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Lead Time and its Minimization for the Betterment of Bangladesh RMG Industry

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Abstract

With the appearance of modern information and communication technology, the effects of physical frontiers are diminishing. Markets are continuously globalized and new competition is gradually entering the market with new and more creative products and services to compete with existing products and services. A variety of main key export and importers from Asia, Europe and the Americas make the clothing industry highly globalized. Besides, the product life cycle of apparel goods is rapidly decreasing, with many fast-fashion items. As a result, the time allowed for design on the market decreases over time and the length of order issue date to shipment date is reduced directly by the supplier or manufacturer of readymade garments. The design and marketing phases of Bangladesh readymade garments manufacturers are not concerned with the supply of raw materials for manufacturing clothing to shipments at Chittagong port. The presence of established competitors and the Bangladesh garment industry has been no longer enjoyed in the US market since 2005 with new competitors' arrival; the garment company is becoming increasingly competitive in quality, cost and lead time.

Keywords: Modern information • Communication technology • Readymade garments • Chittagong port

Introduction

The BGMEA has recently announced an export goal of US$50 billion by 2021. Although the goal is achievable, it has still not yet come to fruition due to a series of events such as the financial crisis of 2008, the Tazreen fire accident, Rana Plaza collapse, the Trans-Pacific Partnership agreement (TPP) and the withdrawal of the Generalized System of Preference (GSP) by America. Therefore, a proper supply chain is necessary to tackle compliance challenges, especially during this global crisis. The country must produce a sustainable supply chain management which focuses on reducing lead time, decreasing wastage and maximizing efficiency to solidify itself a top position in the world RMG sector. A supply chain consists of several strong factions such as raw materials, manufacturers, distributors, customers and consumers. There are other factions, such as customs, Export Promotion Bureau (EPB), ports, transport, Clearing and Forwarding (C and F) agents, etc. An effective supply chain would require a proper connection between all these factions [1].

The strength of Bangladesh's readymade garment industry is the ability to sell products at cheaper rates due to the availability of cheap labor. However, the industries fail to keep pace with the fast changes of the customer's demands. In the 90's, lead time was 120-150 days. Now it has reduced to 90 to 100 days. Still, this is insufficient when other competitors, such as China, can deliver products in 30-35 days. Vietnam has a 60 days grace period. These countries have optimized their supply chain networks in order to respond to market changes more quickly. On the other hand, Bangladesh is lagging far behind the top two competitors in the race to the top of the list. Thus, lead time reductions for readymade clothing industries in Bangladesh are of prime importance in supply chain management. Previous research on Bangladesh's readymade clothing supply chain has found little to no link to lead time reduction strategies. As a result, there are some research gaps in this field. The sole focus of this study is on the factors that increase lead time and the strategies for reducing lead time. This study aims to assist various supply chain analysts in the garment industry and other stakeholders in determining the factors causing bottlenecks in the supply chain network. Furthermore, to provide even more practical lead time improvement methods [2].

Materials and Methods

Concept of lead time

It is the time taken to complete a service, a production lot or an order, as mentioned. The other production management support methods are linked to lead time. Time has become such an essential commodity that any business that can use it will more than ever

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enhance its competitiveness. Time has become a crucial factor in many aspects of the business, including but not limited to planning, innovating, manufacturing, selling, distributing and adopting strategies and policies. While cost, quality, manufacturability, newness/innovation evolved as a source of competitive advantage, the time has positioned itself as the latest weapon to compete in the marketplace [3].

Christopher also asserted that time has become very important to compete against competitors and the main reason for this change is the change of the customer's awareness and preference for time new styles are introduced regularly in the fashion industry and they last only a short time before being replaced by new trends. As a result, end users are becoming more aware of the apparel industry's new fashion trends. Innovative designers from all over the world are now bringing new ideas to market regularly. A modern and incredible style that swept the market in one season (summer/winter) is replaced the following season. As a result, predicting whether a current fashion trend will continue into the next season is extremely difficult. As a consequence, seasonal and cyclical demand is highly variable. As a result, it clearly shows that the end consumer market's fashion life cycle is shortening (Figure 1).

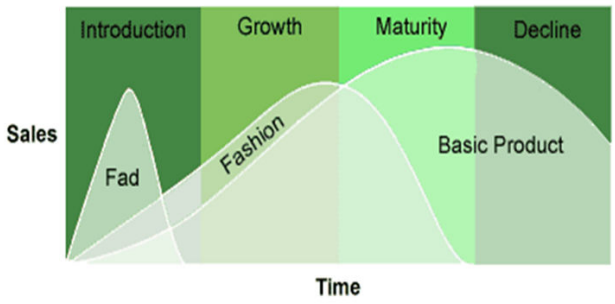

Figure 1. Comparison of life cycle pattern between fashion and basic products.

The life cycle of a product typically goes through several phases, each of which necessitates a different planning strategy to maximize its effectiveness. Introduction, development, maturity and decline are the four stages of the product life cycle that any good product goes through. The product life cycles length varies by product, with the fashion life cycle typically experiencing a sharp decline at the end of the growth period. According to the growth stage is noticeably shorter when compared to an essential product. This means that the declining stage begins immediately after the growth stage's apex, making managing fashion item inventories extremely difficult [4]. Because of the dramatic decline shown, the manufacturing industry is under tremendous pressure to deliver apparel in a short and restricted time frame. As a result, manufacturers' lead times are shrinking (Figure 2).

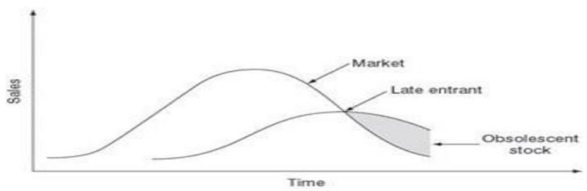

Figure 2. Obsolescence problem for late entrant in the fashion market.

Christopher explained that "if any company introduces its apparels in the market later than its trend, it would probably have a huge number of outdated items as shown in the grey area". The lead time from design to market will be shorter and more crucial as a result of these two essential factors: Short duration of fashion apparels and obsolescence caused by late delivery. Because Bangladeshi garment factories only begin production after receiving orders, their main concern is manufacturing lead-time. As a result, the time between design and market has become critical for all fashion garments worldwide [5].

Lead time in SCM

In supply chain management, a more traditional lead time concept is the time between which a customer places an order and when the customer receives it. The industry's competitive environment influences consumer demands, supply chain technologies and competitive pressure imposes lead time on the supply chain. Competitors that fail to deliver products and services within the agreed time frame are likely to be eliminated [6].

