

Lean Logistics Strategy for the Ready-Made Garments (RMG) Industry of Bangladesh: Review and a Proposed Enhanced Strategy

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Abstract

The study identifies the wasteful activities in the supply chain logistics of the Ready-Made Garments (RMG) industry sector of Bangladesh and aims to present recommendations of superior design ability of controlling the movement and remapping of raw material sourcing, work-in-process (WIP) and finished inventories with fastest time and lowest cost for increasing the flow, speed and profitability of products. The logistics system of the export oriented RMG industry sector has encountered many issues including high lead time, congestion and delays at the ports & lack of multimodal transportation system leading to an unacceptable level of risks at the manufacturer's end and uncertainties of delivery to the international customers. This study, taking the manufacturer's perspective has used qualitative research methods to inquire the strategies that the RMG manufacturers in Bangladesh take for improving their logistics operations by integrating their supplier delivery practices and distribution systems to the customers. The study also demonstrates the applicability and ways of implementation of lean tools and methodology to improve the logistics system of this sector.

Keywords:

Lean Logistics, Lean Six Sigma, Supply Chain Management.

1. Introduction

Logistics is an essential component of Supply Chain for any industry. Composed of aspects such as planning, carrying out and management of products and services, logistics serve as a blueprint of supply chain. The objective behind logistics is to ensure that customers receive the required items within the right time and price. Logistics aim to improve efficiency, reduce cost as well as enhancing customer satisfaction along the process. According to the Council of Supply Chain Management Professionals, logistics management is the integral part of the Supply Chain Management that plans, implements and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.

Meanwhile Lean is a methodology or thinking in a broader sense used to reduce waste in manufacturing technology without sacrificing the productivity of the product or process. Moreover, this thinking is centered around a continuous cycle of looking for perfection through maximizing product value and eliminating waste. This methodology ensures that the customers are not paying for the organizational wastes and inefficiency. Applying this thinking to logistics management, we get lean logistics which refers to the superior ability to design and administer systems to control movement and geographical positioning of raw materials, work-in-process, and finished inventories at the lowest cost. In a simpler term, lean logistics will refer to the method of identifying and eliminating wasteful activities from the organizational supply chain primarily focused on the logistics system with a motive to increase the flow and speed of the products or service from the supplier to the consumer.

Known to all that the Ready-Made Garment (RMG) industry can be dubbed the backbone of the economy of Bangladesh since the tag "Made in Bangladesh" has brought glory for the country. It covers a staggering 84% of Bangladesh's net export. It is evident that over 80% of the revenue earned by exporting is generated through the RMG sector. (Mohibullah *et al.*, 2016)

