APPLICATION OF SUPPLY CHAIN MANAGEMENT IN A LOCAL MANUFACTURING COMPANY AND TO ASSESS ITS IMPACTS ON PERFORMANCE OF THE ORGANIZATION

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Engineering in Industrial Engineering and Management

Khulna University of Engineering and Technology
Khulna 920300, Bangladesh
January, 2008

Declaration

This is to certify that the thesis work entitled "Application of Supply Chain Management in a local manufacturing company and to assess its impacts on performance of the organization" has been carried out by Sk Mohammad Ali in the department of Industrial Engineering and Management, Khulna University of Engineering & Technology, Khulna, Bangladesh. The above research work and any part of the work has not been submitted anywhere for the award of any degree or diploma.

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ACKNOWLEDGEMENT

The author expresses his deep sense of gratitude to Dr. Engr. Md. Kutub Uddin, Professor, head of the Department of Industrial Engineering and Management (IEM), for his deep involvement, continuous inspiration and keen interest in conducting of this research work.

The author is highly grateful to Engr. Sikder Mainul Hasan, Asst. Professor, Department of Industrial Engineering and Management (IEM), for deep involvement, careful supervision, constant guidance, encouragement, and continued assistance. The author is also greatly indebted to him for the effort he put to provide the author thoughtful as well as constructive suggestions and useful necessary correction for completing the work in time.

The author is also grateful to Engr. Md. Lutfor Rahman, Asst. Professor Department of Industrial Engineering and Management (IEM), who extended his kind support at different levels of the work.

The author would like to express his deep appreciation to Engr. A. K. Rashid-Uz-Zaman, Manager , production plan and quality control, BCSL, Khulna, for giving him the opportunity to work in BCSL and making arrangement to provide the necessary information and data. There are individuals who deserve special thanks for their help in conducting the work. In this respect the author must mention the names, Engr. Md. Abu Hadid, Instructor (RCA), Technical Training Center, Khulna, Engr. Bikash C. Roy, Executive Engeneer, BADC, Khulna and Engr. Rezaul Haque Siddique, SSAE, Khulna. Again, the author would like to express his heartful thanks to his respected teachers of the IEM department, Amar Ekushey Hall and all those, who helped him directly or indirectly in this work.

Finally, the author has his heartiest love and affection for his wife (Rosy) and kids (Soma and Rajib) for all types of troubles and disturbances they faced with a very acceptable and encouraging manner during author's long continuation and finishing time of this research work.

Sk. Mohammad Ali.

ABSTRACT

A supply chain consists of all stages involved directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers but also transporters, warehouses, retailers, and customers. A supply chain is dynamic by nature and involves the constant flow of information, products, and funds between different stages. Each stage of the supply chain performs processes and interacts with other stages of the supply chain. A good design, planning, and operations of supply chain management (SCM) can be a competitive advantage for business organization. In contrast, a bad design, planning, and operations of supply chain hurts the performance of the SCM. The key drivers of supply chain performance are identified as facilities, inventory, transportation, and information. A recent study implied that in many organizations the purchase content accounts up to 70 percent of the total cost which is much higher than that of the manufactured accounts. Therefore, the strategic significance of SCM function has become a major determinant both for competitiveness in market and for corporate profitability.

The present study focused on SCM of a cable manufacturing company which manufactures different types of telecommunication cables for local network, subscribers line etc. The company presently meets the entire demand of BTTB and other agencies and thereby playing a vital roll to the national economy. Besides meeting local demand, it is also exporting its cables to Pakistan, Syria, Kuwait, Russia etc. The chief and most important raw material of the company is copper, which is imported from Australia, Korea etc.

Here, we have shown a supply chain model for proper functioning of the supply chain. Among all drivers of supply chain model in BCSL, inventory decision is very important. Due to habitual and conventional inventory policy, BCSL is not much aware of supply chain management and maximum profitability. Situation could be improved further by applying proper supply chain management system and thereby implementing a proper decision in inventory policy or import policy for increase of profitability.

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NOMENCLATURE

BCSL	:	Bangladesh Cable Shilpa Limited
BSP	:	Business System Planning
BTTB	:	Bangladesh Telegraph and Telephone Board
CLM	:	Council of Logistics Management
CRM	:	Customer Relationship Management
CSF	:	Critical Success Factor
EDI	:	Electronic Data Interchange
EDLP	:	Every Day Low Price
EFT	:	Electronic Fund Transfer
EOQ	:	Economic Order Quantity
ERD	:	Enterprise Resource Planning
IOIS	:	Inter Organizational Information System
ISCM	:	Internal Supply Chain Management
IT	:	Information Technology
JAD	:	Joint Application Design
JIT	:	Just In Time
PC	:	Personal Computer
SCOR	:	Supply Chain Operations Reference
SRM	:	Supplier Relationship Management
TC	:	Total Cost
TIC	:	Total Incremental Cost
TQM	:	Total Quality Management
WWW	:	World Wide Web

CHAPTER – 1

INTRODUCTION

(Understanding the supply chain and objectives of present study)

1.1 BACKGROUND

The supply system includes the process of planning, implementing, and controlling the efficient, effective flow, and storage of goods or services from the organization from its place of production to the place where it is required. Supply chain management (SCM) has dominated our lives, our thinking, and our actions for almost half a decade now. Industry and academicians have spent several man-years in understanding and researching the intricacies of SCM. From material management to SCM, the evolution has been slow and steady. The decade of the '90s has been the most turbulent leading to large scale adoption of the concept of SCM. Shift in power from the manufacturer to the consumer, user-friendly technology, advent of the omnipresent internet and economic deregulation leading to stiff competition are just some of the characteristics of this new age. This has also meant shifting of the onus of creating profit and wealth from the market (external environment outside the manufacturer's control) to inside the organization (within the manufacturer's control). The tools and techniques of SCM have come to the manufacturer's rescue. There are several stories of how companies have released locked in capital, thereby generating profits in-house by implementing SCM. The benefits are manifold and long term.

Implementing SCM is a long drawn value creation process that necessitates restructuring of not only internal organizational activities but also demands a relook at the relationships the company shares with its suppliers, distributors and all others who participate in SCM. The starting point, however, is a thorough understanding of what a supply is all about, the background, the thinking, and the various bricks that the supply chain is made of [3].

1.2 HISTORICAL PERSPECTIVE

Following the Second World War, production outstripped demand, resulting in more marketing or selling problems than buying problems. Also, the world war emphasized the importance of reaching the right products at the right time in the right amount and of the right quality. If the soldiers could not get whatever they wanted at the

right time, the consequences could be disastrous. If the enemy was right in front and the soldier started firing at him from his pistol, and if due to quality problems the pistol did not work at that instant, the less said about the outcome, the better. These requirements and the criticalities associated with them made the defence forces seriously analyze the supply chain. Recently the Gulf War was won by USA through a superbly and flawlessly designed supply chain that took into account the ground condition and problems arising thereby [3].

1.3 TYPICAL SUPPLY CHAIN SYSTEM

A. What is a Supply Chain: - A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customer themselves [9]. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distributions, finance, and customer service [2]. Hence, a supply chain encompasses all activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows. Material and information flow both up and down the supply chain [3].

A supply chain is dynamic and involves the constant flow of information, product, and funds between different stages [2]. Customer is an integral part of the supply chain. The primary purpose for the existence of any supply chain is to satisfy customer needs, in the process generating profits for itself. Supply chain activities begin with a customer order and ends when a satisfied customer has paid for his or her purchase [10]. The term "supply chain" conjures up images of product or supply moving from suppliers to manufacturers to distributors to retailers to customers along a chain. It is important to visualize information, funds, and product flows along both directions of this chain. The term “supply chain” may also imply that only one player is involved at each stage. In reality, a manufacturer may receive material from several suppliers and then supply several distributors. Thus, most supply chains are actually networks [11]. It may be more accurate to use the term "supply network" or "supply web" to describe the structure of most supply chains as shown in Figure 1.3

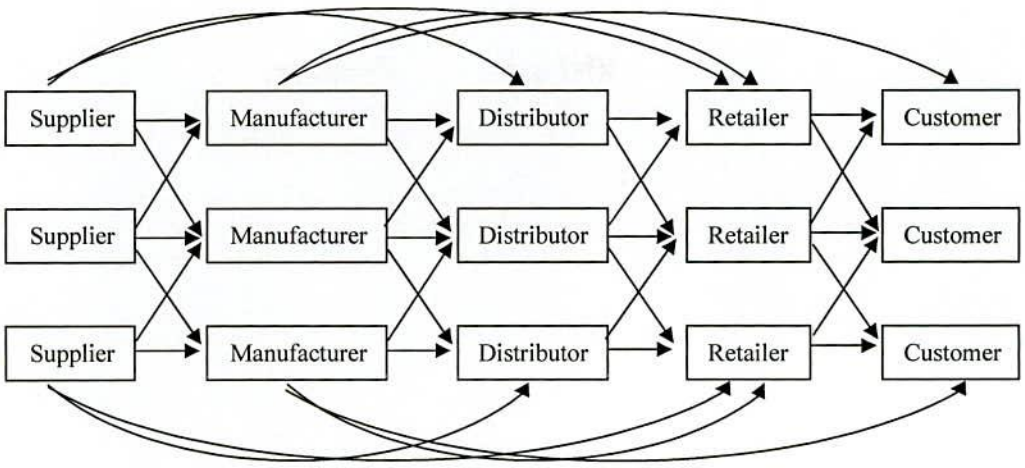


FIGURE: 1.3 Supply Chain Stages

A typical supply chain may involve a variety of stages. These supply chain stages include -

- Customers
- Retailers
- Wholesalers/Distributors
- Manufacturers
- Component/Raw material suppliers.

Each stage in figure 1.2 need not to be present in a supply chain. The appropriate design of the supply chain will depend on both the customer's needs and the roles of the stages involved

B. The Objective of a Supply Chain: The objective of every supply chain is to maximize the overall value generated. The value a supply chain generates is the difference between what the final product is worth to the customer and the effort the supply chain expends in filling the customer's request. For most commercial supply chains, value will be strongly correlated with "supply chain profitability", the difference between the revenue generated from customer and the overall cost across the supply chain. "Supply Chain Profitability" is the total profit to be shared across all supply chain stages. The higher the supply chain profitability, the more successful the supply chain [12]. Supply chain success should be measured in terms of supply chain profitability and not in terms of the profits at individual stage. Having defined the success of a supply chain in terms of supply chain profitability, the next logical step is to look for sources of revenue and cost. For any supply chain, there is only one source of revenue: the customer [2].

1.4 SUPPLY CHAIN MANAGEMENT

Supply chains are essentially a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organization until a finished product reaches the ultimate end user [1]. All flows of information, product, or funds generate costs within the supply chain. Thus, the appropriate management of these flows is a key to supply chain success, which is **"Supply Chain Management (SCM)"**.

Supply Chain Management (SCM) is the integration of all the activities through improved supply chain relationships, to achieve a sustainable competitive advantage or in other words "SCM involves the management of flows between and among all the stages in a supply chain to maximize total supply chain profitability".

1.5 THE OBJECTIVE OF SUPPLY CHAIN MANAGEMENT

Any organization or firm is a member of one or more supply chains. So, it is important to note that from the focal firm's perspective, the supply chain management includes-

A. Management of external upstream supply chain members.

B. Management of internal functions.

C. Management of external downstream supply chain members.

D. Management of recovery, recycling or reuse of products.

1.6 DECISION PHASES IN SUPPLY CHAIN MANAGEMENT

Successful supply chain management requires many decisions relating to the flow of information, product, and funds. These decisions fall into three categories or phases, depending on the frequency of each decision and the time frame over which a decision phase has an impact

The decision phases are

1. Supply chain strategy or design
2. Supply chain planning
3. Supply chain operation

1.7 ACHIEVING STRATEGIC FIT

It is very important that for any successful company, its supply chain strategy and competitive strategy must fit together. "Strategic fit" means that both the competitive and supply chain strategies have the same goal. Is refers to consistency

between the customer priorities that the competitive strategy hopes to satisfy and the supply chain capabilities that the supply chain strategy aims to build. The issue of achieving strategic fit is a key consideration for any supply chain strategy.

A company's success or failure is closely linked to the following key points:

1. The competitive strategy and all functional strategies must fit together to form a coordinated overall strategy. Each functional strategy must support other functional strategies and help a firm to reach its competitive strategy goal.
2. The different functions in a company must appropriately structure their processes and resources to be able to execute these strategies successfully.

A company may fail either because of a lack of strategic fit or because its processes and resources do not provide the capabilities to support the desired strategic fit. If this desired strategic fit is not achieved, conflicts between different functional goals arise. Such conflicts result in different functions targeting different customer priorities. Because processes and resources are structured to support functional goals, a conflict in functional goals leads to conflicts during execution.

Supply chains have many different characteristics and these characteristics depend on the trade-off between "responsiveness" and "efficiency" of the supply chain.

"Supply chain responsiveness" includes a supply chain's ability to do the following:

- Respond to wide ranges of quantity demanded
- Meet short lead times
- Handle a large variety of products
- Build high innovative products
- Meet a very high service level
- Handle supply uncertainty

The more of these abilities that a supply chain has, the more responsive it is.

Responsiveness comes at a cost. "Supply chain efficiency" is the cost of making and delivering a product to the customer. Increases in cost lower efficiency. For every strategic choice to increase responsiveness, there are additional costs that lower efficiency.

So, the second step in achieving strategic fit between competitive and supply chain strategies is to understand the supply chain and map it on the responsiveness spectrum.

The final step in achieving strategic fit is to match supply chain responsiveness with the implied uncertainly from demand and supply.

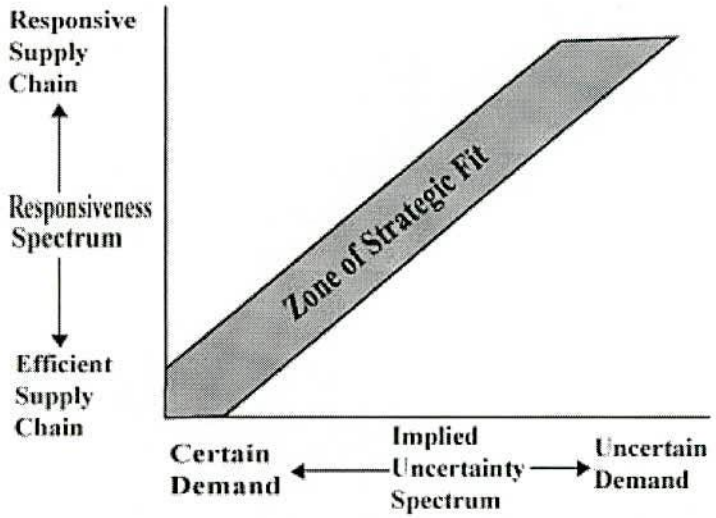


FIGURE: 1.5. Finding the Zone of strategic fit

To achieve strategic fit, the greater the implied uncertainty, the more responsive the supply chain should be. Increasing implied uncertainty from customers and supply sources is best served by increasing responsiveness from the supply chain. This relationship is represented by the "zone of strategic fit" as illustrated in figure 1.5. For a high level of performance, companies should move their competitive strategy (and resulting implied uncertainty) and supply chain strategy (and resulting responsiveness) towards the zone of strategic fit [2].

1.8 SUPPLY CHAIN MANAGEMENT SYSTEM IN LOCAL INDUSTRIES

The concept of supply chain management (SCM) system is very recent in our country. At present there are many manufacturing companies in the country but they are not doing very well due to lack of knowledge of SCM. The identifiable reasons are lack of exposure to the concurrent techniques and facilities, inadequate indigenous support system, scarcity of qualified manpower etc.

On the other hand manufacturing industries in the developed nations are taking the advantage of relevant techniques and thus dominating world trade and business.

The main identifiable problem in implementing SCM system in local industries is identification of leading supply chain driver. Among all drivers of SCM system, one or all coordinated drivers may dominate competitiveness, profitability, and prosperity of the organization. So, the implementation of SCM can lead to disaster when it is used without careful analysis of the specific requirements of the concern company. Therefore, its appropriateness and effectiveness depend upon the extent of its customization. Again, every manufacturing firm wants to maximize profit by reducing the importance of any one or all drivers of SCM. But in course of time when management finds that SCM claims 100% of the total investment then they become conscious to curb the cost of SCM. As local manufacturing industries have to face extreme competition due to globalization and in many cases their production cost is extensively high so they are in require to take the advantage of utilization the concept of SCM and its implementation.

1.9 OBJECTIVES OF THE PRESENT STUDY

The present study was aimed at identifying the present status of SCM application in local industries. In this regard a local manufacturing company was selected as a model. It was understood that there were problems and prospects in implementing SCM in local manufacturing industries and that's why with the following aims and objectives the present study was conducted:

1. To study and investigate the bottlenecks in applying the key drivers of SCM in a local telephone cable manufacturing industry.
2. To estimate total incremental cost (TIC) of main inventory (copper) according to several inventory decisions and find out the most profitable one.
3. To recommend appropriate measures for local manufacturing industries in applying SCM and to identify the action plan for future.

CHAPTER-2

LITERATURE REVIEW

2.1 DRIVERS OF SUPPLY CHAIN PERFORMANCE

The strategic fit requires that a company achieve the balance between responsiveness and efficiency in its supply chain that best meets the needs of the company's competitive strategy.

In any supply chain there are the following 4 (four) major drivers

1. Facilities
2. Inventory
3. Transportation
4. Information

These four drivers determine the performances of any supply chain.

To understand how a company can improve supply chain performance in terms of responsiveness and efficiency, it is important to examine the role of performance of each driver in the overall competency of the company. These drivers not only determine the supply chain's competitive performance in terms of responsiveness and efficiency, they also determine whether the strategic fit is achieved across the supply chain.

2.2 A SUPPLY CHAIN DECISION MAKING FRAMEWORK FOR STRUCTURING DRIVERS

For each of the individual drivers, supply chain manager must make a trade-off between efficiency and responsiveness. The combined impact of these four drivers then determines the responsiveness and efficiency of the company in association with strategic fit and competitive strategy of the entire supply chain.

In this situation we can provide a visual framework for supply chain decision making as shown in Figure 2.2

Most companies begin with a competitive strategy and then decide what their supply chain strategy ought to be. The supply chain strategy determines how the supply chain should perform with respect to efficiency and responsiveness. The supply chain must then use the supply chain drivers to reach the performance level the supply chain strategy dictates. Although this framework is generally viewed from the top down, in

many instances, a study of the four drivers may indicate the need to change both the supply chain and potentially even the competitive strategy.

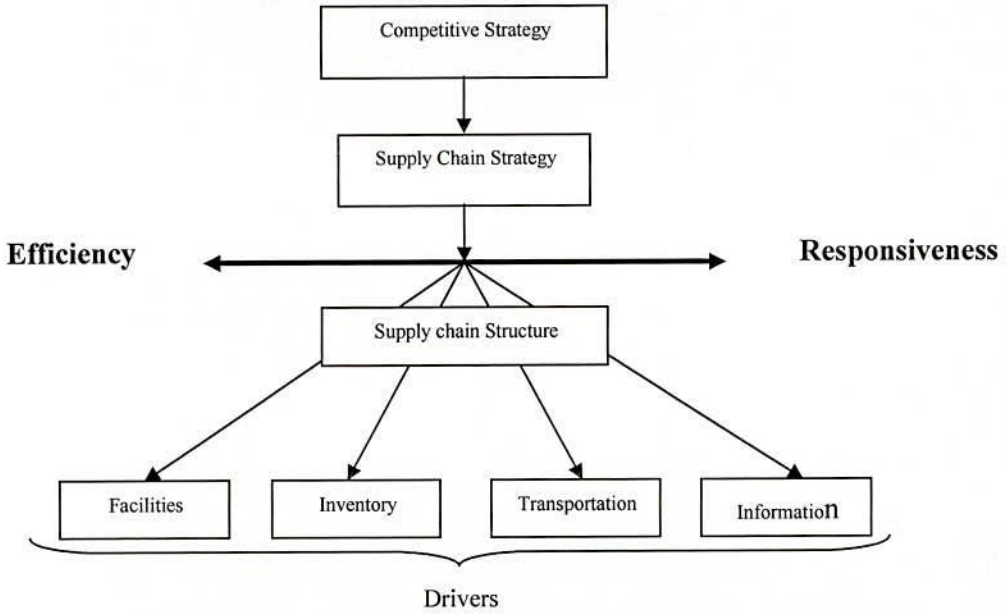


FIGURE 2.2 Supply chain decision-making Framework

Now we will define and devote our attention to a detailed discussion of each of the four drivers regarding their impact and role in the supply chain.

2.2.1. FACILITIES

Definition: Facilities are the places in the supply chain network where product is stored, assembled or fabricated.

Role in the Supply Chain

From the definition we know that facilities are the locations to or from which the inventory is transported. The two major facilities are production sites and warehousing site. In the production site the inventory is either processed or transformed into another state and in the warehousing site the inventory is stored before being shipped to the next stage. Whatever the function of the facility, decisions regarding location, capacity, and flexibility of facilities have a significant impact on the supply chain's performance.

Role in the Competitive Strategy

Facilities and their corresponding capacities to perform their functions are a key driver of supply chain performance in terms of responsiveness and efficiency. Generally companies can gain economics of scale when a product is manufactured or stored in

only one location; this centralization increases efficiency. The cost reduction, however, comes at the expense of responsiveness, as many of a company's customers may be located far from the production facility. The opposite is also true. Locating facilities close to customers increases the number of facilities needed and consequently reduces efficiency. If the customer demands and is willing to pay for the responsiveness that having numerous facilities adds, however, then this facilities decision helps meet the company's competitive strategy goals.

Some companies use facilities decisions to be more responsive to their customers. These companies have an end goal of opening manufacturing facilities in every major market that they enter. While there are other benefits to opening local facilities, such as protection from currency fluctuation and trade barriers, the increase in responsiveness plays a large role in companies' decision to locate in their local markets.

Components of Facilities Decisions

Decisions regarding facilities are a crucial part of supply chain design. Now we will identify the following components of facilities decisions that company must analyze.

- **Location**

  Deciding where a company will locate its facilities constitutes a large part of the design of a supply chain. A basic trade-of here is whether to centralize to gain economics of scale or decentralize to become more responsiveness by being closer to the customer. Companies must also consider a host of issues related to the various characteristics of the local area in which the facility may be situated. These include macro-economic factors, quality of workers, cost of workers, cost of facility, availability of infrastructure, proximity of customers and the rest of the network, tax effects, and other strategic factors.

- **Capacity**

  Companies must also decide what a facility's capacity to perform its intended function or functions will be. A large amount of excess capacity allows the facility to be very flexible and to respond to wide swings in the demands placed on it. Excess capacity, however, costs money and therefore can decrease efficiency. A facility with little excess capacity will likely be more efficient per unit of product it produces than one with a lot of unused capacity. The high utilization facility will, however, have difficulty responding to demand

fluctuations. Therefore, a company must make a trade-off to determine the right amount of capacity to have at each of its facilities.

- **Operations Methodology**

  Companies must make a major decision regarding the operations methodology that a facility will use. They must decide whether to design a facility with a product-focus or a functional-focus. A product-focused facility performs many different functions (e.g., fabrication and assembly) in producing a single type of product. A functional focused facility performs few functions (e.g., only fabrication or only assembly) on many types of products. A product-focus tends to result in more expertise about a particular type of product at the expense of the functional expertise that comes from a functional methodology. Firms must decide which type of expertise will best enable them to meet customer needs.

  Firms must also make a decision regarding the relative level of flexible versus dedicated capacity is their portfolios. Flexible capacity can be used for many types of products but is often less efficient while dedicated capacity can be used for only a limited number of products but it is more efficient. The trade-off, as in previous instances, is between efficiency and responsiveness.

- **Warehousing Methodology**

  As with manufacturing, there are a variety of methodologies from which companies can choose when designing a warehouse facility. Some of these methodologies include:-

  a. Stock keeping unit (SKU) storage: a traditional warehouse that stores all of one type of product together. This is a fairly efficient way to store products.

  b. Job lot storage: a methodology in which all the different types of product needed to perform a particular job or satisfy a particular type of customer are stored together. This generally requires more storage space but can create a more efficient picking and packing environment.

  c. Cross-Docking: a methodology in which goods are not actually warehoused in a facility. Instead, trucks from suppliers, each carrying a different type of product, deliver goods to a facility. There the inventory is broken into smaller lots and quickly loaded onto store-bound trucks that carry a variety of products, some from each of the supplier trucks.

Overall Trade-Off: Responsiveness versus Efficiency

In general, a company striving for responsiveness could have many warehousing facilities located close to customers even though this practice reduces efficiency. Alternatively, a high-efficiency company would have fewer warehouses to increase efficiency despite the fact that this practice will reduce responsiveness. So, the fundamental trade-off managers face when making facilities decisions is between the cost of number, location, and type of facilities (efficiency) and the level of responsiveness that these facilities provide the company's customer.

2.2.2. INVENTORY

Definition: Inventory is all raw materials, work in process, and finished goods within a supply chain.

Inventory is an important supply chain driver because changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness.

Role in the Supply Chain

Inventory exists in the supply chain because of a mismatch between supply and demand. This mismatch is intentional at a steel manufacturer where it is economical to manufacture in large lots that are then stored for future sales. The mismatch is also intentional at a retail store where inventory is held in anticipation of future demand. An important role that inventory plays in the supply chain is to increase the amount of demand that can be satisfied by having product ready and available when the customer wants it. Another significant role inventory plays is to reduce cost by exploiting any economics of scale that may exist during both production and distribution.

Inventory is spread throughout the supply chain from raw materials to work in process to finished goods that Suppliers, manufacturers, distributors, and retailers hold. Inventory is a major source of cost in a supply chain and it has a huge impact on responsiveness.

Inventory also has a significant impact on the martial flow time in a supply chain. Material flow time is the time that elapses between the points at which martial enters the supply chain to the point at which it exits. Another important area where inventory has a significant impact is throughput. For a supply chain, throughput is the rate at which sales occur. If inventory is represented by I, flow time by T, and throughput by D, the three can be related using Little's Law as follows:

$$I = DT \qquad \text{[Little's Law]}$$

For example, if the flow time of and auto assembly process is ten hours and the throughput is 60 units an hour. Little's Law tells us that the inventory is 60×10=600 units. If we were able to reduce inventory to 300 units while holding throughput constant, we would reduce our flow time to five hours (300/60). We note that in this relationship, inventory and throughput must have consistent units.

The logical conclusion here is that inventory and flow time are synonymous in a supply chain. Managers should use actions that lower the amount of inventory needed without increasing cost or reducing responsiveness, because reduced flow time can be a significant advantage in a supply chain.

Role in the Competitive strategy

Inventory plays a significant role in a supply chain's ability to support a firm's competitive strategy. If a firm's competitive strategy requires a very high level of responsiveness, a company can use inventory to achieve this responsiveness by locating large amounts of inventory close to the customer. Conversely, a company can also use inventory to make it self more efficient by reducing inventory through centralized stocking. The latter strategy would support a competitive strategy of being a low-cost producer. The trade-off implicit in the inventory drivers is between the responsiveness that results from more inventory and the efficiency that results from less inventory.

Components of Inventory Decisions

Now we will identify the following major inventor-related decisions that supply chain managers must make to effectively create more responsive and more efficient supply chains.

- **Cycle Inventory**

  Cycle inventory is the average amount of inventory used to satisfy demand between receipts of supplier shipments. The size of the cycle inventory is a result of the production or purchase of material in large lots. Companies produce or purchase in large lots to exploit economics of scale in the production, transportation or purchasing process. With increase in lot size, however, also comes an increase in carrying costs. As an example of a cycle stock decision, consider an online book retailer. This retailer's sales average around 10 truckloads of books a month. The cycle inventory decisions the retailer must make are how much to order for replenishment and how often to place these

orders. The e-retailer could order 10 trucks once each month or it could order one truck every three days. The basic trade-off supply chain managers face is the cost of holding larger lots of inventory (when cycle inventory is high) versus the cost of ordering frequently (when cycle inventory is low).

- **Safety Inventory**

  Safety inventory is inventory held in case demand exceeds expectation; it is held to counter uncertainty [14]. If the world were perfectly predictable, only cycle inventory would be needed. Because demand is uncertain and may exceed expectations, however, companies hold safety inventory to satisfy an unexpectedly high demand. Managers face a key decision when determining how much safety inventory to hold.

  A company must calculate its safety inventory for some baying season. If it has too much safety inventory, some inventory goes unsold and may have to be discounted after the buying season. Again if the company has too little safety inventory, however, then the company will loose sales and the margin those sales would have brought. Therefore, choosing safety inventory involves making a trade-off between the costs of having too much inventory and the costs of losing sales due to not having required inventory.

- **Seasonal Inventory**

  Seasonal inventory is inventory that is build up to counter predictable variability in demand. Companies using seasonal inventory will build up inventory in periods of low demand and store it for periods of high demand when they will not have the capacity to produce all that is demanded. Managers face key decisions in determining whether to build seasonal inventory, and if they do build it, in deciding how mush to build. If a company can rapidly change the rate of its production system at very low cost, then it may not need seasonal inventory because the production system can adjust to a period of high demand without incurring large costs. However, if changing the rate of production is expensive (e.g., when workers must be hired or fired), then a company would be wise to have a smooth production rate and build up its inventory during period of low demand. Therefore, the basic trade-off supply chain managers face in determining how much seasonal inventory to build is the cost of carrying the additional seasonal inventory versus the cost of having more flexible production rate.

- **Sourcing**

  Sourcing is the set of business processes required to purchase goods and services. Managers must first decide the tasks that will be outsourced and those that will be performed within the company. For each task, the managers must decide whether to source from a single supplier or a portfolio of suppliers. If a portfolio of multiple suppliers is to be carried, the role of each supplier in the portfolio must be clarified. The next step is to identify the set of criterion that will be used to select suppliers and measure their performance. Managers then select suppliers and negotiate contracts with them. Contracts should be structured to improve supply chain performance and minimize information distortion from one stage to the next. Contracts also clearly define the role of each supply source. Once suppliers and contracts are in place, procurement processes that facilitate the placement and delivery of orders play a major role. Sourcing decisions are crucial for a company because they affect all other inventory decisions and the level of efficiency and responsiveness the supply chain can achieve.

Overall Trade-Off: Responsiveness versus Efficiency

The fundamental trade-off managers face when making inventory decisions is between responsiveness and efficiency. Increasing inventory will generally make the supply chain more responsive to the customer.

This choice, however, comes at a cost as the added inventory decreases efficiency. Therefore, a supply chain manager can use inventory as one of the drivers for reaching the level of responsiveness and efficiency the competitive strategy targets.

2.2.3. TRANSPORTATION

Definition: Transportation moves product between different stages in a supply chain.

Role in the Supply Chain

Transportation entails moving inventory from point to point in the supply chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on both responsiveness and efficiency of a supply chain. Faster transportation, whether in the

form of different modes of transportation or different amounts being transported, allows a supply chain to be more responsive but reduces its efficiency. The type of transportation a company uses also affects the inventory and facility locations in the supply chain. A company can use a faster mode of transportation to transport its products, thus making the supply chain more responsive but less efficient due to associated high cost. On the other side the company can use slower but cheaper transportation, making the supply chain efficient but limiting its responsiveness.

