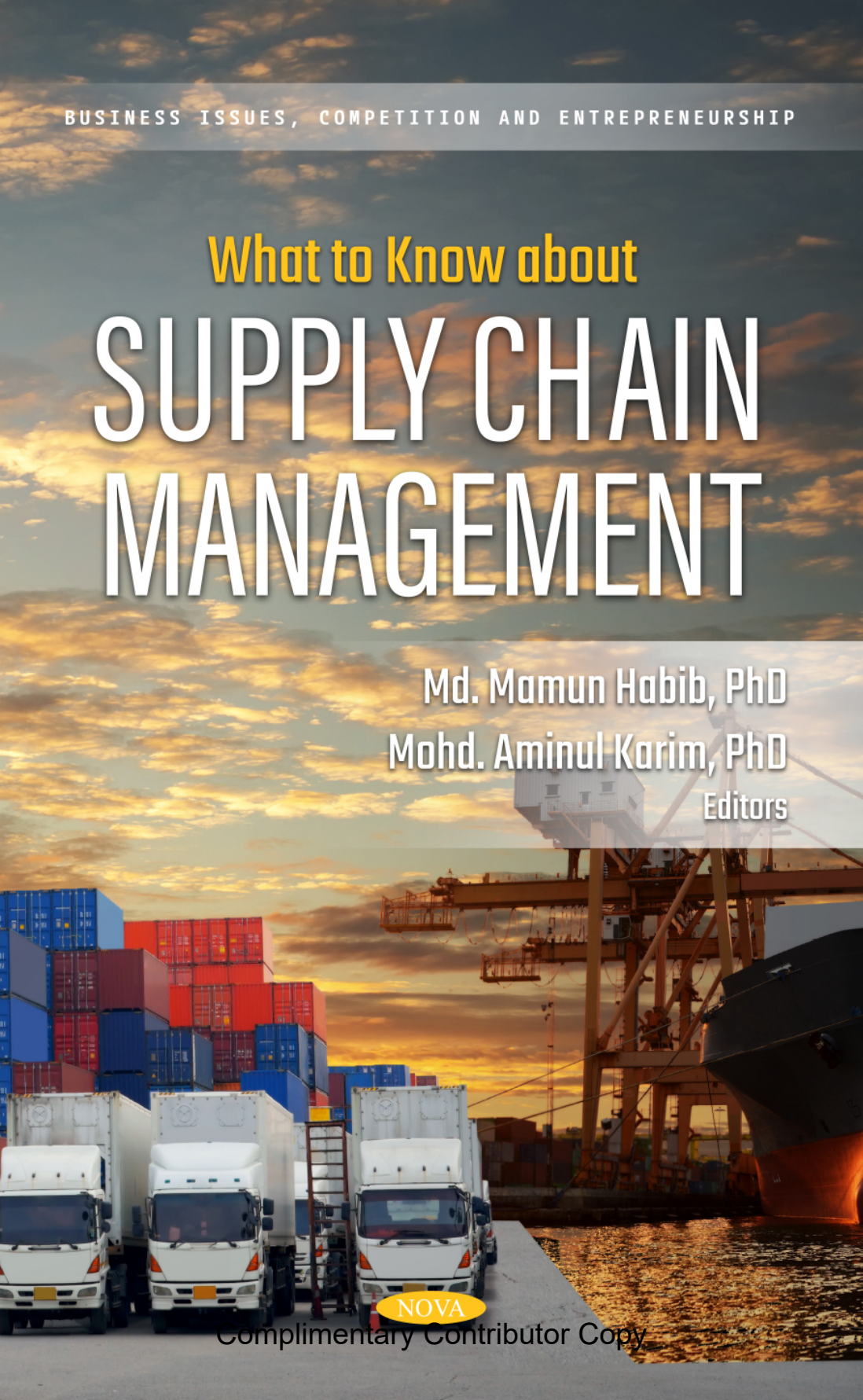

BUSINESS ISSUES, COMPETITION AND ENTREPRENEURSHIP

WHAT TO KNOW ABOUT SUPPLY CHAIN MANAGEMENT

BUSINESS ISSUES, COMPETITION AND ENTREPRENEURSHIP

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WHAT TO KNOW ABOUT SUPPLY CHAIN MANAGEMENT

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AND
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*Dedicated to my beloved father, Late **Alhaj Md. Habibur Rahman**,*
who lies at Jannatul Baqi, Madinah, Saudi Arab
and
*To my dear mother, **Alhaja Shirin Habib***

- Md. Mamun Habib

*Dedicated to my grandchildren **Sakina** and **Zahra***

- Mohd. Aminul Karim

Contents

PREFACE

The objective of supply chain management (SCM) is to incorporate activities across and within organizations for providing the customer/stakeholders value. SCM has been widely researched in numerous application domains during the last decade. Despite the popularity of SCM research and applications, considerable confusion remains as to its meaning. There are several attempts made by researchers and practitioners to appropriately define SCM. Amidst fierce competition in all industries, SCM has gradually been embraced as a proven managerial approach to achieving sustainable profits and growth. This book entitled "What to Know about Supply Chain Management" consists of nine (9) chapters.

Chapter 1 - This paper offers an analysis of Supply Chain Modelling studies for three specific agricultural commodities in Indonesia, palm oil, cacao and kenaf. The three commodities have similar and different characteristics. The aim of this paper is to discuss how researchers, working on the three different commodities, attempted to develop models using different environments and goals. Next researchers delved into the nature of research techniques and methods used to identify what aspects can be learned from each so that in future studies they can either collaborate or make use of the techniques/methods to conduct researches with better results. Initially each researcher discussed the nature of the

industry, goals and approaches, comparing methods and outcomes of the simulation. After all, modelling always follows similar if not the same steps. While there is no perfect generic model of the supply chain, especially in the agricultural business, there is always an opportunity to improve the quality of models in terms of their usability by the supply chain actors. The first two models made use of the combined agent-based fuzzy-AHP approach while the third made use of the soft system methodology and sought to develop an intelligent decision making tool to assist the farmers in order to optimize their added value and measure performances. Readers of this paper will find that interaction and collaboration between the three studies will reveal ways to fine tune their research techniques and methods that will benefit future endeavours.

Chapter 2 - The importance of SCM has grown over time and continues to grow in a ponderous trend. Researchers have been examining the adoption of SCM in different industries. SCM is gaining endless attention. Indeed, the effectiveness of SCM is impactful on the quality of product value, logistics and by extension on customer satisfaction and organizational profitability. Therefore, a strong and efficient relationship has to exist between manufacturers and consumers to ensure the commercial and practical achievement of manufacturers. Ideally, the performance measurement model should consider quantitative as well as qualitative approach and have the capacity to apply different measuring tools. A significant number of studies have been carried out on SC performance measurement, yet a lot of corporations were unsuccessful in implementing effective performance measurement methods in their operations. The authors have unlocked a large number of articles and models which have investigated supply chain performance measurement (SCPM). Each model has its own merits and criticisms from various reviewers and some of the most observed deficiencies from the existing performance measurement models. Based on the gap analysis, the researchers have proposed ten attributes which should be embedded into the supply chain performance measurement (SCPM) for the manufacturing industry and the ISCPM model has been developed. The ten supply chain performance measurement attributes proposed are - Financial Health (FH),

Collaboration (CL), Velocity (VC), Resilience (RE), Reliability (RL), Continuous Improvement (CI), Visibility (VS), Work Place Health (WPH), Sustainability (SS), and Service Excellence (SE).

Chapter 3 - India is known as the fruit and vegetable basket of the world. It is the second largest producer of overall fruits and vegetables production in the world after China and one of the centers of origin of fruits and vegetables. This chapter examines the existing position of fruits and vegetables sector in India and tries to give a conceptual coverage of supply chain management, the supply chain relating to fruits and vegetables sector. The efficiency of fruits and vegetables supply chain is analyzed and the need and importance of the research for efficient supply chain in fruits and vegetables sector has been discussed. It has been evident from the literature that the fruits and vegetables supply chain is highly inefficient. This chapter undertakes a thorough review of basic and contemporary literature available and attempts to identify the business problem in the supply chain of fruits and vegetables sector in India.

Chapter 4 - In this chapter the authors discuss what can be done with regards to supply chain management, in response to the COVID-19 pandemic. The pandemic has disrupted supply chains around the world. Most firms, if not all, faced some degree of disruption in procurement and/or distribution. The authors argue that firms were not prepared to face so much disruption, and therefore struggled. The authors propose two types of solutions for this problem: management-based and market-based. Under the management-based approach, the authors emphasize source and market diversification, introduction of higher level of automation, and maintaining a higher buffer of materials among others. For the market-based approach, the authors emphasize passing the extra cost to consumers, which will not only help producers, but also curb extra demand to ease the gap between supply and demand.

Chapter 5 - This exploratory study addresses a conceptual supply chain management (SCM) model for the ready-made garments (RMG) industry of Bangladesh. The ready-made garments (RMG) industry in Bangladesh has some typical landscapes like low-cost labor, green factory concept, supply chain, time-frame, compliances and effective and efficient supply

chain management, which are at the core among all the features. Supply chain management is a multidimensional approach and it is even more complex for the Bangladesh ready-made garments industry due to different actors of the global supply chain like price, process and lead time. As different parties i.e., the suppliers, manufacturers, distributors, retailers and buyers etc. are involved in different phases of the supply chain of this industry, every stage (procurement, manufacturing, replenishment, customer order) is conflicting with its next stage due to time and process constraints. The conceptual model demonstrated here has taken an effort to create the layout and design of the procurement of raw materials, work-in-process, inventory and finished goods from various sources to the ultimate consumer in the garment business. The model also takes an attempt to show that the manufacturing costs can be reduced and profit can be increased if the supply chain information and integration process can be used carefully. This framework provides the opportunity to integrate and optimize the supply chain process of the ready-made garments industry of Bangladesh. The proposed conceptual framework for the ready-made garments industry provides a novel approach for decision-makers of supply chain components to review and appraise the performance toward fulfillment of ultimate goals, i.e., producing high-quality garments product, reducing the wastage of human labor, time and money with high competitiveness, efficiency and productivity.

Chapter 6 - The COVID-19 pandemic that out broke out in late 2019 has interrupted supply chains across the globe. However, the most prominent disruptions have been experienced in healthcare supply chains (HCSC). Hospitals globally have been overwhelmed in their efforts to manage the flow of COVID-19 positive patients with their limited resources of required medicines, equipment, testing kits, protective gear as well as healthcare professionals themselves. Moreover, the supply of these resources was disrupted due to government-imposed travel restrictions, lockdown measures, and the temporary closure and/or underutilization of suppliers' facilities due to labor and raw materials' shortages. A large number of healthcare professionals were falling sick, which created further pressure on the healthcare service delivery chain. Scholars, policymakers,

and practitioners across the world have proposed and developed a number of innovative ways to combat the aforementioned situation, which also serve as important lessons for the future. This paper is a review of literature focused on the impacts of the COVID-19 pandemic on healthcare supply chains. It attempts to identify key lessons learnt from the journey to date, and offers recommendations to tackle similar future disruptions. The researcher reviewed the findings, analysis, and recommendations from 30 relevant research papers published since December 2019 for this study. Thematic analysis revealed five broad themes: 1. Surge in sudden demand; 2. Virus containment measures 3. Further demand flight; 4. Supply chain disruptions; and 5. HCSCs responses. Recommendations are derived from HCSCs' experiences, and responses to the pandemic and required interventions suggested in the literature. Practitioners and policymakers can use the findings of this paper as a guide when tackling similar situations. Moreover, some of the paper's findings may trigger a number of fundamental changes in the healthcare supply and service delivery chain. The paper also disseminates new perspectives of HCSCs.

Chapter 7 - The COVID-19 pandemic is having an impact on global supply chains with the sudden lockdown of cities or countries hampering the whole business activity except the most critical of supply chain activities. In this situation, total supply chain activities can't be hampered as livelihoods totally depend on this functionality. Thus looking for more flexible, automated and sophisticated supply chain technologies that are now more relevant than ever. This pandemic situation helps to rethink the supply chain leaders in a different way for the successfulness of the Supply Chain activities. As this pandemic is not going away so early, challenges like sourcing, locational issues, logistical advancements, technological upgradation and stock level buffering, all of these are playing vital role/s. These challenges combined with ongoing price and trade wars, diplomatic relationships among countries, shifts in manpower for manufacturing and competitive advantage will make dynamic and flexible remarks of success looking forward. To stay ahead of global supply chain challenges, leaders must concentrate on re-skilling the workforce, re-assessment of risk

management in depth of the supply chain process for the successful and uninterruptable management in this ongoing COVID situation and so on.

Chapter 8 - This research is intended to examine the relationship between Efficiency (EF), Performance (PE), Response (RE), Quality (QU), Facility (FA), and pandemic business management (PBM) in the F&B (Food & Beverage) retail industry in Bangladesh. In total, 309 valid responses were received through the survey questions asked at the retail companies in Bangladesh. In addition, systematic random sampling is used to achieve the research objectives of this study. The data has been examined through Partial Least Squares Structural Equation Modeling (PLS-SEM). The study findings showed that Efficiency (EF), Performance (PE), Response (RE), Quality (QU), Facility (FA), and pandemic business management (PBM) (dependent variable) have an influence on the F&B retail business industry in Bangladesh. Future researchers may replicate the findings of this study in different settings (e.g., developing nations), in various industries (e.g., manufacturing, electronics, and health) and then utilize analogous constructions to enhance the body of knowledge, which may help different stakeholders and industries. This work contributes to the limited body of literature on pandemic business management. According to the authors, the findings may help to understand the effect of the pandemic on the retail business industry. Furthermore, it may also help to identify the essential aspects that can have an impact on the retail sector in the post-pandemic environment.

Chapter 9 - Globalization has turned modern business more unpredictable and challenging. Customers can now order and collect goods from any corner of the world within a very short time. In the past, mass production was the key concern in order to keep the cost low. At present, frequent change in customer preference has made the market more competitive. Therefore, businesses nowadays compete over supply chain's performance rather than simply on cost or on quality. Successful supply chain itself is considered as a key competitive advantage for any company. Modern supply chain has introduced two standardized models that can evade the market fluctuations in certain ways. One of these is "lean" and the other is known as "agile" supply chain mechanism. Though both run

on customer demand, lean emphasizes on cost by eliminating wastages while agile supply chain focus on quality and responsiveness. Both of these models require significant investment especially in technology and innovation. In addition, organizations need to render training and motivate their human resources in order to ensure flawless operation of any of these two supply chain processes. On the other hand, such strategic implementation also demands managers' educative judgment and speculation of near future. As a result, time investment is equality important to achieve the set goal. This chapter has drawn a detailed layout of the two models and their strategic implications in order to attain a certain level of efficiency or responsiveness. Various lean principles like six sigma, kanban, JIT etc. will encourage managers to walk through the way of waste elimination, while three key elements of the agile supply chain (agility drivers, capabilities and agility providers) will guide them towards a higher level of responsiveness. Meanwhile, a new formula known as the "Leagile supply chain strategy" has been identified, which is a combination of both lean and agile supply chain management. This hybrid supply chain sometimes aims to become a "mass customizer" - producing progressively smaller batch sizes (sometimes even one item) targeted to satisfy unique customers' demand. However, managers should always need to be ready for uncertainty in business as there is no scientific tool that can lead towards complete success. Through proper assessment, adjustment, and by establishing required advancement (along the supply chain drivers and strategies), a company can reach the zenith of profitability - this chapter aims to shed light on this process.

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The editorial book entitled *What to Know about Supply Chain Management* encompasses nine chapters. From that point of view, the concept of the editorial book solely depends on the contributors of the book chapters. Therefore, special thanks and gratitude must go to the book chapters' authors. However, review process is also very lengthy but significant in order to ensure uniqueness of the book chapters. The jobs of reviewers and proofreaders, particularly *Ms. Farzana Chowdhury*, were highly appreciable. In addition, the Editor acknowledges a great debt to NOVA Publishers for publishing this book on time.

On the eve of this publication, I wish to acknowledge and thank to my better half - *Dr. Farzana Afzal*, son - *Rafiul Habib* and daughter - *Farzeen Habib*, and other family members for their tireless inspiration to complete this book.

Finally, I express gratitude to the Almighty Allah for spiritual inspiration and guidance in the completion of this publication.

Md. Mamun Habib
The Editor

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Chapter 1

ANALYSIS OF SPECIFIC AGRICULTURAL COMMODITY SUPPLY CHAIN MODELLING IN INDONESIA

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ABSTRACT

This paper offers an analysis of Supply Chain Modelling studies for three specific agricultural commodities in Indonesia, palm oil, cacao and kenaf. The three commodities have similar and different characteristics.

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The aim of this paper is to discuss how researchers, working on the three different commodities, attempted to develop models using different environments and goals. Next researchers delved into the nature of research techniques and methods used to identify what aspects can be learned from each so that in future studies they can either collaborate or make use of the techniques/methods to conduct researches with better results. Initially each researcher discussed the nature of the industry, goals and approaches, comparing methods and outcomes of the simulation. After all, modelling always follows similar if not the same steps. While there is no perfect generic model of the supply chain, especially in the agricultural business, there is always an opportunity to improve the quality of models in terms of their usability by the supply chain actors. The first two models made use of the combined agent-based fuzzy-AHP approach while the third made use of the soft system methodology and sought to develop an intelligent decision making tool to assist the farmers in order to optimize their added value and measure performances. Readers of this paper will find that interaction and collaboration between the three studies will reveal ways to fine tune their research techniques and methods that will benefit future endeavours.

Keywords: research collaboration, soft system methodology, agent-based modelling, intelligent decision making, agricultural supply chain, fuzzy-AHP

1. INTRODUCTION

Management goals in organizations everywhere are to improve overall performance. In order to achieve this goal, management considers Supply Chain Management (SCM) as one of the important areas that can be improved upon. SCM has been considered an important and popular area of research by experts and academicians. Supply Chains (SC) include raw materials, semi-finished or finished products and transfer of products to warehouses, covering the entire lifecycle of a product (Pasi, Mahajan, & Rane, 2020). A Supply Chain is a group of interdependent companies operating in sequence that cooperate in handling, improving and controlling the flow of goods, money and information beginning with suppliers in the upstream all the way downstream to the consumer

(Preckel, Gray, Boehlje, & Kim, 2004); (Van Der Vorst, 2006). Principal roles of the Supply Chains are to add value to products by moving them from one location to another, or to perform modification processes (Janvier, 2008). Value adding changes to the process are applied to quality, costs, delivery activities, flexibilities in shipping products, and innovations (Trienekens, 2011) to improve profitability.

This paper offers an analysis of Supply Chain Modelling studies for three specific agricultural commodities in Indonesia, palm oil, cacao and kenaf. The three commodities have similar and different characteristics. The aim of this paper is to discuss how researchers, working on the three different commodities, attempted to develop models using different environments and goals. Next researchers delved into the nature of research techniques and methods used to identify what aspects can be learned from each so that in future studies they can either collaborate or make use of the techniques/methods to conduct researches with better results.

Initially each researcher discussed the nature of the industry, goals and approaches, comparing methods and outcomes of the simulation. After all, modelling always follows similar if not the same steps. While there is no perfect or generic model for a supply chain, especially in the agricultural business, there is always an opportunity to improve the quality of models in terms of their usability by the supply chain actors. However business model developments are considered to be lagging behind in practice, due to a lack of formalization and structure. The question arises, what are business models made of?

We contend that business models are composed of two different sets of elements: (a) concrete choices made by management about how an organization must operate, and (b) what are the consequences of those choices including but not limited to compensation practices, procurement contracts, location of facilities, assets employed, extent of vertical integration, and sales and marketing initiatives. Every choice has some consequences: for example, offering high level incentives (a choice) has implications regarding the willingness of employees to exert effort or to

cooperate with co-workers (consequences) (Casadesus-Masanell & Ricart, 2010).

The first two models made use of the combined agent based fuzzy-AHP method while the third made use of the soft system methodology and sought to develop an intelligent decision making tool to assist farmers in optimizing their added value and measure performances.

2. NATURE OF THE INDUSTRY

2.1. Palm Oil

One of the most important supply chains in Indonesia is for palm oil. Palm oil is not a native plant to Indonesia. Palm trees were imported to Indonesia from West Africa in 1848. The first commercial palm oil plantation was set up in Sumatra with operations starting in 1911. Since that time, Indonesian palm oil estates have grown to become the largest producer of crude palm oil (CPO) in the world. Three main products produced from palm oil are frying oil, margarine, and soap with several other by-products.

Table 1. Palm Oil Products Exported from Indonesia 2010 – 2019

Year	CPO		Palm Kernel	
	Volume Tons	Value US$ 000	Volume Tons	Value US$ 000
2010	16,291,856	13,468,966	1,572,286	1,727,693
2011	16,436,202	17,261,248	1,442,666	2,113,877
2012	18,845,020	17,602,168	1,460,374	1,510,486
2013	20,577,976	15,838,850	1,644,532	1,301,596
2014	22,892,224	17,464,754	1,479,833	1,540,690
2015	26,467,564	15,385,275	1,819,307	1,565,685
2016	22,761,814	14,366,754	1,576,490	1,910,524
2017	27,353,337	14,366,754	1,717,595	2,211,339
2018	27,898,875	16,530,212	1,772,904	1,701,531
2019	28,279,350	14,716,275	1,937,238	1,268,634

Table 1 and 2 illustrates how important palm oil is to Indonesia (BPS Statistics Indonesia, 2019). Export of palm oil and palm kernels have increased yearly. In 2019 the CPO export volume was 28.2 million tons, an increase of 5% and palm kernel oil export was 1.94 million tons, an increase of 9.3% compared to 2018. Biodiesel product does not offer an attractive profit. Government policies requires the biodiesel to be produced from palm kernals as an alternative to meeting fuel demands for use in public and private vehicles. This is necessary due to dwindling oil reserves which are not renewable, potentially causing an energy crisis in the near future (Rahmawati, Noor, & Zakir, 2016).

Table 2. Indonesian Biodiesel Oil Production and Uses (M-tonnes)

Year	Production	Domestic	Export	Domestic Growth	Blending Rate
2014	3.32	1.55	1.37	0.67	B10
2015	1.39	0.77	0.28	-0.78	B10
2016	3.07	2.52	0.4	1.76	B10
2017	2.87	2.16	0.16	-0.37	B10
2018	5.17	3.15	1.51	0.99	B20
2019	7.04	5.36	1.11	2.22	B20
2020	8.47	8.05	0.42	-2.69	B30

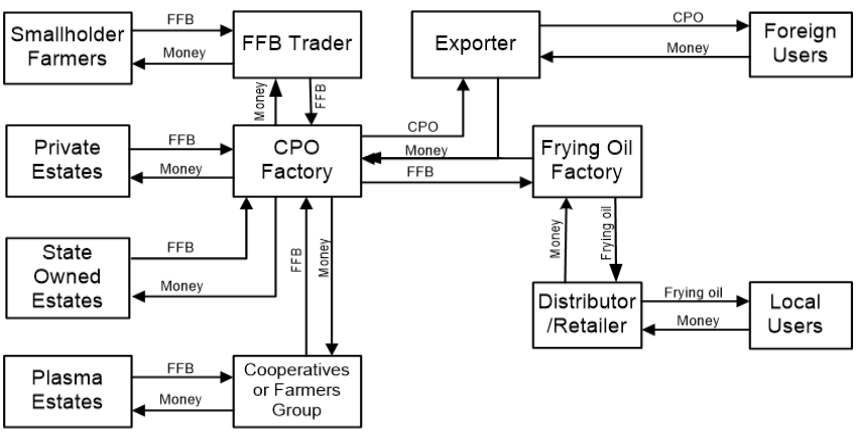

Figure 1. Typical palm oil supply chain in Indonesia (Hidayat, Marimin, Suryani, Sukardi, & Yani, 2012).

Figure 1 shows a typical palm oil supply chain (POSC) in Indonesia. Each multiple actor is represented by a single group. Smallholder farmers, plasma estates and core estates are represented by farmers. Exporters, distributors and retailers are represented by distributors.

Due to monopsonistic conditions, palm oil farmers' bargaining power was low. CAO in 2009 reported difficult conditions for small farmers resulting in low productivity and profit per hectare compared to very high profits per hectare for large estates. Small farmers lack of opportunities to access financial and technical support, and minimum representation in the supply chain decision making processes contributed to this condition.

2.2. Cacao

Indonesia is the third largest cacao producer and exporter in the world after Ghana and Ivory Coast (BPS, 2020). Cacao was first introduced in Indonesia by the Spanish in 1560, in Minahasa, Celebes (now Sulawesi). Cacao pods ripen and are ready for harvest after 5 - 6 months (Wahyudi, Panggabean, & Pujiyanto, 2009). Foreign buyers preference for Indonesian cacao is largely because it does not melt easily at room temperature, making cacao more suitable for blending (Suprapti, Dase, Lopies, Djamaluddin, & Masuri, 2013).

Supply chain for the cacao agro-industry is fairly long. Cacao is produced by farmers, the most common upstream industrial group, who process cacao pods into dry beans. Main consumers of cacao beans are the intermediate cacao industry or grinding industry. The Grinding Industry Group (GIG) converts cacao beans into intermediate products such as cacao liquor, cacao butter and cacao powder.

Dried cacao beans are processed into cacao powder and cacao butter. Rosniati, Yunus, & Duma, 2013 states that to manufacture 3920 kg of chocolate candy, 1170 kg of cacao liquor and 741 kg of cacao butter is required. Based on results of the conversion, it takes 1519.5 kg of cacao to produce 1170 kg of cacao liquor and to make 741 kg of cacao butter, 2359.10 kg cacao liquor or 3063.81 kg cacao are required. It can be further

simplified that from 10.13 kg of dry cacao beans, 7.8 cacao liquor can be produced which can then be processed into 2.45 kg cacao butter and 4.77 kg cacao powder as shown in Figure 2.

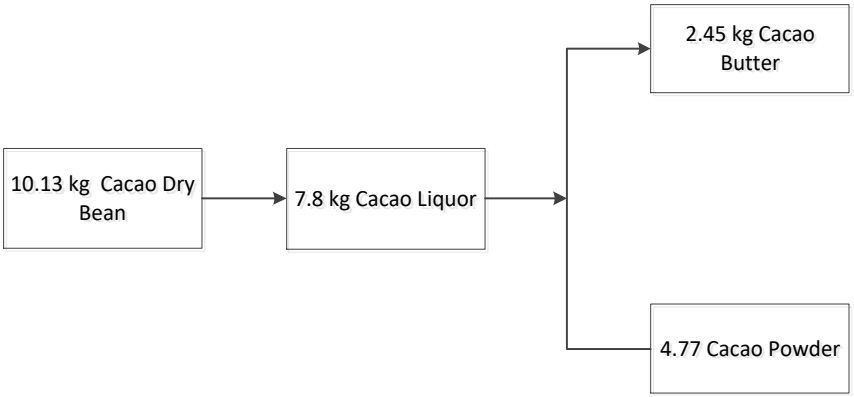

Figure 2. The cacao conversion process (Mulato et al., 2004).

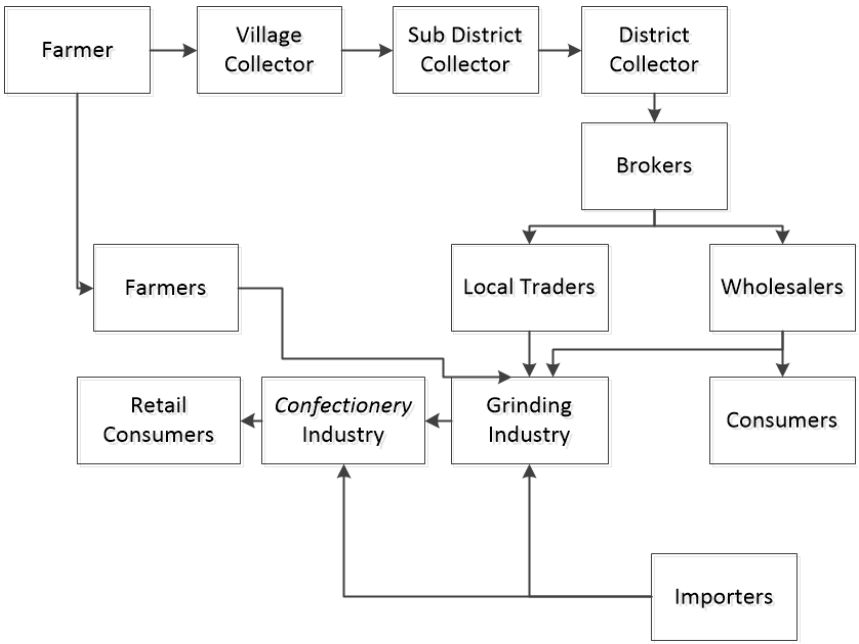

Figure 3. Cacao supply chain in Larompong, Sulawesi.

Products from the grinding industry are sent downstream to be processed into food and beverages such as chocolate candy bars, chocolate powder milk, dry bread, ice cream, biscuits and so on. Cacao intermediate products are also used as raw material in the pharmaceutical and cosmetic industries, including soap, lipstick, skin moisturizer and so on.

The cacao agro-industry supply chain in each region has different paths. Figure 3 illustrates the cacao agro-industry supply chain in Larompong Village, South Sulawesi. It shows that the distribution line from farmers to the grinding industry is very long, resulting in high distribution costs reducing farmers profits.

Most of Indonesia's cacao production is exported with the remaining products marketed domestically. Indonesia's cacao exports span five geographical areas, Asia, America, Europe, Africa and Australia with a major share exported throughout Asia. In 2019, the top five importing countries for Indonesian cacao were Malaysia, America, India, China and The Netherlands. Volume of exports to Malaysia reached 80.59 thousand tons or 22.48 percent of the total export volume. The second largest volume was exported to the United States, shipping 61.77 thousand tons or 17.23 percent, a value of USD 285.68 million. India was the third largest importer buying 28.85 thousand tons.

2.3. Kenaf

Growth of the natural fibre processing industries in the world is perceived to be the most important of the three (Jose, Salim, & Ammayappan, 2016). This is believed to be the case because natural fibre, as a renewable raw material, is abundantly available in nature and exhibits a high toughness (Dunne, Desai, Sadiku, & Jayaramudu, 2016) potentially reducing a product’s weight resulting in energy savings, reduced production costs, and improved appearance of the product’s surface (Global Materials Teams, 2011). Moreover, people’s awareness of environmental sustainability has grown globally.

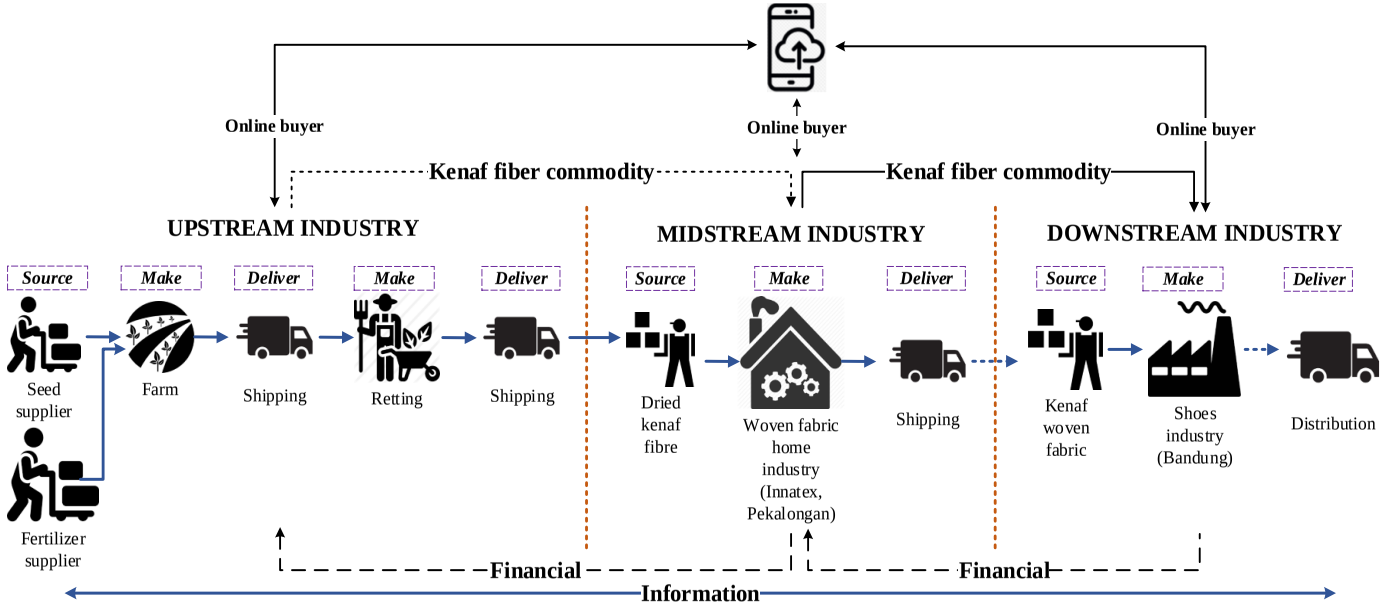

Figure 4. Kenaf fibre supply chain in Indonesia.

Comparison between consumption and production levels of natural fibre in Indonesia resulted in a gap between supply and demand by 90.38% (Global Materials Teams, 2011). Only 9.62% of the kenaf fibre demand in Indonesia is produced domestically while exporting 90.38%. Kenaf, sisal, jute, coir, flax, abaca, and cotton are types of natural fibre documented by Food and Agriculture Organization ([FAO] Food and Agriculture Organization, 2019). FAO recorded the amount of natural fibre imported to Indonesia from 2010 to 2015 ([FAO] Food and Agriculture Organization, 2019). The largest import of kenaf was cotton fibre 648.09 thousand tonnes/year (Gossypium irsutum L.), followed by kenaf fibre (Hibiscus cannabinus L.) averaging 31.12 thousand tonnes/year. Other fibres were imported but in small quantities.

Figure 4 illustrates a typical kenaf supply chain in Indonesia from upstream to downstream with product sales conducted online (Nurhasanah, Machfud, Mangunwidjaja, & Romli, 2020). Stakeholders in upstream companies are owners, company general managers in the middle industries and online buyers at the market place. Level of demand for kenaf dried fibre, from uncertain online buyers is predicted by the artificial intelligence network, while the level of demand from intermediate industries is predicted by a fuzzy approach. This is the importance of the upstream industry in becoming users of the Intelligent Decision Support System (IDSS) platform. Midstream industries use this platform to share information on their inventory levels, so that upstream industries will be alerted if the midstream industries inventory levels have reached the reorder point. This information flow can be received quickly and sent back in a timely manner to be used by the upstream and midstream industries to plan their operations more efficiently. However this can only be of benefit to all users if there is a system that supports the decision-making process. On the basis of this needs analysis, the midstream industry is assigned to be the user in this IDSS blueprint.