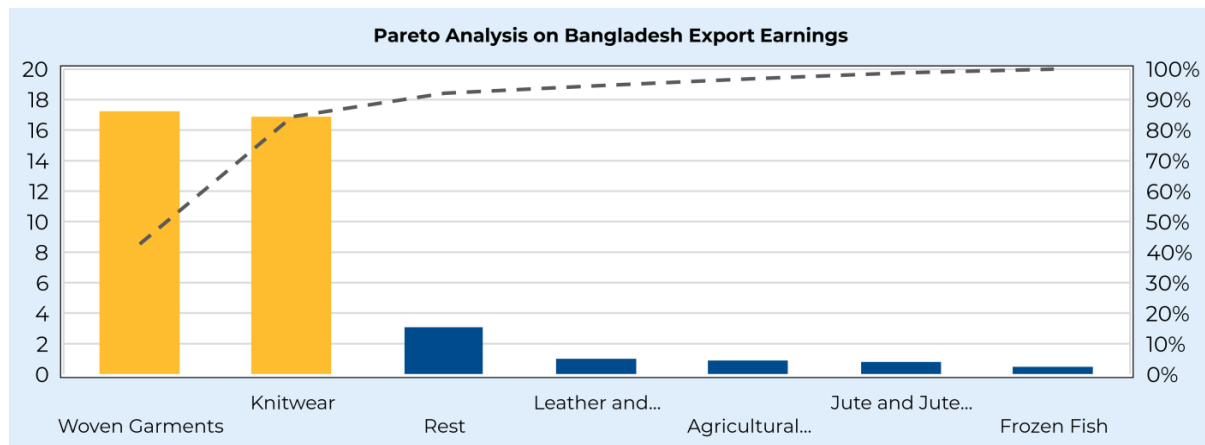


Figure: Pareto Analysis on Bangladesh Export Earnings

But in the first quarter of 2020, the coronavirus pandemic led to a 3.0 percent drop in global trade values. Covid-19 could trigger the biggest economic contraction since World War II, affecting all industries from finance to hospitality. As there is significant uncertainty about how the epidemiological and economic situation will evolve, assessing the duration and the gravity of the pandemic seems like an impossible task.

The sudden closure of businesses around the world has contributed not only to a Supply-Shock where there is a reduction of the economy's capacity to produce goods & services at a given price, but also has led to demand-shocks where the consumers' ability & willingness declines. As of March 2020, 69 member-companies of the BGMEA have faced order cancellation amounting to \$93 million & up to \$7.38 million work orders have been suspended by the top international clothing retailers & brands. With the current supply chain capabilities with multiple shortcomings & loopholes in the Bangladeshi industries, in order to capitalize on the current opportunity these aspects are needed to be worked on- such as the existing lead time which is significantly higher compared to its rival countries. (Mohibullah *et al.*, 2016)

The post-pandemic apparel industry is expected to see the largest paradigm shift in the supply chain in decades. Competitive pricing ipso facto will not be the only determinant in the uncertain days ahead. Aspects like flexibility will be of great importance in the future. [2] In the post-COVID-era, innovation is the alternative to navigate the challenges faced by the Bangladesh apparel industry.

From a logistical point of view, the textile, apparel and garments industry are considered a time-sensitive industry. Irregularities in making goods reach a particular place at a specified location on time can lead to reduced (or no) profits for the textile owner. In addition, clothing collections change quickly: their life cycle is short (as perishable products) and their commercialization is characterized by strong seasonal peaks. In this sense, textile logistics are characterized by small stocks and short delivery times. These goods and raw materials are usually transported using a combination of land, sea, and air. Within this trade logistics context, strong multimodal inter-linkages are key to ensure Just in Time delivery.

1.1 Objectives

Lean thinking has a significant impact on logistics. Any organization that incorporates the concept of lean thinking into its supply chain management can immensely benefit from reduced environmental impact and improved customer service, apart from other benefits of waste reduction, as a result. The process of elimination of waste reduces inventories, which, in turn, reduces the cycle and process times. This subsequently increases the velocity and flow of the supply chain.[2]

Lean thinking also has a strong cultural impact on the logistics process as it focuses on the culture of “total cost”. The lean thinking process emphasizes the total ownership cost, rather than focusing on individual factors of cost such as warehousing or transportation. Making important decisions depending on the total ownership cost has significant implications for logistics as inventory carrying costs usually make up for about 25-40 % of the entire logistics cost in many organizations. Without a lean thinking approach, organizations never completely rely on this total cost concept and keep the focus on individual cost drivers such as warehousing, transportation and inefficient sourcing practices.(Mohibullah *et al.*, 2016)

In the RMG industry of Bangladesh, poor backward linkage is the major bottleneck as like in most other industries; the Lead Time here is at best 90 days whereas in the other competitive rival countries of Latin America it is less than 40 days. It takes time to get the raw-materials in time & start able production since most of the raw materials are imported from China.[3]

The competing Asian countries of the sector like China, India, & Pakistan have their domestic sources of materials. Vietnam & Cambodia are closed to China & it takes only one-week time from Shanghai to Vietnam/Cambodia by sea. Though Bangladesh has reached huge success to upgrade their backward linkage industry over the decade, they still have to depend on overseas markets. Logistics issues in the RMG of Bangladesh and opportunities available by improving the logistics.

2. Literature Review

There are not many articles regarding the Lean Logistics strategy in RMG sector of Bangladesh. We are trying to implement a very basic but effective way to reduce waste in the logistics of RMG industry of our country.

