

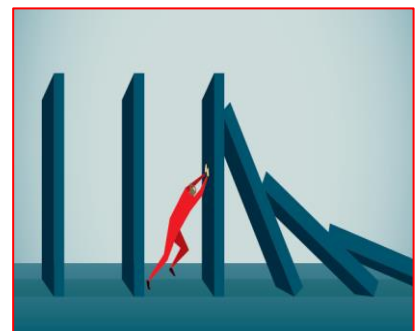


Training on Supply Chain Resilience

Module 1: Supply Chain Management: An Overview and Its Resilience Strategies

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Preface

Supply chain performance has never been as important as it is today. In the current economic environment, increasingly global, there is the general awareness that companies are able to better compete if they act together, in supply chains, and thereby competitiveness can be increased. Therefore, supply chains are becoming vital to the competitiveness of many companies and businesses.

In this increasingly competitive global business environment, the quality of SCM operations, their costs and capability can make the difference between the success and failure of business ventures. The adoption of modern management paradigms, philosophies, strategies, policies, and/or practices to improve effectiveness and reduce operating costs, such as lean manufacturing, Just-In-Time, strategic inventory, reduced product lifecycle, and outsourcing, have created highly efficient supply chains.

Supply chains are subjected to more risks than ever, which are numerous and constantly evolving, and derive both from within and outside of the company. Avoiding such risks or reducing their negative effects is a challenge for today’s management. Nevertheless, some risks cannot be avoided and with today’s complex global supply chains, fragmentary solutions and specific initiatives are no longer enough to cope with the multifaceted nature of risks.

One way to deal with supply chain risk is to increase confidence in the supply chain i.e. confer to the supply chain the ability to be resilient. Supply Chain Resilience is a supply chain's ability to be prepared for unexpected risk events. A resilient supply chain must develop resilience capabilities to react to the negative consequences of unexpected events and to return quickly to its original state, the one before the risk occurrence, or to move to a new best state after being affected by the risk and continue business operations as efficiently as possible. Increase resilience and reduce the likelihood of risk events occurring is the aim of supply chain risk management.

If you have a resilient supply chain, you can manage to respond and recover quickly from these disruptions by returning to the original situation or by moving to a new, more desirable state in order to increase customer service, market share, and financial performance.

Resilience is at the heart of the current supply chain management thinking, and understanding the concept, and where to invest in resilience, can lead to supply chains that quickly respond to and recover from costly disruptions.

Learning Objective

By the end of this training module, you will be able to:

- Know Supply Chain and its basic concepts
- Be familiar with Supply Chain risks and related issues
- Know how natural disaster and climate change affect RMG sector in Bangladesh
- Describe Supply Chain Resilience
- Know how to achieve Supply Chain Resilience
- Understand the core enablers of Supply Chain Resilience strategy: People, Process and Technology
- Explain how to measure Supply Chain Resilience
- Build Supply Chain Resilience for a Post COVID-19 World
- Know key findings and strategic recommendations derived from Study on Supply Chain Resilience of RMG Sector in Bangladesh
- Know how mapping Supply Chain Risk helps to build RSC
- Know how well-timed approach and innovation made significant stride in building SCR in the context of Bangladesh Perspective.
- Be familiar with the 12 Best Supply Chain Companies of 2020

1. Supply Chain Management (SCM): Definitions and Related Issues

1.1 What Is Supply Chain Management (SCM)?

Supply chain management is the management of the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace.

SCM represents an effort by suppliers to develop and implement supply chains that are as efficient and economical as possible. Supply chains cover everything from production to product development to the information systems needed to direct these undertakings.

1.2 How Supply Chain Management Works

Typically, SCM attempts to centrally control or link the production, shipment, and distribution of a product. By managing the supply chain, companies are able to cut excess costs and deliver products to the consumer faster. This is done by keeping tighter control of internal inventories, internal production, distribution, sales, and the inventories of company vendors.

SCM is based on the idea that nearly every product that comes to market results from the efforts of various organizations that make up a supply chain. Although supply chains have existed for ages, most companies have only recently paid attention to them as a value-add to their operations.

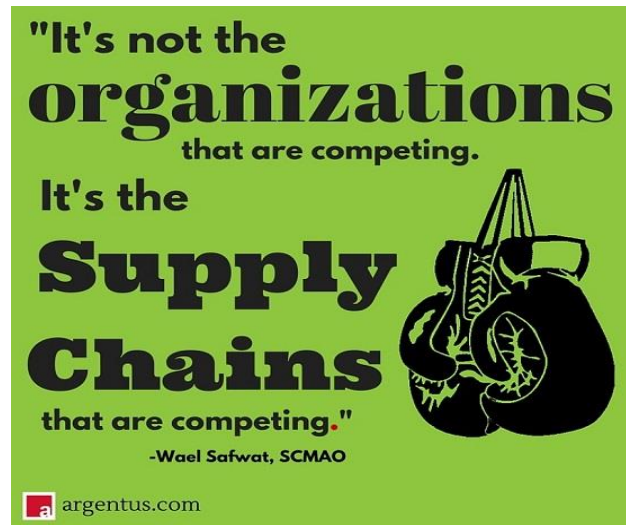
In SCM, the supply chain manager coordinates the logistics of all aspects of the supply chain which consists of five parts:

- The plan or strategy
- The source (of raw materials or services)
- Manufacturing (focused on productivity and efficiency)
- Delivery and logistics
- The return system (for defective or unwanted products)

The supply chain manager tries to minimize shortages and keep costs down. The job is not only about logistics and purchasing inventory. According to Salary.com, supply chain managers, “make recommendations to improve productivity, quality, and efficiency of operations.”

Improvements in productivity and efficiency go straight to the bottom line of a company and have a real and lasting impact. Good supply chain management keeps companies out of the headlines and away from expensive recalls and lawsuits.

Ref: <https://www.investopedia.com/terms/s/scm.asp>



1.3 Four Fundamentals of SCM

a) SCM Objectives

Firstly, the objectives of SCM are to meet or exceed the required or demanded customer service level in targeted markets/segments and to optimize total supply chain investment and cost.

This service/cost approach has long been regarded as central to supply chain management. This approach requires companies to have a clear understanding of both issues.

Customer service requirements, dictated by the market place, “sets the spec” for the supply chain. Achieving this level of service at the optimal cost focuses attention on the elimination of “non-value adding activities” (NVAs) throughout the supply chain.

b) SCM Philosophy

Secondly, every product or service is delivered to the final consumer (the only source of “real” money in the chain) through a series of often complex movements between companies which comprise the complete chain.

An inefficiency anywhere in the chain will result in the chain as a whole failing to achieve its true competitive potential. In other words, supply chains are increasingly competing with other supply chains rather than, in the more traditional axiom, companies simply competing with other companies.

The phrase “supply chain” is used to indicate that the chain is only as strong as its weakest link.

c) Managing the Flows

Thirdly, for a supply chain to achieve its maximum level of effectiveness and efficiency, material flows, money flows and information flows throughout the entire chain must be managed in an integrated and holistic manner, driven by the overall service and cost objectives.

It can be argued that managing the information flows is the most critical of these activities. This is because the flow or movement of materials or money is usually triggered by an associated information movement.

Effective management of material and financial flows is, therefore, predicated upon the effective management of the related information flows. For this reason, information and communications technology (ICT) is becoming an increasingly important SCM enabler.

One more flow is being considered called Reprocess Flow that incorporated the 5 Rs: Reduce, Reallocate, Reuse, Recycle and remanufacture

d) Supply Chain Relationships

Finally, this holistic approach requires a reappraisal of the way in which both internal and external customer/supplier relationships are created and managed. SCM is not a “zero-sum” game based on adversarial relationships. Rather, it needs to be a “win-win” game based on partnership approaches.

This point is relevant to the interactions between the key “internal” supply chain functions of buy, make, store, move and sell, as well as to relationships between an organization and its external customers and suppliers.

Source: Sweeney, E. (ed.), *Perspectives on Supply Chain Management and Logistics – Creating Competitive Organisations in The 21st Century*, Dublin: Blackhall Publishers, 2007.

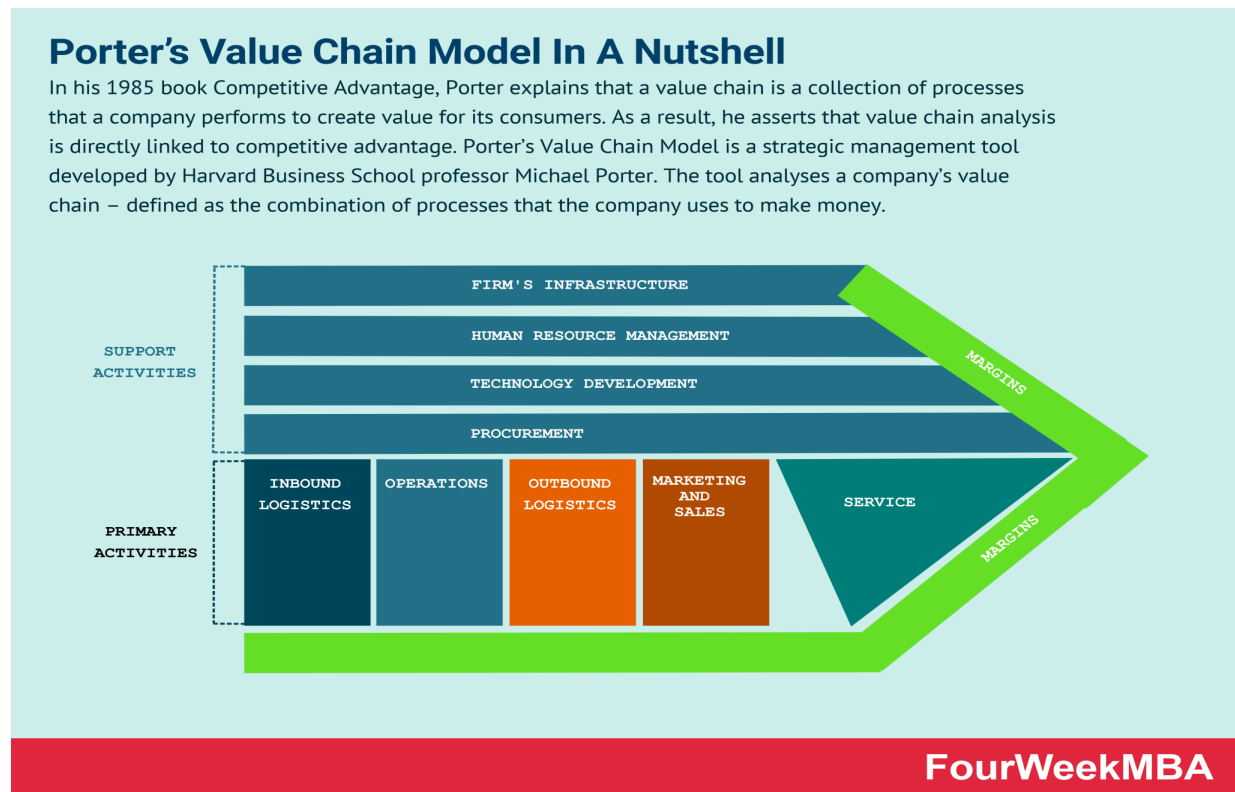
1.4 SCM: Serving the Customer

The foundation of Supply Chain Management is satisfying the end customer. In other words, SCM focuses on the ultimate consumer as the starting and ending point for all intra-and inter-company activities. If the end product or service offered to the consumer does not have the right features, the right quality, the right price and the right timing of delivery, then the supply chain will have failed in its mission.

The value chain represents those strategically important activities that can allow enterprises to archive a competitive advantage in the marketplace. These activities are illustrated in figure/picture.

ITC-MLS-SCM New Module 1

1.5 Value Chain Analysis



- In business, we're paid to take raw inputs, and to "add value" to them by turning them into something of worth to other people.
- This is easy to see in manufacturing, where the manufacturer "adds value" by taking a raw material of little use to the end-user (for example, wood pulp) and converting it into something that people are prepared to pay money for (e.g. paper).
- But this idea is just as important in service industries, where people use inputs of time, knowledge, equipment and systems to create services of real value to the person being served - the customer.
- And remember that your customers aren't necessarily outside your organization: they can be your bosses, your co-workers, or the people who depend on you for what you do.
- Now, this is really important: In most cases, the more value you create, the more people will be prepared to pay a good price for your product or service, and the more they will they keep on buying from you.
- On a personal level, if you add a lot of value to your team, you will excel in what you do. You should then expect to be rewarded in line with your contribution.
- So how do you find out where you, your team or your company can create value?
- This is where the "Value Chain Analysis" tool is useful. Value Chain Analysis helps you identify the ways in which you create value for your customers, and then helps you think through how you can maximize this value: whether through superb products, great services, or jobs well done.
- Value Chain Analysis is a three-step process:
 - Activity Analysis: First, you identify the activities you undertake to deliver your product or service;
 - Value Analysis: Second, for each activity, you think through what you would do to add the greatest value for your customer; and
 - Evaluation and Planning: Thirdly, you evaluate whether it is worth making changes, and then plan for action





1.6 Better Supply Chain Management (SCM) means:

- Reduce Total Cost
- Ensure Continuity of production
- Respond Quickly to Market Changes
- Innovate
- Improve quality

As markets change quickly, it is important for any business to obtain feedback from actual customers (end users). Needless to mention that when a customer buying a product or service, the customer looks for a value i.e. a desired combination of quality, availability, service and low cost.

1.7 Benefits Customers Seek in the Products/Services

a) Benefits at a Glance that Customers Look For:

Benefits Customers Seek in the Products/Services			
			
Quality	Availability	Customer Service & Responsiveness	Low Cost
Functionality	Order Quantity	Product/Service information for customers	Purchase price
Adaptability	Lead-time to delivery	Responsiveness to customer queries	Cost of acquisition
Flexibility	Lead-time in response to needs	Technical support to customer	Total cost of ownership
Uniqueness	Supply range, quantity and flexibility	Maintenance and repair services	Supply range, quantity and flexibility
Ease of Use	Reliability of delivery	Reliability of delivery	Reliability of delivery
Durability	Continuity of supply	Continuity of supply	Continuity of supply
Uniformity			
Environmental Friendliness			
Safety			
Meets requirements			

Ref: ITC-MLS-SCM New Module 1- and old Module 17-

b) Benefits of high quality:

Customers often come back when a product is good, even if the price is high. A quality product creates unshakeable customer loyalty that generates increased leads. When customers find a product they trust, they return, make repeat purchases, and recommend the product or service to other.

c) Some key benefits of quality are given below:

- Customers are often prepared to pay for a price-premium for a good quality product
- Higher quality often leads to repeat business and resultantly the organization gets changed to order winner from order qualifier. This often results in the development of long-term customer relationships and customer loyalty.
- Higher quality frequently results in increased productivity and the lowering of costs, which in turn can translate into increasing market share.
- Higher quality boosts the image of an organization and its brands.
- Higher quality affects employee/staff morale. People like work for a winning company with a good reputation.

- Higher quality reduces risk e.g. safety, health, product safety, fewer complaints, no product recalls etc. thus lowering insurance costs. Liability is reduced.

- Higher quality can results in increased revenues, higher profits, and increased benefits for all stakeholders: owners/shareholders, employees and the community.

d) Consequences of poor quality

- Lower productivity and increased costs

- Warranty/ Guarantee costs and product liability claims

- Loss of business, loss of market share, falling reputation and eventually business survival

1.8) History of Supply Chain

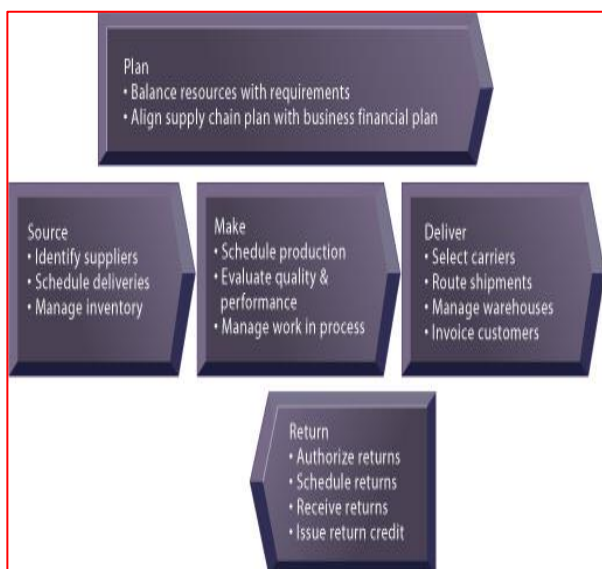
Period	Progress
Ancient Times	The first supply chain was the barter system
1904	Traces of outsourcing was seen when Charles S. Rolls became selling agent for cars made by F. Henry Royce
1960-75	The essence of SCM was understood with the first phase characterized as an inventory 'push' era that focused primarily on physical distribution of finished goods
1975-90	Companies began migrating from an inventory push to a customer pull channel
1980	Emergence of SCM
1996	Internet revolutionized the distribution system of the business
1998	Concept of e-commerce changed the definition of business
2000	Optimized "Value Network" with Real-Time Decision Support; Synchronized & Collaborative Extended Network

Keith Oliver is a British logistician and consultant famous for coining the terms "Supply Chain" and "Supply Chain Management" first using them in public in an interview with Arnold Kransdorff of the Financial Times on 4 June 1982. Ref: "Wikipedia"

1.9 Five Essential Stages in Developing a Successful Supply Chain

Supply chain management encompasses such a wide range of functions that it can seem daunting, even to the most experienced international businessperson. However, the process can be effectively modelled by breaking it down into several main strategic areas.

One common and very effective model is the Supply Chain Operations Reference (SCOR) model, developed by the Supply Chain Council to enable managers to address, improve and communicate supply chain management practices effectively. The SCOR model runs through five supply chain stages: Plan, Source, Make, Deliver, and Return.



Stage 1: Plan

Planning involves a wide range of activities. Companies must first decide on their operations strategy. Whether to manufacture a product or component or buy it from a supplier is a major decision. Companies must weigh the benefits and disadvantages of different options presented by international supply chains.

Options include: Manufacturing a product component domestically, Manufacturing a component in a foreign market by setting up international production facilities, Buying a component from a foreign supplier, Buying a component from a domestic supplier. If companies are manufacturing products, they must decide how they will be produced.

Goods can be:

Make to stock (produced and stored, awaiting customer orders);

Make to order (constructed in response to a customer order);

Configure to order (partially manufactured the product and completed it after a firm customer order is received); or

Engineer to order (manufactured a product to unique specifications provided by a customer).

Sometimes, goods can be produced by a combination of these methods. Companies must also decide whether they will outsource manufacturing. This operations planning is essential because these decisions influence the supply chain. Planning also involves mapping out the network of manufacturing facilities and warehouses, determining the levels of production and specifying transportation flows between sites. It also involves assessing how to improve the global supply chain and its management processes. When planning, companies should ensure that their supply chain management strategies align to business strategies, that communication plans for the entire supply chain are decided and that methods of measuring performance and gathering data are established before planning begins.

Stage 2: Source

This aspect of supply chain management involves organizing the procurement of raw materials and components. When sources have been selected and vetted, companies must negotiate contracts and schedule deliveries. Supplier performance must be assessed and payments to the suppliers made when appropriate. In some cases, companies will be working with a network of suppliers. This will involve working with this network, managing inventory and company assets and ensuring that export and import requirements are met.

Stage 3: Make

This stage is concerned with scheduling of production activities, testing of products, packing and release. Companies must also manage rules for performance, data that must be stored, facilities and regulatory compliance.