Role in the Competitive Strategy

The role of transportation in a company's competitive strategy figures prominently when the company is considering the target customer's needs. If a company's competitive strategy targets a customer that demands a very high level of responsiveness and that customer is willing to pay for this responsiveness, then the company can use transportation as one driver for making the supply chain more responsive. The opposite is true as well. If a company's competitive strategy targets customers whose main decision criterion is price, then the company can use transportation to lower the cost of the product at the expense of responsiveness. As a company may use both inventory and transportation to increase responsiveness or efficiency, the optimal decision for the company often means finding the right balance between the two.

Components of Transportation Decisions

Now we will identify key components of transportation that companies must analyze when designing and operating a supply chain.

Mode of Transportation

The mode of transportation is the manner in which a product is moved from one location in the supply chain network to another. Companies have six basic modes from which to choose:

- *Air*: The faster and most expensive mode.
- *Truck*: A relatively quick and inexpensive mode with high level of flexibility.
- *Rail*: An inexpensive mode used for large quantities.
- *Ship*: The slowest mode but often the only economical choice for large overseas shipments.

- *Pipeline*: Used primarily to transport oil and gas.
- *Electronic Transportation*: The newest mode that "transports" goods such as music, previously sent solely by physical modes, electronically via the Internet.

Each mode has different characteristics with respect to the speed, size of shipments (individual parcels to pallets to full trucks to entire ships), cost of shipping, and flexibility that lead companies to choose one particular mode over the others.

Route and Network Selection

Another major decision managers must make is the route and network along which products are shipped. A route is the path along which a product is shipped and a network is the collection of locations and routes along which a product can be shipped. For example, a company needs to decide whether to ship products directly to customers or to use a series of distribution layers. Companies make some routing decisions at the supply chain's design stage while they make others daily or on a short term basic.

Inhouse or Outsource

Traditionally, much of the transportation function has been performed inhouse. Today, however, much of transportation (and even entire logistics systems) is outsourced. Having to choose between bringing parts of transportation inhouse or outsourcing leads to another dimension of complexity when companies are designing their transportation systems.

Overall Trade-Off: Responsiveness versus Efficiency

The fundamental trade-off for transportation is between the cost of transporting a given product (efficiency) and the speed with which that product is transported (responsiveness). The transportation choice influences other drivers such as inventory and facilities. When supply chain managers think about making transportation decisions, they frame the decision in terms of this trade-off.

2.2.4. INFORMATION

Definition: Information consists of data and analysis concerning facilities, inventory, transportation and customers throughout the supply chain.

Role in the Supply Chain

Information could be overlooked as a major supply chain driver because it does not have a physical presence. Information, however, deeply affects every part of the supply chain. Its impact is easy to underestimate as information affects a supply chain in many different ways. Consider the following:

1. Information serves as the connection between the supply chain's various stages, allowing them to coordinate and bring about many of the benefits of maximizing total supply chain profitability.
2. Information is also crucial to the daily operations of each stage in the supply chain. For instance, a production scheduling system uses information on demand to create a schedule that allows a factory to produce the right products in an efficient manner. A warehouse management uses information to create visibility of the warehouse's inventory. The company can then use this information to determine whether new orders can be filled.

   Finally, information is potentially the biggest driver to performance in the supply chain as it directly affects each of the other drivers. Information presents management with the opportunity to make the supply chains more responsive and efficient.

Role in the Competitive Strategy

Information is a driver whose importance has grown as companies have used it to become both more efficient and more responsive. The tremendous growth of the importance of information technology is a testimony to the impact information can have on improving a company. Like all the other drivers, however, even with information, companies reach a point when they must make the trade-of between efficiency and responsiveness.

Another key decision involves what information is most valuable in reducing cost and improving responsiveness within a supply chain. This decision will vary depending on the supply chain structure and the market segments served. Some companies, for example, target customers who require customized products that carry a premium price tag. These companies might find that investments in information allow taken to respond more quickly to their customers.

Components of Information Decisions

Now we will consider key components of information within a supply chain that a company must analyze to increase efficiency and improve responsiveness within its supply chain.

Push Versus Pull

When designing pieces of the supply chain, managers must determine whether these pieces are part of the push or pull phase in the chain. Because different types of systems require different types of information. Push systems generally require information in the form of elaborate material requirements planning (MRP) systems to take the master production schedule and roll it back, creating schedules for suppliers with part types, quantities, and delivery dates. Pull systems require information on actual demand to be transmitted extremely quickly throughout the entire chain so that production and distribution of parts and products may accurately reflect the real demand.

Coordination and Information Sharing

Supply chain coordination occurs when all the different stages of a supply chain work toward the objective of maximizing total supply chain profitability rather than each stage devoting itself to its own profitability without considering total supply chain profit. Lack of coordination can result in a significant loss of supply chain profit. Managers must decide how to create this coordination in the supply chain and what information must be shared in order to accomplish this goal. Coordination between different stages in a supply chain requires each stage to share appropriate information with other stages. For example, if a supplier is to produce the right parts in a timely manner for a manufacturer in a pull system, the manufacturer must share demand and production information with the supplier. Information sharing is thus crucial to the success of a supply chain.

Forecasting and Aggregate Planning

Forecasting is the art and science of making projections about what future demand and conditions will be. Obtaining forecasting information frequently means using sophisticated techniques to estimate future sales or market conditions. Managers must decide how they will make forecasts and to what

extent they will rely on them to make decisions. Companies often use forecasts both on a tactical level to schedule production and on a strategic level to determine whether to build new plants or even whether to enter a new market.

Once a company creates a forecast, the company needs a plan to act on this forecast. Aggregate planning transforms forecasts into plans of activity to satisfy the projected demand. A key decision managers face is how to collaborate on aggregate planning throughout the entire supply chain. The aggregate plan becomes a critical piece of information to be shared across the supply chain because it affects both the demand on a firm's suppliers and the supply to its customers.

Pricing and Revenue Management

Pricing is the process by which a firm decides how much to charge customers for its goods and services. Demand and supply information is a fundamental input into the pricing decision. A firm must understand the impact of price and competition on demand and the cost of supply when deciding whether to run a price promotion. Information on the availability of supply chain assets and the demand for these assets is needed for a firm to decide the best pricing strategy.

Revenue management is the use of different pricing over time or customer segments to maximize profits from a limited set of supply chain assets. For effective revenue management the supply chain must have good information on asset availability, customer demand, and customer behavior when faced with different pricing.

Enabling Technologies

Many technologies exist that share and analyze information in the supply chain. Managers must decide which technologies to use and how to integrate these technologies in to their companies and their partners' companies. The consequences of these decisions are becoming more and more important as the capabilities of these technologies grow.

Overall Trade-Off: Responsiveness versus Efficiency

Good information systems can help a firm improve both its responsiveness and efficiency. The information driver is used to improve the performance of other drivers

and the use of information is based on the strategic position the other drivers support. Accurate information can help a firm improve efficiency by decreasing inventory and transportation costs. Accurate information can improve responsiveness by helping a supply chain better much supply and demand.

2.3 INTEGRATED SUPPLY CHAIN MANAGEMENT MODEL

All organizations are part of one or more supply chains. Whether a company sells directly to the end customer, provides a service, manufactures a product or extracts martial from earth, it can characterized within the context of its supply chain. Until recently, however, organizations focused primarily on their direct customers and internal functions, and placed relatively little emphasis on other organizations within their supply chain network. Generally each supply chain network has the following major members:

1. Customer
2. Retailers
3. Distributor centers
4. Assembling / Manufacturing
5. First tier suppliers
6. Second Tier suppliers

   and so on.

The supply chain connects all these members as a chain and in this chain there are three types of management such as

1. Information system and supply chain management,
2. Inventory management across the supply chain, and
3. Supply chain relationships management.

However, the following three major developments in global markets and technologies have brought supply chain management to the forefront of management's attention:

1. The information revolution
2. Customer demands in areas of product and service cost, quality, delivery, technology, and cycle time brought about by increased global competition.
3. The emergence of new forms of interorganizational relationships.

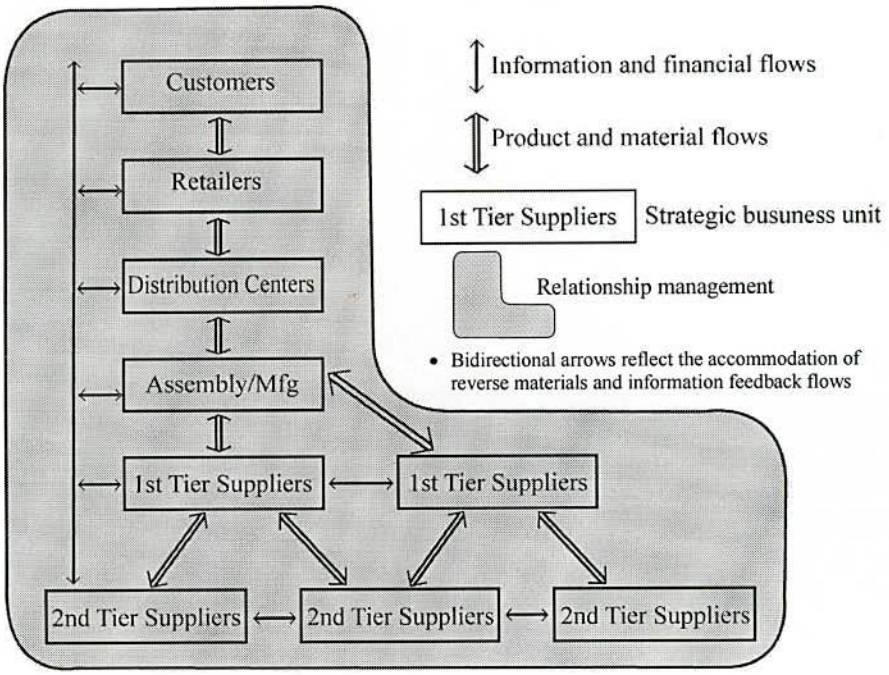


FIGURE: 2.3 Integrated Supply Chain Model

Each of these developments has fostered the emergence of an integrated supply chain approach. In this situation, we are presenting and integrated supply chain model in figure 2.3, which illustrates the nature of supply chain management and integrates all three developments mentioned just before.

2.3.1 INFORMATION FLOW IN AN INTEGRATED SUPPLY CHAIN

As discussed earlier that supply chain management is concerned with the flow of products and information between the supply chain member organizations. At the limit, it encompasses all of those organizations (i.e., suppliers, customers, producers, and service providers) that link together to acquire, purchase, convert /manufacture, assemble, and distribute goods and services, from suppliers to ultimate end users. These flows are bidirectional. These flows are bidirectional. This article addresses the information required for effective supply chain management and introduces a number of technologies that organizations are using to make this information readily available across the supply chain model as shown in Figure 2.3.

Recent developments in technology have brought information to the forefront of resources from which forward-thinking firms can cultivate genuine competitive advantage. These technologies provide the means for multiple organizations to

coordinate their activities in an effort to truly manage a supply chain. As the rate of these technological advances increases, the cost associated with this information has decreased. Simultaneously, the speed with which this vital information can be made useful and applicable in a variety of business situations continues to increase.

By 1980, the information revolution was in full swing in the world's advanced economics. During this period, many standard business processes and functions such as customer order processing, inventory management, and purchasing were altered through the use of computer technology. However, only as the variety of available information technologies and capabilities began to grow exponentially mid-decade, did a more expanded information technology (IT) paradigm begin to emerge.

Industry observes writing at that time suggested, "...managers need to understand that information technology is more than just computers. Today, information technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information. In addition to computers, then, data recognition equipment, communications technologies, factory automation, and other hardware and services are included" [16]. We utilize this paradigm here, describing the role of information and information technology in the supply chain.

The Importance of Information in an Integrated Supply Chain Management Environment.

IT infrastructures today may be quite complex and comprehensive, supporting the firm's communication networks, databases, and operation systems. In fact "IT infrastructure capabilities underpin the competitive positioning of business initiatives such as cycle time reduction, implementing redesigned cross–functional processes, utilizing cross-selling opportunities and capturing the channel to the customer [17]. These infrastructures also support the development, management, and maintenance of interorganizational supply chains.

A key notion in the essential nature of information systems in the development and maintenance of successful supply chains is the need for virtually seamless bonds within and between organizations. This means creating interorganizational processes and links to facilitate delivery of seamless information between marketing, sales, purchasing, finance, manufacturing, distribution and transportation internally, as well as interorganizationally, to customers, suppliers, carriers, and retailers across the supply

chain. Perhaps more importantly, it means alteration of perspective at the firm's highest levels. Changes in thinking that become necessary include aligning corporate strategies to the IT paradigm, providing incentives for functions to achieve common goals through the sharing of information, and implementing the technologies to redesign the movement of goods to maximize channel value and lower cost [18].

"Bullwhip" Effect and Avoiding the Sting of the "Bullwhip".

"Bullwhip" Effect may be explained as inventory stock piles become progressively larger looking backward through the chain from the final customer towards the beginning of the supply chain. (as shown in figure 2.3.1)

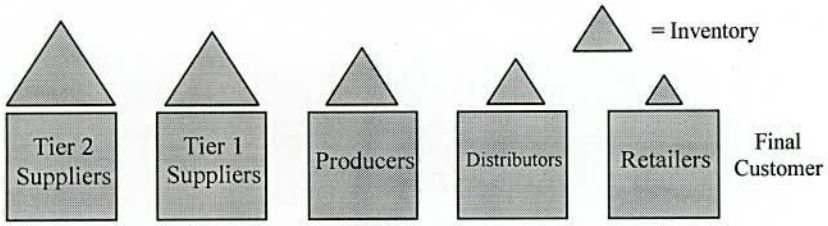


FIGURE: 2.3.1 The bullwhip effect on supply chain inventories.

"Bullwhip" effect occurs due to non accurate information. In fact, "distorted information from one end of a supply chain to the other end lead to tremendous inefficiencies: excessive inventory investment, poor customer service lost revenues, misguided capacity plans, ineffective transportation and missed production schedules [19]."

Interorganizational information system (IOIS)

Information requirements determination for a supply chain IOIS [20]. has 5 (five) steps, (1) Background information, (2) Information requirements determination overview, (3) Determining the information requirements for the supply chain management IOIS, (4) Translation to an information systems prototype, and (5) Prototype review.

Information and Technology Applications for Supply Chain Management

Several technologies have gained popularity recently, due to their ability to facilitate the flow of information across the supply chain. Some of the enabling technologies are as follows:

1. Electronic Commerce
2. Bar Coding and Scanning

3. Electronic Data Interchange (EDI) [21]
4. Internet
5. Intranet / Extranet
6. World Wide Web
7. Enterprise Resource Planning
8. Supply Chain Management Software

Information Systems and Supply Chain Management

Managers developing information systems should not visualize information as a set of repetitive transactions between entities such as buyers and suppliers, or distributors retailers. Rather, an ideal system should span all functions and organizations throughout the entire supply chain. With the explosion of the Internet, the World Wide Web, and company "Intranets," future systems will possess the following set of characteristics [15]:

- Centralized coordination of information flows.
- Total logistics management -- integrating all transportation, ordering, and manufacturing systems.
- Order-change notices that trigger a cascading series of modifications to production schedules, logistics plans, and warehouse operations.
- Global visibility into transportation resources across business units and national boundaries.
- Global inventory management – ability to locate and track the movement of every item.
- Global sourcing – consolidation of the purchasing function across organizational lines, facilitating purchasing leverage and component standardization across business units.
- Intercompany information access – clarity of production and demand information residing in organizations both upstream and downstream throughout the value chain.
- Data interchange – between affiliates and nonaffiliates through standard telecommunications channels.
- Data capture – ability to acquire data about an order at the point of origin, and to track products during movement and as their characteristics change.

- Transformation of the business from within – managers who can see the "big picture" and accept the new forms of business processes and systems.
- Improvements in supplier-customer relationships – to justify investments in technology linkages.

2.3.2 MANAGING THE FLOW OF MATERIALS ACROSS THE SUPPLY CHAIN

Any supply chain is concerned with the flow of materials between the supply chain member organizations. The critical importance of effectively managing the flow of materials across the supply chain has in recent years been realized by corporate executives and academicians alike. The flow of materials across the supply chain is shown in the figure 2.3.

The cost associated with flow of materials has been a matter of particular interest to the executives within the supply chain. Industry experts estimate not only that total supply chain costs represent the majority share of operating expenses for most organizations but also that, in some industries, these costs approach 75 percent of the total operating budget. "According to the U.S. department of commerce, companies are spending more than $600 billion annually on logistics-related services and activities [22] ". A recent study uncovered the global logistics expenditure which exceeds $ 3.5 trillion annually, nearly 20% of world's GDP, making logistics perhaps the last frontier for major corporations to significantly increase shareholders and customer value [4]. One of the main promises that supply chain management holds is the opportunity to improve this flow of materials across the supply chain from the perspective of the end user, while reducing supply chain costs at the same time.

Understanding Supply Chains

In recent year, few topics have generated more interest than SCM. The notion of one's organization, its suppliers, their suppliers, one's customers, and their customers, all working together to meet the needs of the ultimate end customer for the mutual benefit of all parties concerned is a very appealing proposition. Now we will mention several tools and techniques employed by managers to help them fully understanding their organizations' supply chains.

Supply Chain Basics

Most organizations are simultaneously members of multiple supply chains. An organization in each chain typically offers a number of products and services, purchases materials from a wide range of suppliers, and sells to multiple customers. From the perspective of a typical organization, each of its supply chains will have both internal and external "linkages".

Internal Supply Chains

The internal supply chain is that portion of a given supply chain that occurs within an individual organization.

External Supply Chains

Once an understanding of the internal supply chain is gained, it is necessary to extend the analysis to the external portion of the supply chain (i.e., key suppliers and customers). This is an important step as significant opportunities for improvement often lie at the interfaces between the various supply chain member organizations.

Benefits of Interorganizational Supply Chain Collaboration:

External workshop participants indicate that a number of benefits are associated with these sessions in addition to documenting existing supply chain processes. Specific benefits include (1) establishing valuable contacts across the supply chain, (2) gaining insights into current organizational practices, and (3) identifying opportunities for joint projects between supply chain members. This phenomenon is consistent with other research findings in the area of interorganizational collaboration [23].

Supply Chain Performance:

In order to assess the performance of an existing supply chain and its related processes accurately, it is necessary to have objective performance information.

Role of Benchmarking:

In developing an understanding of existing supply chains and their associated processes, benchmarking analysis has been shown to be an effective means to determine the supply chain's performance relative to those of other organizations. Cook (1995) defines benchmarking as "the process of identifying, understanding, and adapting outstanding practices from within the same organization or from other businesses to

help improve performance. This involves a process of comparing practices and procedures to those of the 'best' to identify ways in which an organization (or organizations) can make improvements. Thus new standards and goals can be set which, in turn, will help better satisfy the customer's requirements for quality, cost, product and service [24]".

Reengineering Supply Chain Logistics

Reengineering Supply Chain Logistics has the following considerations:

Logistics as a source of competitive advantage for the supply chain

Logistics is defined by the council of Logistics Management (CLM) as "..... the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements". Another author defines logistics as "the design and operation of the physical, managerial, and informational systems needed to allow goods to overcome time and space". Logistics entails the planning and control of all factors that will have an impact on getting the correct product to where it is needed, on time and at the optimum cost. Superior logistical performance is one of the primary opportunity areas where organizations participating in an integrated SCM initiative can make significant improvements. Logistical management is vital not only to manufacturing and assembly industries, which are goods-oriented, but also to retailing, transport, and other distribution or service–oriented industries. Due to intensive competition in global markets, logistical management is considered an important source of competitive advantage. David Gertz, the author of "Grow to Be Great: Breaking the Downsizing Cycle", says, "Supply chain and logistics are critical components of any successful growth strategy [25]".

International considerations

Relative to domestic supply chains, international supply chains often entail (1) greater geographic distances and time differences, (2) multiple national markets, (3) multiple national operations locations, and (4) greater opportunities because of diversity of supply and demand conditions. There are also additional costs associated with global supply chains. Major costs categories for a global supply chain include:

1. Manufacturing costs – purchased materials, labor, equipment charge, and supplier's margin;

2. Movement costs – transportation cost, inventory in pipeline and safety costs, and duty;
3. Incentive costs and subsidies – taxes and subsidies;
4. Intangible costs – quality costs, product adaptation or performance costs, and coordination;
5. Overhead costs – total current landed costs;
6. Sensitivity to long-term costs – productivity and wage changes, exchange rate changes, product design, and core competence.

The supply chain operations reference model (SCOR)

In November, 1996, Supply Chain Council introduced a Supply Chain Operations Reference (SCOR) model for supply chain process improvement planning, implementation, and management. This model has defined common supply chain management processes, matched these processes against "best practice" examples, and benchmarked performance data as well as optimal software applications with the end results. This model is also a tool for (1) measuring both supply chain performance and the effectiveness of supply chain reengineering, as well as (2) testing and planning for future process improvement [26].

The Importance of Time

Individual organizations and supply chain organizations must be competitive in the areas of cost, quality, delivery, and technology and be able to get their products and services to their customers faster than the competition. Hence, organizations are realizing that they are competing on the basis of time. Reducing the time required to provide the end customer with products and services is one of the major forces that is leading organizations to participate in supply chain management initiatives. Adopting an integrated supply chain management approach provides the means to make significant reductions in the cycle-time required to move materials between supply chain members and to the end customers. Time has also been shown by several authors to be a highly effective area to focus overall improvement efforts within an individual organization [27].

The "balanced scorecard" approach to supply chain performance measurement

The supply chain management requires that the member organizations have a means to assess the performance of the overall supply chain to meet the requirements of

the end customer. In addition, it is necessary to be able to assess the relative contribution of the individual member organizations within the supply chain. This requires a performance measurement system that can not only operate at several different levels but also link or integrate the efforts of these different levels to meeting the objectives of the supply chain. In their 1996 work, *The Balanced Scorecard: Translating Strategy into Action* [28], Kaplan and Norton present an approach that holds great promise for supply chain performance measurement. The "balanced scorecard" approach incorporates both financial and operating performance measures that are used at all levels of the supply chain. In an interorganizational supply chain environment, the supply chain level represents the starting point for the balanced scorecard.

2.3.3 COORDINATION AND SUPPLY CHAIN RELATIONSHIPS

Supply chain coordination improves if all stages of the chain take actions that together increase total supply chain profits. Supply chain coordination requires each stage of the supply chain to take into account the impact its actions have on other stages.

Lack of coordination leads to a degradation of responsiveness and an increase in cost within a supply chain. There are various obstacles that lead to this lack of coordination and acerbate variability through the supply chain. Supply chain coordination improves if all stages of the chain take actions that together increase total supply chain profits. Supply Chain coordination requires each stage of the supply chain to take into account the impact its actions have on other stages.

A lack of coordination occurs either because different stages of the supply chain have objectives that conflict or because information moving between stages gets delayed and distorted. Different stages of a supply chain may have objectives that conflict if each stage has a different owner. As a result, each stage tries to maximize its own profits, resulting in actions that often diminish total supply chain profits. The fundamental challenge today is for supply chains to achieve coordination or developing and maintaining supply chain relationship in spite of multiple ownership and increased product variability.

Developing and Maintaining Supply Chain Relationships

The implementation of a truly integrated supply chain, organizations are continually faced with the challenge of managing the "people" part of the equation. Figure 2.3 shows relationship management model.

Relationship management affects all areas of the supply chain and has a dramatic impact on performance. In many cases, the information systems and technology required for the supply chain management effort are readily available and can be implemented within a relatively short time period, barring major technical mishaps. In addition, the inventory and transportation management systems are also quite well understood and can be implemented fairly readily. A number of supply chain initiatives fail, however, due to poor communication of expectations and the resulting behaviors that occur. Managers often assume that managing the personal relationships within and between organizations in a supply chain will automatically "fall into place" once the inventory and information system are established. However, the management of inter personal relationships between the different people in the organizations is often the most difficult part of the SCM initiative. Moreover, the singe most important ingredient for successful supply chain management may well a *trusting relationship* between partners in the supply chain, where each party in the chain has mutual confidence in the other members' capabilities and actions. Without a good relationship, all of the other systems (information system, inventory, contacts, etc.) cannot function effectively.

The role of solid relationships in supply chain management, we will emphasize that the trust-building process is an element that must continually be managed at all times. One of the most important rules to remember is that trust grows with use and disappears when not used.

In the early stages of supply chain development, organizations will often eliminate those suppliers or customers that are clearly not suitable, because they do not have the capabilities to serve the organization, are too distant, are not well aligned with the company, or are simply not interested in developing a relationship. After these firms are eliminated from consideration, organizations may occasionally encounter a supply chain member that is willing to put forth the time and effort required to create a strong relationship. In such cases, firms may consider developing a special type of supply chain relationship in which confidential information is shared, assets are invested in joint projects, and significant joint improvements are perused. These types of interorganizational relationships are sometimes called *strategic alliance*. A strategic alliance is a process wherein participants willingly modify basic business practices to reduce duplication and waste while facilitating improved performance [29]. Strategic

alliance improves efficiency and effectiveness by eliminating waste and duplication in the supply chain. However, many firms lack of guidelines to develop, implement, and maintain supply chain alliances. This chapter discusses a process developed by case researchers that organizations can use to improve supply chain relationships and that, in the longer run, leads to the development of successful strategic supply chain alliances.

Developing A Trusting Relationship With Partners In The Supply Chain

Trust is not something that can be easily measured or identified. Especially in the early stages of a supply chain relationship, partners must trust not only one another but also other members higher or lower up in the supply chain. A number of studies have been carried out on the types of action and behaviors that lead to trusting relationships between individuals, and this has enabled researchers to develop a "taxonomy" of different types of trusts [30].

The major types of trust are as follows:

- Reliability
- Competence
- Affect-Based Trust ("Goodwill")
- Vulnerability
- Loyalty

Resolving Conflicts in a Supply Chain Relationship

All contracts, no matter how carefully worded and prepared, can be subject to some form of dispute or disagreement between the parties. At is virtually impossible to negotiate a contract that anticipates very potential source of disagreement between two parties in a supply chain. Generally speaking, the more complex the nature of the contract and the greater the dollar amounts involved, the more likely it is that a future dispute over interpretation of the terms and conditions will occur. Supply chain managers must, therefore, attempt to envision the potential for such conflicts and prepare appropriate conflict resolution mechanisms to deal with such problems should they arise.

The traditional mechanism for resolving contract disputes is grounded in commercial law, which provides a legal jurisdiction in which an impartial judge can bear the facts of the case at hand and render a decision in favor of one party or the other. Due to uncertainty, cost and length of time required to adjudicate a dispute, most

organizations prefer to avoid the problems associated with litigation and deal with the situation in other ways. Taking a dispute into the jurisprudence system should be viewed as a last resort, not an automatic step in resolving contractual disputes.

There are deferent forms of conflict resolution among which major two are discussed in the following:

1. **Legal alternatives**

   New methods of settling supply chain disputes have evolved in the last several years. These techniques, although diverse in form of nature, have a number of similar characteristics [31], as follows:

   - They all exists somewhere between the polar alternatives of doing nothing or of escalating conflict.
   - They are less formal and generally more private than ritualized court battles.
   - They permit people with disputes to have more active participation and more control over the processes for solving their own problems than traditional methods of dealing with conflict.
   - Almost all of the new methods have been developed in the private sector, although courts and administrative agencies have begun to borrow and adapt some of the more successful techniques.

2. **Arbitration**

   The use of an outside arbitrator or third party, to help settle contractual disputes is the faster-growing method of conflict resolution among contracting parties, all over the world.

2.4 APPLICATION OF SUPPLY CHAIN MANAGEMENT SYSTEM IN AN ORGANIZATION.

Position of an Organization in a Supply Chain

For application of supply chain management system in an organization, the first requirement is to know the exact position of the organization in a particular supply chain. Every business organization is a part of at least one supply chain and many are part of multiple supply chains. Often the number and type of organizations in a supply chain are determined by whether the supply chain is manufacturing or service oriented.

A supply chain is a sequence of organizations-their facilities, functions and activities-that are involved in producing delivering a product or service. The sequence begins with basic suppliers of raw materials and extends all the way to the final customer. Facilities include warehouses, factories, processing centers, distribution centers, retail outlets, and offices. Functions and activities include forecasting, purchasing, inventory management, information management, quality assurance, scheduling production, distribution, delivery and customer service. There are two kinds of movement in these systems: the physical movement of material, generally in the direction of the end of the chain (although not all material starts at the beginning of the chain), and exchange of information, which moves in both directions along the chain.

Supply chains are sometimes referred to as value chains a term that reflects the concept that value is added as goods and services progress through the chain. Supply or value chains are typically comprised of separate business organizations, rather than just a singer organization. Moreover, the supply or value chain has two components for each organization: a supply component and a demand component. The supply component starts at the beginning of the chain and ends with the internal operations of the organization. The demand component of the chain starts at the point where the organization's output is delivered to its immediate customer and ends with the final customer in the chain. The demand chain is the sales and distribution portion of the value chain. The length of each component depends on where a particular organization is in the chain; the closer the organization is to the final customer, the shorter its demand component and the longer its supply component.

All organizations, regardless of where they are in the chain, must deal with supply and demand issues. The goal of supply chain management is to link all components of the supply chain so that market demand is met as efficiently as possible across the entire chain. This requires matching supply and demand at each stage of the chain. Note that except for the beginning supplier(s) and the final customer(s), the organization in a supply chain are both customers and suppliers.

2.5 NEED FOR SUPPLY CHAIN MANAGEMENT IN AN ORGANIZATION

In the past, most organizations did little to manage their supply chains. Instead, they tended to concentrate on their own operations and on their immediate suppliers. However, a number of factors make it desirable for business organizations to actively manage their supply chains. The major factors are

1. **The Need to Improve Operations:** During the last decade, many organizations adopted practices such as lean production and TQM. As a result, they were able to achieve improved quality while wringing much of the excess costs out of their systems. Although there is still room for improvement, for many organizations, the major gains have been realized. Opportunity now lies largely with procurement, distribution, and logistics—the supply chain.

2. **Increasing Levels of Outsourcing:** Organizations are increasing their levels of outsourcing, buying goods or services instead of producing or providing them themselves. As outsourcing increases, organizations are spending increasing amounts on supply-related activities (wrapping, packaging, moving, loading, and unloading, and storing). A significant amount of the cost and time spent on these and other related activities may by unnecessary.

3. **Increasing Transportation Costs:** Transportation costs are increasing, and they need to be more carefully managed.

4. **Competitive Pressures:** competitive pressures have led to an increasing number of new products, shorter product development cycles, and increased demand for customization. And in some industries, most notably consumer electronics, product life cycles are relatively short. Added to this are adoption of quick-response strategies and efforts to reduce lead times.

5. **Increasing globalization:** Increasing globalization has expanded the physical length of supply chains. A global supply chain increases the challenges of managing a supply chain. Having far-flung customers and/or suppliers means longer lead times and greater opportunities for disruption of deliveries. Often currency differences and monetary fluctuations are factors, as well as language and cultural differences.

6. **Increasing Importance of E-Commerce:** The increasing importance of e-commerce has added new dimensions to business buying and selling and has presented new challenges.

7. **The complexity of supply chains:** Supply Chains are complex; they are dynamic, and they have many inherent uncertainties that can adversely affect the

supply chain, such as inaccurate forecasts, late deliveries, substandard quality, equipment breakdowns, and cancelled or changed orders.