2.1 Supply Chain Management

The supply chain process in the field of manufacturing and service industries is initiated with the suppliers followed by manufacturers, distributors, retailers and finally ends with consumers. Functions of supply chain are as follows:

- Product development
- Marketing
- Operations
- Distribution
- Finance
- Customer service

2.2 SCM in RMG Industry

In the year 2005, Nuruzzaman and Rafiq took an initiative to create a Supply Chain network for Bangladeshi RMG sector in order to accelerate the sector with the aim to create an upper hand in this particular field of worldwide business clothing by breaking down the existing network and tapping into unexplored relationships in the major part of the supply chain network.[4] In the year 2013 Asgari and Hoque quoted that global customers were becoming more time sensitive, that is apart from criterions such as competitive pricing and quality, a decrease in lead time was crucial in order to sustain customers. Hossain and Roy (2013) presented supply chain management as a key determinant in order to achieve sustainable growth in the garments industry in Bangladesh.[5]

2.3 Lean in Logistics

Lean Logistics focuses on optimizing operations at all levels of the supply chain through reducing waste which is a key factor for supply chain control. Through enhanced inventory and material management, cutting down on unnecessary steps in delivery, lean logistics can be achieved. Some unnecessary steps which are to be eliminated are as follows:

- **Minimizing stocks / eliminating excess inventory**
- **Minimizing transport of “air”(transportation resources should be filled as much as possible)**

A lean logistics approach is not a program or short-term cost reduction program. It is rather a way of operating to eliminate waste along entire value streams, where the ultimate goal is to provide a perfect value to the customer.

2.4 Four Principles of Lean Logistics

- **Specifying value:** Customer value is identified and added along the entire supply chain network.
- **Mapping out value stream:** Identify all the process in a supply chain network and determine all the non-value creating processes in order to eliminate them and create an efficient network. Value stream mapping enables identification of these gaps. This will portray areas where there are delays, locations of restraints and excessive inventories.
- **Creating a product flow:** Applying the above factors and making the value-creating steps occur in tight sequence. This will make the product flow smoothly towards the customer, all while minimizing interruptions, inventories and downtime.
- **Establishing customer pull:** A pull system is a production or service process that is designed to minimize on-hand inventory by working directly on the basis of customer demand. Goods are delivered as they are required by the customer. This is also known as a “Just in time” system, as it operates just in time in delivering goods when they are needed, instead of accumulating inventory. The pull system requires demand information to be available throughout the supply chain.

3. Methods

While implementing Lean Methodology to any process another improvement methodology that must be addressed is the Six Sigma; lean looks at ways to increase flow while Six Sigma focuses on achieving consistent results. Lean and Six Sigma Methodologies are usually applied together to improve the quality of product and customer experience by eliminating wastes and improving the process. In the logistics of the RMG industry the methodologies can be applied to obtain the maximum result and productivity.

3.1 Lean Six Sigma Logistics Practice

Six-sigma is another tool like lean, which brings discipline to logistics. These tools, when used in combination, can identify and deal with waste and other gross inefficiencies in an organization. It is a methodology that is used widely to eradicate defects, enhance processes, and minimize variations in any business process. The crux of the Six Sigma approach is built on eliminating wastes and thereby improving efficiency and quality. It also seeks to streamline and improve all the underlying processes. Six Sigma works on an extremely disciplined system of data collection and makes use of improved statistical tools. Hence, the Six Sigma approach can be very handy in our case if applied to logistics because such an approach can increase the satisfaction level of both external or internal clients and, in turn, can result in financial benefit for an organization.[2]

Lean six-sigma is an effective tool to make effective changes in a logistics process, which can be really challenging for an organization. It is based on a disciplined approach towards developing a culture that facilitates improvement. It allows choosing a few of the best possible solutions from a plethora of solutions available for the same problem. It ensures that the right decision is made in this regard so that the identified solution does not involve large investment or implementation cost. These solutions should also be tested thoroughly and their efficacy should be checked before they are cleared for implementation.