2.4. Similarities and Differences between All Three Commodities in Terms of Product Characteristics

- All three commodities are agricultural products. Palm oil and cacao are found in food products people use on a daily basis. Palm oil is used to produce products like frying oil and margarine, and in products used daily such as cleaning soaps and detergents. Palm oil is also the main ingredient used to produce bio diesel and some pharmaceutical products.
- All three products are not processed by a single actor, but require sequential processing to produce the end products to be consumed or used.
- Although kenaf belongs to the agricultural group, it's not a food type but is used to make furnishing components and car interior parts.
- Demand for palm oil and cacao has been increasing every year as the population and the requirement for food increases.
- Differences between all three:
    - Cacao and palm oil plants are grown in large multiyear estates, harvested multiple times a year and does not require replanting oevery time.
    - Kenaf is a seasonal crop which is harvested less than a year after planted. Once harvested the ground is replanted with new seedlings in order for the next crop cycle to grow.

3. GOALS AND APPROACHES

3.1. Palm Oil

The business scale of each POSC actor is different from each other. Risks faced by each actor are different in type and level.

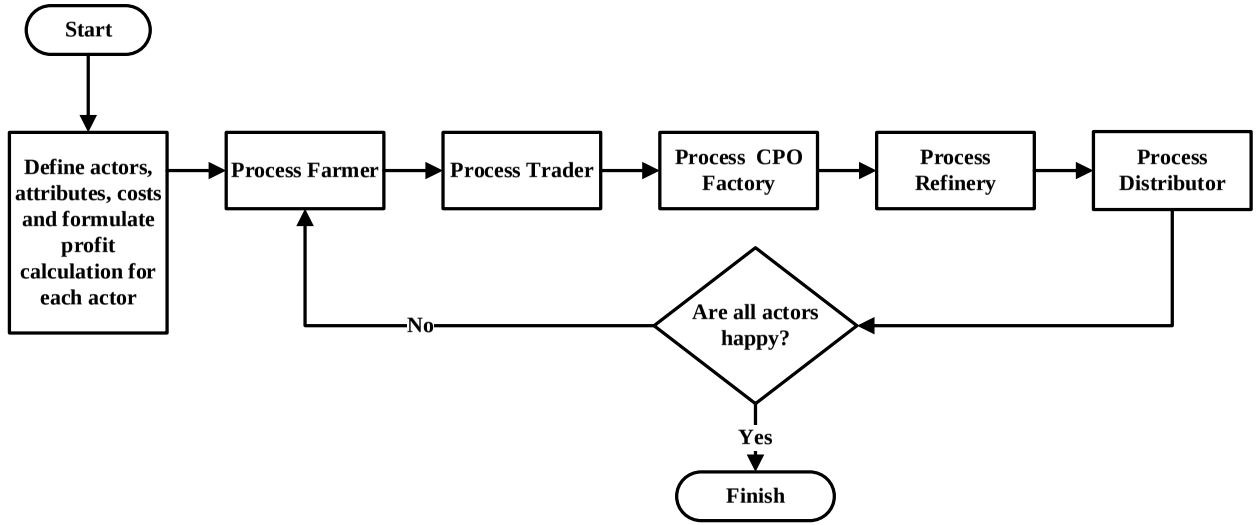

Figure 5. Overall negotiation process in the POSC.

Investment and technology employed by each actor is also at different levels. These three factors influence the opportunity to create added value for each actor. The added value created by each actor helps increase the total added value for the overall supply chain.

Objective of the study on POSC is to design a model to simulate the interactive and negotiation behaviour of POSC actors, and to facilitate optimum fair distribution of the added value for each actor, while considering successive investment, risk, and technology levels. To achieve this objective, implementation of a stakeholder dialogue negotiation procedure was conducted as shown in Figure 5. It starts by ensuring each actor has a fair added value. Afterwards the process is conducted for all actors simultaneously to ensure everyone in the group is happy and onboard.

Agent-based approach was selected as it provides the best means to study supply chain actors (or agents) behaviour and their interaction. This study design is a utility added value model based on the level and weight of risks, investment, and technology faced or employed by the POSC actors.

3.2. Cacao

The cacao supply chain study was conducted over a four year period from 2014 to 2017. Updates were included and new methods were inserted into this report where appropriate. The general objective of cacao research is to design a sustainable cacao agro-industrial supply chain model using a smart system. The specific objectives of this research are:

a. Designing supply chain institutions for the cacao agro-industry in Larompong District, Luwu Regency, South Sulawesi.
b. Designing proposed strategies to increase the sustainability of the environmental dimension.
c. Design a fair profit distribution model.

3.3. Kenaf

The study on kenaf was conducted from 2019 – 2021. The main objective of this study is to design an intelligent supply chain model for the natural fibre agro-industry. In order to achieve the goal, 3 sub models were developed that addressed research questions, i.e., (1) Developing a sub model of collaboration among actors in the supply chain of natural fibre agro-industry, (2) Designing a sub-model of integrated production and inventory planning in supply chain of natural fibre agro-industry, and (3) Developing a sub model for improvement in supply chain performance of natural fibre agro-industry.

4. MODELLING METHODS

4.1. Palm Oil

Fuzzy AHP and Agent-based methods were selected as they provide the best means to study the supply chain actors (agents) behaviour and their interaction. Scope of this chapter is to focus on the POSC beginning with farmer groups, traders, crude palm oil (CPO) factories, frying oil factories (refineries), and frying oil distributors. To achieve this objective some theories, methodologies, and models are utilized.

Figure 6 shows the framework of the palm oil supply chain model. Preparation and literature study starts the supply chain process. Questionnaires were developed to collect data from the field. Data for this model was obtained from POSC actors in palm oil estates, factories and traders in some parts of Sumatera and Java. Validation was conducted by interviews with relevant decision makers and academicians, while verification was done by running the simulation model with an expert Netlogo analyst/programmer.

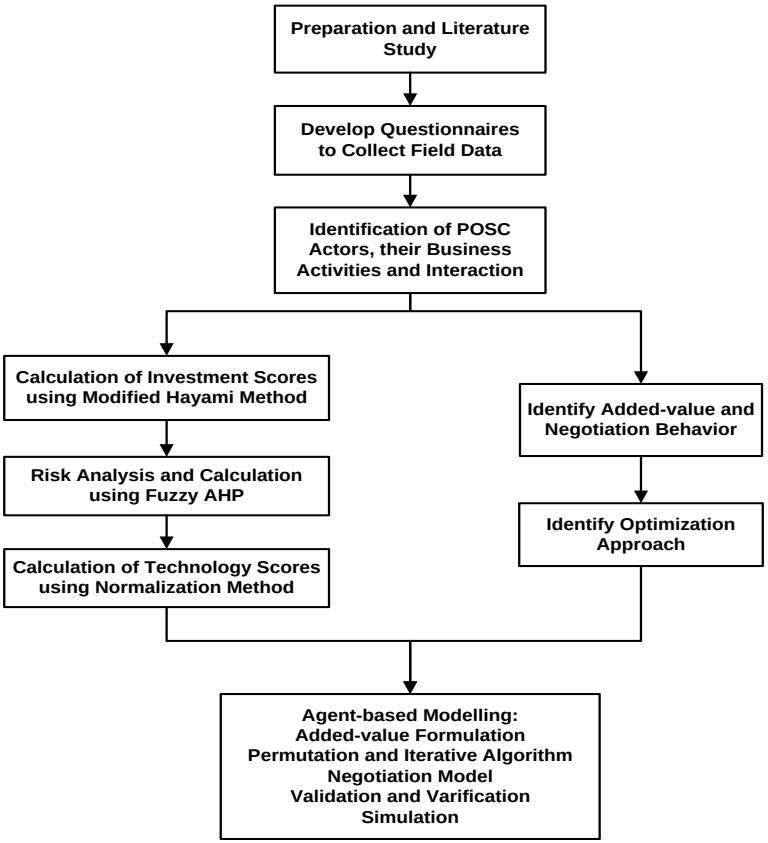

Figure 6. Framework of the POSC Agent-based modelling.

4.2. Cacao

Low productivity of cacao is the initial problem used as a basis for research. Low productivity of cacao has resulted in land conversion for other use. Land conversion can result in a decrease in the amount of production, disrupting the sustainability of the cacao agro-industrial supply chain. This problem must be corrected immediately because cocoa is one of the mainstay commodities of plantations which plays an important role in the Indonesian economy as a source of foreign exchange, a source of income and employment. The problem of low productivity was also

conveyed by Iphov Kumala Sriwana one of the authors in 2021 (Iphov Kumala Sriwana, Arkeman, Marimin, & Assa, 2021).

In 2015, cacao plantations in Indonesia totaled 1.71 million hectares. In 2018, plantations covered 1.61 million hectares, a decrease of 5.74 percent. In 2019, it is estimated cacao plantations will decrease by 1.14 percent to 1.59 million hectares in just one year.

In 2015, production of cacao beans was 593.3 thousand tons and increased to 767.28 thousand tons in 2018 an increase of 29.32 percent in 3 years. In 2019, it is estimated that cacao bean production will increase to 774.20 thousand tons or an increase of 0.90 percent. Research stages, can be seen in Figure 7. This increase each year is significant as each year the productive acreage is decreasing.

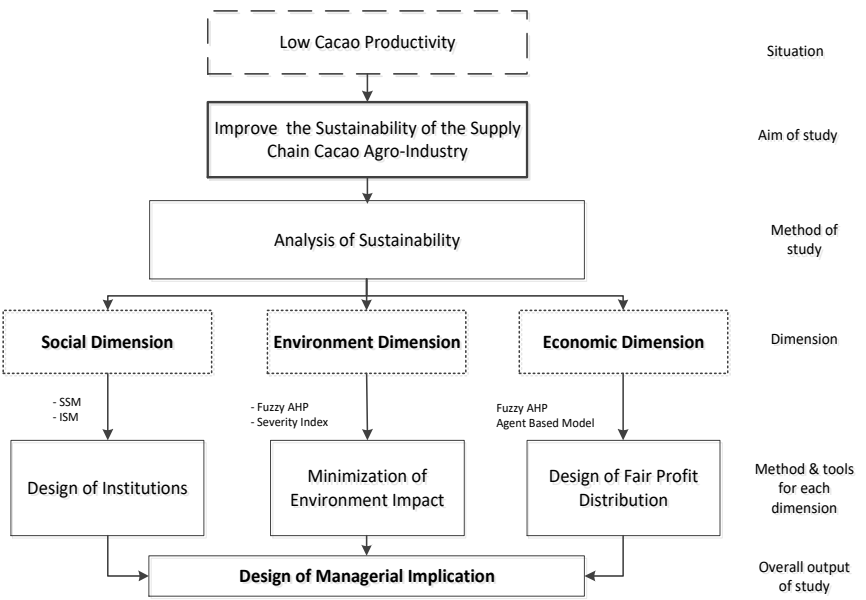

Figure 7. Research stages of cacao supply chain agro-industry.

Fair profit distribution is one of the important criteria in the economic model. This was conveyed in a paper by (Iphov Kumala Sriwana, Menanno, Arkeman, & Shafiq, 2018). Minimizing the environ-mental

impact of using pesticides can provide a high added value of up to 12 times compared to when pesticides were used (I.K. Sriwana, Arkeman, Syah, & Marimin, 2017).

4.3. Kenaf

This research framework is based on developing the kenaf fibre agro-industry (KFA). KFA is part of the upstream supply chain network playing a major role in the sustainability of kenaf fibre downstream. The main focus of the SCM study is to ensure a continuous supply of raw kenaf fibre for industrial users from the midstrem to downstream industries.

Availability of kenaf fibre is very much influenced by results of its production. In order to maintain production levels, KFA must be able to maintain demand for kenaf fibre and establish responsive relationships with industrial users and consumers (online buyers).

In the Volatility Uncertainty Complexity and Ambiguity (VUCA) era, KFA faced difficulties fulfilling demands due to uncertain and unsustainable requests for kenaf. This was due to volatile and complex global conditions, which raises the ambiguity of KFA in making decisions. Therefore, in addressing demand fulfilment and supporting decision making, this study designed a smart supply chain model for use by KFA. Design of the model is supported by a collaborative inventory sub model in the supply chain network. This sub model is supported by a demand prediction sub model for industrial Supply Chain Network users (horizontal relationship) and online buyers (vertical relationship).

The demand prediction sub model is supported by a prototype facility in the form of a Decision Support System (DSS based digital platform), which is adaptive in dealing with VUCA conditions experienced by KFA. Fulfilment of responsive demand, must be a priority, comes from online buyers who are found on the free market in global networks with unlimited access. The system cannot limit access of online shoppers to transact in volatile conditions of time and demand levels. Therefore, with an adequate IDSS, the system will read data in real time in order to fulfil demands.

Adaptive IDSS includes a supply collaboration sub-model to safeguard fulfilment of volatile, uncertain, and dubious demands. In this sub-model, SPKC facilitates KFA to make decisions in determining the level of safety stocks and customer satisfaction so that demand fulfilment is always maintained in order to ensure good relations are maintained.

An inventory collaboration sub model was developed through a multipurpose metaheuristic optimization model, Particle Swarm Optimization (PSO), based on calculation of Economic Order Quantity (EOQ). Determination of the safety stock value is supported by an expert opinion that identifies service levels based on the Mamdani Fuzzy Inference System (FIS).

The demand prediction sub model, which becomes an input for the inventory collaboration sub model, uses artificial intelligence and fuzzy systems. Artificial intelligence based on neural networks is used to predict volatile and uncertain demands of online shoppers. Fuzzy system based on Fuzzy time series and Fuzzy relationships is used to predict industrial demand for kenaf fibre users in the horizontal supply chain network. This sub model will be aligned with the prototype of the IDSS digital platform that can adapt and respond to consumer demands through accountable strategic and tactical decision making.

Global developments related to demand for kenaf fibre products, apart from bark, have forced KFA to make a decision to increase the added value of kenaf fibre products. Kenaf fibre products are starting to appear on the free market. They are derived from the core of kenaf stems, namely kenaf core chip and kenaf core powder. This added value will increase the competitiveness of Indonesian kenaf globally, especially with regards to the quality (grade) of kenaf fibre produced.

Continuously increasing added value will improve performance of the KFA supply chain. KFA's performance will be monitored properly through the adaptive IDSS. The digital platform prototype will support KFA in making decisions to continuously maintain and improve its performance. Monitored performances will make it easier for KFA to be globally competitive. The research framework is presented in Figure 8.

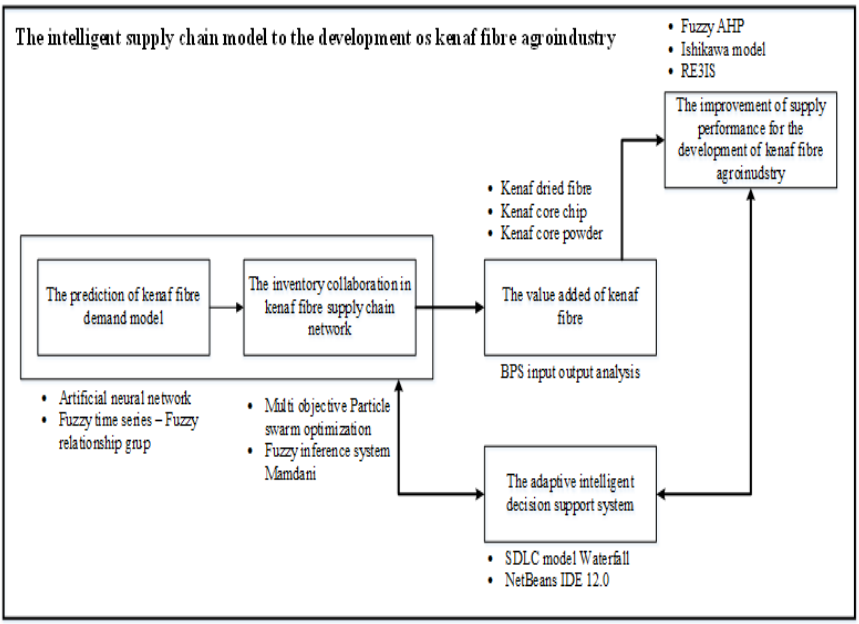

Figure 8. Research stages of kenaf fibre supply agroindustry.

5. INTERACTION AND COLLABORATION

There are three types of industry interaction (modes) among researchers: 1. educational interaction, consisting of conferences or seminars, corporate training programs, or supervising thesis work; 2. research interaction, consisting of shared publications, research-related consulting, public research programs and contract research; 3. integrated interaction, consisting of joint research in shared premises and employment contracts with companies (Kotirantaa, Antti Tahvanainen, Kovalainen, & Poutanen, 2020). The educational and research interaction modes (1 and 2) are motivated by the possibility of individual academic advancement. Integrated interaction mode (3) is rare and significantly correlates with only one of the three types of industry cooperation motivations, commercialization of research findings.

Table 3. Interaction between the three models

	Palm Oil	**Cacao**	**Kenaf**
Modelling techniques - methods	Agent-based	Agent-based	Fuzzy AHP
	Fuzzy AHP	Fuzzy AHP	SCOR v.12
	Utility equation	Soft system methodology	Web mining
		Interpretive structural modelling	Artificial neural network
			Fuzzy time series-fuzzy logical relationship
			Fuzzy inference system Mamdani
		Multi dimensional scaling	Multi objective particle warm optimization
			Fuzzy TOPSIS
			System development life cycle
Software uses	Netlogo based on Java	Netlogo based on Java	Matlab R2014a
			Net Beans IDEA 12.0 based on Java
Nature of market	Global	Global	Local and Global
	Increasing demand	Increasing value added	
	Conflicting of interests between stakeholders		
Major problems in the chain	Unfair profitability spread between agents	Unfair profitability spread between agents	Scarcity of local product
	Resistance from importing countries		
	Opposition based on global warming	Good Mfg practices	
	RSPO issues		
Goals / objectives	Balancing the added value between agents	Sustainability	Improved availability of kenaf stock
Theme	Added-value gain	Added-value gain	Added-value gain
	Access to better price for smallholder farmers	Environmental risk analysis	Supply-chain performance measurement
		Institutional aspects	Inventory collaboration in supply chain network
		Access to better prices for smallholder farmers	Prototype of IDSS

Table 4. Expected collaboration activities

Issues	Detail descriptions
Collaboration opportunities	Develop business intelligence in terms of sharing useful data, information or resources amongst all three models. Thus collaboration is a mutually beneficial arrangement.
	Collaboration provides the opportunity to learn about other disciplines, which leads to development of innovative solutions because discussion can stimulate new ideas.
	Collaboration uses the division of labor to complete tasks in a timely fashion by dividing workload according to collaborator skills. As a result, work becomes more manageable. Each assigned activity targets members with the appropriate experience or expertise.
	Collaboration provides the opportunity to lend credibility and validity to research projects.
	Collaboration with many experienced researchers facilitates ongoing research efforts as well as future collaboration.
	To integrate the supply chain sustainability of the three agro-industry products.
Future ideas	Develop smart farming projects – using IOT based tools in the farm and distribution of products.
	Data mining opportunities on various aspects (seed, market, distribution, etc)
	Use of boiler ash fertilizer from oil palm bunches on the growth of cacao seedlings.
	Apply the concept of intelligent supply chain for POSC and cacao supply chain businesses.
	Use of boiler ash fertilizer from oil palm bunches on the growth of cacao seedlings.

Later we illustrate in Table 4 what we expect to achieve in our research interaction and collaboration. We conclude by identifying future research needs, opportunities for methodological improvement and policy interventions will increase overall productivity.

(Katz & Martin, 1997) explains the enthusiasm for research collaboration: (1) understanding the concept of research collaboration; (2) researchers are dealing with essentially the same phenomenon, whether concerned with collaboration between individuals, groups, institutions, sectors or nations; (3) researchers can in some way measure the level of collaboration; (4) that more collaboration is actually better, whether for the advancement of knowledge or for exploiting the results of scientific endeavours more effectively.

The expected focus of our collaboration in conducting our research is to address mutual expectations for all parties. Each of us may have different expectations about how each person will contribute and how we will be credited. By discussing these expectations openly, it's easier for each of us to contribute to the research project effectively.

The main benefits of conducting research in collaboration with others are promoting shared scientific credits and may lead to publication in high profile research journals. It could also reduce time needed to conduct experiments quickly (through sharing of resources and information).

Table 3 shows interaction between the three models in terms of what research and modelling activities are reasonably expected to achieve. Table 4 describes expected activities and collaboration avenues that we expect to gain.

Since 2007, cooperation between 7 Industrial Engineering Departments (IED) from private Indonesian universities has resulted in yearly annual international seminars on Industrial Engineering and Management (ISIEM). This seminar has attracted hundreds of papers written by industrial engineering researchers from private, state and foreign universities. Every year the number of papers submitted, presented and discussed have increased. This increase has resulted in papers more focused within fields of research and improved quality of papers from an increasing number of countries each year. There are obviously several opportunities for cooperation and collaboration amongst all researchers in the same field of interest, be it the products or commodities, tools, methodologies or organisations.

CONCLUSION

There exist many opportunities to develop cooperation and coordination on research and studies that would benefit the palm oil, cacao and kenaf industries. Collaboration provides the opportunity to lend credibility and validity to research projects, with many experienced researchers gaining access to data and research methods to facilitate

ongoing research efforts as well as advancing further future collaborations. While not everybody has access to all data, some projects exchange data only among those involved while others share everything, data, methods/technology and results.

There always exists the opportunity to invite fellow researchers to collaborate because of the large extent of interest, facilities and available funding. Definitely the personality preferences and timing of research will determine the realization and extent of collaboration or cooperation. Internet and Zoom facilities have removed the distance problem between researchers. What's left behind is perhaps the sources of information or focus of the research open to us.

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Chapter 2

SUPPLY CHAIN PERFORMANCE MEASUREMENT FOR MANUFACTURING INDUSTRY

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ABSTRACT

The importance of SCM has grown over time and continues to grow in a ponderous trend. Researchers have been examining the adoption of SCM in different industries. SCM is gaining endless attention. Indeed, the effectiveness of SCM is impactful on the quality of product value, logistics and by extension on customer satisfaction and organizational

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profitability. Therefore, a strong and efficient relationship has to exist between manufacturers and consumers to ensure the commercial and practical achievement of manufacturers. Ideally, the performance measurement model should consider quantitative as well as qualitative approach and have the capacity to apply different measuring tools. A significant number of studies have been carried out on SC performance measurement, yet a lot of corporations were unsuccessful in implementing effective performance measurement methods in their operations. The authors have unlocked a large number of articles and models which have investigated supply chain performance measurement (SCPM). Each model has its own merits and criticisms from various reviewers and some of the most observed deficiencies from the existing performance measurement models. Based on the gap analysis, the researchers have proposed ten attributes which should be embedded into the supply chain performance measurement (SCPM) for the manufacturing industry and the ISCPM model has been developed. The ten supply chain performance measurement attributes proposed are - Financial Health (FH), Collaboration (CL), Velocity (VC), Resilience (RE), Reliability (RL), Continuous Improvement (CI), Visibility (VS), Work Place Health (WPH), Sustainability (SS), and Service Excellence (SE).

INTRODUCTION

In recent times, manufacturing organizations have witnessed the benefits of an effective SCM in day to day operations and performance evaluation of an integrated supply chain management for manufacturing industry that stimulates supply chain management (SCM) to enable business partners to escalate its efficiency to understand the bottom-line impacts of an organization from procurement, manufacturing, warehouse, distribution, customer service as well as financial aspects of an organization (Kumar et al., 2020; Saleheen et al., 2019).

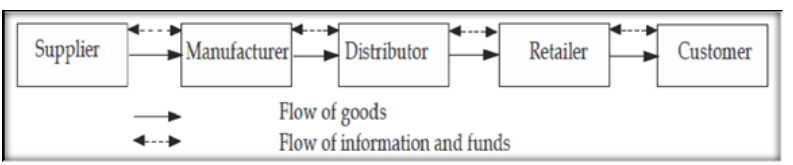

Figure 1. Flow of SCM (Huda et al., 2014).

Figure 1 depicts a basic SCM which conventionally includes suppliers, manufacturers, distributors, retailers, and customers. Every SCM prevails to satisfy customers' needs as well as to make a profit. Hence, the primary emphasis of all SCM is the customer (Elnouaman & Ismail, 2016).

DEFINITION OF SUPPLY CHAIN MANAGEMENT

American Production and Inventory Control Society conceptualized the definition of Supply Chain Management (SCM) as the process of overseeing the flow from raw materials to the consumption of end products by consumers (Frederico et al., 2019; Septiani et al., 2016). This description implies that SCM is a system that synchronizes the entire function and sub-functions of the internal and external entities of an organization. In the same line, some other authors extended the importance of emphasizing the incorporation of the information system in the definition of SCM (Agrawal et al., 2019).

In the same vein, SCM is defined practically as a chain that connects, manages and ensures the flow of products and services between manufacturers, suppliers, and customers. Furthermore, SCM is also responsible for the enhancement of competitive advantage by using an organization's operational capability, information, technology, and suppliers (Molina-Besch, 2016; Saleheen et al., 2019a).

SCM FOR THE MANUFACTURING INDUSTRY

Manufacturers have been investigating innovative methods to attain competitive leverage in consequence of globalized competition. Practically, such methods can be referred to as SCM, which has been chosen as a key measure of consideration by the analysts and experts. SCM is reflected as an effective strategic approach to enhance competitive advantage in this modern era of intense global competition, and as such,

SCM is gaining endless attention. Indeed, the effectiveness of SCM is impactful on the quality of product value, logistics and by extension on customer satisfaction and organizational profitability (Delic & Eyers, 2020; Saleheen et al., 2018; 2018a).

Against this backdrop, manufacturing is the act of using different capabilities and approaches to add value to raw materials to satisfy certain demands. Manufacturing involves innovation, arts, and creativity to invent things that have not been created before. Hence, manufacturers sometimes assume the position of suppliers and managers, managing resources and conveying their end products to end-users (Vanichchinchai, 2019). Therefore, a strong and efficient relationship has to exist between manufacturers and consumers to ensure the commercial and practical achievement of manufacturer's goals and objectives. Additionally, the core objectives of SCM are to ensure the quality, reduction of cost and time management in the cost of adding value to raw materials and conveying end products to end-users (Kottala & Herbert, 2019).

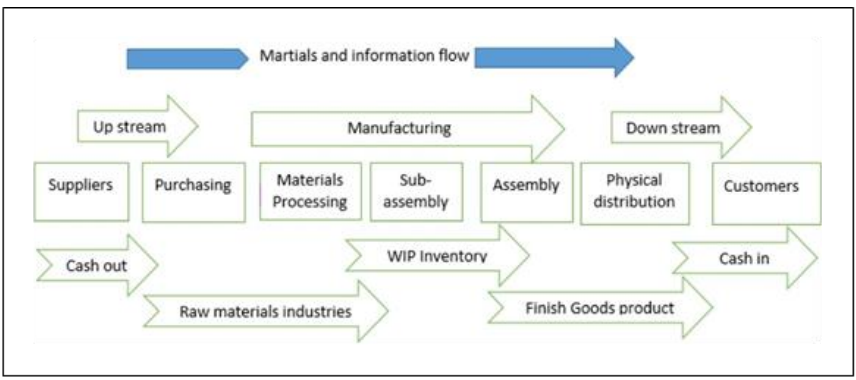

Figure 2. The flow of SCM in the manufacturing industry (Chopra & Meindl, 2016).

In the process of manufacturing illustrated in Figure 2, which involves adding value to raw materials, turning raw materials to end products and meeting consumer demand, SCM functions both in upstream and downstream of the manufacturing processes. The current intensified competition in the global market is posing some challenges to manufacturers. The myriad of challenges includes eliminating waste

products, the innovation, and diffusion of new technologies, improvement of supplier-customer relations, complying with stringent regulations, adopting efficient inventory management and ultimately improving operational and performance effectiveness (Kottala & Herbert, 2019; Chopra & Meindl, 2016; Shamsuddoha, 2015).

SUPPLY CHAIN DRIVERS

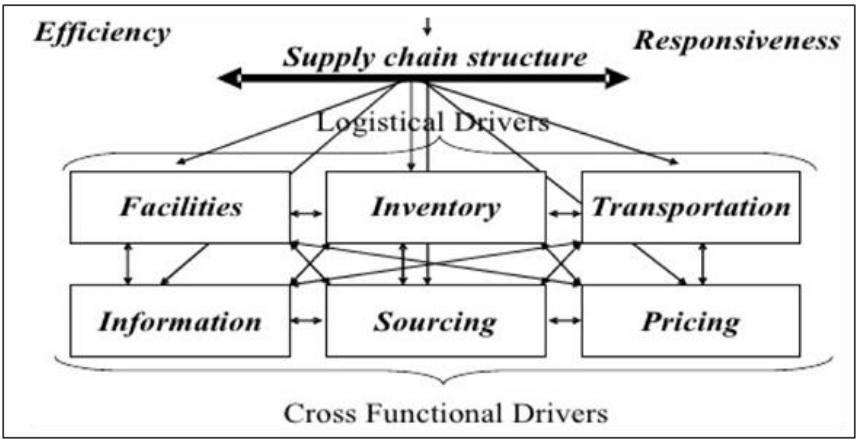

Figure 3. Supply Chain drivers (Chopra & Meindl, 2016).

In order to attain a competitive position, a company needs to be strategically equipped to formulate its supply chain (SC) strategy either through responsiveness or efficiency, where six driving forces that govern the competitive positions are - sourcing, facility, transportation, inventory, information, and pricing illustrated in Figure 3. (Shamsuddoha, 2015).

Sourcing

Four key methods to be embraced in sourcing are - concentrate on corporate resources like Nike and Dell, focus on subcontracting but expand the business like Nokia and Nortel through disruptive innovation where a

company sets its prices comparatively lower in order to gain market share and capture customers and gradually increase the price as IKEA did, and strategic repositioning where companies provide business solutions to customers instead of offering services only related to the final products like IBM did (Singh & Misra, 2020; Ye et al., 2018; Monczka et al., 2016; Saleheen et al., 2019; 2019a; 2018; 2018a).

Facilities

It involves major decisions on product, process and customer market coupled to each facility as well as the location of a facility that are to be evaluated in an SC strategy planning. When determining a place, several aspects are to be considered, such as quality, speed, dependability, flexibility, and cost (Swierczek, 2019).

Inventory

Inventory plays a crucial role in order to determine the performance of a company as most companies carry inventory in one way or another. Monczka et al., (2016) categorize that there are three types of inventory which are raw material, work in progress, and finished goods inventory. Inventory holding cost is also an important factor for an organization in order to improve its operational efficiency and increase profitability. Safety inventory also plays a significant role to support the customer during uncertainties and unforeseen situations when the demand fluctuates (Ye et al., 2018; Wang et al., 2016; World Bank, 2016a).

Transportation

Transportation plays a significant role in the operation to reach its products to its customers where cost is relatively important to measure and

determine the SC strategy. Faster transportation will increase the responsiveness but increase the cost; slower transport operations will lower the transport cost, but it increases efficiency in the cost-benefit analysis.

Information

E-commerce is a modern concept for sharing information effectively and timely among its SC network. Singh and Misra (2020) revealed that there are numerous challenges faced by a supplier or a customer in structuring themselves within an SC software. Monczka et al., (2016) reviewed that if the information is not accurate, then decision- makers would be left to work with false or hoax measurement (Chopra & Meindl, 2016).

Pricing

Researchers identified two approaches to pricing strategy, the standard linear pricing approach and the strategy matrix pricing approach. The standard linear approach includes five steps to determine the correct price - pricing based on business objective, policy-based pricing, develop a list price, discounts, and adjustments and final pricing (Singh & Misra, 2020).

SCM MACRO PROCESS FLOW

The SCM macro process can be classified into three core components - upstream, internal process and downstream (Chopra & Meindl, 2015). Supplier Relationship Management (SRM) encompasses the interaction with suppliers' supplier, supplier and the organization, and it deals with sourcing, negotiation with the supplier, purchase management, design collaboration, and supply collaboration. Internal Supply Chain Management (ISCM) concentrates on the internal operations, production

planning at the strategic level, material requirement planning, supply planning, order fulfilment, etc. All these elements are taken into consideration in the SCM Macro Process diagram illustrated in Figure 4. And finally, Customer Relationship Management (CRM) focuses on the market, call center operations and order management which are mostly the interaction between the enterprise and its customers (Chopra & Meindl, 2015; Saleheen et al., 2014; 2014a).

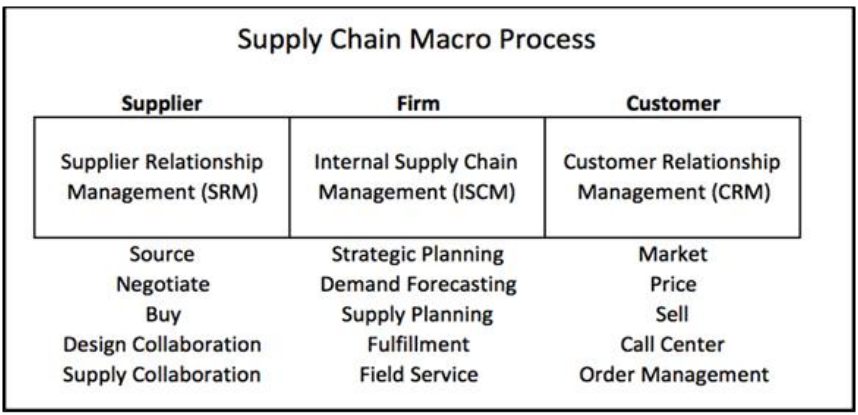

Figure 4. SCM Macro Process (Chopra & Meindl, 2015).

EVOLUTION OF SUPPLY CHAIN MANAGEMENT

The term logistics was adopted as a general concept for the physical distribution of goods. Years before the adoption of logistics for strategic and managerial purposes are known as "dormant years" (Haraburda, 2016). The military-based orientation about logistics was reviewed during the "Transformation" era in the 1950s. This was when logistics was introduced as a term for transporting tangible goods (Ballou, 1992; 2007; Saleheen et al., 2014; Saleheen et al., 2019; 2018).

The concept of Logistics was first incorporated back in the 1950s, and it got matured in the 1970s. During the 1980's Supply Chain Management (SCM) theory was incorporated in the manufacturing industry. In the years between 1992 and 1995, the perception of Balanced Scorecard (BSC), the

SCOR model was conceptualized, and the SCM was also incorporated in the service industry illustrated in Figure 5.

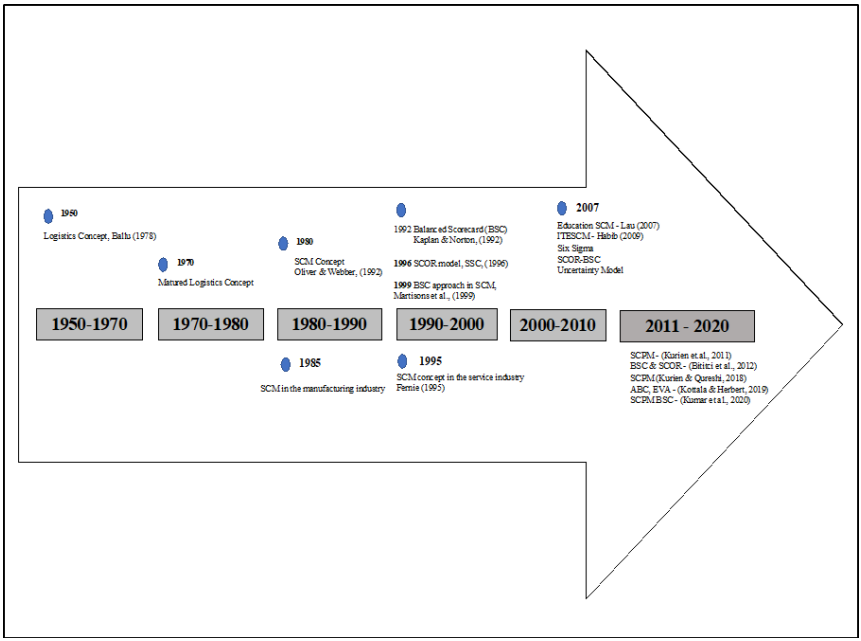

Figure 5. Evolution of Supply Chain Management.

