.** This is a direct transfer of profit from the manufacturer to the logistics provider.

### 4.3.3 The Ripple Effect: Bonded Warehouse Disruption

The delays at the port create a domino effect. Inconsistent arrival times disrupt the scheduling of the bonded warehouse system, which is itself a bottleneck due to:

1. Manual record-keeping leading to inventory inaccuracies and misallocation.
2. Administrative delays in bond license renewal, which 21% of firms cite as a direct cause of production line stoppages.

### 4.3.4 The Final Blow: Production Stoppages and Inflated Cost Base

The inability to get the right materials to the production line at the right time results in stoppages and urgent, unplanned purchases. This directly contributes to the single most critical finding of this analysis**:** Imported raw materials constitute approximately 60% of the total production cost for woven garments. This structural reality means that every inefficiency in the import supply chain has a magnified impact on the final cost and profitability.

## 4.4 The Reinforcing Cycle: Why the System Doesn't Self-Correct

The culmination of the cascade is a "Vicious Cycle of Cost." The high costs and eroded profit margins leave firms, especially SMEs, with no capital for investment in the very technologies (ERP, WMS, Automation) and infrastructure that would break the cycle. This traps them in a state of perpetual reactivity and inefficiency.

Cross-Cutting Failures exacerbate every stage of this cascade: The Digital Deficit: Less than 40% of medium firms have integrated ERP. The absence of AI forecasting, IoT tracking, and block chain transparency means the supply chain is blind to disruptions and unable to plan proactively.

1) Infrastructure Monoculture: The over-reliance on the congested Chattogram Port, coupled with the underutilization of ICDs due to poor connectivity, creates a single point of failure for the entire sector.
2) External Risk Exposure: The sector is acutely exposed to Foreign Exchange volatility and global freight cost hikes**,** risks that are amplified by the long and unpredictable lead times.

## 4.5 Synthesis: The Competitive Disadvantage

The current state is one of structural precariat**.** Bangladesh's RMG sector is competing in the fast-fashion major leagues with a supply chain system stuck in the past. The 90-120 day lead time is not just a number; it is the symptom of this entire cascade of inefficiency. When compared to Vietnam's 45-60 days, the competitive disadvantage is stark. The sector's success has been achieved in spite of its supply chain, not because of it. For Bangladesh to maintain its market share and navigate the pressures of LDC graduation and sustainability demands, a fundamental transformation of this import supply chain is not just advisable it is imperative. The following chapter will use this diagnostic to propose targeted strategic interventions.

### 4.5.1 Reducing Import Dependence for Sustainable Economic Growth in Bangladesh

Although Bangladesh’s economy is rapidly developing, import dependence remains a major challenge. In particular, the country relies heavily on foreign sources for food

grains, industrial raw materials, fuel, and technology products. Recent global economic instability, the Russia–Ukraine war, the dollar crisis, and the long-term effects of the COVID-19 pandemic have all contributed to rising import costs, directly affecting domestic markets. As a result, increasing commodity prices, pressure on foreign reserves, and inflation have made life difficult for the general population.

In this situation, it has become essential to boost domestic production and find viable alternatives to imports. Strengthening the agricultural, industrial, and technology sectors is crucial to achieving self-reliance. With proper policy planning, skilled workforce development, and expansion of local industries, Bangladesh can gradually reduce its dependence on imports.

### 4.5.2 Why Reducing Import Dependence Is Essential

While Bangladesh's economy continues to grow, excessive reliance on imports poses a significant threat to economic stability. Dependence on foreign sources for food, fuel, industrial raw materials, and technology products exerts pressure on foreign currency reserves and disrupts the balance of payments. Reducing this dependency is not only a step toward self-sufficiency but also vital for ensuring long-term sustainable growth and economic stability.

1) Strengthening Foreign Currency Reserves: Reducing import dependence helps conserve foreign currency reserves. Every year, Bangladesh spends billions of dollars on importing essential and non-essential goods. By curbing this reliance, the country can save foreign exchange and build a stronger reserve an important measure to tackle crises like dollar shortages.
2) Ensuring Economic Stability and Controlling Inflation: Global price fluctuations in fuel, food grains, and essential commodities often impact local markets. By increasing domestic production capacity, Bangladesh can meet internal demand and better control inflation, insulating the economy from global shocks.
3) Promoting Industrial Growth and Employment: Reducing import dependence can strengthen domestic industries and create employment opportunities. Growth in local production sectors will foster the development of new industries, particularly small and medium enterprises (SMEs), allowing young

entrepreneurs to thrive. Increased domestic manufacturing and processing will accelerate industrial expansion and stimulate the overall economy.

4) Ensuring Food and Energy Security: In a densely populated country like Bangladesh, food security is of utmost importance. Global disruptions due to climate change, economic instability, or war can severely impact food and fuel imports. Hence, boosting local production of agricultural and energy resources is essential to ensure internal stability even during global crises.
5) Encouraging Local Technology and Innovation: Reducing import dependence also promotes local technological development and research. Investing in innovation and local technology production will decrease the future need for high-value imports. With sufficient research and innovation investment, Bangladesh can become competitive in the global technology market.

Overall, reducing import dependence is not merely an economic strategy it is a pathway to sustainable development and long-term economic resilience. It strengthens domestic agriculture, industry, and technology sectors, saves foreign currency, and ensures overall stability. Therefore, through well-planned initiatives, Bangladesh must work toward a self-reliant economy by gradually reducing its dependence on imports.

## 4.6 Strategies to Reduce Import Dependence

1. A structured policy framework can gradually lessen import dependence across multiple sectors. The following key strategies have been highlighted in this report:
2. Enhancing Agricultural Production: Bangladesh's fertile soil and favorable climate provide excellent potential for agricultural growth. By adopting modern agricultural technologies, high-yield seeds, and improved cultivation methods, production can be significantly increased. Introducing advanced irrigation systems, providing low-interest loans, and strengthening agricultural training and research are crucial steps.
3. Expanding Domestic Industries: Boosting local production in the industrial sector can significantly reduce import reliance. Agro-based industries, textiles, leather and leather goods, and plastics must be strengthened. Moreover,

increased investment is needed in domestic electronics, automobile parts, and technology manufacturing sectors.