Lead time in Bangladesh RMG sector

Lead time is the amount of time that elapses between the start and finish of a phase. The necessary activities to meet customer demand are carried out ahead of time, bringing the product within consumers' grasp. It covers when an order is made and when the goods are shipped to the final destination. Lead times are not specified in the order confirmation document. Typically, two dates are implied: The order date/confirmation and the shipping date the period between these two dates is referred to as lead time in the Bangladesh RMG industry". In this case, the lead time differs from that defined by Chopra and Christopher. Chopra and Christopher both factored shipping time into the lead-time equation; however, the Bangladesh RMG does not. Instead of clothing manufacturers in Bangladesh, European and American traders consider and address this question [7].

Nuruzzaman and Haque, "classified lead time as information lead time and manufacturing lead time. The time spent negotiating with buyers and RMG factory merchandisers about the garments' quality, color breakdown, cost/price per product, order quantity and required delivery date is included in the information lead time. Order lead time at the Chittagong seaport generally starts immediately after the order issue date and continues until the last shipping date". The primary raw material is sourced/purchased by factories during the manufacturing lead period, either locally or from China, India, Pakistan, Sri Lanka, Indonesia or other countries. Fabric procurement is a significant time-consuming factor in the RMG industry and has been factored into lead time [8].

This described lead time as the time between receiving a buyer's order and delivering the ordered goods. This expands on the concept of lead time. He spoke about consumer and production lead times. There is a distinction to be made between these two ideas. Customer lead time is the time it takes between placing an order and receiving the ordered items.

On the other hand, manufacturing lead time is the cumulative period of raw materials input to the production process and the final procedure to produce the output. In the case of supply chain management, the widely acclaimed JIT development concept popularized the concept of lead time reduction, although JIT's primary emphasis was waste reduction. The JIT theory, on the other hand, is best suited for repetitive manufacturing and is not entirely similar to the garment manufacturing method. The batch flow environment is more similar to the garment manufacturing system. A study conducted by Goldratt and Cox, discusses lead time reduction in a batch flow environment. The effects of bottleneck and lot size on lead time were also discussed. The lead time management principle in the readymade Bangladeshi garment industry. They also addressed the importance of reducing lead time to maximize profit and the need for survival and development. The essential definition of planning time and its significance in clothing production was addressed. They addressed the reasons for increasing lead times and offered some solutions. However, the causes that are described need further clarification, as well as other views. So it is useful to examine the horizon with this analysis. The manufacturers of clothing want less lead-time to improve market control and consumer response. In this fast moving period, lead time reductions are necessary to remain ahead in market competition. However, more explanation is required for the causes mentioned and for other opinions. This research, therefore, makes it useful to analyze the horizon. Clothing producers want less lead time to enhance market control and customer response. For this rapidly changing period, lead times must be reduced to keep up with the competition on the market [9].

Importance of lead time in textile industry

Lead time is undoubtedly one of the most important things in the manufacturing fields. The durable global market of the apparel industry depends on the time frame demanded by the customers. For apparel retailers, three main parameters are cost, quality and lead time. But completing the task, taking lower lead time is one of the most important buyer requirements. The following things will demonstrate the importance of lead time.

- Product cost, quality and lead time are all related. Its quality denotes the existence and performance of a product. However, paying a high cost to get the product that exceeds the selling period converts to a massive loss to the retailer.
- Fast fashion apparel is time sensitive and follows a very tight timeline and meeting the deadline is essential than ever.
- Quality and lead time go hand in hand. High quality products with simple designs need a shorter turnaround time compared to the embroidered or premiere fashion cuts.
- The time needed for the raw material like fabric trims or other accessories is essential to define the timing of the finished goods. Longer lead times generally tend to stock higher inventory levels for the retailers.
- By reducing lead time, a company can lower its overall costs and become more responsive to the market.
- Lead time data is, essentially, a measure of the entire manufacturing process. It tells how quickly raw materials can be converted into a delivered product to the customer. The apparel manufacturing process is made up of many steps. Some involve a manufacturing process, while others involve moving materials or products and waiting for them. A long lead time indicates that the process has not been optimized.

Challenges in minimizing lead time

Difficulties in transportation: Bangladesh's transportation logistics system isn't up to the mark regarding both logistics infrastructure and services. The miserable condition of the highways displays a threat to the growth of RMG. The basic infrastructure for all modes of transportation is in place, but there are few intermodal facilities and those that do exist are in poor condition [10].

Poor port facility: A research paper by Rashid et al. presented in 2nd International Conference on Business and Management (ICBM 2019) showed that, due to inefficiency in the Chittagong port average daily ship cost is $8000 on average. Manual processing, limited crane capacity and strikes that sometimes span several days at a time. The average turnaround time in Chittagong port is 2.46 days. In contrast, the average turnaround time at Singapore and Bangkok ports is 0-1 day. Containers are occasionally held in port for up to 15-20 days, even though they are supposed to be released within three days. Between January and July of 2017, the port experienced 84.3 hours of congestion. Inadequate port facilities, it can be said, add to the lead time [11].

Lack of a sustainable model: RMG in Bangladesh is facing this crucial question to adopt a sustainable model in operating their businesses due to lack of wastewater treatment plans and lack of recycling of waste products. The more the industry experiences rapid growth, the higher the demand for the implementation of sustainability. Sustainable models include impacts of industries on the natural, social and economic aspects with the introduction of new technologies.

Technological drawback: Printing, washing, sewing, cutting and related activities are done using low quality technology compared to developed countries. For this, it takes more time to convert the raw material into a finished product [12].

Warehouse management: Warehouse management is an important consideration that comes down to having procedures ready to fulfill orders and ship them out. Looking for new and better ways to find warehouse inventory accuracy and efficient warehouse layout will lower costs, save time and increase income and customer satisfaction (Figure 3).

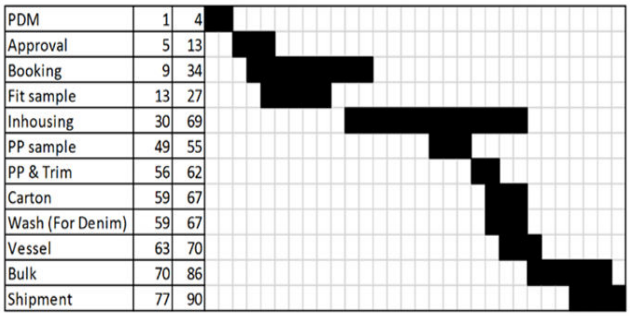

Figure 3. Gantt chart for a typical apparel industry with a lead time of 90 days.

