

# Rethinking Global Supply Chain Management in a Changing Environment to Develop an Integrated Freight Transportation System in Bangladesh

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**Received** December 10, 2023, **Accepted:** December 20, 2023, **Published Online:** December 31, 2023

**Reviewers:** Anonymous Peer Review

**Citation:** Sabur, H M A., 2023. Rethinking Global Supply Chain Management in a Changing Environment to Develop an Integrated Freight Transportation System in Bangladesh. *International Journal of Supply Chain Management*, 12(6), 39-56, <https://doi.org/10.59160/ijscm.v12i6.6217>

**Abstract**— Global supply chain management has been a critical aspect of the international business community for decades. With the rapid growth of globalization, companies have been expanding their businesses to different parts of the world, establishing cross-border partnerships and operations, and relying on global trade for their success. In recent years, the environment in which these supply chains operate has undergone significant changes. The COVID-19 pandemic, changes in government policies, and fluctuations in global trade and investment have created a more complex and challenging landscape for companies to manage their supply chains effectively. This has resulted in a need for companies to rethink their supply chain strategies, especially in developing countries such as Bangladesh. The study employs qualitative research methodology to develop an integrated freight transportation system in Bangladesh just after the changing environment of supply chain management due to COVID-19, geopolitics, and other negative impacts that brought supply chain risks/disruptions in the global freight movement from/to Bangladesh through Bangladeshi seaports. The findings of the research brought the transportation disruptions that lead to problems like operation shutdown, lost sales, late deliveries, and reputation loss remarkably. River transport emerges as the overwhelmingly preferred mode, presenting a substantial 60% of the respondents' choices whereas rail mode is only 30% but rail offers advantages in terms of efficiency and cost-effectiveness to make it a strong candidate for transporting goods. Furthermore, 41.58% of respondents expressed the view that COVID-19 has significantly disrupted various activities, including the global supply chain and shipping trade. The purpose of this research is to provide a comprehensive analysis of the current state of global supply chain management in Bangladesh

and to identify ways to enhance the country's integrated freight transportation system. This research will examine the existing infrastructure, policies, and practices, and suggest mechanisms for improving the efficiency and competitiveness of the supply chain in Bangladesh.

**Keywords**— *Global Supply Chain Management, COVID-19 Pandemic, Qualitative Research, Freight Transportation System, Efficiency and Competitiveness.*

## 1. Introduction

The World Commission on Environment and Development-WCED has identified that transport is one of the main causes of pollution that exceeds limits due to the non-movement of environmental programs or not being implemented on time and seriously [1]. COVID-19 is an extraordinary event that affected the total global supply chain and was denoted as a novel challenge for decision-makers in ensuring sustainability to run global trade timely and economically [2]. Global supply chain management has been a critical aspect of the international business community for decades. With the rapid growth of globalization, companies have been expanding their businesses to different parts of the world, establishing cross-border partnerships and operations, and relying on global trade for their success. However, in recent years, the environment in which these supply chains operate has undergone significant changes. The COVID-19 pandemic, changes in government policies, and fluctuations in global trade and investment have created a more complex and challenging landscape for companies to manage their supply chains effectively. This has resulted in

a need for companies to rethink their supply chain strategies, especially in developing countries such as Bangladesh.

Nowadays, international shipping companies are seeking cooperation and interacting with the port authorities, governments, and others to remain abreast of advancements in the sector and generate new prospects for expansion, establishing efficient supply chain networks and utilizing the resource for providing a complete logistics solution to the port users that is not limited to port premises [3]. In the last 50 years, supply chains have seen dramatic changes because of new technologies in manufacturing, transport, logistics, and communication that are sparked by international economic regulations related to trade liberalization [4]. In the context of Bangladesh, the movement of freight from the international area to seaports is commendable, and port handling meets high standards. However, further inland movement faces significant challenges due to the shortage of transport nodes, integrated intermodal connectivity, and global standards of freight vehicles such as trucks and covered vans. In addition, the working environment of freight handlers especially drivers are not gathered healthy environment to retain in this profession. So, standard systems including quality vehicles and professional human resources are required to develop an integrated freight transportation system in Bangladesh.

The freight transport system of a country is a major pillar of its economy that contributes to international trade timely and economically [5]. They examined that an efficient freight system is also vital for improving trade and the quality of life in a society. Freight transportation is very important for the economy and it gives corporations the ability to specialize in predicting the products for which they are best suited and trade with other companies to obtain products that can be made more efficiently by others [6]. The great realization of inland freight transport management is the modal shift as the most popular freight actions include a shift from road transport to rail or inland waterways, freight efficiency improvements by the intermodal system, and efficiency improvements of freight vehicles by using modern engines and fuels. In supporting the global supply chain, it is indispensable to decrease product costs and further transport costs for entering new markets avoiding additional complexity in the scattering of value chains. A

Researcher has explored that day-to-day operations of freight transport are commonly viewed in the private spheres with less attention given to issues of governance [7].

Transportation disruption leads to problems like operation shutdown, lost sales, late deliveries, and reputation loss [8]. The structure of the paper started with an introduction that was followed by research methodology. After that one conceptual framework is to identify the variables, key factors, and terms in developing the paper purposely. An extensive literature review is conducted in Section 4. The most important section of this paper is a qualitative data survey that is advertised to 300 people available in this trade locally and internationally where 101 people have participated happily. To follow the research gaps in the literature review and qualitative survey data analysis, Section 6 is developed to articulate major findings and their further discussion that resulted in future directions in the next Section before the Conclusion.

Organizations and their supply chains are competing globally becoming complex, and uncertain business environments are looking unfortunately [9]. Here, supply chain operations have profound implications on organizational performance that are critical to the established strategies and trouble to implement timely and accurately. Industrialization in post-war economics and rapid globalization adage to control costs in many industries including the production and manufacturing of the fashion industry [10]. Bangladesh's global supply chain is highly developed to support the fashion industry by importing raw materials and exporting finished products where integrated freight transportation is playing a vital role by centering the principal seaport Chattogram Port. However, the foremost change that is expected to see, is a rather paradoxical co-evolution of surveillance and collaboration [11]. The purpose of this research is to provide a comprehensive analysis of the current state of global supply chain management in Bangladesh and to identify ways to enhance the country's integrated freight transportation system. This research will examine the existing infrastructure, policies, and practices, and suggest mechanisms for improving the efficiency and competitiveness of the supply chain in Bangladesh.