8. **The need to manage inventories:** Inventories play a major role in the success or failure of a supply chain, so it is important to coordinate inventory levels throughout a supply chain. Shortages can severely disrupt the timely flow of work and have far-reaching impacts, while excess inventories add unnecessary costs. It would not be unusual to find inventory shortages in some parts of a supply chain and excess inventories in other parts of the same supply chain. Another very important inventory phenomenon that can occur without good supply chain management is the ***bullwhip effect:*** Inventory stockpiles become progressively larger looking backward through the chain from the final customer towards the beginning of the supply chain. The bullwhip effect increases inventory costs and, hence, final costs.

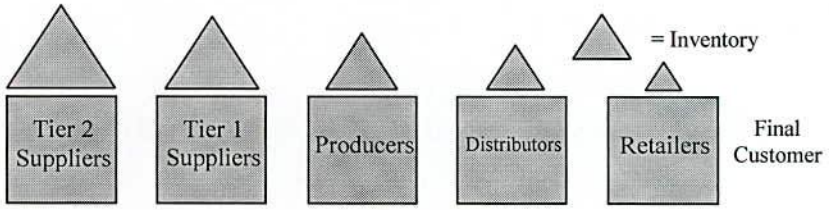


FIGURE: 2.5 The bullwhip effect on supply chain inventories.

Benefits of an Organization from Application of Supply Chain Management

Application of effective supply chain management in an organization offers numerous benefits.

Generally, benefits of effective supply chain management include lower inventories, lower costs, higher productivity, greater agility, shorted lead times, higher profits, and greater customer loyalty.

Elements of supply chain management in an organization

Supply chain management involves coordination activities across the supply chain of the organization. Central to this is taking customer demand and translating it into corresponding activities at each level of the supply chain.

The first element, customers, is the driving element. Typically, marketing is reasonable for determining what customers want as well as forecasting the quantities

and timing of customer demand. Product and service design must match customer wants with operations capabilities.

The key elements of the supply chain management are listed in Table 2.5

Table 2.5
Elements of supply chain management

Element	*Typical Issue*
Customers	• Determining what products and/or services customers want.
Forecasting	• Predicting the quantity and timing of customer demand.
Design	• Incorporating customers, wants, manufacturability, and time to market.
Capacity planning	• Matching supply and demand.
Processing	• Controlling quality, scheduling work.
Inventory	• Meeting demand requirements while managing the costs of holding inventory.
Purchasing	• Evaluating potential suppliers, supporting the needs of operations on purchased goods and services.
Suppliers	• Monitoring supplier quality, on-time delivery, and flexibility; maintaining supplier relations.
Location	• Determining the location of facilities.
Position	• Determining the actual position of the organization in the supply chain.
Logistics	• Deciding how to best move information and materials.

Processing occurs in each component of the supply chain; it is the core of each organization. The major portion of processing occurs in the organization that produces the product or service for the final customer (the organization that assembles the computer, services the car, etc.). A major aspect of this for both the internal and external portions of a supply chain is scheduling.

Inventory is a staple in most supply chains. Balance is the main objective; too little causes delays and disrupts schedules, but too much adds unnecessary costs and limits flexibility.

Purchasing is the link between an organization and its suppliers. It is responsible for obtaining goods and/or services that will be used to produce products or provide services for the organization's customers. Purchasing selects suppliers, negotiates contracts, establishes alliances, and acts as liaison between suppliers and various internal departments.

The supply portion of a value chain is made up of one or more suppliers, all links in the chain, and each one capable of having an impact on the effectiveness— or the ineffectiveness— of the supply chain. Moreover, it is essential that the planning and execution be carefully coordinated between suppliers and all members of the demand portion of their chains.

Location can be a factor in number of ways. Where suppliers are located can be important, as can location of processing facilities. Nearness to market, or nearness to sources of supply, or nearness to both may be critical. Also, delivery time and cost are usually affected by location.

Position is also a factor for the proper running of the chain. Position in the upstream of chain is not very important to final user and involvement with large amount of inventory according to bullwhip effect. On the other hand position closer to final customer has shorter demand component and longer supply component and involvement if inventory is not so large as compared with upstream positioning.

Logistics refers to the movement of materials and information in a supply chain. For materials and work in process, there are support items such as fuels, equipment, parts, tools, lubricants, office suppliers, and mere. Logistics includes movement within a facility, overseeing incoming and outgoing shipments of goods and materials, and information flow throughout supply chain.

Optimizing the supply chain

Optimizing the supply chain means maximizing shareholder and customer value. This is achieved by fully integrating all members of the supply chain, collaboratively balancing resources of chain members, and optimizing the flow of goods, services, and information from source to end customer. To do this, it is necessary to maximize the velocity of information and minimize response time [6].

2.6 INVENTORY-RELATED COSTS

There are four basic and two composite costs, which are related with inventories:

Basic Costs	*Composite Costs*
1. Purchase cost (C_B)	5. Total cost (TC)
2. Holding cost (C_H)	6. Total Incremental cost (TIC)
3. Ordering cost (C_R)	
4. Shortage cost (C_S)	

When purchase cost is constant (without having no purchase discount) regardless of how much to order, then it is simpler to consider the total incremental inventory cost. The three basic costs are associated with inventories are:

1. Holding or Carrying cost (C_H)
2. Ordering or Replenishment cost (C_R)
3. Shortage cost (C_S)

1. Purchase Cost (C_B)

If the price per unite b is the same regardless of the size of the order Q and the demand is D, the purchase cost is

$$C_B = b.D$$

$$\text{or,} \left[\begin{matrix}\text{Purchase}\\ \text{cost}\end{matrix}\right] = \left[\begin{matrix}\text{Price per}\\ \text{unit}\end{matrix}\right]\left[\begin{matrix}\text{Demand per}\\ \text{unit time}\end{matrix}\right] \qquad \text{(Eqn. 2.6-1.1)}$$

However, some suppliers offer discounts for large orders to encourage their customers to buy in greater amounts. Here, the price, which depends on the lot size Q, becomes smaller as Q exceeds certain values. The purchase cost now is variable and depends on the inventory decision of how much to order [7]. Thus,

$$C_B = b(Q).D$$

$$\text{or,} \left[\begin{matrix}\text{Purchase}\\ \text{cost}\end{matrix}\right] = \left[\begin{matrix}\text{Price per unit when}\\ \text{lot size is Q}\end{matrix}\right]\left[\begin{matrix}\text{Demand per}\\ \text{unit time}\end{matrix}\right] \qquad \text{(Eqn. 2.6-1.2)}$$

2. Holding Cost (C_H)

Holding cost relates to physically having item in storage. This cost is associated with carrying surplus inventory.

$$\text{Holding cost } (C_H) = \left[\begin{matrix}\text{Cost of holding}\\ \text{1 unit per unit time}\end{matrix}\right]\left[\begin{matrix}\text{Avarage amount of surplas}\\ \text{inventory held per unit time}\end{matrix}\right] \qquad \text{(Eqn. 2.6-2)}$$

The average amount of surplus inventory held per unit (generally year or month) is determined as follows:

$$\left[\begin{matrix}\text{Avarage amount of}\\ \text{surplas inventory}\end{matrix}\right] = \frac{\left(\begin{matrix}\text{Maximum surplus}\\ \text{during cycle}\end{matrix}\right) + \left(\begin{matrix}\text{Minimum surplus}\\ \text{during cycle}\end{matrix}\right)}{2}\left[\begin{matrix}\text{Precentage of cycle}\\ \text{time surplus exists}\end{matrix}\right]$$

Holding cost includes interest, insurance, taxes (in some cases), depreciation, obsolescence, deterioration, spoilage, pilferage, breakage, and warehousing costs (heat,

light, rent, security). It also includes opportunity costs associated with having funds that could be used elsewhere tide up in inventory. Note that it is the variable portion of this cost that is pertinent.

The significance of the various components of holding cost depends on the type of item involve, although taxes, interest, and insurance are generally based on the dollar value of an inventory. Items that are easily concealed (e.g., pocket cameras, transistor radios, calculators) or fairly expensive (cars, TVs) are prone to theft. Fresh seafood, meats and poultry, produce, and backed goods are subject to rapid deterioration and spoilage. Diary products, salad dressings, medicines, batteries, and film also have limited shelf lives.

Holding cost is stated in either of the two ways:

1. As percentage of unite price
2. As a dollar amount per unit

Typically annual holding cost range from 20 percent to 40 percent of the value of an Item [6]. Any inventory holding cost less than 15 percent is susceptible [5 & 8].

3. Ordering Cost (C_R)

Ordering cost relates to the cost of ordering and receiving inventory. This is the cost that varies with the actual placement of order. Besides shipping cost, it includes determining how much is needed, preparing invoices, shipping cost, inspecting goods upon arrival for quality and quantity, and moving the goods to temporary storage. Ordering cost is generally expressed as fixed dollar amount per order, regardless of order size.

When a firm produces its own inventory instead of ordering it from a supplier, the costs of machine setup (e.g., preparing equipment for the job by adjusting the machine, changing cutting tools) are analogous to ordering costs; that is, they are expressed as a fixed charge per production run, regardless the size of the run [6].

$$\text{Ordering cost } (C_R) = \begin{bmatrix} \text{Cost per order or} \\ \text{per setup} \end{bmatrix} \begin{bmatrix} \text{Average number of orders} \\ \text{or setups per unit time} \end{bmatrix} \qquad \text{(Eqn. 2.6-3)}$$

4. Shortage Cost (C_S)

Shortage cost results when demand exceeds the supply of inventory on hand. This cost can include the opportunity cost of not making a sale, loss of customer

goodwill, late charges, and similar costs. Furthermore, if the shortage occurs in an item carried for internal use (e.g., to supply an assembly line), the cost of lost production or downtime is considered a shortage cost. Such cost can easily run into hundreds of dollars a minute or more. Shortage cost is sometimes difficult to measure, and they may be subjectively estimated [6].

$$\text{Shortage cost } (C_S) = \begin{bmatrix} \text{Cost of being short} \\ \text{1 unit per unit time} \end{bmatrix} \begin{bmatrix} \text{Average amount of shortage} \\ \text{per unit time} \end{bmatrix} \qquad \text{(Eqn. 2.6-4)}$$

The average amount of shortages per unit time is determined in the same manner as the average surplus inventory earlier. Thus,

$$\begin{bmatrix} \text{Average shortage} \\ \text{inventory} \end{bmatrix} = \frac{\begin{pmatrix} \text{Maximum shortage} \\ \text{during cycle} \end{pmatrix} + \begin{pmatrix} \text{Minimum shortage} \\ \text{during cycle} \end{pmatrix}}{2} \begin{bmatrix} \text{Percentage of cycle} \\ \text{time shortages exist} \end{bmatrix}$$

5. Total Cost (TC) of Inventory

When the price per unit depends on the lot size Q. it is important to determine an inventory policy that takes in to account the purchased cost of the item held in stock. Here we wish to minimize total cost of inventory [7]. Here,

$$TC = b\,(Q).D + C_R + C_H + C_S$$

$$\text{or, } \begin{bmatrix} \text{Total cost of} \\ \text{inventory} \end{bmatrix} = \begin{bmatrix} \text{Purchase} \\ \text{cost} \end{bmatrix} + \begin{bmatrix} \text{Ordering} \\ \text{cost} \end{bmatrix} + \begin{bmatrix} \text{Holding} \\ \text{cost} \end{bmatrix} + \begin{bmatrix} \text{Shortage} \\ \text{cost} \end{bmatrix} \qquad \text{(Eqn. 2.6-5)}$$

6. Total Incremental Cost (TIC) of Inventory

When no price discounts are offered, the purchase cost remains constant regardless of how we decide on when, and how much to order. Here it is simpler to consider the total incremental cost of inventory, which includes only those basic costs which are affected by the inventory decisions [7]. Thus

$$TIC = C_R + C_H + C_S$$

$$\text{or, } \begin{bmatrix} \text{Total incremental} \\ \text{cost of inventory} \end{bmatrix} = \begin{bmatrix} \text{Ordering} \\ \text{cost} \end{bmatrix} + \begin{bmatrix} \text{Holding} \\ \text{cost} \end{bmatrix} + \begin{bmatrix} \text{Shortage} \\ \text{cost} \end{bmatrix} \qquad \text{(Eqn. 2.6-6.1)}$$

Shortage cost is sometimes difficult to measure, and this may be estimated. So, for general conventional use, this cost dose not come into account. Therefore,

$$TIC = C_H + C_R$$

$$\text{or, } \begin{bmatrix}\text{Total incremental}\\ \text{cost of inventory}\end{bmatrix} = \begin{bmatrix}\text{Ordering}\\ \text{cost}\end{bmatrix} + \begin{bmatrix}\text{Holding}\\ \text{cost}\end{bmatrix} \qquad \text{(Eqn. 2.6-6.2)}$$

2.7 DETERMINATION OF ECONOMIC ORDER QUANTITY (EOQ)

The basic EOQ model is used to identify a fixed order size that will minimize the total incremental cost (TIC) which is sum of the annual cost of holding inventory and ordering inventory. The unit purchase price of items in inventory is not generally included in the TIC because the unit cost is unaffected by the order size unless quantity discount is a factor. If holding cost is specified as a percentage of unit cost, then unit cost is indirectly included in the TIC as a part of holding cost.

The basic model involves a number of assumptions given below:

1. Only one product is involved
2. Annual demand requirement is known
3. Demand is spread evenly throughout the year so that the demand rate is reasonably constant
4. Lead time does not vary
5. Each order is received in a single delivery
6. There is no quantity discount

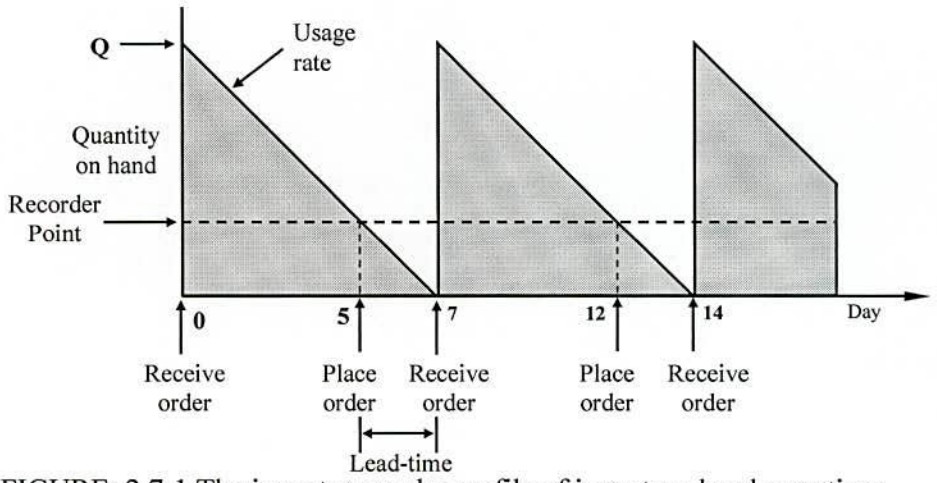


FIGURE: 2.7-1 The inventory cycle: profile of inventory level over time

Inventory ordering and usage occur in cycles. Figure 2.7-2 illustrates several inventory cycles. A cycle begins with receipt of an order of Q units, which are withdrawn at a constant rate over time. When the quantity on hand is just sufficient to satisfy demand during lead time, an order for Q unit is submitted to the supplier. Because it is assumed that both the usage rate and the lead time do not vary, the order

will be received at the precise instant that the inventory on hand falls to zero. Thus, orders are timed to avoid both excess stock and stockouts (i.e., running out of stock).

The optimal order quantity reflects a balance between carrying cost and ordering cost: As order size varies, one type of cost will increase while the other decreases. For example, if the order size is relatively small, the average inventory will be low, resulting in low carrying cost. However, a small order size will necessitate frequent orders, which will drive up annual ordering cost. Conversely, ordering large quantities at infrequent intervals can hold down annual ordering cost, but that would result in higher average inventory levels and therefore increased carrying cost. Figure 2.7-2 illustrates these two extremes.

Thus, the ideal solution is an order size that causes neither a few very large orders nor many small orders, but one that lies somewhere between. The exact amount to order will depend on the relative magnitudes of carrying and ordering costs.

Annual carrying cost is computed by multiplying the average inventory on hand by the cost to carry one unit for one year, even though any given unit would not necessarily be held for a year. The average inventory is simply half of the order quantity: The amount on hand decreases steadily from Q units to 0, for an average of

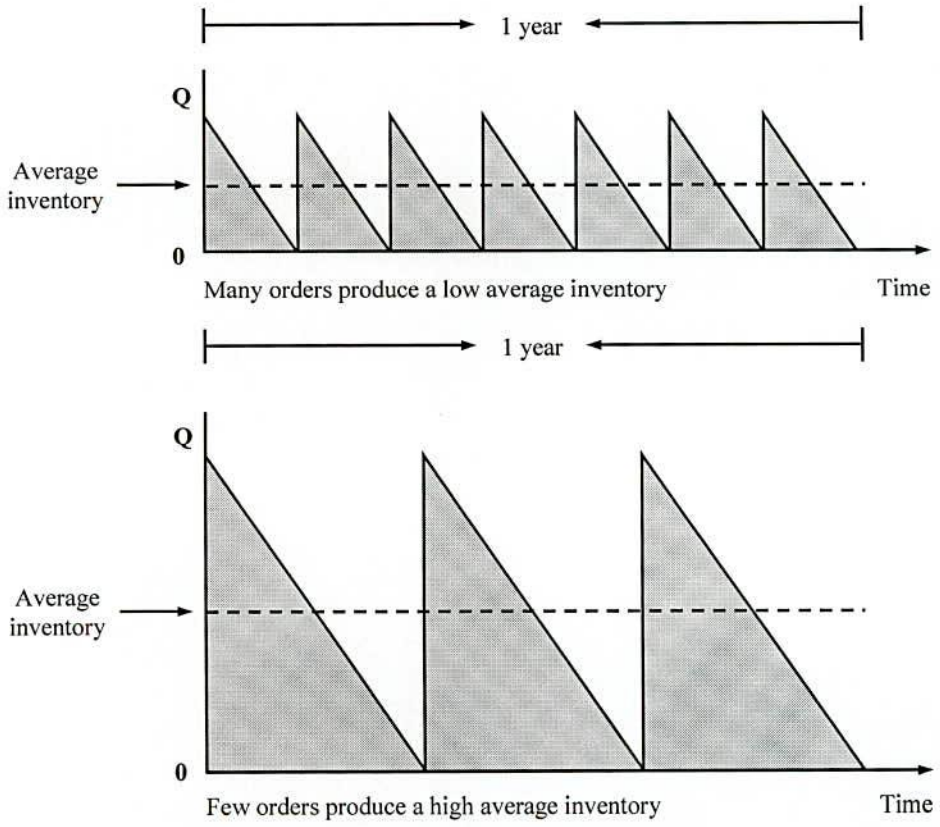


Figure: 2.7-2 Average inventory level and number of orders per year are inversely related: as one increases, the other decreases.

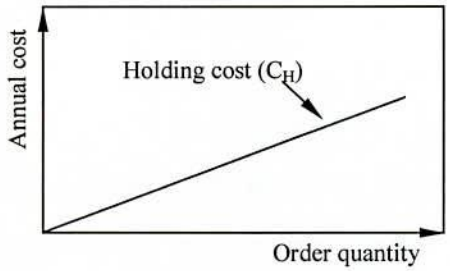
(Q + 0)/2, or Q/2. Using the symbol C_H to represent the average annual holding (carrying) cost per unit, the total annual holding cost is

$$\text{Annual holding cost} = \left(\frac{Q}{2}\right) C_H$$

where, Q = Order quantity in units

C_H = Holding (carrying) cost per unit

Holding cost is thus a linear function of Q: Holding cost increases or decreases in direct proportion to changes in the order quantity of Q, as illustrated in Figure 2.7-3



FIGUER: 2.7-3 Holding cost is linearly related to order size.

On the other hand, annual ordering cost will decreases as order size increases because, for a given annual demand, the large order size, the fewer the number of orders needed. In general, the number of orders per year will be D/Q, where D = Annual demand and Q = Order size. Unlike holding cost, ordering cost is relatively insensitive to order size; regardless of the amount of an order, certain activities must be done, such as determining how much is needed, periodically evaluating sources of supply, and preparing the invoice. Even inspection of shipment to verify quality and quantity characteristics is not strongly influenced by order size since large shipments are sampled rather than completely inspected. Hence, ordering cost is treated as a constant. Annual ordering cost is a function of the number of orders per year and the ordering cost per order:

$$\text{Annual ordering cost} = \frac{D}{Q} C_R$$

Where, D = Demand, usually in units per year

C_R= Ordering cost

Because the number of orders per year, D/Q, decreases as Q increases, annual ordering cost is inversely related to order size, as Figure 2.7-4 illustrates.

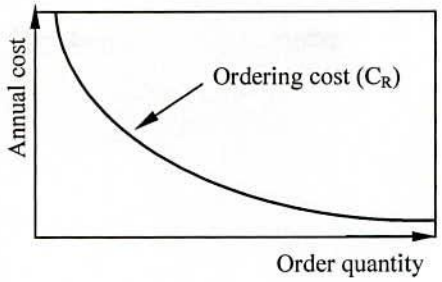


FIGURE: 2.7-4 Ordering cost is inversely and nonlinearly related to order size.

The annual TIC associated with holding (carrying) and ordering inventory when Q units are ordered each time is

TIC = Annual carrying cost + Annual ordering cost

$$= \frac{Q}{2} C_H + \frac{D}{Q} C_R \qquad \text{[Eqn. 2.7-1]}$$

(Note that D and C_H must be in the same units, e.g., months, years). Figure 2.7-5 reveals that the TIC curve is U-shaped (i.e., convex, with one minimum) and that is reaches its minimum at the quantity where holding and ordering costs are equal.

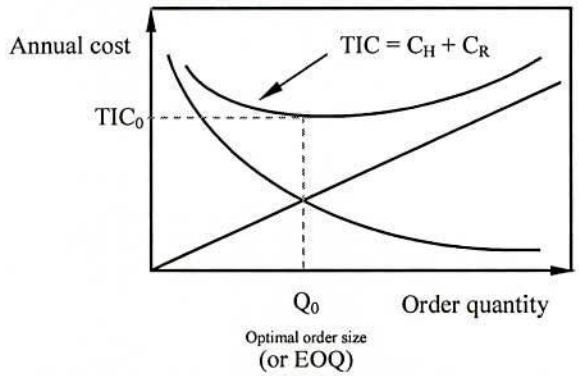


FIGURE: 2.7-5 The total incremental cost curve is U-shaped

An expression for the optimal order quantity Q_0, can be obtained by using calculus. We can find the minimum point of TIC curve by differentiating TIC with respect to Q, setting the result equal to zero, and solving for Q. Thus

$$\frac{d}{dQ}(\text{TIC}) = \frac{d}{dQ}\left(\frac{Q}{2}C_H + \frac{D}{Q}C_R\right) = \frac{C_H}{2} - \frac{C_R D}{Q^2}$$

$$\Rightarrow 0 = \frac{C_H}{2} - \frac{C_R D}{Q^2}$$

$$\Rightarrow Q^2 = \frac{2C_R D}{C_H}$$

$$\Rightarrow Q_0 = \sqrt{\frac{2C_R D}{C_H}} \qquad \text{[Eqn. 2.7-2]}$$

Note that the second derivative is positive, which indicates a minimum has been obtained.

Thus given annual demand, the ordering cost per order, and the annual holding cost per unit, one can compute the optimal economic order quantity (EOQ). The minimum TIC is then found by substituting Q_0 for Q in Eqn. 2.7-1.

Again, annual total cost (TC) of an inventory is the sum of all three costs and given as follows:

Annual total cost (TC) of an inventory = Annual cost of material purchased
+ Annual order cost for the lots ordered
+ Annual cost of holding inventory
$= b(Q).\ D + C_R + C_H$

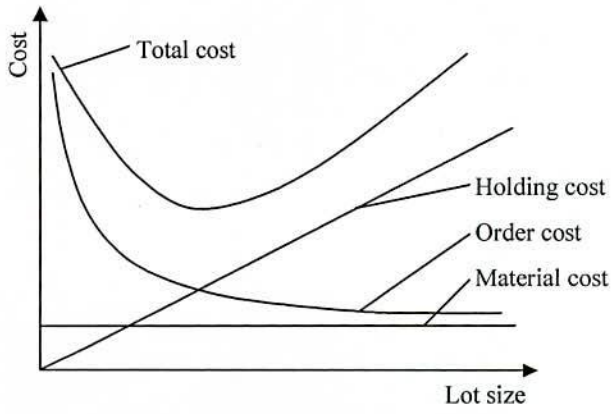


FIGURE: 2.7-6 Effect of lot size on costs

Finally, Figure 2.7-6 shows the variation in different costs as the lot size is changed.

DETERMINATION OF SAFETY STOCK SIZE FOR SPECIFIED SERVICE LEVEL.

Definition:

Safety stock is the amount of extra inventory needed to satisfy maximum reasonable demand for a given service level during the lead time.

The following discussion concerns the determination of safety stocks in a fixed order-quantity inventory system with constant lead time. This is similar in operation to the system assumed in the EOQ model. In that, when the inventory level drops to the reorder point, an order of fixed quantity is placed. With average demand during the lead time the inventory reaches zero, at which time the new order arrives.

In such a system when actual demand during the lead time exceeds expected demand, there will be a stockout. Without safety stocks shortages are likely to occur 50 percent of the time, and so the objective in using safety stocks is to reduce the risk o shortages from 50 percent to a more reasonable level, say 5 or 10 percent. Note that *in a fixed-order-quantity system the lead time is the only time the system is vulnerable to stockouts.*

Let $\bar{D}$ = average demand rate per unit time (usually a year)

D_{max} = maximum reasonable demand rate per unit time

L = supply lead time, days

$\bar{x}$ = average demand during lead time = $D \times L$

x_{max} = maximum reasonable demand during lead time for given service level

$= D_{max} \times L$

B_{FOQ} = safety stock in fixed-order-quantity system

Thus,

$$B_{FOQ} = x_{max} - \bar{x}$$

or $$B_{FOQ} = D_{max} \times L - D \times L = (D_{max} - D)(L)$$

where if x_i occurs with a frequency $p(x_i)$ ($I = 1, 2, \ldots, n$), then

$$\bar{x} = x_1 [p(x_1)] + x_2 [p(x_2)] + \ldots + x_n [p(x_n)]$$

Decision Rule

In a fixed-order-quantity system with lead time longer than the reorder cycle time ($L>t$) an order of a fixed amount Q is placed when the amount of inventory on hand plus the amount (s) ordered but not yet received reach the reorder point R.

In the FOQ system, where an order is triggered when the inventory level reaches a reorder point, it is essential to maintain a perpetual inventory record. This requirement for high visibility of inventory levels can be handled by maintaining inventory status

cards. As the number of items handled may reach several thousand, the need for electronic data processing becomes imperative.

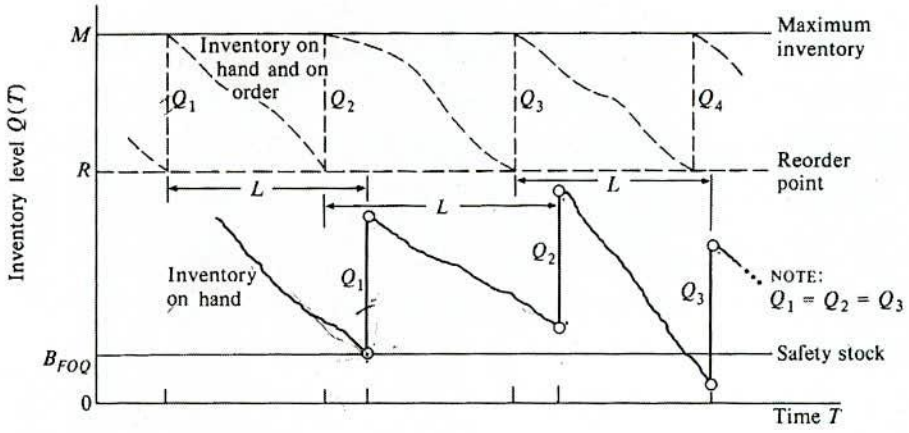


Figure: 2.8 Inventory functions in a fixed-order-quantity system with lead time exceeding the reorder cycle time.

A rather widely used approach for maintaining the equivalent of a perpetual inventory record is the so-called *two-bin system.* Here each item is segregate in a container with two bins. Demand is met from the first bin until its contents are depleted. This corresponds to reaching the reorder point, at which time an order for a fixed amount is placed. Further demand is met from units in the second bin, which contains enough to cover average demand during the lead time plus the safety stock. When the quantity ordered arrives, it is used to bring the amount in the second bin up to reorder point and the balance is then placed in the first bin. The two-bin system in practice has turned out to be an effective and economical method, especially in organizations where it is not feasible to convert to computerized inventory control.

CHAPTER -3

METHODOLOGY

3.1 LOCAL MANUFACTURING COMPANY UNDER STUDY

At the present time supply chain is very important for any manufacturing company for its best services to the customers and its profitability enhancement. But Bangladesh Cable Shilpa Limited (BCSL), the company under this study, is not that much aware regarding introduction of supply chain concept in the company. Now, it is important to know the company as a whole first. BCSL is the only unavoidable company of the supply chain in cable sector of Bangladesh telecommunication and very close to its final customers. It runs with the concept that value is added as imported raw materials progress through its internal production system. Hence, there is a great scope to improve the profitability of the company with the existing facilities through implementation of supply chain management. At the present situation among the four supply chain drives, inventory is the most important one for BCSL supply chain. Since inception BCSL imports 100% production raw materials because of non-availability in the country. Hence material import is an important criterion here. On the other hand BCSL imports raw materials depending on its conventional experience and practice. In this condition economic lot sizing of imported materials is an important factor for BCSL. For economic lot sizing of imported materials, proper data collection and necessary calculation are the demanded issues. Furthermore, application of integrated supply chain model in BSCL will also increase proper functioning and profitability of the organization.

3.2 COMPANY PROFILE

CSL is a local telecommunication cable manufacturing company which manufactures and supplies different types of cables (for local network, for subscriber lines, and for installation of telephone exchanges of present technology). It is situated on the bank of the river Bhairab in Shiromoni industrial area about 15 kilometers north from khulna city. BCSL was established in the year 1967 under the joint collaboration of the then government of Pakistan and M/S Siemens A.G., West Germany. It is a government owned private limited company. It has been planned to produce cables as per VDE (Association of German Electrical Engineers) specification but cables with other specifications can also be manufactured.

BCSL is implementing its production schedule in three steps and has increased the production capacity up to 12,00,000 conductor kilometers (c.Km.) or 6,00,000 pair kilometers per annum with internationally accepted quality. BCSL is meeting the entire demand of Bangladesh Telegraph and Telephone Board (BTTB) and other agencies in Bangladesh and thereby playing a vital role to the national economy. Besides, meeting local demand, it is also exporting its cables to Pakistan, Kuwait, Syria, Russia etc. and earning valuable foreign exchange for the country.

Strength of BCSL

- Producer of exclusive telecommunication cables.
- Strong Government support for marketing of telecommunication cables.
- Many foreign contractors use BCSL's cables for various projects in side the country.
- Expert engineer's trained in European countries are engaged for production.
- Quality testing method meets international standard.
- Longevity of cables meets international standard.

Outstanding Features of the Product

1. Cable with high purity copper (99.9%)
2. High grade insulating and sheathing materials
3. Clear core make up for decade units.
4. Color and ring code for wire identification.
5. Moisture barrier laminated sheath with aluminium tape and extra polyethylene.
6. Extra reliability for core filling and plain steel tape armouring.
7. Strict adherence to electrical parameters.