Stage 4: Deliver

The delivery stage encompasses all the steps from processing customer inquiries to selecting distribution strategies and transportation options. Companies must also manage warehousing and inventory or pay for a service provider to manage these tasks for them. The delivery stage includes any trial period or warranty period, customers or retail sites must be invoiced and payments received, and companies must manage import and export requirements for the finished product.

Stage 5: Return

Return is associated with managing all returns of defective products, including identifying the product condition, authorizing returns, scheduling product shipments, replacing defective products and providing refunds. Returns also include “end-of-life” products (those that are in the end of their product lifetime and a vendor will no longer be marketing, selling, or promoting a particular product and may also be limiting or ending support for the product). Companies must establish rules for the following: Product returns Monitoring performance and costs Managing inventory of returned product

Ref: Original article: <http://www.tradeready.ca/2016/fittskills-refresher/5-essential-stages-developing-a-successful-supply-chain/>

1.10 SCM and its Three Wings

a) Supply Chain Management has three areas/wings:

Supply Management: This involves developing relationship and integration with suppliers.

Demand Management: It uses techniques to forecast demand accurately and develop relationships with customers.

Logistics Management: It focuses on how members of a supply chain manage the movement and storage of their products while interacting with other members of the supply chain.

b) Logistics Systems and Supply Chain has three drivers:

Inventory: Inventory is a list of goods and materials, or those goods and materials themselves, held available in stock by a business. In other word, inventory is stored accumulation of material resources and physically located that are used in a transformation process and/or activated as asset. Managing Inventory in Supply Chain is a complex operation and may have a large impact upon customer service levels and Supply Chain Cost.

Transportation: Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer’s hand. Transportation plays a key role in every supply chain because products are rarely produced and consumed in the same location. Transportation is a significant component of the most supply chain incur. Any supply chain’s success is closely linked to the appropriate use of transportation.

Warehousing Operations: Warehousing is an integral part of Logistics and Supply Chain Management System. For most of the common people, warehousing involves just storing of the products while it involves inbound functions for storing and outbound functions of packing and shipping. The importance of warehousing in logistics management is because it helps to deliver the right products at the right place at right time. Consolidating orders assembly of components and mixing of products etc also comes under warehousing operations. It is also possible to reduce the cycle times and inventories through proper management of products at the warehouse. Through warehousing, it is possible to make the operations efficient and utilize the storage capacity to the maximum. By consolidating and accumulating operations the economic benefits can be seen in warehouse management.

Ref: ITC-MLS-SCM Module-10 (Old version) and <https://mywestford.com/blog/significance-of-warehousing-in-logistics-and-supply-chain-management/>

1.11 Key Factors to Developing a Supply Chain Strategy

Effective Supply Chain Strategy can provide an organization with a most important source of sustainable competitive advantage. There are several elements that an organization (or, ideally, by supply chain member organization working on this together) needs to consider when devising Supply Chain Strategy. These include the following:

a) Globalization:

Globalization has increased competition and changed the way that many organization do business. Global competitors can often compete successfully by using low cost labor which enables them to offer substantially lower prices despite increased logistics cost.

b) Outsourcing:

Outsourcing means obtaining the goods or services, which was previously produced or provided internally, from an external supplier. It is now occurring more frequently and has become an important strategic decision in SCM.

c) Location:

The choice of location usually becomes more difficult as one moves along the supply chain from Mother Earth (the earth considered as the source of all its living beings and natural features) to final consumer. An organization has to take a crucial decision in selecting the best possible location. A poor decision may have a significant negative effect on their capability to compete.

d) Product Life Cycle

Product life cycles are becoming shorter day by day as customers demand new and larger variety of products. This leads to changing requirements for supply chains and the introduction of new supply chains. Once the product or service is established in the market, how does the organization cope with demand and how can it reduce lead-times? These are important strategic decision.

e) Time-based competition

Today **time** is one of the most important strategic issue. It is vital not only to the individual organization but also to all organizations that constitute a particular Supply Chain. Speed in product development, speed in production, and speed in delivery is absolutely paramount. This is the essence of time-based competition, and it requires businesses to do all that is required to tackle bottlenecks, poor operational performance, long set-up times, poor quality, inadequate communications along the supply chain, inappropriate operations planning and control systems, out of date technologies and systems, etc. Once the shortcomings and deficiencies are identified by techniques such as process mapping, their effects can be reduced or eliminated.

f) E-Business

Needless to mention that e-business is the key tool for developing and managing relationship within a supply chain, and greatly facilitates supply chain development it includes any kind of business for which information is shared through internet.

G) Collaborative Planning, Forecasting and Replenishment (CPFR)

CPFR facilitates information sharing among participants along a supply chain in planning, forecasting and replenishment of inventory. It is a concept which aims at increasing the availability of stock items but at the same time reducing inventory as well as transportation and distribution cost. (CPFR is the registered trademark of VICS- The Voluntary Interindustry Commerce Solution Association, website: www.vics.org).

h) Supply Chain Risk Management (SCRM)

Risk is quite simply, the absence of certainty. Risk includes any situation, hazard or danger which can make the organization vulnerable and which can effect profitability and/or assets. This includes financial risk, project risk etc. Examples include commercial risk, financial risk, technological risk, etc. SCRM also deals with risks associated with supply-such as single sourcing, outsourcing, lean systems (i.e. low inventory, long logistics lines, etc. Most organizations include SCRM in their strategic supply chain management planning.

Besides above key factors, there are other relevant factors as below to developing a supply chain strategy:

- Purchasing
- Cross-docking
- The bullwhip effect
- Type of supply chain (based on research by Hau Lee's Uncertainty Framework)

All above four items will be explained in subsequent parts of the module.

2. Managing Supply Chain Risks

An organization faces a huge number of risks in maintaining their supply chain. When assessing its supply chain risks, a supply chain manager has to consider not only the risks that affect it directly (i.e. its internal risks), but also the risks that affect the whole of the supply chains, both upstream and downstream, because sooner or later these risks may affect the whole chain fully or partially.

An enterprise need to pay special attention to those risks that may affect its priority products or services, whether these are provided to customers or purchase from supplier.

The main upstream, internal and downstream supply chain risks are illustrated as follows:

Upstream supply chain (suppliers)	Internal	Downstream supply chain(customers)
-Relationship risks - Supplier performance risks -Supply chain disruption risks -Supplier environmental risks -Market dynamics risks - Disaster risks -Regulatory risks -Political/country risks -	-Operational risks -Technical risks -Financial risks -Occupational health and safety risks -Environmental risks -Legal/regulatory risks -Political/country risks	-Relationship risks -Customer financial risks -Distribution risks -Customer environmental risks -Market risks(changes in demand and effect of competition) -Brand/reputation risk -Product liability risk -Political/country risks

Ref: ITC's Supply Chain Management for SMEs

2.1 Supply Chain Risk Management Strategies

In today's world, supply chain risk mitigation can be difficult due to globalization, potential cyber interference and other factors arising from natural calamities. That said, there are measures you can take to reduce your business' exposure to risk:

a. Leverage the PPRR risk management model.

The PPRR (Prevention, Preparedness, Response, and Recovery) risk management model is a popular global supply chain risk management strategy and is used by many organizations around the world. The "PPRR" stands for:

- **Prevention:** Take precautionary measures for supply chain risk mitigation.
- **Preparedness:** Develop and implement a contingency plan in case of an emergency.
- **Response:** Execute on your contingency plan in order to reduce the impact of the disruptive event.
- **Recovery:** Resume operations and get things running at normal capacity as quickly as possible.

b. Manage environmental risk in your supply chain.

This is more important than ever given that the COVID-19/coronavirus pandemic exposed gaps in global supply chains that leave them prone to disruption.

As recently as December 2019, many manufacturers/enterprises were forced to re-evaluate their vendor relationships because many of their suppliers and manufacturers **were based in China, which was, at the time, the epicenter of the outbreak**. With a significantly reduced workforce, manufacturers /enterprises struggled to process and get shipments out on time, and there were questions of whether certain shipments would need to undergo quarantine before they could be delivered.

As a result, some manufacturers/enterprises decided to move from a single-sourcing to a multi-sourcing model, which would provide them with a contingency plan should their primary supplier become unavailable. Others opted to change their business model entirely in order to adapt to drastic changes in product seasonality and viability.

Although there's no way to prevent environmental risk in your supply chain, you can plan for it. Supply chain risk assessment enables you to take a proactive approach to risk management by providing you with greater visibility into the structure of your supply chain.

It's also important that you develop a contingency plan — something that's come up a few times, now. Transitioning from a single source to a multi-sourcing supply chain model is one example of how you might prepare for the future; mapping your supply chain network is another. For climate-related environmental risks, consider stockpiling products during known periods of high risk (such as hurricane storm, flood, tidal bore seasons), or look to find suppliers and distributors closer to your center of operation and the end point of your supply chain.

c. Gain visibility into suppliers' financial stability.

Certain major credit rating agencies offer predictive financial stability reporting on thousands of potential suppliers in order to reduce the external business risk that comes with dealing with third-party vendors.

Although this won't help you with existing vendors, it can help you develop more secure business relationships and reduce your vulnerability to supply chain risk.

d. Track the right freight carrier metrics.

As a SCM manager, you rely on your merchandise arriving at the right place at the right time in order to make your selling window, so it's important that you partner with a freight carrier that can deliver consistent results. Unfortunately, not every carrier is up to the challenge, and even a single late delivery can disrupt your entire supply chain. When evaluating new freight carriers — or even re-evaluating your current freight carrier — be sure to consider the following metrics to support supply chain risk management:

- **Transit Time:** This refers to the number of hours or days it takes for a shipment to arrive at the customer's location after leaving your facility.

- **Number of Stops & Average Stop Time:** The more stops a freight carrier takes in route to delivering a shipment, the longer it will take your product to reach your customer. Even if a route only includes a few stops, a long average stop time could still jeopardize on-time delivery and disrupt your supply chain. These metrics are important to monitor for the sake of supply chain efficiency.

[Note: It's important to look for a low number of stops and low average stop time while still being mindful of drivers' legally regulated hours of service.]

- **Average Loading Time:** This refers to the amount of time it takes to load a carrier with freight, as well as fill out any necessary paperwork, once it has arrived at the loading dock. Like the previous item on this list, this is a key indicator of supply chain efficiency.

- **Route Optimization:** It's important that retailers consider how field carriers optimize routes for fuel usage and travel time because these have a direct effect on supply chain costs and efficiency. If a retailer has its own fleet, it can monitor this metric closely; if it partners with a third-party carrier, it can monitor this metric through costs charged for shipping.

- **Maintenance Schedule:** A freight carrier with a consistent maintenance schedule is less likely to break down, which can prevent unnecessary supply chain disruption.

e. Implement a logistics contingency plan.

Similar to an emergency response plan, it's imperative that manufacturers have a logistics contingency plan in place to ensure business continuity in the event of supply chain disruption. The need for a solid contingency plan — or, preferably, multiple contingency plans — has become especially pertinent in light of the COVID-19 crisis, which caused supply chain disruption on a global scale.

Some tips when creating a contingency plan for supply chain risk mitigation:

-Map out your supply chain to get a clear understanding of which entities are most vulnerable to risk.

-Perform a full assessment of suppliers based on factors such as political risk, geographic risk, and economic risk.

-Diversify your supplier network so that you aren't reliant on a single supplier.

-Audit logistics providers based on their disaster plans.

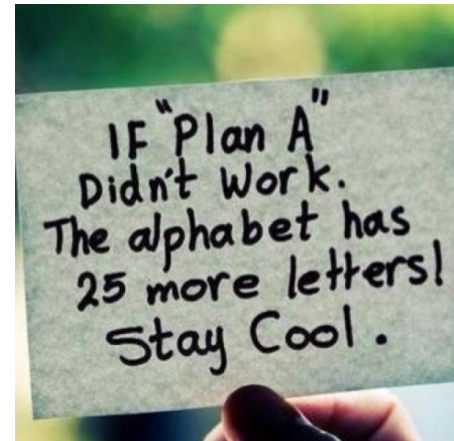
-Establish a crisis response team to make critical decisions in the event of an emergency.

-Develop solid communications channels so that your employees know what their responsibilities are in the event of supply chain disruption.

-Carefully document all processes and create a single source of truth that employees can refer to when executing on your contingency plan.

-Stay up to date on current events and adapt your contingency plan accordingly.

-Create a Plan B, Plan C, Plan D, and so on.



f. Conduct internal risk awareness training.

Management isn't the only area of your organization that can assist in supply chain risk mitigation. In fact, building a risk-aware culture requires buy-in at all levels of your business. The easiest way to achieve this is to conduct risk awareness training for your entire workforce.

g. Consistently monitor risk.

This might seem like a given, but consistently monitoring supply chain risk factors really is the key to protecting operations. Many organizations assume that they're secure once they've implemented a supply chain risk mitigation framework, but the work doesn't stop there. Every level of the supply chain should be carefully observed for potential risk indicators.

The easiest way to do this is to invest in a scalable digital solution that automates monitoring for various aspects of your supply chain. This will not only provide you with security and peace of mind, but also valuable pathway into how you can streamline business operations.

h. Use data to model key risk event scenarios.

Imagine being able to predict a risk event well before it ever happens. Technology hasn't brought us there just yet but, thanks to data science, predictive analytics, and data modeling, we've come pretty close. Big Data has opened up a world of opportunities for organizations, including using data science and predictive analytics to create advanced models for potential risk event scenarios. By using data models to imagine what could potentially happen during a worst-case scenario, you can develop more comprehensive contingency plans that will better prepare your business for if and when disaster strikes.

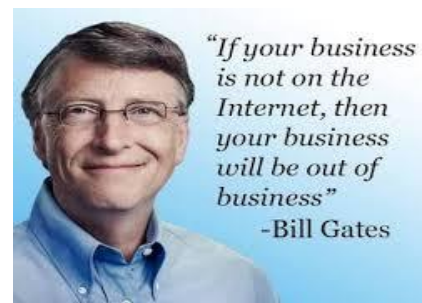
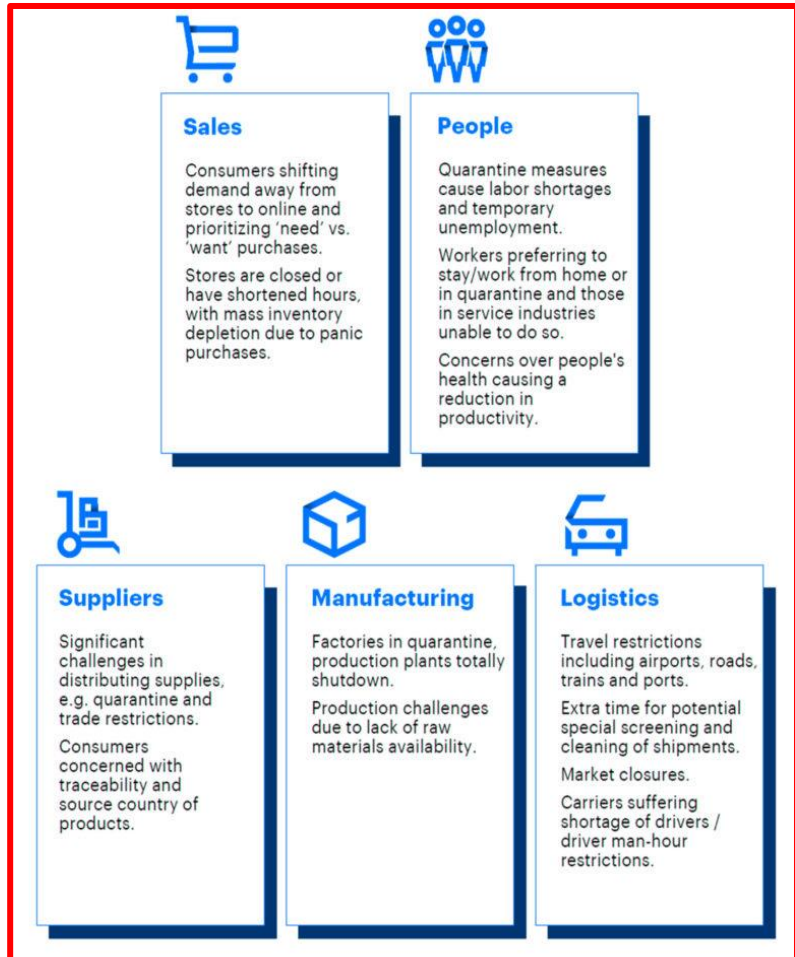
Ref: Deb Marotta -<https://global.hitachi-solutions.com/blog/supply-chain-risk-management>

3. COVID-19 made Supply Chains a household word

Few events brought as much volatility as the COVID-19 pandemic at both ends of the supply chain and most stages in between. Like supply chains, the virus spanned the globe, traversing borders. Factory closings in China, the world's biggest manufacturing economy, sharply reduced supplies, and the ripple effect was felt for months. Retailers across the globe shut down for weeks, and e-commerce spiked along with home deliveries. Air transport was hobbled. High-end goods went unsold as people became cautious about unnecessary spending.

The fallout from COVID-19 has touched aspects of the supply chain that sometimes get short shrift. Privacy and security, for example, have grown in importance as more supply chains become digitized. The challenge is acute because supply chains can involve thousands of participants, including local suppliers working from remote network endpoints that can be entry points for hackers to attack the global supply chain network.

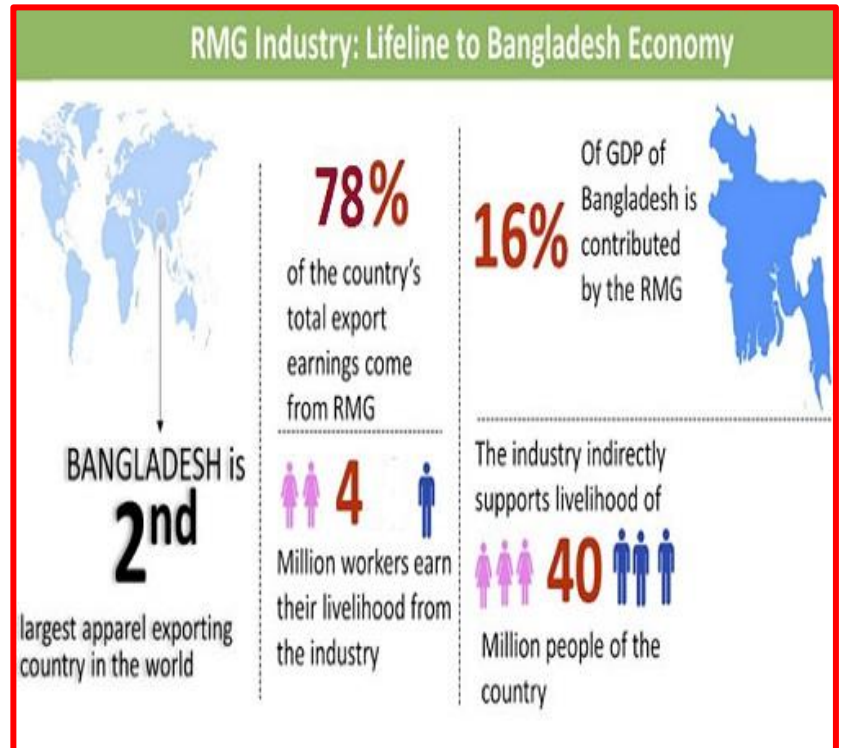
Such supply chain cyber security risks increased when more people began working at home during COVID-19. With more products like home Wi-Fi routers and printers logging on as endpoints on the internet, and other more expensive products from farm tractors to factory robots increasingly equipped with live connectivity for their manufacturers' product-as-a-service offerings, the number of endpoints is growing exponentially. Extending the digital supply chain comes at a cost.