## 2. Research Methodology

This research applies qualitative research methodology to develop an integrated freight transportation system in Bangladesh just after the changing environment of supply chain management due to COVID-19, geopolitics, and other negative impacts that brought supply chain risks/disruptions in the global freight movement from/to Bangladesh through Bangladeshi seaports. Logistics has become a delicate function due to COVID-19 and affected the industry as logistical support or services have been interrupted resulting in a decrease in the manufacturing industry and delivery time frames have been extended dramatically [9]. However, research brought the good news of the quick recovery of major economies in terms of logistical snags from the pandemic-induced economic decline [11]. Therefore, it is essential to rethink global supply chain management and support it by developing integrated freight transportation systems.

The initial phase of this research involves conducting an extensive literature review, following a conceptual framework that articulates the variables related to the research subject. The second or last part is to do focus group discussions in two major cities Dhaka and Chattogram Bangladesh before setting the qualitative research questionnaire to get the opinions of respondents in shaping the global supply chain where freight transport is considered a priority subject other than any other activities of supply chain management. The recovery from COVID-19 is being delayed due to the Russia-Ukraine invasion and, the financial crisis in Bangladesh where the central bank reserve is going down resulting in making slow Letter of Credit (L/C) as well as low performance in the principal seaport Chattogram Port.

## 3. Conceptual Framework

This section is developed to elaborate on the concept of global supply chain management and its relation to freight transportation systems, addressing global challenges and devising strategies to sustain competitiveness in the business world. Two researchers argue that rethinking the supply chain strategies is compulsory to enhance organizational performance and associated results to stay in business and compete in the new global market challenges [9]. Two important points are delivered by a study, firstly, ports that account for

sea level rise and extreme weather events to protect the cargo and container and safe berthing of the vessels, and lastly, to ensure that a certain share of goods is transported via rail or waterways as a modal shift to the environmentally friendly freight transportation system's utilization [4]. A researcher argued for governance in the freight transport sector to maximize economic welfare that must include not merely the formal governance arrangements but also the ability and willingness to apply suitable instruments to regulate the market [7]. On the other hand, it was also discovered that freight transportation planning endeavors to help the public sector in evaluating policy outcomes designed to minimize negative impacts on the environment and promote the sustainable use of natural resources, without hindering economic growth [5]. Table 1 shows the keywords and terms of sustainability for the global supply management related to the freight transportation system of a country. Abbood and Ferenc conceptualized the sustainability of the global supply chain figured the words of freight transportation functions including environmental, economic, and social impacts [6].

*Table 1: Concept Development in Freight Transportation in Global Supply Chain Management (Abbood and Ferenc, 2022)*

Topic	Key Words and Terms	Remarks
Exploring Freight Transportation Systems and its sustainability in global supply chain management	Freight Transportation.	Conceptual
	Sustainable Transportation.	
	Sustainable Freight Transportation.	
	Sustainable Freight Transportation and Environmental Impacts.	
	Sustainable Freight Transportation and Social Impacts.	
	Sustainable Freight Transportation and Economic Impacts.	
Economic Impacts		

	of Freight Transportation.	
	Environment Impacts of Freight Transportation.	
	Social Impacts of Freight Transportation.	

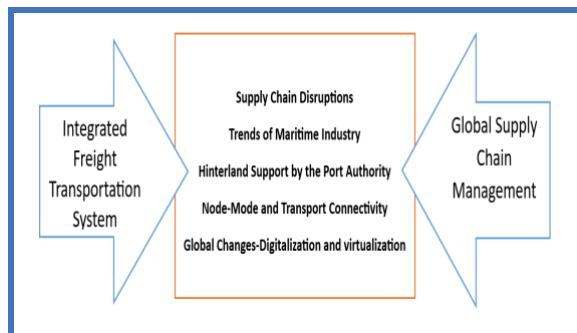


Figure 1: Conceptual Framework developed by Author.

As per above Figure 1, it is seen that an integrated freight transportation system will develop the global supply chain management by considering the key variables of supply chain disruptions (see more in subsection 6.3 and Figure 6), trends of the maritime industry and its inland connectivity also new learnings in managing COVID19 by applying digitalization and virtualization (Details are in Literature Review).

#### 4. Literature Review

This Section of the Literature Review has 6 subsections that start reviewing the literature to learn about a new era of global supply chain management and traditional systems. Just after this focused on the maritime transport and shipping industry imposed by IMO to make a process for decarbonization and targeted a net zero emission by 2050. Among the disruptions that are faced globally is COVID-19 voiced in Section 4.3 and its changes in Sub-section 4.4. A new normal or stable scenario is visible in the seaports, inland nodes, and also the transport connectivity that was reviewed in Sub-section 4.5. Lastly, the Sub-Section tried to find the pieces of literature on integrated freight transportation systems by linking them with global supply chain management.

#### 4.1 A New Era of Global Supply Chain Management and Traditional System.

Some researchers observed that in the post-COVID-19 era, many restrictions have emerged like travel restrictions, physical distance, and social lockdown [12]. Further research has detected an unprecedented reduction in cost, improved efficiency and response, and an expanding geographical extent of business with third-party logistics [13]. However, Bangladesh has little to no practice of third-party logistics despite the countries like USA, Australia, the UK, India, and Malaysia doing it successfully. Third-party logistics ensures an increase in productivity, reduction of logistics costs, boosting employee morale, and customer satisfaction. Connectively, digitalization is one of the most efficient keys due to the uprising Artificial Intelligence intervention [14]. The study is focused on procurement and the procurement process is one of the most supporting sectors of the supply chain. Sustainable performance does not affect cost performance. To follow the law of procurement, it can be used as a guideline to make supply chain policies in the least developed countries [15]. The traditional supply chain was cost reduction-centric; however, the long supply chain is focused on the right time delivery ensuring the quality of the product [16]. The research found that the core of supply chain strategy is Time and Place utilization [17]. Electrification of the supply chain tool does not increase the efficiency rather the interaction of the enterprise with those does [16]. Supply chain risk is denoted as a macro (Natural or Man-made disaster) and micro risk (Manufacturing risk, supply risk, demand risk, and infrastructure risk) [18]. It also explored that a good relationship between customer and supplier provides a positive impact against the supply chain risk.