3.2 Wastes Degrading the Profitability of the RMG Sector & Addressing TIMWOODS in retrospect of RMG Logistics strategy of Bangladesh

Lean identifies eight areas of wastes in Transportation; Inventory; Motion; Waiting; Over processing; Overproduction; Defects and Skills or in short TIMWOODS; that are most common to any production system. Running an efficient business involves lean manufacturing, a waste-reducing method that affects production plans, manufacturing, and customer relations. Using the mnemonic "TIMWOOD" can help us reduce costs, increase profits, improve lead times, and boost customer satisfaction. If monitored closely these wastes could also be found specifically in the aspect of the logistics system of RMG or any industries in our country.



Figure:8 wastes of TIMWOODS

[<https://www.shmula.com/28695-2/28695/>]

3.2.1 Transportation (T)

Transports represent the largest share of direct logistics costs, and road transport is the dominant transport mode, Road transport rates in Bangladesh ranges from \$0.60 for a 16-ton truck to \$0.12 for a trailer. They are higher than in many developing and developed countries. Congestion and delays are pervasive problems across the national logistics system in Bangladesh, from road to sea ports and land ports. Congestions on roads alone doubles standard trucking costs. In addition, Bangladesh has its infrastructure in poor condition. Bangladesh's logistics system is fragmented in terms of both logistics infrastructure and services. The core infrastructure for all modes of transport is in place, but there is a lack of intermodal facilities, and now the few facilities that do exist are poorly operated.

3.2.2 Inventory (I)

Inventories are classified as products that the customers have not received yet, it could be the items in the warehouse; the works in process (WIP) and most importantly for us the products that are being transported. Lean logistics management can play an important role here in reducing transportation time of the inventory thus reducing the inventory waste.

3.2.3 Motion (M)

The trucks and carriers in Bangladesh for the RMG or even any other sectors are not equipped with digital forecasting systems like in-built GPS or SAT-NAV for forecasting fastest routes to take. As a result the workers in the transportation sector always take the route for their delivery they are used to and often end up getting stuck in congestion. This can be classified as a waste in logistics under the area of motion according to lean.

3.2.4 Waiting (W)

The lags and delays are a very crucial issue for the cargo transportation in Bangladesh, whether that is by road or by any other means. Traffic congestion in road & long queue for Ferry or toll –ways made up the wastes under the area of waiting in logistics. Moreover, nine ministries and more than 20 government agencies of Bangladesh play roles in setting policies and regulations, planning, operating infrastructure, and providing services. The fragmented governance of the logistics sector exacerbates the coordination problem intrinsic to infrastructure development, leading to transport modes that developed and evolved in silos and basic mismatches of infrastructure standards, such as bridges that are narrower than approach roads.

3.2.5 Over-processing (O)

The wastes under the area of over-processing in logistics management can be defined as the engagement of excess workforce in loading of products for transportation and other excess transportation related activities.

3.2.6 Overproduction (O)

High trucking rates due to inefficiencies in the transportation and logistics system, low truck utilization, extreme levels of congestion in roads and ports, and a large number of trips of empty trucks are the main causes. Truck owners count that 35 percent of the trips have empty trucks.

3.2.7 Defects (D)

Poor handling of products while transportation are one of the major reasons for defects in industry, thus wastes could be found in the area of defects for logistics.

3.2.8 Skills (S)

Instances of unprofessional behavior by logistics service providers. Most truck drivers are low skilled and illiterate. Lack of skill-training relating to modern warehousing (i.e. temperature-controlled transport & storage), cross-docking, inventory management, efficient customer service, cold chain, etc.