Ref: David Essex, Editor at Large <https://searcherp.techtarget.com/Guide-to-supply-chain-management>
Ref: Major challenges in the global supply and value chains / Source: Accenture

4. RMG Sector: Its Overview and SCM

The ready-made garments (RMG) industry in Bangladesh has experienced an unprecedented growth over the last two decades. RMG alone earned about 78% of the yearly foreign exchange earning of the country. About 4.0 million people are employed in the garment sector. The growth rate of RMG export was over 20% per over the last two decades. Out of 4.0 million manpower employed in factories, 3.20 million are women, which is almost 80% of total manpower (Source form BGMEA). This sector also promotes the development of our other major sections of the economy, such as textiles, banking, transportation, insurance etc. For this reason, they're also lots of change in women's social status and their firm's particular in household decision making of the contribution of their garment industry. Day by day, the garment industry has become the major source of power house of our economy.



4.1 RMG Sector: Few Core Messages to Note:

- 35+ years of experience in apparel manufacturing.
- With 4000+ factories Bangladesh is serving all major global fashion brands.
- Duty-free Market Access to EU,
- Experienced Labor Force, and International Quality.
- More than 150 countries import apparel from Bangladesh.
- Factories equipped with latest machinery and technologies to meet the demand of latest fashion trends.
- Home to world's highest number of Green Factories. These factories use energy-efficient and environment-friendly technology and practices that save water, energy and minimize pollution.



4.2 Business Strategy of RMG Industry:

To fix the profitable business stage of Ready Made Garments industry is most important to our economy. Our RMG sector is totally export oriented business. This export oriented garments manufacturing industry gets export order from a foreign buyer by different ways. The most common ways of getting garments export orders are as below-

a. Buying House:

Most of the garment export order is executed by the different garments buying house in our country. The garment buying house works like as middlemen between foreign buyers and our garments manufacturer. Buying house work as a buyer to the manufacturer and on the other side work as a manufacturer to the buyer.

b. Direct Contact:

There are few large garment manufacturing companies those have many garment factories of their own administration and entrepreneurship. They also have very skill marketing department, travel abroad with sample garments, and talk about directly with the buyer and gathers export order from the buyer.

c. Indirect Contact:

Sometimes a strong brand or corporate image can put the companies in negotiating contract with the buyer. There are few manufactures as well as buying houses are communicating with buyer via internet, e-mail, fax, telephone, visual merchandising, press, TV, radio, cinema, poster, etc., media and confirms an export order in directly.

Ref: Article titled "The Business Strategy of Ready-Made Garments (RMG) in Bangladesh" by Mr. Noor Ahmed Raaz

Ref: <http://textilemerchandising.com/ready-made-garment-rmg-bangladesh/>

4.3 Efficiency of Supply Chain Management of Bangladesh Readymade Garments Industry

Efficient implementation of Supply Chain Management (SCM) is very imperative for Bangladesh RMG sector to remain competitive in the global market. Bangladesh is struggling with meeting customer lead time, quality problem and with productivity comparing with other RMG producing nations.

Moreover, the industry experienced few setbacks relating to building collapse and fire incident which forced the industry into more challenging situation. The country has no alternative to implement proper SCM in order to achieve the desired export goal of US\$ 50 billion set by government within year 2021. But unfortunately the level of practice and efficiency level of SCM is not satisfactory.

The overall SCM practices in Bangladesh RMG sector require more improvement. People working in this sector are not generally aware about the recouping the benefits of implementing proper SCM. Only 5-7% of the companies have separate SCM department (BGMEA, 2016).

The general elements of supply chain process in Bangladesh Garment Industry are Supplier, Garment Industries, Individuals, Raw Materials, Finished Goods, and Payment etc. In addition to that, following activities are conducted as part of company's SCM are:

- Inventory management,
- Transportation service procurement,
- Materials handling,

- Inbound transportation,
- Outbound transportation,
- Operations management etc.

Other elements of SCM including collaborative planning use of appropriate technology, procuring new machine to improve productivity, training company personnel, improving quality on a continuous basis are not very satisfactory in Bangladesh.

Moreover, the poor backward linkage and other infrastructural facilities including port efficiency and custom clearance made the efficient implementation of SCM in the sector more challenging.

Few of the key characteristics of the RMG industry are short life cycle, highly fluctuating end demand which is changing over time, variety of designs and styles evolving everyday worldwide, and yarn and cotton supplies from many countries is very dynamic and difficult to manage (Sen, 2008). So, RMG manufacturing companies should manage the supply chain in a way that satisfies the needs of the end consumers (Gunasekaran et al., 2008).

Bangladesh RMG manufacturers are importing most of the raw materials including woven fabrics from China, Pakistan, India, and Indonesia. So, the lead time is becoming longer which is putting a negative impact on competitiveness. Lead time reduction is possible through integrating supply chain among upstream and downstream partners for making RMG manufacturers competitive (Nuruzzaman and Haque, 2009).

Through using collaborative planning between fabric suppliers and garment manufacturers in Bangladesh it is possible to produce fabrics before taking orders. Bangladesh can create a notable position in the world's market by managing different partners involved in supply chain for reducing lead time. (Ref: Nuruzzaman 2010).

CONCLUSION

A chain is as strong as its weakest link is. It simply means that one single link is enough to make the whole chain dysfunctional. The Bangladesh RMG sector has been enjoying price competitiveness since long as the minimum wage of Bangladesh is still the lowest amongst all garments manufacturing countries.

The lead time now Bangladesh can offer is not very competitive. RMG business is a time sensitive one; delivering products after scheduled time is of no use. The ability of supplying small lot size of different styles within short possible time is considered to be competitive advantage for RMG companies. Reducing the dependency on imported raw materials and removing middlemen are very vital in making the RMG SC stronger.

Without proper implementation of SCM in the sector, it will be very difficult for the sector to become competitive in the global market. The leaders in the RMG sector should align the SC strategy, use appropriate technology and software, integrate all SC partners, and share required information with all strategic partners, follow best practices through benchmarking, adapt ever changing technologies, reduce lead time and improving port and customs efficiency would make this sector more sustainable and competitive.

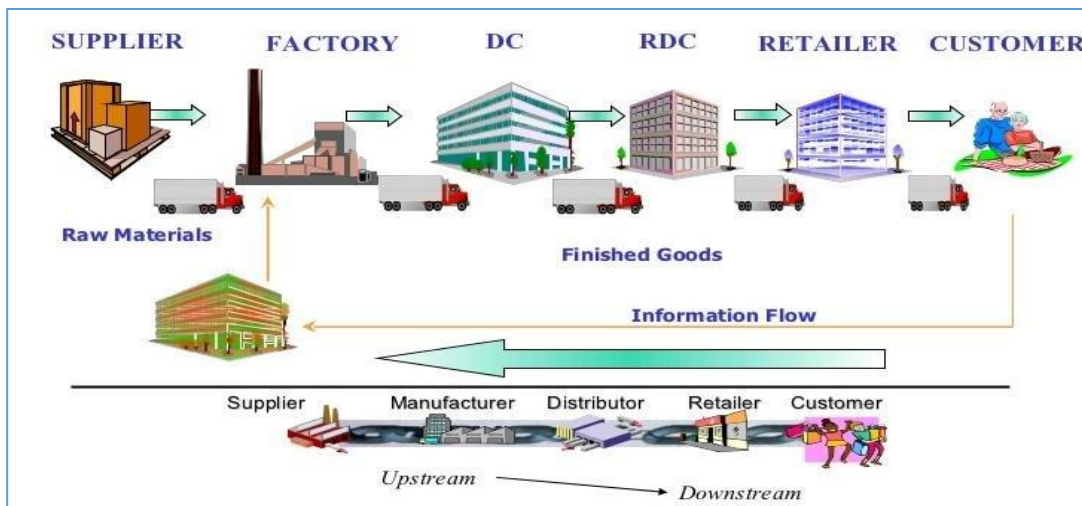
RECOMMENDATION

The SCM process of Bangladesh RMG sector is not efficient enough comparing to global standard. In order to improve efficiency, Bangladesh RMG sector needs to address the followings:

- The instable political situation and workers' unrest put challenge on efficient SCM for Bangladesh RMG sector. Undisrupted power supplies, coping with new technologies, removing inefficiencies in port and customs clearance process can play an important role in promoting efficiency of SCM in RMG sector of Bangladesh.
- There is acute shortage of man power who understand the complex SCM of RMG sector as such man power need to be trained on SCM.
- Buyers now are emphasizing on total cost of ownership (TCO) in purchasing RMG products instead of price alone. TCO can be minimized through efficient implementation of SCM in this sector by linking all parties involved in the chain.
- Vertical and horizontal integration of all the parties involved in the extended SC can ensure desired lead time by the customers.
- Companies should align their SC strategies with all processes of business to improve the overall efficiency.
- Port authority should improve their SCM efficiency and Government need to improve all infrastructural facilities for improving efficiency of SCM of Bangladesh RMG sector.

Ref: AHM Yeaseen Chowdhury, Dr Mamun Habib and Md Zahedul Alam,

The basic diagram of supply chain in garment industry in Bangladesh:



Concluding remarks

There is no specific variable that stimulated the emergence and rise of the RMG sector of Bangladesh; international openings, cheap labor, MFA and GSP trade facilities, skilled workforce, adaptability and government support had collectively attributed to the creation of this phenomenon. However, the path is not as smooth as it used to be. Diminishing demand for mid-tier apparel and mounting competition in the industry is making it more and more difficult for businesses to survive with rising costs and associated risks.

Way outs for Bangladesh textile and RMG industry:

- Redesigning business strategies to build resilience in the supply chain
- Focus on value added products through diversification and innovation
- Investing in appropriate technologies
- Building efficient workforce

Ref: Md. Hasib Uddin, Research Student, Putra Business School, University Putra Malaysia

4.4 SWOT of RMG Sector of Bangladesh

Strength	Weakness
<ul style="list-style-type: none"> - More than 30 years of history and experience of garments manufacturing - Large labor force still comparatively inexpensive compared to competitors - Strong backward linkage especially in knit sector - Resilient and ambitious young entrepreneur - Huge production capacity - Highest number of green industry and a positive sustainable image - Explicit positive change management practices in the factories - Improved worker-management relationship - Support of government as a major export sector 	<ul style="list-style-type: none"> - Low productivity - Weak technology management - Low level of skills and capabilities especially in the mid-level management - Weak backward linkage in woven sector - Longer change over times from style to style compared to competitors - Weak industrial engineering especially in textile industry - Excessive defects and more reworks, weak quality management, poor transport and logistics facility - Sub-standard port facility - High tax rates - Market and product knowledge gap -
Opportunity	Threat
<ul style="list-style-type: none"> - More order flow from China due to change in global business dynamics - Improved image and confidence of foreign buyers - More practices of Sustainable solutions - More emphasize on cost control - Huge growth in denim sector - More practice of product development and expanding value added services like washing, printing etc. - Export flow towards non-traditional markets - Increase in availability of local technology and consulting service providing agent. - 	<ul style="list-style-type: none"> - Over dependency of foreign raw material especially for cotton, woven fabrics, dyes chemical etc. - Very low margin in basic items - No or very little investment in non-cotton based fiber and fabric industries - Energy crisis and price hikes - High worker wages relation to skill level - Rapid technological growth in competing countries - Sub-standard education and training facilities - Little and or no research development - No proper road map for sustainable development - Technological change - Low FDI and local investment due to bureaucratic and lingering problems - Un-noticed worker unrest and political interference - Unstable socio-political situation of the country

Ref: Review and Outlook, 2020 Bangladesh Garments and Textile Industry by Maeen Md. Khairul Akter, Managing Editor, Textile Focus

4.5 Table -1: RMG Export in last 20years (in Million USD)

Year	Export of RMG	Total Export of Bangladesh	% of RMG to Total Export
2001-02	4583.75	5986.09	76.57
2002-03	4912.09	6548.44	75.01
2003-04	5686.09	7602.99	74.79
2004-05	6416.67	8654.52	74.15
2005-06	7900.80	10526.16	75.06
2006-07	9211.23	12177.86	75.64
2007-08	10699.80	14110.80	75.83
2008-09	12347.77	15565.19	79.33
2009-10	12496.72	16204.65	77.12
2010-11	17914.46	22924.38	78.15
2011-12	19089.73	24301.90	78.55
2012-13	21515.73	27027.36	79.61
2013-14	24491.88	30186.62	81.13
2014-15	25491.40	31208.94	81.68
2015-16	28094.16	34257.18	82.01
2016-17	28149.84	34655.90	81.23
2017-18	30614.76	36668.17	83.49
2018-19	34133.27	40535.04	84.21
2019-20	27949.19	33674.09	83.00

Source: BGMEA website

4.6 Table 2: Comparative projection for RMG Export Value in Billion US\$

Market	2% per Annum	5% per Annum	10% per Annum
EU 27 in Year 2025	25.65	29.15	34.98
USA in Year 2025	6.75	7.67	9.21
Total in Year 2025	32.40	36.82	44.19
EU 27 in Year 2030	28.24	36.43	52.47
USA in Year 2030	7.43	9.59	13.81
Total in Year 2030	35.67	46.02	66.28

4.7 Table 3: Comparative projection for RMG Export Value in **TEUs**

Volume in TEU	2% per Annum	5% per Annum	10% per Annum
Total in Year 2025	1,597,004	1,814,777	2,177,733
Total in Year 2030	1,756,704	2,268,471	3,266,599

Table 2 and Table 3 shows the comparative forecast for RMG export value in the two major export destinations, USA and 27-member European Union for the years 2025 and 2030 under different growth scenario and corresponding cargo volume in terms of TEUs. These forecasted figures need to be considered while planning for transportation networks.

4.8 Important Timelines of Bangladesh Readymade Garments Industry

Serial	Year	Issue
1	1970-1980	Early period of growth
2	1982-1985	Boom days
3	1985	Imposition of quota restriction
4	1990	Knitwear sector developed significantly
5	1993	Child labor issue and its solution
6	2003	Withdrawal of Canadian quota restriction
7	2005	Phase out of quota restriction
8	2006	Riots and strike by garments labor
9	2007-2012	Stable growth
10	2013-2017	Decline and facing different challenges
11	2020	COVID-19 (Corona Virus)
12	2021	Plan to implement Resilient Supply Chain

Ref: Study on Supply Chain Resilience of RMG Sector in Bangladesh by National Resilience Programme (NRP) Programming Division, Planning Commission, November 2020.

5. How natural disasters and climate change may affect RMG sector in Bangladesh

You have been informed that “Study on Supply Chain Resilience of RMG Sector in Bangladesh by National Resilience Programme (NRP) Programming Division, Planning Commission, November 2020” has elaborated various aspects of the above issue. In light of outcomes of the said study, the following vital points are mentioned for your better understanding as to how to combat the impact of natural disaster and climate change in the industrial sector of Bangladesh in general and in the RMG sector in particular.

It is evident that different parts of Bangladesh are susceptible to natural hazards of flood, storm surge, earthquake and landslide. The different components of the RMG supply chain, e.g., factory buildings, roads and highways, railways, water ways, utility lines, ports, etc., may experience different levels of damage and/or disruptions caused by different types of natural disaster. In order to formulate appropriate strategy for such events, tentative scenarios of probable damage to the supply chain components are considered useful. Following sections discuss disaster-wise damage scenarios for the RMG supply chain assets. Figure 5.1 shows locations of RMG factories in Dhaka (Hossain, 2020), and Figure 5.2 shows all the roads and highways and railway network all over Bangladesh (Hossain, 2020).

5.1 Impact of Flood

The current trend of flooding is available in a publication of MoEF (2009). In a publication CCAF (2013), provided a map showing prospective increase in the extent of flooding by 2080 as compared to the inundation level of 1998 flood. Mirza (2011) mentioned the percentage increase in flood depth for different time-frames and different climate change scenarios. The CCAF map, has been used here to understand the severity of flooding in different parts of Bangladesh.

1998 flood level is shown in Figure 5.3 and the relative change considering climate change is shown in Figure 5.4. It is observed that on the Dhaka-Chittagong corridor, 1998 flood level of the segment from Dhaka to Chandpur is 3.6 m and considering climate change another 0.6 m may be added. Figure 5.5 shows that any flood level more than 3.6 m may inundate the entire region between Dhaka and Chandpur.

However, 1998 flood level between Chandpur and Chittagong was 0.6 m or less and the increase due to climate change may be less than 0.3 m. At a 0.9 m simulated inundation level as shown in Figure 5.6, it is observed that this part of the Dhaka-Chittagong Corridor will not be severely affected due to flood.

While it is observed that the railway link will be less severely disrupted for flooding. Once the elevation data of highways and railways are available a more precise analysis can be presented in the final report of the assignment. 0.3 m 1998 flood level within Dhaka city may increase another 0.6 m due to climate change. 0.9 m simulated flood level shews, as in Figure 5.7, the entire city will be submerged. However, due to measures to be taken according to the Drainage Master Plan of DWASA the flooding may be restricted to only designated flood flow areas. The major water logged areas in the core of Dhaka City area have been identified in the Drainage Master Plan of DWASA (2016).

Figure 5.8 shows the proposed amount of retention areas and flood flow zone by DAP along with locations of RMG factories and road and rail networks. It is found that few factories are located along the proposed flood flow zones of Dhaka as shown with red circles in Figure 5.8. A segment of National Highway along the Turag River in the eastern side of Dhaka is also along the proposed flood flow zone as shown with a blue rectangle in Figure 5.8.

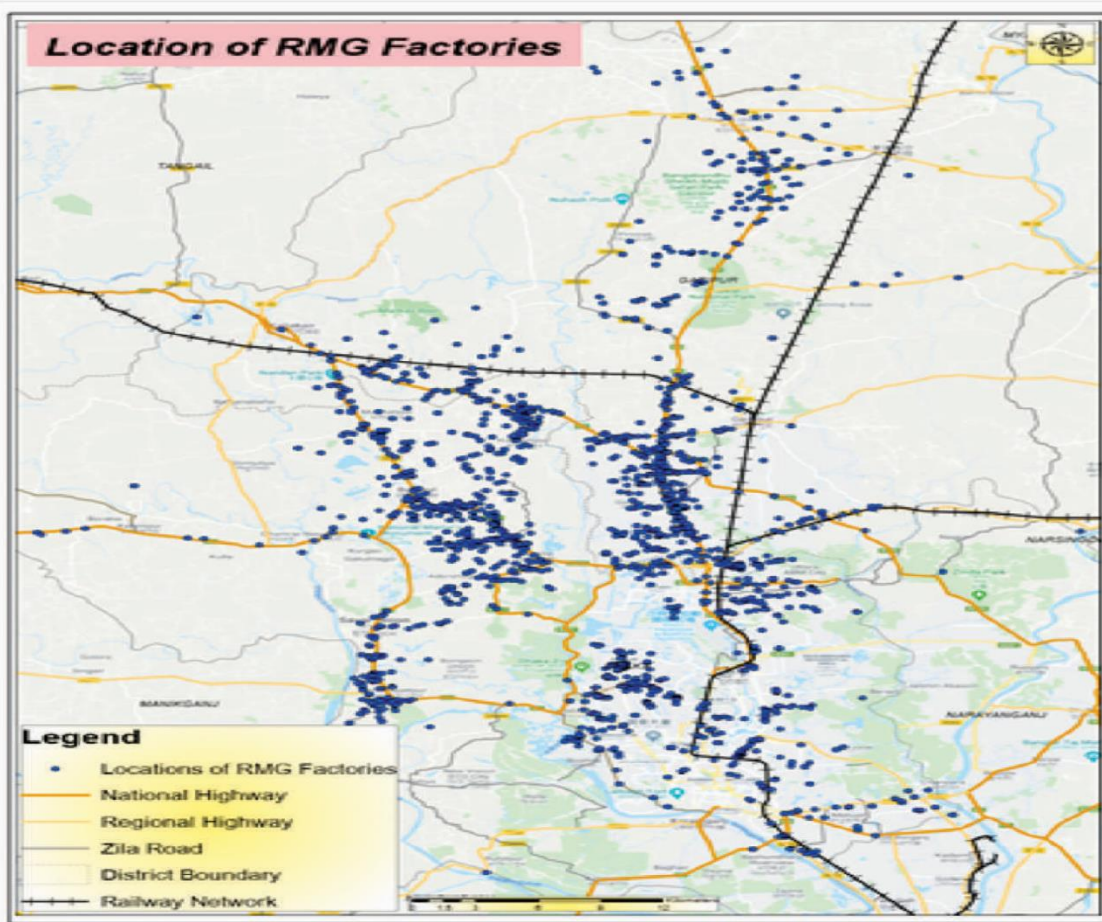


Figure 5.1 Location of RMG Factories in Metropolitan area of Dhaka city (Hossain, 2020).