Inefficiency in planning

In the planning stage, the industry suffers from an inefficient workforce, non-productive time and poor strategic decisions. People involved in the production line planning acquires skill on a trial and error basis, which yields poor performance. To some extent, this has to do with poor recruitment policy. Furthermore, poor communication skills and a reluctance to share basic information between the executive and production teams create barriers to planning efficiency. Customers frequently reject samples during the sample production phase in many industries, according to this research, due to poor planning and understanding of what customers require. These back-and-forth activities cause a delay in the start of production. The percentage of Defects per Hundred Units (DHU) is higher in most industries. It is considered good if the DHU is between 2%-3%. If a factory has a DHU of 5%, it will lose 15% of its productivity, which means it will take three times to complete a task [13].

Weak transportation network

Congested roads and a lack of inland transportation options complicate the apparel export lead time. Because Chittagong is in the center of the country, the clothing industry is heavily reliant on the highway connecting Dhaka and Chittagong. The majority of the apparel industries are concentrated in Dhaka and Chittagong. As a result, the Dhaka-Chittagong route is critical for clothing export. It is currently a two lane road with heavy traffic and a four lane highway is being built. A day long cargo journey from Dhaka to Chittagong seaport is 287 kilometers long. Due to insufficient road facilities, goods laden vehicles must wait for hours in traffic on their way to Chittagong from Dhaka and its surrounding areas. As a result of this issue, many apparel exporters complained that they could not meet the strict lead times set by international buyers. The lack of railroad transportation exacerbates the misery [14].

Lack of deep sea harbor

Sea trade takes place through the two seaports of Chittagong and Mongla, which are too shallow for large ships. The Chittagong port handles approximately 92% of the country's exports. The Chittagong port has a draft of only 9.2 meters, whereas the minimum draft for a deep seaport is 15 meters. As a result, modern container ships are unable to anchor. Surprisingly, Bangladesh has failed to build new seaports since gaining independence in 1971. Due to the lack of deep sea harbor, the lead time for sea freight is increased by at least a week. The export ready products must approach the mother vessel in Singapore after loading in the feeder's vessels. The feeder's vessel takes 7 to 10 days to reach the mother vessel, unload and reload. This extra step raises the overall cost by $15000 per day. A deep-water harbor can undoubtedly eliminate the extra time and costs associated with sea freight [15].

Political instability and labor issues

Bangladesh's apparel industry can provide products at the lowest possible prices because it has the cheapest labor available. However, there is always pressure from worker trade unions to raise the wages periodically. Besides, this pressure sometimes transforms into violent protests that force factories to shut their operation. A major labor unrest situation happened on December 12, 2010. Youngone Ltd.'s 11 factories in the Chittagong export processing zone have been closed indefinitely. In the Gazipur and Narayanganj areas, 25 people got injured during clashes between workers and management staff. Due to wage increase demand, at least ten garment workers, including a journalist, were injured on September 22, 2011, at Square Garments Ltd., Naryanganj. On March 26, 2012, the following incident occurred at the Ishwardi export processing zone, where police and garment workers clashed, injuring over 100 people. In addition to increased wage demands, garment workers take to the streets and stage violent protests in response to rumors of coworker death or increased management punishment, among other things. Furthermore, the country's volatile political situation does not help the cause and factories must sometimes remain closed for weeks at a time. As a result, manufacturers frequently fail to meet the buyer's agreed upon lead time.

Existing supply chain of RMG industry

The BGMEA recently announced a US$50 billion export target for 2021. Although the goal is attainable, it has yet to be realized due to a series of events such as the 2008 financial crisis, the Tazreen fire accident, the Rana plaza collapse, the Trans-Pacific Partnership agreement (TPP) and America's withdrawal of the Generalized System of Preference (GSP). As a result, a proper supply chain is required to address compliance challenges, particularly during this global crisis. To secure sizeable foreign investment from foreign companies, the country must develop a sustainable supply chain management system that focuses on reducing lead time, reducing waste and maximizing efficiency to maintain its top position in the global RMG sector. A supply chain comprises several key players, including raw materials, manufacturers, distributors, customers and consumers. Other factions include customs, the Export Promotion Bureau (EPB), ports, transportation, Clearing and Forwarding (C and F) agents and the rest. An effective supply chain would necessitate a proper link between all of these factions (Figure 4).

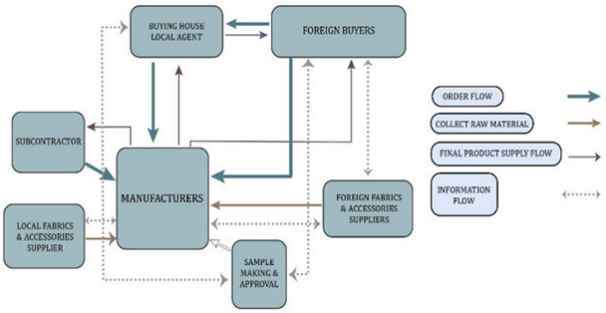

Figure 4. Supply chain of RMG industry.

Lead Time Optimization (LTO): The selecting and management of inbound supply options with (high) unsure demand and long production lead times in high turnover fabrics such as apparel, textile, toys and consumer electronics where (high) downtimes are critical for profitability and branching is critical for achieving significant supply chain savings.

The lead time is the time between the order placed by a customer and the receipt by the customer of the final product or service, *i.e.*, the time needed for the order processing, for the acquisition of the raw materials and their production and the transport of them through the various stages. There are two ways to describe lead time:

- Customer lead time, the time between a customer's order and receipt.
- Manufacturing lead time, the time between the purchase of raw materials and the finished product in the manufacturing phase. An equation of the lead time calculations is the summation of the

lead time and production lead time. The lead time of the information includes the time to negotiate the clothing quality, colors, cost/ price per unit, the quantity of the order and the required date of delivery between the buyers and the dealer of the RMG factory. Order lead time may be specified as starting at Chittagong sea port immediately after the order issuance date and generally extending until the last shipment date. In lead time production, the plants supply and buy the necessary raw materials in Chinese, India, Pakistan, Sri Lanka, Indonesia and other countries, either from local or outsource markets. In the RMG business, source fabrics are a time-consuming consideration and are taken into account in terms of time lead (Figure 5).