Product Range

A. For local Network

1. Solid annealed bare copper wire, cellular solid polyethylene (foam-skin) or high density polyethylene for conductor insulation. Pair or Quad type twisted, unit stranded, jelly filled laminated sheath conduit cable (CC-J) and with extra protection of steel tape armouring buried cable jelly filled armoured (BC-JA).

2. Self supporting aerial cables for stringing along poles carrying telephone and low voltage overhead lines.

B. For Connection to Subscriber's Line

1. PE or PVC insulated subscriber lines (drop wire and house wire).
2. PVC insulated and PVC sheathed insulation cable (TIP).

The Factory Layout Showing Facilities

The factory layout is the type of process layout where production machines are arranged according to requirement of process flow. Figure 3.2A shows the factory layout.

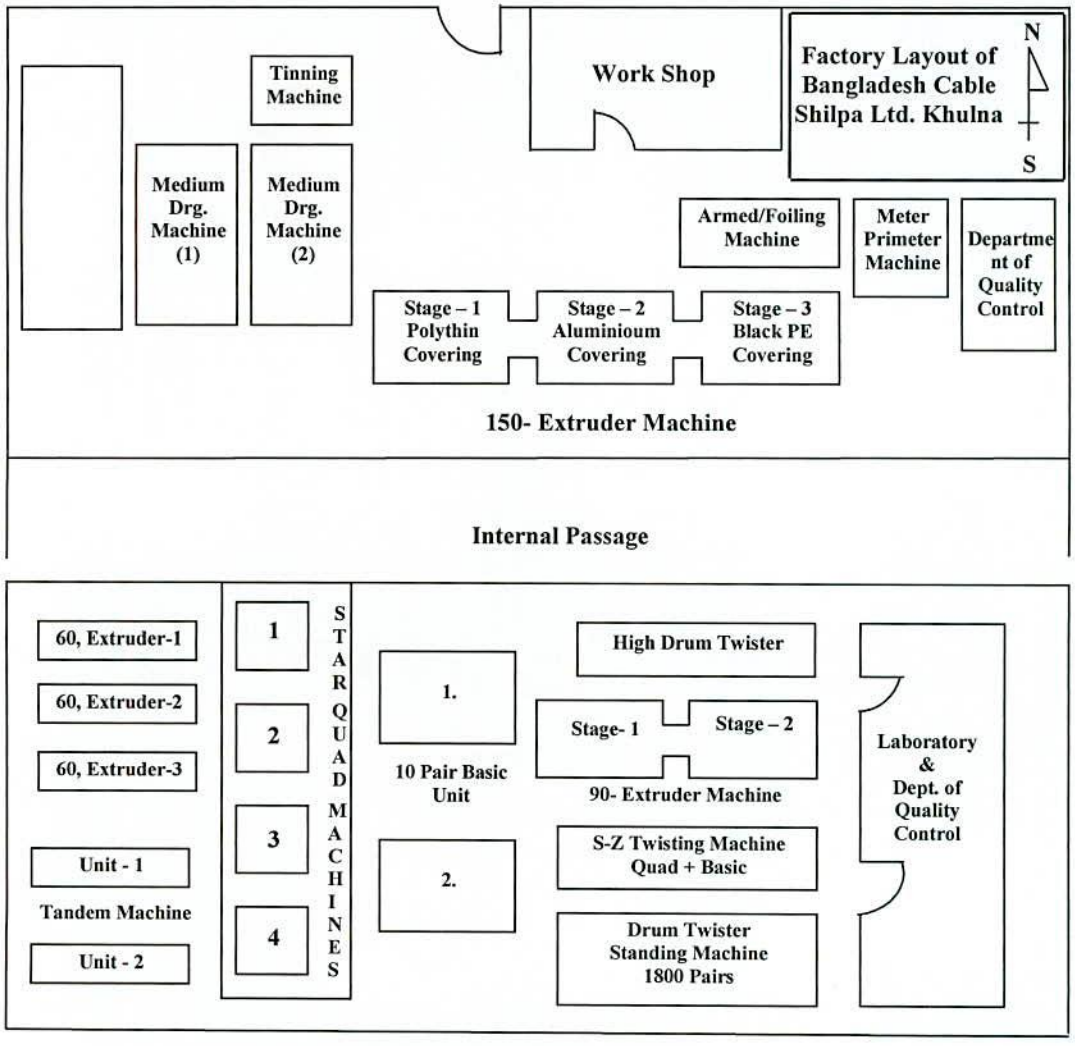


Figure 3.2A Factory layout

Production Flow Diagram in Brief (Step by Step)

Production starts with heavy wire drawing machine and ends with heavy wire drawing machine and ends with final tests as shown in figure 3.2B

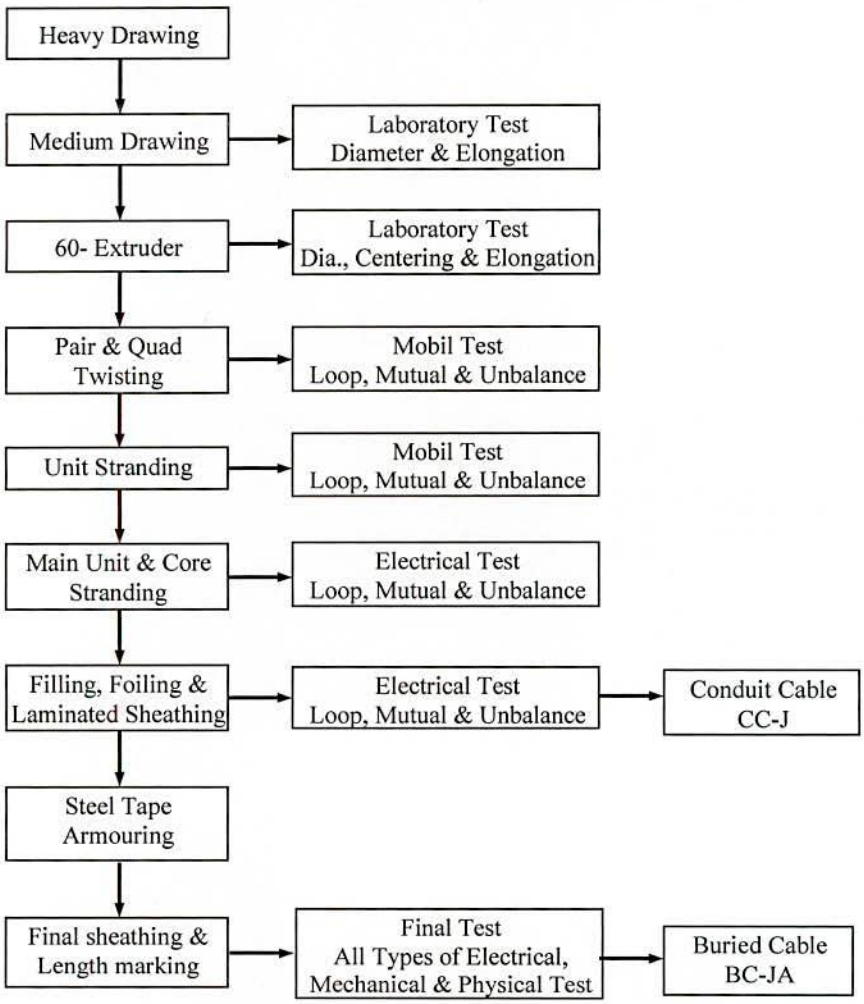


FIGURE: 3.2 B Production flow diagram

Step 1: 8 (Eight) mm copper rod (in coil shape) is drawn to 2.1 mm with the heavy wire drawing machines (Figure-3.2-2).

Step 2: 2.1 mm copper wires are drawn as per requirement to 0.4, 0.5, 0.6, 0.8, 0.9 mm wires etc. with the medium wire drawing machines (Figure-3.2-3).

Step 3: High speed computerized tandem line provides dual insulation (cellular solid polyethylene) in a single operation. 60-Extrnder machine provides single insulation of high density solid polyethylene (HDPE) or PVC over the wires (Figure-3.2-4).

Figure-3.2-1: Copper rod the main and costly raw material of BCSL.

Figure-3.2-2: Heavy Drawing Machine.

Figure-3.2-3: Medium Drawing Machine.

Figure-3.2-4: 60-Extruder Machine.

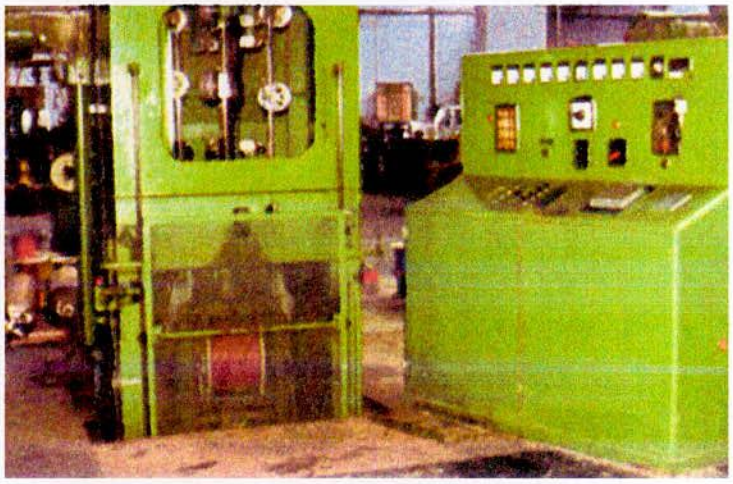


Figure-3.2-5: Pair and Quad Twisting Machine.

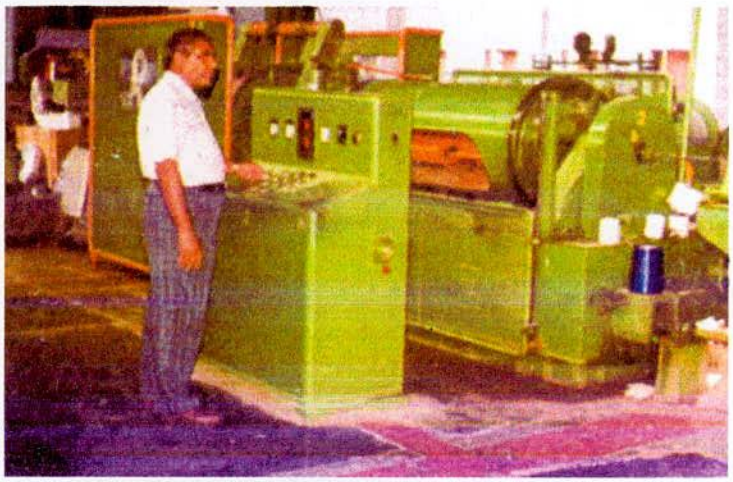


Figure-3.2-6: Unit Stranding Machine.

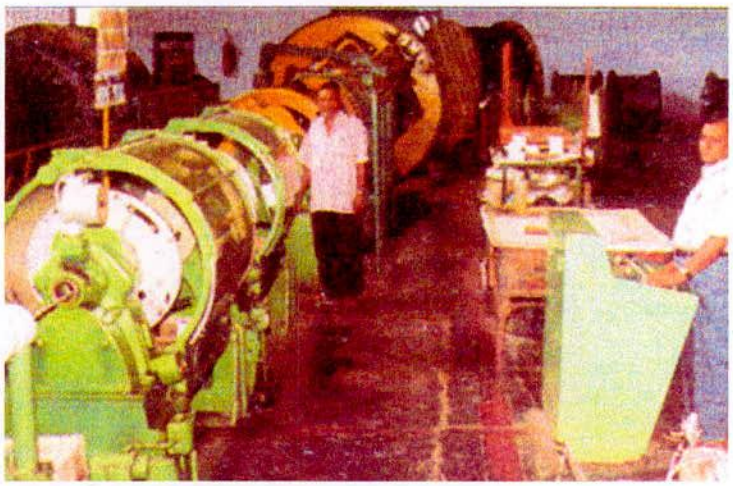


Figure-3.2-7: Main Unit & Core Stranding Machine.

Figure-3.2-8: Diameter Testing Equipment.

Step 4: Two wires/four wires are twisted to form a pair/quad. Four wires are twisted to from a quad by the twisting machines (Figure-3.2-5).

Step 5: Five quads or 10 pairs are twisted to form a 10 pair basic unit (sub unit) by the unit stranding machine (Figure-3.2-6). Sub unit (basic unit) of 10 pair can be produced by twisting to 20 different wires directly by the high speed computerized S-Z stranding.

Step 6: 50 / 100 / 150 / 200 pair units and 20 pair to 3000 pair cores are produced by the stranding machine (Figure-3.2-7).

Step 7: Cores are filled with filling compound (petroleum jelly) and wrapped with non hygroscopic tape and laminated sheath with aluminium tape and jacketed by black P.E. by the 150-Extruder line.

Step 8: Black polyethylene sheath is provided over the cable cores up to 100 pair and single pair drop wire is manufactured by the 90-Extruder line.

Step 9: For extra protection, plain steel tapes are wrapped over the inner sheath by the armoring machine. Buried cables up to 2000 pair are produced by two armoring lines.

Step 10: Final tests

1. **Wire Diameter Tester:** Conductor diameter 0.4, 0.5, 0.6, 0.8, & 0.9 mm as well as insulated wire diameters are accurately measured by digital micrometer (Figure-3.2-8). Tolerance of conductor diameter and insulation thickness are maintained within 0.004mm and 0.03mm respectively.
2. **Elongation Test:** Elongation of conductor and insulation are measured. Elongation for 0.4, 0.5 and 0.6mm conductors are maintained 25% to 31%, for 0.8mm conductor 28% to 35%, and for 0.9mm conductor 30% to 40%. For insulation minimum 500% and for cable jacket minimum 300% elongations are maintained.
3. **Electrical Parameter Test:**
   A. **Mobile Testing:** Loop resistance, Mutual capacitance, Capacitance unbalance and High voltage tests for in process products like quad and 10 pair sub-unit are done. Loop resistance for 0.4mm max. 295.0 Ω/km, for 0.5mm max, 187.0 Ω/km, for 0.6mm max. 130 Ω/km, for 0.8mm max. 73.2 Ω/km and for 0.9mm max. 56.6 Ω/km are maintained.

Mutual capacitance 55.0 nF/km (max. av.), Capacitance unbalance 500.0 pF/km (max. av.) are maintained. High voltage test is done by applying 0.8 KV(DC).

B. **Intermediate/Finished Cable Testing:** Loop resistance, Mutual capacitance, Capacitance unbalance and High voltage tests for semi finished and finished products are done. Loop resistance for 0.4 mm max. to 95.0 Ω/km, for 0.5 mm max. 187.0 Ω/km, for 0.6 mm max. 130.0 Ω/km, for 0.8 mm max. 73.2 Ω/km and for 0.9 mm max. 56.6 Ω/km are maintained. Mutual capacitances 55.0 nF/km (max. av.), Capacitances unbalance 500.0 pF/km (max. av.) are maintained. Here, high voltage test is done by applying 0.5 KV (AC).

4. **Water Penetration Test:** One meter cable with a watertight closer shall be filled with water to a one meter head and there shall be no water leakage in the sheath or any insulated conductors in the core for one hour.

Other Factors that Influence BCSL Capacity

1. **Hardware Store:** Different types of stationary/hardware materials are stored safely in the main store and recorded in the issue and purchase register properly.
2. **Raw Material Store:** Different types of raw materials for production of different types of cables are stored safely in the raw material store and recorded in the issue & purchase register properly.
3. **Spare Parts Store:** Varieties of spare parts for emergency repair of different types of machines are stored safely in the spare parts store within specified temperature and recorded in the issue and purchase register properly.
4. **Cable Drum Yard:** Finished cable drums are stored under shaded drum yard to protect from adverse weather condition.
5. **Fork Lifter:** Loading, unloading & handling of finished products and raw materials are done by fork lifters.
6. **Crane:** Loading, unloading and handling of heavy finished products and raw materials are done by crane.
7. **Mechanical Workshop:** Different parts and components of production machinery are made in the mechanical workshop attached to the production hall.

8. **Electrical Workshop:** Electrical repairing and maintenance works are done by BCSL maintenance team in the electrical workshop attached to the production hall.
9. **Auto Attendance Registration:** Attendance registration of the employees and workers are recorded by punch-clock.

3.3 SUPPLY CHAIN DRIVERS IN BCSL:

The four supply chain drivers of BCSL with their existing strength are as follows:

1. **Facilities:**

   As mentioned earlier in company profile, BCSL has a very healthy facilities required to produce telecommunication cables of any specification with international standard. The facilities can be diversified with some modification, alteration, and addition to meet the future challenges in manufacturing other types of cables as because there is sufficient scope for expansion of the exiting factory and necessary land is available next to the factory.

2. **Inventory**:

   BCSL has to maintain a large variety of inventories for the production of telecommunication cables of different specifications. The name of the notable inventories of BCSL are as follows:

   1. Copper Rod (In Coil Shape)
   2. Black PE
   3. Solid PE
   4. Foam PE
   5. Aluminum Tape
   6. Steel Tape
   7. Petroleum Jelly
   8. Polyester Foil
   9. Polytal Foil
   10. Color Master
   11. PVC Ins
   12. PVC Jacket

All the inventories are imported through tendering system according to Public Procurement Regulation 2003 (PPR 2003) of Bangladesh government. Among all inventories, the main and most important raw material is wax coated 8mm dia copper rod (in coil shape) with 99.9% purity.

3. **Transportation**:

In transportation sector BCSL has no activity of its own. BCSL has a strong government support for marketing of its cables. BTTB and many foreign countries use BCSL cables for various projects inside the country. In this situation BCSL only receives indents from them and after manufacturing, the indenting authorities take delivery of the products directly from BCSL factory according to their own cost and arrangement.

For foreign export, BCSL transports its products from factory to port through transportation agencies according to the contract between Bangladesh government and importing countries.

4. **Information**:

For last 40years BCSL is producing telecommunication cables of specific specifications. In the product sector, generally there is little scope of altering the existing specifications according to BTTB requirements. On the other hand due to strong government support for marketing of its product, BCSL has a limited information flow between BCSL and BTTB.

In case of export, Bangladesh Government makes deal with foreign countries who are in need of cables with BCSL specification and for that BCSL manufactures and supply the cables timely in favor of Bangladesh Government. For raw material procurement BCSL also does not have much information flow regarding sourcing of raw materials and their procurement as because it is only done through international tendering as per PPR 2003.

3.4.1 APPLICATION OF SUPPLY CHAIN MANAGEMENT IN BCSL

As discussed earlier it is important to note that for supply chain management in BCSL, inventory is the most important among all four drivers or in other words at present situation except inventory other drivers are not so prominent for profitability of the organization. So, we will assess the existing inventory management system of the company with a view to improve the system through supply chain management. In doing this, we are in need of several inventory data of the organization.

3.4.2 DATA COLLECTION

BCSL requires several types of inventory for its different products. So, influencing factors for data collection must be considered.

Factors Influencing Collection of Data: BCSL uses copper as main production material for all types of cables. Among all used materials copper is the costliest one and carries 55% to 90% of the total material cost of the cables depending on product variation. So, copper is the main inventory for inventory management in BCSL.

Basically, copper (in the form of coil rod) is imported from countries like Australia, Korea etc. because of availability (sourcing) and quality (99.9% purity). So, in time copper availability for production is an important consideration for the supply chain here. If copper is not available in real time with required amount and quality then production will be interrupted causing loss to all supply chain members associated with BCSL. On the other hand, if excess inventory (copper) is in hand more than economical period, it will decrease profitability for its high carrying cost. So, copper import and its quantity in each lot are most important factors for proper functioning and profitability of BCSL supply chain.

3.4.3 NECESSARY DATA FOR DEMAND AND ASSOCIATED COSTS

The study was conducted after 2005-2006 financial year. So, for simplicity as well as reality copper use and copper import in 2005-2006 are the main considerations.

Copper use in 2005-2006:

In this period BCSL manufactured and supplied 10,52,189.884 cKm cables of different specifications and used 1530.738 MT copper including allowable wastage (Appendix A & Appendix B).

Copper import in 2005-2006:

Copper import in 2005-2006 is shown in Table-CI including imports in 2003-2004 and 2004-2005. The table also shows purchase order (PO) numbers with date, import quantity in each lot, C&F value, dollar exchange rate, name of supplier, and country of origin.

From this table it is clear that in 2005-2006 financial year BCSL has imported 1800MT copper against 3 nos. of PO with 600 MT in each PO and average lead time is 4 months. The 3 POs (as in Table-CI) are PO no. 427 dt. 25.07.05, PO no. 437 dt. 25.10.05, and PO no. 444 dt. 08.03.06. for PO no. 427 there are 3 (three) numbers bill of

entry as shown in appendices BOE 1, BOE 2 and BOE 3. Similarly PO no. 437 has 2 (two) numbers bill of entry (appendices BOE 4, BOE 5) and PO no. 444 has also another 2 (two) numbers bill of entry (appendices BOE 6, BOE 7). These bill of entries are very important documents for calculation of import costs.

TABLE CI
(Copper Import)

Year: 2003-2004

Sl. No.	PO Code & Date	Quantity (MT)	C&F Price in Doller (per MT)	Dollar Ex. rate	Name of Supplier	Country of Origin
1	2	3	4	5	6	7
1.	248 dt. 02.08.03	400.00	LME 1760.28 FOB 160.00 Freight 55.00 Total 1975.28	@ 58.55	M/S M.M.Kembla wire & Rod	Australia
2.	360 dt. 18.11.03	600.00	LME 2201.29 FOB 155.00 Freight 50.00 Total: 2406.29	@ 58.86	M/S M.M.Kembla wire & Rod	Australia
3.	382 dt. 21.04.04	400.00	LME 2948.73 FOB 260.00 Freight 50.00 Total: 3258.73	@ 59.12	M/S M.M.Kembla wire & Rod	Australia

Year: 2004-2005

Sl. No.	PO Code & Date	Quantity (MT)	C&F Price in Doller (per MT)	Dollar Ex. rate	Name of Supplier	Country of Origin
1	2	3	4	5	6	7
1.	391 dt. 31.07.04	400.00	LME 2846.10 FOB 240.00 Freight 50.00 Total: 3136.10	@ 59.35	M/S M.M.Kembla wire & Rod	Australia
2.	400 dt. 01.11.04	600.00	LME 3122.80 FOB 230.00 Freight 50.00 Total: 3402.80	@ 59.8750	M/S M.M.Kembla wire & Rod	Australia
3.	411 dt. 30.04.05	500.00	LME 3249.10 FOB 215.00 Freight 80.00 Total: 3544.10	@ 64.55	M/S Daewoo Int. Corp.	Korea

Year: 2005-2006

Sl. No.	PO Code & Date	Quantity (MT)	C&F Price in Doller (per MT)	Dollar Ex. rate	Name of Supplier	Country of Origin
1	2	3	4	5	6	7
1.	427 dt. 25.07.05	600.00	LME 3797.75 FOB 204.00 Freight 80.00 Total: 4081.75	@ 65.6654	M/S Daewoo Int. Corp.	Korea
2.	437 dt. 25.10.05	600.00	LME 4059.76 FOB 204.00 Freight 80.00 Total: 4343.76	@ 65.95	M/S Daewoo Int. Corp.	Korea
3.	444 dt. 08.03.06	600.00	LME 4982.40 FOB 199.00 Freight 80.00 Total: 5261.40	@ 69.126	M/S Daewoo Int. Corp.	Korea

* LME for London Metal Exchange
** FOB for free on Board.

Cost Associated with Copper Import

For any import of materials as merchandise these are generally several costs are involved in our country as stated below:

Cost- A: Cost associated with issuing a PO to supply a quantity of inventory as shown in table 1 of **Appendix C**

Cost- B: Assessable value is the sum of C&F value, insurance, and landing charges of the imported material contained in each bill of the entry. This is the total value of the imported material in the homeport of the country and thus is the basis of taxes and duties to be imposed according to country's import policy as shown in table 2 of **Appendix D**

Cost- C: Taxes and duties of the imported materials against each bill of entry according to countries tariff rate as shown in table 3 of **Appendix E**

Cost- D: Survey charges of imported material at the homeport against each bill of entry as shown in table 4 of **Appendix F**

Cost- E: Cost associated with material clearing from homeport and carrying it to BCSL store against each bill of entry as shown in table 5 of **Appendix G**

Cost- F: Cost associated with storing and record updating of material for each bill of entry as shown in table 6 of **Appendix H**

Now the total cost of 1800 MT copper is show in Table TC below

Table TC
(Total cost for import of 1800MT copper)

Sl. No	Cost Head	Total Cost (Tk.)	Remarks
1	2	3	4
1.	Cost A (Ordering Cost)	1,17,522.00	Table- 1 (Appendix C)
2.	Cost B (Assessable Value)	57,60,69,456.30	Table- 2 (Appendix D)
3.	Cost C (Taxes & Duties)	21,28,57,665.20	Table- 3 (Appendix E)
4.	Cost D (Survey Charges)	35,000.00	Table- 4 (Appendix F)
5.	Cost E (Clearing & Carrying)	1,55,53,875.33	Table- 5 (Appendix G)
6.	Cost F (Storing & Record updating)	3,900.00	Table- 6 (Appendix H)
Total:		80,46,37,418.80	

From table TC above, the average cost of one MT copper = tk. 4,47,020.80

Table TC shows BCSL's conventional copper import costs in 2005-2006. In this year, there were 3 POs or lots having 600MT in each lot amounting to total 1800MT where as actual demand was 1530.738MT. For copper import, total cost involvement was **Tk. 80,46,37,418.80** and excess **269.262MT** copper was in hand at the end of the year.

From the above statement, it is clear that in conventional method the number of lots and quantity in each lot were not according to supply chain methodology. For any supply or procurement in supply chain management, the lot size and number of replenishment should be economical which can be achieved only by economic order quantity (EOQ) model to exploit economics of scale.

3.4.4 DETERMINATION OF ECONOMIC ORDER QUNTITY (EOQ) IN BCSL FOR COPPER IMPORT

Economic order quantity (EOQ) model specifications:

D = Annual Demand

b = Unit price of inventory (Copper)

f_1 = Percentage of inventory investment.

f_2 = Percentage of insurance cost on order quantity.

f_3 = Percentage of landing charge on order quantity.

f_4 = Percentage of taxes and duties on order quantity.

f_5 = Percentage of clearing cost on order quantity.

f_6 = Percentage of carrying cost on order quantity.

n = No of bill of entry to fulfill the order quantity.

C_1 = Fixed survey cost for each bill of entry.

C_2 = Cost of storing and record updating on the percentage of order quantity.

f_7 = Percentage of order quantity in bill of entry.

C_R = Cost of order production cost.

Q = Order quantity in an order.

O = Zero or no stock in hand.

$\frac{Q}{2}$ = Average stock in hand assuming stock in hand decreases steadily from Q to O.

C_H = Holding cost of unit inventory for unit time (generally one year)

Now, annual ordering cost

$$= (C_R + f_2Q + f_3Q + f_4Q + f_5Q + f_6Q + f_7QC_2)\frac{D}{Q} + nC_1$$

$$= C_R\frac{D}{Q} + (f_2 + f_3 + f_4 + f_5 + f_6 + f_7C_2)D + nC_1$$

Annual Holding Cost = $(f_1.b)\frac{Q}{2} = C_H\frac{Q}{2}$

∴ Total incremental cost (TIC) = Annual holding cost + Annual ordering Cost

$$= C_H\frac{Q}{2} + C_R\frac{D}{Q} + (f_2 + f_3 + f_4 + f_5 + f_6 + f_7C_2)D + nC_1$$

Now, differentiating TIC with respect to Q and setting the result equal to Zero and solving for Q, we get

$$\frac{d}{dQ}(TIC) = \frac{C_H}{2} - \frac{C_RD}{Q^2}$$

$$\Rightarrow O = \frac{C_H}{2} - \frac{C_RD}{Q^2}$$

$$\Rightarrow \frac{C_H}{2} = \frac{C_RD}{Q^2} \qquad \text{[Eqn. EOQ]}$$

$$\Rightarrow Q^2 = \frac{2C_RD}{C_H}$$

$$\Rightarrow Q = \sqrt{\frac{2C_RD}{C_H}}$$

Note that the second derivative is positive, which indicates a minimum has been obtained.

Finally, $Q_\circ = \sqrt{\frac{2C_RD}{C_H}}$ [Eqn. A]

Here, $Q_\circ$ is the optimal order quantity of copper and its determination depends on yearly demand (D), Ordering cost (C_R), and Holding cost (C_H) of copper in BCSL store. Again $Q_\circ$ is the minimum quantity where Carrying cost and Ordering cost are

equal. It is notable to mention here that other related import costs associated with insurance, landing, taxes & duties, clearing, carrying, survey, and storing are not included directly in their actual form during determination of optimal order quantity Q_o, rather these costs are required in determining the actual cost of any imported inventory in store. The actual cost of imported inventory in store is summation of inventory cost at exporting country and associated import costs. This actual cost of inventory in store is very important in determining the holding cost of inventory as well as total incremental cost (TIC).

TIC = Annual holding Cost + Annual Ordering Cost

$$= C_H \frac{Q}{2} + C_R \frac{D}{Q} \qquad \text{[Eqn B]}$$

CALCULATION OF HOLDING COST (C_H) OF COPPER ROD

Imported copper rod is stored in BCSL's own store, which is in the same compound of the factory. So, there is no pilferage, extra insurance, and extra taxes. On the other hand there is no depreciation, spoilage, and breakage due to wax coating on the rod and 99.9% purity of copper. But holding cost due to interest against cost for holding material in store is a factor and for this cost we have the following two considerations:

Consideration One:

According to discussion with Sonali Bank (Leading commercial Bank of Bangladesh in Government level) management, it was learnt that the interest rate is generally 14% for any loan against import of any inventory as merchandise. In this case, BCSL has no calculated holding cost percentage. So, we may assume that BCSL may have more or less interest rate than the Sonali Bank.

In this situation, for our calculation purpose, the holding cost may be considered maximum 11.5% (because of strong government support for having money from government and any extra expenses in this head is compensated by increasing sale price of finished products through prior approval from NBR). Warehousing cost may be assumed another 0.5% (because of own store of BCSL and there is no remarkable related cost in rent, heat, light and security sector). Thus the total holding cost of copper in BCSL own store may be finally assumed to be 12% of inventory investment.

Consideration two:

Generally any inventory holding cost less than 15% is susceptible [5&8]. This may be true for developed countries for hiring warehouses and related costs for heat, light, and security. There may be extra cost for heating in cold areas. But incase of BCSL in Bangladesh, the situation is completely different. Against all these, let us assume the holding cost of copper in BCSL store is also 15%. In this situation, now we will try to calculate the holding cost percentage according to dollar exchange rate.