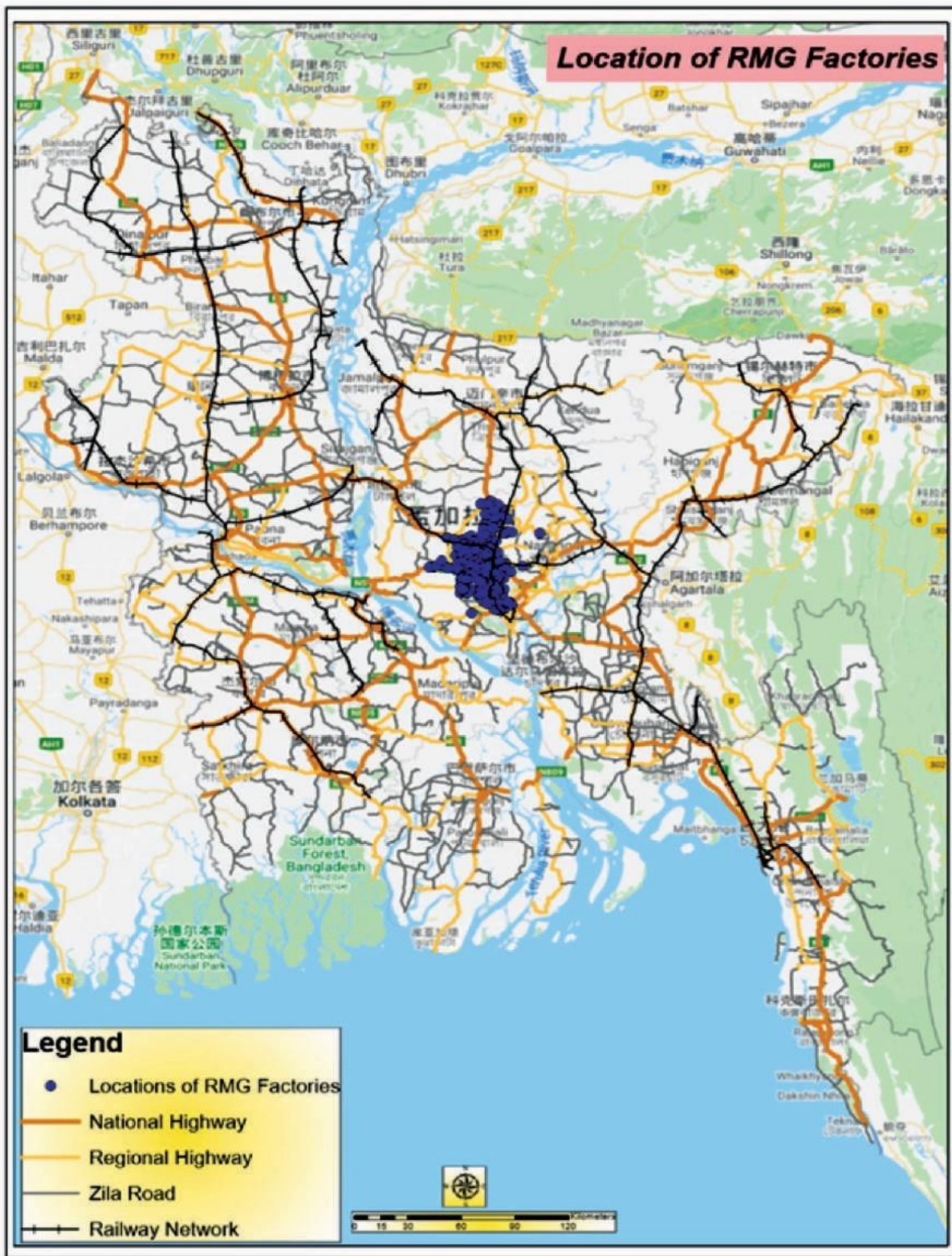


Figure 5.2 Location of RMG Factories in Dhaka Metropolitan area showing roads and highways and railway network all over Bangladesh (Hossain, 2020).

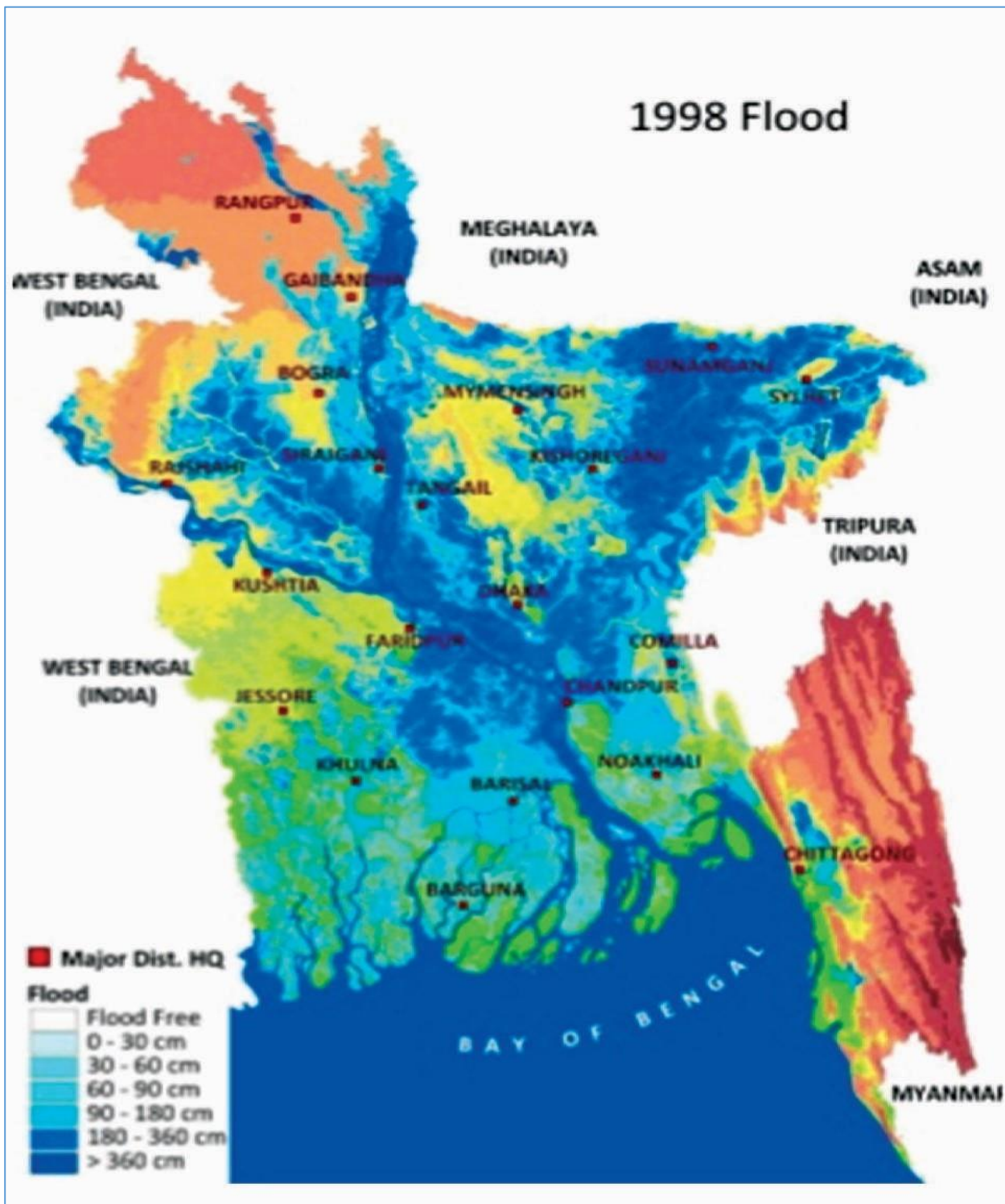


Figure 5.3 Inundation map of 1998 flood

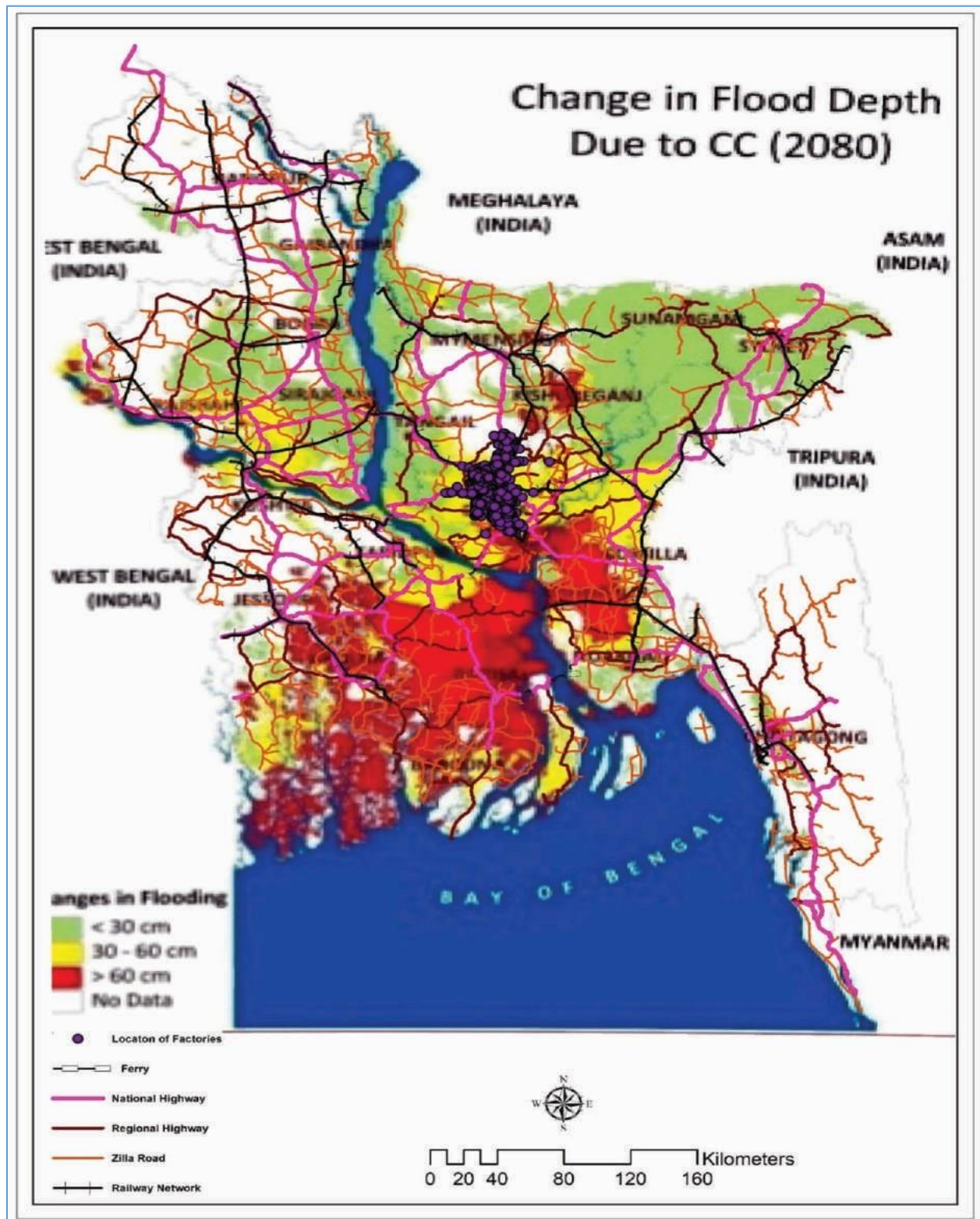


Figure 5.4 Flood scenario of 2080 superposed with land transportation logistics of Bangladesh

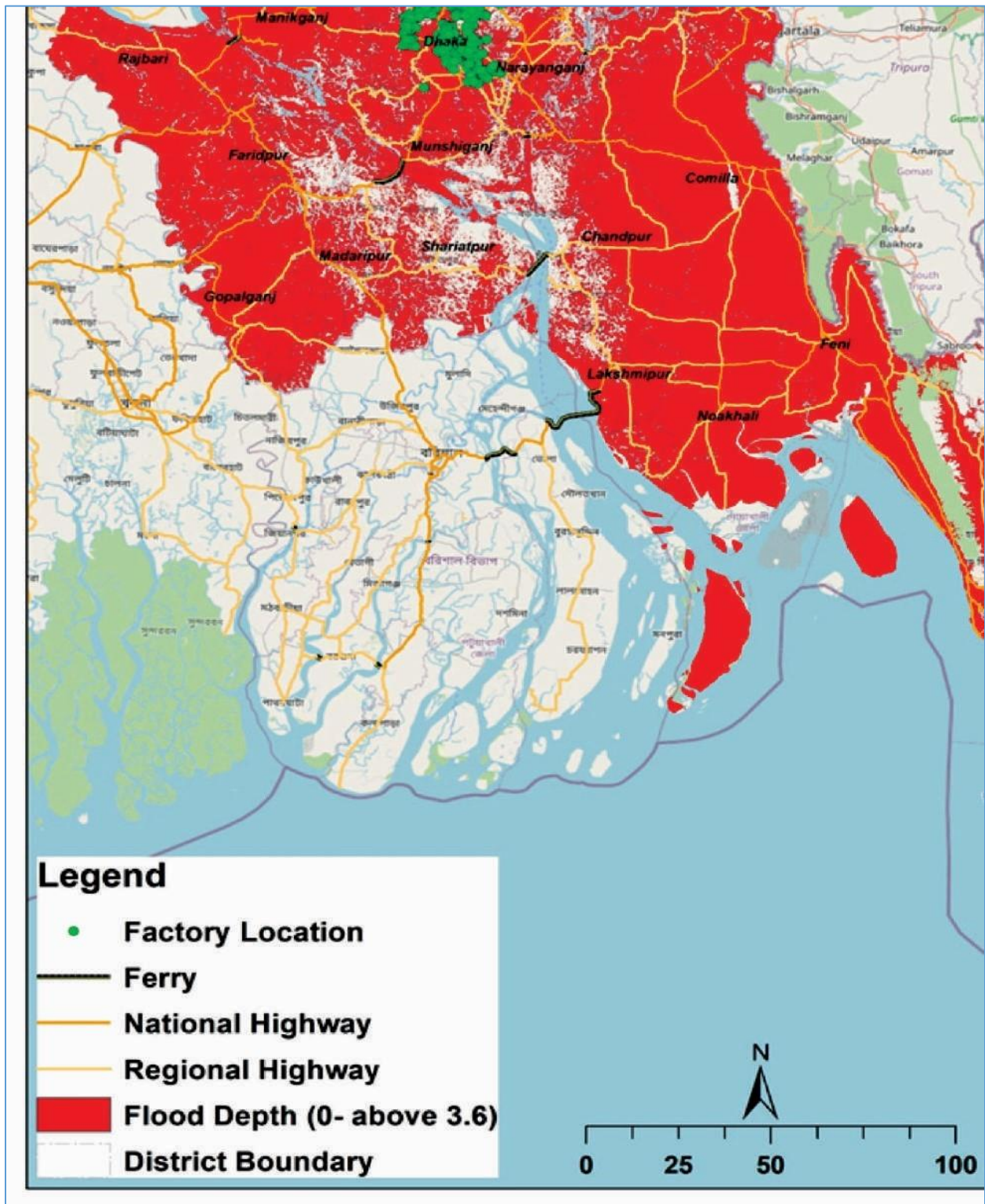


Figure 5.5 Simulated inundation of more than 3.6 m flood level.

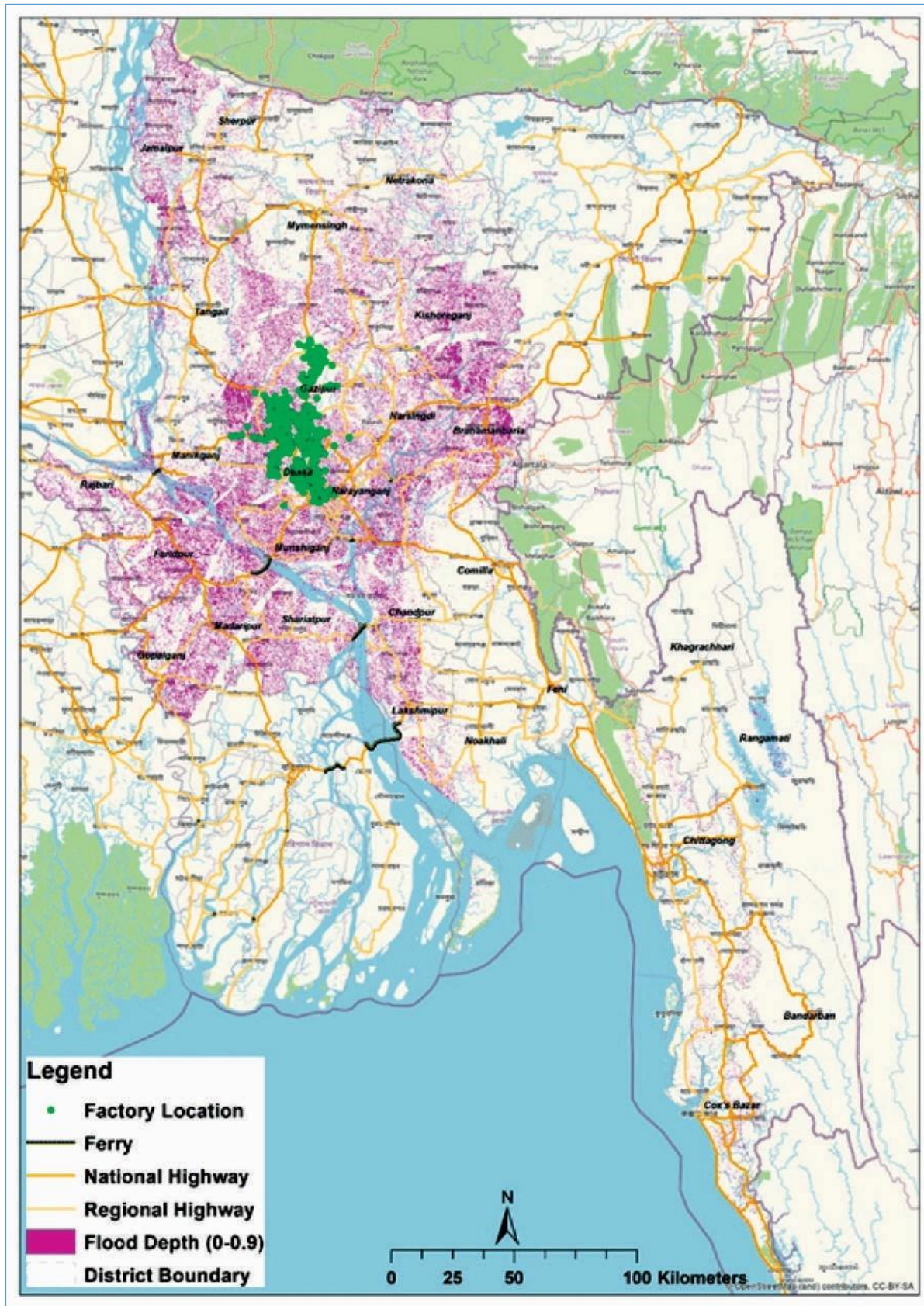


Figure 5.6 Simulated inundation of more than 0.9 m flood level.