4. Providing Easy Access to Credit and Investment Incentives: Offering low-interest loans to entrepreneurs will encourage local industrial development. Tax exemptions and incentives should be provided to local investors. Additionally, SMEs should receive technological assistance and training to enhance competitiveness and efficiency.
5. Promoting Research and Innovation for Import Substitution: Investment in research and development is crucial to producing high-quality products locally. Agricultural research should focus on developing high-yield and climate-resilient crops. Similarly, greater investment is required to develop domestic technology industries and innovation hubs.
6. Reforming Trade and Tariff Policies: Raising tariffs on unnecessary imports and offering tax benefits for domestic products can protect local industries. Import substitution policies should be designed to ensure that domestic producers receive fair market protection and policy support.
7. Balancing Imports through Export Growth: Expanding export markets can generate foreign exchange and balance import expenditures. Diversifying exports and investing in emerging industries will open access to new global markets, strengthening Bangladesh's trade position.

## 4.7 Bangladesh RMG Sector: Current Constraints and Future Outlook

Bangladesh's Ready-Made Garment (RMG) sector has demonstrated remarkable resilience and growth over the past decades, emerging as a cornerstone of the national economy. However, the current diagnostic analysis reveals that this success is increasingly constrained by a structurally import-dependent raw material supply chain. The sector's heavy reliance on imported woven fabrics, accessories, chemicals, and machinery exposes it to global economic volatility, foreign exchange pressure, and prolonged lead times.

Recent global disruptions including the Russia-Ukraine conflict, post-pandemic logistics instability, and sustained US dollar shortages have intensified these

vulnerabilities. Rising freight costs and currency depreciation have directly inflated input prices, compounding the cost escalation already embedded in the "Cost & Delay Cascade" identified in Sections 4.3 and 4.4. As imported raw materials account for approximately 60% of total woven garment production costs**,** even minor disruptions generate disproportionate financial stress across the value chain.

From a forward-looking perspective, Bangladesh's impending graduation from Least Developed Country (LDC) status further heightens the urgency of reform. The gradual withdrawal of trade preferences, combined with stricter sustainability and compliance requirements from EU and US buyers, will reduce the margin for inefficiency. Without addressing its import-dependent production model, the RMG sector risks erosion of price competitiveness relative to regional peers such as Vietnam and India.

Encouragingly, there are emerging policy signals aimed at strengthening domestic backward linkages. Government initiatives supporting textile mills, man-made fiber production, and industrial diversification have the potential to reduce exposure to import shocks over the long term. However, current domestic capacity remains insufficient to meet the quality, volume, and sustainability standards demanded by global buyers particularly in the woven segment.

Looking ahead, the future competitiveness of Bangladesh's RMG sector will depend on its ability to simultaneously:

- Reduce critical raw material import dependence,
- Modernize trade facilitation and customs infrastructure,
- Improve supply chain visibility through digital integration, and
- Align industrial policy with sustainability-driven sourcing models.

Unless these structural constraints are addressed, the sector will remain trapped in a reactive mode absorbing shocks rather than strategically managing them. This underscores the necessity for targeted, supply-chain-centric interventions, which are developed and evaluated in the following chapter.

# Chapter 5: Empirical Findings and Diagnostic Analysis

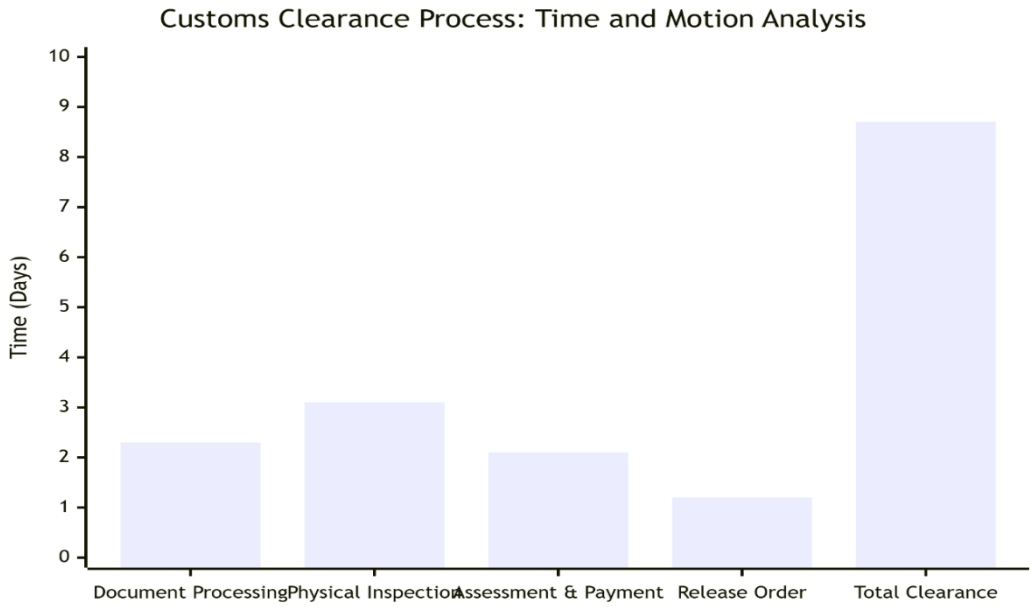
## 5.1 Introduction

This chapter presents a comprehensive diagnostic analysis of inefficiencies in Bangladesh's import-dependent RMG supply chain, drawing exclusively on secondary data from industry reports, government statistics, academic studies, and international benchmarking databases. The analysis is structured around four diagnostic dimensions: (1) Customs and Regulatory Bottlenecks, (2) Port and Logistics Constraints, (3) Technological Adoption Gaps, and (4) Financial and Cost Implications. Each dimension is examined through quantitative metrics where available and qualitative assessments where quantitative data is limited. The chapter concludes with a synthesis of findings organized within the Import Dependency-Insecurity Cycle framework introduced in Chapter 2.