In 2005-2006, BCSL has purchased 1800MT copper in 3 (three) number of POs with three dollar exchange rates as stated below:

Sl. no.	PO no.	Amount of copper purchased in MT	Dollar exchange rate in Tk.
1	427	600	65.6654
2	437	600	65.9500
3	444	600	69.1260

Let us consider holding cost is 15% of inventory value when dollar exchange rate is Tk. 69.1260

Calculation One: When dollar exchange rate is Tk 65.6654

$$\text{Price Discount} = \frac{69.1260 - 65.6654}{69.1260} = 5\%$$

This price discount percentage may be considered as holding cost discount on the holding cost with dollar exchange rate Tk 69.1260

So, the compensated holding cost= 15% - 5% = 10%

Calculation Two: When dollar exchange rate is Tk 65.95

$$\text{Price Discount} = \frac{69.1260 - 65.95}{69.1260} = 4.6\%$$

Here, compensated holding cost = 15% - 4.6% = 10.4%

Calculation Three: When dollar exchange rate is Tk. 69.1260, the holding cost is 15%

Now, combining Calculation One, Calculation Two, and Calculation Three we will get the average holding cost in the year of consideration.

$$\text{Average holding cost of the year} = \frac{10\% + 10.4\% + 15\%}{3} = 11.8\% \cong 12\%$$

Finally: From the above two considerations, we can conclude that in 2005-2006, the holding cost fraction is 12% of inventory investment.

We have, unit price of copper (From **Table TC**)

= Tk. 4,47,020.80/MT

$\therefore$ Holding cost = (0.12 × 4,47,020.8) Tk/MT/Yr

LEAD TIME OF COPPER IMPORT

As per discussion with the people in the purchase department of BCSL, tendering (as per PPR-2003) and getting imported inventory in store through sea route, BCSL has the following maximum lead time

1. Advertisement in national dailies and tender submission	42 days
2. Delivery on board	15 days
3. Arrival of inventory at BCSL store from exporting countries	45 days
Total:	102 days

CALCULATION OF EOQ FOR COPPER PURCHASED IN 2005-2006

Here,

We have Annual demand (D) =1530 MT

Holding Cost (C_H) = (0.12 × 4,47,020) Tk/MT/Yr

Ordering Cost (C_R) = 39,174 (Tk.) [From appendix C]

$$Q_\circ = \sqrt{\frac{2C_R D}{C_H}}$$

$$= \sqrt{\frac{2 \times 39{,}174 \times 1530}{.12 \times 4{,}47{,}020}}$$

= 47.27 MT

≅ 48 MT

Now, we have economic order quantity $Q_\circ$ = 48 MT

Number of Orders $= \frac{D}{Q} = \frac{1530}{48} = 32$ nos.

Total working days in the year = 365-(52+23) = 290 days

Replenishment cycle period $= \frac{290}{32} = 9$ Business days

3.4.5 INVENTORY DECISION FOR COPPER PURCHASE IN 2005-2006

When no price discounts are offered, the purchase and other related percentage basis costs remain constant regardless of when and how much to order. Here, it is simpler to consider TIC which includes only those costs which are affected by the inventory decision.

We know that in 2005-2006, BCSL had actual consumption of Copper 1530 MT including allowable wastage.

For the Year 2005-2006, there may have several inventory decisions as stated below:

Current Approach A: Purchase of copper assuming 1530 MT demand with 200MT safety stock (BCSL generally maintain 200MT safety stock according to its long conventional practice).

Proposed Approach B: Purchase of copper according to FOQ system assuming EOQ model.

Calculation of TIC According To Copper Purchase Decision:

Current Approach A: Calculation of TIC according to practice of BCSL– Assuming 1530 MT demand and 200MT conventional safety stock.

Here, $C_H = .12 \times 4,47,020$ TK. /MT per year

$Q\max = 600 + 200 = 800$ MT

$Q\min = 200$ MT

$$Q = \frac{800 + 200}{2} = 500\text{MT}$$

$D = 1530$ MT

$Q = 600$MT

$$\frac{D}{Q} = \frac{1530}{600} \cong 3$$

$C_R = 39,174$ TK./Order

$TIC_A = (.12 \times 4,47,020)(500) + (39,174)(3)$

$= 2,68,21,200.00 + 1,17,522.00$

$=$Tk. $2,69,38,722.00 =$ Tk. 26.9 Million

Proposed Approach B: Calculation of TIC according to FOQ system assuming EOQ model. The demand is 1530 MT, safety stock is 33 MT with lot size of 48 MT.

Here,

$\overline{D}$ = 1530 MT/Yr = 1530/290 = 5.28 MT/day

S_D = 1.9 MT/day

L= 102 days

C_H = .12 × 4,47,020 Tk./ MT per Year

C_R = 39174 Tk./ Order

α = 5% (95% Service Level)

Calculation of Reorder Point R

For FOQ system the reorder point corresponds to the maximum reasonable demand during the lead time at the specified service level. Thus,

R= $x_{\max} = \bar{x} + z_\alpha s_x$

Where, $\bar{x} = \overline{D}$. L = (5.28)(102) = 538 = average lead time demand

$z_\alpha = z_{.05}$ = 1.645 = number of standard deviation from mean for 95% service level

s_x = standard deviation of demand during lead time

If we assume that daily demands are independent, the variance of lead time demand x will be the sum of 102 daily demand variances

$s_x^2 = 102 s_D^2 = 102\ (1.9)^2 = 368.22$

Therefore $s_x = \sqrt{368.22} \cong 20$ MT

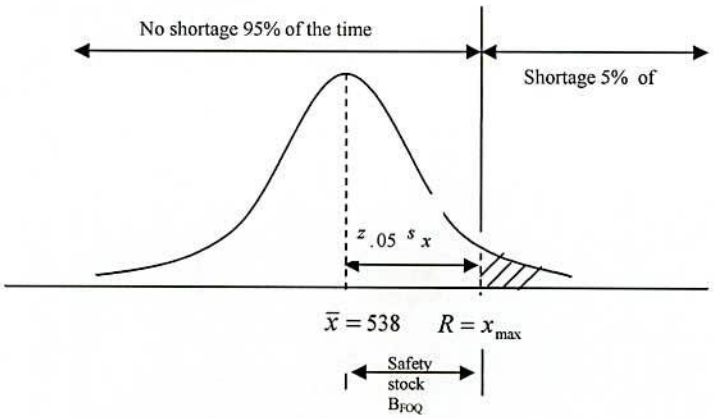


Figure: 3.4.5.1 Normal distribution of lead-time demand x

Reorder point R= $x_{\max} = \bar{x} + z_\alpha s_x$

$= 538 + (1.645)(20) = 538 + 32.9$

$\cong 571$ MT

Therefore, safety stock in fixed order quantity system

$B_{FOQ} = x_{\max} - \bar{x} = 571 - 538 = 33$ MT

Using the EOQ model we obtain the fixed order quantity as follows:

$$Q_0 = \sqrt{\frac{2c_R\bar{D}}{c_H}} = \sqrt{\frac{2(39174)(1530)}{(.12)(447020)}} \cong 48 \text{ MT}$$

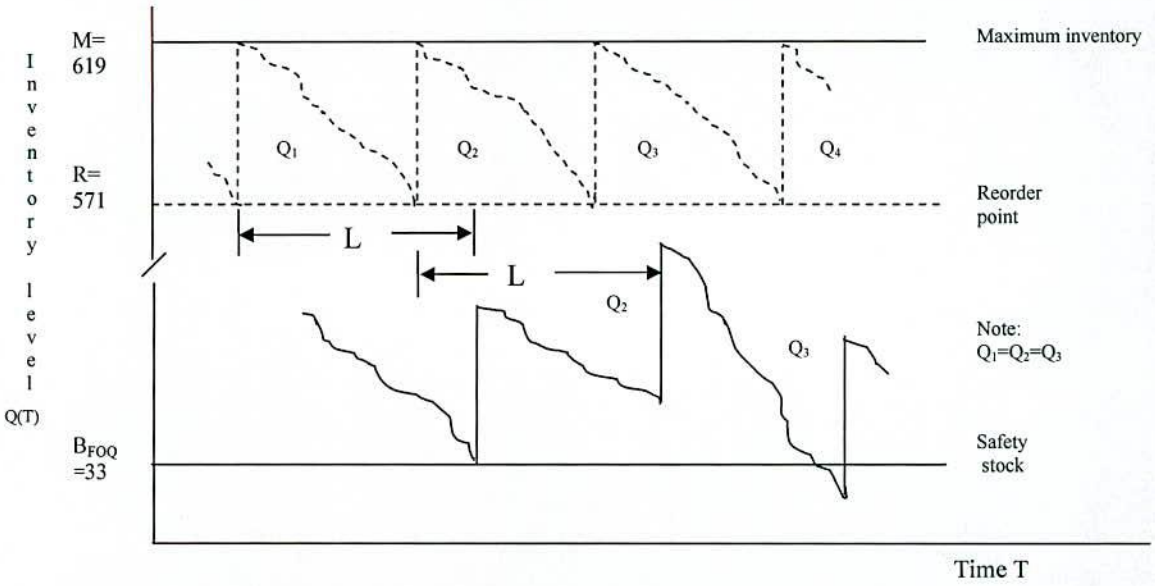


Figure-3.4.5.2: Inventory functions in a fixed-order-quantity system with lead time exceeding the reorder cycle time.

Cost Calculation

Cost	Cost per year
Holding: $C_H(\frac{Q_0}{2} + B_{FOQ}) = (.12 \times 447020)(\frac{48}{2} + 33)$	Tk. 3057617
Ordering: $C_R \frac{D}{Q_0} = (39174)\frac{1530}{48}$	Tk. 1248671
Total inventory cost	Tk. 4306288

Therefore the total inventory cost is found as Tk 4306288 $\cong$ 4.3 million

Table: 3.4 Shows the TIC for the above two approaches:

Table: 3.4

Approach	Total Incremental Cost (TIC) in '00000' (million) Tk.
Current approach A	26.9
Proposed approach B (95% service level)	4.3

Two further Consideration

On the average BCSL maintain safety stock 200 MT throughout the year. According to present consumption rate this safety stock would stock out by 38 days (200 MT/consumption rate 5.28 MT per day), if no replenishment occurs. Roughly they maintain Buffer stock for 40 days emergency consumption. If we assume this buffer stock as safety stock and if they maintain this safety stock for 20 days and again if they did it for 10 days the TICs would be

Case I (if BCSL maintains safety stock for 20 days):

20 days safety stock = $5.28 \times 20 \cong 106$ MT

Holding Cost: $C_H(\frac{Q_0}{2} + B_{for20days}) = (.12 \times 447020)(\frac{600}{2} + 106) =$ Tk. 21778814

Ordering: $C_R \frac{D}{Q_0} = (39174)\frac{1530}{600} =$ Tk. 99894

Total Inventory Cost (TIC) = Tk. (21778814 + 99894) = Tk. 21878708 $\cong$ 21.9 million

Case II (if they maintain safety stock for 10 days):

10 days safety stock = $5.28 \times 10 \cong 53$ MT

Holding: $C_H(\frac{Q_0}{2} + B_{for10days}) = (.12 \times 447020)(\frac{600}{2} + 53) =$ Tk 18935767

Ordering: $C_R \frac{D}{Q_0} = (39174)\frac{1530}{600} =$ Tk. 99894

Total Inventory Cost (TIC) = Tk. (18935767+ 99894) =Tk. 19035661 $\cong$ 19 million

Finally, we can compute and compare all the calculated TICs according to different inventory decisions (two approaches and two considerations) in Table TIC-ID. In a bar chart the cost figures are shown in Figure 3.4.5.3

Table TIC-ID

Approach	Total Incremental Cost (TIC) in '00000' (million) Tk.
Current approach A	26.9
Proposed approach B (95% service level)	4.3
Two further Consideration	
Case I (if they maintain safety stock for 20 days)	21.9
Case II (if they maintain safety stock for 10 days)	19.0

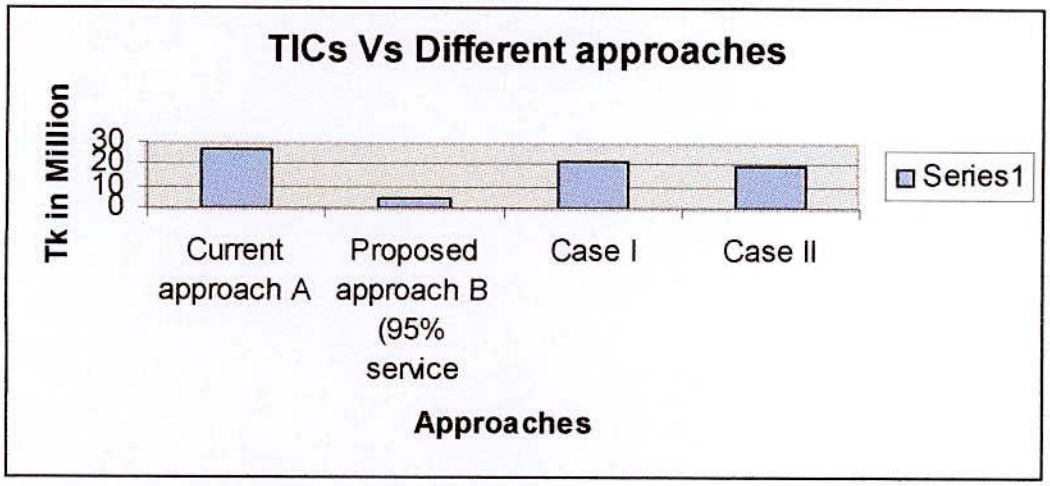


Figure: 3.4.5.3 Comparison of TICs between different approaches

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

Application of four drivers of supply chain management in BCSL requires a master plan for procurement of inventories required for production of demanded product to meet the in time supply schedule. As stated earlier, among four drivers, inventory is the most prominent one and among all inventories copper is must for production of any type of conductor in telecommunication cable. At the same time copper cost may claim 55% to 90% of total cost for its products depending on product variation. So, copper purchase through import is the main consideration for cable production and profitability of BCSL. This chapter incorporates the present integrated supply chain model of BCSL, estimation of the elements of inventory cost, inventory management of BCSL with related issues and benefits.

4.2 CURRENT APPROACH OF SUPPLY CHAIN MANAGEMENT AT BCSL

BCSL, has its own supply chain but not accordance with the recent integrated supply chain model. The supply chain model of the company, still follow the system of 1960s and shown in Figure 4.2 below:

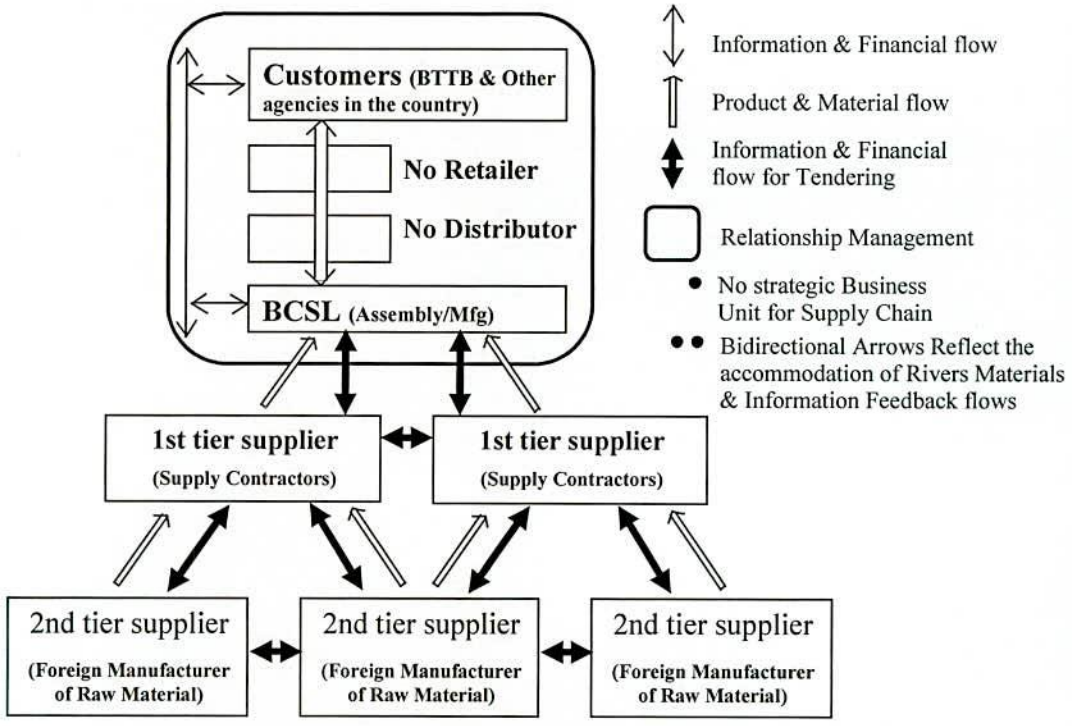


Figure: 4.2 Current approach integrated supply chain at BCSL.

The notable points for discussion regarding the present model are as follows:

A. SUPPLY CHAIN MEMBERS

1. *Customer*

The final customers are BTTB and other agencies who are working in favor of BTTB for expansion and alteration of BTTB telephone exchanges throughout the country. In some cases, BCSL exports some of its products to several foreign countries through government level but with limited amount.

2. *No Retailer and Distributor*

For products marketing BCSL has no retailer and distributor in between BTTB (customer) and BCSL (Manufacturer). The company has a strong government support for marketing of its products. So, BTTB has no sales outlet in the country except factory yard delivery point.

3. *No Strategic business unit in the chain*

In BCSL supply chain there is no conventional strategic business unit. BCSL acts for both manufacturing/accessibility unit and strategic business unit for its supply chain.

4. *First tier supplier*

The first tier suppliers of the company are successful tenderers. In this case, first tier suppliers are not long term suppliers rather their supplies depend on tender finalization. Supply contractors have no capacity for value change in the chain. As per contract, they only collect inventory from actual foreign raw material producers, make delivery to BCSL and earn some money out of this delivery. Here supply contractors are not first tier suppliers in actual sense and work just as an intermediator.

5. *Second tier supplier*

Here the second tier suppliers are foreign manufacturers of raw materials. BCSL has no relation with them, although the company is using their raw materials since establishment of the factory.

B. SUPPLY CHAIN DRIVERS

The four supply chain drivers of BCSL with their existing strength are as follows:

1. Facilities:

As mentioned earlier in company profile, BCSL has a very healthy facilities required to produce telecommunication cables of any specification with international standard. The identified components of the facilities of the company are as follows:

Location facility

(i) Location:

BCSL has a centralized location at Shiromoni, which is close to Mongla sea port and Benapole land port. It is situated on the bank of the river Bhoirob and it has a very good road connection facility with any part of the country. It imports all its raw materials through sea route (the cheapest route) which reduces import cost and in some cases it also imports some raw materials through Benapole land port with truck route which also reduces import cost. On the delivery side the final customers of BCSL products, use road and river routes according to their choice which is also cheap and convenient.

(ii) Quality of workers and cost of workers:

BCSL is situated in Shiromoni Industrial Area and around BCSL their are many jute mills and other industries which facilitates BCSL with good quality workers at reasonable cost. Again BCSL has its own facility to train up all its workers according to requirements.

BCSL has a good reputation in the job market. There is a engineering university very close to BCSL. Therefore, they can hire engineers or take expert help very easily.

(iii) Infrastructure:

The factory has a very good quality of infrastructures. The product testing equipments at different stages of production are of very high quality and as a result the product quality is very high (as per international standard) with less rejection or rework.

The facilities of the BCSL can be diversified with some modification, alteration, and addition to meet the future challenges in manufacturing other types of cables as because there is sufficient scope for expansion of the present factory and necessary land is available next to the existing factory.

(iv) Proximity to customer and the rest of the network:

BCSL has a centralized location at Shiromoni industrial area and it has a strong Government support for marketing of all its products and BTTB is the main customer of its product. On the other hand, BCSL has no sales point outside of its factory yard. In this situation, the supply chain of BCSL is something different from conventional supply chain. Here, customers take delivery of its products directly from factory delivery point and there is no network for selling the product of BCSL outside the factory area.

(v) Tax effects:

Custom department has its bonded warehouse inside the factory and BCSL sales its products after getting prior price approval from NBR. So, tax effects are well accounted and BCSL gets some advantages due to strong Government support in this sector.

Capacity Facility

As mentioned earlier the company's factory layout is the type of process layout and there are some important computer numerical controlled machines which has increased its production capacity up to 12,00,000 c.km. per annum.

Having very good quality testing equipments and skilled manpower, BCSL has reasonable minimum rejection and rework during production. There is hardware store, raw material store, spare parts store, cable drum yard, mechanical workshop, electrical workshop, and many other factors which influences BCSL's capacity directly or indirectly.

The production capacity of the company has been increased to satisfy the demand up to 12,00,000 c.km./year. But record shows that BCSL has produce maximum 10,52,189.884 c.km. in the year 2005-06 for the first time. Hence, the company is yet to fulfill its full capacity.

Operational Methodology

The company's factory layout is the type of process layout where production machines are arranged according to the requirement of process flow and BCSL's flexible operational methodology is very suitable for production of a wide range of products with international standard.

Warehousing Methodology

The company uses cross-docking warehousing methodology. After production of different types of products they are rolled in different drum sizes (according to product specifications) and stored in delivery yard of the factory. When purchaser comes, product is delivered according to their (customer) given indent directly from delivery point of the factory.

2. Inventory:

BCSL has to maintain a large variety of inventories for the production of telecommunication cables of different specifications. The name of the notable inventories of BCSL are as follows:

1. Copper Rod (In Coil Shape)
2. Black PE
3. Solid PE
4. Foam PE
5. Aluminum Tape
6. Steel Tape
7. Petroleum Jelly
8. Polyester Foil
9. Polytal Foil
10. Color Master
11. PVC Ins
12. PVC Jacket

All the inventories are imported through tendering system according to Public Procurement Regulation 2003 (PPR 2003) of Bangladesh government. Among all inventories, the main and most important raw material is wax coated 8mm dia copper rod (in coil shape) with 99.9% purity.

At present time the price of copper is increasing with elapse time due to high copper consumption throughout the world. Copper cost is the main source of inventory cost in the supply chain of BCSL and it has a great impact on profitability of the company.

Inventory Decision

The two major inventory related decisions of BCSL are:

i. Demand of Inventory:

   According to demand, BCSL imports copper from foreign countries. In 2005-2006 financial year BCSL imported 1800 MT copper in 3 (three) numbers of POs with 600 MT copper in each PO but the actual use of copper was 1530.738 MT and there was 269.262 MT copper in stock at the end of the year.

ii. Safety Inventory:

   Safety Inventory of BCSL is 200 MT as per its long conventional practice since starting of the factory.

Seasonal Inventory

Seasonal inventory is the inventory that is build up to counter predictable variability of demand. Companies using seasonal inventory will build up inventory in periods of low demand and store it for periods of high demand when they will not have the capacity to produce all that is demanded. In BCSL there is no seasonal inventory.

Sourcing

Raw materials required for production of high quality telecommunication cables should also be of very high quality and in Bangladesh those raw materials are not available. There are few countries in the world that actually produce those. In this situation BCSL imports all its raw materials from foreign countries through tendering. According to past data the outsourcing countries are Australia, Korea, USA etc.

3. Transportation:

BCSL has no transportation driver of its own. It sales all its products directly from factory yard sales point and customers take delivery of their indented product according to their (customers) own cost and transportation. It is to be mentioned here that BCSL has no other sales point except factory yard delivery point. Hence, transportation driver of BCSL supply chain is totally absent.

4. Information:

For last 40years BCSL is producing telecommunication cables of specific specifications. In the product sector, generally there is little scope of altering the existing specifications according to BTTB requirements. On the other hand due to strong government support for marketing of its product, BCSL has a limited information flow between BCSL and BTTB.

In case of export, Bangladesh Government makes deal with foreign countries who are in need of cables with BCSL specifications and BCSL manufactures and supplies the cables timely in favor of Bangladesh Government. For raw material procurement BCSL also does not have much information flow regarding sourcing of raw materials and their procurement as because it is only done through international tendering as per PPR 2003.

C. SUPPLY CHAIN MANAGEMENT

1. Information System in BCSL supply chain

The information system of BCSL supply chain is not so prominent. BTTB places indents to BCSL for supply of cables with their requirement and after production BCSL informs BTTB for taking delivery. Here information & financial flow exists between BTTB and BCSL. After getting indent from BTTB, BCSL goes for tender to procure required raw materials. According to PPR 2003, tendering system is time consuming as described in article 4.4. BCSL has no linkage with supply contractors without tender. Floating of tender in newspaper is the information system between them. After participation in tender, only the successful tenderer supply the raw materials to BCSL after collecting those from foreign raw material producers. This down stream Information and Financial (I&F) flow is due to tendering. The down stream I&F flow is completely different from I&F flow between BTTB and BCSL.

2. *Material flow in BCSL supply flow*

There are two types of material flow in BCSL supply chain.

a. Flow of finished materials between BCSL and BTTB. This flow is bidirectional

b. There exist the flow of raw materials between foreign raw material producers and successful tenderer of BCSL and between tenderer and BCSL. This flow is unidirectional as because after delivery and payment there is little scope of reverse flow of materials.

3. *Relationship Management of BCSL Supply Chain*

In BCSL supply chain relationship exists only between BCSL and BTTB. Both of them have Government support and for the last forty years they have trusted relationship in between them. But the down stream relationship between BCSL and successful tenderer continues upto finalization of a particular contract and there is no surety that the previous successful tenderer will be successful in the next tender. An important factor is to mention here that any successful supply contractor of BCSL's supply chain is not a member of the value chain of BCSL. Another very important issue is BCSL has no close relationship with foreign manufacturer of raw materials although BCSL is using their raw materials for last forty years.

4.3 PROPOSED INTEGRATED SUPPLY CHAIN MODEL OF BCSL

At present time BCSL is not in a position to continue with its products of telecommunication cables only due to great impact from cell phones and advanced satellite communication system. In this situation with the existing products BCSL may changeover to other products for its existence and there is available location facility and required infrastructures. The other products may be electrical wires of different qualities, different specifications, and other necessary wires of prime requirements in the market according to recent advanced technology.

In the proposed integrated supply chain model there is only 1st tier suppliers. Here, the 1st tier suppliers are foreign raw material producers who will directly supply

their products to BCSL, and in-between they should have trusted relationship. In this situation, BCSL need not to have 2nd tier suppliers in its down stream supply chain.

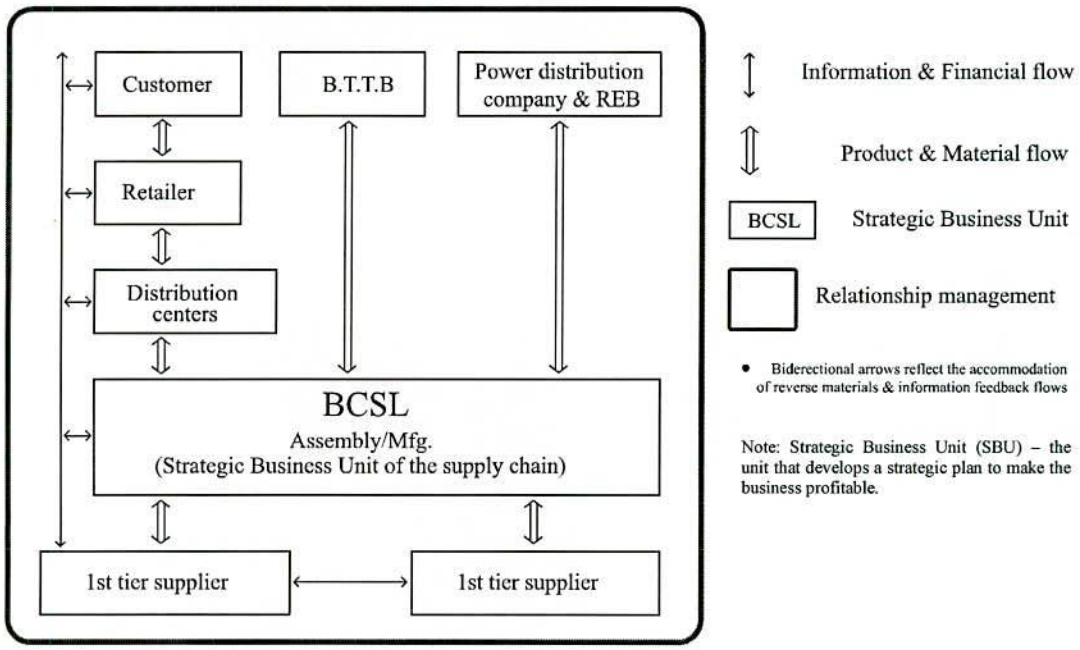


Figure: 4.3 Proposed integrated supply chain of BCSL.

The up stream chain is like conventional supply chain of the market and in this case BCSL has to establish distribution centers and use transportation facility of its own.

BCSL may also go for production of electrical power supply cables and in this case the main production raw material is aluminium. For electrical power supply cables BCSL may have direct customers of different power distribution companies and REB of the country.

4.4 PRESENT COSTING PROCESS OF BCSL

BCSL imports all its raw materials for production of different types of cables according to demand. Due to PPR-2003 and import through sea route BCSL has a minimum lead time of 102 days for any foreign procurement.

BCSL generally produces cables after getting orders mainly from BTTB and many organizations working in various telecommunication projects inside the country. BCSL also gets indents from foreign countries through government of Bangladesh. So, the demand depends on BTTB requirement, number of ongoing telecommunication projects in the country, requirements from foreign countries and so on. Hence, the yearly demand is not constant rather fluctuating. In this situation apparently BCSL has

nothing to do regarding demand generation but due to strong government support for its product marketing, BCSL is just continuing.

Generally the company is not well aware of future demand. In that case the company always keeps 200MT copper as safety stock, which is in accordance with its long conventional practice. Thus the present practice of the company to proceed with gross and rough estimation leaves enough room to result in unnecessary high holding cost. On the other hand BCSL does not collect all its required inventories directly from the actual producers rather purchases through tender which also increases ordering cost as well as material cost.

From the study it reveals that BCSL generally compensates its high holding cost, excess ordering cost, excess material cost and all other related costs by increasing required profit margin of its products (which gets necessary approval from NBR due to strong government support) and estimating the value of any inventory in its store according to current value rate or adding up all related costs with the purchase cost during fixation of the value of inventory in store.

According to "Appendix-Costing", each cost element has been shown as a fraction of total manufacturing cost and corresponding profits in table 4.4 for production of one kilometer of 10 pair / 0.4 cc-J cable.

Table 4.4

Fraction of total manufacturing cost and profit against each cost element

Sl. no.	Cost Elements	Cost in Taka	Fraction of total cost	Profit against cost element in Taka
1	2	3	4	5
1.	Copper cost (23.84 kg including wastage)	15,382.04	0.32695	1,472.890
2.	Other materials cost	12,440.02	0.26442	1,191.196
3.	Packing	749.00	0.01592	71.719
4.	Electricity	1,129.60	0.02401	108.164
5.	Telephone	89.60	0.00189	8.514
6.	Direct labor charge	1,660.00	0.03529	158.979
7.	Factory overhead cost	10,056.80	0.21376	962.976
8.	Administrative expenditure	5,540.00	0.11776	530.502
	Total:	47,047.06	1.00000	4,504.940

From the table 4.4

Total production cost = Tk. 47,047.06

Copper cost (23.84 Kg including wastage) = Tk. 15,382.04

Profit against copper = Tk. 1,472.89

$$\text{Holding cost of 23.84 Kg copper} = \frac{.12 \times 4{,}47{,}020.8 \times 23.84}{1000} = \text{Tk.1278.84}$$

This holding cost amounting to Tk 1,278.84 has been compensated by increasing required profit margin up to Tk.1,472.89

Again,

Profit – holding cost = 1,472.89 – 1,278.84

= Tk.194.05

In BCSL, there is no calculated value for excess ordering and material cost for tendering. So, we can assume that all costs associated with tendering along with some profit has been included in Tk. 194.05

According to copper import in 2005-2006

Cost of 1 Kg copper = 4,47,020.8 / 1000 = Tk. 447.02

From Table 4.4

Cost of 1 Kg copper = 15,382.04 / 23.84 = Tk. 645.22

In "appendix- costing", the cost of copper has been estimated on 27.07.06, but this copper is a portion of imported copper in 2005-2006, as because no copper has been imported at the beginning of 2006-2007 financial year. Here, increment of copper cost in store is 44.34%, which is remarkable and may be considered as compensation of high holding and other related costs.