Two researchers have defined freight forwarding as a third-party activity where buyers and sellers are outsourcing the shipping activity of goods to any third-party logistics service provider [19]. The research found major 5 key factors that are causing disruption and those are- corruption in customs, gasoline-related issues, infrastructural bottlenecks, political unrest, and machine breakdown [8]. Supply change is based on key parameters like energy cost, raw materials, and currency exchange rate [20]. Resilience, reconfigurability, and responsiveness are now standing above the traditional supply chain key factors like cost,

quality, and delivery [21]. Network complexity has a significant adverse impact on Supply Chain Management [22]. MacCarthy et al. argued that no one supply chain management system can be fixed for all types of enterprises rather a market at least needs two fundamentally different supply chains [23]. Supply chain management plays a role in the enhancement of productivity and profitability [24]. Technology and Innovation, Economics, Market Competition, Policy, and Regulation are the factors influencing supply chain evaluation. The supply chain stays balanced if the four factors- financial, customer, internal business processes, and innovation and learning perspectives stay balanced [23].

#### ***4.2 Maritime Transport and Shipping Industry: Process for Decarbonization.***

The major concern in the supply chain of port logistics management is the lack of information sharing externally and internally [25]. The transport system has been influenced by factors like environmental, historical, technological, political, and economic [26]. Freight transportation for the smart world needs two quality-efficient transportation and transshipment solutions. It was suggested that the transports be planned to fulfill efficiency, effectiveness, and equality then a proper evaluation can be presented to the policymakers to make prudent decisions based on the response of stakeholders [27]. In ocean-going vessels, speed and accuracy are the key factors in the evaluation of service quality discovered by research [19]. However, it was observed that mega ship does not reduce the cost [28].

Optimal ship size depends on the transport segments, terminal type, trade route, and technology [17]. Moreover, air freight is mostly chosen when the product is highly valued but when the bulk shipment is in the process then the ocean freight is the first choice of the enterprise. The positive influence of tangibility, reliability, and responsibility are the key factors that directly influence customer satisfaction [19]. It was shown that sustainable development in the transportation system mainly evolves around their particular facts-environment, economy, and society [29]. A rating system should be introduced to evaluate the sustainable transport system- there is already existing few like green rating system and infrastructure-based decision-making is also necessary if it is considerable in the place. The

main research gap is the process and steps to be taken by the Bangladesh government in this context.

#### ***4.3. COVID-19 and Supply Chain Management: Digitalization to See Virtualization.***

Fortune Magazine reports that 94% of the Fortune 1000 companies have been affected by COVID-19 [30]. In this connection, COVID-19 is denoted as the Black Swan that disrupted the supply chain [31]. The supply change management concept arose only 30 years ago and has made rapid progress over the years [20]. The industry has three integrated companies: procurement, production, and distribution [32]. It was also defined that the distribution process has been organized into four levels namely production level (Plants), regional distribution level (Warehouse), customer level (Last mile delivery), and real-time management level [32]. The heart of freight transportation is the marketplace, reliability, cost competition, time, and demand response [28]. An example of Dell's recent air-to-sea freight shipment change strategy has resulted in a massive cost reduction [17]. The supply chain is not static rather it changes and evolves in size, shape, and configuration along with the way its management [23]. However, competition in the future will not be between individual enterprises but between competing supply chains [16].

#### ***4.4 Global Changes Just After COVID-19: A New Normal.***

COVID-19 has raised more issues like shortage of parts and materials, delays in transport, planning, and difficulty in production along with questions on reliance [12]. Negatively, Japan's earthquake and Thailand's flood natural disasters have impacted the global business majorly [33]. In 2019, COVID-19 has also disrupted the supply chain process all around the world and significantly affected trade across countries. However, it was explained that global environmental change in most detail including the change in Earth's climate change, ecosystem change, and biodiversity change are the major environmental changes taking place [34]. Indirect factors like genes, spices, water balance, ocean chemistry, and extreme weather are the indirect influencers. These global changes also influence the emergence of diseases that are

harming people directly and indirectly. Among those major diseases, the most devastating epidemics are COVID-19, Ebola, Nipa Virus, and Monkey Pox. This epidemic has something in common which is the change in the condition of human interaction with nature. Also, the impact on people due to this pandemic is not a new thing, it was always there and will be. Therefore, it is important to regulate human activity to prevent it. Supply chain strategies should be applied to ensure a more robust impact for recovery. This can single-handedly remove the post-COVID-19 disruption [31]. It was noted that global supply chain risks arise from natural disasters, war, terrorism, Fire accidents, economic and political instability, social and cultural grievances, and decrease in the post-COVID-19 era [35]. The research identified 30 global risks and categorized them into five different levels - economic, environmental, geographical, societal, and technological risks. Also, this risk has strong dependencies and frequently comes with another or more risks [36]. In a time of supply chain disturbance, research emphasized to maintain good relationships with the supply chain partners [22]. There should be a contingency plan like emergency funds to rebuild the supply chain structure or restore manufacturing facilities or supplier capacities in the post-COVID-19 era to strive against bad destiny [24].

#### ***4.5 New Scenarios of Seaports, Inland Nodes, and Transport Connectivity.***

The disintegration of ports, railways, and inland container depots and terminals is also putting logistical challenges on the Dhaka-Chattogram corridor [13]. However, the government is in the process of approving the integrated multi-modal transport policy for making an integrated freight forwarding system through road, rail, and inland water transports. In terms of such freight movement in the passage, last-mile delivery metro can be used in Ecuador- metro stations can be used as pickup and delivery points [33]. In this last-mile delivery, the stakeholders are the cargo transport costs, delivery time, and the passenger service level. The data was always available but the inefficient use of that and non-integration of data led to this disruption as well. As a result, technologies have increased supply chain objectives more than before the COVID-19 period [33]. Research findings show that Big Data will analyze every product and the AI

will make all the decisions instead of humans [14]. A study assessed the leadership in transformation in the supply chain industry with information Technology where the result is astonishing that the transformed leaders are very much into the improvement of the wireless IT Capacity [37]. Unexpectedly, transportation disruption comes when the flow of delivery interacts from one node to another of a supply chain [8]. Sea-worthy Containers, Special equipment like Tracks, container availability, additional digital infrastructure, and shipment tracking physical facilities along with staff sufficiency all together contribute to the service quality [19]. The paper-based system promotes inefficient control, the scope of fraud and forgery, and failures, along with many disputes which can be reduced with the integration of the Blockchain [25]. Notably, a study argued that transport information systems should stay in place [38]. The need for large-scale plants has become obsolete and isn't necessary for sustainable returns [20].