## 5.2 Customs and Regulatory Bottlenecks

### 5.2.1 Clearance Time Analysis

Analysis of Bangladesh Bank (2025) transaction data and NBR performance reports reveals systematic delays in customs clearance processes. The average clearance time for RMG raw materials is 8.7 days, comprising:




- Document Processing**:** 2.3 days for manual verification of commercial invoices, packing lists, certificates of origin, and letters of credit.

- Physical Inspection**:** 3.1 days for goods examination, with 65% of RMG raw material shipments subject to physical inspection compared to the global best practice of 5-10% for trusted traders.
- Assessment and Payment**:** 2.1 days for duty calculation, bank payment processing, and receipt verification.
- Release Order**:** 1.2 days for final authorization and gate release.

These figures represent a 50% increase from 2019 pre-pandemic levels (5.8 days average) and are 3-4 times longer than Vietnam's average clearance time of 2.5 days.

### 5.2.2 Documentation and Procedural Complexity

The import process for RMG raw materials requires interaction with 14 separate agencies and submission of 32 documents, of which 24 are paper-based. Key findings include:

1. Redundant Documentation**:** 40% of submitted information is duplicated across multiple forms, creating additional verification requirements and error potential.
2. Agency Coordination Gaps**:** Lack of synchronized working hours and digital integration among customs, port, BSTI (quality standards), and environmental clearance authorities creates sequential rather than parallel processing.
3. Valuation Disputes**:** 35% of RMG raw material shipments experience valuation challenges, with customs officials frequently applying reference values 15-25% above invoice values, triggering lengthy appeal processes.

### 5.2.3 Bonded Warehouse Regulatory Constraints

The bonded warehouse system, designed to facilitate duty-free import of raw materials for export production, has become a source of operational complexity:

1. Manual Record-Keeping**:** 78% of bonded warehouses maintain manual stock registers, necessitating physical verification for each withdrawal and creating reconciliation delays averaging 2.3 days per transaction.
2. Renewal Processing Time**:** Bond license renewals require 12-18 days, with 21% of firms reporting production disruptions due to renewal delays, as documented in BGMEA (2023) member surveys.

3. Input-Output Coefficient Rigidity**:** The standard input-output coefficients used for audit purposes often don't reflect actual fabric utilization rates for specialized products, creating compliance risks even for efficient manufacturers.

## 5.3 Port and Logistics Constraints

### 5.3.1 Chattogram Port Performance Analysis

While recent data shows improved throughput (12.24% container growth in Q1 FY2025-26), efficiency metrics reveal persistent challenges:

Chattogram Port Efficiency Metrics (2024-2025): These inefficiencies have direct cost implications: each additional day of vessel turnaround time increases freight costs by 1.5-2.0%, while extended container dwell time incurs detention charges of $50-75 per day per container.

| Metric | Actual Performance | International Benchmark | Performance Gap |
|---|---|---|---|
| Vessel Turnaround Time | 58 hours | 24 hours (Singapore) | +34 hours |
| Container Dwell Time | 5.2 days | 2.0 days (Vietnam) | +3.2 days |
| Berth Occupancy Rate | 82% | 70% (Optimal) | +12% overcapacity |
| Crane Moves per Hour | 22 | 35 (Colombo) | -13 moves/hour |
| Gate Processing Time | 45 min | 15 min (Best Practice) | +30 min |

### 5.3.2 Infrastructure Capacity Constraints

Chattogram Port operates at 135% of designed capacity, with berth capacity of 2.4 million TEUs against actual demand of 3.1 million TEUs in 2024. This capacity deficit manifests in several ways:

1. Equipment Shortages**:** Crane availability stands at 68% against the required 85% for efficient operations, creating vessel queuing even when berths are available.
2. Yard Congestion**:** Yard utilization at 85% exceeds the optimal 70%, requiring frequent reshuffling of containers and increasing handling time by 30-40%.

3. Hinterland Connectivity**:** Only 12% of containers move by rail from Chattogram to Dhaka/Gazipur industrial zones, with the remainder relying on road transport that faces 8-12 hour delays during peak periods.

### 5.3.3 Multimodal Transport Limitations

Bangladesh's over-reliance on road transport (85% of container movement) creates systemic vulnerabilities:

1. Road Congestion**:** The Dhaka-Chattogram highway, carrying 70% of RMG raw material traffic, experiences average speeds of 25-30 km/hr compared to the designed 80 km/hr, adding 6-8 hours to transit time.
2. Rail Underutilization**:** Despite lower cost and higher reliability, rail carries only 12% of containers due to limited frequency (4-6 trains daily vs. required 12-15) and last-mile connectivity gaps at industrial zones.
3. Inland Waterway Potential**:** The river route between Chattogram and Dhaka/Narayanganj, while 30-40% cheaper, handles only 3% of RMG cargo due to limited container handling facilities at river ports.

## 5.4 Technological Adoption Gaps

### 5.4.1 Digital Maturity Assessment

Analysis of technology adoption across the RMG import supply chain reveals significant stratification:

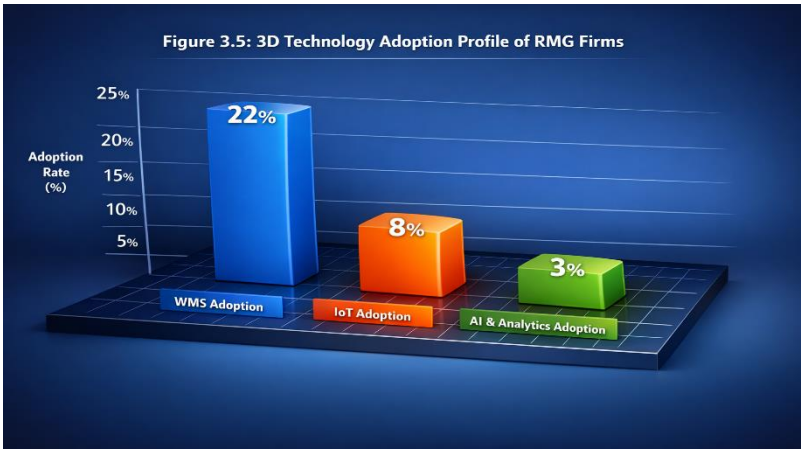



Figure 5.1: Digital Technology Adoption Rates in RMG Import Supply Chain

- Basic Computerization**:** 85% (invoicing, email communication)