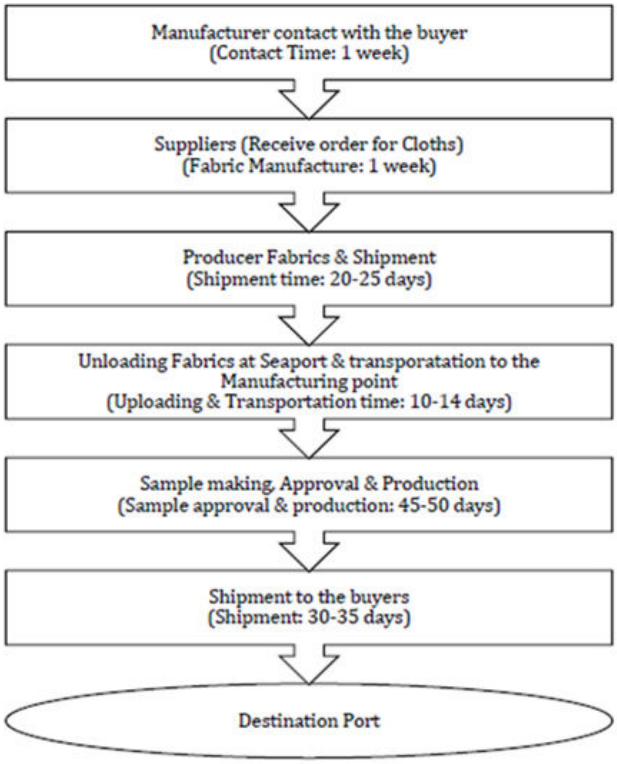

Figure 5. Lead time.

The lead time order plus shipping time for overseas traders purchasing garments from Bangladesh is the refilling lead time. The less time for refilling the supply chain is permitted, the more pressure every supplier is put under which the manufacturer competes.

Customer lead time=Information lead time+order lead time Total lead time=Information lead time+manufacturing lead time +shipping time for import fabrics+shipping time for export final product

For Bangladesh garments (in general):

LT=MFT+FX+I+GM+FI+buffer time (woven

garments)

Generally, it takes 120 days LT in Bangladesh for woven garments.

LT=MFT+MGT (Knit garments)

It takes 90-110 days LT for knit garments. The import time shall cover transport from port to manufacturing point, shipping time and transport time. Export delivery time covers production time for finished goods and export shipping time.

(Note that, shipping time for import includes shipping time, unloading time and transport time from port to manufacturing point. Shipping time for export includes manufacturing time for final products and shipping time for export.)

Research methodology

The project work is entirely based on the primary data. The primary data was gathered through open dialogue and interviews with key staff from various companies. Based on a formal questionnaire designed in light of the study's objective, primary data were collected from 10 Bangladeshi RMG units, including five leading garment factories in Dhaka city. The sample units in this study were chosen randomly, but five leading factories were chosen on purpose. Managing directors, managers and other merchandise department officials were interviewed. Secondary data was also gathered from surveys, documents and other materials given by the businesses. The study's objectives have evaluated the collected literature, data and information. In this analysis, some conceptually established models were used and a lead time calculation equation. In this analysis, the qualitative research approach and various statistical methods such as averages, percentages, growth rate, etc., were used to view and evaluate the collected data in a descriptive manner (Figure 6).

Figure 6. A flow chart of the methodology.

Analysis of current lead time in Bangladesh

Bangladesh's RMG industry continues to be the customer in the apparel industry. Most of the materials have to be imported from abroad. “The industry relies heavily on imports and has spent approximately 55 to 75 days importing materials abroad”. The fundamental explanation for long lead time is this context. Bangladesh's export of clothing in volume is up 15%-20% over 20 years, while Bangladesh's RMG relies exclusively on Chittagong. The port of Chittagong facilities did not rise at the same pace. Containers are store in the port and some containers are blocked for 15 to 20 days, which must be published within three days. The raw materials will certainly have a severe negative effect if they stay idle in the container at the Port of Chittagong for 10-15 days. It is estimated that to receive a product from Singapore, it hardly might take four days.

In comparison, the same products needs 18-19 days or almost three weeks on average in Inland Container Depot (ICD), Kamalapur, Dhaka. In addition to the customs dilatory and tedious process and port activities, the movement or delivery of goods is often considerably delayed. The time for unloading goods from a ship in Chittagong is about six days, while it is just a few hours for the same goods in Singapore. On port management, Mr. Anisul Haque, the MD of the Muhammadi group and former chairman of BGMEA, said, "we

spend 15 to 20 days, regrettably, to receive our fabrics and raw materials from the sea port to our factory".

Again, 15 companies, including five leading clothing units, were chosen to collect primary data to determine the possible reasons for the long lead time and the empirical study. They listed several factors behind this issue during interviews, but 100% commented on import dependence as the main reason for increased lead time. Then 91.66% *i.e.* 33 respondents on CBW, 75% *i.e.* 27 respondents on inefficient port management, 69.44% *i.e.* 25 respondents on poor infrastructure and 41.66%, *i.e.,* 15 respondents on communication system respectively. The same causes were identified in our analysis based on secondary data. This fact enhances the credibility of our findings.

At the time of the interview, A.K.J. fashions limited's managing director divided the lead time into three points. First, the estimated lead time for the first stage is 40-55, including fabric production time, from P-Q (fabrics manufacturers, sea port, manufacturer) to approximately 15-20 days and finally, from RMG (manufacturer, purchaser), the approximate lead time for the final stage is 35-45 days. The approximate start time for the second stage is 35-55 days, respectively (Figure 7).

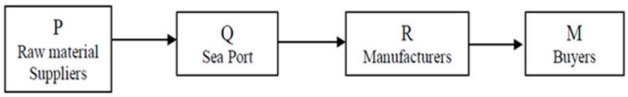

Figure 7. Basic supply chain of Bangladeshi RMG industries.

The current estimated time is unnecessary from point Q to point R. The main task here is to unload the container and transport it to the point of production. Effective management of port and successful transportation systems can only be achieved for 2 or 3 days. However, it takes 15 to 20 because of inefficiency in port management and a weak transport system. The above observation shows that only Bangladeshi production companies are forced to pay 55-75 days longer to import raw materials. The fundamental explanation for a longer lead time is also import reliance on fabrics.

The critical analysis in this article is the "primetime order" (see the Lead time theory) which shows how we can minimize the time by managing the supply chain. Manufacturers asked several questions to highlight this subject, the ineffectiveness of the management in the chain and the consequences it can have. All manufacturers replied in the interview that "command lead time is the key factor behind RMG lead times. We should cut as much as possible. Thirty days in the supply chain by taking the right decision." Most manufacturers replied that lead times could be affected when the buyer contracts with the suppliers before giving the manufacturers a final order and when government agencies take appropriate action on seaport productivity. We usually order fabric suppliers after a definite agreement with buyers and count 15-20 days to produce fabrics. The managing director of 'Azmat group' said. By buyers or by purchasing a home, this production period can decrease. We should first prepare our necessary materials and then contract with us. For the appropriate fabrics, we do not need to waste 15-20 days.