#### ***4.6 Integrated Freight Transportation Systems.***

The railway network between Bangladesh and India was restored. Nepal is also planning to extend its railway network to West Bengal and an extension to Assam and Bhutan [39]. A researcher was discussing low-carbon transportation and green logistics to emphasize the importance of using low-carbon techniques [40]. The development of low-carbon solutions faces challenges related to various factors such as social, and economic development, environmental issues, and technology. In this context, it is essential to employ multi-criteria decision-making for a successful launch. In terms of designing the multi-modal transport system, the factors affecting the transport system should be considered [38]. Research has been conducted on the four-way multi-modal plan through bus, train, air, and walking freight transportation where in many countries they use one or two modes of transportation while taking cargo inland [41]. However, vulnerabilities like storms can affect this kind of system. Freight carriers should have a few characteristics like being economically efficient, and operationally flexible along with reliable and high-quality services [32]. Smart logistics management should be put in place which includes auto identification tags, sensors for real-time data gathering, and an environment for real-time data

sharing [26]. To ascertain the assets, a study introduced the concept of “do more with less” which prioritizes the utilization of existing assets [28]. Carrier corporations have to manage the process with complexity, variability, flexibility, and collaboration [16]. Technology companies are moving towards airfreight as the products are lightweight, and valuable compared to the charge of air freight [31]. Having employees with better functioning skills than general management skills is the most effective solution for risk management of freight transportation providing enterprise [24].

### 5. Qualitative Data Analysis

This section analyzes 10 research questions that were compiled from the 101 respondents (**Details are in Appendix 2**) in the field. To follow the qualitative research method, a set of questionnaires (**See Appendix 1**) was developed to reach at least 100 respondents at home and abroad and received 101 responses. Details are articulated before going to the next sections of major findings and discussions.

#### 5.1. Preferred mode for managing inland transport for doing international shipping in Bangladesh.

Table 2: Mode choice by port users for international shipping.

Mode	Rail	Road	River	Air	Pipeline	Total
Response	40	26	29	4	2	101
Share in Percentage	39.60	25.74	28.71	3.96	1.98	100.00

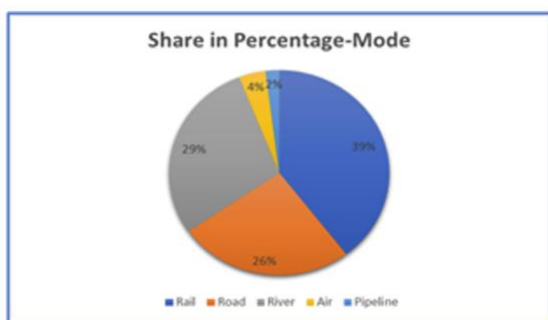


Figure 2: Mode choice by port users for international shipping.

The pie chart in Figure 2 depicts a comparative analysis of preferred modes for managing inland transport for international shipping in Bangladesh, based on responses from 101 respondents (as per Table 2) who contributed happily. Firstly, Rail transport emerges as the overwhelmingly preferred

mode, presenting a substantial 40% of the respondents' choices. This preference reflects the significant reliance on railways for facilitating international shipping cargo transport in Bangladesh. Secondly, River transport follows as the second most favored option, with a notable approximately 29% share. The river offers advantages in terms of efficiency and cost-effectiveness to make it a strong candidate for transporting goods. On the other hand, Road transport, though with a smaller share at approximately 26%, remains relevant, often chosen for its accessibility for last-mile delivery.

Furthermore, Air transport has a minimal representation, with approximately 4% of respondents favoring it. This suggests limited use for inland international shipping, possibly due to higher costs. Finally, Pipeline transport shows no preference, also at approximately 2%, indicating a lack of implementation in the context of inland international shipping. In summary, the chart reveals a clear hierarchy of preferences with Rail transport leading, followed by River, Road, and a very minimal preference for Air. Pipeline transport does not feature as a preferred choice mostly. This data is instrumental for stakeholders and policymakers in optimizing Bangladesh's transportation infrastructure for international trade.

#### 5.2. Mostly disrupted place in doing shipping trade in the last 5 years in Bangladesh.

Table 3: Disrupted areas for international shipping.

Disruption	COVI D-19	Seaport	Russia-Ukraine Invasion	L/C Management	Financial Crisis	Remarks
Response	42	19	15	22	3	101
Share in Percentage	41.58	18.81	14.85	21.78	2.97	100.00



Figure 3: Disrupted areas for international shipping.

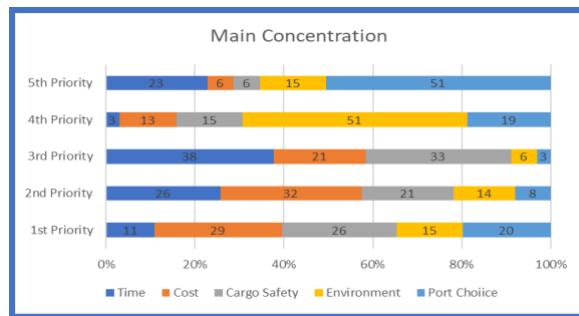
The provided bar chart in Figure 3 outlines disruptions in international shipping across various sectors in Bangladesh over the past five years, drawing on insights and causal factors for the supply chain as risks. Notably, COVID-19 (See Table 3) emerges as the predominant disruptor, commanding a substantial 42% share. This underscores the profound repercussions of the global pandemic on international shipping, causing widespread disruptions in supply chains, workforce, and logistics. Following closely are L/C Management disruptions, constituting a smaller yet noteworthy share of 22%. In contrast, Seaport disruptions account for a comparatively minor approximately 19%, indicating localized challenges in seaport operations.

The disruptions attributed to the Russia-Ukraine Invasion are marginal, contributing to approximately 15% of the total, signifying a limited impact on international shipping in Bangladesh relative to other factors. Notably, the Financial Crisis exhibits a negligible impact at approximately 3%, suggesting stability in the financial aspect of international shipping in Bangladesh. In summary, the bar chart underscores the overwhelming impact of COVID-19 on international shipping disruptions in Bangladesh, with L/C management issues, the Russia-Ukraine invasion, Seaport challenges, and financial crises exerting relatively smaller or negligible effects. This data serves as valuable input for stakeholders and policymakers to assess and address the most critical challenges within the industry.