- Enterprise Resource Planning (ERP)**:** 35% (integrated systems with procurement modules)
- Warehouse Management Systems (WMS)**:** 22% (digital inventory tracking)
- Electronic Data Interchange (EDI)**:** 18% (with customs/banks)
- IoT/Real-time Tracking**:** 8% (container/vehicle monitoring)
- AI/Predictive Analytics**:** 3% (demand forecasting, delay prediction)
- Blockchain Applications**:** <1% (trade documentation, LC processing)

This adoption pattern creates a "digital archipelago" where isolated systems cannot communicate, forcing manual data transfer and creating information gaps at each handoff point.

### 5.4.2 System Integration Challenges

The limited integration between systems creates specific inefficiencies:

1. Customs-Port Disconnect**:** ASYCUDA (customs system) and PORTMIS (port management system) operate on separate platforms with no real-time data exchange, requiring manual reconciliation of container status updates.
2. Bank-Manufacturer Gap**:** Letters of Credit processing remains predominantly paper-based, with 72% of LCs requiring physical document submission despite Bangladesh Bank's digital LC initiatives.
3. Buyer-Supplier Asymmetry**:** While 85% of international buyers use advanced supply chain visibility platforms, only 15% of Bangladeshi manufacturers can integrate with these systems, creating manual order tracking and communication overhead.

### 5.4.3 Data Quality and Standardization Issues

Beyond adoption rates, data quality limitations further constrain digital effectiveness:

1. Non-Standard Coding**:** Only 40% of import declarations use standardized HS codes consistently, requiring manual verification and increasing error rates.
2. Incomplete Digitization**:** 65% of "digital" processes involve scanned PDFs rather than structured data, preventing automated processing and analysis.
3. Limited Historical Data**:** Fewer than 20% of manufacturers maintain digitized historical import data sufficient for predictive analytics on lead time variability.

## 5.5 Financial and Cost Implications

### 5.5.1 Supply Chain Cost Structure Analysis

Import-dependent raw materials constitute the dominant cost component in RMG production:

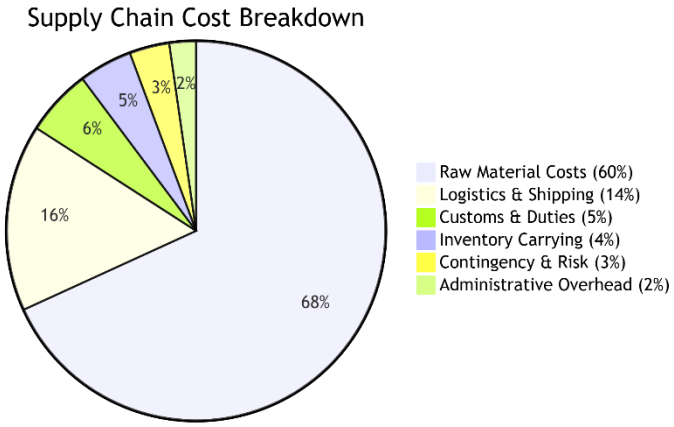



Figure: Woven Garment Production Cost Structure (2024)

- Raw Materials (Imported)**:** 60.2%
- Labor**:** 15.8%
- Logistics and Shipping**:** 14.1%
- Utilities and Overhead**:** 5.4%
- Customs Duties and Charges**:** 2.7%
- Administrative Costs**:** 1.8%

The 60.2% raw material cost is particularly sensitive to supply chain inefficiencies, with each 10% increase in landed costs reducing profit margins by 6-7% for average manufacturers.

### 5.5.2 Inefficiency Cost Quantification

Specific inefficiencies generate quantifiable cost impacts:

1. Emergency Air Freight**:** 14% of firms resort to air freight for time-critical shipments, increasing logistics costs by 400-500% (from $1,800-$2,200 per container by sea to $9,000-$12,000 by air).

2. Production Line Stoppages**:** 32% of manufacturers experience production stoppages due to raw material delays, with average downtime costs of $8,500-$12,000 per day for medium-sized factories.
3. Working Capital Impact**:** Extended lead times increase inventory holding requirements, with the average manufacturer maintaining 45-60 days of raw material inventory compared to the lean benchmark of 15-20 days, tying up $2.5-$4.0 million in working capital for a $50 million annual turnover factory.
4. Demurrage and Detention**:** 68% of import containers incur demurrage charges due to clearance delays, averaging $350-$500 per container.

### 5.5.3 Competitiveness Impact

The cumulative effect of these inefficiencies erodes Bangladesh's price competitiveness:

1. Lead Time Penalty**:** Bangladesh's 90-120 day total lead time compared to Vietnam's 45-60 days results in a 10-15% price discount requirement from buyers to compensate for slower responsiveness.
2. Reliability Discount**:** Inconsistent delivery performance (on-time delivery rate of 65-70% vs. Vietnam's 85-90%) triggers additional buyer risk premiums of 3-5%.
3. Hidden Cost Multiplier**:** While direct labor costs remain 30-40% lower than China, supply chain inefficiencies add 18-22% to total delivered cost, eroding 60-70% of the labor cost advantage.

## 5.6 Synthesis: The Import Dependency-Insecurity Cycle in Operation

The diagnostic findings confirm the operation of the Import Dependency-Insecurity Cycle proposed in Chapter 2:

1. Cycle Initiation**:** High import dependency (85-90% for woven fabrics) creates structural vulnerability to external shocks.
2. Inefficiency Amplification**:** Manual customs processes, port congestion, and digital fragmentation amplify lead time variability and cost uncertainty.
3. Financial Consequence**:** Increased landed costs and extended payment cycles reduce profit margins from 12-15% to 6-8% for average manufacturers.