Some producers have indicated two key issues responsible for increasing lead time, *i.e.,* time for shipping and unloading in port. Some other manufacturers noted that railway and road transport infrastructure is not good enough to transfer their goods from port to plant. Even if governments take appropriate measures to improve harbor productivity and expand rail and road transport, they all think that order lead time can decrease. The respondents seem to have distinct but almost the same views on this matter. A designer, KM fashions ltd., more logically articulated his view and said, "we must minimize import dependence as soon as possible in order to reduce lead-time effectively. Only by effective and efficient management of the supply chain can we immediately minimize lead times of 30%-40%." The lead time for woven garments is usually 90-120 days, the largest RMG manufacturer, 'Opex group,' said. However, during imports of products, we can instantly cut 30% in lead time by careful management of the supply chain and only by improving port facilities can 15% be feasible. If we are developing our textiles industry and buying local products, we will reduce the overall lead time by 60%. We supply all raw materials from the local market for knitwear, so the Knitwear industry is not faced with a time lead issue.

The discussion suggests that manufacturers in the RMG sector are mainly confronted with "order lead time" issues and this is due to inefficient management in the supplier chain. The primary reasons for increasing lead time are time spent in the first four stages of the supply chain. The other three fields, contact, port management and transportation management in the supply chain, are allowed to reduce a significant portion of the order lead. By considering the lead time equation, we can get a good picture of the lead time in the supply chain and can use an average approximate interview time for every point.

Total lead time=Information lead time+order lead time)})

Or, =Information lead time+time to manufacturing fabrics+time to shipment of fabrics+time to unloading fabrics and customs formalities at port+time to take fabrics from port to manufacturing point+time to sample approval and production of final product+time to shipment or export of final products

Or, 120=7+15+25+14+6+23+30

From the above equation, we can assume that a producer obtained materials after 60 days on average within the first four phases. The delivery time is constant from there of 25 days. No opportunity exists to minimize this time of shipment, but we may reduce the remainder for 35 days. The suppliers and distributors of the supply chain have two parties and different practices. It is widely visible (Figure 8).

Figure 8. Four boxes (A-D) or phases have demonstrated activity and time usage here.

Following the previous agreement with the customers, producers order the international supplier first (A). The supplier then produces (B) textiles and sends them by shipment. The ship enters the port after some time (C). In this case, fabrics are sent by train or road transport to the producer plant/storage after unloading and completing some custom formalities (D). The A-D manufacturers need 55-75 days to complete this entire process. Proper management will minimize 30-35 days when importing into the supply chain. Just shipping takes the remainder of the 25-35 days.

Results and Discussion

The interview shows that most purchasers do not have regional offices in Dhaka. Hennes and Mauritz (H and M) from Sweden is one of the largest European suppliers of clothing based in Dhaka. Until concluding a final contract with the manufacturers, the regional offices and buyers living in Dhaka may build up a stock of the necessary quality of fabrics. The production time would reduce undoubtedly. Proper and effective port management and sound transport systems will minimize the time from the harbor to manufacturing plants to receive raw materials. However, if we do not fully import fabrics, we can minimize the period between 55-75 days and ensure that RMG goods are regularly exported for 45-60 days.

Landmark Group is a leading manufacturer of clothing in Bangladesh's knitwear market. From the merchandising department we got to know that, they did not face lead time delay issues. They just take 45-60 days to complete their manufacturing process and the shipment process. When we ask them how they manage in that early time frame? They replied, we don't import raw materials from abroad. We maintain a good supply chain with the local suppliers and collect our necessary raw materials from them. Which helps us to maintain lower lead time.

Analysis of the lead time management of a model company (Reedisha Knitex Ltd.)

We got an opportunity to have an interview with the merchandising department of Reedisha Knitex Ltd. Basically after getting the final order from the manufacture the fabrics as per buyers' direction. They don't need to import fabrics from abroad or local suppliers as they manufacture the knit fabric by their own. But they import the raw materials for fabric production. They prepare the sample product as per the design. Then it sent for the approval. After getting the final approval the company goes for mass production and shipment to buyers. To complete the whole process the company takes 90-120 days. But sometimes for some buyers it takes more than 120 days. Even they have some European buyers, who asked them to complete the whole proce4ss within 50-60 days. Here is some lead time analysis of Reedisha Knitex Ltd. with their major clients.

First time we are considering DIADORA. We know that;

Total lead time=Information lead time+order lead time

Or =Information lead time+fabrics manufacturing time +fabrics shipment time+unloading and transportation time+sample approval and production time of garments product+shipment time for export of final products

= 6+11+24+12+35+12+30

So, total average lead time=130 days

Secondly, the buyer KAPPA has been considered. For this

buyer, Total lead time=Information lead time+order lead time

Or =Information lead time+time to manufacturing fabrics+time to shipment of fabrics+time to unloading fabrics and customs formalities at port+time to take fabrics from port to manufacturing point+time to sample approval and production of final product +shipment time to export of final products.

=6+12+25+14+6+23+30

So, total average lead time=116 days

Thirdly has been considered the buyer of UMBRO. For this buyer,

Total lead time=Information lead time+order lead time

Or, =Information lead time+time to sample approval and production of final product+shipment time to export of final products

=6+17+30

So, total average lead time=53 days.

In conclusion, we can also conclude that effective management of the supply chain reduces the overall lead time by 29%. However, to succeed in competition, the lead time must be reduced by at least 50% and the overall lead time reduced by 55% to 60% by avoiding import dependence and removing the mindset of import dependence.

The strategy of lead time reduction

There are different approaches and strategies regarding lead time. In production management, theoretical evidence describes and gives importance:

- **Look for WIP:** The more WIP, the longer will the lead time be.
- **Keep things moving:** If the product moves in a continuous flow against the finished product, both WIP and flow time will decrease.
- **Synchronize production:** Whit synchronized production, the WIP will reduce and due to this, the lead time will decrease.
- **Smooth the workflow:** An actual workload affects the lead time with increased variance and long flow times.
- **Eliminate variability:** Several causes can cause variability, e.g., lack of consistency, downtime and rework. The typical approaches had taken in the last century to focus on the manufacturing processes.

The researcher in the past also made their endeavor to improve the value added processes regarding lead time reduction. After successfully implementing lean philosophy, especially in Toyota, the intention has been growing to reduce the non-value added activities time. Moreover, the overall impact of reducing processing time has very little influence over the lead time will be minimal. According to G Corner, "he observed many industries and found 90%-95% of non-value-added activities in lead time. The opportunity in the non-value-added processes than value-added process has given more straightforward solutions to lead time reduction. The approach is selected here for this project to look for the non-value added activities and find out how to reduce the wastes".