4.1 Challenges in the Air Cargo and its Solutions

Air cargo will be essential for shipping high value industrial export products but the present situation is unacceptable for any modern manufacturing economy. All **outgoing** cargo is stuffed inside the air-cargo terminal, where facilities are very crowded resulting delays, shipment errors & pilferage.

| Air Cargo Export and Import Tonnage at HSIA | | | |
|---|------------|---------|---------|
| YEARLY EXPORT (IN TONS) | | | |
| YEAR | PERISHABLE | DRY | TOTAL |
| 2015 | 43,376 | 157,184 | 200,560 |
| 2016 | 42,677 | 171,885 | 214,562 |
| 2017 | 37,127 | 185,299 | 222,424 |
| YEARLY EXPORT (IN TONS) | | | |
| YEAR | | | TOTAL |
| 2016 | | | 75,351 |
| 2017 | | | 109,453 |

Note: Calendar year Source: Biman Bangladesh Airlines



Figure: Air Cargo Export & Import Tonnage at HSIA

RMG factories & almost all industries are dependent on-air cargo imports. Garment factories receive samples, fabrics for testing, accessories, labels etc. through air-freight. But there are widespread complaints of harassment, trouble-making & demands by the authorities for goodies. For both import & export air-cargo the solutions are straightforward & using the private sector makes them easy to implement. The RMG sector needs such improvements immediately as there is minimal progress despite growing user complaints.

| | | | |
|------------------------|---|--|------------------------------|
| Short Term Plan |  | To Operate a High Ceiling Computerized Warehouse inside the Airport | Private Initiative |
| Long Term Plan |  | Air Freight in Biman | Government Initiative |

Figure: Short & Long-term plans for Air Cargo Logistics in Bangladesh

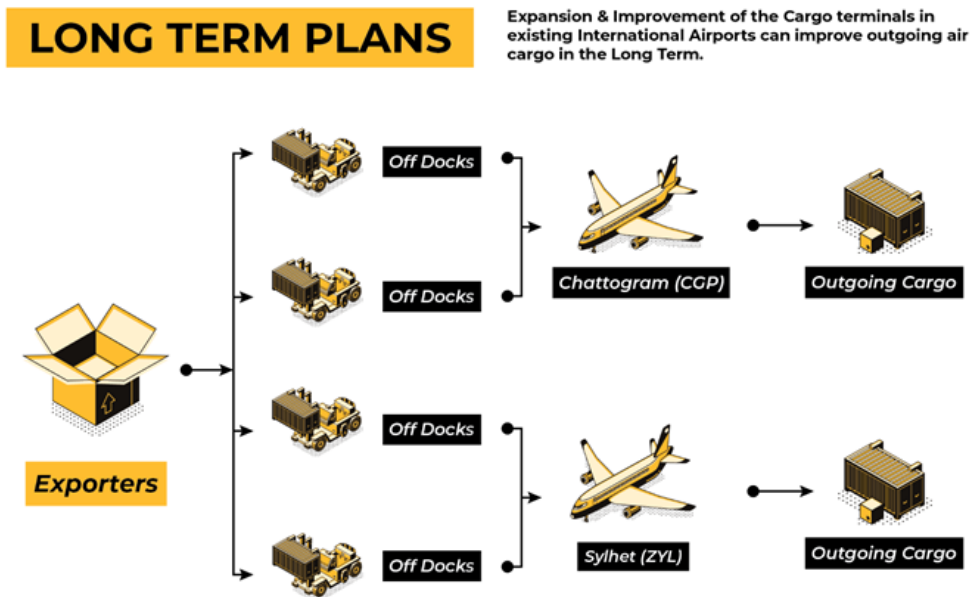
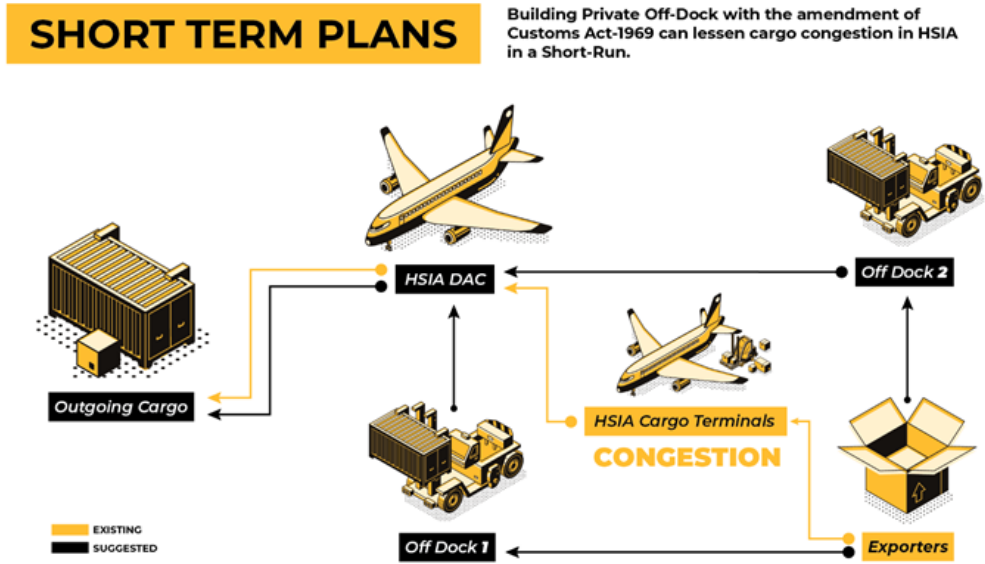