Again, there is no sufficient record regarding increase of copper price in BCSL costing department. So, it may be assumed that, the following two considerations may be the cause for increasing the price of copper in BCSL store:

a. Copper price may increase during time of estimation (i.e., on 27.07.06) and for that reason BCSL also increased its copper price in store.
b. BCSL may have the practice to add holding and other related costs with purchase cost and the resulting accumulated cost of copper in store thereby increases in respect of actual purchase cost.

Another point may be mentioned here that value added items like direct labor charge, factory overhead cost, and administrative expenditure were not clear during study period. BCSL may have their own calculations but no recorded data was available except "appendix-costing". Hence, here is the scope of thinking that extra expenses in

inventory or any other sector may be also included in value added items including profits for survival of BCSL.

From the discussion above, the company under study generally compensates its holding and other related costs (including profit) somehow and does not hesitate to import a bulk amount of copper in a single PO having 200MT safety stock. This may be practice for BCSL, but from the view point of supply chain management these unnecessary high holding and related costs are not at all acceptable and implementation of EOQ model inventory decision in BCSL claims more profitability.

4.5 INVENTORY MANAGEMENT OF BCSL

a. Estimation of the elements of inventory costs

Different inventory costs are estimated depending on various available facts and figures. Documentation and recording of the relevant data and information in detailed form are very important. Precious determination of the various cost elements of inventory needs accurate and reliable data. But recording system of BCSL, like many other local companies, is not tuned accordingly. For example, in case of telephone bill, like many other organizations, the company does not record which of the calls are made exactly for ordering or expediting an order. In fact it is not possible also to keep track so that extent unless the organization deliberately adopts such requisite measures. Similarly records like expenses for lighting, maintenance, security etc., shares of which should be apportioned correctly in inventory holding cost calculation. But absence of precise records of such data and information lead to some sort of guess. To minimize the error in such guesses organization should adopt necessary changes and modifications in its operations system [5].

b. Application of EOQ model and FOQ system

Using the EOQ model, we obtain the fixed order quantity Q_0 = 48 MT. This value of Q_0 from a model assuming that demand is exactly known is in practice a good approximation because the total inventory cost is not sensitive to deviations of Q around its optimal value; i.e., the TIC curve is quite flat around Q_0. Thus, random fluctuations of annual demand around its mean value $\overline{D}$=1530 MT would not affect inventory costs significantly. The derivation of

Q_0 by more precise methods is mathematically quite advanced and beyond our scope.

The inventory system with thus operate by placing an order for 48 MT when inventory on hand and on order reaches the reorder point of 571 MT. At that level there is a buffer stock of 33 MT to protect against stockouts ($x>R$) during the lead time of 102 days figure: 3.4.5.2 (page-71) shows the fluctuations of the inventory level.

In the absence of uncertainty in demand the holding cost would be equal to $C_H.Q_0/2$=(.12 × 447020) (48/2) = Tk. 1287418 = Tk. 1.3 million, since there would be no need for safety stock. Because in this case demand is probabilistic, there is a cost of uncertainty. This is the extra holding cost for the safety stock, or (.12 × 447020) (42) = Tk. 2252981 = Tk. 2.25 million per year. In setting the service level at 95%, management feels that this extra cost more than offsets the expected cost of stockouts avoided with the additional 33 MT.

For Q_0 = 48 there will be an average of 1530/48 = 31.875 orders per year. The 95 percent service level would allow shortages to occur 5 percent of the time, or around two times in every year [(31.875) (.05)=1.59 per year], which is relatively high and we can't allow it. In that case we can increase the service level to 98% instead of 95% and recalculate the TIC's and other findings.

Here,

$\overline{D}$ = 1530 MT/Yr = 1530/290 = 5.28 MT/day

S_D = 1.9 MT/day

L= 102 days

C_H = .12 × 4,47,020 Tk./ MT per Year

C_R = 39174 Tk./ Order

α = 2% (98% Service Level)

Calculation of Reorder Point R

For FOQ system the reorder point corresponds to the maximum reasonable demand during the lead time at the specified service level. Thus,

R= $x_{max} = \bar{x} + z_\alpha s_x$

Where, $\bar{x} = \overline{D}$. L = (5.28)(102) = 538 = average lead time demand

$z_\alpha = z_{.02}$ = 2.054 = number of standard deviation from mean for 98% service level

s_x = standard deviation of demand during lead time

If we assume that daily demands are independent, the variance of lead time demand x will be the sum of 102 daily demand variances

$s_x^2 = 102 s_D^2 = 102\ (1.9)^2 = 368.22$

Therefore $s_x = \sqrt{368.22} \cong 20$ MT

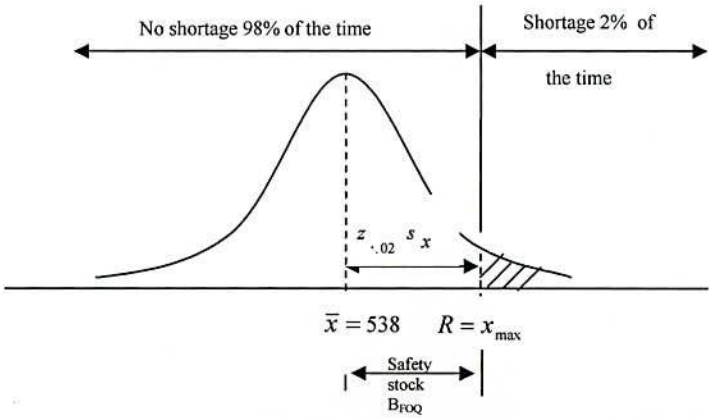


Figure: 4.5.b-1 Normal distribution of lead-time demand x

Reorder point R= $x_{max} = \bar{x} + z_\alpha s_x$

= 538 + (2.054)(20) = 538 + 41.08

≅ 580 MT

Therefore, safety stock in fixed order quantity system

$B_{FOQ} = x_{max} - \bar{x}$ = 580 – 538 = 42 MT

Using the EOQ model we obtain the fixed order quantity as follows:

$$Q_0 = \sqrt{\frac{2c_R\overline{D}}{c_H}} = \sqrt{\frac{2(39174)(1530)}{(.12)(447020)}} \cong 48 \text{ MT}$$

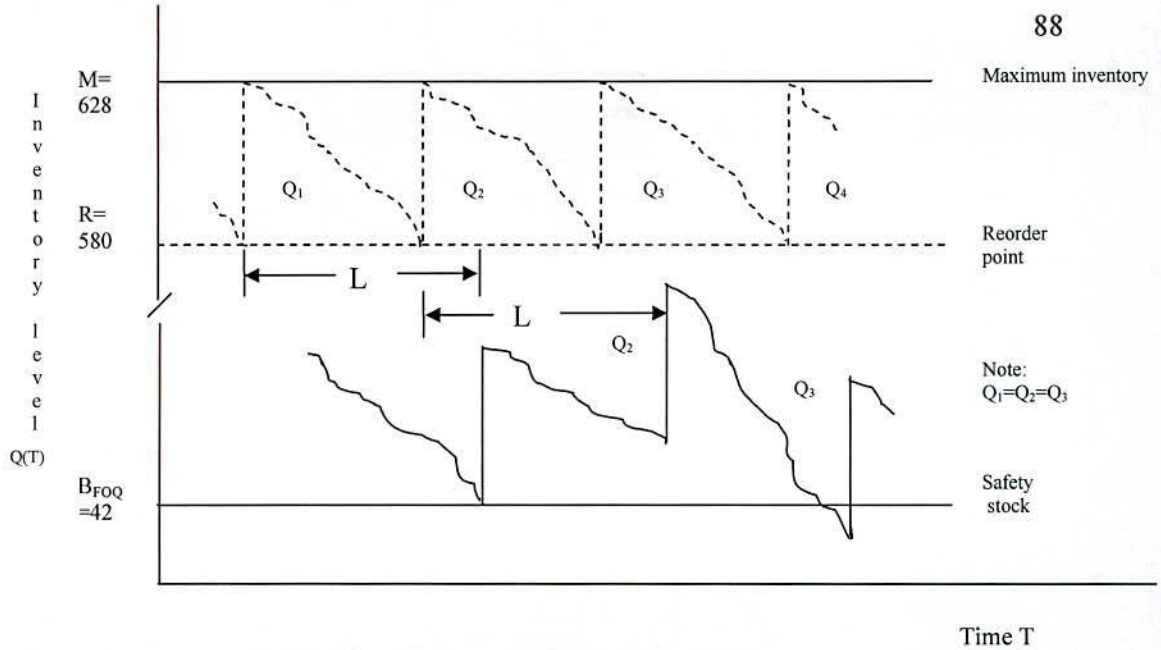


Figure-4.5.b-2.: Inventory functions in a fixed-order-quantity system with lead time exceeding the reorder cycle time (with 98% service level).

Cost Calculation

Cost	Cost per year
Holding: $C_H(\frac{Q_0}{2}+B_{FOQ})=(.12\times 447020)(\frac{48}{2}+42)$	Tk. 3540398
Ordering: $C_R\frac{D}{Q_0}=(39174)\frac{1530}{48}$	Tk. 1248671
Total inventory cost	Tk. 4789069

Therefore the total inventory cost is found as Tk 4306288 $\cong$ 4.8 million

Table 4.5.b

(Table shows the TIC for the above two approaches)

Approach	Total Incremental Cost (TIC) in '00000' (million) Tk.
Current approach A	26.9
Proposed approach B (95% service level)	4.3
Corrected Proposed approach B (98% service level)	4.8
Two further Consideration	
Case I (if they maintain safety stock for 20 days)	21.9
Case II (if they maintain safety stock for 10 days)	19.0

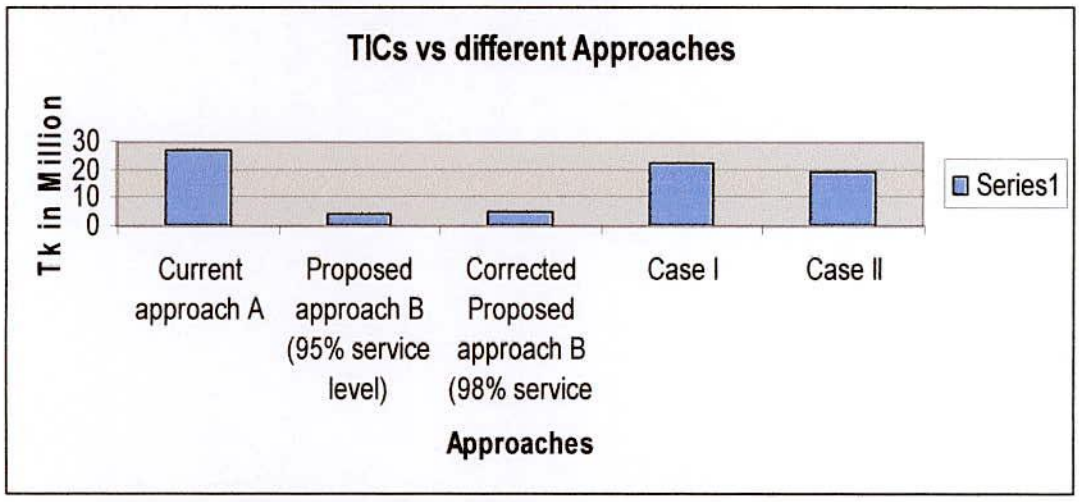


Figure: 4.5.b-3 Comparison of TICs between different approaches

This time the 98 percent service level would allow shortages to occur 2 percent of the time, or a little more than once every 2 year [(31.875) (.02)=0.6375 per year].

c. *Comparison of Lot-Sizing Performed By Various Inventory Decisions*

The total incremental cost (TIC) of any inventory depends on how much the lot size is and how frequently the order is being placed. It is simpler to consider TIC which includes only those costs, which are affected by the inventory decisions. Here, two main inventory decisions (approach A and approach B) along with another two decisions (case I and case II) are tried and the incremental inventory costs for copper are evaluated. In table TIC-PD, the TIC against each inventory decisions are presented. Annual TIC of each inventory decision helps to compare the decisions in terms of cost saving. It is evident that ordering a large amount of inventory per order and to maintain an excess or even a reasonable excess inventory (as safety or dead stock) in store for a longer period resulting in huge amount of holding cost. Presently BCSL is following its long practicing conventional inventory decision and not much aware of EOQ model technique. On the other hand, for raw material procurement BCSL requires lead time of 102 days and this lead time is about 1/3 (one third) of a year.

During this study, it has been observed that factor relating to estimation and holding cost and ordering cost are not considered at all Table 3.4.C includes TICs of different inventory decisions and compare with "proposed approach B".

Table 4.5.C below indicates the percentage increase of TIC of different inventory decisions as compared with EOQ model inventory decision "proposed approach B_2".

Table 4.5.c

(Percentage of TIC as compared with inventory decision "approach B".)

Sl. No.	Inventory decision	Total Incremental Cost (TIC) in '00000' (million) taka	Cost as compared with inventory decision "approach B*"	Remarks
1	2	3	4	5
1	Approach A	26.9	6.26 times	Highest (5th preferable)
2	Approach B (95% SL)	4.3	--	Lowest (Preferable)
3	Approach B (98% SL)	4.8	1.12 times	Forth highest (2nd preferable)
4	Case I	21.9	5.1 times	Second highest (4th preferable)
5	Case II	19.0	4.42 times	Third highest (3rd preferable)

* "Proposed approach B" with 95 percent service level.

From the Table 4.5.c it is noticeable that inventory decision with EOQ model approach B (98% SL) has a lot size (48MT) with safety stock (42 MT) and no stockouts.

Another important point to mention here that in "approach A", the company keeps 40 days safety stock and the corresponding TIC is 26.9 million Tk. But when the calculations are made for 20 days safety stock (Case I) and 10 days safety stock (Case II) the TICs are 21.9 million Tk. and 19.0 million Tk. respectively. This figures indicates that the decrease of TICs are not proportional to safety stock. This indicates that TIC depends on lot size and high holding cost. Finally we can make a conclusion that with high holding cost TIC increases for big lot sizes (600 MT).

Here, the proposed decision B (95% SL) is about 1/6th of current approach A which is noticeable in case of cost saving of BCSL.

On the other hand, TIC of "proposed approach B (98% SL)" with 42 MT safety stock and 48 MT lot size is forth highest (4.8 million Tk.) among all inventory decisions but there is no stockout and only (4.8-4.3=)0.5 million above the proposed approach B (95% SL).

4.6 APPLICATION OF SUPPLY CHAIN MANAGEMENT IN BCSL

BCSL is the only one and most vital member of telecommunication cable supply chain in Bangladesh. The company manufactures telecommunication cables from imported raw materials and supplies all its products to the real user. So, the company can be characterized with the context of its own supply chain. Presently the company receives raw materials from its successful tenderers, manufactures the products to satisfy the demand, and finally supply the products directly to the end users from its own store. From this it is clear that according to the sense of SCM, the company does not have any direct supplier who produces the raw materials, rather the company collects its inventories from the successful tenderers who are just intermediators and make profit out of these supplies. This is a lapse of the company regarding real SCM application in the company and related profitability. On the other hand, after production the sales department just informs the purchasers regarding delivery of the products. Purchasers take delivery directly from company's stack yard accordingly with their own costs and arrangements. In product delivery sector, the company has no sales center outside the factory yard. As a result the company has no transportation cost for reaching its products to the door of customer. Hence, the company has no extra expenses for selling its products.

Finally, it is clear that at the present prevailing situation of the company, all four drivers are not equally prominent regarding application of SCM in the company in real sense. The facility driver of the company is very strong as because its production capacity has been increase upto 1200000 cKm/year with most modern technology but till now the company is running with under capacity. Inventory driver is working with great criticality in the sense of profitability, transportation driver is totally absent, and information driver is just working for receiving orders along with delivery of the products but not developing trust and good relationship with all members of its supply chain for proper functioning and profitability. Analyzing all the drivers of SCM in the company, only the inventory driver requires special attention to remove the critically for making the company most profitable and efficient one.

4.7 BENEFITS FROM SCM

The primary benefit from SCM is the solution of problems in running the production system with full capacity of the company. Facility assets of the company exist for production and if production increases up to the full capacity then 100% benefit will be available from facility driver. The second substantial benefit from SCM is implementation of EOQ model in inventory sector for proper functioning of the company and increased profitability.

The following list of improvements in the operation of the company is frequently attributed for implementation of SCM:

- Improve customer service
- Improved vendor relationship
- Trust generation in supply chain members
- Reduction in unnecessary product delivery delay.
- Better understanding of capacity constraint.
- Best utilization of facilities.
- Significant increase in productivity.
- Reduction in lead time.
- Reduction in delivery time.
- Reduction in high holding cost.
- Reduction in safety stock.
- Elimination of annual inventory.
- Significant drop in annual accounting adjustment for inventory problem.
- Significant increase in profitability.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The study was undertaken to make an overview of the present status of SCM application in local manufacturing company, to asses its impacts on performance of the organization, to discuss the relevant issues and to suggest the action plans for successful implementation of SCM concept. In this regard a local telecommunication cable manufacturing company was selected as a representative organization. The analysis, comments, suggestions, action plans etc. are, therefore, based on the data and information collected from the company. The aims and objectives of the study include the investigation of bottlenecks in applying SCM concept, identification of most important and vital supply chain driver at present prevailing situation of the company, estimation of relevant inventory costs required for running the company more profitability, and recommendations for application of SCM in complete sense in future. On careful analysis of the findings, the necessary conclusions and recommendations can be made for the following:

1. Present scenario of the company in the context of SCM application.
2. Contributions of SCM for the company
    a. In operations and management.
    b. In cost saving.
    c. In profitability increase.
3. Suggested future action plan of the company.
4. Limitation of present study.

1. Present scenario of the company in the context of SCM application

- In the context of applying the concept of SCM, it can be said that the position of the company under investigation has its own supply chain but not accordance with the recent SCM in true sense. In BCSL's own supply chain, the direct relationship exists between BCSL and BTTB as because there is no retailer and distributor in between them. Relationship between raw material supply contractor and BCSL depends on tendering and on the other hand BCSL has no direct linkage with foreign raw material manufacturer. Hence, recording of data and information regarding on hand-

inventory, lead-times, various inventory costs is not properly classified and stored.

- The company is running with under capacity. For full capacity running requires searching markets for increase in demand. The company has no its own initiative to work for demand generation in international market. In the country the company has the highest market shear but except some foreign countries its international market shear is not at all prominent.
- In addition to the unfavorable external factors for SCM, most of the local companies are not much aware about the advantages of SCM application in manufacturing organizations. As a consequence, the scenario regarding SCM application is not expected to be encouraging in BCSL also.
- The company has a long practiced and conventional own supply chain, which is not accordance with the concept of recent SCM system. So, there is a wide scope of improving the current situation through implementation of SCM. At this stage even an approach with EOQ model can be a remarkable advantage.
- The study reveals that the company currently procures raw materials on the basis of its own conventional approach instead of following any formal methods commonly used for lot sizing.
- Compared to the present practice of determining the quantity in a lot i.e., the lot-size, SCM approach by using EOQ method can reduce the TIC of the inventory significantly.

2. Contribution of SCM for the company

There are direct and indirect or spin-off benefits in using SCM, which may be categorized in the context of superior management, cost reduction, and increase of profitability. Through the application of SCM, the company can be benefited from better management, reduction in costs and profitability increase.

a. Contribution in operations and management

- Quick decision-making is possible because of availability of structured information about products and production facilities as well as capacity.
- Accurate decision can be taken with reliable and up-to-date information from different members of the supply chain. Proper SCM application demands reliable and up-to-date data and information. Availability of such

data allows analyzing the decision-making parameters using mathematical model.

- There is better understanding of capacity constraints. The company operates with stores, machines, equipments and human resources having limited capacities. While implementing production schedule, the figures regarding capacities of these resources become critical and act as constraints or limitations. Through the application of SCM, the members of the total supply chain can overcome these types of limitations through their joint effort.
- As SCM maintains a tight schedule from procurement of raw material for in time delivery of products, it is necessary to monitor the supply in process and take necessary steps where needed in the entire supply chain. This certainly helps in time schedules of deliveries.
- There is scope of improved customer service, as SCM ensures timely delivery of products. In addition, a company may receive some urgent orders of a product, and in such cases, supply chain members can better manage to meet the customer's urgent need by adjusting with the situation and taking necessary measures jointly.
- Significant increase in productivity is possible through supply chain management. Thus material shortage or prolonged idle time of machine and labor are very unlikely in SCM oriented manufacturing.
- A product delivery lead-time is the summation of raw material ordering lead-time, manufacturing lead-time and assembly lead-time. SCM optimize all these lead-times and can deliver product in a shorter period.
- SCM estimates the inventory flow through the entire supply chain after economic analysis of demand. As a result there is a reduced level of inventory in the entire supply chain.

b. Contribution in cost saving

- Ordering cost is a significant cost, which can be curved only through mathematical determination of lot-size and number of order(s) for a certain period. EOQ lot sizing of SCM is based on reduced set-up or ordering and product changeover cost, and minimizes ordering cost significantly.

- SCM always updates the holding cost and ordering cost elements and determines total inventory cost which would facilitate annual accounting adjustment. Thus there is possibility of significant drops in annual accounting adjustment for inventory problem.
- SCM excels customer satisfaction by satisfying demand in time, which opens the opportunity for sales increment, generate higher productivity and optimize man-machine-material. As a result in SCM application there is increased sales and reduction in sales price.

c. Contribution in profitability increase

- For procurement of raw materials through tendering, the successful tenderers supply the inventories to the authority after purchasing from real inventory producer and having a measurable amount of profit. But if the authority procures the same inventories directly from the producers then the costs of inventories will be less than the supply prices of the tenderers. In supply chain management any supply takes place between producer and consumer. As a result the consumer gets the supply at reduced price as a member of same supply chain and with this fact the consumer's profitability increases.
- Through EOQ model in supply chain the holding cost is generally minimum as because there is no unnecessary large inventory in stock. Hence, with minimizing the holding cost a company can increase its profitability through implementation of SCM.
- With proper application of SCM, a company can satisfy its customers. With the customer satisfaction the sales of the company increases. When the sale increases, the profitability also increases.

3. Suggested future action plan of the company

- The company generally receives most orders for home requirement and some orders from foreign countries through government level. But these orders are not sufficient enough to run the company's factory with full capacity. So, from the point of profitability, the company is always under profitable in respect of its capacity. To make the company more profitable than the existing situation, the company must capture reasonable international market share.

- Presently the company procures all its required inventories through international tendering system according to PPR 2003 of Bangladesh government. In this system the company collects all inventories from the successful international tenderers but not directly from the actual producers of the inventories, which is the negative sense of SCM. For this the company can establish close relationships with actual foreign producers and make necessary arrangements for procuring all its inventories directly from them.
- BCSL may insists economic ministers of Bangladesh embassies in Middle East and African countries for working at Government level of those countries for marketing of BCSL's products and thereby generating foreign currency for Bangladesh.
- During the present study it has been learnt that the company practices ordering of raw materials with thumb rule or its own conventional approach, which increases high inventory holding cost. For reducing this cost, BCSL may use a practicable moderate small lot size and thereby computing an economic time interval between replenishment orders.
- At the present situation BCSL is facing less demand from BTTB due to sudden expansion of cell phones and satellite communication systems in recent years. On the other hand, company spends about two million taka for the salary purpose of its 250 workforce (10 engineers, 40 other officers, 130 factory staff and 70 others staff) and incurs a huge amount of establishment cost. Now, for existence BCSL should go for product mix. The necessary additional products may be high quality electrical wires of different specifications and power supply cables. The location facilities and required infrastructure are available there with some modification and alteration.
- According to conventional practice of BCSL, TIC of imported copper is very high (more that six times) as compared with calculated TIC of EOQ model. In conventional practice there were 3 (three) number of orders with 600 MT lot size, and 200 MT safety stock. In this connection, we have a TIC curve for copper import of BCSL as shown in Figure 5.1.3-1. From the curve we can observe that TIC curve starts to be flat at the point of 6 (six) orders in a year which means TIC is relatively and reasonably minimum with 6 orders here.

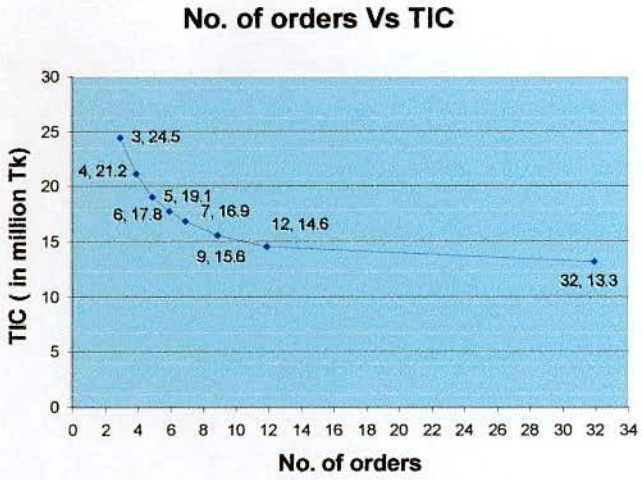


Figure 5.1.3-1 Showing TIC against number of orders when safety stock is 200MT.

In the EOQ model, the calculated number of orders is 32 with 48 MT lot size, and 42 MT safety stock (to avoid stockouts the revised calculated safety stock is 42 MT). The EOQ model calculation for imported copper is mathematically correct and provides an indication regarding conventional inventory practice of BCSL, but from the view point of import and shipping considerations, the EOQ model may not work properly. Now, we have another TIC curve (with 42 MT safety stock as per EOQ model FOQ system) for copper import with different numbers of yearly orders as shown in figure 5.1.3-2

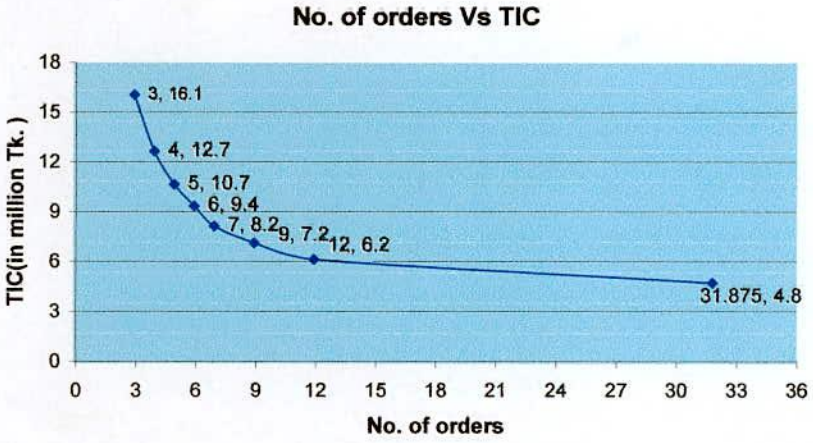


Figure 5.1.3-2 Showing TIC against number of orders with 42 MT safety stock.

In this situation BCSL can select the number of yearly orders according to shipping feasibility from exporting country. From Figure 5.1.3-2 it appears that, according present situation, there may be around 6 (six) orders in a year and after selection of yearly order numbers BCSL can determine practical receivable order size according to demand of the year concerned.

- For procurement of raw materials, BCSL generally goes for tender at least three times in a year. Tendering is time consuming practice and delays quick procurement. According to PPR-2003 tendering time period is minimum 42 days. Within 102 days lead time of BCSL, tendering system claims 42 days. To minimize this 42 days BCSL can go for advanced tender for selection of supplier and price for future supplies for the next year with anticipated demand or open demand. After fixation of supplier and rate of inventory, BCSL can procure its tendered inventory throughout the next year as per provision in the tender document and thereby can eliminate 42 days lead time associated with tender.

4. Limitations of the present study

In estimating various cost parameters, some assumptions were made. In reality the assumptions are not strictly valid, which may be considered as limitations of the study. The following have been identified as major limitations:

- In reality a number of items are usually ordered at a time for procurement. This is true for foreign materials because of time consuming international tendering systems. So, analysis on the basis of single item may lead to some deviation from reality.
- Fixed lead-time was considered, which is not strictly true.
- Ordering cost was considered to be independent of the lot-size. In real life there may be some deviations.
- Uncertainly was not taken into account.
- During determination of EOQ cycle time, shipping time for import of inventory was not considered which is deviation from reality.
- During purchase the fund availability may act as constraint. Limitation of liquid money was not treated as a factor.

5.2 RECOMMENDATIONS FOR FUTURE WORK

This is a good opportunity to work on SCM application in a local manufacturing company of the country. The scenario of local companies in respect of SCM application is not expected to be very different from what has been observed in the study. So, this is a tremendous scope of applying this technique and thus help to improve the productivity of profit margin of the local companies. Recommendations are given below:

1. Presently BCSL is producing only telecommunication cables but facing great impact from cell phones and as well as satellite telecommunication system. For the existence, BCSL should go for product mix and other additional products may be high quality electrical wires, power supply cables etc. For the production of additional products, BCSL needs necessary facilities. Hence, new facility creation and calculation of related profitability can be a future work area.
2. Cycle time 9 (nine) days may work as a constraint for shipping. If it works as a constraint, it should be imposed as a new constraint for developing a new optimization technique.
3. BCSL procures all its foreign raw materials through international tendering according to PPR-2003. The tendering procedure is time consuming and retires 42 days. It is to be mentioned here that in the total lead time (102 days) of the company there is 42 days for tendering. So tendering system according to PPR-2003 has some effects over the performance of the company. Therefore, it may be another future work area to measure the effect of PPR-2003 over the performance of BCSL.