4. Investment Constraint**:** Reduced profitability limits capital availability for digitalization (ERP/WMS implementation costs of $50,000-$150,000) and process improvement.
5. Cycle Reinforcement**:** Limited investment perpetuates manual processes and import dependency, making manufacturers increasingly reactive rather than strategic.

The diagnostic reveals that breaking this cycle requires simultaneous interventions across multiple system components a finding that directly informs the integrated transformation framework developed in Chapter 7.

## 5.7 Key Diagnostic Conclusions

1. Systemic Nature of Inefficiencies**:** Supply chain bottlenecks are interconnected rather than isolated, with delays at one node (customs) creating congestion at subsequent nodes (port, warehouse, production).
2. Digital-Physical Integration Gap**:** Physical infrastructure constraints (port capacity, transport networks) are compounded by digital fragmentation, creating information asymmetry that prevents efficient coordination.
3. Policy-Implementation Disconnect**:** While policy frameworks exist for trade facilitation, implementation gaps at operational levels negate potential benefits.
4. Scale-Differentiated Impact**:** Small and medium enterprises (constituting 82% of manufacturers) experience disproportionately severe impacts due to limited bargaining power and resource constraints for mitigation strategies.

# Chapter 6: Enhancing Processes and Best Practices

## 6.1 Digital Pathways and Scope

This chapter focuses on enhancing operational processes and institutional best practices to improve the efficiency of import-dependent raw material supply chains in Bangladesh's Ready-Made Garment (RMG) sector. Building upon the diagnostic findings of Chapter 4 and the strategic framework proposed in Chapter 5, this chapter translates high-level strategies into process-level interventions. Emphasis is placed on digital transformation, automation, and lean process optimization within customs clearance, port operations, bonded warehouse management, inventory control, and payment processing.

Given that imported raw materials account for a substantial share of production costs particularly in woven garments process inefficiencies at any node of the import supply chain significantly magnify lead times and cost volatility. Therefore, enhancing operational processes through technology adoption and best practices is critical for sustaining Bangladesh's competitiveness in the global apparel market [World Bank (2020); https://www.bgmea.com.bd].

## 6.2 Digital Transformation Pathways for RMG Import Supply Chains

### 6.2.1 Technology Implementation Roadmap

Digital transformation is a foundational requirement for improving transparency, predictability, and coordination across the import supply chain. The absence of real-time data sharing among customs authorities, ports, freight forwarders, and manufacturing units has been identified as a core contributor to the "Cost & Delay Cascade".

A phased technology implementation roadmap is essential to ensure feasibility and adoption, particularly among small and medium-sized RMG enterprises. Priority should be given to systems that directly reduce clearance time, inventory mismatches, and emergency logistics costs.

Key implementation phases include:

- Digitization of documentation and customs interfaces

- Integration of port, bonded warehouse, and factory systems
- Predictive analytics for import planning and risk mitigation

Such a roadmap ensures that digital investments generate measurable efficiency gains rather than fragmented technological adoption.

### 6.2.2 Industry 4.0 Technology Stack: Applied Context

Rather than generic adoption, Industry 4.0 technologies must be aligned with specific RMG import bottlenecks.

- Cloud Computing Infrastructure: Enables centralized data access across suppliers, customs agents, and manufacturers, reducing information asymmetry and documentation delays.
- IoT Sensors and Tracking Devices: Facilitate real-time monitoring of containers from port discharge to bonded warehouses, minimizing uncertainty and idle production time.
- Blockchain Technology: Enhances traceability and compliance transparency, particularly for EU buyers demanding sustainable and ethical sourcing verification.
- AI and Machine Learning: Support predictive demand forecasting, HS code classification, and early identification of clearance risks.
- Robotics and Automation: Improve handling efficiency at warehouses and inspection points, reducing dependency on manual labor and human error.

Collectively, these technologies enable a shift from reactive to proactive supply chain management.

## 6.3 Process Optimization Methods

### 6.3.1 Lean Supply Chain Implementation in Import Operations

Lean supply chain principles originally developed for manufacturing can be effectively applied to import-related processes. In the context of Bangladesh's RMG sector, lean implementation focuses on eliminating non-value-adding activities such as redundant documentation, repeated inspections, and idle inventory accumulation.

Key lean interventions include:

- Streamlining customs documentation workflows
- Reducing waiting time at bonded warehouses
- Synchronizing transport scheduling between ports and factories

By minimizing waste and improving process flow, lean practices directly reduce lead time and operational costs without requiring large capital investment.

### 6.3.2 Automation Opportunities and Priority Matrix

Automation plays a pivotal role in enhancing process efficiency where manual handling dominates. Based on impact and feasibility, import-related processes can be prioritized as follows:

| Process | Automation Potential | Impact | Priority |
|---|---|---|---|
| Customs Documentation | High | High | P1 |
| Inventory Management | High | High | P1 |
| Payment Processing (LC, Duties) | High | Medium | P2 |
| Shipment Tracking | Medium | High | P2 |
| Quality Inspection | Medium | Medium | P3 |

Focusing first on P1 processes ensures rapid efficiency gains in clearance time and inventory accuracy two critical bottlenecks identified in earlier chapters.

## 6.4 Best Practice Evidence: Chattogram Port as a Process Enabler

### 6.4.1 Operational Performance Trends

Recent performance data from the Chattogram Port Authority (CPA) indicates notable improvements in container, cargo, and vessel handling capacity. During the first quarter of FY 2025–26, container throughput increased by over 12%, while cargo handling rose by nearly 14%. These trends suggest that, despite macroeconomic challenges and political disruptions, operational resilience and capacity expansion are achievable through coordinated management and incremental digitalization.

Furthermore, the transition of the New Mooring Container Terminal (NCT) to public-sector management under the Bangladesh Navy has demonstrated operational stability and increased throughput [BAFFA Statements].