**5.3. Concentrations in doing import-export trade in Bangladesh.**

*Table 4: Main Concentration in doing import-export trade in Bangladesh*

Main Concentration in doing import-export trade in Bangladesh					
Indicators	1st Priority	2nd Priority	3rd Priority	4th Priority	5th Priority
Time	11	26	38	3	23
Cost	29	32	21	13	6
Cargo Safety	26	21	33	15	6
Environment	15	14	6	51	15
Port Choice	20	8	3	19	51



*Figure 4: Concentrations in doing import-export trade in Bangladesh.*

According to the chart in Figure 4, the report implies the key concentrators for import-export trade in Bangladesh focusing on 101 participants. The participants have given relatively moderate importance to “Time” in import-export trade while “Cost” holds the priority in comparison to other factors like “Cargo Safety”, “Environment” and “Port Choice”. Table 4 shows that cost is the most crucial factor for the participants in import-export trade, as it holds the 1st rank in the top 2 priorities (1st and 2nd) which has approximately 50% impression. This indicates that the participants consider cost-effectiveness and financial aspects as their top priority. On the other hand, Time is of moderate importance to the participants, with 2nd ranked and weighting value is 38%. In addition, “Cargo Safety” holds a significant consideration in their import-export activities with 3rd ranked. Besides, the environment is also of moderate importance, ranked 4th. This suggests that participants are concerned about environmental factors but may not prioritize them as highly as cost, time, or safety. Interestingly, port choice is the least important factor according to the survey participants, with a 5th rank which could imply that while participants consider port choice, it is not their primary focus when engaging in import-export trade. Overall, the survey results reveal that participants in import-export trade in Bangladesh prioritize Cost the most, followed by Time, Cargo Safety, Environment, and finally Port Choice. This suggests that while various factors play a role in their decision-making process, financial considerations are the dominant driver.



#### 5.4. Factors behind the development of freight transport systems.

Table 5: Factors behind the development of freight transport systems.

Indicators	Rank -1	Rank -2	Rank -3	Rank -4	Rank -5
Environmental	11	24	16	11	39
Historical	18	22	24	23	14
Technological	33	14	28	22	4
Political	15	29	14	23	20
Economic	24	12	19	22	24



Figure 5: Factors behind the development of freight transport systems.

Table 5 indicates the importance of technological development in setting the freight transportation system where the least consideration is given to environmental issues (39 respondents). The bar chart in Figure 5 shows the 2nd priority of economic factors because cost reduction in the supply chain or freight transport will add profit to the business significantly. Respondents also prioritized the factors of political and historical that affected the performance of transport management seriously. Historically, port users like to go to Chattogram Port for international trade. In addition to these political disturbances such as strikes, blockades, and others are causing the full stop of cargo movement, highly negative factors for a smooth supply chain or freight transport locally.

#### 5.5. Barriers to developing environmentally friendly freight transportation systems in Bangladesh.

The primary challenge in establishing an eco-friendly freight transportation system in Bangladesh is the lack of collaboration among

involved parties. The Bangladesh Inland Water Transport Authority (BIWTA) holds significance, and without effective coordination, the navigation of inland waterways connecting seaports becomes flawed. Excessive traffic and non-compliance with traffic rules contribute to the environmental drawbacks of the transportation system. Disorder stemming from poor law and order further adds to the chaos within the Freight Transportation System (FTS). The cumbersome government system, which is slow and not user-friendly, hinders transport providers from obtaining certificates until accidents occur. Business groups perpetuate this cycle, and financial constraints impede companies from upgrading their trucks and vans.

The transport industry in Bangladesh faces several hurdles hindering the development of sustainable freight systems. These include issues like inadequate infrastructure, policy limitations, low awareness, coordination problems between transport modes, insufficient skills, limited research, and education in eco-friendly transportation. Additionally, there's a lack of standardization, minimal networking, inadequate financing for green logistics, and a gap in cultural leadership in the transportation sector. Overcoming these challenges requires a thorough, cooperative effort involving government entities, private businesses, and other stakeholders to promote an eco-conscious and effective freight transportation network in Bangladesh.

#### 5.6. Pathways to overcome the barriers to integrated freight transportation systems.

Meeting with stakeholders is one of the most suitable ways to mitigate these barriers. Regular monitoring of BIWTA can make the citation far better. As navigation is influencing the environmentally friendly transportation system, BIWTA should also focus on dredging in the inland waterways along with channels. Implementation of a proper traffic system can also influence the corporation to maintain the regulations properly in the waters and roads. However, before that, proper legislation, guidelines, and regulations are to be made. Based on that, the government officers have to be efficient and user-friendly to provide clearance and certification. Also, proper checkups by them should be maintained at periodic intervals. The transport authorities should give their sight in the control of fuel price so that proper fuel standards are maintained. As there is a lack of

finance in the transport companies, so, it will ease their burden in the compliance of proper fuel regulations. Also, if the government can ease the foreign currency trade system, then foreign investment will come as Bangladesh is a booming economy. With these funds, companies could replace existing conventional trucks and covered vans with modern freight vehicles. Modern vehicles are more environmentally friendly than traditional ones because of their option of using alternative fuels.

The transportation industry needs to invest in and maintain infrastructure such as inland waterways, railways, and terminals to prevent deterioration and disruption. Additionally, a policy framework must be developed to support environmentally friendly freight transportation systems. This includes reducing emissions and improving efficiency, as well as penalties for breaking environmental regulations. Education is necessary to increase awareness and provide incentives for green logistics practices and technologies, and financial support is needed for green innovation and investment. Multimodal integration and coordination of freight transportation networks can be achieved by constructing and strengthening multimodal terminals and corridors and improving communication among stakeholders. Top-notch education and training programs are required to equip the transportation workforce with the necessary skills to operate and maintain environmentally friendly freight transportation systems.

### ***5.7. Factors influencing to do cross-border trade in Asia.***

Bangladesh should use its currency besides USD through bilateral agreements to facilitate foreign trade in the neighboring countries in Asia, especially in South Asia and Southeast Asia. Besides that, a One Stop Solution for Customers on both land and sea has to be organized. So that they have to face less complexity in the trades. Bar Codes Scanning System Develop, Paper Less Trade can be included to ease all the documentation processes along with easy access to ports with minimal requirements for the countries who are already in the Trade Agreements. Special Trade Agreements or regional cooperation access can be introduced to build better trade relations with neighboring countries. Reduction of Tariffs and duties from other countries can also influence

cross-border trade. Joint ventures in developing new port infrastructure can provide trustworthiness in the port's work and that also can influence the increase in trade. A separate jetty is needed to be developed in the Mongla Port and that can be built with a cross-border agreement and for any specific use based on that country's requirements. As Japan exports it's all its cars to Bangladesh through the Mongla Port, they can jointly build this infrastructure to facilitate their favorable conditions and setups.