During 2007, SCM was incorporated in the education supply chain, and the Six Sigma and the hybrid model SCOR-BSC model was also incorporated. From 2011 till 2020 Supply Chain Performance Measurement (SCPM) got priorities amongst the researchers. Alternatively, SCM was conceptualized by the logistics experts (O'Neall & Haraburda, 2017). The conceptualization of SCM was justified to approach and manage the supply chain (SC) with a unitary strategy. Hence, strategic decisions would be harmonized between the parties involved in the chain. This notion was considered unanimous among logistics and marketing theorists (Beamon, 1999). SCM is a central concept to the entire management theoretical realm. Hence, SCM resonates across so many other management aspects (Gilling & Ulmer, 2016).

Invariably, the importance of SCM has grown over time and continues to grow in a ponderous trend. Numerous researchers have examined the adoption of SCM in different industries. Besides, it also has an effect on all major departments in an organization to integrate and coordinate the flow both within and outside the organization (Hussain et al., 2019; Jeble et al., 2019; Baliga et al., 2019; Romule et al., 2019).

It is also recommended that performance measurement be well defined and concise enough for easy understanding. Taghipour et al., (2015) opined that the metric for choosing an effective performance measurement instrument should be - reliability, validity, accessibility, and relevance to the processes or the concerned personnel.

Neely et al., (2004) stated that performance measurement system is grouped into two classes - the internal and the external environment, the internal environment presents the organization itself while the external environment reflects the market within where an organization competes (Kottala & Herbert, 2019; Fosso & Akter, 2019; Sweeney et al., 2015).

Collaboration is a vital component to achieve external assimilation with other chain members, and SC collaboration necessitates a rational amount of exertion from all contributing members to warrant the accomplishment of prospective benefits (Salam, 2017; Nagashima et al., 2015). SCPM approach is divided into financial and non-financial measures. Board members and executives in an organization usually look for financial data in order to make decisions, whereas mid-level executives require more operational information.

Supply Chain Performance in Manufacturing Organizations

Manufacturing organizations have been in search of comprehensive SCM performance measurement methods, but they were not successful in developing an integrated Supply Chain Performance Measurement (SCPM) model. As of now, the Supply Chain Performance Measurement

(SCPM) is evaluated into financial and non-financial measurement system through nine different measuring tools. Business enterprises witnessed a paradigm transformation in order to evaluate SCPM, where all major global companies applied either SC Operations Reference (SCOR) model or SC Balanced Scorecard (BSC) model. In spite of incredible appreciation of the Balanced Scorecard model (BSC) in the corporate world, the model has found numerous constraints. As time goes by, these constraints becomes more noticeable. In contrast, the SCOR model was formulated to provide a business to enhance its efficiency with a vision to regulate the Supply Chain Performance Measurement (SCPM) parameters and investigate as a point of reference for enterprises and inter-link the financial statement.

The SCOR model also fails to anticipate the global outlook on market uncertainty and business risk. Multifold issues such as sustainability, visibility, and IT-related upgradations were also not covered within the SCOR model. Training and development, capacity building, a collaboration of inter and intra organizational or functional activities are not reflected either.

This research observes performance measurement for the manufacturing industry where its relevanc was established and authenticated through an exploratory study based on primary and secondary data through a self- administered questionnaire. During this approach, both quantitative and qualitative data is converged so that the research problem is analyzed and both data are collected by the investigator simultaneously within the study (Saleheen et al., 2019; 2018).

SUPPLY CHAIN PERFORMANCE MEASUREMENT GAP ANALYSIS

The authors unlocked a large number of articles, and models which have been investigated in the literature review on supply chain performance measurement (SCPM). To measure the supply chain

performance, several tools and methods which have been already applied are - the balanced scorecard (BSC) model, the SCOR model, Key Performance Indicators (KPI), Management by Objectives (MBO), total productivity management, activity-based costing, and economic value added (Kottala & Herbert, 2019; Kurien & Qureshi, 2018; Taghipour, et al., 2015; Saleheen et al., 2019; 2018).

However, the authors identified that, each model has its own merits and criticisms, which has been discussed. Therefore, based on various reviewers, some of the most observed deficiencies from the existing performance measurement models are - green organization and sustainability in Supply Chain Management (SCM), focus on resilient SCM due to increased uncertainties and risks, focus on continuous improvement in SC due to technological advancement, focus on agility in SCM due to competition and short product life, focus on e-commerce and e-SCM, focus on incorporating mathematical model or operations research technique such as analytic hierarchical process (AHP) or structural equation model (SEM) through multiple linear regression (MLR) equations, the systematic technique to select SCPM, incorporate a composed method in SCPM, application of precise metrics in SCPM, develop an integrated model in measuring SCM performance, and, performance measurement connected with the organization's mission and strategy aligned to company bottom-line financial performance (Kottala & Herbert, 2019; Kurien & Qureshi, 2018; Taghipour, et al., 2015).

Supply chain performance measurement (SCPM) supports the decision-making process through a holistic approach. It assists an organization meaningfully, where top-level executives are enthusiastic about understanding the bottom-line impacts of an organization and performance measurement parameters reflects from procurement, manufacturing, warehouse, distribution, customer service as well as financial aspects of an organization (Kumar et al., 2020).

Ideally, the performance measurement model should consider quantitative as well as qualitative approach and have the capacity to apply different measuring tools. Furthermore, the performance measurement parameters should come together in agreement with certain features like comprehensiveness, universal acceptability, and steadiness (Hussain et al., 2019).

Researchers reported that accurate measurement of performance could be beneficial to businesses in order to formulate, implement and control organizational strategy, where Agarwal et al., (2019) stated that employee motivation and organizational culture retention are also impactful in this performance measurement.

Besides, it also effects all major departments in an organization to integrate and coordinate the flow both within and outside the organization (Hussain et al., 2019; Jeble et al., 2019; Baliga et al., 2019; Romule et al., 2019). It is also recommended that performance measurement be well defined and concise enough for easy understanding. Taghipour et al., (2015) opined that the metric for choosing an effective performance measurement instrument should be - reliability, validity, accessibility, and relevance to the processes or the concerned personnel. Neely et al., (2004) stated that performance measurement system is grouped into two classes - the internal and the external environment, where; the internal environment presents the organization itself while the external environment reflects the market within where an organization competes (Kottala & Herbert, 2019; Fosso & Akter, 2019; Sweeney et al., 2015). Collaboration is a vital component to achieve external assimilation with other chain members, and SC collaboration necessitates a rational amount of exertion from all contributing members to warrant the accomplishment of prospective benefits (Salam, 2017; Nagashima et al., 2015). SCPM approach divided into financial and non-financial measures. Board members and executives in an organization usually look for financial data’s in order to make decisions, whereas mid-level executives require more on operational information (Saleheen et al., 2019; 2018; 2014; 2014a).

BALANCED SCORECARD MODEL

Despite an incredible appreciation of the Balanced Scorecard model (BSC) in the corporate world to evaluate supply chain performance measurement (SCPM), the model has multifold constraints.

As time passes by, it becomes more noticeable - the model did not think through leadership or capacity building to assess its performance, it is also considered as an observing and monitoring apparatus instead of a development apparatus and inclined towards strategic level as opposed to planning or operational level (Kottala & Herbert, 2019; Kurien & Qureshi, 2018).

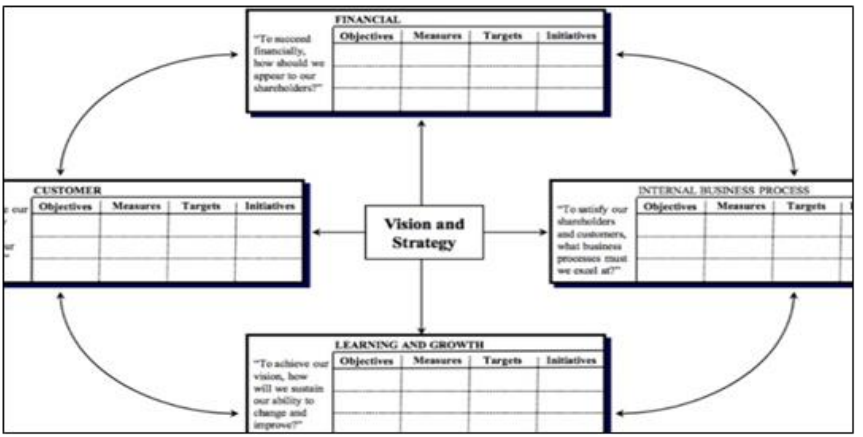

Figure 6. The Balanced Scorecard Model (BSC, 2019).

SUPPLY CHAIN OPERATIONS REFERENCE MODEL (SCOR)

In contrast, the SCOR model was formulated to provide a business to enhance its efficiency with a vision to regulate the supply chain performance measurement (SCPM) and investigate as a point of reference for enterprises and inter-link the financial statement. The SCOR model is

unsuccessful in anticipating the global outlook on market uncertainty and business risk. Multifold issues such as sustainability, visibility, and IT-related upgradations were not also shielded within the SCOR model, training and development, capacity building, a collaboration of inter and intra organizational or functional activities are not also reflected (Shokouhyar et al., 2020; Khanuja & Jain, 2019; Shamsuddoha, 2015).

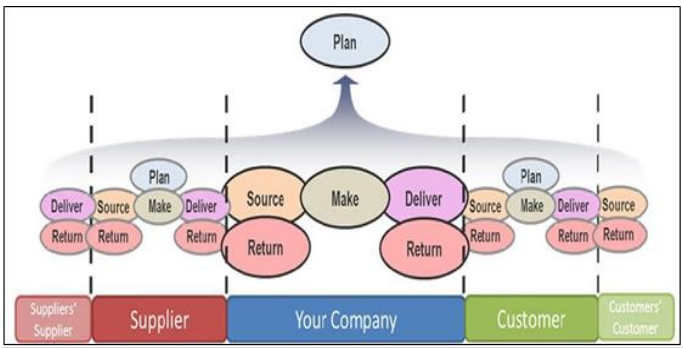

Figure 7. The SCOR model (SCOR 10, 2012).

The summary of constraints and critics of different models and frameworks on supply chain performance measurement (SCPM) are as follows:

Lack of a methodical technique (Kurien & Qureshi, 2018). Nonexistence of a balanced approach (Kurien & Qureshi, 2018; Taghipour et al., 2015). Multiple metrics and measures (Kurien & Qureshi, 2018; Taghipour et al., 2015). Supply chain attributes and performance measurement index are not established, connecting with bottom-line impacts of an organization (Kurien & Qureshi, 2018; Taghipour et al., 2015). Absence of provision for benchmarking (Kurien & Qureshi, 2018; Sachin & Gunasekaran, 2020). Lack of association with the organization's mission and strategy (Kurien & Qureshi, 2018). Failure in addressing the practicalities of measurement (Kurien & Qureshi, 2018). Lack of methodical thinking of measuring SC as a whole (Kottala & Herbert, 2019). Lack of systematic method for prioritizing measures (Taghipour et al., 2015).

Alternatively, the SCOR model does not contemplate market uncertainty, where information visibility, IT-related issues, business sustainability, training and development, capacity building, etc., are also excluded in the scope of the SCOR model. No clear interaction of inter and intra organizational or functional activities are mentioned in the SCOR model (Kurien & Qureshi, 2018; Frederico et al., 2019).

TIMELINE OF SUPPLY CHAIN PERFORMANCE MEASUREMENT

The timeline of Supply Chain Performance Measurement (SCPM) is as follows:

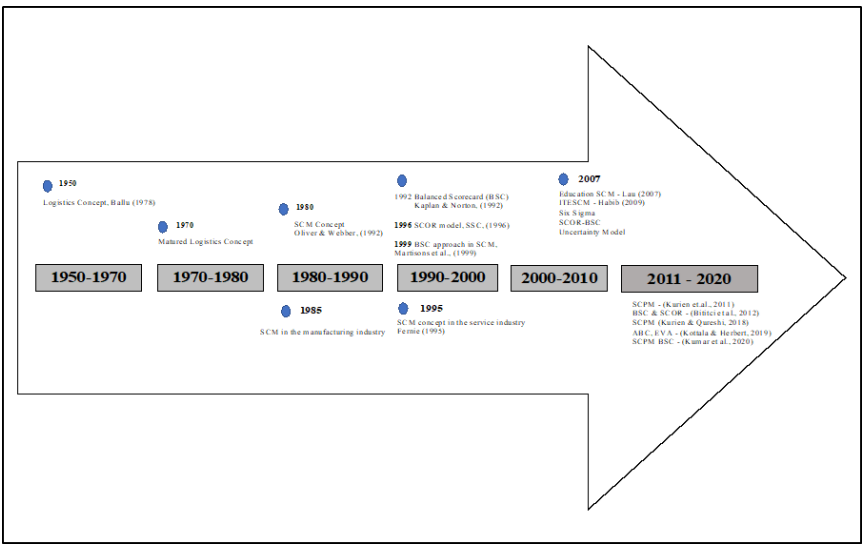

Figure 8. Timeline of Supply Chain Performance Measurement.

The term logistics was adopted as a general concept for the physical distribution of goods. The years before the adoption of logistics for strategic and managerial purposes are known as “dormant years” (Haraburda, 2016). The military-based orientation about logistics was

reviewed during the "Transformation" era in the 1950s. This was when logistics was introduced as a term for transporting tangible goods (Ballou, 1992; 2007). Alternatively, SCM was conceptualized by the logistics experts (O'Neall & Haraburda, 2017). The conceptualization of SCM was justified to approach and manage the supply chain (SC) with a unitary strategy. Hence, strategic decisions would be harmonized between the parties involved in the chain. This notion was considered unanimous among logistics and marketing theorists (Beamon, 1999). SCM is a central concept to the entire management theoretical realm. Hence, SCM eliminates across so many other management aspects illustrated in Figure 8 (Gilling & Ulmer, 2016; Saleheen et al., 2019)

Invariably, the importance of SCM has grown over time and continues to grow in a ponderous trend. Numerous researchers have examined the adoption of SCM in different industries.

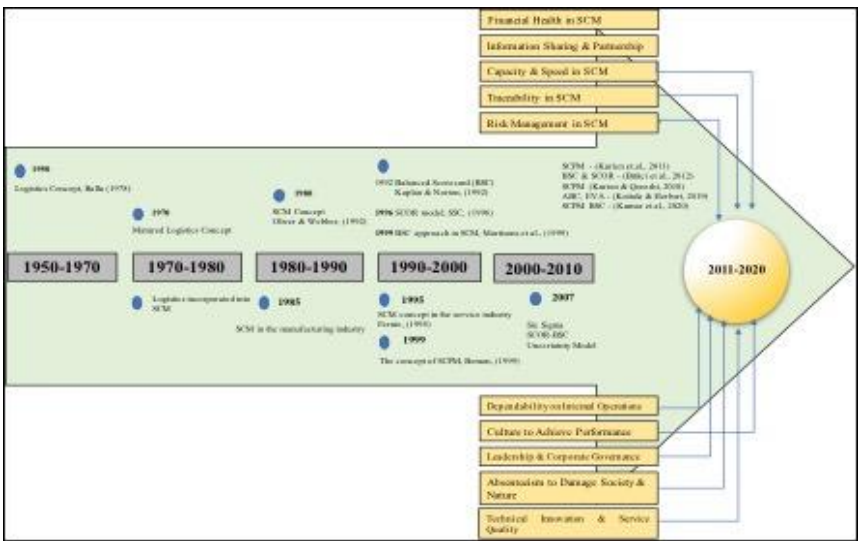

Figure 9. Evolutionary timeline of SCM (Habib, 2017).

ATTRIBUTES OF SUPPLY CHAIN PERFORMANCE MEASUREMENT

Based on the gap analysis, the researcher has proposed ten attributes which should be embedded in supply chain performance measurement (SCPM) for the manufacturing industry are as follows:

FINANCIAL HEALTH (FH)

The transaction of financial assets in SCM is the focal point for SCM professionals, where the accountability of a finance manager begins from the funding, capital budgeting, analysis of suitable ventures and ends once the payment from the customer is deposited to the bank. Incorporating enterprise resource planning (ERP) software with financial SCM that channels the information flows to internal parties, external parties and escalates the reliability and quality of the financial information (Calle et al., 2019; Alora & Barua, 2019; Baymout, 2015; Xiangfeng et al., 2017; Alora & Barua, 2019; Chen, 2018; Ali et al., 2018).

COLLABORATION (CL)

The idea of collaboration has been recognized in SC as CPFR which stands for collaborative planning forecasting and replenishment. One of the constituents of collaboration is a collaborative culture that consists of an exchange of information, openness, communication, mutuality, and trust, etc. A collaborative culture is to accept, share, nourish information, and trust is extremely important (Narasimhan et al., 2015; Salam, 2017; Panahifar et al., 2018; Nagashima et al., 2015; Soosay & Hyland, 2015; Maghsoudi & Pazirandeh, 2016; Barratt, 2004)

VELOCITY (VC)

Due to market dynamics, demand fluctuations and technological innovations, the vocabulary of competitiveness has developed abruptly where it is influenced by the ability to reduce cycle time, lead time, total SC cost (TSCC), improving customer service level, and product quality. The ultimate challenge for a SC is to secure a balanced composition of efficiency and responsiveness towards its products and services, where a firm has been directed to design its SC more efficient considering its TSCC, SC cycle time and time to market (Taghipour et al., 2015; Kurien & Qureshi, 2018).

VISIBILITY (VS)

SC transparency, visibility and information sharing between the SC partners is a pre- requisite where availability of authentic data can increase the SC visibility. In a rapidly changing and competitive business environment, an organization views its SC and its network as a critical determinant of efficiency and effectiveness where short product lifecycle and rapid market fluctuations trigger a higher level of bullwhip-effect in operation

(Shamsuddoha, 2015; Sundram et al., 2018; Maghsoudi & Pazirandeh, 2016).

RESILIENCE (RE)

Managing risk in a borderless economy is getting exponentially challenging due to uncertainties in demand & supply to shorter product lifecycles to outsourcing. In reality, business is harshly influenced by multifold factors such as financial unpredictability, merger & acquisition, the innovation of technologies, e-business, shorter time-to-market etc., that

pushes organizations to embrace a smarter way of doing business (Chen, 2018; Panova & Hilletofth, 2018; Kurniawan et al., 2017; Panova & Hilletofth, 2018; Chen, 2018).

RELIABILITY (RL)

In order to ensure reliability in the SC, a dependable association between the partners and mutual conviction in each other's abilities and undertakings is essential. An increase in assurance and conviction between the associates and conceiving trustworthiness from them enhances a sustainable success in the SC. Three-level operational evaluation metrics are supported by the SCOR model. The level one metric assesses the management, level two and level three comprises more precise and comprehensive principles with regards to the classifications and fundamentals of the methods (Garay-Rondero et al., 2019; Chen, 2018).

CONTINUOUS IMPROVEMENT (CI)

In a borderless economy having enormous uncertainty, fierce rivalry, business firms are enforced to bring innovation in design, quality and support services where Japanese companies have demonstrated their supremacy through bringing a concept of Kaizen, where the core beliefs are troubleshooting and paying attention on continuous improvement. Continuous improvement is synonymous with everyday run-of-the-mill up-gradation from production processes, and services that affect the perfection of the quality, productivity and cost reduction (Antony & Sony, 2019; Kumar et al., 2020; Bacoup et al., 2019; Zhang, 2017; Garay-Rondero et al., 2019; Sreedharan et al., 2019; Kumar et al., 2019;

WORK PLACE HEALTH (WPH)

Leadership in an enterprise has a twofold management style to perform in a positive direction for individuals as well as for the whole organization to foster an outlook and build a working principle to empower an individual to lead the organization at all decision levels. It is imperative to make the most of the strengths and efficiently manage the weaknesses of an organization as well as individuals in order to be successful. Simultaneously, a successful leader should not only be capable of thinking strategically and have an understanding of the vision of an organization but also have the aptitude to accomplish and communicate that vision effectively. The fundamentals of leadership are ethics and transparency, commitment, fairness, and respect for the individual (Sabiu, 2019; Zhang, 2017).

SUSTAINABILITY (SS)

The most debated and intensifying environmental alarm for customers is to have a superior awareness on whether corporations are instigating to offer green alternatives for their traditional products and services, where at the moment all major global companies have pronounced the initiative towards green operations whether products are being sold or being processed through firms. Irrespective of all these, firms generate a contradictory management strategy such as profitability, product quality, high return on investments, etc. Therefore, organizations face hurdles in order to bring sustainable SCM (Beske-Janssen et al., 2015; Tuni et al., 2018; Baliga et al., 2019; Shokri Kahi et al., 2017).

SERVICE EXCELLENCE (SE)

Organizations need to focus on improving the quality service and overall process in order to attain customer satisfaction. As we enter a truly borderless free-trade economy, companies strive to safeguard their market position to establish its longstanding customer relationship (Garay-Rondero et al., 2019; Kumar et al., 2020) (Ghadge et al., 2020; Antony & Sony, 2019; Kumar et al., 2020).

CONCLUSION

This study has developed the ISCPM model which incorporates ten comprehensive attributes to evaluate the supply chain performance for the manufacturing industry to address issues for all its stakeholders that have an impact on the organizational bottom-line performance, vision, mission, values, and objectives. A significant number of studies have been carried out on designing a comprehensive performance measurement framework model. Yet, a lot of corporations were unsuccessful in implementing an effective performance measurement methods in their operations. Despite an incredible appreciation of the Balanced Scorecard model (BSC) in the corporate to evaluate supply chain performance measurement (SCPM), the model has found multiple constraints. In contrast, the SCOR model was formulated to assist a business to enhance its efficiency with a vision to regulate the supply chain performance measurement (SCPM) and investigate as a point of reference for enterprises and inter-link the financial statement.

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Chapter 3

SUPPLY CHAIN MANAGEMENT EFFICIENCY: FOCUS ON INDIAN FRUITS AND VEGETABLES MARKETS

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ABSTRACT

India is known as the fruit and vegetable basket of the world. It is the second largest producer of overall fruits and vegetables production in the world after China and one of the centers of origin of fruits and vegetables. This chapter examines the existing position of fruits and vegetables sector in India and tries to give a conceptual coverage of supply chain management, the supply chain relating to fruits and vegetables sector. The efficiency of fruits and vegetables supply chain is analyzed and the need and importance of the research for efficient supply chain in fruits and vegetables sector has been discussed. It has been

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evident from the literature that the fruits and vegetables supply chain is highly inefficient. This chapter undertakes a thorough review of basic and contemporary literature available and attempts to identify the business problem in the supply chain of fruits and vegetables sector in India.

Keywords: supply chain management, fruits and vegetables sector, supply chain efficiency

1. INTRODUCTION

In the emerging economies as well as matured markets, the power of the buyer has overtaken that of the customer. As the world grapples with the human and economic crisis unraveling before us, supply chains are finding themselves squarely within the public eye and experiencing unique challenges of their own. The highly competitive global marketplace and the pressure on organizations to find new ways to create and deliver value grow even stronger. The rules are different in a buyer market. Customer service becomes a key differentiator as the sophistication and the demands of customers continually increase, in particular. At the same time, market maturity combined with new sources of global competition has led to over capacity in many industries leading to an inevitable pressure on prices.

Supply chains are showcasing singular resourcefulness and adaptability, though the challenges are far from over. But the outcome may be fundamental changes and a whole host of managers and regulators who find it second-nature to rethink global models and supply dependencies. Supply chain management plays an integral role in keeping business costs minimum and profitability as high as possible.

The challenge in supply chain management is to maintain all the three flows: a) the product flow, b) the information flow, and c) the finances flow in an efficient manner, resulting in optimal results for farmers, growers, wholesalers and customers. Despite rapid growth of the services and industries sector as globalisation leads to assimilation of foreign technology and practices, agriculture continues to live in medieval times.

India's food supply chain leads to massive wastage and inefficiencies with 30% of India's vegetable and fruit produce being wasted. The inadequate supply chain leads to periodic shortages of food items used by the Indian part of the daily diet. Onion prices have hit around Rs. 70-100 per kg. In the Indian market, there exist two different kinds of supply chain in the fresh fruits and vegetables market.

Fisher states that the root cause of the product availability problem in present-day supply chains is a mismatch between the type of product and the type of supply chain. Supply chains that deal with functional products should focus on 'efficiency/leanness' to minimize the physical costs related to production, transportation and inventory storage. On the other hand, supply chains that deal with innovative products should be designed focusing on 'responsiveness/agility' to minimize market mediation costs, i.e., the cost that arises when the variety of products reaching the marketplace does not match what consumers want to buy resulting in lost sales opportunities and dissatisfied customers. India is known as fruit and vegetable basket of the world. It is the second largest producer of overall fruits and vegetables in the world after China and one of the centers of origin of fruits and vegetables with the total production of 97.4 million tonnes of fruits and 184.4 million tonnes of vegetables till the year end 2018 (NHB, 2018). It has the potential to be the world's largest food producer which is bestowed with one of the best natural resources in the world and several factors like increasing urbanization, nuclear families, working women, disposable income and changing lifestyles that are gearing up the Indian food supply chains for a better future.

Organized retail and private label penetration, demand for functional food, and increased spend on health food are major drivers for the growth of this sector (Viswanadham, 2007). As the population is increasing, the demand for such food is also increasing. To meet such demand and provide food of proper quality and nutrition, supply chain plays a very vital role in this sector and becomes even more important because of perishability and very short shelf life.

1.1. Significance of Fruits and Vegetables

The scenario of horticulture crops in India has become very encouraging. The percentage share of horticulture output in agriculture has become 33%. Under the purview of agriculture and allied activities, the share of plan outlay for horticulture which was 3.9% during the IX Plan, has increased to 4.6% during the XII Plan. Currently horticulture has established its credibility in improving income through increased productivity, generating employment and in enhancing exports. Resultantly, horticulture has moved from rural confines to a commercial venture in general, focusing on vegetables and fruits in particular.

1.2. Production

India has witnessed increase in horticulture production over the last few years. Significant progress has been made in the expansion in the area under cultivation resulting in higher production. Over the last decade, the area under horticulture grew by 2.6% per annum and annual production increased by 4.8%. During 2017-18, the production of horticulture crops was 311.71 million tonnes from an area of 25.43 million hectares. The production of vegetables has increased from 101.2 million tonnes to 184.40 million tonnes since 2004-05 to 2017-18 and the production of fruits has increased from 50.9 million tonnes to 97.35 million tonnes from 2004-05 to 2017-18. In 2017-18, the total horticulture production was the highest in Uttar Pradesh (392.48 lakh tonnes), among Indian states, followed by West Bengal (324.2 lakh tonnes). The total production of fruits was the highest in Andhra Pradesh (152.15 lakh tonnes) followed by Maharashtra (117.28 lakh tonnes). Apart from nutritional benefits, the production of vegetables improves the economy of the country as these are very good source of income and employment. The contribution of vegetables remains highest (59%- 61%) in horticulture crop productions over the period from 2012-13 to 2017-18.

India witnessed the shift in area from food grain towards horticulture crops over the five years, from 2012-13 to 2017-18. The production of horticulture crops has outpaced the production of food grain since 2012-13 (Horticulture Statistics at a Glance, 2018, GOI).

1.3. Prices and Arrivals

Prices of agricultural commodities fluctuate in accordance with their supply and demand situation which, in turn, is characterized by seasonality of production and marketing. Horticulture commodities are produced seasonally and are perishable. On account of these characteristics, such commodities register fluctuation of prices from month to month. These fluctuations ultimately affect the return to the growers. The difference between retail and wholesale prices reveals the margin of various intermediaries involved in the sale and purchase of potato, onion and tomato. This would also throw light on the incidence of fiscal measures, e.g., taxes, freight rates and transportation (ibid, 2018).

1.4. Infrastructure Availability

In India because of imperfect coordination between supplies and demand, seasonality and perishable nature of horticulture crops, storage plays an important role in the supply chain. A chain of cold storages are set up in different states of India. The state of Uttar Pradesh (2368) was having highest number of cold storage followed by Gujarat (890) and Punjab (672).

1.5. Consumption

The nutritional intake from fruits and vegetables is higher among the urban population than that of the rural population. Along with the

urbanization, people are likely to increase their calorie intake at a higher pace through fruits and vegetables -the increase in calorie intake is more than 10% in the urban area, whereas it is merely 1.89% in the rural area over the period from 2004-05 to 2011-12. It is estimated that per capita fruits availability in our country is 207.9 grams per day, which is far below the recommended quantity of 230 grams per capita per day.

1.6. Trend in Fruits and Vegetables Production

The Table 1 shown below depicts the trends in total horticulture production in India for five years from 2013-14.

The Table 2 presents a consolidated statistics on Fruits and Vegetables production in India.

Table 1. Percentage share of production of various horticulture crops in total horticulture during the period from 2013-14 to 2017-18

Crops	2013-14	2014-15	2015-16	2016-17	2017-18
Fruits	32.1	30.8	31.5	30.9	31.2
Vegetables	58.7	60.3	59.1	59.3	59.2
Flowers and Aromatics	1.0	1.1	1.1	1.1	1.2
Plantation Crops	5.9	5.5	5.8	6.0	5.8
Spices	2.1	2.2	2.4	2.7	2.6
Total Horticulture	100.0	100.0	100.0	100.0	100.0

Source: Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare

Table 2. Production of fruits and vegetables for three years

Crops	2015-2016		2016-2017		2017-2018	
	Area (in '000 Ha)	Production (in '000 MT)	Area (in '000 Ha)	Production (in '000 MT)	Area (in '000 Ha)	Production (in '000 MT)
Total Fruits	6301	90183	6373	92918	6506	97358
Total Vegetables	10106	169064	10238	178172	10259	184394

Note: Self compiled.

Source: Agricultural Statistics at a Glance, 2018, Directorate of Economics and Statistics, Ministry of Agriculture, GOI

The Table 3 exhibits where India stands in the world agriculture scenario as on 2016.

1.7. World Scenario

India is the second largest producer of vegetables and fruits, and its presence in the global market is significant (Table 3). The different types of fruits are exported to the outside world. Grapes occupy the premier position in exports. Other fruits which have attained significant position in exports are banana and mango. Fresh vegetable (e.g., onion, peas, and potato) exports have been on the rise. The development achieved in the horticulture sector is indicative of the fact that there is growing demand for horticulture produces. The past experiences have been rewarding for enhanced output from the investment. Availability of timely robust information and efficient Supply Chain Management in this sector will certainly improve the socio-economic conditions of Indian citizens by providing self-reliance besides environmental protection.

2. SUPPLY CHAIN CONCEPTS

Supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hand of the ultimate customer (Christopher, 1998). In other words, a supply chain consists of multiple parties/firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the final consumer. It is the planning and control of the flow of total material from suppliers to manufacturers to distributors and finally to the end users (Jones and Riley, 1985). Ballou (2004) says that supply chain refers to all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users.

Table 3. India's position in world agriculture in 2016

S. No.	Item	India	World	India's		Next to
				Share%	Rank	
1. Area (Million Ha)						
	Total Area	329	13466	2.4	7th	Russia Federation Canada USA China Brazil Australia
	Land Area	297	13009	2.3	7th	Russia Federation Canada USA China Brazil Australia
	Arable Land	159	1411	11.3	2nd	USA
2. *Population (Million)						
	Total	1311	7349	17.8	2nd	China
	Agriculture	661	2617	25.2	2nd	China
3. *Economically Active Population (Million)						
	Total	491	3282	15.0	2nd	China
	Agriculture	267	1310	20.4	2nd	China
4. Crop Production (Million Tonnes)						
4.1	Total Cereals	294	2849	10.3	3rd	China USA
	Wheat	93.5	749.5	12.5	2nd	China
	Rice (Paddy)	159	741	21.4	2nd	China
	Total Pulses	17.6	82	21.5	1st	
4.2	Oil Seeds					
	Groundnut (in shells)	7	44	15.6	2nd	China

S. No.	Item	India	World	India's		Next to
				Share%	Rank	
	Rapeseed	6.8	69	10	3rd	Canada China
5. Fruits and Vegetables (Million Tonnes)						
	Vegetables and Melons	120	1075	11.2	2nd	China
	Okra	5.5	9	62	1st	
	Potatoes	44	377	11.6	2nd	China
	Tomato	18.4	177	10.4	2nd	China
	Onion (Dry)	19.4	93.2	21	2nd	China
	Cabbages and Other Brassicas	9	71.2	12.3	2nd	China
	Cauliflower and Broccoli	8.2	25.2	32.5	2nd	China
	Brinjal	12.6	51.3	24.5	2nd	China
	Fruits excluding Melons	91	866	10.5	2nd	China
	Banana	29.1	113.2	25.7	1st	
	Mango, Mangosteen and Guava	18.8	46.5	40.4	1st	
	Lemon and Lime	3	17.3	17.2	1st	
	Papaya	5.6	12.6	44.4	1st	
6. Commercial Crops (Million Tonnes)						
	Sugar Cane	348	1891	18.4	2nd	Brazil
	Tea	1.3	6	21.0	2nd	China
	Coffee (Green)	0.35	9.22	3.8	7th	Brazil Vietnam Colombia Indonesia Ethiopia Honduras
	Jute and Allied Fibers	1.9	3.3	57.4	1st	
	Cotton (Lint) - 2014	6.1	26.6	23.6	1st	
	Tobacco Leaves	0.8	6.7	11.4	2nd	China
7. Livestock (Million Heads) - 2014						
	Cattle	187	1474	13	2nd	Brazil
	Buffaloes	110	194	57	1st	Somalia Sudan

Table 3. (Continued)

S. No.	Item	India	World	India's		Next to
				Share%	Rank	
7. Livestock (Million Heads) - 2014						
	Camels	0.4	27.7	1.4	12th	Kenya Niger Chad Mauritania Ethiopia Pakistan Mali Somalia Sudan Yemen UAE
	Sheep	63	1196	5.3	3rd	China Australia
	Goats	133	1011	13	2nd	China
	Chicken	0.7	21.4	4	7th	China USA Indonesia Brazil Iran Pakistan
8. *Implements (000' numbers)						
	Agriculture Tractors-in-use	3149	29320	1027	2nd	USA
9. Animal Products (2014)						
	Total Milk ('000 MT)	121847	723143	16.8	1st	
	Total Eggs ('000 MT)	3378	69103	4.9	3rd	China USA
	Total Meat ('000 MT)	6190	295462	2.1	5th	China USA Brazil Germany

Note: Self compiled. *Figure related to 2007.