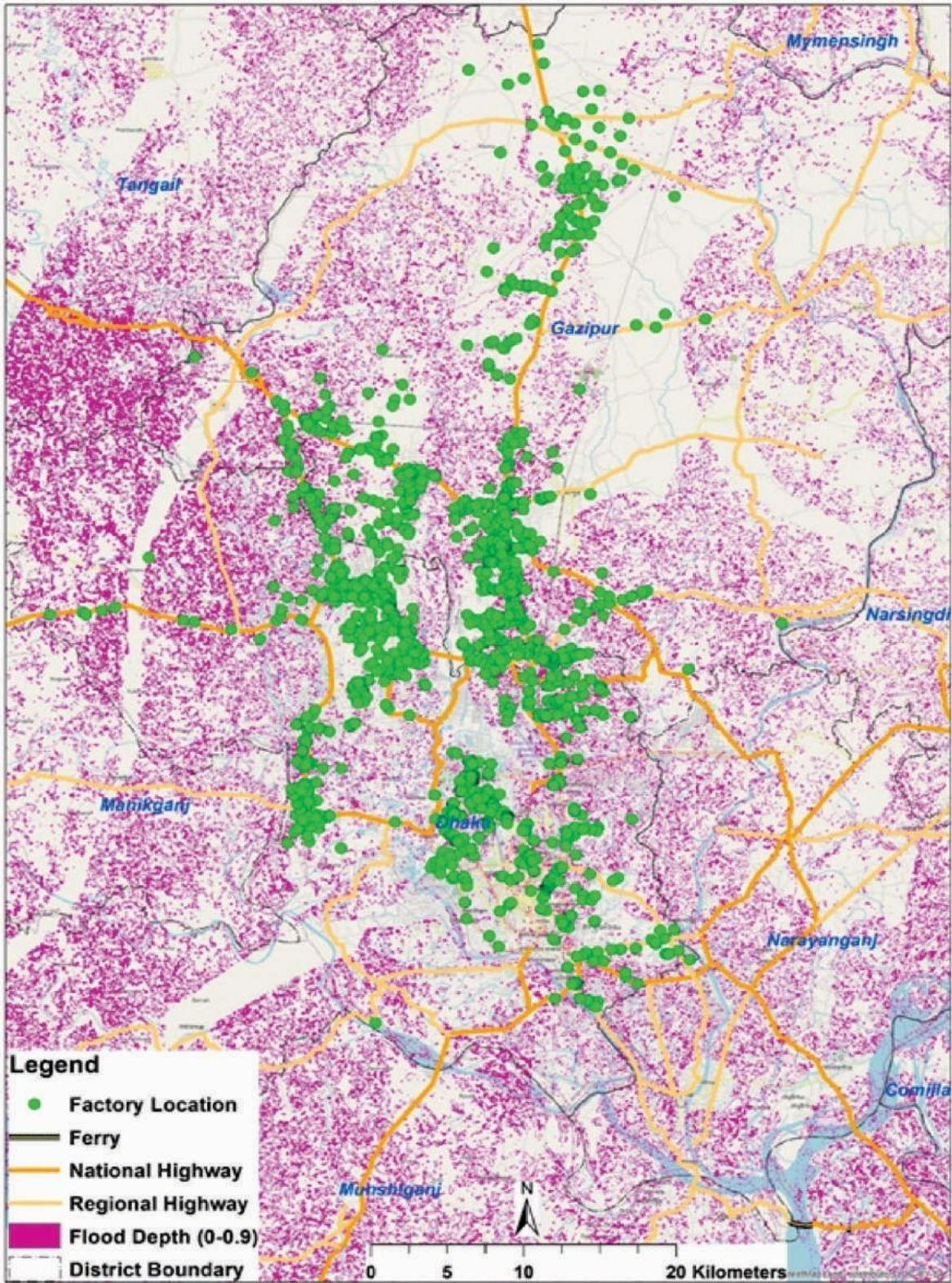


Figure 5.7 Simulated inundation of 0.9 m flood level in Dhaka

(2016). Figure 5.8 shows the proposed amount of retention areas and flood flow zone by DAP along with locations of RMG factories and road and rail networks. It is found that few factories are located along the proposed flood flow zones of Dhaka as shown with red circles in Figure 5.8. A segment of National Highway along the Turag River in the eastern side of Dhaka is also along the proposed flood flow zone as shown with a blue rectangle in Figure 5.8.

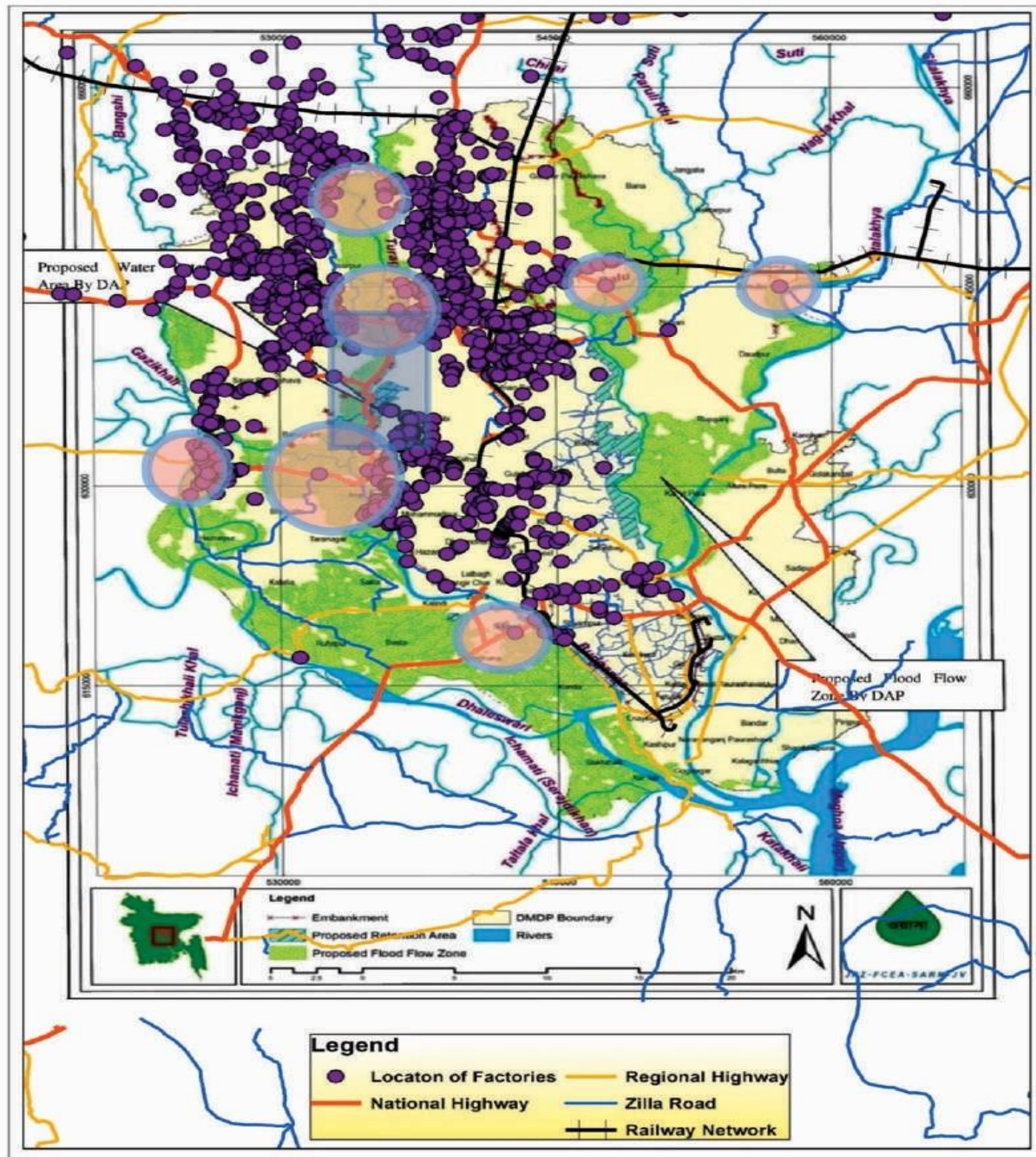


Figure 5.8 Flood flow zones and retention areas of Dhaka superposed by RMG factory locations and road and rail networks

In recent years, rainfall induced ‘urban storm water-logging’ (USWL) events have been experienced in Chittagong City like other urbanized parts of Bangladesh. Figure 5.9 shows simulated inundation of Chittagong city due to 0.9 m flood level considering climate change effect. Similar scenario has also been reported by Akter et al. (2017). With the support of secondary data source 13 most vulnerable USWL locations (Figure 5.10) have been identified in Chittagong City by Akter et al. Among the water logging hotspots Haliashahar and Nasirabad are industrial areas. National avenue N1 (CDA Avenue) from Kapasgola to Bakalia is along the waterlogging hotspots shown with a blue rectangle in Figure 5.10.

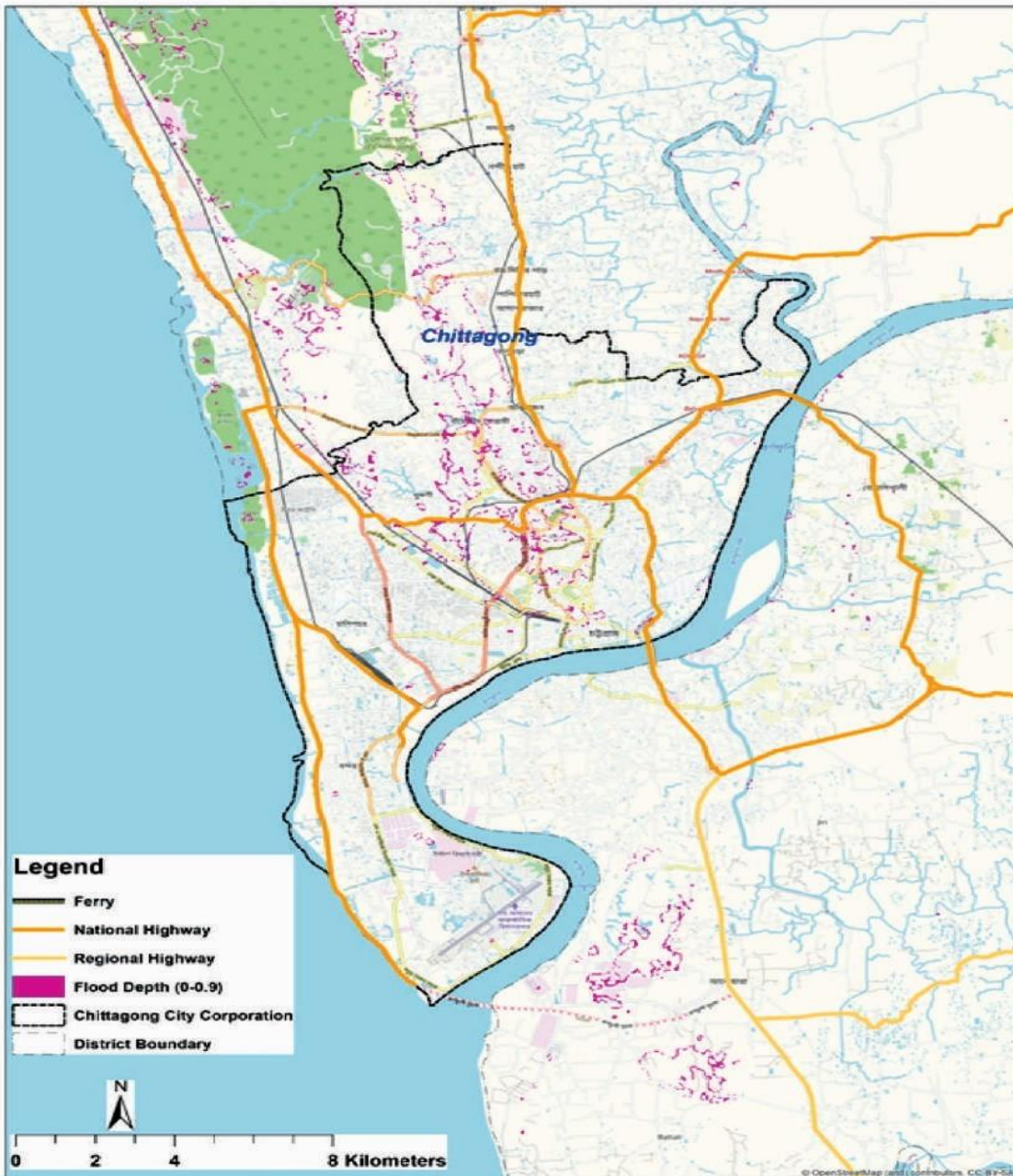


Figure 5.9 Simulated inundation of 0.9 m flood level in Chittagong

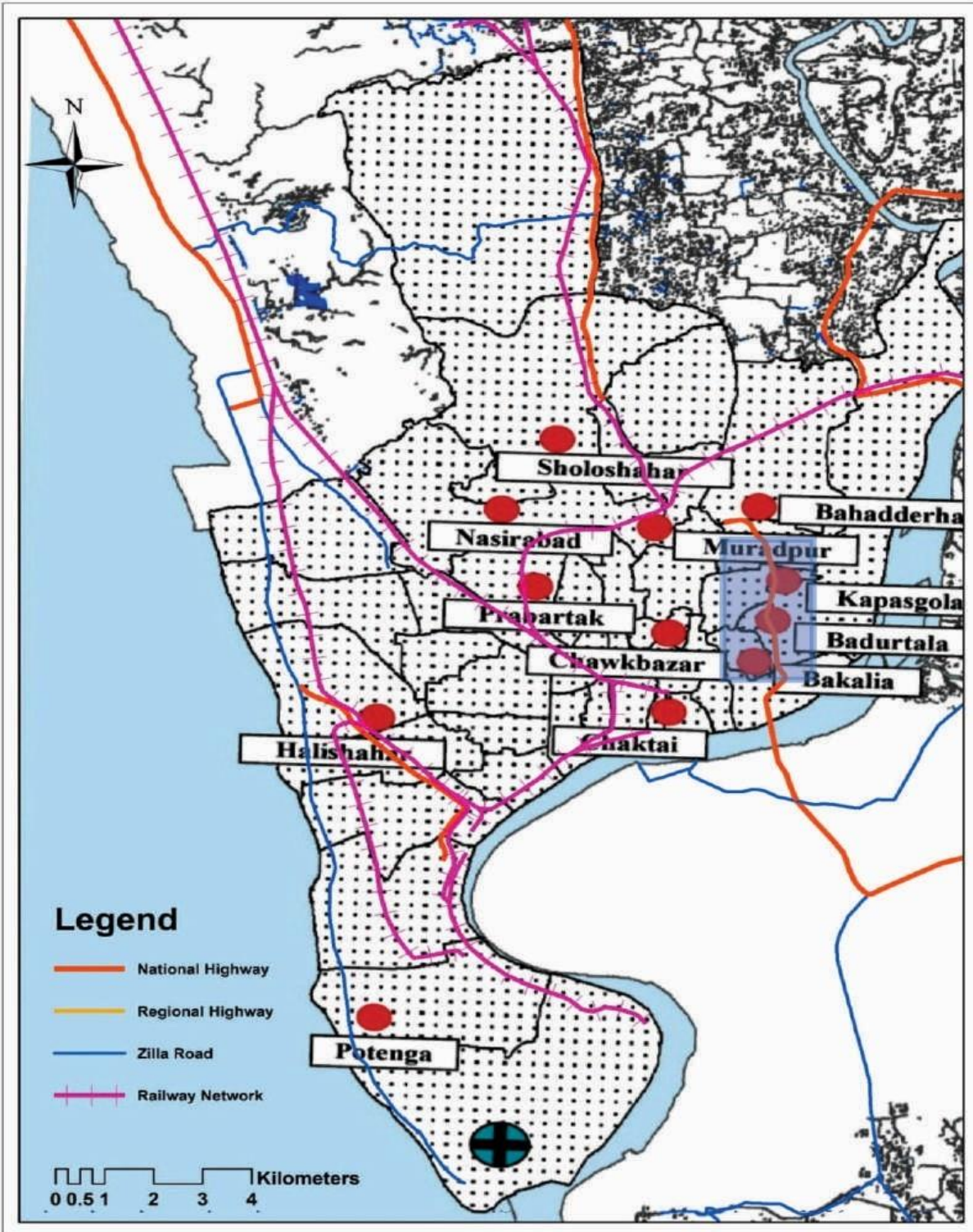


Figure 5.10 Water logging hotspots in Chittagong superposed with road and rail network

5.2 Impact of Storm Surge

From historical data a relationship of wind velocity, storm surge height and extent of inundation is given in a World Bank publication (World Bank, 2011). However, this does not incorporate the effect of sea level rise due to climate change. Comprehensive Disaster Management Program (CDMP-II) (MoDMR, 2014) gives an estimate of change in storm surge inundation level due to climate change as shown in Figures 5.11 and 5.12.

In the Third National Communication of Bangladesh to the UN Framework Convention on Climate Change (MoEFCC, 2018), the current trend of sea level rise is provided. Figure 5.13 shows the current trend of storm surge inundation considering sea level rise superimposed with road and rail networks. Dhaka-Chittagong highway (N1) from Baryarhat to Cox's Bazar via Chittagong is vulnerable to storm surge. The rail line from Baryarhat to Satkania via Chittagong is also in the Meghna estuary flood plain.