Bangladesh needs to focus on improving its connectivity and infrastructure with its neighboring countries such as India, China, Myanmar, and Nepal, including roads, railroads, canals, ports, airports, bridges, border posts, customs facilities, and telephones, to increase trade efficiency, competitiveness, and regional integration. Trade facilitation and cooperation also need to be enhanced with its neighbors, including standardizing and streamlining trade procedures and documentation, reducing tariff and non-tariff barriers, establishing mutual recognition agreements, promoting transit and transshipment arrangements, and settling trade disagreements. Additionally, Bangladesh should diversify its export products and markets beyond traditional strengths in readymade clothing, textiles, leather, jute, and agricultural products to include rising industries such as shipbuilding, light engineering, plastics, information technology, engineering, and medicines. Leveraging regional value chains and fostering people-to-people ties are also crucial for Bangladesh to benefit from local value chains, increase productivity, competitiveness, and value from trade, and create new opportunities for economic collaboration.

### ***5.8. Avoiding physical presence at seaports/inland nodes in clearing cargo***

Automation is one of the key processes that can be introduced to avoid physical presence at the seaports and inland nodes to clear cargo. However, the Internet of Things (IoT) can also be implemented to make total automation. Few suggested to implement a one-window system so that everything can be controlled from one space and single entry. However, the concern arises in transparency and accountability. Blockchain technology is suggested to keep that transparency intact and accountability proof.

To avoid physical presence at seaports and inland nodes when clearing cargo, digital platforms and technologies can be utilized to enable online and paperless customs clearance processes. Electronic data interchange (EDI) systems can be employed to electronically communicate customs-related documents and information between different parties involved in the process. Single window solutions can be used to provide a single point of entry for submitting and processing the required data and papers for customs clearance. Blockchain technology can enable a secure and transparent record of the origin, ownership, transportation, and status of the cargo, as well as the payments and clearing transactions between the authorized parties. Remote container inspection, utilizing X-ray, gamma-ray, or neutron scanning, can allow customs officers to inspect the cargo inside containers without physically opening them. Approved economic operator (AEO) schemes can offer reputable shippers and carriers specific benefits during the customs clearance process. Pre-arrival processing technology can enable shippers and carriers to manage and submit the required documentation and information before the cargo reaches seaports or inland hubs. These methods can reduce traffic, line-ups, and direct physical contact at seaports and inland hubs.

#### ***5.9. Global standard supply chain in Bangladesh for doing international trade.***

Close working with stakeholders is the most important standard to be followed if a global supply chain in Bangladesh for international trade is in thought establishment. Supply chain collaboration with government authorities and national stakeholders primarily should be ensured. Moreover, all the business ethics have to be on point. No bribes or preferential treatment should be provided to any business group based on biases. The global standard cannot be achieved with old technology. Conventional trucks and covered vans have to be reduced and the modernized vehicle system has to be placed. The IT professionals should be encouraged to work with nod infrastructural technology to ensure efficiency. The whole freight system should be disciplined. Moreover, a dry port should be established in Dhaka.

In the ever-evolving global market, optimizing supply chain management has become paramount to remaining competitive. There are numerous

strategies that businesses can implement to improve the quality, safety, efficiency, and sustainability of their supply chain processes and products. Enhancing the quality, safety, security, sustainability, and traceability of supply chain processes and items, global standards and accreditations such as ISO series be implemented. Additionally, a supply chain digital transformation strategy that includes EDI, blockchain, AI, cloud computing, or IoT can enhance collaboration, communication, and creativity within the supply chain while reducing expenses, errors, delays, and dangers. Providing training, education, and development programs can improve the efficacy, efficiency, and professionalism of the workforce participating in the supply chain. Establishing and nurturing strong bonds and connections with all supply chain participants can cultivate loyalty, cooperation, and trust, while also identifying and seizing new opportunities and markets for international trade. Regular evaluation of the supply chain's performance using benchmarks, audits, feedback, or best practices can identify and resolve gaps, issues, and challenges while supporting the execution of corrective and preventive actions.

#### ***5.10. Suggestions and recommendations for the port logistics sector of Bangladesh.***

The Port logistics sector should introduce an intermodal system among its employees. Communication between nodes should be improved and made more efficient. Hinterland to last mile freight should be modified and the inclusion of new technology has to be placed soon. Automation in the drayage system along with the integration of artificial intelligence is important in the coming age. Upholding business ethics and eliminating bribery should be among the key steps taken by government authorities. Finally, expeditious cargo clearance, by any means, will always make the port more suitable for the future.

The development and management of the port industry requires a long-term vision, strategy, and action plan that takes into account demand, capacity, challenges, and opportunities. Improving governance and laws that govern ports is crucial for efficiency, accountability, transparency, and sustainability. Fostering private sector involvement and investment can mobilize financial resources, knowledge, and innovation, and promote competition and incentives for improving

performance and service quality. Expansion and modernization of equipment and apparatus are necessary to increase physical capacity, productivity, and safety. Utilizing digital platforms and technologies for information flow, communication, and port procedure automation is important. Green port policies and procedures can minimize negative environmental impacts and raise social responsibility. Strengthening security and toughness is vital to protect against threats and risks. Enhancing connectivity and integration with other transportation networks is necessary to promote efficient and smooth movement of commodities.

## 6. Major Findings and Discussions

This section discussed the major findings explored in the conceptual framework, literature review, and qualitative data survey. To manage international trade, the global supply chain must be uninterrupted, and a good freight transportation system to be applied in transferring commodities/cargo or containers from one chain to another chain or country to country.

### 6.1. *Traditional Global Supply Chain Management and Current Applications.*

WCED forecasted that vehicle markets would be developed in developing countries rapidly and proactively participate in air pollution in cities that could become a major factor limiting industrial development [1]. In general idea of the global supply chain is a contribution of freight transport that will ensure the timely transfer of cargo from one place to another place. Technologies like AR and VR are one of the key proposed instruments to overcome post-COVID-19 issues, especially for logistics. AR can assist in order picking, facilities planning, transportation support, maintenance support, last-mile delivery, and many more [12]. Low productivity and lack of investment in the port are adversely impacting the country's economy [13]. Moreover, the railways and air freight are way behind the road because of inefficient operation, costs, and heavy capital requirements. Metro cargo transportation will reduce the use of fossil fuel for the carrier solely used for cargo transportation. Joint transportation of cargo and passengers is the key to greater efficiency [31]. RFID has provided real-time data visibility all over the organization. Overall, they provide services like identifying

problems, evaluating different alternatives, offering real-time insights, information sharing and retrieval capabilities, and performing modelling and simulation [33]. Beautifully, the integration of freights and passenger transport is effective in terms of mobility and also reduces environmental and social constraints [27].