Source: Agricultural Statistics at a Glance, 2018, Directorate of Economics and Statistics, Ministry of Agriculture, GOI

According to Simchi-Levi et al. (2008), Supply Chain Management (SCM) may be defined as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements. It involves many independent organizations and develops through intra and inter-organizational integration and coordination encompassing the initial stage to the end user. It includes a two-way flow of materials, services and information, and the related managerial and operational tasks. It aims at providing high value to customers with appropriate resource utilization, and building competitive advantage (Cooper et al., 1997).

The key elements involved in a supply chain are customer value, competitive advantage and integration and coordination. Customer needs can be met efficiently with Efficient Customer Response (ECR) which is based on efficient assortment, replenishment, promotions and new product development. All these are dependent upon the range of products, its pricing, and the management of space in the retail outlet.

Competitive advantages to any firm come through enhancement of productivity and value. Advantage of productivity accrues by achieving better results with minimum resource utilization compared to others. Value emanates by providing customized products or services, reliability and responsiveness, which require innovation and resources (Christopher, 1998). Integration and Coordination come through partnership in the supply chain which requires healthy interactions among the partners over time, with sharing of information, risks and rewards (Ellram and Krause, 1994).

3. FRUITS AND VEGETABLES SECTOR - SUPPLY CHAIN

Over the years, the definitions have changed and broadened the scope of SCM, but these definitions are still limited to manufactured products and services with little attention being paid to agriculture. Fruits and

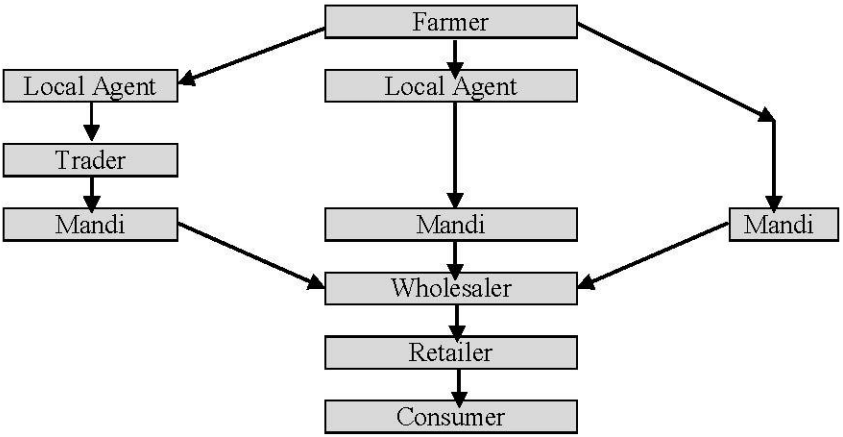
Vegetables constitute a major part of the world economy and are the raw material for many industries. Among the agricultural produce, perishable food produce like fruits and vegetables have got the least attention. The SCM of fruits and vegetables constitute the processes from production to deliver of the agro-fresh produce, i.e., from the farmer to the customer. The SCM of fruits and vegetables is complex as compared to other SCM systems due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for food safety and quality (Vorst and Beulens, 2002), and dependence on climate conditions (Salin, 1998). The existing supply chain in the fruits and vegetables sector involves many intermediaries (Figure1) who eat up all the share of about 75 percent of the total net margin accruing to the entire supply chain (Modi et.al., 2009). From a farm gate to a consumer, a horticulture product passed through six-seven different distribution channels (Viswanadham, 2007).

Fruits and Vegetables produced in the farmer's field reaches the end consumer through a chain of intermediaries. These intermediaries carry out various functions, such as transfer of ownership of commodities, its movement, maintenance and preservation of quantity and quality, payment to the seller and commodity delivery to the buyer (Halder and Pati, 2011).

The commission agents and local traders perform the function of aggregators. On behalf of big traders they procure fresh produce from small growers. Some big farmers used to sell their produce directly to the Local Mandis (marketplace).

Mandi (market) system has a number of inefficiencies like non-transparent price setting where seller and buyer are often cheated, high losses due to non-scientific handling and storage. There exists inadequate infrastructural support leading to high losses, as high as 40 percent in the case of fruits and vegetables. Usually, farmers prefer to sell their produce to local agents or traders rather than selling directly to Mandi.

Sidhu et al. (2010), in their study found that more than 90 percent of the produce was disposed through commission agents/wholesalers and a small proportion sold through retailers and directly to consumers. All the links from farmers to end user of the commodity constitute the supply chain of the fruits and vegetables sector in India.



Note: Self compiled. Source: Modi et al., 2009

Figure 1. Supply chain for fruits and vegetables sector in India.

3.1. Fruits and Vegetables Sector - Supply Chain Players in India

There are several players involved in fulfilling the needs of the consumer in the supply chain management of fruits and vegetables. Those are farmers, local traders, agents (commission agents), transporter, auctioneers, wholesalers, processors, traditional retailers of all types of formats, family run stores, roadside shops, pavement shops and cart vendors apart from farmers and customers. Farmers are the cultivators of produce and source of supply. They are small by land holding and yield volume of crop and are highly fragmented across geographical areas. Agents, auctioneers, and wholesalers are traders in this supply chain. Agent and auctioneers are the first level of middlemen in this supply chain and transfer commodity from producers to wholesalers. Numbers of transfers of ownership as well as transshipments of fruits and vegetables depend upon the number of agents present between farmers and wholesalers. An agent operates from shops of small space, works for one or more wholesalers and normally deals with a particular range of fruits

and vegetables. The traditional retailers buy vegetables from wholesalers and sell directly to customers.

Farmers may sell the produce directly to the consumers or to traders or manufacturers, without or after storage of the fresh produce; cold storage units; food processing entities; packaging units; wholesalers or distributors; retail chains or other form of retailers; hotels, restaurants, caterers; and consumers. The consumers may get the fresh produce from the farmers directly or through a combination of the different players in the supply chain.

The supply chain may pass through all the stages referred above or only through some of them. Some farmers may sell their produce on the farm itself to the intermediaries. Some may sell to the trader through a local commission agent. Some big farmers with large land size holdings may sell directly to the Mandi. Some may keep a small part of the produce for consumption and sell the rest. These approaches provide low return to the farmer. If the produced is stored and sold according to the favorable marketing condition, then, the return will be higher. But the farmers do not store any produce because of the lack of a storage facility.

The processing of fruits and vegetables will add value to it. Only primary processing is done by the farmers which include manual sorting and grading, packaging, etc. Generally food items are processed by the firm who are involved in the business of export, processing units, etc.

3.2. Cold Chain

A cold chain protects a wide variety of fruits and vegetables produce from deterioration in the whole supply chain by providing temperature controlled facility. It is a logistic system that provides a series of controlled temperature storage and transport conditions from the point of origin to the point of consumption, i.e., from farm to fork. It saves fresh produce from degradation, humidity, improper expose to temperature and keeps them frozen, fresh and chilled (Bishara, 2006). Any disorder in temperature or

time-distance in the cold chain could hamper the net present value and their added value (Bogataj et al., 2005).

The cold chain starts at farm level and covers up to the consumer level in a temperature- controlled practices and behavior. Cold chain infrastructure generally consists of grading, sorting, packing, storage, processing and transportation facilities.

Cold chain is Rs 62,000-crore industry in India and is growing at a rate of 20 percent. India has 6,300 cold-storage facilities with a capacity to hold 30 million tons of products. Almost 40 percent of fruits and vegetables, worth about Rs 13,000-crore, go as waste. In a research study conducted on the supply chain of fruits and vegetables in Uttarakhand suggested that there was an improper supply chain management, lack of cold chain infrastructure and food processing units which were leading to maximum inefficiencies and resulting in losses and wastage of fruits and vegetables in Uttarakhand and India as a whole (Negi and Anand, 2015).

3.3. Cold Storage Gap

In 2010, the cold storage gap was about 370 lakh MT on the basis of peak season production and highest arrival/harvesting of storable Fruits and vegetables in a month (NCCD, 2012). The existing cold storage facilities are available only in the wholesale market or nearer to that market. The local market or regional market does not have the cold storage facility where the major fresh produce is sold by the farmer (Negi and Anand, 2014). Supply chain of perishable food requires proper controlled temperature to maintain and sustain the quality as well as to increase the shelf life of the produce and make them easily available to the customer in a quality manner, but the weak and ill-equipped cold chain infrastructure (Rathore et al., 2010), improper marketing systems and facilities (Gauraha and Thakur, 2008; Singh et al., 2008) of the country has become the major impediments in the growth of the sector.

4. Supply Chain Efficiency

Efficiency, according to Beamon (1998), is the measurement of how well the resources expended are utilized. In general, it describes the extent to which time, effort or cost is well used for the intended task or purpose. It is often used with the specific purpose of relaying the capability of a specific application of effort to produce a specific outcome effectively with a minimum amount or quantity of waste, expense, or unnecessary effort. Supply chain efficiency is how well the resources are utilized in the supply chain.

Efficiency is the measure of how well the resources are utilized (Beamon, 1999). Three perspectives to create value for customers are economic, market and relevancy value (Bowersox et al., 2000).

The future market leaders will be the ones that have achieved cost and service leadership (Christopher, 1998). The success of supply chains is composed of customer service, capital employed, and total cost (Collin (2003). There is an excellent supply chain when a company provides products of high quality (De Meyer et al., 1989).

The overall objective of any logistics system is to maximize profitability (Dornier, 1998). There is an excellent supply chain when a company provides products at low cost (Goonatilake, 1990). There is excellent Supply chain when a company provides products with short lead-time (Hoover et al., 2001).

There will be an excellent supply chain when a company provides the required customer support (Haug, 1985). Effectiveness is defined as the extent to which goals are accomplished (Mentzer and Konrad, 1991). The most efficient supply chain has the lowest possible cost and at the same time meets the customer's expectations on service like delivery precision and lead-time (Pettersson, 2008). Efficient supply chain strategies must take into account the interactions at the various levels (Simchi-Levy et al., 2000).

It can be inferred from these viewpoints that high customer service, less lead-time, low cost, less wastage, high value, quality, resource

utilization, and profitability are the main factors that defines supply chain efficiency.

4.1. Fruits and Vegetables Sector - Supply Chain Efficiency

Supply chains in the case of the fruits and vegetables sector may vary from product to product in terms of the number of players/parties involved and the value addition of product at each stage. The value added depends upon the type of product/commodity and business. Some players are involved in export business, and some are in food processing entities, so in this case value addition is higher, and it is very low in the domestic supply chain of fruits and vegetables. The supply chain of the fruits and vegetables sector is influenced by the availability and quality of infrastructure such as roads, storage facilities, transport network and connectivity, and technology.

The present supply chain in the fruits and vegetables sector that connects the farmers to both the organized as well as the unorganized retail is still in a very pathetic state and highly inefficient with several intermediaries and manual handling. This results in lots of wastages as much as nearly 30% and more and also less remuneration for the farmers (Viswanadham, 2007). A large share of a farmer's realizable value is lost as commission, supply chain mishandling and losses (Narula, 2011). Due to inefficient supply chain, price received by farmers is only about 24% to 58% of the consumer price. It is the inefficient supply chain that costs middlemen, consumers and more dearly the farmers (Veena et al., 2011). Without an efficient supply chain, there is a high cost of wastage for the companies (Rathore et al., 2010). Inefficiency in the supply chain of the fruits and vegetables sector leads to high losses and wastages which result in the availability of inferior quality commodities to the consumer and fewer price to the farmers. Due to inefficient supply chain, the extent of loss of fruits and vegetables is about Rs. 10,000 crore to Rs. 12,000 crore per annum, and the loss of quantity ranges from 10% and 80% in some of the most perishable fruits and vegetables (Mittal, 2007). It is estimated that

the food production in India is going to double in the next ten years; but post-harvest losses of about 35-40% of the total produce which amounts to Rs. 58,000 crore annually is a cause of concern.

From various studies on post-harvest losses in India, it is evident that the amount of food wasted in a year in India is equivalent to annual food consumption in the UK (Rathore et al., 2010). Estimates of post-harvest losses in developing countries vary from 1 to 50% or even higher (Kader, 2005). According to the calculation of ASSOCHAM (2013) India, the producers have to forgo every year Rs. 2.13 lakh crore due to losses in the supply chain of fruits and vegetables. Highly inefficient supply chain results in high wastage of fresh produce, instability in prices, farmers not getting remunerative prices as the differential between the farmer's realization and the final consumer price in India is the highest in the world even in the fresh produce (GOI, 2012), rural impoverishment resulting in farmers' frustrations and suicides (Rathore et al., 2010), and increased additional costs in the supply chain which ultimately enforces the final consumers to pay high charges from their pocket. Many researchers have found inefficiency in the supply chain as the major problem in the supply chain of fruits and vegetables sector in India, which leads to supply chain losses and wastages which finally results in higher prices paid by final consumers and less income to the farmers and other stakeholders.

There is a comprehensive requirement of research in the area not only to fully understand the challenges in supply chains management but also to identify the opportunities for improvement and also to reduce several inefficiencies in the supply chains (Bhardwaj and Palaparthy, 2008). fruits and vegetables are highly perishable in nature; and because of the high level of wastage and inefficiency in this sector efficient supply chain after the farm gate to the final consumer has become an absolute necessity, hence there is an urgent need to develop intelligent supply chains to curb losses and increase the shelf life of fruits and vegetables and ensure safety and desired quality (Rathore et al., 2010). The extent of wastage can be reduced only by a proper and efficient supply chain (Shukla and Jharkharia, 2013). So the efficient supply chain is a necessity for the fruits

and vegetables sector, and its importance in this sector has been discussed in the next section.

4.2. Importance of Efficient Supply Chain in Fruits and Vegetables Sector

Efficient supply chain is very important in the fruits and vegetables sector, and it will lead to increase in the profit of the stakeholders involved in the chain and, most importantly, reduce the losses and wastages in this sector. It will also reduce the chances of deterioration in the quality of Fruits and vegetables produce and help to enhance the value and make reliable delivery to the consumer at the right time with right quality and at the right prices. As the Indian economy is still based on agrarian economy, proper measures and an efficient supply chain will play a crucial role in reducing the losses and wastages at various stages of the supply chain (Halder and Pati, 2011). Inadequate usage/improper management of cold supply chains are leading to loss in quality of the vegetables and fruits, which in turn is leading to loss of profits and business opportunity. Establishing an efficient and effective cold supply chain would not reduce post-harvest losses but also increase the shelf life of food (Rathore et al., 2010). Efficient value chain management will certainly add value and help in bringing the produce to the market (Reddy, G. P et al., 2010). In future there will be several changes in the consumption pattern of the population in the developing countries such as India and China which will trigger the need for an efficient supply chain (Shukla and Jharkharia, 2013). Efficient supply chain not only increases the profitability and efficiency of retailers but also adds value to different stakeholders like farmers, consolidators and consumers (Veena et al., 2011).

An efficient supply chain and distribution structure is an important means for increasing income of the farmers and increasing affordability (Dharni and Sharma, 2008). By building an efficient and effective supply chain using state of the art techniques it is possible to serve the population

with value added food while simultaneously ensuring remunerative prices to the farmers (Viswanadham, 2007).

These literatures suggest that for improving the efficiency and the performance of the whole supply chain in the fruits and vegetables sector it is necessary to significantly reduce the perishable food waste and increase the income of farmers and other stakeholders. In brief, it helps in loss and wastage reduction; increases profitability; value addition to stakeholders; increases shelf life of fresh produce; increases income of the farmer; value addition to customers; and balance between demand and supply gap.

CONCLUSION

Fruits and vegetables sector in the case of agriculture and allied sector in India account for a significant share in the world production. This chapter presents the status of the fruits and vegetables sector supply chain in India, supply chain efficiency, and highlights the need and importance of an efficient supply chain to remove various gridlocks and reduce the losses and wastage in this sector. The study and research conducted on the supply chain of bottlenecks sector in India suggest that the supply chain is highly inefficient, which is leading to huge losses and wastages and less income to the stakeholders. Fruits and vegetables sector in India is a growing sector and presents a huge opportunity to the stakeholders and entrepreneurs through setting up the cold chain infrastructure and food processing units. As Indian economy is based on agriculture and there are huge potential to serve domestic or global markets through various value addition, development of intelligent and efficient supply chain will play a crucial role in reducing the losses and wastages, increase in farmer income, increase revenue from export, generate employments opportunities for the local peoples, and improve the livelihood of the farmers which leads to developing the economy and help India to emerge as a global leader in Food Sector.

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Chapter 4

SUPPLY CHAIN MANAGEMENT AND COVID-19 PANDEMIC: SOME THOUGHTS

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ABSTRACT

In this chapter we discuss what can be done with regards to supply chain management, in response to the COVID-19 pandemic. The pandemic has disrupted supply chains around the world. Most firms, if not all, faced some degree of disruption in procurement and/or distribution. We argue that firms were not prepared to face so much disruption, and therefore struggled. We propose two types of solutions for this problem: management-based and market-based. Under the management-based approach, we emphasize source and market diversification, introduction of higher level of automation, and maintaining a higher buffer of materials among others. For the market-based approach, we emphasize passing the extra cost to consumers, which will not only help producers, but also curb extra demand to ease the gap between supply and demand.

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INTRODUCTION

Supply chain management is one of the important aspects of modern business decision-making. Businesses have to deal with several issues including accounting, management, human resources, marketing and so on, not to mention the technical aspects of production. All of these aspects have their own important complexities that could make them separate disciplines. In the 1950s, a typical firm used to manage everything on their own. It was not unusual to find a firm during that time that procured its raw materials, made components using those materials, produced the whole product, and then sold the product to consumers through its own outlets. Certainly, they had much better control over their product and production process, but at the cost of efficiency. Later, firms realized that by concentrating on their core activities and letting other expert firms do subsidiary/associated activities, they could be more efficient. Porter (1985) argued that by focusing on internal activities only, a firm's ability to improve efficiency is limited. Firms frequently have to deal with external stakeholders, and any efficiency-enhancing model has to incorporate them as well. These stakeholders are typically the suppliers and buyers of the firm. They can affect the firm's ability to operate smoothly. In addition to buyers and direct suppliers, there are the suppliers of the suppliers who can also affect efficiency. A plan of operation that incorporates all of these groups can bring synergy to the operation. Incorporating all stakeholders in the process of production and consumption and in decision-making is known as supply chain management (SCM).

The supply chain consists of suppliers, producers, consumers and everything in between. It is an integrated efficiency-enhancing mechanism to control overall business activities. Such an integrated approach generates huge amounts of information to run a business in a more profitable way. It becomes easy for the decision makers to control day-to-day flow of goods, including the final products reaching consumers.

The supply chain has existed for a long time, but its importance was highlighted only in the last three to four decades. The extra attention paid to the supply chain created enormous synergy in production, consumption,

and most importantly job creation. Such importance is also evident in international trade and business. People are producing and exporting far more than they used to a few decades ago. Such trends have two distinct benefits:

a. People are taking advantage of specialization, i.e., the service of workers who do the best job
b. Lots of jobs are being created in many countries, sometimes in countries far from the country where the product is produced and consumed

The figure below shows some basic economic parameters in recent years. There is hardly anything to complain about in this achievement.

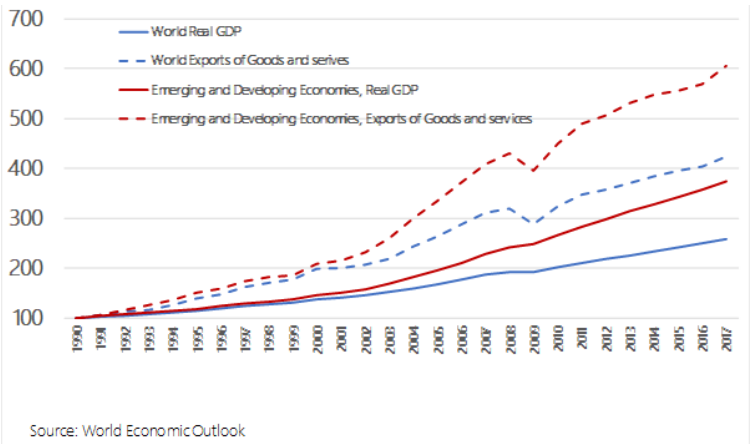

Figure 1. Real GDP and real exports of goods and services (1990 = 100).

Below we have a schematic diagram of a typical supply chain management operation:

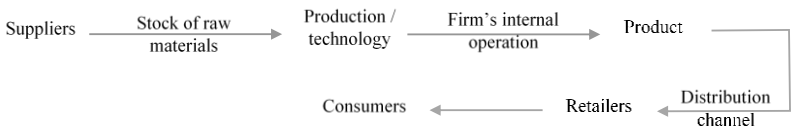

Figure 2. Typical flow of a supply chain.

Modern products are highly sophisticated, in the sense that they perform many tasks simultaneously. They are made of many small components, sometimes called modules, that are dedicated to performing a specific job. Naturally, these components are of different technical types (a motor car may use highly sophisticated metals along with specialized glasses, a wide range of computer chips, paints with exclusive features and so on). It is somewhat difficult for a single manufacturer to produce all of these components with a high level of precision and sophistication. Again, performance and other properties of the end product depend on the performance of each component. Therefore, it is important that a manufacturer keeps track of the quality and availability of all components. When such control is ensured, it becomes economically viable for firms to accommodate the latest technology and desired features in end products, leading to higher consumer satisfaction.

POSITIVE EFFECTS GENERATED AFTER GIVING THE SUPPLY CHAIN SPECIAL ATTENTION

An integrated approach has many benefits, such as:

a. Specialization: Better management of the supply chain frees up decision makers' time, as they can focus on the core portion of their work (sometimes just the assembling). They also have more time to find people who do other important tasks relevant for production. SCM is not strictly necessary; however, organizing the supply chain increases the volume of orders and frees up the time of decision makers. Firms can have better control over their suppliers and their suppliers' suppliers.
b. Production of high-quality products: Such a level of specialization can improve end product quality. Such products will naturally attract consumers of wider markets.

c. Smart application of SCM can remove bottlenecks from the production process. Since every step of the business operation is managed in a continuous manner, potential bottlenecks can be easily identified and averted. Especially with the rise of artificial intelligence, bottleneck avoidance can be automated. That helps with ensuring an on-time delivery. It also reduces the likelihood of miscommunication and associated problems.
d. Smart application of SCM can significantly cut down inventory levels and associated storage costs without affecting consumers' demand.

SCM has some shortcomings. Although SCM helps us increase the firm's level of operation, increasing in scale naturally creates other issues. If a firm has to manage a production system that brings components from different parts of the globe and a distribution system that delivers products to people of different cultures and backgrounds, it can create a very low tolerance of error in planning. To make things even more complicated, the products have to be of a predefined quality and match the continuously increasing expectations of consumers. In many cases, such daunting task can end in product failure.

Large-scale operations also come with the challenge of collecting large amounts of information from varied sources. It also makes the firm work in different countries with varied legal structures. All these add more challenges to an already complicated situation.

For many decades, things went smoothly, and the benefits of SCM became evident. Society grew in affluence and consumption. Connectivity increased, communication became more reliable, material affluence spilled over from affluent countries to different corners of the world. Although there were occasional glitches, the system worked satisfactorily.

But the COVID-19 pandemic changed everything. Although standard SCM models are resilient enough to bypass small supply and demand shocks, the pandemic was large enough to make these models futile.

COVID-19 - ORIGIN AND EXTENT OF THE PROBLEM

The pandemic started in the city of Wuhan, Hubei province, China which later affected the whole world. SARS COV-2 has a rather low fatality rate but can quickly spread, causing great harm to vitality and restricting economic progress. Not surprisingly, governments of different countries have practiced lockdowns, which effectively restrict all movement, including public transportation.

Wuhan was affected in late December 2019 or early January 2020, but by the beginning of February 2020 concerned authorities around the world and the World Health Organization (WHO) realized the extent of the problem, and individual countries started to impose a ban on air travel. Although there was no such global ban on container vessels, lack of demand and production restricted movement of ocean freight. UNCTAD (2020) reported a 27% drop in ocean cargo. Travel bans, along with ceasing movement of container vessels, exponentially complicated the problem, and production facilities sensed severe supply chain disruption. The WHO declared COVID-19 to be a pandemic in March 2020. In the midst of uncertainty and a lack of high quality scientific data, panic broke out. Most countries stopped internal physical contact, and transportation of goods was severely hampered. The supply chain broke down, and firms were in confusion. Everybody was concentrating on finding a COVID-19 treatment, and factories were busy producing surgical masks, personal protection equipment, ventilators, and ICU beds, which were mostly unknown to most people even a few months before. Any residual attention was paid to food supply and other key essentials.

The COVID-19 pandemic affected the supply of essential and non-essential goods differently. Food-related essentials got priority in transportation, although they got interrupted as well. Medicine and health-related supply got uninterrupted highway passage during this time.

The pandemic affected the economy at different levels. It affected production by a) restricting availability of raw materials due to travel bans b) restricting availability of the work force due to poor health c) restricting the working environment due to practicing of social distancing and other

factors related to reducing the spread of COVID-19. How much companies are affected is yet to be assessed (probably not until the pandemic is over), but we have some estimates. *Fortune 500* magazine found that 94% of Fortune 1000 companies are seeing supply chain disruptions from COVID-19. 75% of those companies have been negatively or strongly negative impacted and 55% of those companies plan to downgrade their growth outlooks[1]. This is certainly not encouraging, and they published this report in February 2020, well before the pandemic reached its current level of severity. A recent study by Dun & Bradstreet (May 2020) collected some fascinating facts. The most affected provinces of China house over 90% of Chinese businesses. They also found "at least 51,000 (163 Fortune 1000) companies around the world have one or more direct or Tier 1 suppliers in the impacted region, and at least five million companies (938 Fortune 1000) around the world have one or more Tier 2 suppliers in the impacted region."

The pandemic affected the transportation sector as well. Due to the restriction of free movement of goods, a) production was hampered due to unavailability of raw materials components b) distribution of finished goods was hampered, as they need to be transported from factory warehouses to distributors.

Lastly, the pandemic also affected demand. People's income decreased, and their overall demand for goods also decreased, especially non-food consumer goods. People panicked, as many lost their loved ones, which naturally had a negative effect on consumption. Demand for goods fell considerably with lost income. The situation was especially difficult for businesses, as consumers kept demanding cheap goods, while production costs rose.

Therefore, the pandemic affected both the supply side and the demand side. Firms could not meet production expectations, and consumers also did not have their usual level of demand.

This pandemic forced us to revisit something economics had long forgotten. For at least one century, economists have been actively arguing

[1]https://fortune.com/2020/02/21/fortune-1000-coronavirus-china-supply-chain-impact/ accessed 14th April 2021.

for more trade, and have developed logic that highlights efficiency of trade. While such theories and practices are difficult to refute, the pandemic has shown that domestic production has not lost its importance, even though sometimes it can be inefficient. Food security and domestic production of essentials are two examples of this.

WHAT CAN BE DONE

It is true that we did not invite the COVID-19 virus. Although there is a conspiracy theory that the virus somehow escaped a Chinese research laboratory, the theory has not been confirmed by any reliable third party. It may, however, be the case that we misunderstood the strength of the virus and handled it too casually. Nevertheless, it is a problem now, and we have to deal with it. We need to be innovative so that the firms can operate and the economy can recover.

We can potentially think of two types of solutions

a. Management based solutions and
b. Market based solutions

MANAGEMENT-BASED SOLUTIONS

Under management-based solutions, we have the following options:

1) Scan the environment, find possible suppliers: When the usual suppliers dry out, firms should go for new suppliers. This may sometimes be unconventional, for example, somewhat unpopular markets and somewhat inefficient suppliers. These suppliers may be from the firm's own country. For multinational companies with production plants in different countries, the concept of one's "own country" may be a little misleading. In that case, own country refers to the country in which the

supply is being used. This may seem a little inefficient, but in cases of a worldwide disruption of the flow of goods, such practices may be useful.

Of course, China supplies finished and intermediate goods for the whole world at a very competitive price. The professionalism and production capacity of China is also time-tested. However, China is not close to many countries. In the case of pandemics like this one, relying on China alone can bring disaster. The China Plus One idea is already gaining prominence.

China has undoubtedly proved its credibility as an efficient and reliable supplier. It has a large workforce, a willing entrepreneur community, smart researchers along with distributed networks of ports, and infrastructure for land communication. Therefore, it would not be wise to dump China altogether and look for other suppliers. Firms need to diversify their suppliers, while including China. Some components can be a little technically demanding to produce, and it may be difficult to find suppliers other than China, but unavailability of such a component can create a bottleneck which restricts the whole production process.

1. Broadening suppliers: The pandemic also taught us the lesson that it may not be smart to focus on Tier 1suppliers, that is the suppliers who directly supply raw materials or components to firms. Maybe it would be better to look into Tier 2 suppliers who are the suppliers of the Tier 1 suppliers. That way, firms can have a better idea about possible delays in supply chain. In some cases, firms can also look into to Tier 3 suppliers.
2. Diversify markets: Pandemics like this affect people's purchasing power as well. Relying too much on one market can bring disaster as well. Therefore, looking for an alternate market during normal times is a strategy to avoid reliance on one market. The very basic principle of diversification can be handy here. To avoid different types of possible disruptions, diversification can be done geographically.

Demand in different markets have dropped by different proportions. Therefore, it may be possible to have higher demand in other market segments. Businesses need to be open to that option as well.

3. Flexible production plan: This depends on the technical aspects of the production process. Production processes that can handle producing multiple products using the same machine or procedure can be really helpful in this volatile situation.

It is not unusual that firms will have to reorganize their production system, which can bring them opportunities. This forced change may facilitate expedited adoption of new technology and can make the production system more flexible and resilient to future shocks. Globalization, or to be specific producing for global consumption, has motivated businesses for a long time. This pandemic should not challenge their comprehensive nature. Producers should instead be mentally agile and open to any possible opportunity that may come along during this demand and supply rearrangement.

This pandemic may also be seen as an opportunity for the producers to learn from their mistakes in marketing strategy or product design. They could also take this time to develop and design new products for a flexible marketplace.

4. Have a higher buffer of materials: COVID-19 pandemic has highlighted the shortcomings of the Just in Time (JIT) inventory plan. Firms normally accommodate the JIT plan or something close to that to reduce inventory cost. Warehouses are costly to build and there is always a risk of obsolescence. However, lost production opportunities are even more costly. Higher buffers may help production smoothing.
5. Higher level of automation in production process: Automation is a new trend, and along with artificial intelligence, it has become indispensable. The COVID-19 pandemic has highlighted its importance. Automation will not only make firms less dependent

on human laborers, it also allows firms to improve hygiene in the work place easily. Most likely, in the post-pandemic world firms will have to continue practicing social distancing. Such a practice will not only restrict the firm's environment, but will also increase costs, as floor space requirements will be higher.

6. Better level of preparation: This pandemic certainly highlighted that firms are not at all prepared for such a large scale of interruption. Now it is time to prepare for the rest of this pandemic and any others that may still come[2].

Preparation should include complete mapping of the supply chain including Tier 1, Tier 2, and possibly all other factors that can potentially affect final production and their distribution. This also should include all physical transportation routes and their possible by passes. Possible alternatives of existing suppliers should also be identified. Suppliers should be categorized according to their risk class and other sensitive information (location, cluster, capacity, reliability etc.).

Preparation also includes paying more attention to employee health, including supplying supplementary diets to boost their immune system and arranging for vaccines if appropriate, making the system prepared for more absenteeism, and planning for succession of key positions.

MARKET-BASED SOLUTIONS

Markets are an important structure within any economy. Market based solutions are little harsh, in the sense that they involve consumers as well. But passing a share of harshness to consumers may be necessary in the long run, as it will signal to consumers that the situation has changed and production costs have gone up. It may be more pragmatic to accept that the

[2] I am not becoming pessimistic here, but the level of vulnerability that has been highlighted by the pandemic, it is not at all unusual to think that such a virus attack may happen again anytime soon. Also, an apocalyptic event of climate change and other types of natural disaster can happen anytime.

COVID-19 crisis will be with us for a long period of time, necessitating a new normal. In that new normal, we will not only have to adopt many things as a society, but also as an economy.

Among market-based solutions we have:

1. Pass extra cost (due to supply disruption) to customers: The pandemic is imposing financial strain on firms, and it is only natural that a portion of that will be passed on consumers. At first, it may seem challenging as the pandemic has also hit consumer income considerably. But giving it a second thought may reveal some promise. First, passing cost to consumers will increase the possibility of viability of the firms, and second, it will help to restrict demand, thus easing up the gap between supply and demand.
2. In that respect firms may adopt Total Cost of Ownership (TCO) approach, in which buyers will not only pay for the good but also take operational cost in their consideration. That will make their transaction closer to the real value of the supply.
3. Make delivery timing a decision variable: Normally, prompt delivery is considered an amenity for most of the businesses. However, in this crucial time, delivery timing can be considered a product attribute. This will bring in some extra revenue for the firm and will encourage consumers to wait when they can.
4. Pay more attention to "transaction costs": Standard economic arguments for perfectly competitive markets assumes that there is no transaction cost. Inspired by such motivation, market players worked hard to keep transaction cost low. However, the pandemic reemphasized the issue of transaction costs, and it may be a good time to explicitly incorporate transaction costs again in the contract.

WHAT OTHER PROBLEMS CAN HAVE SUCH A LEVEL OF GLOBAL DISRUPTION

Although COVID-19 caused disruption on a much larger scale, there are some problems in the past that disrupted the supply chain to a considerable degree. One example is the Fukushima nuclear disaster: On March 11, 2011, a deadly earthquake hit Japan. Japan is hit by numerous earthquakes every year, but this one was important as it partially damaged a nuclear power plant there, causing great damage to the surrounding area and associated production units. That was a lesson for supply chain management professionals around the world. Later on, the world found that the narrow area is the major supplier of very crucial electronic equipment like silicon wafer, lithium battery chemicals, flash memory, and anisotropic conductive film used in LCD flat panel displays, and that there are limited alternative sources. This event interrupted production of many well-known brands like Apple Inc., General Motors and French automaker Peugeot Citroën among others.

Thai flood: In July 2011, Thailand was hit by a devastating flood which not only caused serious harm to its people and wealth, but also put its factories out of commission, which created a supply shock to auto industries, among others. The giant automakers of the current world like Honda, Toyota, Nissan and Ford, were affected to such a degree that they had to downsize their production. Computer hard disc company Western Digital experienced similar problems, like closure of factories.

CONCLUSION

While the COVID-19 pandemic is far from over, and we may have yet to see the worst, we have learnt some important lessons from COVID-19 pandemic. We were very unprepared to handle a crisis of this magnitude. The aggressive pursuit of efficiency has made our business practices very risky, with very little room to make adjustments. The problem of COVID-

19 will probably be over sooner or later, but such problems may still reoccur. There are many viruses which can potentially jump from animals to humans. HIV, Ebola, SARS, MERS, Avian influenza, Dengue fever are just few which have already made this jump. Newer viruses could come next. Some of them may have the potential to disrupt the economy at large scale, by generating a similar level of supply chain interruption. It happened in the past and there is a large probability that it will happen again in the future.