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Appendix A

2005-2006												
Sl	Raw-Material	Op. Bal.	Issued	Total	Cl. Bal.	Actual use	Net req.	Allowance	Act.	Req	Allow	Per
		01/07/05	Up to June ,06		01/07/06	1052189.884			%	with allow.	%	Lac ckm
No		kg	kg	kg	kg	kg	kg	kg		kg		kg
	1	2	3	4=2+3	5	6=4-5	7	8=6-7	9=8/7*100	10=7*11	11	12
1	Copper	10541.0	1700000.0	1710541	186292.801	1524248	1530738.7	-6490.5	-0.42%	1607275.65	5.0	152755.285
2	Black PE	1227.0	583079.0	584306	5982.541	578323	566774.8	11548.7	2.0% ✓	589445.768	4.0	56020.855
3	Solid PE	728.0	203545.0	204273	18787.936	185485	187998.9	-2513.8	-1.3% ✓	197398.856	5.0	18760.764
4	Foam PE	333.0	127986.0	128319	13664.768	114654	111569.7	3084.6	2.8% ✓	122726.649	10.0	11663.926
5	Alu-Tape	2000.0	168789.0	170789	6750.000	164039	162841.2	1197.8	0.7% ✓	164469.597	1.0	15631.171
6	Steel Tape	1350.0	105653.0	107003	400.000	106603	128394.4	-21791.4	-17.0% ✓	128394.376	0.0	12202.586
7	Petro-Jelly	200.0	310530.0	310730	4080.000	306650	443531.8	-136881.8	-30.9%	447967.123	1.0	42574.742
8	Polyester foil	500.0	25182.0	- 25682	1550.000	24132	25363.2	-1231.2	-4.9%	25616.831	1.0	2434.621
9	Polital foil	25.0	11356.0	11381	25.000	11356	12621.3	-1265.3	-10.0%	12747.556	0.0	1211.526
10	Colour Maste	150.0	7175.0	7325	1125.000	6200	6933.3	-733.3	-10.6%	7279.976	5.0	691.888
11	PVC Ins.	0.0	0.0	0	0.000	0	0.0	0.0	-100.0%	0.001	10.0	0.000
12	PVC Jecket	25.0	5.0	30	650.000	-620	4518.2	-5138.2	-113.7%	4698.904	4.0	446.583

Appendix B

বাংলাদেশ কেবল শিল্প লিঃ,খুলনা
উৎপাদন পরিকল্পনা বিভাগ
২০০৫-২০০৬ অর্থ বছরের উৎপাদন

কেবলের প্রকার	জুলাই,০৫	আগষ্ট - ০৫	সেপ্টেম্বর -০৫	অক্টোবর -০৫	নভেম্বর-০৫	ডিসেম্বরর-০৫	জানুয়ারী,০৬	ফেব্রুয়ারী,০৬	মার্চ,০৬	এপ্রিল,০৬	মে,০৬	জুন,০৬	মোট
	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ	কঃ কিঃ মিঃ
প্রাইমারী	৭০৯৪৮.৯০৪	৭২৩৮৬.২৫২	৬৯৯৩৭.৮৮০	৫৮১৩২.১০৪	৭২১৪৭.৯৮৪	৭৭৬০৫.৭৮৮	৭৪৩৩৮.৪০০	৪৭৯৫২.০৫২	৪১৫৫৪.১৫৬	৪৫৪৭৩.৩১২	৩৮১৪৭.৪৫৬	৪৪৭৭৪.৩৯৬	৭১৩৩৯৮.৬৮৪
সেকেন্ডারী	৬৭১৯.২০৮	৩৬২৮৭.০৪০	৩৬০৪২.৬১৬	১৮৭৭০.২৪৪	২৬৬৬৯.০৬৮	২৩৪৮৪.৫৮৮	২০৫৯১.১৪৮	৩১২৫২.১৬৪	১৭১৬৬.২১৬	২৯৫৭৭.৫৪৪	৩৬৯৬৭.১৫২	২৬৭৬৯.২৪৮	৩১০২৯৬.২৩৬
সুইচবোর্ড	২০৫.৮১২	৮৭.৬০০	২৩৭৮.১৩২	৫৭২.৭৭২	১০৬.৪৮৮	২০৮.৮৪৮	২৯.৪৭২	১০২০১.২৩২	৬৬৭.১৩২	৪.৪৮৮	০.০০০	০.০০০	১৪৪৬১.৯৭৬
ড্রপ-ওয়ার	৪৩৪১.৮১৮	১৩২৮.২২৪	১৭১৬.৩৬০	২৬২৩.৯৩০	১১১৯.৪৭২	৭৭৯.৯৮৪	১২৪.১০৮	৬০৮.৪৭৮	৭০৬.২৭২	২০০.৯৭৬	১২৯.৫২০	৩৫৩.৮৪৬	১৪০৩২.৯৮৮
মোট =	৮২২১৫.৭৪২	১১০০৮৯.১১৬	১১০০৭৪.৯৮৮	৮০০৯৯.০৫০	১০০০৪৩.০১২	১০২০৭৯.২০৮	৯৫০৮৩.১২৮	৯০০১৩.৯২৬	৬০০৯৩.৭৭৬	৭৫২৫৬.৩২০	৭৫২৪৪.১২৮	৭১৮৯৭.৪৯০	১০৫২১৮৯.৮৮৪
পর্যন্ত	৮২২১৫.৭৪২	১৯২৩০৪.৮৫৮	৩০২৩৭৯.৮৪৬	৩৮২৪৭৮.৮৯৬	৪৮২৫২১.৯০৮	৫৮৪৬০১.১১৬	৬৭৯৬৮৪.২৪৪	৭৬৯৬৯৮.১৭০	৮২৯৭৯১.৯৪৬	৯০৫০৪৮.২৬৬	৯৮০২৯২.৩৯৪	১০৫২১৮৯.৮৮৪	

পরিকল্পনা সহকারী ৩৫/৭/০৬

উর্দ্ধতন প্রকৌশলী (উৎঃ পরিঃ) ৩৫/৭/০৬

ব্যবস্থাপক (উৎঃ পরিঃ ও মান নিঃ) ৩৫/৭/০৬

Appendix C

"Cost-A" (tender preparation and PO issue) for copper import in 2005-2006

BCSL imports all its raw materials through international tender. For tender preparation, publication in national dailies, informing sourcing countries, tender receiving, decision taking against received tenders, and issuing purchase order, BCSL has the following associated costs:

1. **Tender preparation cost**
   a. One computer operator (Tk. 150.00/day) works for 3 working days.
   b. One junior officer (Tk. 9000/month) works for 1 working day.

   Tender preparation cost = (150.00 × 3) + (9000.00/30) = Tk. 750.00

2. **Computer compose print out and photocopy costs of tender schedule**

   Generally 36 sets of tender schedules are prepared and each set contains 18 pages. Here, one set is computer print out and rest 35 sets are photocopy.

   a. Computer compose print out =18 × 5.50 (per page cost)
      = Tk. 99.00
   b. Photocopy paper = 35 × 18 × 0.6 (Per page paper cost)
      = Tk. 378.00
   c. Photocopy Cost = 35 ×18 × 0.25 (Per page photocopy cost)
      = Tk. 157.50

   Total cost of item 2 = Tk. 99.00 + 378.00 + 157.50
   = Tk. 634.50

3. **Tender document set preparation cost**

   One computer operator requires half working day.

   Cost of item 3 = Tk. 75.00

4. **Tender advertising cost**

   For wide circulation, advertisement is made in 3 nos national dailies (each daily advertisements for one day with a charge of Tk. 5000.00) for one day

   Cost of item 4 = Tk. 5,000.00 × 3 = Tk. 15,000.00

5. **Courier service charge**

   Tender documents are sent to 3 nos national dailies, 12 local agents, and 15 embassies (1.Sweden, 2.Poland, 3.Turkey, 4.Belgium, 5.Malaysia, 6.Denmark, 7.Canada, 8.Italy, 9.Australia, 10.USA, 11.Japan, 12.UK, 13.Germany, 14.France, 15.Korea) through courier service (courier service charge is less than post office charge) and courier service charge is Tk. 15.00 per document.

   Cost of item 5 = Tk. 15.00 × 30 = Tk. 450.00

6. **Cost associated with tender receiving and opening**

   Two managerial level officers (Tk. 23,000.00/month), one juniour level officer (9,000.00/month) and one computer operator work for one hour.

   Cost of item 6 = Tk. 247.92

7. **Cost associated with tender decision against received tenders**

   5 members from BCSL (one managerial level officer with salary Tk. 23,000.00/month, four deputy managerial level officers with salary Tk. 17,000.00/month), 2 members from outside, and one computer operator work for one working day. Outside members get Tk. 500.00 as honorarium and additional miscellaneous cost is Tk. 100.00

   Cost of item 7 = Tk. 4283.33

8. **Cost associated with correspondence regarding submission of performance security by the successful tenderer.**

   a. Preparation of letter by one computer operator in one working hour.
   b. Fax cost (3 minutes, Tk. 22.00 per minute).

   Cost of item 8 = Tk. 84.75

9. **Cost associated with preparation and issue of purchase order (PO).**

   a. Preparation of final purchase order (one computer operator works for two working hours).
   b. One copy computer print out (one copy costs Tk. 5.50).
   c. 6 nos photocopy of computer print out (each page costs Tk. 0.6 and photocopy charge is Tk. 0.25 per page).

   Cost of item 9 = Tk. 48.10

Now total cost (from item 1 to item 9) = Tk. 21,573.6

≅ Tk. 21,574 (Approx)

But in case of copper purchase, the tender value generally becomes more than Tk. 3 crores, and requires 7 (seven) member board recommendation. For this recommendation meeting each board member gets Tk. 2500.00 as honorarium and there is a miscellaneous cost of Tk. 100.00 for each board meeting. So, generally for each copper purchase order (PO), there is an additional cost of Tk. 17,600.00.

Hence, ordering cost of each PO for copper = Tk. 39,174.00

In 2005-2006, BCSL imported 1800 MT copper against 3 nos of POs. Ordering cost of three POs have shown in Table 1.

Table 1

Sl. No	PO code & date	Imported quantity in MT	Ordering cost associated with issuing PO
1	2	3	4
1.	427 Dates. 25.07.05	600	39,174.00
2.	437 Dates. 25.10.05	600	39,174.00
3.	444 Dates. 08.03.06	600	39,174.00
	Total:	1800	1,17.522.00

Appendix D

"Cost B" (assessable value) for copper import in 2005-2006

During any import the assessable value of any merchandise is the combination of C&F value of the materials, insurance and landing charges. **Assessable value is the value of imported material at homeport.**

In 2005-2006, the basis of insurance and landing charges are as follows.

Insurance = 2.84 (approx) % of C&F value

Landing charge = 1% of (C&F value + Insurance)

According to appendices BOE 1, BOE 2, BOE 3, BOE 4, BOE 5, BOE 6 and BOE 7, the assemble values of imported copper against each bill of entry of 3 POs are shown in Table 2

Table 2

Sl. no	PO code & date	Bill of entry (no & type)	Amount in MT	Assessable value in Tk.
1	2	3	4	5
1	427 dt. 25.07.05	1. Import	300.000	8,35,18,583.81
		2. Ex Bond	40.177	1,11,85,087.02
		3. Ex Bond	259.823	7,61,45,508.89
		Total:	600	17,08,49,179.70
2	437 dt. 25.10.05	4. Import	400	11,90,08,176.44
		5. Import	200	5,95,04,087.23
		Total:	600	17,85,12,263.60
3	444 dt. 08.02.06	6. Import	300	11,33,54,006.53
		7. Import	300	11,33,54,006.53
		Total:	600	22,67,08,013.00
		Grand Total:	1800	57,60,69,456.30

Appendix E

"Cost C" (taxes & duties) for copper import in 2005-2006

For any import, associated taxes, duties and other relevant costs are assessed by the custom department according to the custom rule of the country. Cost items and their shares depend on the assessable value of each bill of entry. Cost items are given below.

- Custom Duty (CD)
- Value Added Tax (VAT)
- Advance Income Tax (AIT)
- Infra-structure Development Surcharge (IDSC)

Taxes and duties against each bill of entry (appendices BOE 1, BOE 2, BOE 3, BOE 4, BOE 5, BOE 6, and BOE 7) for copper import are shown in Table 3

Table 3

Sl. no	PO code & date	Bill of entry (no & type)	Amount in MT	Total tax & duties in Tk.
1	2	3	4	5
1	427 dt. 25.07.05	1. Import	300	3,08,60,116.72
		2. Ex Bond	40.177	41,32,889.65
		3. Ex Bond	259.823	2,81,35,766.55
		Total:	600	6,31,28,772.92
2	437 dt. 25.10.05	4. Import	400	4,39,73,521.20
		5. Import	200	2,19,86,760.24
		Total:	600	6,59,60,281.44
3	444 dt. 08.02.06	6. Import	300	4,18,84,305.42
		7. Import	300	4,18,84,305.42
		Total:	600	8,37,68,610.84
		Grand Total:	1800	21,28,57,665.20

Appendix F

"Cost D" (survey charges) Survey for copper import in 2005-2006

After arrival of imported material at homeport the material requires to be surveyed in the presence of government appointed agency. Generally this survey charge is Tk. 5000.00 for each bill of entry. The survey charge is fixed and generally does not depend on the amount of material in each bill of entry.

Survey charges of each bill of entry against each PO are shown in table 4.

Table 4

Sl. no	PO code & dt.	Bill of entry (no & type)	Amount in MT	Total survey charges in Tk.
1	2	3	4	5
1	427 dt. 25.07.05	1. Import	300.000	5,000.00
		2. Ex Bond	40.177	5,000.00
		3. Ex Bond	259.823	5,000.00
		Total:	600	15,000.00
2	437 dt. 25.10.05	4. Import	400	5,000.00
		5. Import	200	5,000.00
		Total:	600	10,000.00
3	444 dt. 08.02.06	6. Import	300	5,000.00
		7. Import	300	5,000.00
		Total:	600	10,000.00
		Grand Total:	1800	35,000.00

Appendix G

"Cost E" (clearing & carrying charges) for copper import in 2005-2006

This cost is associated with clearing the imported material from homeport and carrying it up to BCSL store yard. This cost is generally 2.7% of assessable value of each bill of entry.

Cost associated with clearing and carrying of imported copper up to BCSL store yard are shown in Table 5.

Table 5

Sl. no	PO code & date	Bill of entry (no & type)	Amount in MT	Total clearing & carrying charges in Tk.
1	2	3	4	5
1	427 dt. 25.07.05	1. Import	300.000	22,55,001.76
		2. Ex Bond	40.177	3,01,997.35
		3. Ex Bond	259.823	20,55,928.74
		Total:	600	46,12,927.85
2	437 dt. 25.10.05	4. Import	400	32,13,220.76
		5. Import	200	16,06,610.36
		Total:	600	48,19,831.12
3	444 dt. 08.02.06	6. Import	300	30,60,558.18
		7. Import	300	30,60,558.18
		Total:	600	61,21,116.36
		Grand Total:	1800	1,55,53,875.33

Appendix H

"Cost F" (storing & record updating cost) for copper import in 2005-2006

Storing and necessary record updating for imported materials contained in each bill of entry have associated cost at BCSL end. Materials unloading, loading, placing properly in store, overall supervision, and updating stock books are the necessary works required to be done. According to discussion with BCSL store section it was known that generally 3 persons (one storekeeper, one store helper and one forklift driver) require one working day for storing and updating stock records for above 100MT of material and half working day below that amount. It is also known from the concern office that the three mentioned persons have the same salary amounting to Tk. 6000.00 per month. Now, we can have the storing and record updating cost against each bill of entry as shown in Table 6.

It may be mentioned here that storing and record updating cost depends on materials contend in each bill of entry and not on the amount mentioned in each PO.

Table 6

Sl. no	PO code & date	Bill of entry (no & type)	Amount in MT	Total storing & record updating cost in Tk.
1	2	3	4	5
1	427 dt. 25.07.05	1. Import	300.000	600
		2. Ex Bond	40.177	300
		3. Ex Bond	259.823	600
		Total:	600	1500
2	437 dt. 25.10.05	4. Import	400	600
		5. Import	200	600
		Total:	600	1200
3	444 dt. 08.02.06	6. Import	300	600
		7. Import	300	600
		Total:	600	1200
		Grand Total:	1800	3900

Appendix BOE1

TRIPLICATE

BILL OF ENTRY / EXPORT

General Information

1. DECLARATION: IM 4 | a | b | c N/A
d. Office Code: 501
e. Office Name: CHITTAGONG CUSTOM HOUSE
f. Manifest No.:
g. Registration No.: C-A[illegible]
h. Date: 16 OCT 2005

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL SINGAPORE LTD, 7,TEMASEK BOULEVARD 2703, TEC TOWER,SINGAPORE 038987
BIN :

3. Page: a 1 | b 1 | 4. N/A
5. Items: 1
6. Tot Pack: 120 Pallets
7. Agent Reference Number: 55 /05

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD,SHIROMONI,KHULNA. VAT.NO.3031000084
BIN :

9. N/A
10. N/A | 11. N/A
12. Total Assessable Value: Tk.8,35,18,583.81
13. N/A

14. Declarant/Agent [name and address]
SEAGULL SHIPPING,40,CENTENARY ROAD,KHULNA. LICENCE NO.01/C7 VAT.NO.3011013839
AIN :

15. Country of Export: a BUSAN KOREA | b KR | c N/A
15. Cntry.Exp.Code: a BD | b N/A
16. Country of Origin: BUSAN KOREA
17c. Country of Destination: BANGLADESH

18. Name of Carrier: KOTA RAMBA | Nationality: SG | 19. C.F.: 1
20. Delivery Terms: C+R

21. N/A

22. Currency: Total Invoice US.D. 12,24,525.00
23. Exch. Rate: 65.6654
24. Nat. of Trans: LC

25. MOT: 1
26. N/A
27. Place of loading/unloading: BUSAN/INCHON
28. Financial & Banking Data: Sector & Fund Source : 052
Bank Code : 0532
Bank Name : SCHALI BANK,KHULNA CORPORATE BRANCH,KHULNA.
L/C No : 0352 05 01 0076 dt: 26 / 07 / 05
L/C A No : 38664 dt: 24 / 07 / 05

29. Office of Entry/Departure: 501 MONGLA CUSTOM HOUSE
30. Location of Goods: YARD NO.3

Packages and Description of Goods

Marks and Numbers : 1.APLU-292351-6,2.APLU-300695-7, 3.APLU-301370-5,4.APLU-310171-8,5.APLU-319194-9
32. Item No.: 1
33. HS Code: 7408.11.00
Number of Packages : 120 Pallets | Packages Code : PT
34. C.O. Code: a KR | b N/A
35. Gross Weight [kg]: 303.240 M.T
36. Agr. Cd.
Container Number(s): 15x20' 6.CAKU-660957-5 7.CLHU-335933-6 8.CAKU-150534-0 9.GESU-307569-3 10.GESU-314103-3 11.GESU-262377-4 12.GESU-343058-0 13.APLU-308211-3 14.TCLU-252359-6 ....
37. CPC: a 4000 | b 173
38. Net Weight [kg]: 300.000 M.T
39. Visa Ref.
Tariff Description of the Goods : COPPER WIRE
40. Line Number/Sl. Number - Cargo Listing No.: 02 APLU-005706751 dt.12.09.05
Commercial Description & Specification of the Goods : COPPER WIRE (HOT ROLLED ELECTROLYTIC CLEANED OXYGEN-FREE PICKLED AND WAX COATED COPPER WIRE) 5/16 INCH(8MM) DIA.
41.Quantity/Unit: a PER M.T | b
42. Item Invoice Value: US.D.12,24,525.00
43. VM Code
IRC/EXC NO. : D/52604 | CRF / EXP NO. :
45. Adjustment :
Attach Doc. Codes : 101,102,203
Preceding I/E No. | Warehouse Code :
Invoice No. HID0000077533 | Date : 12 / 09 / 05
46. Item Assessable Value : =Tk.8,35,18,583.81
UP/UD No. : | Date : / /

Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	8,35,18,583.81	13%	1,08,57,415.90	
SD				
VAT	9,43,75,999.71	15%	1,41,56,399.96	
AIT	8,35,18,583.81	3%	25,05,557.51	
LF				
ESC	8,35,18,583.81	4%	33,40,743.35	
AVAT				
PSESC				
	TOTAL :		3,08,60,116.72	

48. Account Current No. : 11,APLU-332702-0
49. Warehouse Number
Period [days]
50. ACCOUNTING DETAILS
Mode of Payment :
Assessment No. : Date :
Receipt Number : Date :
Guarantee : Date :
DF / VAT : PAID VIDE CHALLAN NO. 189(KA)-10 dt. 16.0 10.05 Tk 41,39,300.00
Total Duty & Taxes : Tk 16,129.00
AIT PAID VIDE CHALLAN NO.189(KHA)-15 dt. 16.10.05

51. N/A
52. N/A
53. N/A
54. N/A

Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG): G 303.240 M.T | N 300.000 M.T

Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF)	12,24,525.00	USD
External Freight		
Insurance ACTUAL	34,763.26	USD
Landing Charge 1%	12,592.88	USD
Other Dutiable Costs		
Allowable Deductions		
TOTAL	12,71,881.14	USD

56. DECLARATION : I/we confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years

Name of Importer/Exporter | Designation | Signature | Date
MD. MOSHIUL ISLAM PARTNER SEAGULL SHIPPING.
Name of Authorized Person | Card No. | Signature | Date

(FOR OFFICIAL USE ONLY)
Name of Examination/Assessment Officer | Signature | Date

Appendix BOE2

EX. CONTROL COPY

EX-BOND

BILL OF ENTRY / EXPORT

General Information

2. Consignor/Exporter [name and address]
[illegible] 27-03 [illegible] 038987.
BIN :

8. Importer/Consignee [name and address]
[illegible] 3031000084
BIN :

14. Declarant/Agent [name and address]
[illegible] 3011013039
AIN :

18. Name of Carrier [illegible] | Nationality [illegible] | 19. C.F. 1

21. N/A

25. MOT 1 | 26. N/A | 27. Place of loading/unloading [illegible]

29. Office of Entry/Departure 501 [illegible] | 30. Location of Goods. [illegible]

1. DECLARATION [illegible] 7 a | b | c N/A

d Office Code [illegible]
e Office Name [illegible] CUS[illegible]
f Manifest No. 109/10[illegible]
g Registration No. 129
h Date 24 OCT 2005

3. Page a 1 | b 1 | 4. N/A

5. Items 1 | 6. Tot. Pack 16 Pallets | 7. Agent Reference Number : 59/05

9. N/A

10. N/A | 11. N/A | 12. Total Assessable Value : Tk.1,11,85,007.02 | 13. N/A

15. Country of Export a KOREA | 15. Cntry.Exp.Code b KR c N/A | 17. Cntry. Dest. Code a LD b N/A

16. Country of Origin KOREA | 17c. Country of Destination BANGLADESH

20. Delivery Terms C• R

22. Currency U.S.D. Total Invoice Value 163992.47 | 23. Exch. Rate 65.6654 | 24. Nat. of Trans. LC

28. Financial & Banking Data Bank Code : 0352
Sector & Fund Source : 052
Bank Name : SONALI BANK, KHULNA CORPORATE, BRANCH, KHULNA.
L/C No : 0352 05 01 0076 dt: 26 / 07 / 2005
L/C A No. : 36664 dt: 24 / 07 / 2005

31. Packages and Description of Goods

Marks and Numbers : [illegible]

Number of Packages: 16 Pallets Packages Code : PL

Container Number(s) [illegible] 1) 2) 3) 4)

Tariff Description of the Goods: COPPER WIRE [illegible]

Commercial Description & Specification of the Goods: [illegible] 5/16 INCH (8MM) DIA.

32. Item No. 1 | 33. HS Code 7408.11.00

34. C.O. Code a KR b N/A | 35. Gross Weight [kg] | 36. Agr. Cd.

37. CPC a 4071 b 173 | 38. Net Weight [kg] 40.177 M.T | 39. Visa Ref.

40. Line Number/Sl. Number - Cargo Lading No. 01 [illegible]-005709027 dt.19.09.05

41. Quantity/Unit a [illegible] b | 42. Item Invoice Value USD.163992.47 | 43. VM Code

44. Add. Infos Doc./ Produ.Certif. & Aut.

IRC/ERC No.: C/52604 CRF/ EXP No.:

Attach Doc. Codes: 101,102,[illegible]

Preceding I/E No.: Warehouse Code:

Invoice No.: [illegible]77533 (A) date: 19 / 09 / 2005

UP/UD No.: date: / /

45. Adjustment :

46. Item Assessable Value : Tk.1,11,85,007.02

47. Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	1,11,85,007.02	13%	14,54,051.31	
SD				
VAT	1,26,39,[illegible]	15%	18,95,[illegible].25	
AIT	1,11,85,007.02	3%	3,35,551.81	
LF				
IDSC	1,11,85,007.02	4%	4,47,403.48	
AVAT				
PSISC				
		TOTAL:	41,32,809.65	

48. Account Current No. | 49. Warehouse Number | Period (days)

50. ACCOUNTING DETAILS
Mode of Payment :
Assessment No.: Date :
Receipt Number : Date :
Guarantee : Date :
DF/VAT : PAID VIDE CHALLAN NO.189(KHA)-14 dt.16.10.05 against In-Bond B/E No. 124 dt. 16.10.05
Total Duty & Taxes: TK :
AIT PAID VIDE CHALLAN NO.189(KHA)-14 dt.16.10.05

51. N/A 41,32,899.85

52. N/A against In-Bond B/E No. 124 dt. 16.10.05

53. N/A

54. N/A

55. Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG)	G	N 40,177 [illegible]
Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF	1,63,992.47	USD
External Freight		
Insurance [illegible]	4,655.61	USD
Landing Charge 1%	1,686.48	USD
Other Dutiable Costs		
Allowable Deductions		
TOTAL	1,70,334.56	USD

56. DECLARATION: I/We confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.

BOND WAREHOUSE NO.5
IN-BOND B/E.NO.124 dt.16.10.05
[illegible]

Name of Importer/Exporter | Designation | Signature | Date

MD. MOMINUL ISLAM
PARTNER
SEAGULL SHIPPING.

Name of Authorized Person | Card No. | Signature | Date

(FOR OFFICIAL USE ONLY)

24-10-05

Name of Examination/Assessment Officer | Signature | Date

[illegible] 208 [illegible] 24/10/05

41,32,894.85

Appendix BOE3 TRIPLICATE

BILL OF ENTRY / EXPORT

General Information

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL SINGAPORE PTE.LTD.,
7,TEMASEK,BOULEVARD,27-03 SUNTEC EXE TOWER ONE
SINGAPORE 038987
BIN :

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD.,SHIROMONI,KHULNA.
VAT.NO.2031000084
BIN :

14. Declarant/Agent [name and address]
SEAGULL SHIPPING, 40,CEMETERY ROAD.,KHULNA.
VAT.NO.3011013839
AIN :

1. DECLARATION: IM | 7 | c N/A
d Office Code: 501
e Office Name: KHULNA CUSTOM HOUSE
f Manifest No.: 109/05
g Registration No.: 201
h Date: 05 APR 2006
3. Page: a 1 | b 1
4. N/A
5. Items: 1
6. Tot Pack: 104 PALLETS
7. Agent Reference Number: 11/06
9. N/A
10. N/A
11. N/A
12. Total Assessable Value: Tk.7,61,45,508.89
13. N/A
15. Country of Export: KOREA
15. Cntry.Exp.Code: b KR | c N/A
17. Cntry. Dest. Code: a BD | bN/A
16. Country of Origin: KOREA
17c. Country of Destination: BANGLADESH

18. Name of Carrier: KOTA RATNA | Nationality: SG | 19. C.F.: 1
20. Delivery Terms: CFR
21. N/A
22. Currency: US.D. | Total Invoice Value: 10,60,532.53 | 23. Exch. Rate: 69.1256 | 24. Nat. of Trans.: LC
25. MOT: 1
26. N/A
27. Place of loading/unloading: BUSAN SOUTH/KOREA
28. Financial & Banking Data | Bank Code: 0352
Sector & Fund Source: 052
Bank Name: SONALI BANK,KHULNA CORPORATE BR.KHULNA.
L/C No: 0351 05 01 0076 dt: 26 / 07 / 2005
L/C A No.: 38664 dt: 24 / 07 / 2005
29. Office of Entry/Departure: 501 KHULNA CUSTOM HOUSE
30. Location of Goods: WAREHOUSE NO.5

31. Packages and Description of Goods

Marks and Numbers: AS PER INVOICE
32. Item No.: 1
33. HS Code: 7408.11.00
Number of Packages: 104 PALLETS | Packages Code: PL
Container Number(s): 15x20' 1) 2) 3) 4)
34.C.O. Code: KR | a | b N/A
35. Gross Weight [kg]: 262,808 KGS.
36. Agr. Cd.
37.CPC: 4071 | a | 173 | b
38. Net Weight [kg]: 259,823 KGS.
39. Visa Ref.
Tariff/Description of the Goods:
Commercial Description & Specification of the Goods: COPPER WIRE(NOT ROLLED ELECTROLYTIC CLEANED OXYGEN-FREE PICKLED AND WAX COATED COPPER WIRE) 5/16 INCH (8MM) DIA.
40.Line Number/Sl.Number - Cargo Lading No.: 01 APLU0057090?2 dt.10.09.05

44. Add. Infos/ Doc./ Produ.Certif. & Aut.

IRC/ERC No.:
CRF/ EXP No.:
Attach.Doc. Codes: 102,101,203
Preceding I/E No.:
Warehouse Code:
Invoice No.: HIDoooo77533(A) date: 19 / 09 / 05
UP/UD No.: date: / /
41.Quantity/Unit: a 259.823 KGS | KGS.
42. Item Invoice Value: US.D.10,60,532.53
43. VM Code
45.Adjustment:
46.Item Assessable Value: Tk.7,61,45,508.89

47. Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	7,61,45,508.89	13%	98,98,916.16	
SD				
VAT	8,60,44,425.05	15%	1,29,06,663.76	
AIT	7,61,45,508.89	3%	22,84,365.27	
LF				
IDSC	7,61,45,508.89	4%	30,45,821.36	
AVAT				
PSISC				
	TOTAL:		2,81,35,766.55	

48. Account Current No.
49. Warehouse Number
Period (days)
50. ACCOUNTING DETAILS
Mode of Payment:
Assessment No.: Date:
Receipt Number: Date:
Guarantee: Date:
DF/VAT: PAID VIDE CHALLAN NO.189(KA)-09 dt.16.10.05 AGAINST B IN-BOND B/ENTRY NO.124 dt.16.10.05
Total Duty & Taxes: TK.
AIT PAID VIDE CHALLAN NO.189(KHA)-16 dt.16.10.05 AGAINST IN-BOND B/ENTRY NO.124 dt.16.10.05

51. N/A
52. N/A
53. N/A
54. N/A

55. Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG)	G 262808 KGS	N 259823 KGS
Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF	10,60,532.53	USD
External Freight		
Insurance ACTUAL	30,107.65	USD
Landing Charge 1%	10,906.40	USD
Other Dutiable Costs		
Allowable Deductions		
TOTAL	11,01,546.58	USD

56. DECLARATION: I/We confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.
BOND WAREHOUSE NO.5
IN-BOND B/ENTRY NO.124 dt.16.10.05

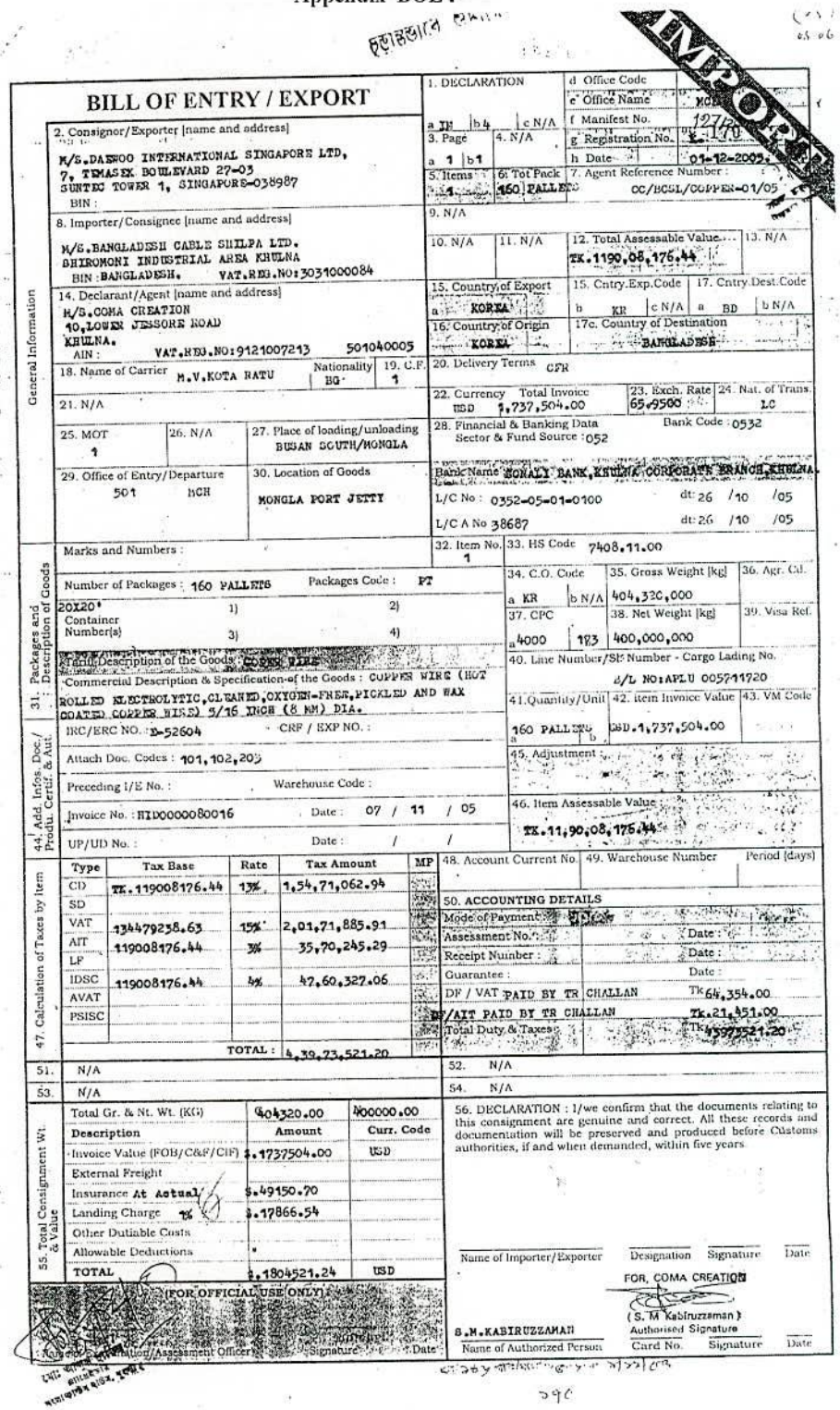
Name of Importer/Exporter | Designation | Signature | Date
MD. SHAMSUDDIN
PARTNER
SEAGULL SHIPPING.