Figure: Short & Long-term plans for outgoing air cargo.

4.2 Challenges in the Land Port and its Solutions

Although Bangladesh had been a victim of yarn-dumping from India, with import prices quoted to be up to 30% lower than local production costs by India, before the COVID-19, domestic prices have since rebounded. Delivery time of fabrics now takes 7-10 days from the time an Indian truck joins the queue until the Bangladesh truck departs Benapole. This is an unacceptable situation for the crucial RMG sector. If there was no congestion in roads, logistics costs would be $\leq 7-36\%$ as well.

This situation calls for

- I. Construction of a larger parking space for incoming trucks, a warehouse facility, & proper warehouse management in the land ports.
- II. A building with a high ceiling to stack shipments using forklift will enable prompt storage of incoming materials. The Bangladeshi truck can come in on the other side of the warehouse to be loaded.
- III. Construction & management of the warehouse to be awarded to a private company that can finance & manage the warehouse & provide the facilities needed by the customs authority.

With proper warehouse facilities in the port the delay time can be reduced to 2 days with lower costs for transports & much greater speed of delivery. In the long run the government can plan to set up dedicated land port(s) since the trade with India plays a major role in RMG & other sectors. Close to the Benapole land port which is the prime-gate-way for the Supply Chain Logistics with India, enrouteBhomra; Darshana or the newly proposed Mujib-Nagar-Port can be implemented as a dedicated port(s) for commercial-trade only.

4.3 Challenges in the Sea Port and its Solutions

Single-port dependency on Chittagong & its high-charges with poor services deteriorate export-competitiveness. Currently, activities at Chattogram port, which handles 80 percent of the country's external trade, have come to a standstill as the number of import containers has exceeded the port's storage capacity. On 23rd May, 2020 the volume of import containers at the port reached 49,468 TEUs (Twenty-foot Equivalent Units) whereas it has a storage capacity of 49,019 TEUs. A bulk portion of import containers stuck at the port constitute raw materials for the RMG sector followed by other industrial raw materials. Resistance from local people is preventing entry and exit of trucks, eventually hampering transportation to and from factories in different locations across Bangladesh. As a remedy, Chattogram Port Authority (CPA) is trying to move some containers to private Inland Container Depots (ICDs) as an alternative measure to tackle the current situation. If the National Board of Revenue (NBR) permits, they will be able to transfer 15,000 TEUs.

This situation also calls for:

- I. Developing Chittagong Port as "Climate Resilient" against sea level rise (SLR) and land subsidence potential.
- II. Mongla Port needs to be fixed for certain products and necessary logistics must be ensured. Jetties could be solely dedicated for major export sectors, significantly RMG.
- III. Enhanced trade logistics through higher investments in order to raise competitiveness at export-level.
- IV. Explore Mongla and Payra ports and speed up Matarbari terminal construction which will enhance the port's container handling capacity.

5. Proposed Improvements

Lean Thinking is centered on a continuous cycle of looking for perfection through maximizing product value and eliminating waste. This process ensures that the customers do not have to pay for the organizational waste and lack of efficiency.