Supply chain management has many important and useful features, and by following supply chain management efficiently, firms have experienced enormous increases in productivity. Therefore, it will not be helpful to dump the concept and go back to the 1950s. Rather, we should make the system more resilient by careful planning, sorting out alternatives, and preparing ourselves for such interruptions.

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Chapter 5

SUPPLY CHAIN MANAGEMENT FRAMEWORK FOR READY-MADE GARMENTS INDUSTRY: A BANGLADESH PERSPECTIVE

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ABSTRACT

This exploratory study addresses a conceptual supply chain management (SCM) model for the ready-made garments (RMG) industry of Bangladesh. The ready-made garments (RMG) industry in Bangladesh has some typical landscapes like low-cost labor, green factory concept,

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supply chain, time-frame, compliances and effective and efficient supply chain management, which are at the core among all the features. Supply chain management is a multidimensional approach and it is even more complex for the Bangladesh ready-made garments industry due to different actors of the global supply chain like price, process and lead time. As different parties i.e., the suppliers, manufacturers, distributors, retailers and buyers etc. are involved in different phases of the supply chain of this industry, every stage (procurement, manufacturing, replenishment, customer order) is conflicting with its next stage due to time and process constraints. The conceptual model demonstrated here has taken an effort to create the layout and design of the procurement of raw materials, work-in-process, inventory and finished goods from various sources to the ultimate consumer in the garment business. The model also takes an attempt to show that the manufacturing costs can be reduced and profit can be increased if the supply chain information and integration process can be used carefully. This framework provides the opportunity to integrate and optimize the supply chain process of the ready-made garments industry of Bangladesh. The proposed conceptual framework for the ready-made garments industry provides a novel approach for decision-makers of supply chain components to review and appraise the performance toward fulfillment of ultimate goals, i.e., producing high-quality garments product, reducing the wastage of human labor, time and money with high competitiveness, efficiency and productivity.

Keywords: Supply Chain Management, SCM Model for RMG, Ready-Made Garments (RMG), Supply Chain (SC), Retail Brand Owners (RBO), Total Cost of Ownership (TCO), Distribution Channel (DC), Cost of Making (CM), Letter of Credit (L/C)

1. INTRODUCTION

The ready-made garments industry is a pride and success story for Bangladesh which built its base in the 1970s, expanded rapidly in the 1980s and boomed in the 1990s. There are various positive factors behind the quick expansion of the ready-made garments industry in Bangladesh such as the use of low-cost labor and wages, low cost of running the operations, using less complicated technology and comparatively cheap and abundant female workforce. Bangladesh has been the second-largest

exporter of garment products in the world for the past three decades. Even during the global pandemic when imports by major sourcing countries dropped significantly, Bangladesh garments industry remained the preferred choice for many buyers around the globe. The apparel industry took the export earnings from USD 31.57 million in 1983 to USD 27.95 billion in 2020 [8]. However the export value decreased from 2019 which amounted to just over 34 billion U.S. dollars to USD 27.95 billion in 2020 due to the global pandemic of COVID-19.

Product diversification is important like range expansion for the ready-made garments industry of Bangladesh because value growth is more important than volume growth as Bangladesh only focused on volume growth from the inception of the sector. However, there was no magic wand that helped the sector to come to today's position; rather various factors act as the impetus for steady growth of the RMG sector in Bangladesh. It is still surprising to many to see how the garment industry in Bangladesh continues to show robust performance even sometimes paddling against the tide.

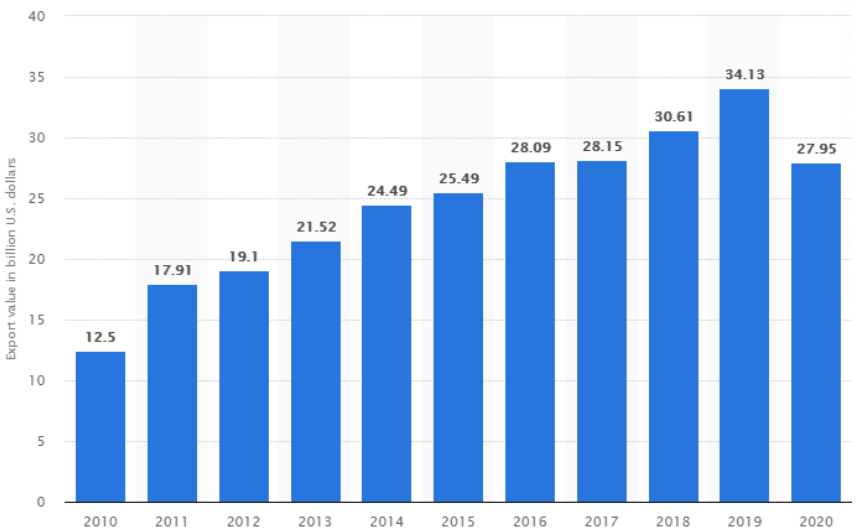

Figure 1. Export value of ready-made garments (RMG) in Bangladesh from 2011 to 2020(in billion U.S. dollars) [8].

There are several reasons why Bangladesh has been a favorite sourcing destination for international buyers and the supply chain is one of the cores that attracts international retail brand owners. Supply chain management systems helps in reducing inventories, operational costs, compress order cycle time, enhance asset productivity as well as increase the companies' responsiveness to the market.

Besides these benefits, the apparel industry can achieve a quick response through efficient supply chain management practices. Effective and efficient supply chain management offers high-quality, low-cost products within the shortest possible lead time as it integrates the whole supply chain as a whole.

Quick response is another competitive advantage achieved through the collaboration and sharing of information among manufacturers, suppliers, and distributors, allowing them to respond more rapidly to the needs of the customers.

The ready-made garments industry of Bangladesh needs to collaborate with all the supply chain partners like manufacturers, suppliers, transporters, warehouses, retailers, customers and service providers as the landscape of low-cost sourcing countries is changing gradually and retail brand owners are more interested in the total cost of ownership (TCO) approach as it includes all stages that are involved directly or indirectly in fulfilling a customer request.

This book chapter is divided into six parts. The introduction discusses the background and the rationale for the study and the objectives of the study.

The next section outlines the overview of the previously published works on the RMG supply chain. Then, the fourth and subsequent parts of this paper describe the methodology of data collection, process and structure of the supply chain network of the RMG industry, key indicators of the supply chain of the RMG sector and proposes a framework for the RMG industry of Bangladesh.

Finally, the conclusion presents a summary of the conceptual framework of the supply chain model in the ready-made garments industry of Bangladesh.

2. LITERATURE REVIEW

Most of the ready-made garment factories in Bangladesh are subcontractors, producing low-end and low-cost products for the international markets. One of the main reason is that, most of the factories are not skilled in supply chain management and industrial benchmarking in either manufacturing or retailing industries. The supply chain performance of most of the Bangladeshi factories is below the world average because they are still following the traditional approaches in their supply management function. Therefore, it is in dire need to improve the supply chain performance to achieve competitive advantages compared to other countries of the world.

2.1. Supply Chain Management

A supply chain is a system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer. Supply chain activities transform natural resources, raw materials and components into a finished product that is delivered to the end customer.

The supply chain process for manufacturing and service industries started with tier one and two suppliers, manufacturers, distributors, retailers, service providers and end with customers/ultimate buyers respectively [7]. The customers are the most vital focal point of the supply chain since the primary purpose of the existence of any supply chain is to directly or indirectly satisfy customer needs. Every manufacturing organization, follows a basic supply chain process. The following diagram depicts the basic supply chain for manufacturing organizations. The basic supply chain of the ready-made garment industry in Bangladesh involves suppliers, manufacturers, distributors, retailers, ultimate buyers and service providers. A supply chain is strong when all the actors are strong within the chain. Similarly, it is weak when all the actors are weak and a single weak actor can make the whole system dysfunctional.

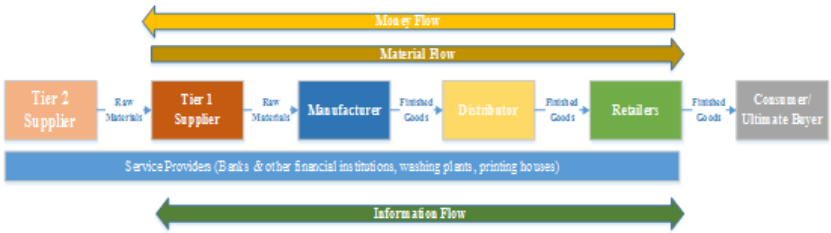

Figure 2. Basic Supply Chain Process [7].

As the ready-made garments supply chain is related to the lead time, factories are always under pressure to meet the deadlines of the buyers. Without proper management in the supply chain, low-cost competitiveness alone will not be able to ensure the future profitability and sustainability of the ready-made garments business in Bangladesh. An efficient and undisrupted supply chain with proper planning can increase the ready-made garments market share worldwide.

Following are the actors of the supply chain in the RMG industry of Bangladesh.

2.1.1. Tier 1 & 2 Supplier

Fabric, accessories, packaging producers are defined as the suppliers in the garments industry. The fabric can be sourced from around the world but accessories and packaging items are procured locally most of the time.

2.1.2. Manufacturer

Garments producers or the factories are defined as the manufacturer. From Bangladesh's perspective, all the garments' factories are working as manufacturers.

2.1.3. Distributors/Middleman

Merchandising organizations or buying houses are defined as distributors.

All merchandising organizations and buying houses are working as a middleman between the buyers and the garment factories and they earn a commission for providing their services.

2.1.4. Retailers

Retail Brand Owners (RBO) - H&M, M&S, Tesco etc. are called the retailers in the world apparel industry. They are the main buyers and they act as a retailer as they merchandise all the garments and distribute it through the distribution channel to make it available for their consumers.

2.1.5. Consumer/Ultimate Buyer

Consumer (who buys the product for ultimate use) is the most vital point in the value chain for the garments industry. All the activities are perfomed to meet the consumers' needs.

2.1.6. Service Provider

Banks, washing plants, printing centers are the service provider. All service providers also act as a vital part of the value chain. Banks are involved in L/C, export-import processes, washing plants are used for washing the garments, all the printing centers work on printing designs or logo labels on the garments.

2.2. SCM in RMG Industry

Islam (2013) analyzed that apparel supply chain issues such as new orders, raw materials supply, production processes and logistics related to finished goods delivery can be improved by using efficient supply chain process and also mentioned that Bangladesh garment industry improvement is desired in reducing the lead time required to produce and fulfill the orders placed by foreign companies. His suggests using modern fast and effective machinery to reduce the time taken to deliver the order [1]. Lam and Postle (2006) have reviewed the concept of supply chain management in textile and apparel supply chain management in Bangladesh. They discussed the strengths and problems faced by the Bangladesh textile apparel supply chains. They argued that the Bangladesh apparel industry is generally not aware of the concept of supply chain management and industrial benchmark for both manufacturing and

retailing industries in Bangladesh [2]. Nuruzzaman and Rafiq (2005) took an attempt to develop a more effective supply chain for Bangladeshi RMG to enjoy a competitive advantage in the global apparel business through analyzing the current supply chain and investigating the relationship among the players in the supply chain [3].

Saiful and Noorul (2013) took an approach to compile and analyze the supply chain management issues concerning the Bangladesh garment industry. In the RMG sector, the supply chain management is more complex owing to characteristics of the global supply chain (SC). In the global supply chain, crossing borders nearby supply with a multiplicity of general obstructions to intercontinental business: tariffs, nontariff obstructions, switch over rates and differences in product necessities, consumer savors and business observes. Borders also present some impediments in transportation services, which are very common for the RMG sector in Bangladesh. Manufacturers, suppliers, and buyers at all stages of the supply chain in the RMG sector are decentralized. Different stages of the supply chain have conflicting goals and objectives [4].

Asgari and Hoque (2013) examined the opportunity that lies in an integrated supply chain to provide a competitive advantage to the Bangladesh RMG sector. A system dynamics approach has been used to identify the dominant variables of supply chain performance such as enablers, performance or results, and inhibitors in the RMG sector. Since the end consumers of the apparel fashion market are becoming increasingly time-sensitive, a decrease in lead time, besides quality and cost criteria, is needed to win more orders from buyers [5].

3. METHODOLOGY

In order to ensure a more complete evaluation of the data and to help us draw a solid conclusion to our findings, both qualitative and quantitative data has been collected. This study developed its findings based on the detailed qualitative approach along with semi-structured interviews with industry experts. An in-depth review of the journals, research articles,

newspapers and books were undertaken to gain an understanding of the subject matters. This research work depended on both primary and secondary data. Mostly secondary data has been used to collect information and expert opinion is considered as the primary data.

The study conducted semi-structured individual interviews with the supply chain experts and merchandisers of the ready-made garments industry to understand the present supply chain process, its scopes and constraints. Primary data has been collected through an unstructured questionnaire and also by undertaking other approaches, such as interviews, observation and questionnaire methods. The primary data sources can be grouped into two types as-

1. Relevant information shared by supply chain experts and merchandisers and other concerned officials;
2. Semi-structured interview and observation of various departments and production plants.

Secondary data collected from research work, journals, articles, magazines, newspapers, books, conference papers, annual and audit reports of Bangladesh Garment Manufacturers & Exporters Association (BGMEA), different websites etc. related to the RMG sector of Bangladesh. The secondary data sources can be grouped into two types as-

1. Internal secondary data from published reports of RMG factories;
2. External secondary data from the internet, case studies, journals, magazines and newspapers.

4. GARMENTS MANUFACTURING PROCESS IN BANGLADESH

A ready-made garments factory goes through several stages in the manufacturing processes starting from order negotiation with buyers to

pre-production and post-production processes to producing a finished product. It is necessary to have a process flow chart to follow during garments manufacturing because the manufacturing process of garment products, especially the ready-made garments is a versatile process from operational and technical points of view. The garment manufacturing processes change according to the design, order quantities and buyer requirements. So, it's important to follow every single step of the process very carefully otherwise retail brand owners may refuse to take the delivery/shipment.

4.1. Negotiation Processes in Garments Manufacturing

In this phase, all the details of the orders are negotiated between the buyer & the manufacturer. The main purpose of negotiation is to ensure that both parties can reach common ground regarding the cost of the product that ensures win-win situation for both of the parties. The negotiation is done on the costing/pricing sheet. The negotiation on costing is dependent on the following factors:

4.1.1. Product

The first negotiation point is the product type & design. For basic products, the price tends to be lower with a minimum profit margin. For complex products, the price tends to be higher with a bigger profit margin.

4.1.2. Material

Materials is considered as all the materials required in production of the garment and if all materials are available for procurement from the manufacturer's point of view. If not, what other alternatives are available & acceptable by the buyer for production. At the end of the negotiation, both parties agree on what materials to use in the production process. Materials can be catergories as - local & overseas materials. Local materials are considered a low-cost margin, while overseas materials are considered a higher cost margin.

4.1.3. Time

The lead time is a very important factor during the negotiation process. The time taken for production should be acceptable by both the buyer & the manufacturer otherwise it will lead to a direct loss for both parties. Most of the companies in Bangladesh take 80-90 days lead time to deliver the garments.

If a manufacturer can significantly reduce the lead time, then it will be considered as their competitive advantage & if the buyers pushes for a shorter lead-time then it will lead to a higher cost of making/ production therefore a higher profit margin for the manufacturer.

4.1.4. Quality

This factor emphasizes the quality of product the buyer requires and what it will cost the manufacturer to produce such items. Depending on the quality allowances provided by the buyer the manufacturer can ensure whether the buyer wants high-quality work or they are looking to make the product cheaply and the manufacturer can adjust their costing accordingly. Usually, with the high-quality requirement, the price tends to be higher and with an average quality requirement, the price tends to be lower.

4.1.5. Quantity

Quantity is the number of garments required by the buyer and if the manufacturer can deliver the required quantities to the buyer. In the case of small quantity orders, the profit margin is higher to compensate the overhead & set-up cost.

For a big bulk orders, the profit margin is lower as the overhead & set-up cost dissolves over the quantity.

4.1.6. Packaging

Packaging refers to the type of instructions and packaging materials to be used for delivering the garments to the buyer. If the instructions and packaging are basic and simple then the cost is less and if it is complex or needs to be customized according to buyers requirement then the cost is more.

4.1.7. Shipping

What type of shipping procedures or agreement should be followed (e.g., FOB, CF, CIF etc.) depends on that who will bear the shipping/freight charges. As the order is confirmed, the buyer provides a master Letter of Credit to the manufacturer and this Letter of Credit or L/C is a promise to pay.

It is a letter from a bank guaranteeing that a buyer's payment to a seller will be received on time & for the correct amount. For example, Importers & exporters might use L/C to protect themselves.

4.2. Production Processes in Garments Manufacturing

Garment manufacturing includes a number of processes from order receiving to dispatching shipment of the finished garments. A process flow chart helps to understand how raw materials are moved from one process to another process until raw materials are transformed into the desired product (garments).

Note that a process flow chart made for the garment manufacturing processes will vary based on manufacturing facility and product type. However, this study has tried its best to come up with a comprehensive process flow chart that most of the garments manufacturers follow and can be easily understood by the reader of this chapter. Based on the present ready-made garments industry practice, manufacturing processes are categorized a pre-production process, production process and post-production processes.

4.2.1. Pre-Production Processes

The pre-production process includes sampling, sourcing of raw materials, approvals of PP materials etc. In the pre-production process the manufacturer develops samples as per buyer requirement and get approval from the buyer for bulk production.

At this stage, garment factories also source the material from the local or international markets [9].

4.2.1.1. Order Receive

Garments manufacturer received purchase order (PO) from buyers like H&M, Wal-Mart and other RBO's. All information needed by garment manufacturers are included in the PO such as - size, barcode, department name etc.

4.2.1.2. Strategic Planning

This involved the management team working on planning for human labor, building, machineries and material management to ensure the best use of it. At the strategic planning level, the management team works on production planning, deciding what quantity of garments will be produced in a certain period and how many workers and machines will be used for production.

4.2.1.3. Sample Development

In the sample development stage the merchandising department works on preparing samples as per artwork and measurement provided by the buyer.

4.2.1.4. Pre-Production Sample Approval

Upon sample development, the merchandising department sends the samples to the buyer for approval. Initial sample development, pre-production sample etc. are related to the sample development process.

4.2.1.5. Material Sourcing

At this stage, the materials are sourced as per the strategic plan from the domestic or international market and in-house from the factory warehouse. From the perspective of the Bangladesh ready-made garments sector, most of the procurement is done from the international market and it is one of the most vital factors for a garment factory.

4.2.1.6. Material In-House

Fabric, non-fabric, trims and other accessories items are in-house or stored as inventory.

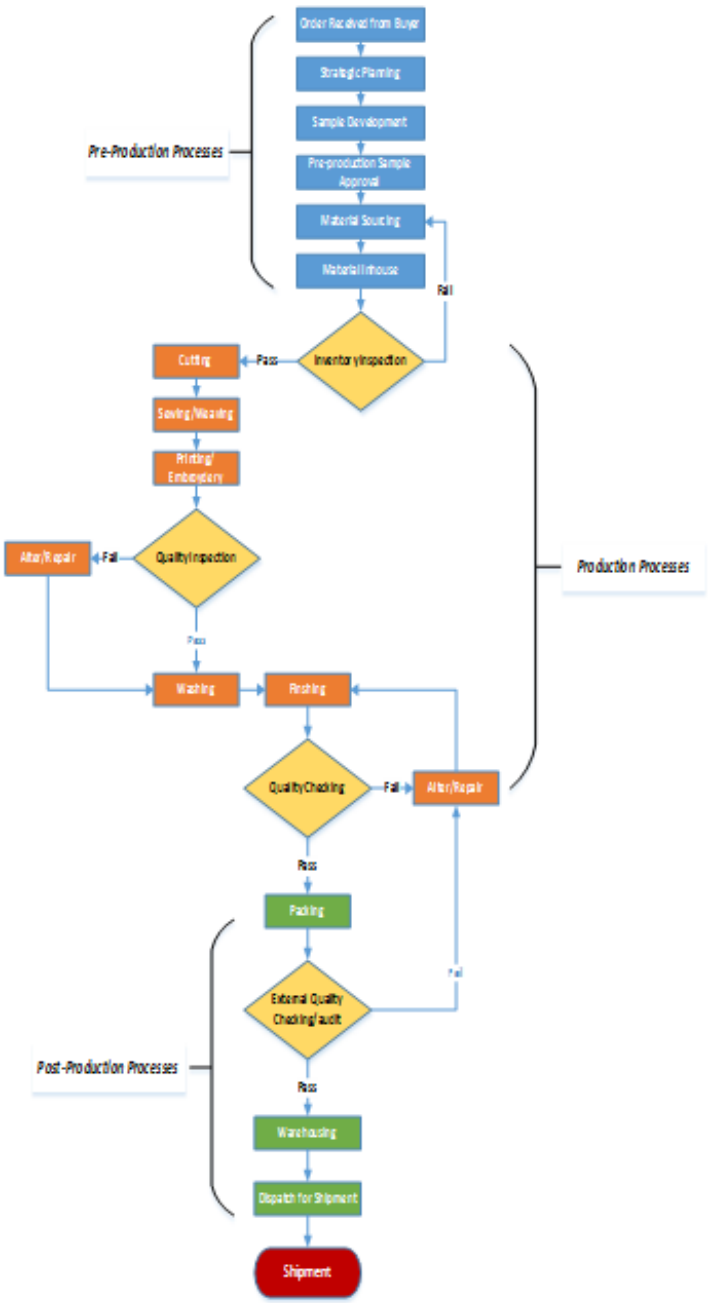

Figure 3. Production flow chart of RMG [6].

After materials are in-house, it will be checked to match the physical quantities with the booking quantity and then scheduled for production.

4.2.2. Roduction Processes

Production processes include cutting, sewing, finishing etc. Production process means all the raw materials are in the store and the factory can go for bulk production of garments. Therefore, material in-house is the pre-requisite for starting production [9].

4.2.2.1. Cutting

At this stage, fabric items are cut as per the garments requirements. The top and bottom parts of the garments should be in the different cutting processes and different types of machines are need to cut the fabric.

4.2.2.2. Sewing/Weaving

All the cut fabrics are joined and sewn together to produce a full garment. All the sewing processes are done in the different production lines.

4.2.2.3. Washing

Washing is one of the important stages in the garment manufacturing process because washing is done to soften the garment while maintaining the color quality of the products. Some garments do not need washing. About 80% percent of the garments produced needs washing.

4.2.2.4. Finishing

It is the final stage of the production process. In this process, all the accessories and trims are sewn or attached to the garment. After all accessories and and trims are attanched to the garment, it is ready for packing.

4.2.3. Post Production Processes

Thread trimming, pressing, checking, folding and packing, shipment inspection on etc. is part of the post-production process [10]. Mostly thread trimming, packing, warehousing and shipment dispatch processes are done in this step.

4.2.3.1. Packing

In the packing stage, all the garments are packed and finally quality check for shipment. Pressing, checking, folding and packing are the different parts of this stage.

4.2.3.2. Shipment Audit

Shipment audit is done by the third-party quality checker or buyers direct quality checker appointed by buyers to check whether all the garments are ready based on the PO. This is one of the most crucial part for a garment factory because, in order to ship the garments, a garment factory must be pass the shipment audit.

4.2.3.3. Warehousing

Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc for storage of the goods/inventory. In the warehouse, all types of raw material, finished goods and accessories items are stored. All the prepared garments are sent to the central warehouse for shipment.

4.2.3.4. Dispatch for Shipment

Inventories in the central warehouse are consecutively dispatched for shipment. Goods can be dispatched by air, train or sea. The most common mode of transportation used to dispatch products from Bangladesh is by sea. In case of emergency, goods can be shipped by air to avoid any sort of claim by the buyer.

5. SCM CONCEPTUAL FRAMEWORK FOR RMG INDUSTRY

A conceptual model of the supply chain for RMG sector of Bangladesh in terms of tier one and two suppliers, manufacturer, distributors, retailers and consumers or ultimate buyers are depicted in figure 2. In the RMG sector of Bangladesh, most of the factories are working as a subcontractor. These factories are performing cutting, making and trimming (CMT) activities on behalf of the retail brand owners.

The Bangladesh RMG industry is highly dependent on imported raw material and about 90% of woven fabrics and 60% of knit fabrics are imported to make the garments for export.

Therefore, this industry requires maximum lead time to process an order compared to other garments-producing countries of the world. The lead time for apparel export varies between 90 - 120 days in Bangladesh due to inefficient and ineffective supply chain processes.

In fact, the supply chain is the main competitive factor in the worldwide ready-made garments industry to offer better value to the end customers.

The proposed conceptual framework of supply chain management focuses on the interrelated nature of relations among the process of the RMG supply chain in Bangladesh. The proposed framework is closely related to the following elements:

- Inbound Supply Chain (Input);
- Internal Supply Chain (Process);
- Outbound Supply Chain (Output).

All the abovementioned elements of the conceptual framework are interrelated and interconnected with each other and with the absence of one element the total system becomes obsolete and cannot work independently. So, the relationship among all the elements of the framework is important

for an effective and efficient supply chain in the RMG industry of Bangladesh.

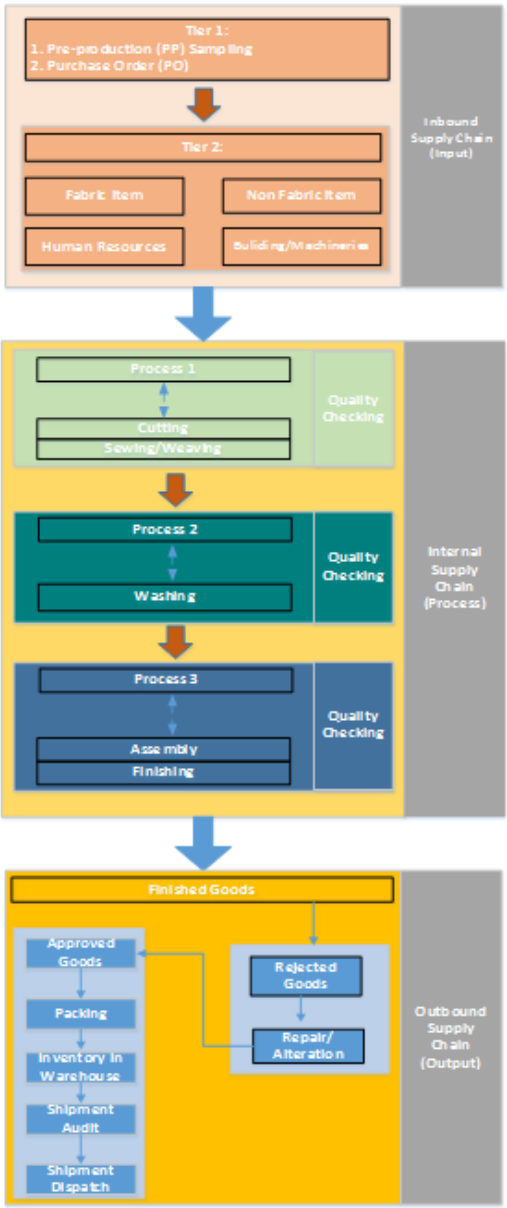

Figure 4. Conceptual framework of SCM in the RMG industry of Bangladesh [6].

The proposed conceptual framework tried to avoid the multi-tier supply chain and at the same time suggests adding more suppliers in each tier to tackle all unexpected and avoidable situations. This model tried to show how input, process and output factors are affecting the RMG supply chain management of Bangladesh.

This study tried to reveal an understanding that low-cost labor should not be the only focus; rather, working towards achieving faster lead time and delivery should be the focus of the RMG manufacturers of Bangladesh to ensure a smooth supply chain process within this sector.

5.1. Inbound Supply Chain (Input)

5.1.1. Tier 1

5.1.1.1. Pre-Production (PP) Sampling

PP sample needs to be manufactured first to get approval from the buyer on whether bulk order should be manufacture as per PP or not.

5.1.1.2. Purchase Order (PO)

When the buyer approve the PP sample, they will also issue the PO on behalf of the concerned garment manufacturer to manufacture the bulk goods.

5.1.2. Tier 2

5.1.2.1. Fabric Item

Fabric names in this list include woven, non-woven fabric, as well as knitted fabrics, netting fabrics and technical fabrics such as Gore-Tex and Gannex. All of the fabric items are in the input process because garment production mostly depends on the fabric.

5.1.2.2. Non-Fabric Item

Many non-fabric items are needed for production like chemical, flash spun fabric etc. Non-fabric items are accessories and packaging material.

5.1.2.3. Human Resources

Human resources are put into the input system because it found that human capital needs for the production of garments.

5.1.2.4. Building & Machineries

Building and machineries are facilities for the RMG factories and it works as an input.

Most of the production processes need building or machineries and these items are depreciated over the time.

5.2. Internal Supply Chain (Process)

The internal supply chain is a continuous action, operation, or series of changes taking place in a definite manner. [11] In the processing system, it was found that the main mechanism is executed to produce a garment. There are some steps in the process flow.

5.2.1. Production Process 1 (Cutting, Sewing, Quality)

In this step, all the fabric item need to be cut as per the design and sample and the sewing is based on the approved sample.

Most of the time there are three types of garments that can be found top, bottom and inner.

All of these items can be cut in different processes and also use different types of machines for sewing.

5.2.2. Production Process 2 (Washing, Quality)

In this step when the sewing is complete then, most of the items need washing, about 80% of the manufactured grments need washing. washing

is done to soften the garment so that it can provide comfort to the users while maintaining the color quality of the products.

5.2.3. Production Phase 3 (Finishing, Quality)

At this stage, all the parts of the garment are assembled for making the final good.

There are different types of work associated with this step. The activity of all the departments come together in this step to produce a complete garment.

5.2.4. Quality Checking

Quality checking is inbuilt with above mentioned three steps as it is important to standardize the quality of the products. After the final assembly and finishing of the goods, quality inspectors check the garments to ensure that the garments maintain the specific standard provided by the buyers.

If the garments are approved then they will pass as finished goods or if it is rejected then they will go for alteration/repair. This part is very important for an RMG factory because if the quality checking does not maintain the buyer's standard, then it will be rejected by the buyer's QC checking.

5.3. Outbound Supply Chain (Output)

In the context of the ready-made garments industry of Bangladesh, the output is the number of goods produced by a garment factory. Outbound supply chain means finished goods with good quality or rejected goods [12].

If the garments are approved by the quality checker then they will go to the warehouse for final shipment or if it is rejected then it will go for alteration/repair.

5.3.1. Finished Goods

After quality inspection, if the garments pass inspection by the quality inspector, then all the goods converted as finished goods and other accessories are added with the garments for final packing.

5.3.2. Approved or Rejected Goods

Approved finished goods ready for packing and reject goods are sent for alteration or repair.

Approval or rejection of goods depend on different criteria set by the buyer.

5.3.3. Packing

In this step, all the approved goods are packed and ready for final buyer inspection. Here, all the packaging materials can be used and made ready for the final inspection.

5.3.4. Quality Checking

Buyer's appointed quality checking team or third-party checking team checks all the packed goods as per buyer's guidelines. This step is crucial for the garment factory because, the products may the pass the internal quality checking but if it is rejected by the buyer's QC then they needs to go for further alteration/repair work. Therefore, internal quality checking of the garment items is vital to passing the buyer's QC.

5.3.5. Shipment Audit

Shipment audit is done by the third party or buyer's appointed auditor to check whether all the garments are ready for shipment and meet all the specifications against the buyer's PO. This part is crucial for a garments factory because it must pass the shipment audit for shipping the garments to the buyers.

5.3.6. Dispatch for Shipment

If the garments lot are approved by the buyer or buyer's appointed audit then all the goods are dispatch for shipment. Goods can be shipped by air, sea or train.

CONCLUSION

RMG industry in Bangladesh has come a long way to position itself as the second-largest exporter of ready-made garments in the world. To continue its march forward, the RMG industry is now stressing on ensuring sustainability through product diversification rather than volume game business. Supply chain management is the core in the total value chain process of the RMG sector business in Bangladesh and it is the most critical, complex and cumbersome process within this sector. However, at present Bangladesh's performance are not up to the mark in the global value chain process as a ready-made garments' producer. Bangladesh RMG sector has been enjoying very clear price competitiveness due to minimum wages and low cost of labor. It is still lowest among other competitors like India, Pakistan, Vietnam and Cambodia. Bangladesh is facing enormous pressure to optimize the lead time and this long lead time has made it impossible to offer innovative products and generate revenue for future profitability and sustainability. Without proper management in the supply chain process, only wage competitiveness could not ensure a sustainable and profitable future for the Bangladesh RMG sector. Therefore, to escalate as an efficient global RMG industry leader, Bangladesh has to maintain standard operating procedures and factories operating within this industry must be able to implement supply chain business strategies that would assist to the sustain growth of the clothing industry. It is highly recommended for Bangladesh's readymade garments industry to use this conceptual model so that it can be more effective and efficient in the global market. This paper designates further frontiers for prospective researchers as well as practitioners who are involved with Garments Industry.

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Chapter 6

HEALTHCARE SUPPLY CHAINS DURING THE COVID-19 PANDEMIC: LESSONS LEARNED AND THE WAY FORWARD

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ABSTRACT

The COVID-19 pandemic that out broke out in late 2019 has interrupted supply chains across the globe. However, the most prominent disruptions have been experienced in healthcare supply chains (HCSC). Hospitals globally have been overwhelmed in their efforts to manage the flow of COVID-19 positive patients with their limited resources of required medicines, equipment, testing kits, protective gear as well as healthcare professionals themselves. Moreover, the supply of these resources was disrupted due to government-imposed travel restrictions,

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lockdown measures, and the temporary closure and/or underutilization of suppliers' facilities due to labor and raw materials' shortages. A large number of healthcare professionals were falling sick, which created further pressure on the healthcare service delivery chain. Scholars, policymakers, and practitioners across the world have proposed and developed a number of innovative ways to combat the aforementioned situation, which also serve as important lessons for the future. This paper is a review of literature focused on the impacts of the COVID-19 pandemic on healthcare supply chains. It attempts to identify key lessons learnt from the journey to date, and offers recommendations to tackle similar future disruptions. The researcher reviewed the findings, analysis, and recommendations from 30 relevant research papers published since December 2019 for this study. Thematic analysis revealed five broad themes: 1. Surge in sudden demand; 2. Virus containment measures 3. Further demand flight; 4. Supply chain disruptions; and 5. HCSCs responses. Recommendations are derived from HCSCs' experiences, and responses to the pandemic and required interventions suggested in the literature. Practitioners and policymakers can use the findings of this paper as a guide when tackling similar situations. Moreover, some of the paper's findings may trigger a number of fundamental changes in the healthcare supply and service delivery chain. The paper also disseminates new perspectives of HCSCs.