FOR OFFICIAL USE ONLY

Name of Examination/Assessment Officer | Signature | Date

Name of Authorized Person | Card No. | Signature | Date

Appendix BOE4



IMPORT

BILL OF ENTRY / EXPORT

General Information

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL SINGAPORE LTD,
7, TEMASEK BOULEVARD 27-03
SUNTEC TOWER 1, SINGAPORE-038987
BIN :

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD.
DHIROMONI INDUSTRIAL AREA KHULNA
BIN : BANGLADESH. VAT.REG.NO:3031000084

14. Declarant/Agent [name and address]
M/S.COMA CREATION
10,LOWER JESSORE ROAD
KHULNA.
AIN : VAT.REG.NO:9121007213 501040005

18. Name of Carrier M.V.KOTA RATU | Nationality BG | 19. C.F. 1

21. N/A

25. MOT 1 | 26. N/A | 27. Place of loading/unloading BUSAN SOUTH/MONGLA

29. Office of Entry/Departure 501 hCH | 30. Location of Goods MONGLA PORT JETTY

1. DECLARATION | d Office Code | e Office Name MCT
a IM | b 4 | c N/A | f Manifest No. 127/05
3. Page a 1 | b 1 | 4. N/A | g Registration No. C-170
5. Items 1 | 6. Tot Pack 160 PALLETS | h Date 01-12-2005
7. Agent Reference Number : CC/BCSL/COPPER-01/05

9. N/A

10. N/A | 11. N/A | 12. Total Assessable Value TK.1190,08,176.44 | 13. N/A

15. Country of Export a KOREA | 15. Cntry.Exp.Code b KR | c N/A | 17. Cntry Dest.Code a BD | b N/A
16. Country of Origin KOREA | 17c. Country of Destination BANGLADESH

20. Delivery Terms CFR

22. Currency Total Invoice USD 1,737,504.00 | 23. Exch. Rate 65.9500 | 24. Nat. of Trans. LC

28. Financial & Banking Data Bank Code : 0532
Sector & Fund Source : 052
Bank Name SONALI BANK,KHULNA CORPORATE BRANCH,KHULNA.
L/C No : 0352-05-01-0100 dt: 26 /10 /05
L/C A No 38687 dt: 26 /10 /05

32. Item No. 1 | 33. HS Code 7408.11.00

Packages and Description of Goods

Marks and Numbers :
Number of Packages : 160 PALLETS | Packages Code : PT
20X20' Container Number(s) 1) 2) 3) 4)
Retail Description of the Goods : COPPER WIRE
Commercial Description & Specification of the Goods : COPPER WIRE (HOT ROLLED ELECTROLYTIC,CLEANED,OXYGEN-FREE,PICKLED AND WAX COATED COPPER WIRE) 5/16 INCH (8 MM) DIA.

34. C.O. Code a KR | b N/A | 35. Gross Weight [kg] 404,320,000 | 36. Agr. Cd.
37. CPC a 4000 | 183 | 38. Net Weight [kg] 400,000,000 | 39. Visa Ref.
40. Line Number/Slc Number - Cargo Lading No.
B/L NO:APLU 005711920
41. Quantity/Unit a 160 PALLETS | b | 42. Item Invoice Value USD.1,737,504.00 | 43. VM Code
45. Adjustment :
46. Item Assessable Value : TK.11,90,08,176.44

Add. Infos. Doc. / Produ. Certif. & Aut.

IRC/ERC NO. : E-52604 | CRF / EXP NO. :
Attach Doc. Codes : 101,102,205
Preceding I/E No. : | Warehouse Code :
Invoice No. : HIV0000080016 | Date : 07 / 11 / 05
UP/UD No. : | Date : / /

Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	TK.119008176.44	13%	1,54,71,062.94	
SD				
VAT	134479238.63	15%	2,01,71,885.91	
AIT	119008176.44	3%	35,70,245.29	
LF				
IDSC	119008176.44	4%	47,60,327.06	
AVAT				
PSISC				
	TOTAL :		4,39,73,521.20	

48. Account Current No. | 49. Warehouse Number | Period (days)

50. ACCOUNTING DETAILS
Mode of Payment : PAY ORDER
Assessment No. : Date :
Receipt Number : Date :
Guarantee : Date :
DF / VAT PAID BY TR CHALLAN TK 64,354.00
SD/AIT PAID BY TR CHALLAN Tk.21,851.00
Total Duty & Taxes : TK 43973521.20

51. N/A
52. N/A
53. N/A
54. N/A

Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG) 404320.00 | 400000.00

Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF)	$.1737504.00	USD
External Freight		
Insurance At Actual	$.49150.70	
Landing Charge 1%	$.17866.54	
Other Dutiable Costs		
Allowable Deductions		
TOTAL	$.1804521.24	USD

56. DECLARATION : I/we confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.

Name of Importer/Exporter | Designation | Signature | Date
FOR, COMA CREATION
(S. M Kabiruzzaman)
Authorised Signature
S.M.KABIRUZZAMAN
Name of Authorized Person | Card No. | Signature | Date

(FOR OFFICIAL USE ONLY)
Name of Examination/Assessment Officer | Signature | Date

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Appendix BOE5

TRIPLICATE

IMPORT

BILL OF ENTRY / EXPORT

General Information

1. DECLARATION: a IM | b 4 | c N/A

d Office Code:
e Office Name: [illegible]
f Manifest No.: 1341[illegible]
g Registration No.: [illegible]
h Date: [illegible] DEC [illegible]

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL SINGAPORE PTE LTD.,
7,TEMASEK BOULEVARD 27-03
SUNTEC TOWER 1, SINGAPORE-038987
BIN :

3. Page: a 1 | b 1
4. N/A
5. Items: [illegible]
6. Tot Pack: [illegible]
7. Agent Reference Number : CC/BCSL/COPPER-02/05

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD.,
SHIROMONI INDUSTRIAL AREA,KHULNA
BANGLADESH.
BIN :
VAT.REG.NO:3031000084

9. N/A
10. N/A
11. N/A
12. Total Assessable Value: TK.5,95,2[illegible]
13. N/A

14. Declarant/Agent [name and address]
M/S.COMA CREATION
90,LOWER JESSORE ROAD
KHULNA.
AIN : VAT.REG.NO:9121007213 301040005

15. Country of Export: KOREA
15. Cntry.Exp.Code: b KR | c N/A
16. Country of Origin: KOREA
17. Cntry.Dest.Code: a BD | b N/A
17c. Country of Destination: BANGLADESH

18. Name of Carrier: M.V."KOTA RATU" | Nationality: BD | 19. C.F.: 1
20. Delivery Terms: CFR
21. N/A
22. Currency: USD | Total Invoice: 8,68,752.00
23. Exch. Rate: [illegible]
24. Nat. of Trans.: LC
25. MOT: 1
26. N/A
27. Place of loading/unloading: BUSAN SOUTH/MONGLA
28. Financial & Banking Data — Bank Code : 0932
Sector & Fund Source : 052
29. Office of Entry/Departure: 501 MCH
30. Location of Goods:
Bank Name: [illegible]
L/C No : 0352-05-01-0100 dt: 26 / 10 / 05
L/C A No :38687 dt: 26 / 10 / 05

31. Packages and Description of Goods

Marks and Numbers :
32. Item No.: 1
33. HS Code: 7408.11.00
Number of Packages : 80 PALLETS | Packages Code : PT
34. C.O. Code: a KR | b N/A
35. Gross Weight [kg]: 202,160.00 KGS
36. Agr. Cd.:
Container Number(s): 10X20' 1) 2) 3) 4)
37. CPC: a 4000 | b 173
38. Net Weight [kg]: 200,000.00 KGS
39. Visa Ref.:
Tariff Description of the Goods: COPPER WIRE
40. Line Number/Sl. Number - Cargo Lading No.: 01 B/L NO:APLU 003712288
Commercial Description & Specification of the Goods : COPPER WIRE(HOT ROLLED, ELECTROLYTIC,CLEANED,OXYGEN-FREE,PICKLED AND WAX COATED COPPER WIRE) 5/16 INCH (8 MM) DIA.
41. Quantity/Unit: 80 PALLETS
42. Item Invoice Value: $.868752.00
43. VM Code:

44. Add. Infos. Doc./Produ. Certif. & Aut.

IRC/ERC NO. : B-52684 | CRF / EXP NO. :
Attach Doc. Codes : 101,102,203
Preceding I/E No. : | Warehouse Code :
Invoice No. EID0000080016(A) | Date : 14 / 11 / 05
UP/UD No. : | Date : / /
45. Adjustment : [illegible]
46. Item Assessable Value: [illegible]

47. Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	5,95,04,087.23	13%	77,35,531.34	
SD				
VAT	6,72,39,618.57	15%	1,08,85,942.79	
AIT	5,95,04,087.23	3%	17,85,122.62	
LF				
IDSC	DO	4%	23,80,163.49	
AVAT				
PSISC				
		TOTAL :	2,49,86,760.24	

48. Account Current No.
49. Warehouse Number | Period (days)

50. ACCOUNTING DETAILS
Mode of Payment :
Assessment No. : | Date :
Receipt Number : | Date :
Guarantee : | Date :
DF / VAT PAID BY TR CHALLAN | Tk : 37,576.00
DF/AIT PAID BY TR CHALLAN | TK. : 12,525.00
Total Duty & Taxes : | Tk :

51. N/A
52. N/A
53. N/A
54. N/A

55. Total Consignment Wt. & Value

Description	Amount	Curr. Code
Total Gr. & Nt. Wt. (KG)	202160.00	200000.00
Invoice Value (FOB/C&F/CIF)	868752.00	US$
External Freight		
Insurance ACT.	24575.34	
Landing Charge 1%	8933.27	
Other Dutiable Costs		
Allowable Deductions		
TOTAL	902260.61	

56. DECLARATION : I/we confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.

Name of Importer/Exporter | Designation | Signature | Date

FOR COMA CREATION
(S. M. Kabiruzzaman)
Authorised Signature

S.M.KABIRUZZAMAN
Name of Authorized Person | Card No. | Signature | Date

(FOR OFFICIAL USE ONLY)
Name of Examination/Assessment Officer | Signature | Date

মোঃ/আবদুল কাদের
[illegible]
[illegible]

Appendix BOE6

TRIPLICATE

IMPORT

BILL OF ENTRY / EXPORT

1. DECLARATION: IM 4 | a | b | c N/A
d. Office Code: 501
e. Office Name:
f. Manifest No.: 85
g. Registration No.:
h. Date: 14/03/2006

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL CORPORATION
PO BOX 2219 SEOUL 100-714,SOUTH KOREA.
M/S.DAEWOO INTERNATIONAL SINGAPORE PTE.LTD.
7,PENAISK BOULEVARD 27-03 SUNTEC TOWER 1.
BIN: SINGAPORE.

3. Page: a 1 | b
4. N/A
5. Item
6. Total No. of Pack
7. Agent Reference Number

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD,SHIROMONI,
KHULNA. VAT.NO-3051000884
BIN:

9. N/A

10. N/A | 11. N/A | 12. Total Assessable Value | 13. N/A

14. Declarant/Agent [name and address]
COMA CREATION 55/1.ASSAN AHMED ROAD,KHULNA.
VAT.NO.3071025461
AIN:

15. Country of Export | 15. Cntry.Exp.Code: a | b KR | c N/A
17. Cntry.Dest.Code: a BD | b N/A

16. Country of Origin | 17a. Country of Destination

18. Name of Carrier: KOTA PETANI | Nationality: SG | 19. C.F.: 1

20. Delivery Terms: CFR

21. N/A

22. Currency: Total Invoice: US.D.1578420.00 | 23. Exch. Rate: 69.1200 | 24. Nat. of Trans.: LC

25. MOT: 1 | 26. N/A | 27. Place of loading/unloading: BUSAN SOUTH/BUSAN

28. Financial & Banking Data: Bank Code: 0352
Sector & Fund Source: 062

29. Office of Entry/Departure: 501 KHULNA CUSTOM HOUSE | 30. Location of Goods: YARD NO.3

Bank Name: [illegible] BANK KHULNA CORPORATE BRANCH KHULNA
L/C No: 0352 06 01 0008 dt: 09 /02 /06
L/C A No: 38693 dt: 09 /02 /06

31. Packages and Description of Goods

Marks and Numbers: 1.APLS2955779 2.CLHU-3328778 3.XOLU-2213300 4.COTU-3660914 5.XILU-2251872
Number of Packages: 120 PALLETS | Packages Code: PT
Container Number(s): 6.XLCU-2089748 7.XOSU-2289229 8.XDSU-2375287 9.XOSU-2400897 10.XDSU-2474810 11.XDSU2481709 12.XOSU2497830 13.SCZU-7764799 14.TRHU6786934
Description of Goods
Commercial Description & Specification of the Goods: COPPER WIRE (HOT ROLLED) ELECTROLYTIC CLEARED OXYGEN-FREE, PICKED AND WAX COATED COPPER WIRE) 5/16 INCH (8MM) DIA

32. Item No.: 1
33. HS Code: 7408.11.00
34. C.O. Code: a KR | b N/A
35. Gross Weight [kg]: 303.240 M.T
36. Agr. Cd
37. CPC: a 4000 | b 262
38. Net Weight [kg]: 300.000 M.T
39. Visa Ref.
40. Line Number/Sl. Number - Cargo Lading No.: 2 APLU-005745846 dt.14.03.06
41. Quantity/Unit: PER KG 303240 KG
42. Item Invoice Value: USD.1578420.00
43. VM Code

44. Add. Info & Doc./ Prodt. Certif. & Aut.

IRC/ERC NO.: E/52504 | CRF / EXP NO.:
Attach Doc. Codes: 101,102,203
Preceding I/E No.: | Warehouse Code:
Invoice No.: 60014722(A) | Date: 14 / 03 / 06
UP/UD No.: | Date: / /

45. Adjustment:
46. Item Assessable Value: [illegible]

47. Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	11,33,54,006.53	13%	1,47,36,020.85	
SD				
VAT	12,80,90,027.38	15%	1,92,13,504.11	
AIT	11,33,54,006.53	3%	34,00,620.20	
LF				
IDSC	11,33,54,006.53	4%	45,34,160.26	
AVAT				
PSISC				
		TOTAL:	4,18,84,305.42	

48. Account Current No.: 15.TRLU2253501
49. Warehouse Number | Period (days)
50. ACCOUNTING DETAILS
Mode of Payment:
Assessment No.: | Date:
Receipt Number: | Date:
Guarantee: | Date:
DF / VAT PAID VIDE CHALLAN NO. TK 61,810.00
189(KA)-3206 dt. 18 /04/06
Total Duty & Taxes: | TK
[illegible] CHALLAN NO. 189(KA)-[illegible]

51. N/A
52. SND dt. 18/04/06
53. N/A
54. N/A

55. Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG): G 303.240MT | N 300.00MT.

Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF)	15,78,420.00	USD
External Freight		
Insurance ACTUAL.	45,161.43	USD
Landing Charge 1%	16,259.81	USD
Other Dutiable Costs		
Allowable Deductions		
TOTAL	16,39,817.24	USD

56. DECLARATION : I/we confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.

Name of Importer/Exporter | Designation | Signature | Date
FOR COMA CREATION
AS C & F AGENT

Name of Authorized Person | Card No. | Signature | Date

Appendix BOE7

TRIPLICATE 38

IMPORT

BILL OF ENTRY / EXPORT

1. DECLARATION: IM | 4 | a | b | c N/A — d. Office Code: 301 — e. Office Name: [illegible] — f. Manifest No.: 35 — g. Registration No.: 3024 — h. Date: 16 APR 2006

2. Consignor/Exporter [name and address]
M/S.DAEWOO INTERNATIONAL CORPORATION
CPO BOX 2810 SEOUL 100-714,SOUTH KOREA.
M/S.DAEWOO INTERNATIONAL SINGAPORE PTE. LTD.
7,TEMASEK BOULEVARD 27-03 SUNTEC TOWER1,
BIN : SINGAPORE.

3. Page: a 1 | b 1 — 4. N/A — 5. Items: 1 — 6. Type/Pack: [illegible] — 7. Agent Reference Number:

8. Importer/Consignee [name and address]
M/S.BANGLADESH CABLE SHILPA LTD,SHIROMONI,
KHULNA.-VAT.NO.3031000084
BIN :

9. N/A

10. N/A — 11. N/A — 12a. Total Assessable Value: [illegible] — 13. N/A

14. Declarant/Agent [name and address]
GOMA CREATION 55/1,AHSAN AHMED RAOD,KHULNA.
VAT.NO.3071025481
AIN :

15a. Country of Export: KOREA — 15. Cntry.Exp.Code: b KR | c N/A — 17. Cntry.Dest.Code: a BD | b N/A

16. Country of Origin: KOREA — 17c. Country of Destination: BANGLADESH

18. Name of Carrier KOTA PINTAR — Nationality: SG — 19. C.F.: 1

20. Delivery Terms CFR

21. N/A

22. Currency: US.D. — Total Invoice: 1578420.00 — 23. Exch. Rate: 60.1200 — 24. Nat. of Trans: LC

25. MOT: 1 — 26. N/A — 27. Place of loading/unloading: BUSAN SOUTH/BUSAN

28. Financial & Banking Data — Bank Code : 0352
Sector & Fund Source : 062
Bank Name & Address : BANK ASIA [illegible] KHULNA.

29. Office of Entry/Departure: 301 KHULNA CUSTOM HOUSE — 30. Location of Goods: YARD NO.3

L/C No : 0352 06 01 0008 — dt: 09 / 02 /06
L/C A No :38695 — dt: 09 / 02 /06

31. Packages and Description of Goods

Marks and Numbers : 1.APLS2566586-8,2.APLS2566622-6 3.APLU-328013-8 4.CAXU-679246-3 5.BMLU-2256581

32. Item No. 1 — 33. HS Code 7408.11.00

Number of Packages : 120 PLASTS — Packages Code : PT

34. C.O. Code: a KR | b N/A — 35. Gross Weight [kg]: 305.240 M.T — 36. Agr. Cd.

Container Number(s): 15x20' 6.CBSU2970560 7.CBSU-3152444 8.CLHU-2981616 9.MLCU-2958199 10.MOSU-2599400 11.MOSU-2419549 12.TRHU-0847576 13.TRLU-2443807 14.TRLU-2494661 etc

37. CPC: a 4000 | 262 — 38. Net Weight [kg]: 300.000 M.T — 39. Visa Ref.

Country of Origin of the Goods

40. Line Number/Sl. Number - Cargo Lading No.: 03 / APLU-085745847 dt.19.03.06

Commercial Description & Specification of the Goods COPPER WIRE(HOT ROLLED ELECTROLYTIC CLEANED OXYGEN-FREE,PICKED AND VAX COATED COPPER WIRE)5/16 INCH (8MM) DIA.

41.Quantity/Unit: PER KG — 305240 KG b — 42. Item Invoice Value: USD.1578420.00 — 43. VM Code

IRC/ERC NO. : E6 52304 — CRF / EXP NO. :

45. Adjustment

Attach Doc. Codes : 101,102,203

Preceding I/E No. : — Warehouse Code :

Invoice No.: 0000147221 — Date: 19 / 03 /06

46. Item Assessable Value: [illegible]

UP/UD No. : — Date : / /

47. Calculation of Taxes by Item

Type	Tax Base	Rate	Tax Amount	MP
CD	11,33,54,006.53	13%	1,47,36,020.85	
SD				
VAT	12,80,90,027.38	15%	1,92,13,504.11	
AIT	11,33,54,006.53	3%	34,00,620.20	
LF				
IDSC	11,33,54,006.53	4%	45,34,160.26	
AVAT				
PSISC				
	TOTAL :		4,18,84,305.42	

48. Account Current No.: 15,TRLU-2819176 — 49. Warehouse Number — Period (days)

50. ACCOUNTING DETAILS

Mode of Payment :
Assessment No. : — Date :
Receipt Number : — Date :
Guarantee : — Date :
DF / VAT PAID VIDE CHALLAN NO. 169(KA)-3005 dt. 18 /04/06 — Tk 61,810.00
Total Duty & Taxes : — Tk 20,604.00
PAID VIDE CHALLAN NO.169(KHA)-3005 dt 18 /04/06

51. N/A

52. N/A

53. N/A

54. N/A

55. Total Consignment Wt. & Value

Total Gr. & Nt. Wt. (KG)	G 305240 KG	N 300000 KG
Description	Amount	Curr. Code
Invoice Value (FOB/C&F/CIF)	15,78,420.00	USD
External Freight		
Insurance ACTUAL	45,161.43	USD
Landing Charge 1%	16,233.81	USD
Other Dutiable Costs		
Allowable Deductions		
TOTAL	16,39,817.24	USD

56. DECLARATION : I/we confirm that the documents relating to this consignment are genuine and correct. All these records and documentation will be preserved and produced before Customs authorities, if and when demanded, within five years.

Name of Importer/Exporter — Designation — Signature — Date

FOR GOMA CREATION
A & F AGENT

Name of Authorized Person — Card No. — Signature — Date

FOR OFFICIAL USE ONLY

Name & Designation of Assessing Officer — Signature

24/8/06

Appendix- "Costing"

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
জাতীয় রাজস্ব বোর্ড ।
উপকরন/উৎপাদন সম্পর্ক বা সহগ ও মূল্য ভিত্তি ঘোষনা পত্র
বিধি ৩ (১) দ্রষ্টব্য

মূসক - ১

১। নিবন্ধিত ব্যক্তির নামঃ মেসার্স বাংলাদেশ কেবল শিল্প লিঃ । ২০০৬ -২০০৭
২। ঠিকানাঃ শিরোমনি শিল্প এলাকা, খুলনা-৯২০৬ ।
৩। নিবন্ধন সংখ্যাঃ ০০০১০০০০৮৪
৪। এলাকা কোডঃ ০০১০৩

৫। মূল্য ঘোষনা বছর ৩(১)|০১- ০৭ /বৎসর
৬। টেলিফোন নং ঃ ০৪১-৭৮৫০৮৫
৭। ফ্যাক্স নং ঃ ৮৮ - ০৪১ - ৭৮৫০৭৫

ক্রমিক নং	পণ্যের সামঞ্জস্যপূর্ণ নামকরণ কোড (H.s. Code)	পণ্যের নাম ও বিবরন	সরবরাহ/ বিক্রয়ের একক	পণ্য উৎপাদনে ব্যবহার্য উপকরন/কাঁচামাল এবং প্যাকিং সামগ্রীর নাম ও বিবরণ।	একক পণ্য উৎপাদনে ব্যবহার্য অপচয়সহ উপকরন/কাঁচামাল ও প্যাকিং সামগ্রীর পরিমান(অপচয়ের পরিমান প্রথম বন্ধনীর মধ্যে আলাদা ভাবে উল্লেখ করিতে হইবে)। (কেজি)		কলাম(৫) এ বর্ণিত উপকরণ বা প্যাকিং সামগ্রীর মূল্য(আমদানীকৃত হলে শুল্কায়ন যোগ্য মূল্য+শুল্ক+সম্পূরক শুল্ক+এল,সি ফি+অবকাঠামো উন্নয়ন সারচার্জ/স্থানীয় উৎপাদিত হইলে সম্পূরক শুল্কসহ মোট ক্রয়মূল্য(প্রদত্ত মূসক ব্যতিত)/অব্যাহতি পণ্য হইলে অব্যাহতি শুল্কসহ মোট মূল্য/মূসক অব্যাহতি প্রাপ্ত হইলে মোট ক্রয় মূল্য)।	মূল্য সংযোজনের খাত/আইটেমের নাম	প্রতি একক পণ্য মূল্যের কলাম(৭) এ উল্লেখিত প্রতিটি আইটেম বা খাতের অবদান/মূল্য সংযোজনের পরিমান।	সম্পূরক শুল্ক আরোপযোগ্য মূল্য(যদি বিক্রেয় পণ্যের উৎপাদন পর্যায়ে সম্পূরক শুল্ক প্রযোজ্য থাকে)। কলাম(৬) ও (৮) এর যোগফল।		কলাম (১০)এ প্রস্তাবিত মূল্যের উপর সম্পূরক শুল্কের পরিমান	মূসক আরোপ যোগ্য মূল্য[কলাম(১০)+কলাম(১১)] বিঃদ্রঃ যে ক্ষেত্রে স্থানীয় পর্যায়ে সম্পূরক শুল্ক প্রযোজ্য নয় সে ক্ষেত্রে[কলাম(৬) + (৮)]]		শুল্ক ও করসহ বিক্রয় মূল্য	
										বর্তমান	প্রস্তাবিত		বর্তমান	প্রস্তাবিত (কলাম (৬) + (৮))	পাইকারী	খুচরা মূল্যমূল্য (যদি থাকে)
১	২	৩	৪	৫	৬		৭	৮	৯	১০	১১	১২	১৩	১৪	১৫	১৬
					অপচয় সহ পরিমান	অপচয়ের পরিঃ		প্রত্যক্ষ মুজুরী	১,৬৬০.০০				৪৫,৭৮৫.০০	৫১,৫৫২.০০		
১	৮৫৪৪.৫৯.২০	১০ জোড়া /০.৪ সি,সি,জে, কেবল	প্রতি কিলোমিটার	১। তামার তার	২৩.৮৪	১.১৪	১৫,৩৮২.০৪	কারঃ উপরি খরচ	১১,০২৬.৮০							
				২। এ্যালুমিনিয়াম টেপ	১৮.৩৩	০.১৮	২,১২৮.৫৫	প্রশাসনিক ব্যয়	৫,৫৪০.০০							
				৩। ষ্টিল টেপ	-	০.০০	-									
				৪। ষ্টিল রোপ	-	০.০০	-	লাভ	৪,৫০৪.৯৪							
				৫। টিন ইন গট	-	০.০০	-	মোট ঃ	২১,৭৬১.৭৪							
				৬। পেট্রো জেলী	৭.৭৮	০.০৮	৭৫০.৬৯									
				৭। ফোম পি,ই	-	০.০০	-									
				৮। পি,ই ইনসুলেশন	৮.০৯	০.৩৯	৯৪৪.৩৫									
				৯। পি,ভি,সি ইনসুলেশন	-	০.০০	-									
				১০। কালার মাষ্টার	০.২০	০.০১	২৫.৮৩									
				১১। ইনক পি,ই/পি,ভি,সি	-	০.০০	-									
				১২। থিনার	-	০.০০	-									
				১৩। পলিটাল ফয়েল	০.১৫	০.০০	৫৮.০১									
				১৪। পলিয়েষ্টার ফয়েল	২.০০	০.০০	৪৫৭.০২									
				১৫। কেবল পেপার	-	০.০০	-									
				১৬। পলিইথিলিন ফয়েল	-	০.০০	-									
				১৭। এ্যালুকেসি ফয়েল	-	০.০০	-									
				১৮। পি,ই জ্যাকেট	৪০.৫৬	১.৫৬	৫,০৭৫.২৭									
				১৯। পি,ভি,সি জ্যাকেট	-	০.০০	-									
				মোটঃ-------------------			২৭,৮২২.০৬									
				২০। প্যাকেজিং খরচঃ	ডিন - ৮		৭৪৯.০০									
				২১। বিদ্যুৎ			১,১২৯.৬০									
				২২। টেলিফোনঃ			৮৯.৬০									
				সর্বমোট ঃ			২৯,৭৯০.২৬									

১। কলাম (৭),(৮) ও (৯) এ প্রদত্ত তথ্যের সমর্থনে মূল্য সংযোজন কর বিধিমালা, ১৯৯১ এর বিধিমালা ১৬.১৭ ও ১৮ মোতাবেক বা প্রযোজ্য অন্যান্য প্রামানিক দলিলাদি এই ঘোষনাপত্রের সহিত সংযুক্ত করা হইয়াছে।

২। আমি এই মর্মে অঙ্গিকার করিতেছি যে,কর ধার্যের জন্য উপযুক্ত মূল্য ভিত্তি সম্পর্কিত সকল তথ্য সত্য ও সঠিক এবং ইহা নির্ধারণের অনুকূলে সকল দলিলাদি আমার এখতিয়ারে আছে।

৩। উল্লেখিত বিধি মালার বিধি(৩) এ বর্ণিত পরিস্থিতির আলোকে মূল্য সংযোজন কর কর্তৃপক্ষ কর্তৃক পরিচালিত কোন তদন্তে বা জরিপে উদ্ঘাটিত ঘোষিত মূল্য ভিত্তি অসংগতিপূর্ণ বা কম প্রতিয়মান হওয়ার ক্ষেত্রে উক্ত কর্তৃপক্ষ কর্তৃক নির্ধারিত মূল্য ভিত্তি অনুযায়ী ঘোষনা প্রদানের তারিখ হইতে প্রদেয় কর প্রদানে আমি বাধ্য থাকিব।

[বিঃ দ্রঃ ব্যবসায়ীর ক্ষেত্রে ক্রীত পণ্যের নাম কলাম (৫) এ এবং পণ্যের ক্রয় মূল্য কলাম (৭) এ দেখাতে হইবে।]

২৭/০৭/০৭

Mahmud Hasan FCMA
Deputy Manager (Finance ...)
Bangladesh C...