Proposed solutions

Based on the qualitative data, some possible solutions are proposed here:

Implementation of firm HRM policy: The majority of Bangladesh's garment industries have either a limited or no human resource management policy. In Bangladesh's garment industries, there are three levels of human resources: Top-level (mostly owners or top management teams, CEOs), mid-level (executives) and lower-level (production line workers). At the mid and lower levels,

inefficiency and lower productivity are most prevalent. At the lower level, employee inefficiency is at an all-time high. "Production line supervisors who are not adequately trained or educated control these low level employees and some of them are recruited through nepotism. Hence their lack of knowledge about proper human resource management cannot ensure an optimum level of efficiency and productivity". Besides, a lack of proper safety in regular operations and adaptation to a familiar working environment contributes to accidents, injuries, Etc. The infamous Rana plaza incident in 2013 is ample proof. As a result, one of the solutions proposed in this paper is implementing a firm HRM policy. Because the research was focused elsewhere, HRM policy is not discussed here.

Adoption of automation in the production stage

The fourth industrial revolution is currently a subject of debate at a table of discussion, summits and conferences in Bangladesh. As a result, Bangladesh's garment industries have yet to reap the benefits of automation technology and robot controlled production. Nonetheless, automation or artificial intelligence is gradually making its way into manufacturing processes. Bangladesh Garments Accessories and Packaging Manufacturers and Exporters Association (BGAPMEA), published a statistical data where it mentioned that, the newly established factories are adopting the industry 4.0 automation technology. The total number of adopting factories is estimated to be around 250. These factories are already benefiting from increased productivity, shorter production times and product value addition. Nonetheless, the industries will face challenges as a result of the implementation of Industry 4.0. The most difficult challenge is employee layoffs. However, there is always another side to every coin. Some new jobs will also be created due to automation technology, such as machine supervision, maintenance and the rest. Employees will, however, need to improve their skill set.

Implementing the Kanban theory

In lean manufacturing philosophy, a technique used for work and inventory discharge is called Kanban methods. The word Kanban means card signal. Originally Kanban methods were developed at Toyota. The word Kanban means card signal. In the Toyota production house, the card was used to control the material flow on the assembly line. The main concept of introducing Kanban has to coordinate supplier and manufacturer appropriately so that supplier can deliver parts or component exact requested and desired quantity at the right time. To do that, the manufacturer does not need to store parts in the inventory (Figure 9).

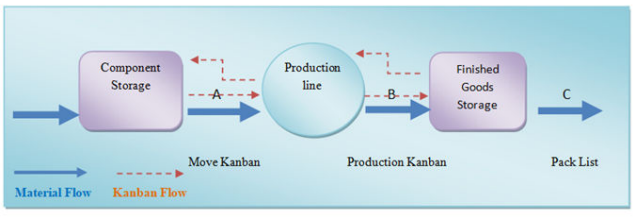

Figure 9. Kanban flow in the production line.

The flow of the Kanban card and the flow of the material opposite to each other are depicted in Figure 10. The Kanban card sends the information of demand and consequently, the material flow starts as requested. Hence the Kanban Method guides to produce or delivery parts by pulled rather than forecast oriented method.

Warehouse management

"When warehouse operations are smooth, the entire company can rely on a reliable supply chain to prevent shortages and holdups. Most of our industries are using a traditional warehouse. However, an updated warehouse can play a massive impact on overall production".

Significant improvements over the traditional layout:

- Two docking areas allow us to concentrate on specific tasks without impeding each other. Since the staging areas are typical bottleneck places that block the efficient flow of products, we added two staging areas that will develop the flow in and out of the warehouse.
- We also utilized the racks, so they run along the long side of the building. This strategy increases overall space utilization.
- We expanded the space provided to the case lot/ fast movers compared to the other storage areas. Since most of our time is spend on fast movers, it is more efficient to allow them more space.
- The conveyor belt system is more elaborate, but we have extended it for easier access from the end of each aisle.
- The various areas are combined and moved to one side of the building, not to impede the flow within the warehouse.

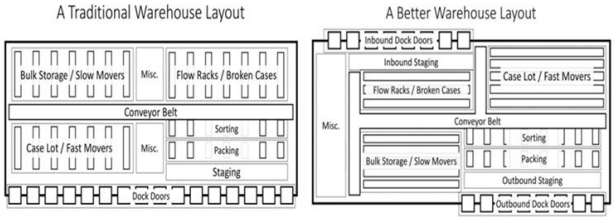

Figure 10. Warehouse management.

Since buyers want to source more fashionable products with a shorter period, the high lead time has become one of the most significant bottlenecks hampering our garments industry. In Bangladesh, the average lead-time varies between 90-120 days, whereas the time for China and India can deliver the products within 50-60 days and 60-70 days respectively Vietnam takes 60-120 days, Thailand consumes 45-60 and the Philippines needs 120-145 days for similar products.

Improvement of the railway network

"Bangladesh's readymade garment industries rely heavily on Dhaka-Chittagong highway for transporting goods to the port city. This highway, also known as the economic lifeline, remains super busy all year-round". Traffic congestion on this highway consumes valuable time from the lead-time. Due to road construction, accidents, public procession and VIP movements, there are frequent tailbacks on this highway. More than 110 kilometers of traffic have backed up due to the construction of a flyover, which took five days from start to finish. So to reduce time consumption due to logistics, we are proposing an improved, innovative railway network. Currently, it takes around 6 hours to reach Chittagong from Dhaka by train.

With the introduction of high-speed trains as planned by the Bangladesh Government, it will take one hour to reach Chittagong, as reported by the daily star. If the containers are transferring by train equipped with GPS devices, exporters may able to track the status of the goods. The rail transportation system is more environmentally friendly than the road transportation system because its CO_2 emissions are less than one-eighth of a car (JICA).

Implementation of vertical integration strategy

The advantages of vertical integration over horizontal integration in the supply chain are well known. Vertical integration strategies are much easier to implement in large industries with adequate financial backing. However, in general, Bangladesh's readymade garment industries are more interested in sourcing raw materials such as fabric, yarn, trimmings and so on from outsourced suppliers. These suppliers are frequently late in delivering the goods, which adds to the lead time. However, if the raw materials can be manufactured in-house, valuable time is saved, costs will be reduced and effective quality control can be achieved. If this strategy is implemented, a firm may achieve time advantage, efficiency advantage, cost advantage and quality advantage. Furthermore, vertical integration strategy implementation is sufficient to reap the most fundamental benefits from Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM) and Enterprise Resource Planning (ERP) software. If the buyers select the raw materials, the buyers should direct the sourcing strategy. As a result, many industries see vertical integration as a waste of money. As a result, buyer willingness is also required for independently selecting sourcing strategy by industry.