1. INTRODUCTION

Healthcare organizations (HCOs) like primary care units, secondary and tertiary care hospitals, diagnostic centers, nursing homes, and long-term care homes provide different services to ensure patient safety, care, and well-being. For effective delivery of these services, they require a smooth flow of a variety of resources, including medicines, chemicals, reagents, medical equipment, supplies and machinery, skilled technicians, medical professionals such as doctors, nurses, pharmacists, and many more. Healthcare supply chains (HCSC) are thereby characterized by interdependent networks of local and international organizations spread over multiple tiers. For example, medicines, chemicals, pathology and surgical reagents, equipment, and supplies are manufactured in many different parts of the world. Health departments of various governments and international bodies like the World Health Organization (WHO) play

an overarching role in procurement and distribution of the same. In the process, they formulate policies, procedures, and standards to ensure the quality of materials, equipment, and machinery that directly impact patient safety. Locally and internationally trained healthcare professionals require licenses issued by the licensing authority operating in their region. As a result, HCSCs operate in a highly regulated and constrained ecosystem.

Although healthcare is a basic human right, HCOs across the globe systematically struggle with inadequate resources to serve their populations. On one hand, the rising costs of healthcare, aging populations, and an increased need for healthcare services is juxtaposed with frugal government allocations for the sector that intensify the problem. In such situations, any disruption—even a small ripple—in HCSC can trigger tremendous pressure on the timely and effective delivery of healthcare services. However, most pre-COVID-19 disruptions were localized or single dimensional, such as a problem with a particular source of raw materials, the closing of a factory producing an essential product, or turmoil in a single country. With their internationally spread matrixed networks, HCSCs could withstand or self-heal from such isolated disruptions when they happened in the past.

The new coronavirus-induced disease (COVID) spread across the world within months of the first documented case in the People's Republic of China in late December 2019. The disease's rapid spread, the nature of its progression, and its manifestation on the human body were a whole new set of experiences. As very little was known about the virus and its nature, manifestation, treatment, or prevention, a "fear of the unknown" overwhelmed healthcare professionals, policymakers, and the general population across the globe. On the one hand, the burgeoning number of patients requiring critical, intensive, or emergency care created tremendous pressure on HCSCs, which were already struggling with inadequate resources. On the other hand, the WHO-endorsed virus containment measures that were largely adopted by governments worldwide disrupted the production and distribution of vital resources, including life-saving medicines, active pharmaceutical ingredients (APIs), packaging materials, face masks, surgical gloves, face shields, gowns, etc.

Hygiene instructions for the general population exerted further pressure on the demand for personal protective equipment (PPE): face masks, gloves, face shields, sanitizers, and other disinfectants. Thus, the COVID-19 pandemic exerted spiraling thrust on both the upstream and downstream of HCSCs.

From the very beginning of the pandemic to date, HCOs and their supply chain partners have implemented a variety of measures to tackle the situation; governments and international bodies intervened with policies and aid. We have also witnessed many different innovations during this troubling period. Scholars, researchers, and practitioners have gone the extra mile to analyze and evaluate the situation. Their recommendations will help to tackle similar crises in future and regressed about the new-normal HCSCs in the post-COVID-19 era. As a whole, a large body of knowledge has been created in relation to HCSCs during this ongoing fight against COVID-19 over the last 16 months. The objectives of this paper are to identify and analyze HCSCs experiences and interventions during the COVID-19 pandemic. It will offer a summary of the key lessons learned to date, give recommendations to tackle similar disruptions as well as shed light on the prospective changes to HCSC structure and practices in the post-COVID-19 era.

2. RESEARCH METHOD

The foundation of this paper is a secondary literature review. Research papers were accessed from Google Scholar and Science Direct using a keyword search for the following terms: healthcare, hospital or pharmaceutical; supply chain; COVID-19, coronavirus or pandemic. A total of 47 research papers published between December 2019 and March 2021 were selected. Abstracts of these papers were then reviewed to confirm their fit with the focus of this paper, which resulted in a pool of 30 relevant research papers. Of these, 24 were published in indexed journals and the remainder were grey literature sources.

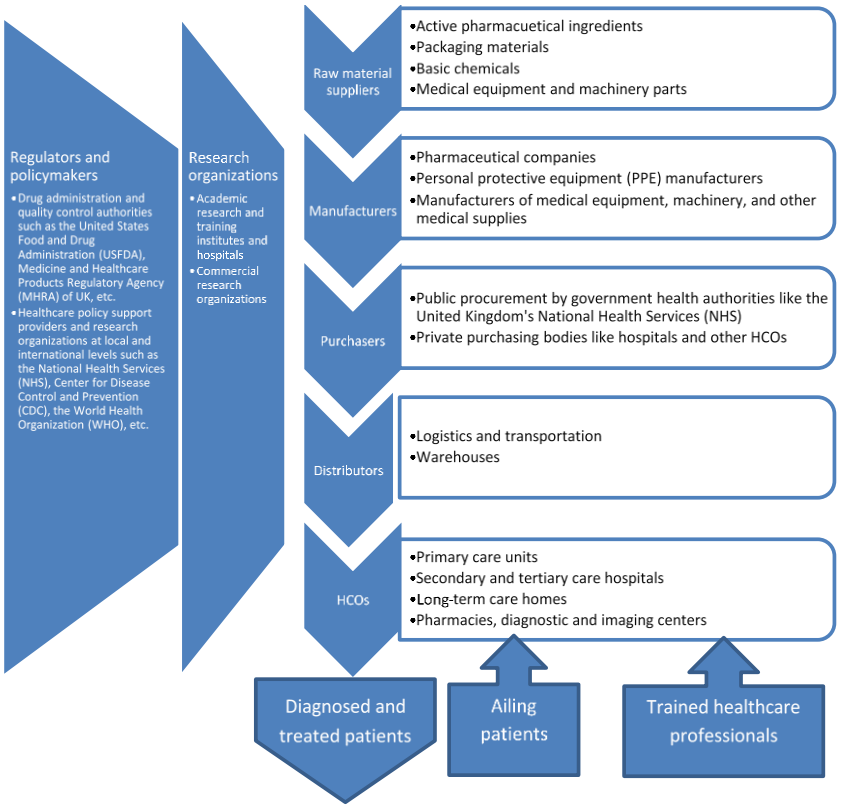

Figure 1. Healthcare supply chain (constructed by the author).

The researcher adopted a qualitative approach to conduct a thorough review of the relevant literature. A thematic analysis was conducted on the findings, analysis, discussion, conclusion, and recommendation sections of the 24 selected papers. The researcher's personal observations from news broadcasts during the pandemic and five key informants' views are also considered. Thematic analysis is one of the most common approaches to qualitative data analysis, which involves seeking out themes in available transcripts or literature (Bell, Bryman, and Harley, 2018). Themes are generally unique ideas, concepts, conducts, or categories. As no new themes were emerging within the last few papers that the author reviewed, it can be asserted that a thematic saturation stage was approached.

The healthcare supply chain (HCSC) framework presented in Figure 1 has been used as a guiding pillar for the thematic analysis conducted for this paper. Themes and sub-themes are categorized according to the major nodes of disruptions and interventions during the pandemic.

3. FINDINGS AND ANALYSIS

Through a thorough analysis of the literature, five broad themes were identified: 1. Surge in sudden demand; 2. Virus containment measures; 3. Further demand flight; 4. Disruptions in supply chains; and 5. HCSCs' responses. The researcher also identified several sub-themes under each of these broad themes. This section elaborates on these themes and sub-themes.

3.1. Surge in Sudden Demand

The WHO declared COVID-19 a pandemic on March 11, 2020, three months after its first manifestation as pneumonia of an unknown origin in Wuhan, China. Within this short period of time, the disease had spread to over 114 countries, claimed 6,500 lives, and affected about 300,000 people (WHO, 2020). As the disease propagated, the demand for healthcare services was immediately impacted. HCOs began to encounter an exponentially rising number of patients with symptoms of ordinary cold and flu. However, an unusually large number of patients were also being rushed to hospitals with symptoms of acute pneumonia and other complications (Sharma, Gupta, and Jha, 2020). As a result, the demand for medications skyrocketed, not only those used for pain, fever control, and breathing but also many sophisticated prescription medicines such as immune modulators, corticosteroids, anticoagulants, hydroxychloroquine, remdesivir, etc. (Harvard Health, 2021).

For patients with moderate to acute symptoms, medications are often administered as IV injectables. Many of these patients also need

supplementary oxygen and mechanical ventilator support. Patients with severe symptoms like very high fever, breathing difficulties, and reduced oxygen saturation are required to be hospitalized for close observation of the disease's progress and treatment adjustments (Edward-Elmhurst Health, 2021). Therefore, demand escalated for other medical supplies, equipment, hospital beds, medical oxygen, ventilators, high dependency units (HDU), and critical and intensive care units (ICU). The spiking numbers of COVID-19 patients was akin to heaping sorrow upon sorrow on HCOs since the whole sector was already systematically suffering from a lack of resources. Moreover, caregiving in HDUs and ICUs requires highly skilled professionals and a higher patient to caregiver ratio. This exerted further pressure on the demand for skilled and trained healthcare professionals (doctors, nurses, and technicians).

Due to the highly contagious nature of the disease, doctors, nurses, and other caregivers attending to these patients were advised to wear personal protective gear, including N95 face masks, surgical gloves, protective gowns, face shields, goggles etc. As the disease spread across the globe, demand for personal protective equipment (PPE) spiked. In March 2020, the WHO projected that there would be an additional monthly demand for 89 million N95 face masks, 76 million pairs of medical examination gloves, 1.6 million goggles during the COVID-19 outbreak (WHO, 2020).

3.2. Virus Containment Measures

The WHO, along with leading experts and associates, dedicated themselves to developing a scientific understanding of this novel virus and provided guidance and regulations to conserve human health and impede the outbreak's spread. One of the first precautions was halting international air traffic to and from Wuhan, where the outbreak first occurred. As the disease continued to spread, many countries cancelled shipments of pharmaceutical ingredients, medical accessories and equipment etc from China (Grida, Mohamed, and Zaied, 2020). Regional lockdowns and travel restrictions across cities and international boarders were imposed.

International transportation along many routes was suspended. Many factories were forced to close or to operate with fewer employees in order to maintain physical distancing protocols (Grida, Mohamed, and Zaied, 2020). The public was instructed to wear face masks, frequently wash their hands with soap, sanitize their hands and surface areas, and maintain a minimum of six feet (about two arm lengths) physical distance from other people who were not from the same household (CDC, 2020). Frontline service providers such as doctors, nurses, pharmacists, and emergency and essential service providers were advised to use PPE.

3.3. Further Demand Flight

As news of the disease circulated, healthcare authorities regularly communicated health and safety protocols in the mass media to educate the public and increase awareness about the circumstances. This quickly created a demand for essentials medicines, medical equipment, disinfectants, cleaning agents, and PPE. People almost in all countries started to purchase more supplies than they needed or could consume and prices of these items started to rise abnormally. This panic buying created an artificial shortfall in the market, which resulted in further spikes in demand. Some vendors began hoarding materials. Due to uncertainties about the scale and span (temporal as well as spatial) of the pandemic, HCOs built buffer stock, thereby intensifying the demand shock (Kuo, Ou, and Wang, 2021; Sharma, Gupta, and Jha 2020; Liv, 2021; Francis, 2020).

3.4. Supply Chain Disruptions

Different tiers and branches of HCSC were simultaneously affected during the pandemic, including by a short supply of medical goods, raw materials, parts and equipment due to: delayed delivery; production interruptions; lean management and problems in scaling up; uncoordinated procurement and distribution of COVID testing kits; newly imposed trade

barriers; and evolving environmental and sustainability issues. These disruptions are explored in the following section.

3.4.1. Short Supply of Medical Goods, Raw Materials, Parts, and Equipment

Wuhan, China was the first location that COVID-19 first seriously impacted. As the virus spread, employees working in the city's factories began to fall sick. As the disease propagated, factories began to encounter labor shortages, as did those in many other cities across China. As a result, product deliveries from these factories were delayed. Later on, the closure or partial closure of many of them became inevitable. China is the world's manufacturing hub as well as one of the largest exporters of active pharmaceutical ingredients (APIs), surgical face masks, gloves, and other medical supplies and equipment. In fact, one in every 13 major global manufacturers of PPE has at least one factory located in China (Roy, 2020). Although China brought the COVID situation under control within few months, reopened factories and resumed exports, product quality suffered (Roy, 2020).

Most of the production capacity of solidarity drugs such as remdesivir, chloroquine/hydroxychloroquine, ritonavir/lopinavir, and ritonavir/ lopinavir-interferon-beta, which are in high demand for treating COVID-19 patients, and their chemical precursors are located in the United States, China, and India. Other major suppliers of pharma raw materials and healthcare equipment are based in Italy and Germany (Kuo, Ou, and Wang 2021; Sharman, Gupta, and Jha, 2020). The pandemic deeply affected all these countries. As a result, the global HCSC experienced multi-tiered disruptions. Production was hampered by transportation bans, sea and air cargo shipping suspensions, and labor storages due to ill employees or their migration. As the virus spread globally, the suspension of vessel and carrier transportation on many international routes aggravated the disruption in the flow of raw materials, pharmaceutical products, and other medical goods. Beyond the movement of health products and supplies, HCSC logistics involve the movement of people between nations who work for firms that specialize in pharmaceutics, healthcare technology,

pharmaceutical research, and service delivery (Rahman, 2021). COVID-19 halted the movement of people, thereby negatively interfering with manufacturing and service delivery activities.

The past 16 months have revealed that about 15 percent of COVID-19 patients require critical care (CDC, 2020). In hospitals, this is a highly resource-intensive service. The minimum standard for a ventilator unit used in critical care is four nurses and one duty medical doctor on call around the clock. Moreover, ventilators require an uninterrupted power supply, oxygen, and regular maintenance. The increased need for critical care support strained the supply network that includes ventilators, medical oxygen, and trained professionals. In most countries, tertiary care hospitals with ventilators and other required equipment are only available in urban areas (Sharman, Gupta, and Jha, 2020). This means that patients requiring critical care need to be transported to urban hospitals, which creates further stress on the supply chain.

3.4.2. Lean Management and Problems with Scaling-Up Production

Organizations' lean management practices made the COVID-19 situation more fragile since lean supply chains systematically thrive on optimizing alignment between the volume of healthcare supplies delivered and the demand from healthcare facilities. As a result, most healthcare systems and even entire nations keep only a modest inventory of healthcare supplies in anticipation of future demand (Kuo, Ou, and Wang 2021; Bhaskar et al., 2020; Yu, Razon, and Tan, 2020). The same practice applies to terms of capacity of production. For instance, as of February 2020, the United States had a stockpile of only 12 million N95 face masks, far fewer than what was estimated to be adequate amid the outbreak (Ayati, Saiyarsarai, and Nikfar, 2020). As the manufacturers did not have much additional capacity to ramp up production, federal and state governments inexplicably competed with one another for the same pool of PPE and testing kits. This competition gave rise to skyrocketing prices and the proliferation of irregular contracting practices. Almost the whole globe suffered from the above-mentioned phenomenon.

3.4.3. Uncoordinated Procurement and Distribution of Testing Kits

The procurement of effective testing kits was another dire supply chain issue that HCOs continued to experience during the pandemic. Initially, only national governments procured testing kits from internationally approved suppliers on a quota basis. Public health authorities of national governments administered the tests and, in some cases, distributed testing kits to other HCOs to conduct the testing. Almost in every affected region, as the number of patients demonstrating COVID-19 symptoms far exceeded the testing capacity, people endured long waits to receive a test. This created chaos in the management of COVID-19 testing, especially in developing nations like Bangladesh, India, and some African countries. On the other hand, developed nations like the United States were testing not only those with symptoms, but also people who came in contact with symptomatic patients irrespective of the manifestation of any symptoms. This was a contact tracing initiative that most developing and underdeveloped nations could not afford. Later on, private HCOs in some of the countries like Bangladesh and India were given permission to import testing kits and conduct tests. While this increased the accessibility of testing, the accuracy of test results and the quality of the test kits remains to be a cause for concern in many of the developing and underdeveloped countries. Some studies suggest that testing kits imported from China had only a 6 percent accuracy rate against the European Union's medicine agency guideline of 80 percent accuracy (Sharma, Gupta, and Jha, 2020).

3.4.4. Newly Imposed Trade Barriers

The speed and scale of demand surge, in addition to the lack of adequate scientific knowledge to project such growth in demand, intensified the uncertainties and vulnerabilities that HCSCs faced. This led some countries to restrict the export of items deemed essential during the pandemic. Such a nationalist or protectionist approach is justified on the grounds of prioritizing local demands and strengthening national public health. For example, India decided to halt exports of medicines such as paracetamol, chloroquine, tinidazole, erythromycin, vitamin B12, and

progesterone, among others as well as 26 active pharmaceutical ingredients and other healthcare equipment such as face masks (Rahman, 2021; Liv, 2021; Laker 2020) amid fears of shortages within the country. Similarly, the United States commandeered some production facilities owned by companies, including 3M and Philips, to ensure that they focused their production on medical necessities, namely face masks and ventilators, solely for the American market (Abbas, 2021). In some cases, powerful partners in the global value chain make such restricting efforts difficult and they retaliate. For instance, Philips' US production of ventilators relies heavily on components sourced from the European Union (EU). The EU and its allies are likely to retaliate in response to the attempt to prioritize American healthcare at the expense of the EU (Rahman, 2021). However, countries with limited bargaining power, especially developing and underdeveloped nations that also have limited medical supply chain capabilities, are likely to experience adverse effect of such trade restrictions (Khot, 2020).

3.4.5. Evolving Environmental and Sustainability Issues

Increased hospitalization rates, emergency transportation of necessary items and patients, increased production of the required medicines, medical supplies and PPEs, heightened use and disposal of face masks, gloves, face shields, protective gowns, and disinfectants as well as frequent washing of materials and human body parts contributed to HCSCs' increased energy consumption and environmental footprint (Klemeš, Van Fan, and Jiang, 2020). Moreover, the sheer scale of certain drugs' use during the pandemic is likely to cause a substantial negative impact on the environment and human health. Unmetabolized drugs and their metabolites are widely regarded as emerging trace pollutants that are problematic as even conventional sewage treatment plants cannot destroy them (Gogoi et al., 2018).

3.4.6. Growing Pervasiveness of Contactless Healthcare Service

Due to time and resource constraints on the part of HCOs as well as their patients/clients, telemedicine has been practiced in the United States

since the 1990s. Telemedicine refers to remote medial consultation through real-time phone or audio-video calls using a landline, smartphone, tablet, or computer. However, contactless healthcare services can go far beyond consultation. Patient appointments, monitoring, surgery, record keeping, diagnostics, and much more can be done with precision and at lower cost using telecommunication networks, the internet, mobile apps, smartphones, wearable medical devices, artificial intelligence (AI), the internet of things (IoT), and cloud computing, among others. The new-normal norm of social distancing and precautions against the spread of COVID-19 infection have exerted momentum on the growth of telemedicine and other contactless healthcare services. Before the outbreak of the pandemic, the rate of telemedicine service utilization in the United States was only around 11 percent, which has now (at the time of writing this paper) increased to about 46 percent. Physicians and HCOs' use of telemedicine has expanded by 50 to 175 times on average (Lee and Lee, 2021). Recently, contactless healthcare services have become popular in many countries, including France, South Korea, China, and Japan. A Global Market Insights (2020) project found that the capital size of the global telemedicine market was estimated to reach US$ 175.5 billion in 2026, up from US$ 45.5 billion in 2019.

3.5. Responses by Healthcare Supply Chains (HCSCS)

This section presents different initiatives that various HCOs and relevant stakeholders have taken to tackle the disruptions experienced during the pandemic. Major initiatives include enhancing/building local capacity, alternate and unusual sourcing, internal resource mobilization to maximize utility of the resources, adopting a system-wide approach to enhance agility, telemedicine, resource rationing, and use of disruptive technologies.

3.5.1. Enhancing/Building Local Capacity

As deliveries from international suppliers were delayed and/or postponed, many nations stepped up to develop local capacity. For example, in October, 2020, the government of India announced a scheme to establish bulk drug parks with the aim of manufacturing key starting materials (KSMs)/intermediates and APIs in the country (Sharma, Gupta, and Jha, 2020). Taiwan set-up a consortium of manufacturers and began to manufacture 15 million medical face masks per day within a few weeks of predicting shortages (Dai, Bai, and Anderson, 2020). Geneva University Hospital (HUG) began in-house production of hydro-alcoholic solution or sanitizer and Dulbecco's Modified Eagle's Medium (DMEM) used for Polymerase Chain Reaction (PCR) screenings of COVID-19 cases (Garnier, Falaschi, Bonnabry, and Bouchoud, 2021). But in order to be successful at ramping up the domestic supply chain in a timely manner, a full-scale industrial common consisting of manufacturing and infrastructure, human resources, and research and development capabilities that span across the entire supply chain is a must. Full-scale industrial commons are expensive, a path towards implementation thus mandates private-public partnership. On the other hand, to enhance local capacity, countries like India, Iran, the United States, the United Kingdom, and some EU countries have imposed barriers on the export of essential materials whereas some other powerful countries forward purchased a large bulk of supplies from manufacturers by offering premium prices (Abbas, 2021; Rahman, 2021; Liv, 2021). Such actions, perhaps, have some short-term benefits to those countries, but are not sustainable in the long run and ethically questionable because healthcare is a basic right for all. In countries such as Iran and some Nordic countries who systematically maintain a large stockpile of medicines, experienced supply shortages much later than in other parts of the world. They had more time to strategize on how to best manage the potential shortages.

3.5.2. Alternate and Unusual Sourcing

Iran, Taiwan, some other countries, and some hospitals in Switzerland relied on alternate sources of supplies in Europe when their regular

suppliers in China and India could not meet the demand (Garnier, Falaschi, Bonnabry, and Bouchoud, 2021; Francis, 2020). Some others like India, South Korea, and Sri Lanka opted for unusual local sources for their face masks and PPE gowns supply. Garments manufacturers improvised their production to produce cloth face masks and PPE (Kuo, Ou, and Wang, 2021; Ayati, Saiyarsarai, and Nikfar, 2020; Sharma, Gupta, and Jha, 2020). Breweries in Europe and Canada moved to producing sanitizers and auto manufacturers made ventilators to meet the demand in the market (Iyengar, Vaishya, Bahl, and Vaish, 2020; Garnier, Falaschi, Bonnabry, and Bouchoud, 2021). These sorts of unusual sourcing were often win-win solutions since virus containment restrictions meant that demand for these suppliers' original products plummeted.

3.5.3. Internal Resource Mobilization

During the pandemic, demand as well as access to non-emergency healthcare services was reduced. Medical professionals switched to online consultation and telemedicine. A 2020 WHO survey found that in 53 percent of the countries surveyed, governments had partially or completely discontinued their regular healthcare services for hypertension, diabetes, and diabetes-related complications, among others. Nearly 63 percent of the countries also discontinued rehabilitation healthcare services (Lee and Lee, 2020). As a result, HCOs drew on human and other resources from these departments to care for COVID-19 patients. Some HCOs reorganized existing facilities or built temporary makeshift facilities in open and/or unutilized spaces to accommodate the spiking number of COVID-19 cases. Recently retired professionals—doctors, nurses, and technicians—were re-employed to meet the demand that the pandemic created (Tharanga and Fernando, 2021; Garnier, Falaschi, Bonnabry and Bouchoud, 2021).

3.5.4. Telemedicine and Hospital at Home

As mentioned earlier, the pandemic has triggered the accelerated growth of telemedicine. Although it is being adopted as an alternative way of providing healthcare services during the pandemic, the thorough adoption of smart and communication technology used for telemedicine is

likely to remain as a new norm in the post-COVID-19 era. Hospital at Home (HaH) is an example of an advanced version of telemedicine. San Giovanni di Dio Ruggi d'Aragona Hospital, located in San Leonard, Italy, launched a research project in collaboration with Centre of Salerno University and Magaldi Life Ltd., a local firm, to evaluate the effectiveness of providing long-term, in-home care for patients with specific chronic diseases. The outcome of the project was very encouraging. Participating patients reported better care and a better experience. Practitioners also expressed better satisfaction. Above all, the implementation of HaH meant better patient care—the readmission rate dropped by 16 percent—was delivered with less resources (cost savings of 38 percent) (Badr, Carrubbo, and Ruberto, 2021). Although the HaH project was tested before the pandemic, professionals suggest that this can be considered as a very effective way to deliver healthcare services during the pandemic. In fact, during the COVID-19 pandemic, many HCOs are providing telephone consultation to patients and asking patients' families to check and report vital signs using handheld devices. This reduces the strain on HCOs, while at same time contributing towards increases patient and caregivers' safety.

3.5.5. Adopting a System-Wide Approach

The scale of demand surge perpetuated by the pandemic remains unpredictable. The manifestation of the virus is continuously changing due to the evolution of newer strains. Treatment of the disease is still (as of Mach 2021) at a solidarity trial stage. Tackling so many unknowns and uncertainties require a system-wide approach. Leading HCOs have adopted a wholistic approach to deal with the crisis.

For instance, the Mayo Clinic developed an interdisciplinary predictive analytics task force to provide hospital census forecasting for COVID-19. The task force delivered predictive insights through a structured set of visualizations and key messages to all HCOs under the Mayo Clinic. It helped the practices to anticipate and react to changing operational needs and opportunities (Amrami et al., 2021). Similarly, the Taiwan Food and Drug Administration (FDA) set up a drug supply and shortage information network, a proactive measure that provides regular

inventory updates and projects nationwide supply shortages. The government, in collaboration with a private drug manufacturer, made concerted efforts to locate substitute therapeutics, alternative sources of APIs as well as need-based manufacturing and imports. It also offered financial stimulus to manufacturers to aid their search for and procurement of APIs from alternate sources. Infrastructure and policies were in place for the rational distribution of drugs and medical supplies. All types of HCSC risks were communicated through multiple channels to ensure timely actions from stakeholders (Kuo, Ou, and Wang, 2021). This integrated system paid off during the pandemic. Taiwan is considered by many to be a role model for its management of the pandemic; its low fatality rate is one of the lowest in the world. A base hospital in Udugama, Sri Lanka is also seen as an effective model for tackling the COVID-19 situation. Through a multidisciplinary COVID-19 coordination committee, hospital administration implemented hospital-wide action plans. The committee worked towards capacity building and awareness raising, upgrading infrastructure and systems, instituting locally led cost-effective innovations, improving logistics management and drug delivery, establishing isolation wards, and developing a triage system. The hospital also paid adequate attention to its staff's safety and well-being to keep them motivated to serve the community (Tharanga and Fernando, 2021). The South Korean government's purchasing scheme, nationwide distribution, and rationed retail sales policy to combat supply chain disruptions due to panic buying and hoarding behavior is another example of successful planning and execution during the height of the pandemic (Liv, 2021).

3.5.6. Resource Rationing

The rationing of resources is inevitable for the overall good of a population. Healthcare is not an exception. Especially when resources are scare and demand is very high, rationing becomes unavoidable. It has therefore become one of the obvious responses to the aggravated healthcare resource crisis during the pandemic (Srinivas et al., 2021). For instance, frontline service providers received priority access to COVID-19

testing and PPE. Critical care resources were channeled to patients who were expected to receive the most benefit. Elderly people, those with comorbidity, and frontline service providers who were at higher risk of infection were given priority for vaccinations. The institutional-level and bedside rationing presented above rationing was also done on an international scale. For the equitable distribution of medical supplies, the WHO launched the COVID-19 Technology Access Pool (C-TAP) that allows for the worldwide sharing of patents covering pharmaceuticals, vaccines, and/or methods of treatment related to COVID-19. The waiving of IP rights on COVID-19 drugs, diagnostics, and vaccines for low income countries like South Africa, Bangladesh, and India is another promising development toward ensuring equitable access (Rahman, 2021). Discriminatory pricing of COVID-19 drugs and vaccines is another important move towards ethical rationing of resources.

3.5.7. Lifting /Relaxing Trade Barriers

On one hand, some countries took nationalistic restrictive measures to ensure the local surge in demand was met first, as mentioned earlier. On the other hand, a number of countries like Brazil, Argentina, Canada, the United States, and China lifted or relaxed some trade barriers to facilitate the quick flow of medicines, raw materials, medical equipment, and supplies (Rahman, 2021). Brazil simplified its customs clearance process to expedite the import of goods designed to combat the spread of the deadly virus, e.g., surgical face masks, disinfectants, antiseptic gels, medicines, medical equipment, and other essential products. Argentina suspended its anti-dumping duties on imports to ensure sufficient supplies to its domestic markets. Canada temporarily eliminated tariffs on a specific group of goods deemed critical to handle the pandemic. The United States excluded a range of medical gear and equipment from the additional duties previously imposed under (Rahman, 2021); China did the same on certain goods imported from the United States.

3.5.8. Technological Adaptations

The use of technology in decision-making, projection of demand and supply uncertainties, logistic and inventory management, product designing and testing, resource mobilization, and much more has become common in recent days. HCSCs somehow fell behind in this trend when compared to fast-moving consumer goods (FMCG) and tech-product supply chains. However, during the pandemic, many HCSCs have turned to technology to tackle the crisis. One good example is the growth of telemedicine as an alternative to physical service delivery (Lee and Lee, 2021; Badr, Carrubbo, and Ruberto, 2021). The use of wearable technologies like pulse oximeters has been common for COVID-19 patients treated at home. Some entrepreneurs in Srinlanka, India, and Bangladesh etc. began using apps like Uber to rent and deliver essential medical equipment used in the treatment of COVID-19 patients.

The use of 3D printing is a technological disruption that gained momentum during the pandemic. The stock of venturi valves in a northern Italian hospital was quickly depleting. Two guys reverse-engineered the valve within a few hours using a desktop 3D printer and were able to supply enough valves to run 100 ventilators within a day (Abbas, 2021). 3D printing technology has also been used in the design and production of face masks, goggles, and other PPE (Iyengar, Vaishya, Bahl, and Vaish, 2020).

Not only used in patient monitoring, consultation, and equipment design, technologies like artificial intelligence (AI) and augmented realities have been onboarded during the COVID-19 pandemic in various healthcare service delivery functions, including AI-based surgeries, the monitoring of critical care patients, safety management of patients and staff, and in administrative tasks (Lee and Lee, 2020). AI is also used for COVID-19 virus analysis, the enforcement of quarantine regulations, and the disinfection of large areas.

RECOMMENDATIONS

Lean management practice and globalized supply chains are two limiting factors that have contributed to the fragility of HCSCs during the pandemic. Hence, investing in redundancy and strategic reshoring should be on the agenda for building an agile HCSC. In this regard, national procurement, distribution, and regional stockpiling to meet emergency needs is essential. As redundancy and reshoring are often expensive, national governments and regional coalitions should provide financial incentives and policy supports. Global healthcare risk management protocol must be developed and maintained with adequate professional capacities. The objective should be to build an integrated and collaborative network to identify risks and formulate and facilitate comprehensive risk management initiatives.

The lack of visibility in both upstream and downstream supply chains is another reason that HCOs could not identify and measure the risks of the pandemic to make appropriate response plans. In the case of the PPE supply chain in the United States, for example, the government and healthcare providers alike did not know where PPE was being manufactured, how much each facility was capable of producing, or whether a product was subject to shortages, delayed delivery, or quality assurance issues (Dai, Zaman, Padula, and Davidson, 2021). From now on, HCSCs should aim to enhance real-time communications and data updates among all stakeholders in the chain. In this way, HCSCs can build a seamless communication infrastructure by deploying information and communication technology—the Internet of Things (IoT)—as well as predictive analytics, among others. Upholding a culture of open and clear communication is also crucial. To enhance HCSCs resilience, responsiveness, and reconfigurability, healthcare leaders and policymakers should work towards building a community of supply chain partners who work together during times of crisis maximize the overall value of healthcare service delivery. A global governance infrastructure, rooted in shared ethical values, is mandatory for crisis response, but also for increasing the resilience of the healthcare supply chain.

The deployment of smart technologies like AI, IoT, 3D printing, 5G networks, and others will contribute towards faster real-time responses to unexpected disruptions. These technologies will also open a pathway for low-cost design, prototype building, localized production, collaborative design, and much more (Siriwardhana, Gür, Ylianttila, and Liyanage, 2020). Technology deployment such as real-time telephonic and web-based video communication, wearable smart devices, and digital twins, among others, will facilitate telemedicine, care at home, and consultation at a distance (Lee and Lee, 2021; Javaid and Khan, 2021; Badr, Carrubbo, and Ruberto, 2021). Adopting such technologies must be accelerated to expand the public's access to essential health services during situations like the COVID-19 pandemic. Specifically designed apps and even AI-enabled robots can be used to check a patient's condition 24/7, assist with inpatient rounds, and prepare medical records, treatment information, and payment platforms (Bhaskar et al., 2020).

Above all, with the help of technology, communication, and leadership, a new model of a sustainable medical supply chain should be developed to take account of economic, social, and environmental factors involved in supply chain disruptions during such extraordinary circumstances as COVID-19 and develop an optimum combination of all of the above (Goodarzian, Taleizadeh, Ghasemi and Abraham, 2021). Multi-criteria decision support systems and evidence-based mathematical models can be of use in situations of multifaceted disruptions and unforeseen risk management in supply chains (Govindan, Mina, and Alavi, 2020; Grida, Mohamed, and Zaied, 2020).

An international framework of open-source platforms must be created to facilitate "Findable, Accessible, Interoperable, and Reusable (FAIR)" data. There should also be international governance standards in place to address excessive pricing, collusion as well as the fair and reasonable incentivization of intellectual property and data holders (Rahman, 2021; Srinivas et al., 2021).

CONCLUSION

This paper contributes to the literature by highlighting HCSCs experiences and responses in different parts of the world. The paper also analyzes instances of policy intervention at local, national, and international levels. The recommendations provided in this paper are derived from a thorough literature review of HCSCs and their responses during the pandemic. The downsides of lean management and globalization or off-shore manufacturing have become evident during this period. The need for international governance standards and ethical rationing of healthcare resources are also highlighted. Investment in redundancy, strategic on-shore capacity development, and building agility and resilience in HCSCs through deployment of technology and seamless communication among stakeholders are essential for COVID-19 and post-era. Telemedicine and contactless healthcare will be the new norms. However, the physical delivery of services will not become obsolete, but rather become more sophisticated, cost effective, and democratic.

HCOs and healthcare leaders will benefit from the response experiences and recommendations presented in this paper. Policymakers can work towards addressing the issues raised in this paper that require policy intervention and support. Building and managing integrated logistics infrastructure, distribution networks, stockpiling, Intellectual Property Right (IPR), anti-dumping laws, ethical trade policies, and others are some of these issues. In the future, researchers can explore developing strategies and operational guidelines for implementing specific recommendations provided in this paper. The major limitation of this study is the limited number of sources; many innovative interventions and experiences may have been omitted from the analysis. Future studies may focus on these sources. Another limitation is that this researcher reviewed HCSC as a whole from a very high level. Each branch and/or tier of HCSCs may actually have very specific and different sets of interruptions, experiences, and responses that could not be covered in this study.