Recommendations:

There are four principles involved towards ensuring minimal waste. These are mentioned below-

- I. **Specification of value**- In this process, the value of the customer is specified and incorporated along the entire supply chain network.
- II. **Mapping of the value stream**-In this process, the value of processes along the entire supply chain network are measured and those processes are identified that do not add value to the product. The value creation and identification are done from the perspective of the customer.
- III. **Creation of a product flow**- Here, the factors identified towards assimilation of the valuable processes into the system are applied. These factors are – minimizing downtime, reducing interruptions and reduction of inventories.

- IV. **Establishing customer demand**– The demands from customers are given due importance while manufacturing a product. The demand information is processed and made available in all stages of the supply chain.

Each of these above-mentioned processes is perfected on a continuous basis so the product value is maximized and the waste is minimized.

6. Conclusion

Bangladesh's export revenue is highly dependent on the RMG sector and indeed in these pivotal episodes of Bangladesh economy, protecting the industry which contributes to the influx of billions of dollars should be prioritized. The government will have to take stringent steps to ensure better living standards for its garment workers and their survival as well as mitigate any bureaucratic shackles which will only hinder the growth. Thus, it can be concluded that through strengthening the supply chain capabilities of the RMG sector, it will create a ripple effect on other major export-oriented industries in enhancing their existing SCM and therefore aid the national economy as a whole. Observable changes derived from the pandemic concerning maritime transport networks include, for example a reduction in service frequency (blank sailings and idle fleet) and changes in routing affecting particularly Asia-Northern Europe services, a key axis in the trade of fashion goods. Shipping lines are reducing the number of ports calls in the maritime services they offer to adapt to declining demand and cargo imbalances.

This is likely to affect the liner shipping connectivity of sourcing countries both in terms of intercontinental as well as intra-regional feeder calls and, if this situation persists, could make economic recovery even harder. The fashion industry is undoubtedly under pressure in these uncertain times. Depending on the role that countries play in the supply chain, building resilience could entail different needs and approaches. About the logistics business in Bangladesh, the dominating subsector is the freight transport services sector. It is worth mentioning that Bangladeshi export-related logistics especially that of garments and textile, are operationally advanced while the rest of the logistics sector in Bangladesh is unsophisticated.

Various studies identified several subsectors in this area evident in Bangladesh, such as (1) wholesale trade services; (2) retail trade services; (3) freight transport services; (4) cargo handling services; (5) storage and warehousing services; (6) postal and courier services; and (7) 4PL. In the context of Bangladesh, rail and road freight are major segments for inland services. Shipping freight's share in the export and import business in Bangladesh stands at 80%, while that of air and road is 20%. In general, logistics companies provide transport services of freight through sea, road and airways. However, the rail transport of freight for exports and imports is yet to be introduced in Bangladesh.

References

- [1] A. T. M. Mohibullah, U. M. Takebira, S. A. Abir, and F. Jannat, "The consequence of backward linkage of RMG sector in Bangladesh - An overview," *Am. Sci. Res. J. Eng. Technol. Sci.*, vol. 26, no. 4, pp. 169–185, 2016.
- [2] S. Hasan, G. Khan, M. R. Hoque, F. Hassan, and N. Ahmed, "Lean practices in the Bangladeshi ready-made garments industry and global significance," *Int. J. Logist. Res. Appl.*, vol. 0, no. 0, pp. 1–19, 2020, doi: 10.1080/13675567.2020.1847262.
- [3] "Artigo - 2002 - Effective Lean Logistics Strategy for the Auto Industry.pdf." .
- [4] M. Farhan Shahriar, "A Research Framework of Supply Chain Management in Ready Made Garments Industry of Bangladesh," *Int. J. Bus. Econ. Res.*, vol. 3, no. 6, p. 38, 2014, doi: 10.11648/j.ijber.s.2014030601.16.
- [5] A. Y. Chowdhury and M. Habib, "Use of Collaborative Plan in Supply Chain Management: A Case Study on Bangladesh Readymade Garments Industry," *Int. Supply Chain Technol. J.*, vol. 3, no. 12, 2018, doi: 10.20545/isctj.v3i12.128.

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