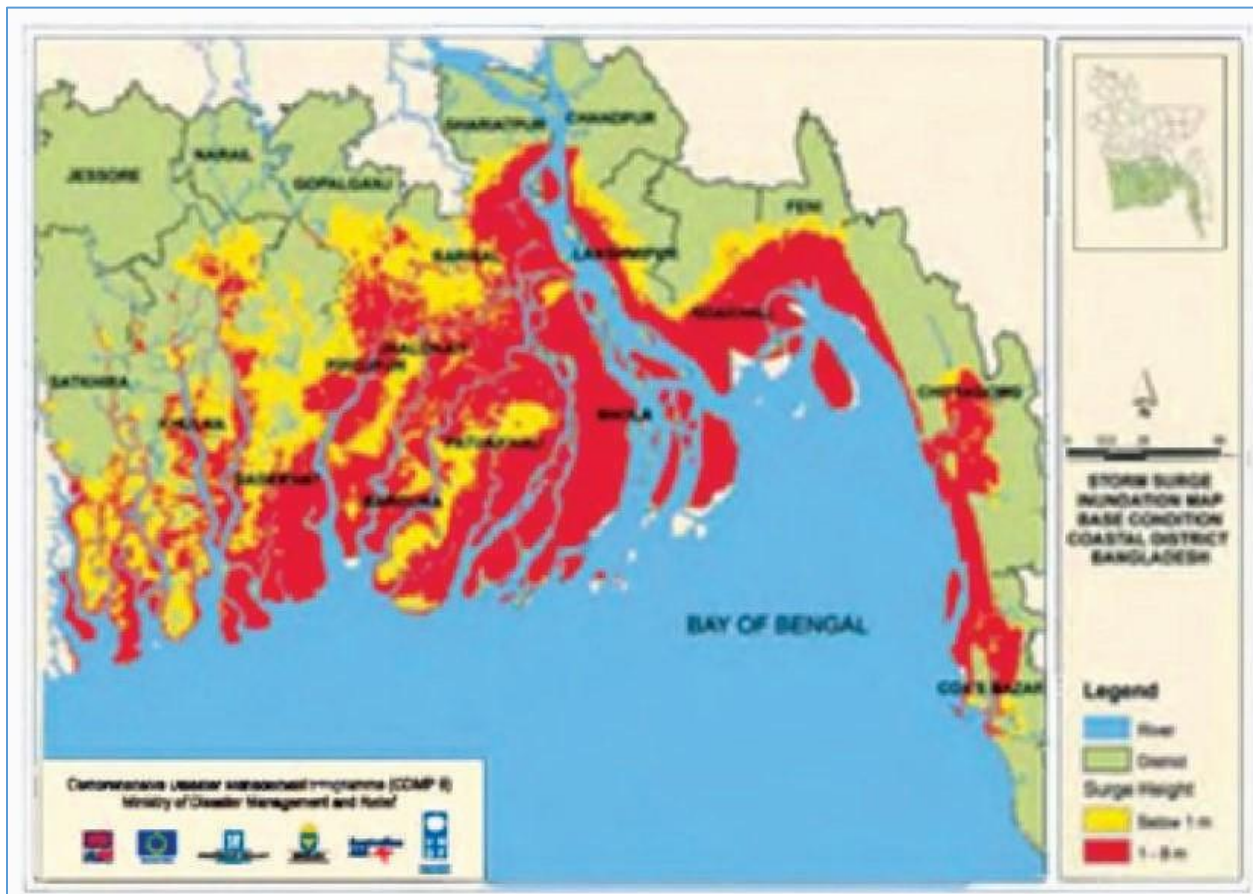


Figure 5.11 Cyclone induced inundation depth greater than 1 m under base condition (MoDMR, 2014)

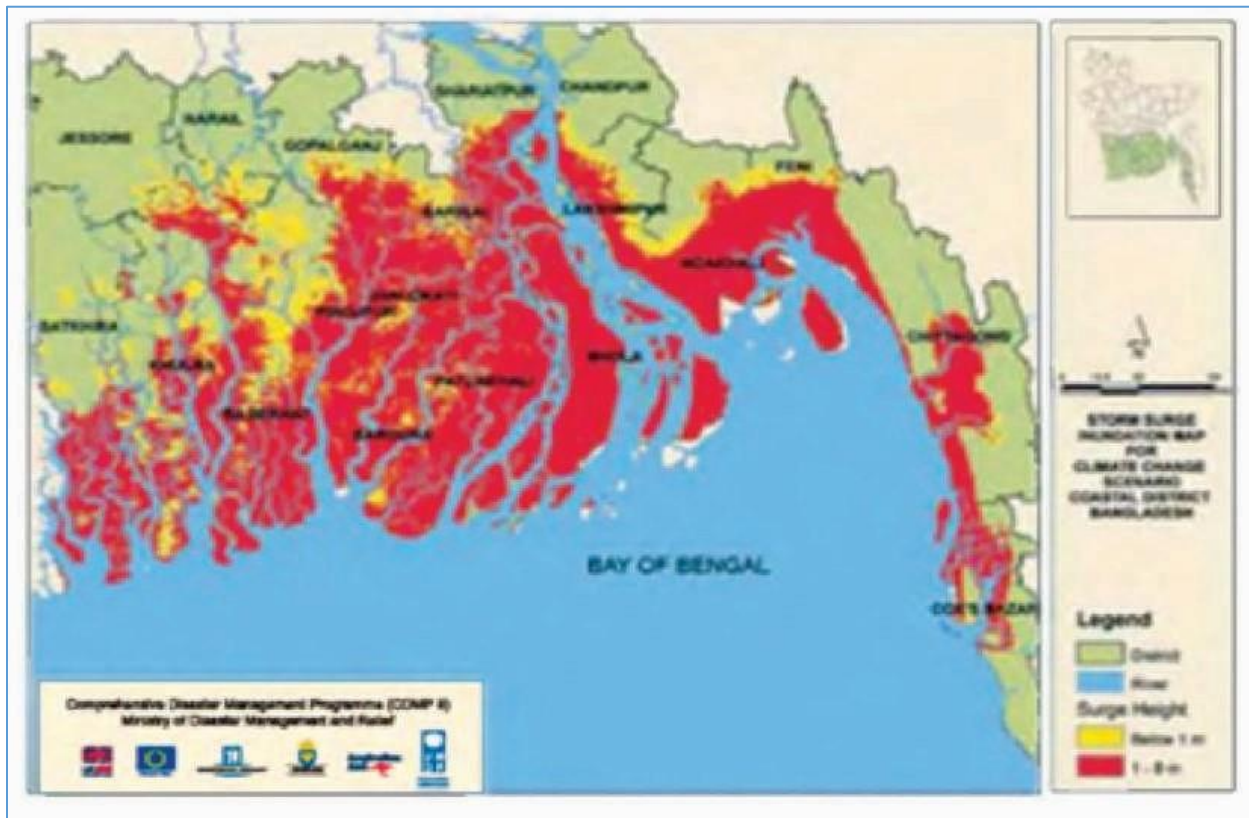


Figure 5.12 Cyclone induced inundation depth greater than 1 m under for changing climate in 2050 (MoDMR, 2014)

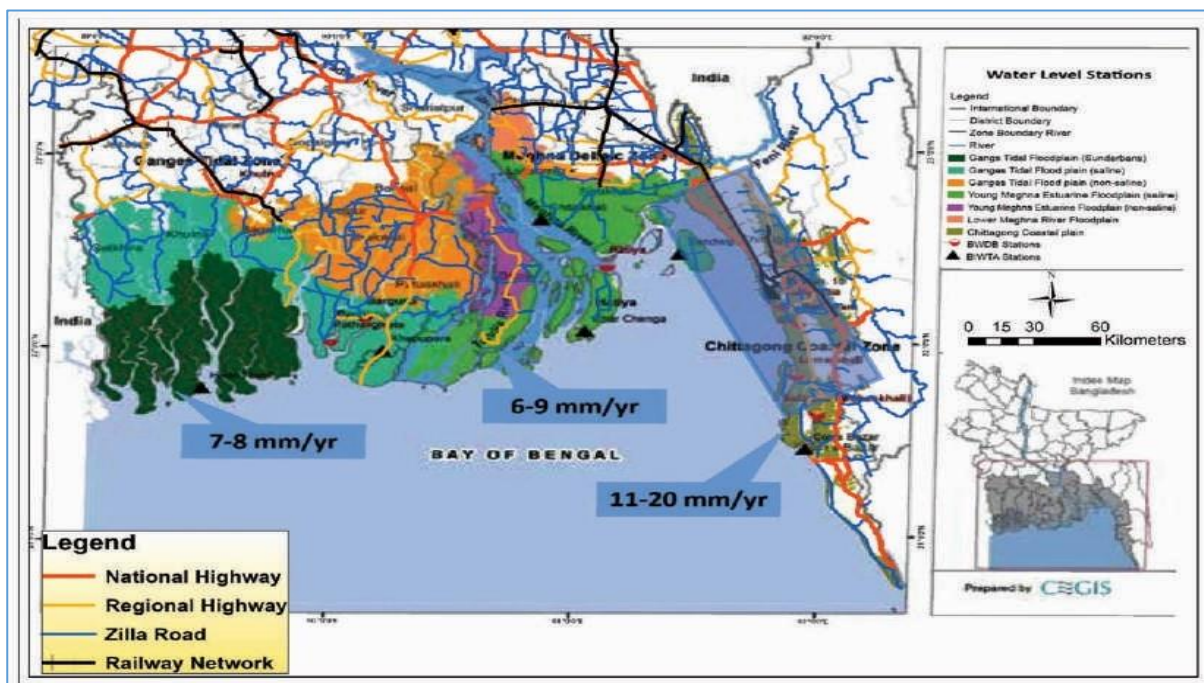


Figure 5.13 Current trend of storm surge inundation considering sea level rise superposed with road and rail networks

5.3. Impact of Earthquake

Bangladesh suffered damages from large earthquakes historically, viz., the 1548 earthquake, the 1664 earthquake, the 1762 earthquake, the 1869 Cachem earthquake (Ms 7.5), the 1885 Bengal earthquake (Ms 7.0), the 1897 Great Assam earthquake (Ms 8.1), and the 1918 Srimangal earthquake (Ms 7.6) (CDMPa, 2009). The epicenters of the historical earthquakes in and around Bangladesh are shown in Figure 5.14. In the BNBC 2020 (HBRI, 2020), a modified seismic zonation map (Figure 5.15) is proposed for the maximum considered earthquake (MCE) derived from probabilistic seismic hazard analysis. Dhaka is located in Zone 2 and Chittagong in Zone 3.

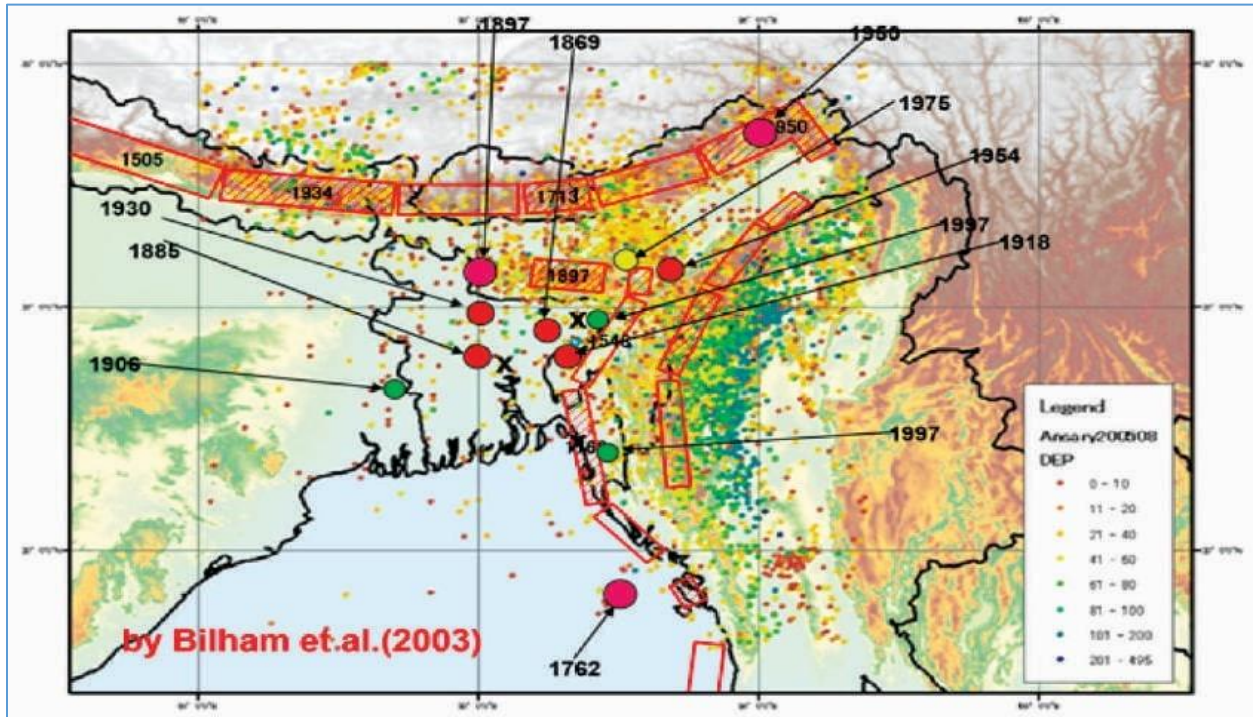


Figure 5.14 Epicenters of historical earthquakes (1664 – 2007) (Sabri, 2001)

After the Rana Plaza disaster in 2013, a large number of RMG factory buildings were assessed by the National Initiative (NI), the Accord on Fire and Building Safety in Bangladesh (Accord) and the Alliance for Bangladesh Workers' Safety (Alliance). Vulnerable buildings are gradually being retrofitted to comply with the building code. It is expected that over the years most of the factory buildings will be seismically resilient. However, liquefaction may be a major problem in supply chain of RMG factories in case of an earthquake.

During an earthquake areas with loose sandy soil with high water table may experience liquefaction which may cause extensive damage to overlying structures. Figures 5.16 and 5.17 show liquefaction susceptibility of Dhaka and Chittagong respectively superposed by the road and rail networks. Figure 5.16 shows a large number of factory buildings in Dhaka are situated on liquefiable sites. Some portion of National Highway and rail lines are also on liquefiable soil. Figure 5.17 shows that CEPZ and Kalurghat industrial areas are highly susceptible to liquefaction. A portion of rail line along the Karnaphuli River is also on liquefiable soil.



Figure 5.15 Seismic Zonation Map of the BNBC 2020 (HBRI, 2020)

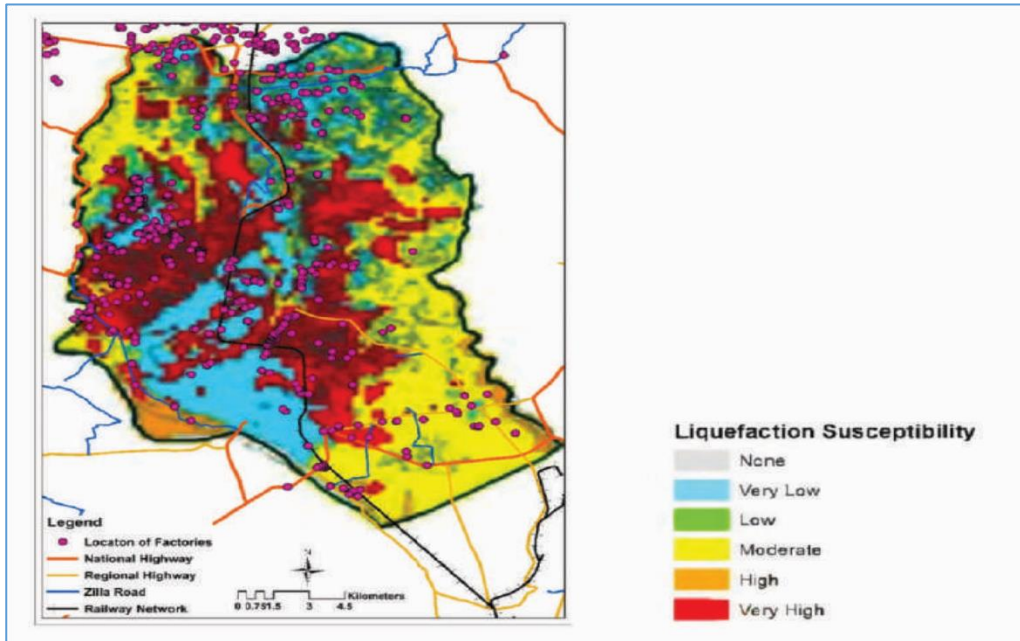


Figure 5.16 Liquefaction susceptibility of Dhaka with locations of RMG factories and road and rail networks.

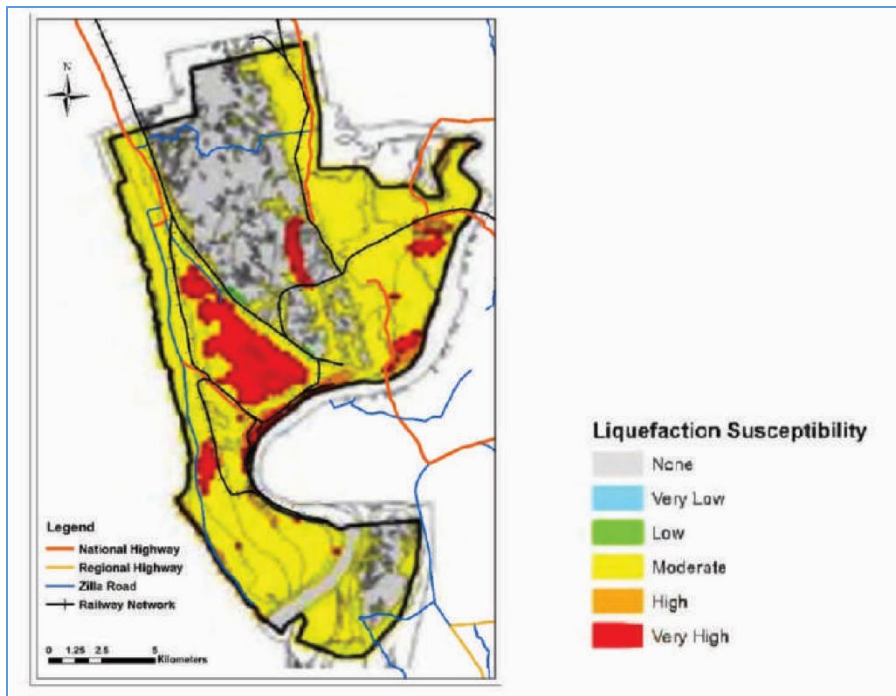


Figure 6.17 Liquefaction susceptibility of Chittagong superposed with road and rail networks

5.4. Impact of Landslide

Landslide is a potential hazard particularly for Chittagong region since there have been some disastrous rainfall induced landslides in Chittagong in 2007, 2008 and 2017. In CDMP studies [13], landslide potential of Chittagong was investigated. Figure 6.18 shows the slope angle distribution in Chittagong City with road and rail networks. It is found that rail lines near Jhautala, Pahartali and Kaibaldham stations are close to steep slopes. Nasirabad industrial area is also in high slope zone.

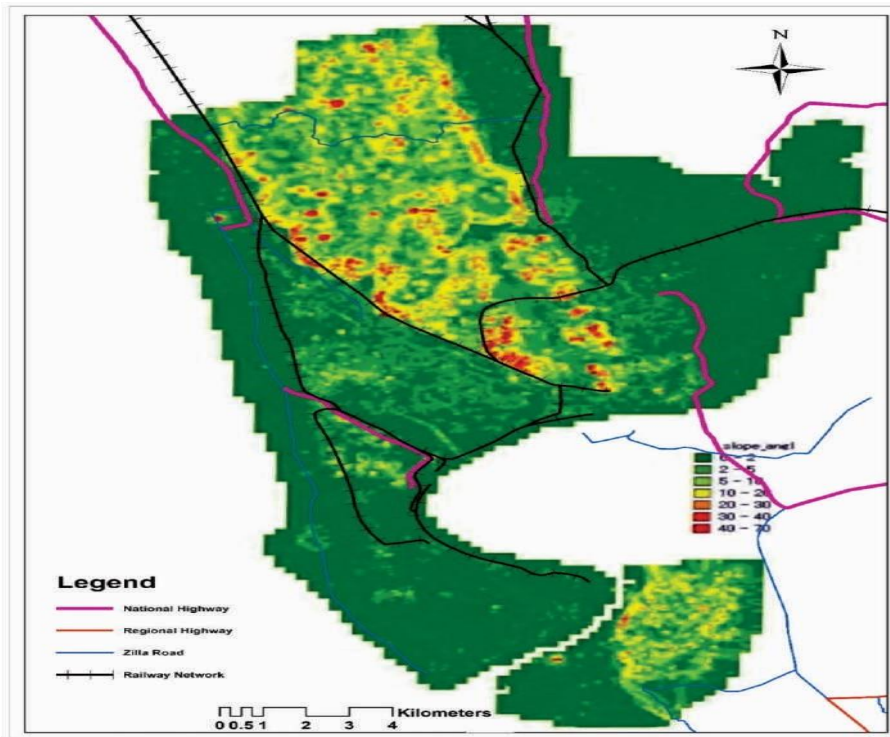


Figure 5.18 Slope angle distribution in Chittagong with road and rail networks

5.5. Impact of Pandemic

Unlike Europe where pandemic struck multiple of time after the industrial revolution, Bangladesh faced a pandemic situation for the first time in 2020 after development of the RMG industrial sector in this country. Like in the rest of the world, outbreak of Covid-19 has caused serious devastation to the country in all aspects. Till date total number of deaths in this country is 3,740 and total number of diagnosed cases is 282,344. Progression of both the number of deaths and cases has been a steady incline as is seen from Figures 6.19 and 6.20.