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Chapter 7

TACKLING SUPPLY CHAIN CHALLENGES IN THE PANDEMIC WORLD

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ABSTRACT

The COVID-19 pandemic is having an impact on global supply chains with the sudden lockdown of cities or countries hampering the whole business activity except the most critical of supply chain activities. In this situation, total supply chain activities can't be hampered as livelihoods totally depend on this functionality. Thus looking for more flexible, automated and sophisticated supply chain technologies that are now more relevant than ever. This pandemic situation helps to rethink the supply chain leaders in a different way for the successfulness of the Supply Chain activities. As this pandemic is not going away so early, challenges like sourcing, locational issues, logistical advancements, technological upgradation and stock level buffering, all of these are playing vital role/s. These challenges combined with ongoing price and trade wars, diplomatic relationships among countries, shifts in manpower for manufacturing and competitive advantage will make dynamic and

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flexible remarks of success looking forward. To stay ahead of global supply chain challenges, leaders must concentrate on re-skilling the workforce, re-assessment of risk management in depth of the supply chain process for the successful and uninterruptable management in this ongoing COVID situation and so on.

Keywords: sourcing challenges, risk assessment, inventory management, automation, robot, Supply Chain, 3PL, 4PL.

INTRODUCTION

The COVID-19 pandemic introduced unexpected flaws in the supply chain hampering the total system (i.e., production, sourcing, delivery, etc.) creating anonymous immediate challenges. So far the supply chain leaders are trying to give a remarkable footprint to speed up the supply chain operations thereby reorganizing the whole functions. Yet some challenges are there and new disruptions are emerging in each and every day while new variants' outbreaks of COVID-19 are occurring in countries. In this pandemic situation, if we think about the basic needs to be fulfilled through the chain; the major responses of the food supply chain and medical supplies (especially vaccines and other life-saving equipment) have the highest importance in both national and international trading environment, which allows firms to think of new sources of supply while existing sources are compromised or non-existent. With the unavailability of sourcing new tension arises with the sudden lockdown/ shutdown of whole regions/ area specific which sometimes hamper concept of continuous production, uninterrupted delivery and many more.

LITERATURE REVIEW

Here there shall be a brief theoretical discussion on Supply Chain Management and in the second part of this section there shall be the real

world examples which helped me to think about tackling the SC challenges in this pandemic.

SUPPLY CHAIN MANAGEMENT IN BRIEF

The supply chain encompasses all activities involved in the transformation of goods from the raw material stage to the final stage, when the goods and services reach the end customer (Shah 2009). In order to be successful, organizations are required to carefully manage their operations by planning, scheduling, and controlling SC activities (Bozarth and Handfield 2016). So, it is easily understandable that SCM starts with planning, flow of materials and information, value conversion and lastly delivery to the end customers. According to Mentzer et al. (2001), "Supply Chains are a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer." Seuring and Müller define sustainable SCM as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental, and social, into account which are derived from customer and stakeholder requirements" (Seuring and Müller 2008). Most companies have outsourced and extended many production and SC activities resulting in a great dependency on global suppliers and complexity, which makes them especially vulnerable to SC disruptions (Bozarth and Handfield 2016). Developments are in the pipeline due to the continuous change in logistics chains due to the efficient transfer of goods and services within the boundary and also at the international level. The demand is always to fulfill the needs in a very cost effective manner and the lesser lead time. To acquire a competitive advantage over the competition, business needs to be perfect in terms of time management, cost management and also it should be hassle-free. As a result, Third Party Logistics (3PL) has become an integrated concept in recent years. However, with the advancement of

new technologies and upgraded thoughts Fourth Party Logistics and Fifth Party Logistics have been introduced as an extension to the concept of the third party logistics concept (Hosie et al. 2007). Moreover, firms are outsourcing their logistics, support functions, and entire supply chain management to third parties/ fourth parties rather of doing it themselves. Why the businesses are moving to the third parties/ fourth parties (in terms of outsourcing the logistics/ support functions/ whole SCM) rather than their own. Customers are always asking for new designs, innovations, cost-effective products and moreover, they prefer easy delivery (least lead time) with the strongest customer service. All these things take almost 25% to 30% of the total cost of production, which makes the product expensive at the customers' end. To reduce this huge cost, businesses begin outsourcing their whole functions or some of the processes to these agents. Outsourcers have the resources, scope and efficient in SCM processes i.e., producing, warehousing, distributing, transporting and moreover much efficient in logistical support with less expenses than the in-house. Before going to the whole discussion, let's stretch out 3PL which is the origin of 4PL. 3PL provides support like contract logistics or semi-integrated logistics support to its clients. There are some definitions which simplifies the concept of 3PL. According to the Council of Supply Chain Management Professionals, 3PL refers to a firm that provides multiple logistics services for use by customers. Preferably, these services are integrated, or bundled together, by the provider. Among the services 3PLs provide are production, transportation, warehousing, cross-docking, inventory management, packaging, and freight forwarding. Bridge field Group tells that "3PL as an outsourced provider that manages all or a significant part of an organization's logistics requirements and performs transportation, locating and sometimes product consolidation activities". Bagchi and Virum refer to 3PL as a long-term partner that provides all or a considerable number of logistics activities for the shipper. Berglund et al. define 3PL as a logistics service company providing service on behalf of a shipper responsible for the management, transportation and warehousing of goods. Sink and Langley refer to a 3PL provider as an external supplier performing some or all of a manufacturer's or a customer's logistical

functions. These definitions simplify that 3PL manages the activities as per its principal's requirements. With the passing of time, the logistics needs are not only confined to one or two activities. To give a total package of solutions, the concept of 4PL came to light. The concept and content of 4PL were first defined by Accenture. Accenture- a global management consulting and professional services firm introduced a new concept called fourth party logistics (4PL). 4PL Company works as a coordinator who pulls together the resources, capabilities and technology of other organizations to design, build and run the whole supply chain network on behalf of its principal. 4PLs basically do the administrative activities but leaves the physical movement like warehousing, trucking, and other services to their contracted 3PLs. 4PLs mostly do not belong to any kind of physical assets rather than providing knowledge relative to fulfilling the customer/principal's requirements. Fourth party logistics providers act as a "chain integrator" and are established to deal with the relationships that exist between the supplier, customer and the third party logistics provider and also have the effect of reducing transaction costs (Bourlakis and Bourlakis 2005). Following concepts make the logistics concept easier for the global supply chain and somehow there is always an underlying risk while handling the operations by $3^{rd}/4^{th}$ party. To mitigate the underlying risks, many measures have been taken to make the process profitable and both parties accountable in terms of doing business. This pandemic has changed the equation since 2020! When it comes to diversifying the risk by outsourcing or creating several sources to minimize the cost and to sustain the business, COVID-19 has changed the definition. It is always for the people and by the people and the people are the main victims of this disaster. Outsourcing or several source maintenance is somehow difficult in these days due to the emergency situation and the business is now looking for internal resource building which is changing the concept of risk diversification. Thus the risk has been seen as the "expected outcome of an uncertain event." Important dimensions of risk in global SC are probability and impact of losses, speed and frequency (Manuj and Mentzer 2008).

REAL WORLD SCENARIO IN THE BEGINNING OF COVID- 19 PANDEMIC

Following scenario has been taken directly from "COVID-19 and Supply Chains: A Year of Evolving Disruption" by Julianne Dunn 2021 to understand this pandemic situation's severity.

Supply chain disruptions have been ever-present since the onset of the COVID-19 pandemic, but they've been largely idiosyncratic, impacting different firms at different times for different reasons. Most recently, a shortage of microchip shortage has hampered auto manufacturing, capacity constraints in steel production have resulted in rapidly rising prices, and COVID-19-related absences have caused bottlenecks in logistics networks. Indeed, one of the first ways the corona virus impacted the US economy was through disrupted supply chains caused by factory shutdowns in Wuhan, China. The Federal Reserve Bank of Cleveland has been monitoring these disruptions for more than a year. Here, I chronicle the evolution of supply chain impacts since the beginning of the pandemic.

The Start of the Pandemic: Chinese Factory Shutdowns Create Ripples and Uncertainty

In February and early March 2020, most business contacts we spoke with indicated that they expected the impact of factory shut downs in Wuhan, China, to be manageable. Some noted that trade tensions in recent years have prompted many firms to diversify their supplier base. Still, given the unclear email outlook, other firms said that they scrambled to find new suppliers and stockpiling items they felt, might become scarce.

February 25, 2020

A manufacturer based in Erie, Pennsylvania, reported that he anticipated there would be a bottleneck and he said the firm was trying to diversify as quickly as it could. The firm tried to buy castings months and

months ahead of its production schedule. There was a cost associated with that research and casting prices also increased.

February 26, 2020

A retailer based in Columbus, Ohio, said that because of trade tensions with China during the last couple of years, the firm moved a lot of its supply chain out of China. So, the virus had been less of a disruption to its supply chain than it would have been in the past. However, the goods that come from China are goods for which there are no good substitutes.

Spring 2020: Lockdowns in the United States and Europe Add to Product Shortages

As the virus spread and the governments around the world imposed stay-at-home orders, reports of supply chain disruptions increased. Many firms, especially manufacturers, reported that factory shutdowns led to shortages of products. These shortages persisted despite the fact that several contacts stated that production in China returned to normalcy sooner than expected. Firms were forced to look for new suppliers and in some cases, reschedule production based on available materials and components. The complete shutdown of automotive assembly plants was especially painful for firms in the Cleveland Fed's service area; suppliers were left with cancelled orders for several weeks and production was halted as a result. Grocers and restaurateurs also noted that even as the initial surge in consumer pantry-stocking behavior subsided, COVID-19 outbreaks at meatpacking facilities led to shortages and price increases in the month of May.

April 16, 2020

A manufacturer based in Toledo, Ohio, said his firm was calling its suppliers daily so that the firm could stay on top of what was coming in order to plan production accordingly. The firm also tried to ensure it had more than one supplier for materials—a departure from past practice.

May 21, 2020

A grocer based in Wheeling, West Virginia, reported that early in the pandemic, it was difficult to secure cleaning and paper products, but these disruptions had subsided more recently. However, due to COVID-19 outbreaks among employees, many meat processing plants have closed making it increasingly difficult and expensive to obtain pork and beef products.

Summer 2020: Following the Reopening of the Economies, Disruptions Have Become Idiosyncratic

During four surveys, we asked contacts whether they saw significant supply chain disruptions that hampered their operations. In each survey, around one-third of respondents indicated that they had. These results are largely consistent with responses to the US Census Bureau's Small Business Pulse survey. In that survey, the share of Ohio respondents reporting supply chain disruptions peaked in April and May and then leveled off in the early summer. Domestic supplier delays were reported by 30 to 35 percent of respondents in surveys conducted throughout the rest of the year.

As time passed, the nature of the disruptions and the contacts evolved. Of the 136 contacts who responded to more than one of the Federal Reserve Bank of Cleveland's surveys, 43 percent gave different answers at different points in time. For example, some respondents reported that supply chain disruptions hampered operations in March and April, subsided in July, but re-emerged in October.

When factories reopened and many governments lifted stay-at-home orders, reported supply chain disruptions became more idiosyncratic than they were in March and April. This was in part because the speed with which producers could reopen varied. Shuttered steel mills and automotive production lines took weeks to come back online. The automotive supply chain was further stressed because of government restrictions and COVID-19 outbreaks at factories in Mexico, contributing to low inventories for

auto dealers as demand for light vehicles exceeded industry participants' expectations. Although many contacts reported that it became easier to obtain materials and component parts in the summer than in the spring, prices for some products increased substantially. Notably, a hot housing market and an increase in do-it-yourself remodeling projects created shortages of treated lumber.

During the summer months, European supply chains improved slightly; in a mid-July survey, only 8% of firms reporting supply chain disruptions indicated that Europe was a pain point, down from a high of 28% in the last week of March. However, as cases of COVID-19 began to rise and the outlook for Europe's economic recovery was uncertain, the share rebounded to 18 percent in late October. The October survey also reported an increase in disrupted supply chains in Canada and Mexico. While the share remained relatively stable at just above 20% in the previous three surveys, it jumped to 32% in October. Additionally, the industry composition shifted somewhat: In July, half of the contacts that reported supply chain disruptions in North America outside of the United States were manufacturers but in October, respondents were clustered in retail (primarily auto dealers) and construction and real estate.

June 2, 2020

A residential builder based in Northeast Ohio reported paying a premium for some materials due to COVID-19 supply disruptions. He said his firm could either pay the premium to keep construction rolling or halt operations until the local supply chain rebuilt capacity.

October 13, 2020

A manufacturer based in Cleveland, Ohio, said that there had been a lot of disruption in the supply chain, with lead times from European suppliers increasing three fold from pre-pandemic levels. Lengthened lead times and uncertainty regarding Europe's recovery necessitate stockpiling of materials and component parts and "if you don't have a large ware house right now, you're out of luck."

Fall 2020: Constraints in Logistics Networks Create Additional Pain Points

In the fourth quarter of 2020, an increase in disruptions to logistics networks has been piled on to the ongoing erratic parts shortages and shipping delays. Freight haulers said that in addition to a massive shift in holiday shopping from brick-and-mortar stores to e-commerce (one logistics software firm reported a record 3 billion packages were shipped during peak season), manufacturers that had kept inventories relatively lean throughout the year now found the need to replenish to keep up with stronger than expected demand. Meanwhile, a shortage of truck drivers was exacerbated by absences as employees contracted COVID-19 or needed to be quarantined. Additionally, there was a smattering of reports that trucks were idled because repair parts were in short supply.

Strong demand for shipping combined with capacity constraints has resulted in dramatic increases in freight costs and lead times. In our late October survey, 44 percent of contacts indicated that they had experienced delays in receiving products and 16 percent reported that the base cost of shipping final goods had increased. In subsequent conversations, an increasing number of contacts reported very long lead times and steeply rising freight costs. Moreover, the surge in COVID-19 cases in the United States impacted labor availability and contacts reported that more and more products were out of stock because worker quarantines led to unmet production schedules.

November 10, 2020

A West Virginia-based manufacturer said that the main constraint on production was staffing, not shortages of materials. Based on its past-due inventory, the firm's production volume would be 3 percent higher if it was fully staffed. Transport lanes of all types were congested and it took longer to receive materials. As a result, freight prices increased substantially—10 percent to 15 percent depending on the shipping lane.

November 12, 2020

A freight hauler based in northern Kentucky reported that two of its biggest e-commerce customers were doing 10 times their normal volume of business. The firm had some delays receiving truck parts. Before the pandemic, it would take two to three days to receive parts. Now, it took two to three weeks. In a couple of cases, it took two months to receive shipments. The firm swapped parts out of idled trucks until it received the necessary parts.

Winter 2020-21: Logistics Bottlenecks and Product Shortages Continue

As the winter wore on, firms continued to report shortages and shipping delays. Manufacturers reported steel shortages, which ratcheted up prices as producers clamored to bring additional steel mills back online. Making matters worse, a microchip shortage threatened first quarter automotive production. Freight haulers expected demand to remain strong at least through the first quarter of 2021 and bottlenecks at ports worsened because of COVID-19 outbreaks.

January 22, 2021

A manufacturer based in Cleveland, Ohio, said that supply chain issues continue and they were making things scarcer (which led to delays) and more expensive. Most firms were working around the situation as best they could. Freight rates increased by more than 50%, and the US Postal Service, in particular, experienced significant delays.

January 26, 2021

A manufacturer based in Toledo, Ohio, said that his "biggest headache" related to logistics. There appeared to be a fair amount of port congestion which was most acute at the port of Los Angeles.

They tried to move some shipments through Vancouver and in some cases, through the Panama Canal to ports on the east coast but it was not much faster and it was much more expensive.

DISCUSSION

In this COVID-19 era, the world looks different than in previous ones. If we can recall the 2020, when it started in China, "The World's Factory" was detached from the world partially or fully. As a result, we observed difficulties in the production strategies and supply chains of firms just about everywhere resulting temporary trade restrictions and shortages of pharmaceutical products, critical medical supplies and other basic necessities. This scenario made the national leaders to think or concentrate more on domestic production, creating employment opportunities in their home countries, reducing dependence on a single source that was risky and rethinking the use of lean manufacturing strategies which involve reductions in inventory cycle in the global supply chains. If we see the growth of the market; we can see a boom in the FMCG industry, Pharmaceuticals and E-commerce predominantly. Due to the lockdown and other financial issues, people tend to spend less and there is a tendency of savings. Now consumers want low prices and also want flawless delivery (especially at their doorstep). These demands from consumers rethink firms/producers rethink their efforts to ensure low cost goods with home delivery.

These challenges for companies will be to make their supply chains more robust without compromising their competitiveness. Let's, firms first understand their vulnerabilities and then consider a number of steps to meet those the vulnerabilities:

SORTING OUT THE VULNERABILITIES

Firstly, in this situation where sudden outbreaks call for a lockdown and limit the functionality, it needs to analyze the supplier's strength. Manufacturers in most industries are relied on specific supplier/s for reasons like dependability, low cost approach, on-time delivery and others. Due to the ease of deliverability, producers rely on suppliers' centralization (single supplier from a single place of sourcing/ producing), which is having a very bad impact and we are observing it right now. If we think an example of current immunization, the giant vaccine producers from Asia and Europe had committed millions of doses to its customers and some of the customers were dependent on a single producer due to the deliverability or ease of logistics or agreement and didn't go to various producers. Situation arises like a shortage of delivery or zero delivery to the customers as there is a mass outbreak of COVID-19 variants in the producer's home country or the region. Taking the mindset on this simple example in this situation, suppliers and subcontractors who were previously focused on just one area, in turn, usually have to rely on many others.

According to Willy C. Shih "Manufacturers in most industries have turned to suppliers and subcontractors who narrowly focus on just one area, and those specialists, in turn, usually have to rely on many others. Such an arrangement offers benefits: You have a lot of flexibility in what goes into your product, and you're able to incorporate the latest technology. But you are left vulnerable when you depend on a single supplier somewhere deep in your network for a crucial component or material. If that supplier produces the item in only one plant or one country, your disruption risks are even higher."

RISK ASSESSMENT FOR VULNERABILITY

Vulnerabilities should always be assessed in terms of Risk Metrics as Low Risk, Medium Risk and High Risk. This sort of assessment is time

consuming and somewhat expensive but once it is done then it shall be easier to map and drive the full Supply Chain strategy. Manufacturers always focus on big suppliers due to the strategic relationship to minimize the cost but a little disruption in supplies can bring a huge business obstacle which is costlier in terms of businesses' cost-benefit analysis. Assessing the suppliers (single source/factory, single country of origin) from low to high risk can give benefits in either way. If the suppliers' risk is high, then it needs to find an alternative supplier in the same time it also needs to be assessed that with an interrupted supply or the shortage of supply how long the factories can run or to find out the speedy recovery rate while the total industry collapses or faces the same. In the real world, it mightn't be suitable for some industries like automated factories, Automobile or Technology industry due to the very few suppliers' orientation or knowledge in that segment. However, if there is the possibility of agility (i.e., flexibility and a dynamic approach) in responding to the situation, manufacturers can be benefited by eliminating the risk of supplier by diversifying as well as restructuring of the production facility.

MANAGING THE SOURCE

High risk of vulnerabilities should always be eliminated by the way of alternative sourcing or building totally new network for uninterrupted supplies. Depending on a single supplier from a specific region always troublesome and we are learning this from the ongoing pandemic situation. Choosing or depending on a single supplier or suppliers from the same region can always be risky due to regional incident or unpredictable situations such as pandemics, natural calamities or regional instability due to various factors. Rather than choosing a single supplier and a specific region; creating various suppliers from various regions can eliminate the risk. Definitely, this concept will be bit difficult as there will always be issues like cost, logistical solutions, expertise and many more. On this perspective suppliers or the factories should be chosen in regions on the basis of their expertise, logistical availability and commitment to the work

and quality of work. Along with that factors like continuity of business, business environment, political stability and labor laws should also be considered while choosing a region or country for new suppliers or factories. While creating new sources or factories, the existing supplier or factory shouldn't be neglected as it already having a network and the flexibility for the manufacturer and also the competitive advantage.

LEVEL OF INVENTORY MANAGEMENT

Creating a new network is not an easy task. Building new sources in a steady process, production should not be compromised and for that reason, raw materials should be at an optimal level or maintaining a safety stock which is very important. Stock keeping is always expensive and it hampers cash flow but in the meantime of this pandemic situation while searching for a new source will be time consuming, and in the middle of searching consumers shouldn't be lost. Though keeping safety stock or the extra stock in inventory will be losing cash flow for a while, it will compensate by retaining the consumers. Thus profiting the firm in the long run.

GRABBING ADVANTAGE OF TECHNOLOGIES

To avoid more contamination, authorities are going for lockdown and preferring home offices. In terms of supply chain functions, manpower is a vital resource and people are the victims of this pandemic. If we see the amazon's working procedure then we can see that they are using robots in their warehouses for pic-packing and at the same time they are delivering the goods to consumers by drone to avoid human touch. So the supply chain should be using the most advanced technologies like automated factories or the processes where it can be offered. For more detailed information technologies like Blockchain, Vendor Managed Inventories and others can be used to make the on time information streamline. The

production line should be following continuous and unhampered production to assist the supply chain in this pandemic. Moreover, there should always be thinking for process innovation in the basis of continuous improvement.

CONCLUSION

Following steps are the solutions to the first-hand exposed challenges which are being faced right now. In the basis of supply chain function, in the real world, firms are having different challenges. The main issue always deals with sourcing and logistical solution which are critical in terms of solving. As it is always not possible to source a new supplier or factory within a night or to cut off the existing supplier immediately, it is always best to wait until the next day. If the supplier can be managed with respect to regional diversity, then comes another issue like logistical advancement. So, the real world solution shall always be adding or deducting the pros and cons and always depend on the cost-benefit analysis. However, this pandemic situation helps us to learn and figure out the loopholes in the supply chain and going on this will always help us to overcome in any sort of future obstacles. In this tensed moment, one good news is that; According to a recent Baker, McKenzie assessment,

> Oxford Economics forecasts that global manufacturing value-added output will rebound, reaching USD 13,789 billion in 2021. This represents a rebound from a 3% drop in 2020 to a 6% increase for global manufacturing in 2021. In Asia-Pacific (excluding China), this is set to hit 4%, while the US may see up to 6% value-add for 2021. Forecasted data for the pick-up in Europe, also in 2021, is currently estimated at 5%.

So, there is no slow down for the supply chain industry, and we should be ready to jump into the growth.

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Chapter 8

POST-PANDEMIC SUPPLY CHAIN: A STUDY ON THE F&B RETAIL INDUSTRY IN BANGLADESH

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ABSTRACT

This research is intended to examine the relationship between Efficiency (EF), Performance (PE), Response (RE), Quality (QU), Facility (FA), and pandemic business management (PBM) in the F&B

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(Food & Beverage) retail industry in Bangladesh. In total, 309 valid responses were received through the survey questions asked at the retail companies in Bangladesh. In addition, systematic random sampling is used to achieve the research objectives of this study. The data has been examined through Partial Least Squares Structural Equation Modeling (PLS-SEM). The study findings showed that Efficiency (EF), Performance (PE), Response (RE), Quality (QU), Facility (FA), and pandemic business management (PBM) (dependent variable) have an influence on the F&B retail business industry in Bangladesh. Future researchers may replicate the findings of this study in different settings (e.g., developing nations), in various industries (e.g., manufacturing, electronics, and health) and then utilize analogous constructions to enhance the body of knowledge, which may help different stakeholders and industries. This work contributes to the limited body of literature on pandemic business management. According to the authors, the findings may help to understand the effect of the pandemic on the retail business industry. Furthermore, it may also help to identify the essential aspects that can have an impact on the retail sector in the post-pandemic environment.

Keywords: Efficiency, Performance, Response, Quality, Facility, Pandemic business management

Research Type: Research paper.

1. INTRODUCTION

Many countries have decided to halt the widespread spread of coronavirus illness (COVID 19) by restricting travel and in-person business activity (Guan, Wang, et al., 2020). The consequences of lockdown scenarios and the global trade modeling framework are subjects for investigation and analysis (Lenzen et al., 2020). Most of the supply-chain losses associated with the initial lockdowns are attributed to many nations implementing limitations and the length of time that the lockdown was in effect due to the disease's infectious nature (Shan et al., 2021). Lockdowns that are more stringent and shorter in duration can also help to reduce the overall loss in most supply chains in the F&B industry (Aldaco

et al., 2020). Even though the techniques are advantageous, the complexity of global supply chains will result in losses in addition to those caused by Covid-19 (Ivanov & Dolgui, 2021). Consequently, developing a pandemic control strategy is a smart idea to mitigate the impacts of such events.

2. LITERATURE REVIEW

In recent decades, business organizations have been confronted with enormous obstacles due to significant illness epidemics (Chakraborty & Maity, 2020). The severity of the outbreaks in question significantly impacts the magnitude of these organizations' challenges. In the event of a widespread public health incident, such as an epidemic or pandemic, businesses and supply chains may suffer significant negative consequences, including decreased efficiency and performance (Guan, Ni, et al., 2020) and a propagation of disruptions throughout supply chains (known as ripple effects), which may have long-term consequences for their resilience and sustainability (Ivanov & Dolgui, 2020). In the recent past, supply chains have been impacted by several disease outbreaks; the World Health Organization (WHO) has reported 1438 epidemics between 2011 and 2018 (Hudecheck, Sirén, Grichnik, & Wincent, 2020). The current COVID-19 pandemic, on the other hand, is unprecedented.

Compared to earlier epidemic outbreaks such as the SARS epidemic in 2003 or the H1N1 outbreak in 2009, COVID-19 has had even more diverse and dynamic consequences (Koonin, 2020). According to a Fortune magazine report released on February 21, 2020, before the World Health Organization designated the COVID-19 outbreak as a pandemic on March 11, 2020, 94 percent of Fortune 1000 companies were already experiencing supply chain interruption as a result of the COVID-19 pandemic (Dohale, Ambilkar, Gunasekaran, & Verma, 2021). Furthermore, in contrast to previous outbreaks, this pandemic has affected all of the nodes (supply chain members) and edges (ties) in a supply chain at the same time (Gunessee & Subramanian, 2020). As a result, the flow of goods through the supply chain has been significantly slowed or stopped

entirely (Mahadi, Ferdoush, & Rahman, 2016; Miraz, 2020b). (Miraz & Habib, 2016a; Miraz & Habib, 2016b; Miraz, Hasan, & Sharif, 2018, (Hye, Miraz, Abdullah, et al., 2020; Hye, Miraz, Sharif, & Hasan, 2019, 2020; Miraz, 2020a, 2020b),). supply-market lockdown, a halt to vehicle movements and international trade (Miraz, Hye, Alkurtehe, et al., 2020; Miraz, Hye, Wahab, et al., 2020; Miraz, Majumder, Chowdhury, & Habib, 2018), a labor scarcity, and the preservation of physical distance between manufacturing sites are examples of these disruptions (Paul & Chowdhury, 2020). The pandemic is expected to significantly influence world international trade due to the multiple consequences on supply chains and other economic and financial issues (Dontoh, Elayan, Ronen, & Ronen, 2020). Therefore, the research constructs the flowing hypothesis.

- H1: Efficiency has a significant positive effect on the pandemic business management in the F&B retail industry in Bangladesh.
- H2: Performance has a significant positive effect on the pandemic business management in the F&B retail industry in Bangladesh.
- H3: Response has a significant positive effect on the pandemic business management in the F&B retail industry in Bangladesh.
- H4: Quality has a significant positive effect on the pandemic business management in the F&B retail industry in Bangladesh.
- H5: Facility has a significant positive effect on the pandemic business management in the F&B retail industry in Bangladesh.

3. Crucial Factors During Pandemic in Supply Chain

Pandemic-related issues have heightened the interest of both academics and practitioners, and preliminary findings from a few current research have revealed discrepancies in their conclusions (Akter, 2021). According to the study results, the usage of pandemic business management (PBM) is positively associated to the organization's

performance. Furthermore, because the pandemic supply chain is a new concept, additional research is needed to understand the variables considered when operating in the F&B industry (El-Ebiary et al., 2021). Despite this, only a tiny amount of research has been done on the role of enabling efficiency. The pandemic is directly tied to the supply chain performance, quality, facility, and timely response. It continues to be important in terms of new ideas and understanding, making it imperative to research further and investigate the Internet of Things in corporate management (Mohajan, 2015). The current pandemic business policy is also stable, and it appears to play a vital role in developing the F&B retail industry (Das et al., 2021). In addition, the pandemic business management is not well-known in the Bangladeshi F&B retail industry (Al Amin et al., 2020).

Although the supply chain is influenced by the pandemic business management during the epidemic, there is no further push to explore pandemic business management in the retail industry, and there is no activity to make it usable to the commercial sector. The pandemic business management is experiencing difficulties due to a lack of efficiency and performance of the supply chain (Kumar, Raut, Narwane, & Narkhede, 2020). Apart from that, there has been little research on the pandemic business management in the F&B retail in Bangladesh (Jaim, 2021). This has prompted the study to investigate the subject matter primarily from the standpoint of F&B retail in Bangladesh. This study describes several issues in pandemic business management that should be investigated further.

The researcher carries out an in-depth investigation and analysis in order to explain the problems and propose remedies. The study discovered some aspects that need to be addressed to improve the PBM further in Bangladesh (Sen, Antara, Sen, & Chowdhury, 2020). The F&B industry in Bangladesh grapples with many difficulties, including supply chain response, supply quality, facility, and pandemic business management (PBM) (Lalon, 2020). The lack of enabling facility has been one of the most significant obstacles to PBM management in the F&B retail market (Mandal et al., 2021). In addition, the lack of response time and supply performance is a problem in the PBM. Aside from that, the issue of

restricted supply facilities in pandemics has been a persistent problem that must be addressed in order to ensure that the master plan's objectives are realized (Shammi, Bodrud-Doza, Islam, & Rahman, 2021). Another significant issue that has been discovered is the lack of efficiency in the PBM (Rahman, Mona, Al Noman, & Avi, 2020). Furthermore, the purpose of using a quality supply has not been investigated yet. These difficulties hinder the growth of pandemic business management in the F&B retail sector in Bangladesh.

4. RESEARCH FRAMEWORK

The independent variables in our research framework are Efficiency (EF), Performance (PE), Response (RE), Quality (QU), Facility (FA). On the other hand, pandemic business management (PBM) represents the dependent variable.

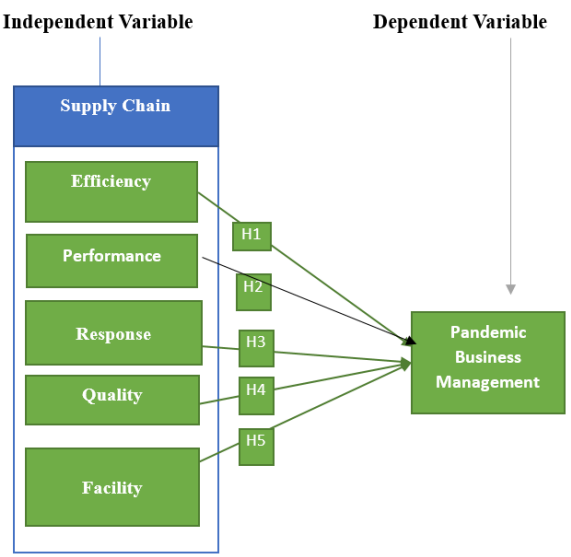

Figure 1. Research Framework.

5. ANALYSIS

Depending on the researcher, reliability will differ; therefore, it is necessary to analyze the reliability of each predictor. The indicator's dependability is frequently referred to as "outer loading," which suggests that the latent design is responsible for most of the variance in the indicator (Afthanorhan, Awang, & Mamat, 2016; Akter, Fosso Wamba, & Dewan, 2017). The overall load can range between 0 and 1 in magnitude (Becker, Klein, & Wetzels, 2012). It is generally accepted that a researcher should delete any objects with loading values less than 0.4 and leave any objects with loading values larger than 0.7 in place (Becker et al., 2012; Goodhue, Lewis, & Thompson, 2012; Hair, Ringle, & Sarstedt, 2011; Hair Jr, Matthews, Matthews, & Sarstedt, 2017).

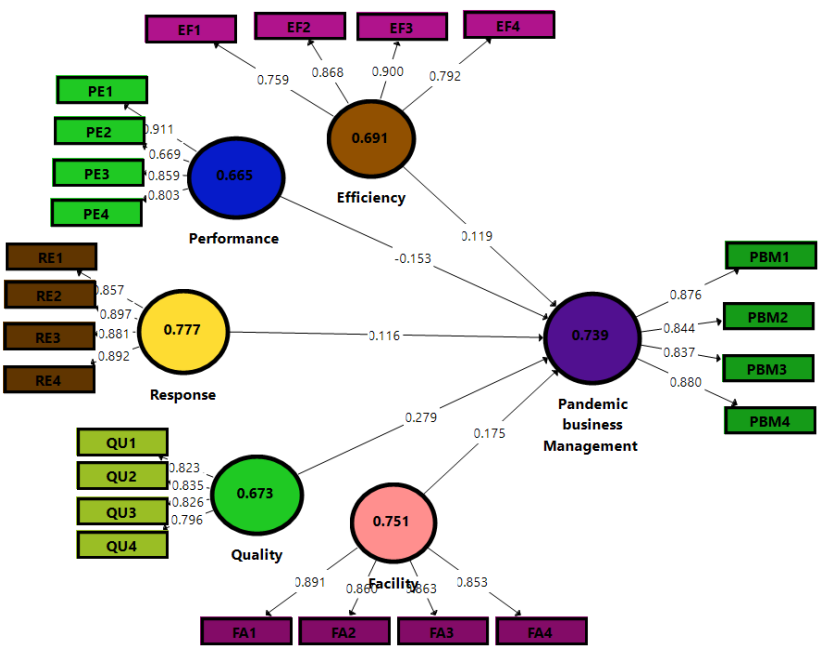

Figure 2. Measurement Model.

Figure 3 shows the discriminant validity, the presence of significant distinctions between two separate conceptions which is characterized as the presence of valid discrimination between them. It has also been argued that the separate constructs must be distinguishable from one another. The Fornell-Larcker Criterion and Cross Loading are two regularly used measures (Hair Jr et al., 2017; Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014a, 2014b). The condition that a latent variable explains more variation than other latent variables is an acceptable criterion, according to Fornell Larcker (Fornell et al., 1996; Fornell & Larcker, 1981c). The difference in significance between its indicators is greater than the difference in importance between its indicators (Hulland, 1999; Jin & Wang, 2019). Cross-loadings are another criterion for discriminative validity that should be considered. Or, to put it another way, every indicator loading must be greater than the sum of all of the cross-loadings on the indicator (Chin, 1998; Kimmerl, 2020). The Fornell-Larker ratio was used to determine the discriminant validity in this study. Figure 3 demonstrates that the diagonal value is greater than the value below it. Because the highest value is slanted and higher, it indicates no discriminant in the study.

	Efficiency	Facility	Pandemic...	Performa...	Quality	Response
Efficiency	0.832					
Facility	0.278	0.867				
Pandemic...	0.275	0.303	0.860			
Performa...	0.084	0.328	-0.066	0.816		
Quality	0.303	0.425	0.432	0.044	0.820	
Response	0.313	0.232	0.303	0.059	0.425	0.882

Figure 3. Discriminant Validity.