Joint routing

Increasing traffic congestion leads to a rise in transportation costs for RMG sectors and a high level of congestion also increases the lag time. All these signals are a huge disadvantage for the RMG sector as the rising transportation congestion has a hugely detrimental effect on the delivery time of the products. In order to tackle congestion-companies can look to undergo joint route planning. Joint route planning helps to decrease production costs through the collaboration of supply chain trading partners and service providers by sharing a common route and executing the process with the help of horizontal cooperation and outsourcing. The companies take advantage of economies of scale by collecting orders collaboratively and providing route schemes for those particular orders. This helps in reducing the pressure in the main highways, especially during peak time, thus, reducing lag time and time of delivery. Usage of Joint route planning decreases cost and the number of kilometers driven by 30.7% and 30.8%. Also, the number of tracks decreases by 30.2%, largely due to maximum utilization of volume. The average load taken by a truck (load factor) increases by 43.2%. In conclusion, it is evident that joint route planning is more efficient and is a better approach (Figure 11).

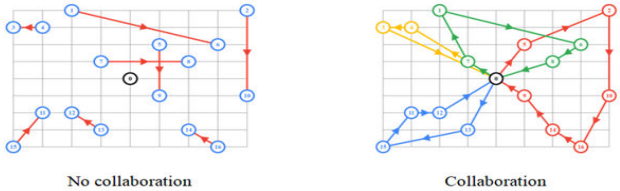

Figure 11. Collaborative routing.

Port management

The country could not achieve its export target for RMG in the last FY16-FY17 due to a longer lead time at the port. However, RMG exporters from Cambodia, Sri Lanka and India, who are the main competitor of Bangladesh, achieved their export target because of shorter lead times and excellent management performances. Due to delay and traffic at the Chittagong port, Bangladesh is lagging behind exporters are forced to use a more expensive mode of transportation, *i.e.*, air shipment, to maintain the strict deadlines of the international buyers. Port users have stated that it is easier to transport goods at a very minimum cost from ports in Malaysia and china rather than using the Chittagong port, which they are reluctant to use (Figure 12).

Figure 12. Ports of Bangladesh.

If the port facility is improved, it may help to reduce lead time by about 14 days. The containers must be loaded and unloaded to the ship without any delay. The turn-around time of feeder's vessels in Chittagong port is now 7 to 10 days, while it is two days in Bangkok and one day in Singapore. The maritime transport costs account for 14% of Bangladeshi textile exports to the US, compared to less than eight percent for countries like India, Thailand, China and Taiwan. So, improving the turn around time and redesigning the maritime transport costs are essential. Improvement offering vessels and port management will undoubtedly contribute towards the improvement of lead time (Figure 13).

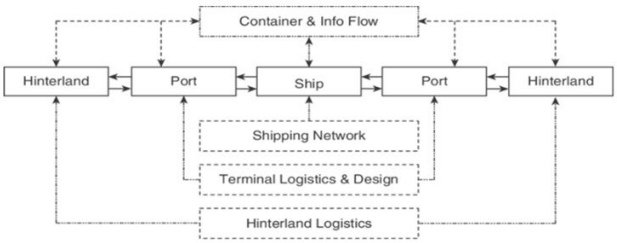

Figure 13. Port management flow chart.

Tracking the product

We suggest tracking the product from manufacture to transfer to the customer to ensure that the geographic location of the product is updated in real time. Two monitoring tools can help to implement this protocol.

Identification through radio frequency

RFID stands for Radio Frequency Identification and the name describes how the system operates using radio frequency signals.

The RFID system includes the RFID Reader and a tag used to identify and monitor the items. Let us see the singularity of this technology and its overall implementation before discussing more RFID. Barcodes are today most of the time used to identify an object in the warehouse or supermarket through barcode scanners, an upgrade with RFID technology is available to this current system. RFID, like barcodes, can provide unique identification numbers to all items, but unlike barcode systems, this device can detect the RFID tag within its proximity range (Figure 14).

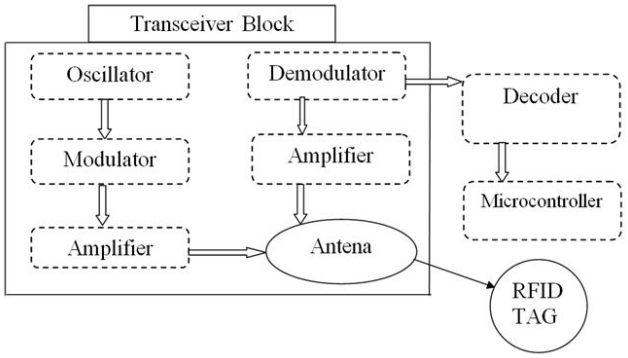

Figure 14. RFID tag system.

No person is required to look for the barcode and point the barcode scanner at it. Since the tag can be scanned and billed when it hits the RFID reader, this function allows most of the system to be automated and human interference to be reduced. RFID door locks and RFID attendance systems are becoming increasingly common and many hotels now offer RFID tags to their customers in order for them to lock and unlock the door.

Tracking through GPS

A space-based satellite navigation system offers position and time information in all weather conditions, anywhere on or near the Earth, where four or more GPS satellites have an unobstructed line of sight. GPS technology will be used to monitor the product from the factory to the terminal (Figure 15).

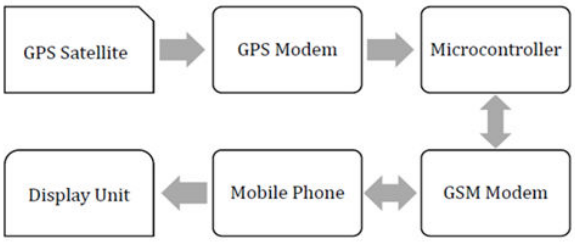

Figure 15. GPS system.

The tracking will happen in two steps:

Step 1: Assembly line; when applied correctly to manufacturing and warehousing, technology can offer both creativity and value. RFID tags attached to objects can identify automatically and tracked using electromagnetic fields. The tags gather and electronically store unique information that remains with the product as it travels down the production line, to the warehouse and finally to the consumer. RFID technology emerges as a promising but cost-effective means to be used in such a versatile manufacturing process for obtaining more precise current and predicted position of items in the assembly line. The RFID-assisted object tracking device aids in the location of an object in an assembly line and facilitates decision-making about when and where to process the assembly's working objects (Figure 16).