### 6.2. *Global supply chain and freight transportation systems.*

Ocean shipping is the most efficient and cost-effective transport mode but it needs big support from inland transportation systems where road mode is the main factor in reaching the last mile and supports the main transport activity of supply chain management [3]. From the perspective of modal choice 39.60% of respondents preferred the rail mode as it is an environmentally friendly transport system and secured in Bangladesh. River has the opportunity to be the first choice but seasonal verification in distance and passage time are not allowing to development of a good system in the existing supply chain of international shipments. Decarbonization trends in global supply chains across different transport modes for transferring road mode to rail or waterways, this spotlight focuses on the historical evolution of global supply chains for adopting new technologies, extracts the learning from the recent disruptions, and future outlooks to combat against the bad things in shaping the global supply chain [4].

### 6.3. *The changing environment of Supply Chain Management due to COVID-19, War, and others.*

A changing environment is seen as the result of COVID-19 has pushed to undergo significant work to re-design supply chains, improve resilience, and reexamine relationships with suppliers to reduce systemic risks [10]. In addition to this, it was explored that the COVID-19 pandemic has disrupted the supply chains on a global scale [2]. There are various reasons for this supply chain disruption but the weather is the most major reason that will affect the port operations seriously [8]. The factors and sub-factors causing the disruptions are nonlinear as well therefore, predicting the next condition is harder. It was viewed in the port operation that the disturbance in the supply chain

was majorly arising from hazards, fire, accidental damage, labor unrest, and political instability [22].

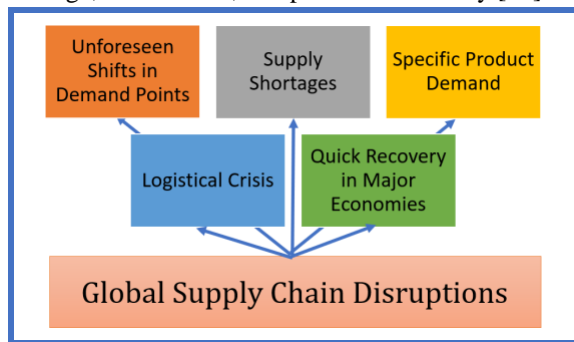


Figure 6: Global Supply Chain Disruptions [11]

To follow the disruptions in global supply chain management, it was argued that a global value chain development will increase the value of the commodity at every step and show the importance of supply chain management. Figure 6 shows supply chain disruptions that affected the global economy as well as uncertainty in global trade [11]. In the survey, 41.58% of respondents argued that COVID-19 is a big break in all activities including the global supply chain including shipping trade. In this relation, it was explored that quick recovery is also seen in major economies, fortunately [11].

A study found that sourcing has an effect on all aspects of the supply chain and is essential to both improving competitive advantage and successful organizational performance [9]. Organizations are facing new difficulties in the wake of COVID-19 and returning to the earlier situation is tough as the adjustment is seeking new technology for future prevention and measuring tools are costly. Therefore, supply chains are working hard to be both flexible and efficient in responding to market demands. However, research suggested that Supply Chain integration requires a wireless IT capacity-based leader; so, the growth of logistics, and supply chain digitalization has made this process easier [37].

#### 6.4. Sustainable supply chain management.

A study discovered on cost performance research that a sustainable supply chain is positively supported by two variables: sustainable procurement and investment recovery [15]. However, on the other hand, it is negatively influenced by cost performance. A scope was referred to and examined the possible pathways and possible technologies available that will help the shipping sector achieve the International Maritime

Organization's (IMO) deep decarbonization targets by 2050 for the shipping industry as a main or core element of freight transport globally [42]. So, the environment is the best priority to bring sustainability to global shipping.

The growth of Bangladesh's economy is closely tied to its relationships with neighboring countries. To improve trade efficiency and regional integration, it is crucial to enhance connectivity and infrastructure. Distributed ledger technology is an incorruptible and irrevocable collection of data enclosed and shared in an encrypted database [25]. Thus, the blockchain is a distributed ledger that can be audited and evaluated by anyone but cannot be changed by anyone [24]. Advanced supply chain technologies and artificial intelligence can produce a significant impact on the supply chain and labor roles [21]. Interactive graphic modelling can provide better efficiency as the graphical display provides better error detection and reacts to solutions [32]. Small warehouses require manual or semi-automation on the other hand, the large warehouse needs more active automation and real-time data to keep the product quality the same [43]. Relationship skill in supply chain management is the most important in the reduction of operational risks like inventory, warehouse, or transportation management [43].

#### 6.5. Integrated freight transportation system in Bangladesh.

A Researcher has observed that intermodal traffic has been very successful, both port-hinterland and domestic traffic to develop integrated freight transportation systems [7]. The premier port Chattogram Port handles more than three million TEUs annually, demonstrating the role of the intermodal system in achieving the success of freight transport and retail resilience in supply chain management in Bangladesh. Heavier trains are much more economically sustainable than longer trains [28]. In moving commodities along a supply chain, the research found that sustainability in freight transportation necessitates a balance of economic, environmental, and social factors because it has an impact on numerous supply chain connections and has become increasingly essential to all relevant stakeholders [6]. Creating a comprehensive national port master plan that maps out a strategic and actionable path for the growth and administration of the port industry is of utmost

importance. Uplifting the regulations and policies that oversee ports is a key factor in ensuring effective, responsible, open, and sustainable operations. Encouraging private sector participation and funding can activate financial reserves, insight, and originality, and encourage rivalry and motivation to elevate performance and service standards.

The performance of supply risk management depends on three factors- supplier orientation, supplier dependency, and systemic purchasing [18]. Additionally, cultural development, support of authorities by widening the streets, optimizing infrastructure, and public transport are the key points to develop a good transport system [38]. Research and innovation must be promoted, and green logistics curricula and training programs must be developed for professionals. National or regional certification programs must be established to develop green logistics standards and programs, and a platform for public and private sector representatives, research institutions, and international partners needs to be established and strengthened. Finally, financial resources must be organized and deployed for the development of green logistics, and a strong green logistics culture and leadership must be established. Ultimately, the development of sustainable freight transportation systems in Bangladesh will not only benefit the environment but also result in more efficient and cost-effective transport solutions for businesses and consumers alike.