On 26 March, the government first introduced a 10 day shutdown until 4 April. On 1 April, the government announced that the shutdown would be extended until 11 April. Finally the shutdown was extended until 30 May. On 10 April, The Bangladesh Garment Manufacturers and Exporters Association (BGMEA) announced that the readymade garment (RMG) factories would remain closed until 25 April. Many workers, however, came back to the capital under the assumption that they would return to work on 5 April. On 25 April, BGMEA said it would set dates for reopening member factories gradually. In the first phase, starting 26 April, factories operations were to start with 30% of the workforce, advising to ask only

the workers living near their respective factories to join. In the second phase, on 2 May, based on the success of following health and safety guidelines, factories invited back an additional 20% of the workforce. 1,427 export-oriented units reopened on 26 April, followed by another 1,820 factories on 27 April (www.fairwear.org). To fight COVID-19's unfolding fallouts, the government announced a stimulus package of Tk956 billion (\$11.2 billion), or 3.3% of GDP to revive the economy. The package allocates Tk50 billion for RMG and other export-oriented industries which could only be used for paying salaries and allowances to workers and employees. The size of the Export Development Fund has been increased from \$3.5 billion to \$5.0 billion which provides short-term facilities for importing raw materials for export-oriented industries.

The RMG sector in Bangladesh has faced three pronged vulnerability to this pandemic. The first being the loss of demand in the market economies. Secondly, disruption of supply-chain due to suspension of international travels and closure of supply by the countries of origin. And thirdly domestic disruption by shutdown. The main reason of domestic disruptions was the unpreparedness and lack of awareness and knowledge about the specific disease. Otherwise RMG sector has quite a bit of strength or capacity to face such challenge of pandemic.

Maintaining social distancing is not a big problem in the garments factory working environment. Usually, most of the factories has some sort of in-house health services. And most importantly all the factories have strict access control. All these points might contribute to better management of such viral pandemic in the RMG sector in Bangladesh. However, there are certain points of vulnerability that we have to be aware of. Firstly, although, the environment within the factory premises allow the workers to maintain social distancing, outside the factory it is most likely that it is quite difficult for the workers to maintain social distancing in their day to day activities. Secondly, mass travel of the workers to and from the city areas during shutdown and reopening, might have made the pandemic situation much worse. Thirdly, the factories were not properly prepared with the required protective gears and hygienic materials.

Analysis of Risk Situation

The present report presents findings of the Key Informant Interviews and some tentative scenarios of impact of disasters and climate change on RMG supply chain system in Bangladesh. The BGMEA representatives highlighted on the importance of developing a Business Continuity Plan for the RMG sector. The Chittagong Port Authority informed that the port authority is completely prepared for any natural disaster situation. Institute of Water and Flood Management cooperated by sharing relevant literature.

From the present study, it is found that the segment from Dhaka to Chandpur of Dhaka-Chittagong Highway is likely to be most severely impacted by flooding. There are few factories which are located along the proposed flood flow zones of Dhaka. A segment of National Highway along the Turag River in the eastern side of Dhaka is also along the proposed flood flow zone. Haliashahar and Nasirabad industrial areas are located at water logging hotspots in Chittagong.

The segment of the CDA Avenue (N1 National Highway) from Kapasgola to Bakalia is also along the waterlogging hotspots. Dhaka-Chittagong highway (N1) from Baryarhat to Cox's Bazar via Chittagong is vulnerable to storm surge. The rail line from Baryarhat to Satkania via Chittagong is also in the Meghna estuary flood plain. A large number of factory buildings in Dhaka are situated on liquefiable sites. Some portion of National Highway and rail lines are also on liquefiable soil. CEPZ and Kalurghat industrial areas in Chittagong are highly susceptible to liquefaction. A portion of rail line along the Karnaphuli River is also on liquefiable soil. It is found that rail lines near Jhautala, Pahartali and Kaibaldham stations are close to steep slopes. Nasirabad industrial area is also in high slope zone. More scenarios will be produced in this study with additional data in the final report along with recommendations for sustainability of the supply chain of the RMG sector.

6. Supply Chain Resilience

6.1 What Is Resilience?

"Resilience" means the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. (Ref: Executive Order: President, USA Proclamation- Critical Infrastructure Security and Resilience Month, 2013)

In materials sciences, resilience represents the ability of a material to recover its original shape following a deformation. In the corporate world, resilience refers to the ability of a company to bounce back from a large disruption—this includes, for instance, the speed with which it returns to normal performance levels (production, services, fill rate, etc.).

Resilience is a proactive approach to reducing damages, preventing losses, and shortening critical recovery times. Traditional risk management focuses on planning and reducing vulnerabilities. Resilience management puts **additional emphasis on speeding recovery and facilitating adaptation.**

Today's complex global supply chains are the heart of business strategy, driving bottom-line and top-line growth, and creating competitive differentiation for companies. But they are fraught with risks, including quality concerns, competitive issues, supplier continuity, natural disasters and rising energy costs, pandemic to name just a few.

Across industries, businesses are vulnerable to supply chain disruptions that can move a company from leader to lagged in a relatively short period of time. The companies that will succeed in the global economy are those that develop successful risk mitigation strategies, and who use resilience as a competitive advantage.



Factors: Resilience Competences

- Procurement flexibility
- Manufacturing flexibility
- Distribution flexibility
- Production capacity
- Logistics efficiency
- Supply chain visibility
- Adjustability
- Risk management
- Crisis management
- Distribution of assets
- Collaboration
- Security programs



Factors: Risk Sources

- Geographical risks
- Intentional attacks
- Pressures from the market, government & civil society
- Limited resources
- Interdependence

Threats to your supply chain, and therefore to your company, abound—natural disasters, accidents, and intentional disruptions—their likelihood and consequences heightened by long, global supply chains, ever-shrinking product lifecycles, and volatile and unpredictable markets.

No sure way exists for overcoming all such risks, especially high-impact/low-probability events such as an outbreak of SARS or foot-and-mouth disease, or a major terrorist attack, because the absence of historical data excludes the use of predictive statistical tools to help ensure containment of those risks.

But some organizations cope far better than others with both the prospect and the manifestation of unquantifiable risk. They don't have in common a secret formula or even many of the same processes for dealing with risk, but they share a critical trait: resilience.

The notion of organizational resilience is not new: the ability of an organization to successfully confront the unforeseen has always been a core element of success. But because the numbers and types of threats that can undermine a supply chain are now greater than ever, resilience has taken on even more significance in supply chain management. As a result, leaders in the discipline have worked to better understand what makes a particular enterprise resilient, and thus there is a burgeoning body of knowledge from which other companies stand to benefit.

Supply chain resilience no longer implies merely the ability to manage risk. It now assumes that the ability to manage risk means being better positioned than competitors to deal with—and even gain advantage from—disruptions.

6.2 Achieving Resilience

Companies can develop resilience in three main ways: increasing **redundancy**, building **flexibility**, and changing the corporate **culture**. The first has limited utility; the others are essential.

a. Redundancy.

Theoretically, a resilient enterprise can be built by creating redundancies throughout the supply chain. The organization could hold extra inventory, maintain low capacity utilization, have many suppliers, etc. Yet although redundancy can provide some breathing room to continue operating after a disruption, typically it is a temporary—and very expensive—measure. A company must pay for the redundant stock, capacity, and workers; moreover, such excesses are likely to lead to sloppy operations, reduced quality, and significant cost increases.

Admired and emulated supply chain strategies such as the Toyota Production System, lean production processes, and Six Sigma practices aim to create hyper efficient enterprises—those that operate with little inventory to deliver high-quality products in a timely fashion. A focus on redundancy actually inhibits an organization's ability to achieve such efficiency.

b. Flexibility.

In contrast, when a company increases supply chain flexibility, it can both withstand significant disruptions and better respond to demand fluctuations.

To achieve built-in flexibility, a company should take the following actions:

- **Adopt standardized processes:** Master the ability to move production among plants by using interchangeable and generic parts in many products, relying on similar and even identical plant designs and processes across the company, and cross-training employees. Interchangeable parts, production facilities, and people allow a company to respond quickly to a disruption by reallocating resources where

the need is greatest. Intel, for example, builds semiconductor fabrication factories with identical layouts for machinery and production processes. Because of its standard fabrication design, Intel can switch production among facilities if the need arises.

- **Use concurrent instead of sequential processes:** Employing simultaneous rather than sequential processes in such key areas as product development and production/distribution speeds up the recovery phase after a disruption and provides collateral benefits in improved market responses. Lucent Technologies achieves concurrency through a centralized supply chain organization that spans various company functions, including engineering and sales. By aligning these activities with the supply chain, the company can view each operational area simultaneously—and quickly assess the status of the activity in each if an emergency arises.

- **Plan to postpone:** Design products and processes for maximum postponement of as many operations and decisions as possible in the supply chain. Keeping products in semi-finished form affords flexibility to move products from surplus to deficit areas. It also increases fill rates and improves customer service without increasing inventory carrying costs, because the products can be completed when more accurate information about what the customer wants becomes available. Italian clothing manufacturer and retailer Benetton redesigned its manufacturing processes so that select products—particularly those subject to extreme demand variability—are made as generic, undyed items to be finished later, when the company obtains more accurate demand information.

- **Align procurement strategy with supplier relationships:** If a company relies on a small group of key suppliers, it must maintain a deep relationship with each. Such suppliers are so vital to an enterprise that the failure of any among them can have a catastrophic effect on that enterprise. By knowing each trading partner intimately, a company can better monitor the group to detect potential problems—and rely on them for help to deal in unforeseen circumstances.

On the other hand, if a company is not closely allied with a small group of suppliers, its supplier network had better be extensive if it is to be resilient and responsive to the market. A company with shallow relationships is less knowledgeable about its trading partners and therefore less likely to be forewarned about supply problems. Therefore, maintaining a large network of arm's-length suppliers would distribute the risk should a failure occur.

Neither strategy is necessarily correct; the issue is to choose the approach that aligns a company's supplier relationships with its procurement strategy.

Inadequate monitoring of its supplier base almost cost Land Rover its business when UPF-Thompson, its sole supplier of chassis frames for the Discovery models, unexpectedly went bankrupt in December 2001. Land Rover was totally unprepared and eventually had to pay off some of UPF's debt to ensure the resumption of chassis supplies. A deeper relationship with UPF would likely have alerted Land Rover before the crisis.

c. Cultural Change.

After a disruption, the factor that clearly distinguishes those companies that recover quickly, and even profitably, from those that falter is corporate culture. On the surface, Nokia, Toyota, UPS, Dell, Southwest Airlines, and the U.S. Navy may not seem to have much in common, but these resilient organizations share several cultural traits:

- **Continuous communication among informed employees.** They keep all personnel aware of the strategic goals, tactical factors, and day-by-day and even minute-by-minute pulse of the business. Dell employees have continuous access to product manufacturing and shipment data and a wide variety of other information. Thus, when a disruption takes place, employees know the company's status: what is selling,

where the raw materials are, what it is they were trying to do before the disruption hit, and so on. They can use that knowledge to make better decisions in the face of the unforeseen.

An example is that of mobile phone manufacturers Nokia and Eriksson. A fire at a major supplier cut off the supply of a type of chip that was crucial to their manufacturing operations. Nokia's open culture circulated the news, and the company recovered very quickly by finding other sources. Eriksson, on the other hand, was more closed, and sat on the news. The result: by the time Eriksson realized it was in deep trouble, Nokia has bought up most of the alternative sources of chips. Eriksson later exited the business.

- **Distributed power**, so that teams and individuals are empowered to take necessary actions. Toyota assembly-line workers can halt production by pushing a special alarm button, and the members of U.S. Navy aircraft carrier crews can stop flight operations if they detect an emergency. Before a potential disruption is even visible to managers, those that are thus empowered and are "close to the action" can take necessary measures; moreover, they can respond quickly, significantly enhancing the chances of containing a disruption early on.

- **Passion for work**. Successful companies engender a sense of the greater good in their employees. Southwest Airlines CEO Herb Kelleher recounts the words of one of his managers: "The important thing is to take the bricklayer and make him understand that he's building a home, not just laying bricks."

- **Conditioning for disruptions**. Resilient and flexible organizations are apparently conditioned, as a result of frequent and continuous "small" operational interruptions, to become innovative and flexible in the face of HILP (high impact/low probability disruptions). Albert Wright, speaking of working conditions at UPS, has said that "disruptions are really normal." Since its operations are subject to adverse weather, traffic congestion, road closures, and many other problems that cause delay, the company's recovery processes are tested daily.

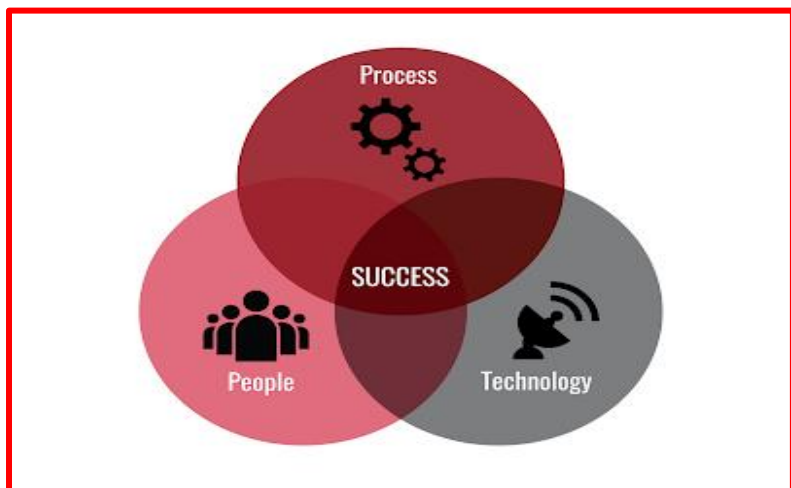
Ref: "Building a Resilient Supply Chain" by Paul Michelman and by Yossi Sheffi (Yossi Sheffi is a professor of Engineering Systems at MIT, where he heads the MIT Center for Transportation and Logistics.) (<https://hbr.org/2007/08/building-a-resilient-supply-chain%20May%2011>)

6.3 The Core Enablers of a Supply Chain Resilience Strategy: People, Process and Technology

How can you minimize disruptions in your supply chain? Affected companies need more resilient supply chains to ensure that they can continue production in the face of any challenge. A good supply chain resilience strategy has three core enablers: people, process and technology.

a. People

Companies need enough manpower to complete the work, but they also need skilled workers with the knowledge to help their employers tackle tough challenges. Scout for knowledgeable engineers, procurement specialists and supply chain managers who can supplement existing talent and help the company navigate a difficult business environment. Concurrently, look for people with market knowledge, who can help the company stay ahead of market



trends. Manufacturing will never slow down, so you need the right people to help you keep up with the pace of business.

Once you have the talent you need, structure your organization for success. Organize a commodity management team and a supplier relationship team. Commodity managers focus on short-term goals and should be experts in their specific commodities markets. This means they are constantly aware of new products, supply chain developments, pricing changes and other market activities. Such awareness can help mitigate issues related to cost increases and component shortages.

Supplier relationship managers work with a long-term technology roadmap. These individuals do not handle price negotiations or the short-term business of their commodity counterparts. Instead, they are focused on building relationships with suppliers at the executive level by understanding their core business strategies and proactively approaching these partners with opportunities for mutual benefit.

Unfortunately, COVID-19 has complicated supplier relationship management. Before the pandemic, supplier relationships relied heavily on face-to-face interactions and in-person meetings. However, travel restrictions are creating a new virtual environment as supply chain professionals conduct their discussions without traveling.

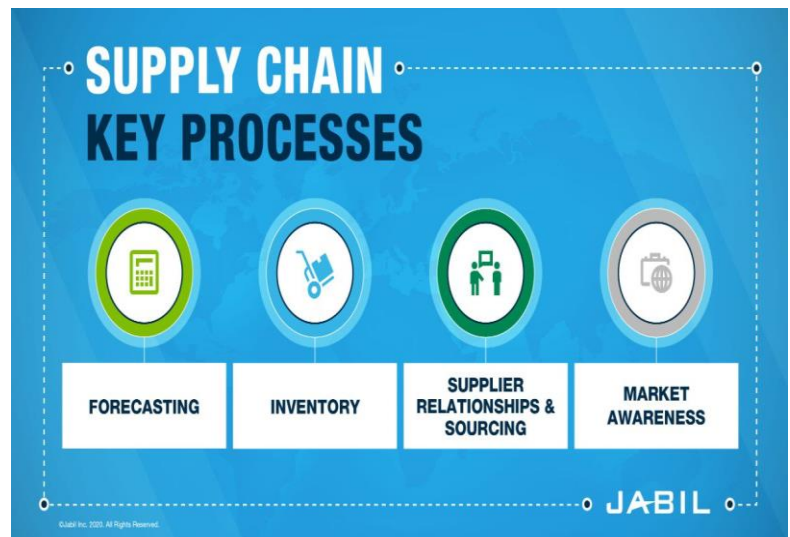
This inability to travel builds uncertainty, especially with companies that have been maintaining numerous supplier relationships over many years. Supply chain managers are having to rethink how they can maintain those relationships in a new way. This is especially crucial since supply chain, at its core, is a people business. If a supplier is only running at 20% or 30% capacity because of a disruption, you can bet their limited goods will be prioritized by the strength of their relationships.

This type of organizational structure should help cover your bases, but it may seem unrealistic for some businesses. Companies that are unable to accomplish this or have different business needs should consider partnering with a manufacturing solutions provider, which can help enable supply chain resilience.

b. Process

Employees do their best work when they are empowered by effective, robust processes. To manage component shortages and obsolescence and to increase supply chain resilience, companies need to bolster their processes in the following areas:

- **Forecasting:** No matter what, you need to understand what's necessary. This helps secure supply with good information. Then, think about what you need in the long term. If you start ordering parts two weeks before they're needed (because you didn't forecast effectively), you'll have a very low chance of procuring what you need in time. But, knowing in advance that you have demand in the pipeline from good forecasting, you may have time to secure supply and stay ahead of shortages.



To drive a robust forecasting process, you need to link sales requirements to operations and materials availability. In the past, sales and operations planning (S&OP) has resembled a "load and chase" process as companies made decisions in silos with disconnected tools. This time-consuming and reactive approach has resulted in an excess of materials and capacity. However, an integrated S&OP allows realistic, feasible and flexible planning with trade-off analysis. Overall, it is a more efficient and proactive approach to supply chain management.

- **Inventory:** Look at low-volume parts that might impact the availability of high-value features. Add safety stock to reduce the risk of a production slow down or halt. Also, focus on supply assurance versus shortage management. Shortage management is a strategy that looks at how many of a specific item is needed by a specific date and guides purchasing managers to procure based on this information. Supply assurance looks at all the needed parts over a very long horizon, taking into account possible shortages and obsolescence, and develops supply plans for those parts.

Companies should invest in optimized inventory strategies to drive order flexibility and service level performance. These include: managing long lead times, inventory positioning, safety stock to counter unexpected demands and dynamic, localized replenishment models to ensure materials are delivered exactly when they are needed - not simply when they're forecasted to be needed.