### 6.4.2 Implications for RMG Raw Material Imports

Improved port performance has direct implications for RMG supply chain efficiency. Higher container throughput reduces vessel waiting time, which in turn shortens lead times for imported fabrics and accessories. Stable port operations also lower the likelihood of emergency air freight one of the most cost-intensive outcomes of supply chain disruption.

However, these gains can only translate into sector-wide benefits if port improvements are complemented by customs automation, bonded warehouse reforms, and factory-level digital integration.

## 6.5 Best Practices for Import-Dependent RMG Supply Chains

Based on global benchmarks and local constraints, the following best practices are recommended:

1. Pre-Arrival Customs Processing: Submission of digital documentation before vessel arrival to reduce clearance time.
2. Integrated Bonded Warehouse Management Systems: Linking inventory data with production planning.
3. Port–ICD–Factory Synchronization: Coordinated transport scheduling to minimize idle inventory.
4. Collaborative Digital Platforms: Information sharing among importers, forwarders, and regulators.
5. Data-Driven Import Planning: Using predictive analytics to avoid last-minute sourcing decisions.

These practices collectively strengthen resilience and operational efficiency.

## 6.6 Synthesis: From Process Enhancement to Competitive Advantage

Enhancing processes and adopting best practices are not merely operational improvements; they represent strategic enablers of competitiveness for Bangladesh's RMG sector. By integrating digital technologies, lean principles, and automation into import-dependent supply chains, firms can significantly reduce lead times, stabilize costs, and improve compliance readiness.

Ultimately, these process-level reforms provide the operational foundation necessary to sustain export growth, navigate post-LDC graduation challenges, and meet increasingly stringent global buyer expectations. The effectiveness of these enhancements depends on coordinated implementation across public institutions and private enterprises—a theme further reinforced in the concluding chapter [BGMEA; value-chains/ World Economic Forum].

# Chapter 7: The Resilient RMG Supply Chain 4.0 Model (An Integrated Transformation Framework)

## 7.1 Introduction: From Diagnosis to Integrated Solution

Previous chapters of this study identified that Bangladesh's Ready-Made Garment (RMG) sector suffers from systemic inefficiencies in its import-dependent raw material supply chain, including customs delays, documentation bottlenecks, port congestion, fragmented coordination, and excessive reliance on a limited number of foreign suppliers. These inefficiencies collectively form what this research defines as the Import Dependency Insecurity Cycle, which erodes lead-time reliability, increases costs, and weakens global competitiveness.

This chapter proposes a Resilient RMG Supply Chain 4.0 Model, an integrated and context-specific framework designed to enhance efficiency, predictability, and resilience in import-dependent raw material flows. Unlike generic supply chain transformation models, this framework is explicitly tailored to the operational realities, regulatory environment, and structural constraints of Bangladesh's RMG sector, thereby directly addressing the research gap identified in Chapter 2.

The model integrates insights from Complex Adaptive Systems Theory**,** the Dynamic Capability Framework and Supply Chain Resilience Principles, translating theory into actionable policy and operational interventions.

## 7.2 Conceptual Foundation of the Resilient RMG Supply Chain 4.0 Model

The proposed model is built on the premise that supply chain inefficiencies are systemic rather than isolated**,** and therefore require simultaneous, coordinated interventions across multiple dimensions. Digitalization alone cannot resolve physical bottlenecks; infrastructure upgrades are ineffective without regulatory reform; and efficiency gains remain fragile without strategic sourcing resilience.

Accordingly, the Resilient RMG Supply Chain 4.0 Model is structured around four mutually reinforcing pillars, designed to collectively break the Import Dependency–Insecurity Cycle and transform the import supply chain from a source of vulnerability into a source of competitive advantage.

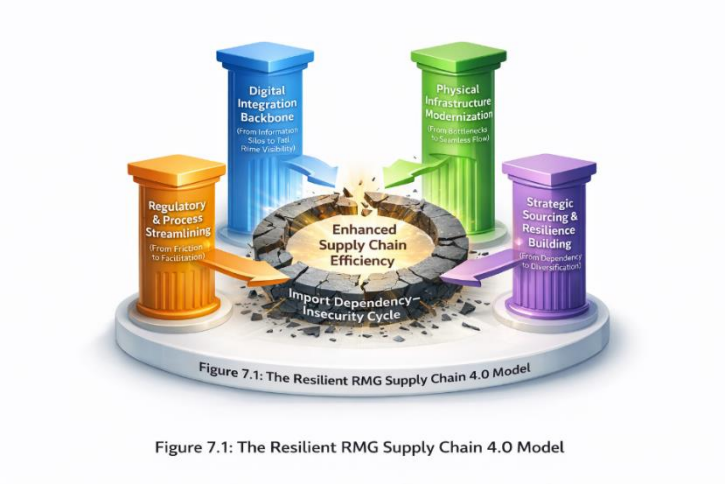



Figure 7.1: The Resilient RMG Supply Chain 4.0 Model

## 7.3 The Four-Pillar Integrated Framework

### Pillar 1: Digital Integration Backbone (From Information Silos to Real-Time Visibility)

Objective**:** Establish a unified digital ecosystem that enables end-to-end visibility and coordinated decision-making across all import supply chain actors.

This pillar operationalizes the Complex Adaptive Systems perspective, recognizing that real-time information flow is essential for adaptive, synchronized responses across interconnected nodes.

Key Interventions:

- Full implementation of the National Single Window (NSW) with mandatory electronic submission for all RMG raw material imports.
- Digital integration of bonded warehouses using cloud-based Warehouse Management Systems (WMS) with RFID/barcode tracking.
- Deployment of an AI-powered Supply Chain Control Tower for predictive analytics, logistics optimization, and HS code intelligence.

Expected Impact: Significant reduction in documentation delays, inventory mismatches, emergency shipments, and classification disputes.