Figure 4 represents the reliability of the study. The researchers offered two internal quality metrics, including Cronbach's alpha and composite reliability, as alternatives to external quality measures (Bonett & Wright, 2015; Brown, 2002). Cronbach's alpha and composite reliability are the most commonly used metrics when doing an internal coherence test (Hair

et al., 2017; Jin & Kang, 2011). It is also fairer to use composite reliability for evaluating internal accuracy rather than individual dependability when determining internal precision (Brown, 2002; Cronbach, 1951). It is fair to have composite reliability between 0.6 and 0.7, and it is satisfactory to have it between 0.7 and 0.9 in both cases (Ringle, Sarstedt, & Straub, 2012; Tehseen, Sajilan, Gadar, & Ramayah, 2017; Xie, Sun, & Cheung, 2015). Throughout this investigation, the dependability values for all composites were acceptable; in other words, they were more than the 0.7 norms established by the researchers (Figure 4).

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Efficiency	0.856	0.886	0.899	0.691
Facility	0.890	0.891	0.924	0.751
Pandemic...	0.882	0.884	0.919	0.739
Performa...	0.856	0.959	0.887	0.665
Quality	0.838	0.843	0.892	0.673
Response	0.905	0.920	0.933	0.777

Figure 4. Reliability.

Figure 5 explains the structure model. This stage involves calculating the relationship between the structural model and the latent buildings, which reflects the presumed relationship between the latent structures and the structural model (Ariyanti & Joseph, 2020; Awang, Afthanorhan, & Asri, 2015). T and p values are used to determine the significance of a given relationship (Figure 6), regardless of whether it is essential to do so in the first place. The PLS-SEM approach makes use of an observational t and p-value bootstrapping methodology (Bryant & Satorra, 2012; Chin, 1998). Even though t-values more than 1.645 are statistically significant, p-values of 0.05 and lower are acceptable or justified (Fornell & Larcker, 1981a, 1981b). This study used normal bootstrapping to determine the value of the direction coefficients, with a range of 500 bootstraps and 309 cases in total. In addition to latent external mechanisms, a mediating element (intention to use), and a latent endogenous component, as

illustrated in Figure 5, the conceptual model for this study includes latent internal processes.

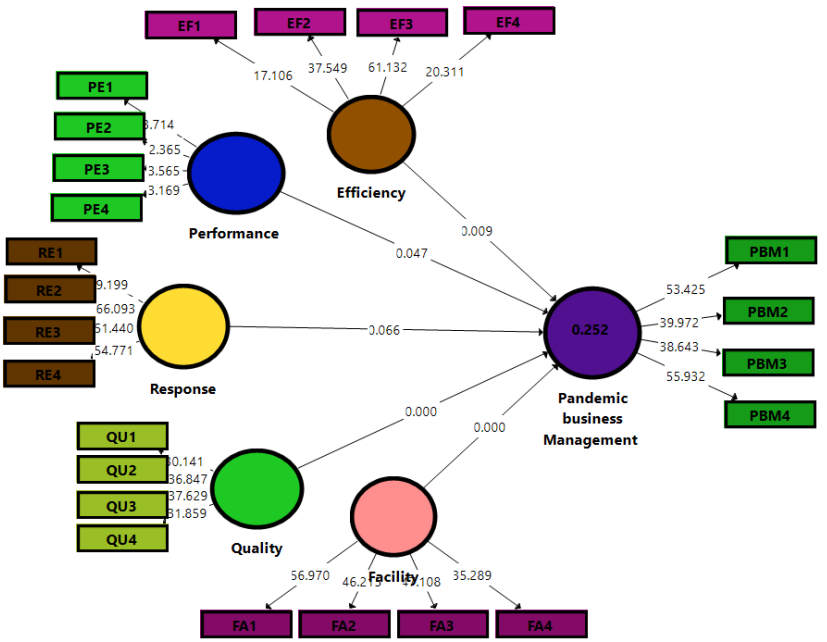

Figure 5. Structure Model.

	Original ...	Sample ...	Standard ...	T Statistic...	P Values
Efficiency -> Pandemic business Management	0.119	0.122	0.045	2.636	0.009
Facility -> Pandemic business Management	0.175	0.165	0.050	3.517	0.000
Performance -> Pandemic business Manageme...	-0.153	-0.144	0.077	1.993	0.047
Quality -> Pandemic business Management	0.279	0.288	0.063	4.418	0.000
Response -> Pandemic business Management	0.116	0.111	0.063	1.844	0.066

Figure 6. Path Coefficient.

6. DISCUSSION

Figure 6 and Table 1 demonstrates the research output of the study. It shows that the relationship between efficiency and pandemic business management was significant. H1 showed that efficiency influences pandemic business management since their relationship was significant (β = 0.119, t = 2.636, and p = 0.009), thus H1 was supported. Similarly, the relationship between facility and pandemic business management was significant (β = 0.175, t = 3.517, and p < 0.000), and hypothesis H2 was supported. On the other hand, hypothesis H3 demonstrated that performance was insignificant toward PBM (β = -0.153, t = 1.993, and p = 0.047). However, H4 shows that quality and PBM are supported in this study, and the effects are (β = -0.279, t = 4.518, and p < 0.000). Lastly, hypothesis H5 execute that response in predicting PBM and the relationship was insignificant. It is seen that the response directly predicts PBM (β = 0.116, t = 1.844, and p < 0.066). Therefore, this study has supported four hypotheses (H1, H2, H3, H4), though H3 has shown a negative relation and H5 is not supported.

Table 1. Assessment of path model

Hypothesis	Relationships	Beta Values	SD	T Values	P Values	Findings
H1	EF-> PBM	0.119	0.045	2.636	0.009	Supported
H2	FA -> PBM	0.175	0.050	3.146	0.000	Supported
H3	PE -> PBM	-0.153	0.077	1.993	0.047	Supported
H4	QU -> PBM	0.279	0.063	4.418	0.000	Supported
H5	RE -> PBM	0.116	0.063	1.844	0.066	Not Supported

CONCLUSION

This research aimed to examine the variables that affect the relationship between supply chain factors and pandemic business management in the F&B retail industry in Bangladesh. Bangladesh's F&B

retail industry needs to improve its supply chain towards business management. Efficiency, performance, response, quality, facility have played a significant role in pandemic business management in the F&B retail industry in Bangladesh. However, supply chain response cannot directly affect pandemic business management within the F&B retail sector in Bangladesh.

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Chapter 9

LEAN OR AGILE SUPPLY CHAIN - A BETTER TOOL TO MANAGE BUSINESS?

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ABSTRACT

Globalization has turned modern business more unpredictable and challenging. Customers can now order and collect goods from any corner of the world within a very short time. In the past, mass production was the key concern in order to keep the cost low. At present, frequent change in customer preference has made the market more competitive. Therefore, businesses nowadays compete over supply chain's performance rather than simply on cost or on quality. Successful supply chain itself is considered as a key competitive advantage for any company. Modern supply chain has introduced two standardized models

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that can evade the market fluctuations in certain ways. One of these is "lean" and the other is known as "agile" supply chain mechanism. Though both run on customer demand, lean emphasizes on cost by eliminating wastages while agile supply chain focus on quality and responsiveness. Both of these models require significant investment especially in technology and innovation. In addition, organizations need to render training and motivate their human resources in order to ensure flawless operation of any of these two supply chain processes. On the other hand, such strategic implementation also demands managers' educative judgment and speculation of near future. As a result, time investment is equality important to achieve the set goal. This chapter has drawn a detailed layout of the two models and their strategic implications in order to attain a certain level of efficiency or responsiveness. Various lean principles like six sigma, kanban, JIT etc. will encourage managers to walk through the way of waste elimination, while three key elements of the agile supply chain (agility drivers, capabilities and agility providers) will guide them towards a higher level of responsiveness. Meanwhile, a new formula known as the "Leagile supply chain strategy" has been identified, which is a combination of both lean and agile supply chain management. This hybrid supply chain sometimes aims to become a "mass customizer" - producing progressively smaller batch sizes (sometimes even one item) targeted to satisfy unique customers' demand. However, managers should always need to be ready for uncertainty in business as there is no scientific tool that can lead towards complete success. Through proper assessment, adjustment, and by establishing required advancement (along the supply chain drivers and strategies), a company can reach the zenith of profitability - this chapter aims to shed light on this process.

1. INTRODUCTION

From ancient days, businesses have been driven by necessity; hence by customer demand. In the 20th century, efficiency drove economic growth. The push for efficiency increased productivity and lowered product prices from luxury goods to daily necessities, making them available to a wide segment of the population. Yet efficiency requires two things predictability and stability. Managers need to be able to predict the future demand and cost of raw materials of a certain product. Based on these two, they can determine the right selling price and firms can produce the right quantity to maximize profit margin.

Now, in the 21st century, modern business has become more unstable and challenging due to robust globalization. Order placement as well as collection is taking place with the click of a mouse. Previously, companies were focused on mass production in order to minimize the cost. On the contrary, recurrent change is customer's preferences has emerged as a big challenge for today's business. Supply chain as an individual network of all connected parties has to deal with all the unpredictability of business. From raw material collection to final product distribution, at each stage, it has to keep the cost at a level while fulfilling customer preferences. Earlier, it was only efficiency or responsiveness that was the focal point of supply chain performance. However, the current supply chain has to align both. Through evolution in time, supply chain has developed two fundamental models that can address market fluctuations in various ways. Drawn on the versatile supply chain landscape, these two models are frequently being adopted by successful companies. These two models are known as, the lean supply chain and the agile supply chain.

2. LEAN SUPPLY CHAIN

The lean manufacturing supply chain is mainly customer driven where the fundamental philosophy is to identify and to remove waste throughout the business. In lean supply management, organization goes for mass production by relying heavily on numerous suppliers and by reducing the number of outsourcing activities. Originally developed by Toyota, lean manufacturing is a comprehensive production management system. There are two major features of lean manufacturing that distinguishes it from mass manufacturing:

1. Increased efficiency through the reduction of waste and error
2. Reduced carrying cost of inventories achieved by manufacturing in small "batches."

2.1. Fundamentals of Lean

Figure 1 shows the fundamentals of lean manufacturing. Lean philosophy emphasize on waste elimination, process simplification and continuous improvement. Lean strategies involve systematic and continuous elimination of waste that is generated from- inefficient processes, excess inventory, over production, waiting, transportation, motion, over processing and product defects. Lean enablers are those tools that make the strategies work according to the lean plan. The lean planning and execution varies from company to company by adopting various mechanisms like JIT sequencing, consignment inventory, Vendor-Managed Inventory, centralized warehousing, connecting partners throughout the supply chain process.

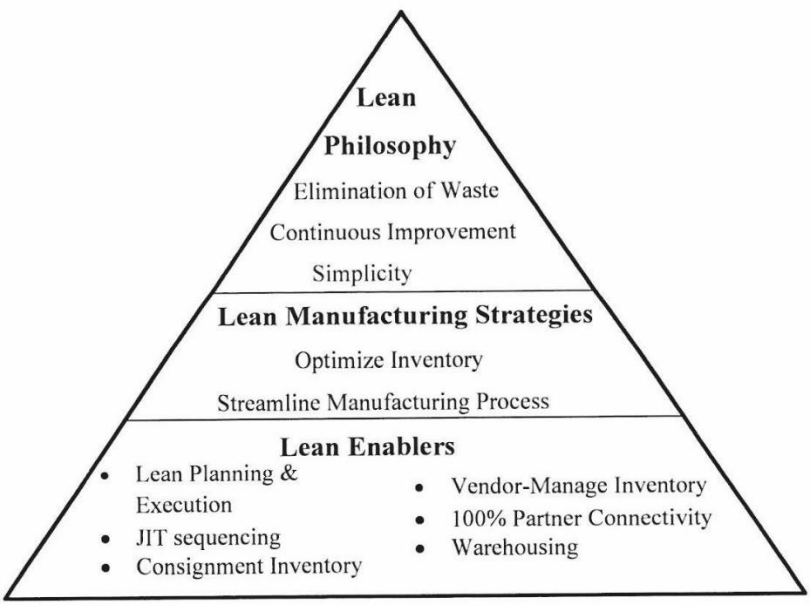

Figure 1. Fundamentals of lean manufacturing.

2.2. Lean Philosophy

Lean philosophy emphasizes on two main areas.

2.2.1. Muda (Eliminating Waste)

The Japanese word "Muda" means elimination of waste. According to the lean philosophy, there are eight types of wastes:

1. Defects - anything that has used raw material and labor but cannot be used; it is an obvious waste of time, effort, and inventories.
2. Overproduction - one of the most disguised wastes is producing more than required, often it occurs to meet the key performance indicator (KPI).
3. Waiting - when all factors of production are ready but production cannot be started due to material shortage, it is called "waiting" for which costs increase.
4. Non-utilized talent - the most common waste where people who are directly involved in the production or service generation are ignored while management is planning or formulating strategies.
5. Transportation - Traditional supply chains emphasize centralized distribution that incurs huge waste of energy, time and cost. Lean philosophy encourages decentralized warehousing system by establishing distribution stores closer to the customers hence making every mile productive.
6. Inventory - Storage of excess inventory raises the cost and is a waste. Hence lean concentrates on supplier integrations and technological advancement in order to deliver goods or services at the right time.
7. Motion - Motion indicates unrequired movement or repetition of any task that increase the production time and costs. Hence, emphasizing on continuous process improvement, lean targets to eliminate such waste of time, energy and money.

8. Extra-processing - It indicates those extra-efforts in process correction and adjusting planning repetitively rather than emphasizing on simplicity or continuous movement.

2.2.2. Mura (Eliminating Unevenness)

Mura indicates those wastages that results from peaks and valleys of demand. During festival or due to seasonal impact, each product face some demand fluctuations even in a stable market. However, under a lean supply chain, demand would be consistent or predictably increasing. Through proper forecasting or appropriate planning lean ensures an even distribution of production schedules that fulfill the economies of scale for the business with zero wastage of time, energy or materials.

2.3. Tools of Lean Supply Chain Management

2.3.1. Six Sigma

Sigma Sigma is a quality standard that sets control over variability in product. It helps to set goodwill in the market by assuring quality standards. Under such circumstances, customers become loyal and are ready to pay even a higher price. Reliability in quality means more accurate forecasting leading towards “Just in Time” inventory.

2.3.2. Just in Time (JIT)

Under the JIT approach, the supply chain ensures the right product availability in the right quantity at the right place and time. The fundamental of JIT is forecasting. The more accurate the forecasting, the smoother the operation of a supply chain. Such accuracy helps to reduce waste by eliminating production or supply of excess materials or products.

2.3.3. Kanban

Kanban is a system that helps company to reorder or to replenish or even to start transportation rather than relying on forecast or on customer

order. Successful establishment of kanban requires seamless integrations among the stakeholders.

2.3.4. Kaizen

Kaizen is the art of continuous improvement. Every company should focus on continuous improvement in order to sustain the market by offering new and advanced products to the customers. This improvement involves not only process up gradation but also the skill development of existing manpower.

2.4. Objectives of Lean Supply Chain

Though lean knowledge has proven successful for many companies yet the implementation is not followed by many. One reason for such unfamiliarity is knowledge limitation regarding lean technology. To ensure smooth operation of lean supply chain, managers need to monitor these objectives frequently.

2.4.1. Eliminating Waste in Order to Hold Only Values

Lean supply chain ensures a total integration of downstream production and all internal departments to work in collaboration. In every supply chain there are seven areas where wastage remains concentrated:

a. System Complexity- Involves additional and unnecessary steps or confusing processes.
b. Lead time- Excessive waiting times.
c. Inventory- Inactive raw materials, (WIP) work-in-progress, or finished goods.
d. Transport - Waste that creates unnecessary inventory or product movement.
e. Packaging- Includes containers that transport air or allow damage.

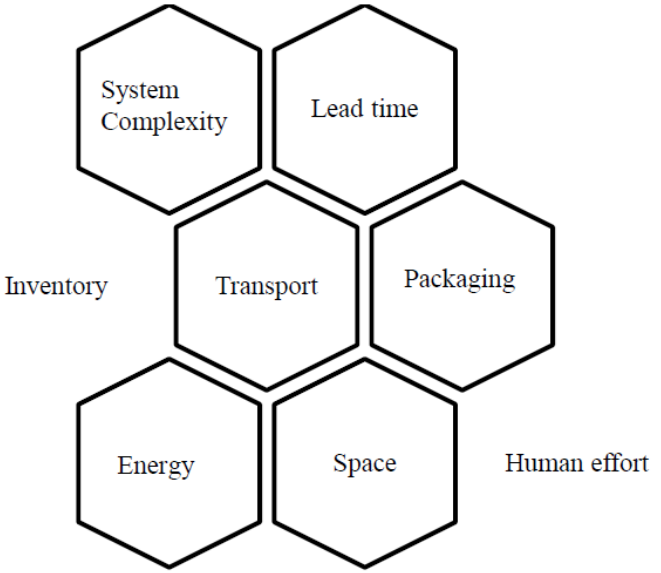

Figure 2. Wastage generating areas in supply chain.

f. Energy- Indicates wastage of energy in the supply chain process. Such elimination minimizes usage of electricity, gas, utilities and reduce costs at large.
g. Space- Holding spaces for unnecessary inventory.
h. Human effort- Human activities that do not add value.

2.4.2. Establishment of Technology to Stimulate the Supply Chain's Performance

Technology plays a crucial role in supply chain. As the success of modern supply chain vastly rely on supplier integration, implimentation of advanced technology in day to day business can help a company raise the profit margin. Under lean management, technology investments should be on the top of the list in order to reduce waste and to develop integrated networks both inside and outside the business entity.

Table 1. List of a few technology investments

Name	**Area of Investment**
Radio-frequency Identification (RFID)	Production
Trading Partners Interface (TPI)	Retail Value Chain
Electronic Data Interface (EDI)	Information Management
Yard Management Systems (YMS), Global Positioning System (GPS) & Transportation Management System (TMS)	Transportation
Cloud Solutions	Customer Relationship Management

2.4.3. Establishment of Visible Customer Usage throughout the Supply Chain

Lean supply chain drives mainly on customer demand. Visibility assurance like implimentation of "Kanban system" helps all involved parties to become aware of customer usage, hence they can easily track the replenishment point. Such mechanism ensures efficiency in the supply chain by eliminating waste.

2.4.4. Reduce Lead Time

Under lean management, all parties like sales, production, inventory, transportation and distribution work together in an integrated way that helps to reduce lead time (waiting time). As a result, in one hand, it reduces cost by eliminating waste, while on the other hand it reduces the waiting time for the consumers.

2.4.5. Creation of a Level Flow

Within the lean supply chain networks, both material and information flow pass through the proper channel at an optimum level (the required quantity, at the right time). Thus, enhancing the performance and reducing the bottle neck (if any).

2.4.6. Behind Pull System Rather than Push Dogma

Pull system commits on visual control of material flow throughout the supply chain. By blending waste management rules in this process, lean guarantees profitability over customer satisfaction.

2.4.7. Collaborate and Process Discipline

As lean supply chain establishes visibility, all engaged parties can easily collaborate to identify bottleneck and develop appropriate solutions to solve such issues. Lean's value stream mapping (VSM) helps break down processes and provides insights to rebuild new process. Utilization of six sigma assures quality at every stage of production while Lean's PDCA (Plan, Do, Check and Act) discipline helps to solve problems and reduce costs. All these add value for customers.

2.4.8. Focus on Total Cost of Fulfillment

Under the lean policy, customer expectations are met at the lowest possible total cost. This can be achieved when all partners of the lean supply chain share in operational and financial benefits when waste is eliminated. In such ways, the impact of lean strategies become beneficial for both company as well as for end users.

2.5. Importance of Lean

Industrialization has vast impact on the socio-economic pattern of every nation which has shaped people's living standards as well. Now, people seek quality at a certain cost margin. Organizations are also looking for market expansion besides meeting local demand. As a result, successful establishment of lean supply chain is beneficial for both the company and the customer. In addition, it provides following advantages.

2.5.1. Value Addition

Under lean supply chain, customer demand pushes the production circle. Based on their demand and through systematic production

enhancement lean technology adds value at each stage of the supply chain. Such value addition assures customer satisfaction as well as the company's profitability.

2.5.2. Accuracy through Better Manufacturing Techniques

By implementing quality control, lean supply chain establishes better production techniques that assure timely delivery of materials at each stage of the production flow. Moreover, in order to eliminate waste, lean supply chain continuously focuses on innovation. Altogether, it results in better accuracy in inventory management, production, transportation as well as in delivering the goods to final consumers.

2.5.3. Systematic Integration

For flawless operation, lean system requires proper resource allocation including facility to information as well as benefit sharing to the strategic partners. All these systematic integrations develop a positive image of the company and motivates all its stakeholders to work for excellence.

2.5.4. Lower Administrative Costs

When waste is controlled, a good number of administrative work (like dealing customer complains, product recollection and redelivery etc.) are minimized. On the other hand, zero defects also lower the inventory holding cost. All of these, reduce the administrative workloads at large and push down the cost.

2.5.5. Efficient Information Network

Modern supply chain is a cumulative network of intranets through which information flows frequently, maintaining accuracy that guarantees timely logistics service. Efficient information management helps to forecast, plan and supply accordingly. Moreover, an efficient information network works for better market projection as well.

2.5.6. Brand Image

Successful establishment of lean philosophy enhances the brand image through quality assurance and maintaining the cost margin. Such advantage creates a positive image of the company which helps develop a loyal customer group in return.

3. AGILE SUPPLY CHAIN

Agility refers to flexibility and efficiency. Agility in business means companies have the ability to respond quickly, adapting to change in the environment. Agile supply chain management is focused on speed, cost efficiency, responsiveness, flexibility and productivity in the production and delivery of goods.

Using digitalization, augmented reality, artificial intelligence and other advanced technical tools, agile supply chains rely on real-time data in order to conduct day-to-day business, as well as to project supply and demand. Altogether, it creates a more vigilant process that saves cost and consumer's money, eliminates waste of excess inventory, foresees potential shortages, and does it all quickly and productively.

3.1. Model of Agility

According to Sharifi and Zhang (1999), following is the model of agility (Figure 3) that highlights two main features - agility drivers and agility providers that work together to establish agile supply chain capabilities.

- Agility drivers - changes or pressures from the business environment that drive a company to search for new ways of running business in order to sustain its competitive advantages.

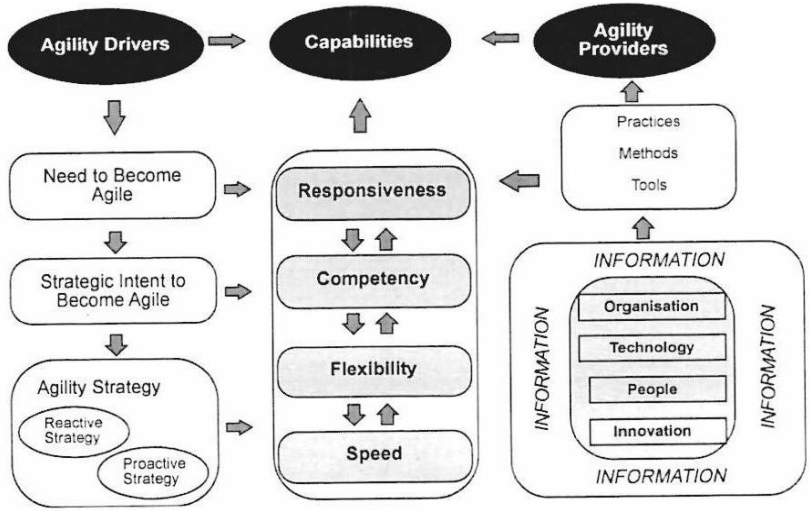

Figure 3. Model of agility.

- Agility capabilities- potentials and capabilities that the company needs in order to respond positively and to take advantage of the changes.
- Agility providers - concern about the potentials and capabilities of an organization in order to respond towards changes. Such capabilities vastly depend on organizational policies, established technology, people and innovation.

Based on the market demand, company sets or modifies its existing supply chain strategy. It can be either a reactive or a proactive strategy towards the market. All agility drivers influence the supply chain's capabilities (increased responsiveness). Such responsiveness requires flexibility, as well as speed in order to develop competency.

Meanwhile, agility providers also play a key role in enhancing capabilities. The role of information is crucial in such development. Based on proper information, organization formulates proper strategies and plans, based on which managers coordinate throughout the supply chain networks. Failure to do so, results in lack of or malfunction of the agile capabilities. Again, technological investment has vast impact on the

success of an agile supply chain. In addition, organization needs to train and continuously motivate its people who directly work with suppliers as well as serve the customers. Human capital (manpower) should be encouraged continuously to simplify, upgrade and innovate new ways that will contribute altogether to promote the capabilities of an agile supply chain.

3.2. Benefits of Agile Supply Chain

3.2.1. Ability to Quickly Respond to Change

Implication of agile supply chain helps a company to adjust with frequent market change, changes in the economy, technological change and change in other related variables quicker than normal supply chain networks. As this system mainly relies on real data, day to day forecasting become quite accurate which helps production and other related partners to plan accordingly.

3.2.2. Mass Customization

Compared to early days, customer demand is changing more frequently at present. Companies that focus only on cost find it challenging to sustain with such variations in demand. Therefore, adaptability in mass customization has become a demand of time and, through an agile supply chain, companies can ensure variation and frequent customization.

3.2.3. Low Inventory Cost

In general, companies incur huge cost mostly in inventory management. As discussed, in agile supply chain the whole network operates on the basis of real time data. Here, suppliers also respond according to the market change and time requirement. Therefore, inventory cost is reduced which is a huge advantage of agile network.

3.2.4. Reduced Risk of Stock Obsolescence

Under mass scale production, supply chain usually holds huge inventory. In addition, high inventory cost is associated with risk of stock obsolescence. Both these costs can be eliminated in agile supply chain.

3.2.5. Enhance Relationship

Agility allows supply chain partners to work together to produce only the right amount of product on a daily basis rather than based on quarterly, monthly, or annual forecasts. Essentially, agile solution is an integration of lean supply chain that works to enhance supplier-to-customer-to-manufacturer relationships.

3.2.6. Quality Assurance

Like lean supply chain, agile networks also focus on zero defects, hence no waste. From procurement to final distribution agility continuously monitors customer expectations and quality.

3.2.7. Improved Performance

By controlling costs, assuring quality, and continuously adjusting with changing customer demands- an agile network assists the company to establish its market reputation, and all of this results in higher and improved performance for all partners engaged in the agile supply chain network.

3.2.8. Localization

Aligning lean technology, agility focuses on backward integration. For specialized products and to save the time, this system emphasize on localization rather than relying on distant partners. Due to globalization, distant partnership is always associated with some risk and waiting time. Through emphasizing regional or local development (backward integration) agile network guides the business towards success.

4. Placement of Lean and Agile Strategies in Supply Chain

As discussed before, consumers are the pivotal element of a business; hence companies need to prioritize the changing demand of the market while keeping a close eye on cost. Even though economies of scale can be attained through successful application of lean principles, responsiveness cannot be achieved by it. The implementation of agile principles along with the lean can help a company ensure a balance between the two (cost and responsiveness).

Figure 4 shows the strategic implications of lean and agile principles. When a business offers fewer varieties of products in low volume, a lean supply chain is best suitable. Businesses that offer a wide variety of products in small quantities have to adopt agile strategies in order to keep pace with changing customer demands. Again, when product variety is low, the company can employ a lean technology in supply chain for large scale production. Lastly, while offering a wide variety of products in large volume, the company can initiate a hybrid strategy of both lean and agile supply chain.

In Figure 5, the same condition is evident based on demand – supply characteristics. When the market is stable, in order to meet the short lead time, companies continuously emphasize on lean technology to replenish the empty shelves. Again, in a stable market, a lean mechanism is suitable when customers are ready to wait for a long time. On the contrary, when the response time is less (short lead time) and market demand fluctuates frequently, companies plan to follow an agile supply chain process. However, when the demand it quite unpredictable with longer lead time on hand, companies can opt for a lean-agile technique to run the total supply chain.

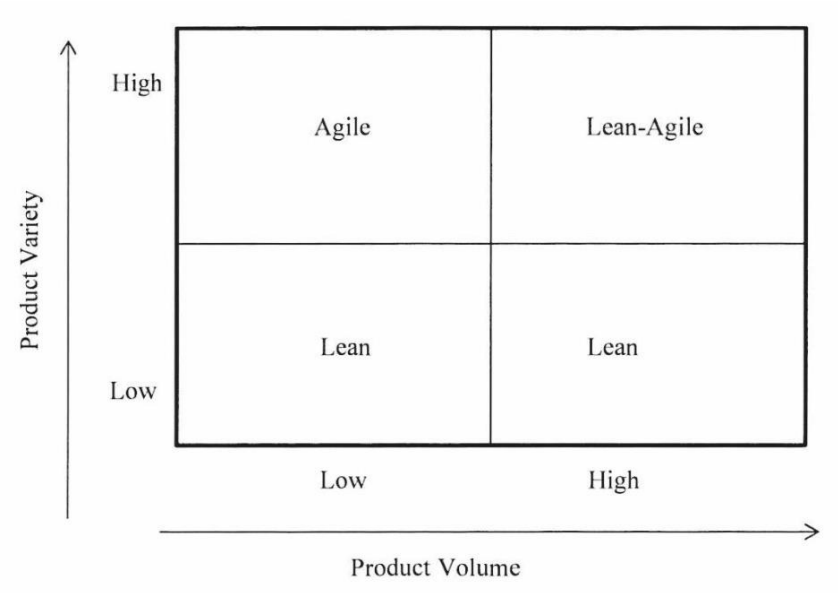

Figure 4. Strategic placement of lean/agility based on product criterion.

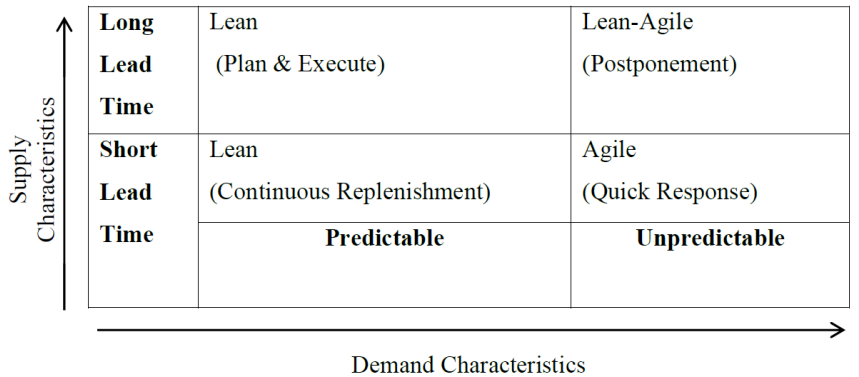

Figure 5. Strategic placement of lean/agility based on demand supply characteristics.

4.1. Lean VS. Agile: Impacts on Supply Chain Strategies

Table 2. Attributes to consider in supply chain strategies

Supply Chain Instrument	**Elements of Supply Chain Instrument**	**Efficiency (Lean supply chain)**	**Responsiveness (Agile supply chain)**
Product Characteristics	Type of Product	Functional Product	Innovative Product
	Order lead time	Long	Short
	Demand uncertainty	Predictable product	Unpredictable product
	Market Winner	Cost	Availability
	Product life cycle	Long	Short
	Product Variety	Low	High
Manufacturing Characteristics	Product	Standard (functional)	Customized (innovative)
	Manufacturing strategies	MTS	ATO, MTO, ETO
	Manufacturing process	Push supply	Pull supply
Decision drivers of the Supply Chain	Production	- Little excess capacity - Narrow focus - Few central plants	- Excess capacity - Flexible manufacturing - Many small factories
	Inventory	- Low inventory levels - Fewer items	- High inventory levels - Wide range of items
	Location	Few central locations serve wide areas	Many locations close to customers
	Transportation	- Shipments: few and large - Slow, cheaper modes	- Frequent shipments - Fast and flexible mode
Decision drivers of the supply chain	Information	Cost of information decreases while other costs rise.	Collect and share timely, accurate data.
	Sourcing	Supplier selection criteria based on low prices.	Supplier selection criteria based on high service levels.
	Pricing	- Pricing is a key means for balancing supply and demand. - Based on low margins and high volumes.	- Pricing does not normally impact on short term demand. - Based on high margins.

Source: Ambe. (2014).

As mentioned, supply chain runs on six fundamental drivers- facilities or production, inventory, transportation, information, sourcing and pricing. Both lean and agile principles have significant impacts on each driver. Therefore, besides customer demand, managers also need to evaluate the benefit that the company will enjoy following any one techniques to plan as well as to operate its supply chain. In table 2, the key features of lean and agile supply chain has been listed based on the properties they deliver to supply chain drivers.

For better understanding, let's again focus on the strategic fit of the supply chain. Along the cost-efficiency frontier, a company needs to find out its position best suitable according to its competitive strategy. Once the supply chain strategy is defined (whether to prioritize on efficiency or responsiveness), the supply chain manager then formulates proper action plans for the entire supply chain process taking into consideration all the associated costs and benefits of any one of these two strategies.

5. LEAGILE SUPPLY CHAIN STRATEGY

In modern business, companies often adopt a lean-agile hybrid to deal with unpredictable and uncertain market. The leagile supply chain strategy is a combination of both lean and agile supply chain strategies. Sometimes it is also known as the "hybrid supply chain strategy." Adaptation of such strategy becomes preferred by a company when it aims to become a "mass customizer" - producing progressively smaller batch sizes (sometimes even one item) targeted to satisfy unique customers' demand. Another practice can be, preparing certain parts ahead of time to meet small amount of customization. Forecasting and real-time data are needed to closely monitor the level of overall risk.

Again, through such hybrid supply chain strategy (combining lean and agile principles), supply chain can hold a strategic inventory of some generic or unfinished goods, where a certain level of finished goods can be delivered immediately based on real demand. The goal of such strategy is to build an agile response upon a lean platform. Application of various

other disciplines like TQM (Total Quality Management), employee empowerment, JIT (Just in Time) production, MRP II (Manufacturing Resource Planning (MRP II) along with lean production can increase the agility further.

However, to decide and to plan for such hybrid supply chain strategy, mangers need to be speculative and evaluate all previous and current information regarding the following aspects:

1. The product
2. Target market
3. Changing frequency of the demand
4. Macro-economic factor of the industry
5. Supply chain strategies
6. Supply chain partners and;
7. Firm's competitive advantages.

CONCLUSION

There is no single rule or method to formulate "the best" supply chain.

Due to the covid-19 pandemic outburst, the world economy is passing through a massive shock. There is a huge downfall in demand for luxury goods (fashion wares, automobiles, jewelry items, etc.) while demand for daily necessities and healthcare products are at hike. Balancing such crisis is an enormous challenge for the supply chain managers as well as for the company. Under such circumstances, many companies are moving towards the hybrid strategy. Products like pharmaceuticals at present need to concentrate more on mass production (lean) helping mankind to survive immediately (less response time) and economically (economy of scale). Again, for certain goods lean technology is best suitable (e.g., daily goods). In addition, localization or back ward integration is a burning issue. Companies that overlooked this earlier are now suffering more as many restrictions on mobility are imposed worldwide to stop the virus from spreading further. It is the top level managers who need to evaluate the

situation, the real time data, and the forecasts and plan to survive accordingly. Successful binding of these two principles or even one ensure profitability while failure to do so will results in tremendous mismanagement.

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