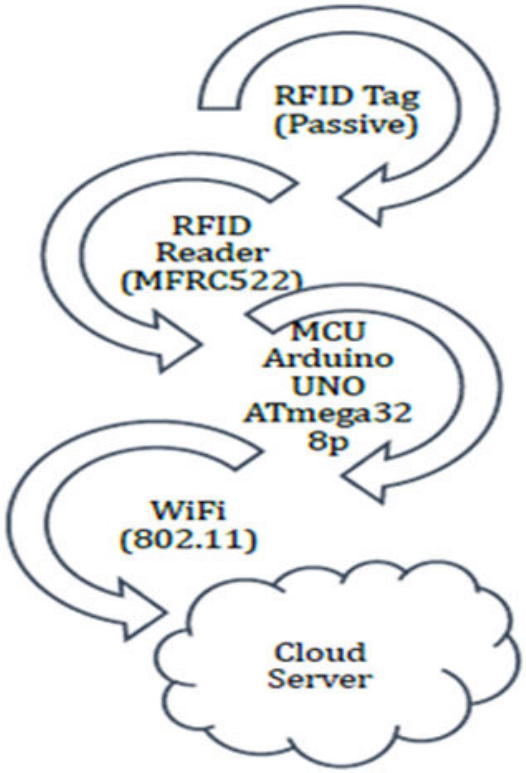

Figure 16. RFID tracking.

Step 2: From factory to port; GPS, GSM/GPRS, digital maps and use of particular applications in vehicle tracking systems. Mobile data devices installed on vehicles transmit two pieces of information received from satellites the time the satellite information was transmitted and the location of the satellite in orbit at the time of transmission as well as telemetry data such as temperature to control and contact centers through the GSM/GPRS network. As received data is then compiled using special software and stored in a database on servers. Vehicles can be monitored on their instantaneous and background records through a computer and smartphone/tablet using special software that allows users to visualize all information from vehicles and change alarms and program statuses. This framework serves as the foundation for the operation of vehicle tracking systems (Figure 17).

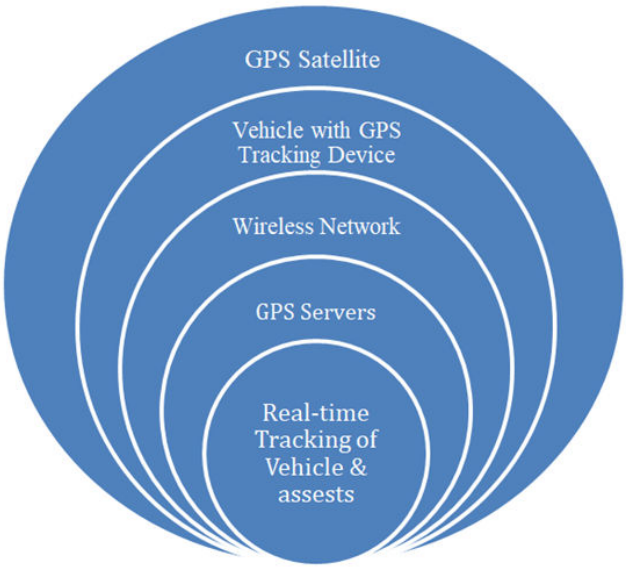

Figure 17. GPS tracking.

Our main priority behind to do this report is how sourcing, sea port, transportation influence lead time. We collect data from factory management, buying house, merchandiser, supply chain authorities and port authorities through phone and physically. Our result part is made of depending on the data collected from those areas.

- To overcome the issue of lead time.
- Central bonded warehouse is another solution to overcome.
- Road alignment for cargo truck.
- Government should take strong and helpful steps in political case.
- Should make easy rules in custom.

We can see that lots of time we spend to collect the raw materials because the maximum no. of raw materials we collect from foreign countries. The main raw material which we need complete a product is fabric. Unfortunately the maximum amount of product we collect from foreign countries like China, Pakistan, India etc. In 8 weeks of collecting raw materials around 3 weeks required to make the fabric, around 2 weeks required to reach the fabric in port, around 1 week spend to pass out the documentation process of port and rest of the time spend to in house the fabric, relaxation and going for bulk production.

CBR (Case-Based Reasoning is an experience-based approach to solving new problems by adapting previously successful solutions to similar problems) systems have been developed for enhancing traditional rule based approaches. Their higher advantage is that they can be applied to one of a kind problem instances after appropriate adaptations, without needing assistance from expert rationales and experience. Thus, previous knowledge is effectively reused for the acquisition of the valuable knowledge for e.g. estimation of the performance indices for a newly introduced case. An issue in case retrieval is the vast amount of embedded knowledge in the past cases. CBR excels in managing case memories by incorporating a case memory organization model. CBR is based in to a dynamic memory related to past earlier cases and situation patterns to learn and solve new problems.

By implementing the proposed solution given by the scholars such as we can reduce the overall lead time by almost about 10% by our assumption. Joint route planning allows us to cut the time it takes to transport fabrics by 30% and updated warehouse facilities will help cut the time to manufacture garments and inspect them before sending them to the Chittagong seaport. Below is a detailed chart of the average lead time reduction.

Below given table is an assumption of the minimization of lead time. They shows a comparison of the current supply chain and the proposed supply chain of the RMG industry. We hope that if we implement the proposed solution according to this report then we can be able to reduce lead time, we can make more profit and near future we may get more buyer order in the global apparel market (Table 1).

Lead time analysis	Current supply chain	Proposed supply chain
Fabric manufacturing time	25	25
Time to import fabrics	28	22
Fabric inspection and other processing	7	7
Garments manufacturing	20	18
	5	4
Buffer time	5	5
Total lead time	90 days	81 days

Table 1. Lead time comparison for proposed supply chain.

Conclusion

An extended lead time is one of the major problems that the apparel sourcing world is facing when exporting readymade apparels from Bangladesh is concerned. Bangladesh has entered the quota free market after 2005. After entering the free market, Bangladesh apparels face competition from others competitors. Analysis has found that import dependency on the backward linked industry is the main factor for long lead time. More than 80% imported. The lack of a sufficient backward linking sector means that the import process of manufactured goods by the RMG sector in Bangladesh takes a total of another 55-75 days. As a result, this sector faces a long lead time which is 90 to 130 days on average. The analysis shows that the impact on the total lead time of information is negligible. To conclude, given this analysis, it was found that import dependencies contribute 50% or more in the problem of long lead times and it is the standard lead time to compete with the other manufacturer and exporter in the world that is the principal factor for the problem of long

lead times in the RMG industry. It becomes possible only to avoid the import of fabrics when the RMG sector ensures the availability of fabric from the local market by developing backward linkages industries, especially in the oven sector and establishing textile mills by the buyer for their consumption.

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