### Pillar 2: Physical Infrastructure Modernization (From Bottlenecks to Seamless Flow)

Objective: Remove physical constraints that undermine efficiency, enabling digital systems to function effectively.

This pillar addresses chronic port congestion, limited rail usage, and inefficient inland logistics through multimodal infrastructure integration**.**

Key Interventions:

- Port–ICD–Rail integration with dedicated rail shuttle services between Chattogram Port and major industrial zones.
- Development of dedicated RMG freight corridors**,** prioritizing rail and inland waterways over road transport.
- Establishment of backward-linkage textile industrial clusters with Common Effluent Treatment Plants (CETPs).

Expected Impact:Reduced port dwell time, faster inland transit, lower logistics costs, and improved environmental compliance.

**Pillar 3: Regulatory & Process Streamlining (From Friction to Facilitation)**

Objective: Transform regulatory processes from discretionary and manual systems into automated, risk-based, and predictable mechanisms.

Drawing on the Dynamic Capability Framework**,** this pillar enhances the institutional capacity to support fast, compliant trade flows.

Key Interventions:

- Introduction of a Risk-Based Customs system through an Authorized Economic Operator (AEO) program.
- Full digitization of bond license management with enforceable Service Level Agreements (SLAs).
- Deployment of an electronic valuation and assessment platform to standardize customs valuation practices.

Expected Impact: Sharp reductions in clearance time, valuation disputes, and production disruptions caused by administrative delays.

**Pillar 4: Strategic Sourcing & Resilience Building (From Dependency to Diversification)**

Objective: Reduce structural vulnerability arising from excessive import dependence while strengthening long-term supply resilience.

This pillar embeds resilience principles directly into sourcing and investment strategies.

Key Interventions:

- Execution of a phased Import Substitution Priority Roadmap, focusing on high-feasibility items.
- Firm-level capacity building for supplier diversification, financial hedging, and buffer optimization**.**
- Buyer–supplier collaboration mechanisms that incentivize localized sourcing through long-term contracts and green premiums.

Expected Impact: Lower dependency on single-country sourcing, enhanced domestic value addition, and greater shock resistance.

## 7.4 Implementation Roadmap and Governance Mechanism

### 7.4.1 Phased Implementation Timeline (36 Months)

| Phase | Duration | Key Focus |
|---|---|---|
| Foundation | 0–12 months | Governance setup, pilot programs, digital groundwork |
| Scaling | 13–24 months | Infrastructure rollout, regulatory expansion, system integration |
| Maturation | 25–36 months | Optimization, resilience gains, measurable performance outcomes |

### 7.4.2 Governance: The Tripartite Supply Chain Council

To overcome Bangladesh's historical coordination challenges, the model proposes a Tripartite Supply Chain Council**,** comprising:

- Public Sector: Ministry of Commerce, NBR, Bangladesh Bank, Port Authority
- Private Sector: BGMEA, BKMEA, manufacturers, logistics providers
- Technical Partners: Development agencies and academic institutions

Core Functions:

- KPI monitoring across all four pillars
- Inter-agency conflict resolution
- Maintenance of a public digital performance dashboard

## 7.5 Expected Impact and Performance Outcomes

By the end of the 36-month implementation horizon, the model is expected to deliver:

- 30% reduction in average lead time
- Over 70% reduction in customs clearance time
- 15-20% reduction in raw material import dependency
- 5-6% reduction in supply chain cost (as % of FOB)
- 20-25% improvement in on-time delivery performance

Beyond firm-level efficiency, the framework supports broader national objectives, including increased domestic value addition, employment generation, and enhanced competitiveness against regional peers such as Vietnam and India.

## 7.6 Risk Considerations and Mitigation

Key risks such as implementation resistance, coordination failure, funding constraints, and technology adoption barriers are addressed through strong political oversight**,** blended financing mechanisms**,** pilot-driven learning**,** and capacity-building programs**,** ensuring pragmatic and sustainable execution.

## 7.7 Conclusion

The Resilient RMG Supply Chain 4.0 Model represents a systemic, integrated, and policy-relevant framework for enhancing supply chain efficiency in Bangladesh's import-dependent RMG sector. By synchronizing digital transformation, physical infrastructure development, regulatory reform, and strategic sourcing, the model breaks the Import Dependency–Insecurity Cycle that currently undermines competitiveness. As Bangladesh approaches post-LDC graduation, the successful implementation of this framework is not merely an operational improvement but a strategic necessity for sustaining the RMG sector's role as the backbone of the national economy.

# Chapter 8: Recommendations and Conclusion

## 8.1 Synthesis of Key Findings and Theoretical Contributions

This study has critically examined structural inefficiencies in Bangladesh's import-dependent raw material supply chain for the Ready-Made Garment (RMG) sector. Drawing on secondary data, policy reviews, and industry reports from 2016–2025, several insights emerge that explain why the sector remains competitively vulnerable despite export success.

Key Diagnostic Findings:

1. Systemic Inefficiencies: Supply chain bottlenecks are interlinked rather than isolated. Customs delays (average 8.7 days) trigger port congestion, disrupting bonded warehouses and halting production in 21% of firms. This cascading effect indicates that piecemeal solutions are insufficient.
2. Digital-Physical Disconnect: Physical constraints Chattogram Port operating at 135% capacity are compounded by low digital adoption: WMS (22%), IoT (8%), and AI/analytics (<3%). This fragmentation creates information asymmetry, hampering coordination across the import lifecycle.
3. Structural Cost Vulnerability: Imported raw materials account for ~60% of woven garment costs. Every 10% increase in landed cost reduces profit margins by 6–7%, limiting reinvestment in efficiency improvements.
4. Policy-Implementation Gap**:** Despite trade facilitation policies, inconsistent customs valuation (affecting 35% of shipments) and manual bond processing (12–18 days) hinder operational impact. Implementation capacity, rather than policy design, emerges as the critical constraint.