## 7. Major Findings and Discussions

Chattogram Port is providing restless services to the port users and developing its quality day by day [44]. Building capacity for the port industry through development programs and advancing partnerships and collaborations on regional and international levels are also needed. Based on the qualitative research survey and literature review and further discussion on major findings, future directions below are prescribed to manage the global supply chain and develop integrated freight transportation in Bangladesh.

- ❖ Port development is essential to support the trade of Bangladesh [45]. It is essential to connect seaports to hinterlands via rail and waterways rather than congested road mode. Rail and waterways are popular freight transport modes that are

underutilized due to infrastructural problems also the mindset of users in using waterways. A modal shift from road mode to waterways or rail will reduce the cost of transportation. The government may allow more rail depots in the major cities and inland river terminals by converting river ports in all major cities of Bangladesh.

- ❖ To regime supply chain sustainability following the COVID-19 outbreak, a study guided to confirm supply chain digitization and virtualization [2]. Artificial Intelligence (AI) built integrated drones can be a future alternative for last-mile deliveries [26]. Digitalization is appreciated in freight transportation management exclusively for tracking and tracing of cargo and containers. This will reduce the physical presence at transport nodes as well as reduce operational costs significantly.
- ❖ Many years ago, WCED argued that climate change will be a global issue that will mostly affect the industrialization of developing countries where energy transport will play a big factor in product manufacturing [1]. Furthermore, research recommended that the transport sector articulate the needed transformations related to supply chain management, which include reducing movements and distances, alongside technological changes [4]. Finally, the effective integration of digital supply chain technology will enhance communication and operational efficiency [38]. This digitalization has been effectively utilized in the areas of production and warehousing. A comprehensive climate change program is required to develop sustainable supply chain management.
- ❖ To promote the global value chain in their research on the perspective of global supply chains that need to go beyond analyzing single companies and reckon with the interconnected network of companies involved in the production and supply of products and services [11]. The framework of supply chain and data may serve as an objective environment for efficient organization, and supply chain

and data will help firms advance their efficacy[46]. Addressing the value chain management will ensure competitive advantages to the global market and timely transaction or chain transfer of commodities in reaching the final destination.

- ❖ Research identified that to combat key challenges that pose a threat to corporate activity, it is a prerequisite to do further research into the importance of flexibility in supply chain management [10]. Particularly, the study found that research on freight transport is still insignificant and managed by the private sector but the governance of transport has focused for the most part on the provision of passenger transport [7]. So, privatization of the transport sector is to be prioritized especially in establishing new transport nodes such as container depots and terminals.

## 8. Conclusions

Globalization is largely attributed to the shipping, transport, and logistics industry influenced by a wide range of economic, political, social, technological, and other variables to cope with the dynamic approaches of freight transport management. The adoption of competitive enhancement approaches and the process of making strategic decisions are heavily influenced by the global environment. In this situation, it is crucial to develop an integrated freight transportation system in Bangladesh to support import-export trade as well as mitigate the demand of local users as the country is highly dependent on the imports of commodities. A smooth supply chain from/to the port is a must factor in managing the rhythm of commodity supply chain management uninterruptedly. It is widely seen that COVID-19 has impacted to supply chain management of Bangladesh and also the global supply chain management as Bangladesh is one of the largest exporters of ready-made garments that is the basic needs of all. Rail mode was the favourite mode in the survey where rail infrastructure for freight is not up to the mark and not integrated with seaports. Particularly, for infrastructural development of seaports, inland transport nodes, and other freight

transport connectivity to fit with the global standard in supply chain management [45].

Addressing challenges that are observed as disruptions will require a comprehensive and coordinated effort among various stakeholders, including the public and private sectors, civil society organizations, research institutes, and international partners. It will also require a strong culture of leadership and clear policy frameworks that encourage the deployment of green freight transportation technologies. Respondents are privileged to rail mode for managing inland transport for doing international shipping in Bangladesh. While COVID-19 has significantly disrupted shipping trade in Bangladesh over the last 5 years, shippers/consignees have consistently prioritized considerations such as transport cost and cargo safety in the supply chain. Just after COVID-19, it is clear that technological enhancement is a must in the freight transport system and ensures tracking and tracing of cargo globally from the origin to the destination. As long-distance trucks, zero-emission aircraft, and other technological solutions for reducing freight transport emissions are still a way off from being fully developed, more focus will need to be placed on the systemic reorganization of global supply chains to achieve net zero emissions and reduce industry risks during the energy transition. Lastly, an integrated freight transportation system in Bangladesh will help to improve logistics performance indices and take advantage of the global supply chain.

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**APPENDIX 1: RESEARCH QUESTIONNAIRE.**

1. What do you think, which mode of inland freight transportation system should be preferred in managing international shipping? **Mark anyone.**

A. Rail	B. Road	C. River	D. Air	E. Pipeline
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2. Where have you disrupted highly in managing your freight in the last 5 years? **Mark anyone.**

A. COVID19	B. Seaport	C. Russia-Ukraine Invasion	D. L/C Management	E. Financial Crisis
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3. Where do you have the main concentrations in doing import-export trade in Bangladesh?

**Mark in SL 1, 2, 3, 4 and 5. Here 1 is the top priority.**

A. Time	B. Cost	C. Cargo Safety	D. Environment	E. Port Choice
1	2	3	5	4

4. Rate the factors behind the development of freight transport systems.

**Mark in SL 1, 2, 3, 4 and 5. Here 1 is the most important factor.**

A. Environmental	B. Historical	C. Technological	D. Political	E. Economic
3	4	2	5	1

5. What are the barriers to develop environmentally friendly freight transportation systems in Bangladesh?

6. How will we overcome the barriers that you stated in your response (Q5)?

7. What are the key potential factors that Bangladesh needs to focus on to do cross-border trade with neighboring countries in Asia?

8. How we may avoid physical presence at seaports/inland nodes in clearing cargo? Please provide your opinion.

9. How we will create a global standard supply chain in Bangladesh for doing international trade? Please advise.

10. Any suggestions and recommendations from your end for our port logistics sector?

**APPENDIX 2: DETAILS OF PARTICIPANTS.**