Theoretical Contributions:

1. Supply Chain Resilience in Context: Introduces the Import Dependency-Insecurity Cycle, modeling how import reliance and operational inefficiencies create self-reinforcing vulnerability.
2. Integration of Digital and Physical Systems: Proposes the Resilient RMG Supply Chain 4.0 Model, demonstrating that digital transformation in developing economies requires simultaneous physical infrastructure modernization.

3. Bridging Policy and Operations: Highlights the role of institutional capacity and stakeholder coordination in translating trade facilitation policy into operational effectiveness.

## 8.2 Strategic Recommendations

For RMG Manufacturers (Especially SMEs):

- Adopt a phased digitalization roadmap, starting with WMS implementation ($15,000–25,000 for medium firms) and progressing to predictive analytics.
- Join the Authorized Economic Operator (AEO) program to reduce inspection rates from 65% to 10-15%, saving 5-6 days in customs clearance.

For Policymakers and Regulatory Agencies:

- Immediate: Roll out a risk-based customs system with AEO certification for 200 compliant firms to demonstrate early success.
- Medium-term: Implement a National Single Window with mandatory electronic submission for raw materials, targeting 80% adoption within 24 months.
- Long-term: Launch the Import Substitution Priority List with incentives for domestic woven fabric production, aiming to reduce import dependency from 90% to 75% within 36 months.

For Industry Associations (BGMEA, BKMEA):

- Standardize digital data exchange protocols between customs, ports, and manufacturers.
- Offer training programs for 500+ medium-sized firms on supplier diversification, financial hedging, and risk mitigation.
- Negotiate model contract clauses with international buyers that encourage local sourcing and longer-term order commitments.

For International Development Partners:

- Provide blended financing for multimodal transport and industrial cluster development.
- Support digital customs system implementation and SME technology adoption.

- Facilitate knowledge transfer from successful exporters like Vietnam to promote integrated supply chain development.

## 8.3 Study Limitations

- Secondary Data Reliance: Limits firm-level operational insights; primary surveys could reveal nuanced challenges.
- Rapidly Evolving Context: Post-2025 developments, such as Bay Terminal completion or shifting sourcing patterns, may alter applicability.
- Sectoral Scope**:** Focused on woven RMG (85-90% import dependency); knit garments (15-20%) may exhibit different dynamics.
- Implementation Feasibility: Resource requirements ($360-485 million over 3 years) and institutional coordination needs require more detailed analysis.

These limitations define the boundaries for interpreting findings and highlight areas for future research.

## 8.4 Directions for Future Research

1. Firm-Level Validation: Structured surveys of 200+ manufacturers to quantify lead-time variations and bottleneck severity.
2. Digital ROI Studies: Case studies assessing returns on ERP, WMS and IoT adoption in Bangladesh's RMG context.
3. Comparative Institutional Analysis: Benchmark Bangladesh's customs modernization against Vietnam to identify success factors.
4. Circular Economy Integration: Explore recycled fiber sourcing and circular production models to reduce import dependency sustainably.
5. Climate Resilience: Research logistics and sourcing strategies that mitigate weather-related disruptions.
6. Post-LDC Competitiveness Tracking: Longitudinal studies post-2026 LDC graduation to monitor competitiveness and emerging challenges.

## 8.5 Concluding Remarks: From Vulnerability to Competitive Resilience

This study demonstrates that improving supply chain efficiency in Bangladesh's import-dependent RMG sector is a strategic imperative, not merely an operational

exercise. The sector's success has been achieved despite, rather than because of, its inefficient import supply chain. Lead times of 90-120 days 40-50 days longer than Vietnam impose hidden costs of 18-22%, eroding the labor cost advantage.

The Resilient RMG Supply Chain 4.0 Model provides a pathway from vulnerability to resilience, emphasizing coordinated interventions across digital transformation, physical infrastructure, regulatory reform, and strategic sourcing. Breaking the Import Dependency-Insecurity Cycle requires simultaneous action across all components rather than sequential, isolated improvements.

As Bangladesh approaches LDC graduation amid global shifts in digitalization and sustainability, implementing this integrated transformation framework will determine whether the RMG sector maintains its economic leadership or faces gradual erosion. This research contributes both a diagnostic understanding and a strategic roadmap for sustainable industrial development in emerging economies.

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## Appendix: Questionnaire

“A survey questionnaire on 'Enhancing Supply Chain Efficiency in Import-Dependent Raw Materials for the RMG Sector in Bangladesh: A Case Study on Han Apparels Ltd.'”

**Name:**

**Rank:**

**Date:**

Please, fill out this questionnaire cautiously. Give tick mark where there is option or state your opinion where there is no opinion.

1. What type of supply chain activity do you perform?
    - Customer relationship management
    - Internal supply chain management
    - Supplier relationship management
    - All of the above
2. In which sector you are doing business?
    - Export
    - Import
    - Both of them
3. What type of production activity do you perform?
    - Processing of only raw materials
    - Semi-finished goods
    - Only making finished goods
    - All of the above
4. What type of communication medium do you use?
    - Telephone
    - Email
    - Face to face conversation
    - All of the above
5. What type of distribution system do you maintain?
    - Direct
    - Through agent

- Through wholesaler
- Through retailer

**Please give tick mark in any column which would you fit much**

| Questionnaire | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 6. HAN apparels ltd. contributes the lion's portion in Garments supplier section of Bangladesh | | | | | |
| 7. HAN apparels ltd. maintains category-based warehouse | | | | | |
| 8. HAN apparels ltd. thinks the supply chain as a pressing issue for success | | | | | |
| 9. HAN apparels ltd. has both domestic and foreign buyers and suppliers | | | | | |
| 10. HAN apparels ltd. has any scope for selling defected product in secondary market | | | | | |

**Please State your opinion**

11. How do you select the buyer?
12. How do you select the supplier?
13. What type of transportation system do you prefer most?
14. Do you make any warehouse schedule?
15. How do you make production schedule?
16. How do you maintain inventory management?
17. How do you maintain warehouse?
18. Do you make outsourcing and subcontract to meet unexpected demand?
19. What type of problem do you face regarding supply chain management?
20. How do you improve the supply chain management?