- **Supplier Relationships and Sourcing:** Follow a clearly defined sourcing strategy linked to supply chain risks...not just cost. Make sure you have a good reason for working with specific suppliers. Stay away from single-source relationships and work to expand your supply network. Develop a second source relationship and define geographic priorities to reduce risk.

That said, there are times when companies have to rely on a single source relationship as a result of cost, technology or other factors. In those cases, ensure you have a solid C-level relationship with your key supplier. Developing a solid supplier-customer relationship takes time, and it's usually best to start building this relationship in a balanced market. Then, when the market turns, your supplier base or partner should return the favor and help you procure the items you need.

- **Market awareness:** You need to make sure you're as smart as everybody else and staying on top of market trends. Keep tabs on what products are available in the market, where you can procure them, as well as the latest standards of design and best practices for managing your supply base. Also, keep an eye on the needs and trends of the specific market(s) you serve. This can assist in supply chain management and more effective decision-making.

As part of this, monitor the technology curve for materials and design and make product design a regular conversation – your company depends on it.

c. Technology

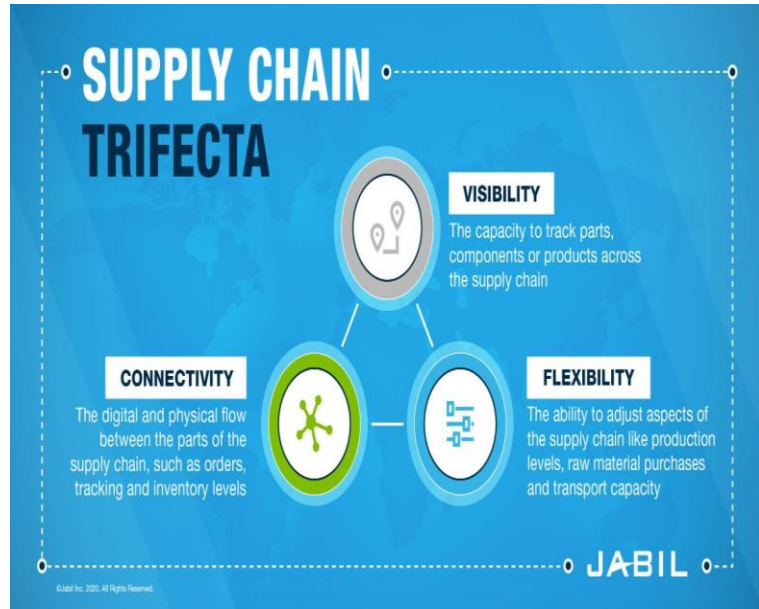
Technology can help organizations complete the above-mentioned processes more easily and accurately. For example, real-time analytics and decision support tools, including enterprise resource planning (ERP) and electronic data interchange platforms, can help provide baseline data which, in turn, justifies investments in spend, supplier and commodity analyses.

Together, these provide enriched data sets that can help managers better understand the dynamics of the procurement process; make decisions related to customer needs, production schedules, logistics and delivery requirements; and anticipate upcoming challenges, including shortages, and respond quickly to market shifts.

Visibility—along with **connectivity and flexibility**—is commonly recognized as a key part of the trifecta of supply chain success. But this supply chain visibility needs to be both complete and instantaneous. It relies

on analytics; it requires having technology that can gather and deliver real-time data that translates into actionable insights.

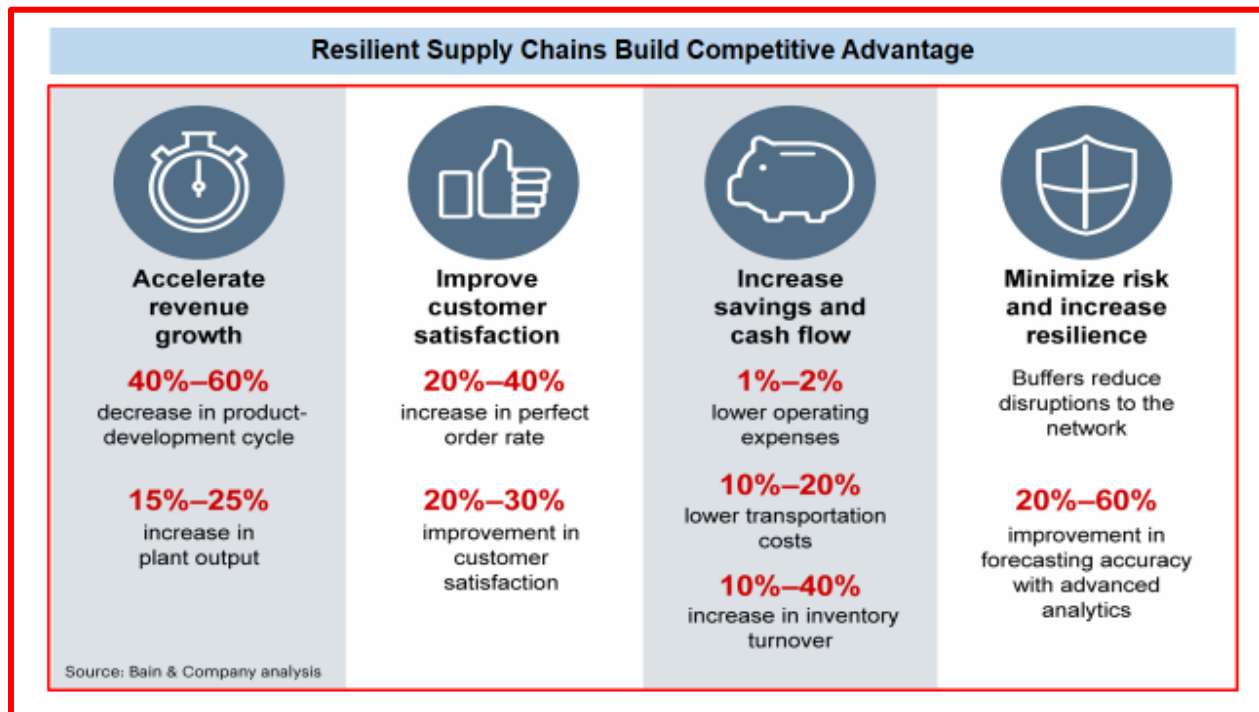
Today's digital economy demands a new approach to manage the entire supply chain ecosystem—a solution that leverages the cloud, real-time connectivity and advanced analytics. That's where a fully integrated suite of planning, sourcing, orchestration and logistics platforms that uses big data analytics and AI can deliver greater visibility, recommended actions and predictive risk mitigation for supply chain resiliency.



After all, things can change in a matter of minutes; you need to be able to make decisions just as quickly. The need for end-to-end visibility, rapid response and immediate availability is changing business models. Companies should invest in solutions that can be tailored to meet their individual requirements for better supply chain risk management and to reduce the overall cost of their bill of materials (BOM).

Resilient supply chains have to do more than simply keep up; they need to stay ahead.

Ref: <https://www.jabil.com/blog/successful-supply-chain-resilience-strategy.html>.



7. What COVID-19 Taught Us about Strategizing for Supply Chain Resiliency

COVID-19 exposed holes in nearly every company's supply chain. Thankfully, there are measures that businesses can take to minimize their supply chain vulnerability in the event of future disruptions.

a. Start with Strategic Product Design

Market shift is happening in the design arena. Many companies previously did not need to allocate engineering resources to handle qualifications, requalification or approvals of new parts and suppliers. Now, priorities are changing, and engineers need to spend more time redesigning products and future-proofing when possible. This means there's a need to update the parts selection process and evaluate components for current and future market availability. Engineers also must stay abreast of what parts gain legacy status and ensure they're not included in new product designs. This is all part of making your supply chain more resilient.

Again, paying attention to trends in the supply base can help guide design processes. For example, the supply base has been indicating for a long time that it's time to miniaturize. Engineers who have been aware of this trend know to choose the smaller passive components that are more likely to be available as this trend intensifies.

Companies also need to be aware that it will be difficult to keep product designs stable throughout the next 10 or 15 years. Suppliers will most likely discontinue parts – or at least make fewer of them – so products should be designed with some flexibility to incorporate the different parts that will be readily available in the future. Or, at the very least, companies will need to be prepared to redesign products to keep pace with the components market. An unexpected redesign process can set your product and company back considerably.

b. Establish a Demand Plan for the "New Normal"

Right now, demand planning is not a typical approach to supply chain. Most companies use history to project the future. They consider macroeconomic and market conditions as well as cyclical markets caused by factors like the holiday season. Typically, you can look back at history and note all the different dynamics throughout the year. That's how you shape demand. However, the novel coronavirus is severely impacting companies' ability to do this.

There has been a lot of buzz about the "new normal." But we wish there would be better normal in future. COVID-19 has significantly affected the current state and likely the future of retail. Online retailing is through the roof; some estimates say an extra \$107 billion has been spent online since March as a result of the pandemic, and Amazon had to hire 100,000 new workers in the U.S. and Canada to meet burgeoning demand.

This unstable environment makes demand forecasting increasingly difficult. After all, product development can take two or three years, and the average lead time for most supply chains is 25-40 weeks. That means that to deliver a product in October, companies need to start planning in January. In January 2020, no one could have predicted that many parts of the world would be on lockdown for the foreseeable future and people's needs and wants would change drastically as a result (think about the unexpected toilet paper shortage and sudden demand for ventilators). Even now, no one knows what the world will look like in 10 months and how it will affect various markets.

In response, companies are increasing their investments in analytics and visibility.

Macroeconomic conditions make it extremely difficult for people to project forward. Supply chain managers aren't going to be able to forecast accurately. They don't know what features they want, when they want it or what price they're going to pay. After all, the products that were designed last year were for a different kind of market condition than what the markets need today. Consequently, people are rushing new and different products into the market. It's a very interesting dilemma for supply chains to attack and manage, and it makes the importance of having an agile, resilient supply chain even more important.

c. Develop a Business Continuity Plan for Multiple Disruptions

With so many potential disruptions—from natural disasters to geopolitical conflict to component shortages—it's impossible to definitively plan for the next crisis. For instance, a pandemic has always been on that list, but nobody was prepared to actually contend with one. But companies are re-energizing their supply chain strategy by ramping up their business continuity plan.

According to the Jabil supply chain survey, the top goals of companies' supply chain resilience programs are to gain the ability to recover quickly without impacting customer delivery timelines, maintain multiple sourcing options and develop high levels of supply chain agility to increase or decrease production. Creating a continuity plan supports these goals.

A continuity plan looks at all the risks, quantifies them and establishes a plan to deal with them in case they occur. Because of COVID-19 disruptions, companies are re-examining all the elements of supply chain risk and their business and re-energizing their efforts to close any gaps. Companies are still trying to address the continuity of their workforce and the investments they need to make to have backup plans for single-source factories, thereby giving them greater flexibility.

8. How to Measure Supply Chain Resilience

There are three core metrics to evaluate supply chain resilience: **time-to-survive**, **time-to-recover** and **time-to-thrive**.

Time-to-survive refers to the amount of time it takes for your business to resume your supply chain operation after a disruption. For example, the "time-to-survive" for some factories in China took about three weeks. That's approximately how long it took to secure the necessary personal protective equipment (PPE), establish safety regulations, obtain government clearance and re-open the factories.

There are a number of questions companies need to work through in time-to-survive: how do we pay people? How do we get people back into the workplace? Can we take corrective action to reopen our doors? What is the problem, do we understand it and how do we resolve it?

Essentially, **time-to-recover** is the time it takes you to recover all of your backlog. Even though the Chinese factories were functioning again in less than a month, they were running at a fraction of their normal capacity because of lost time and a lack of workers. As a result, it took about three or four months to recover their backlogs.

Time-to-thrive is an evaluation of the company after it has emerged from a crisis. It compares the states of the company pre- and post-crisis and asks, "how are we stronger now because of what we learned during the disruption and how we changed in response?"

Companies that navigate volatile supply chains and turbulent market conditions and adjust their strategies to be more prepared in the future can emerge from disruptions with a win. To do this, they need to pivot their services to match what the market really needs as opposed to what it needed before. Because of this, they can earn more business. For example, when restaurants were shut down, many tweaked their business model to accommodate delivery or pick-up.

Leading companies with an agile and digital supply chain that could respond to that unforecasted, massive increase in demand thrived. But supply chains have to be that dynamic and nimble to do that.

When I look back on how Jabil handled the COVID-19 disruption, we didn't have to invent anything new. There weren't any strategies, analytics or processes we had to put into place to deal the disruption; we already had them because that's what our customers needed. We just leaned on our existing people, processes and technologies. And we didn't break. Our established capabilities kept every "domino" in our supply chain upright.

Because of the Rube Goldberg machine-like nature of supply chain, it is essential to protect your company by building supply chain resilience as a competitive advantage. Planning ahead with a robust supply chain resilience strategy will help your company tackle any potential disruption; protect production capacity while staying at the forefront of the technology curve; and most importantly, deliver the highest quality products and services to meet your customers' rapidly changing needs.



Ref: Articles composed by John Caltabiano, Vice President, Global Supply Chain, Jabil' <https://www.jabil.com/blog/successful-supply-chain-resilience-strategy.html>.

N. B.: Some parts of the article have been modified/dropped/added for necessary reasons.

9. Building Supply Chain Resilience for a Post-Covid-19 World

The Covid-19 pandemic has permeated every aspect of our lives. The World Trade Organization estimates that the pandemic could result in anywhere from a 13% to a 32% decline in global trade for 2020.

With China being ground zero for this pandemic, the "world's factory" has also slowed its output and supply of goods. As of April 2020, the export value from China had fallen to a shocking low of \$202 billion — the largest drop in recent times. This has had a global ripple effect.

According to estimates, the GDP of the Eurozone, one of the largest and most important economic entities in the world, shrank by as much as 3.8% in the first quarter of 2020 alone as a result of this disruption in the global supply chain. The U.S. has felt a similar bloodletting, with the country's GDP falling 4.8% in the

first quarter of 2020. This even led to the International Monetary Fund revising global GDP growth to fall from 3.3% to 3% within just three months — the largest drop since the Great Depression.

Rethinking the Supply Chain to Be More Resilient

The Covid-19 crisis may well be the final nail in the coffin for the legacy supply chain structure and has accelerated the need for technology adoption.

Supply chain resilience depends on two complementary factors:

- **Resistance capacity**, which refers to the avoidance and containment capabilities of a supply chain system.
- **Recovery capacity**, which indicates the capability of a supply chain system to return to functionality after the disruption.

To achieve resistance and recovery capacity, supply chains need to build three critical components:

- Visibility and end-to-end shipment tracking across all touch points.
- Velocity with the real-time flow of information.
- Responsiveness to quickly act on the insights presented by the data.

Here are some use cases that show how technology can be intelligently leveraged to add visibility, velocity and responsiveness to your supply chain:

IoT

As per estimates, companies are set to spend more than \$40 billion by the end of 2020 to increase their delivery productivity. IoT plays a pivotal role in identifying, locating and tracking the status of shipment until delivery. This information is useful throughout the extended value chain, benefitting vendors, suppliers and customers alike, allowing for a better experience. Moreover, this data also helps enhance and ensure an efficient processing pipeline, which reduces handling times, helps prepare for contingencies and provides alternatives when needed.

Big Data and Analytics

As organizations deploy more IoT sensors and other information sources, enormous amounts of data will be generated, and making sense of this data to generate actionable business insights will be a mammoth task. Additionally, a supplier network where data can be shared seamlessly will be a key enabler for building resiliency, making it critical to build robust data pipelines.

By applying statistical and mathematical algorithms, organizations can create a resilient supplier network map that can provide complete visibility into primary, secondary and tertiary supplier bases, as well as recognize high-risk suppliers and identify alternate routes in case of any failure. For example, in a similar pandemic type of scenario, suppliers in the most affected geographies will be assigned a higher risk level, and subsequent mitigating measures can be applied in time.

Analytics can also enable risk assessment models by examining current threats and weaknesses or identifying the criticality of parts/components in overall revenue risk.

Artificial Intelligence (AI) and Deep Learning

Because supplier networks are complex and global, critical information resides in structured, unstructured, image and voice formats across disparate systems. AI can find signals across data sources, drawing correlations between impacting variables that are hard to achieve with traditional statistical modeling. Contextual information derivation, image analytics and voice analytics are examples of AI and deep learning at play that are relevant to supply chain resiliency.

Distributed Ledgers (Blockchain)

Distributed ledgers offer the additional transparency and efficiency necessary for today's complex supply chains. This digital database records every transaction or exchange of data in the network and stores it in increasing blocks of information linked to previous blocks in a way that cannot be altered.

These ledgers contain a product's entire life cycle. It works across both forward and reverse logistics by tracking goods and recording where they arrived, who received and handled them, and how and when they were transported to the next stage.

Augmented Reality/Virtual Reality (AR/VR)

While AI can help improve the accuracy of failure-mode predictions of high-value goods, AR/VR can help in minimizing downtime, driving better knowledge/training and increasing the effectiveness of field technicians. Using AR, experts sitting in offices can now assist field service technicians and guide consumers.

Automation and Robotics

Automation undoubtedly has the potential to enhance logistical efficiency, throughput and productivity while also freeing up human capital to create an impact on critical functions. The deployment of robots could lead to nearly \$22 million in annual savings for an average business, which translates to an estimated 20% reduction in operating costs.

Automating key junctures with robotic upgrades can help optimize the supply chains of the future, while also protecting human lives from hazardous processes.

A New Paradigm for Supply Chains

The Covid-19 crisis has served as a wake-up call for numerous industries and organizations, forcing them to question their fundamental assumptions.

If you're looking to build an agile, robust and resilient supply chain, start here:

- Categorize core and noncore operations, and analyze supplier risks.
- Explore the ability to contract and expand scale based on the demand curve.
- Apply analytical models to derive business insights and generate measurable economic benefits.
- Make careful investments in emerging technologies such as AR, VR, robotics and blockchain to solve business problems.

- Focus on the automation of repetitive tasks and processes to increase productivity and reduce costs.
- Pick small, incremental, ROI-focused use cases that drive exponential impact across your supply chain.

It's only by investing in the core resilience of their supply chains that organizations can be prepared for an uncertain future. Digitization will equip businesses for greater flexibility, adaptability and agility in the future.

Ref: Amit Gautam Forbes Councils Member

10. Study on Supply Chain Resilience of RMG Sector in Bangladesh: Key Findings

1 Need for a business continuity plan

It has been agreed by both the private sector business leaders and the government officials that a national business continuity plan is required to be in place to prepare for contingencies meeting the supply chain disruptions due to natural disasters. This plan may have multi-sector focus, covering the specific needs for different industrial sectors, such as, RMG, agro food, jute, leather, and so forth, and needs to have a multi-disciplinary approach covering resilient civil infrastructure and storage, transportation and supply chain infrastructure and network, utility services, information sharing platform, and responsive regulatory regime for handling port and customs clearance procedure.

2 High concentration makes it more vulnerable

A very high concentration of RMG production assets in and around two major cities, Dhaka and Chittagong make them more vulnerable to risks arising from natural disasters, for twofold reasons — more number of production facilities per square kilometer of area puts the probability of getting more number of assets affected by disaster should any occur in the area, and their high dependability on Dhaka-Chittagong corridor makes them vulnerable to disrupted supply chain network, because absence of any alternate route. If the Dhaka Chittagong corridor gets blocked due to any natural disaster, then there is no easy and inexpensive alternative for the goods to be transported to and from between Dhaka and Chittagong. It has been perceived that the upcoming 100 Special Economic Zones (SEZs) spread out in all over the country would minimize the risks arising from concentrated locations when these become operational.

3 Inadequate coverage of supply chain vulnerability in the national policy and regulatory framework

Bangladesh has developed a good disaster management system under the aegis of the disaster management laws and policies, but this system is mostly focused on saving lives, and managing shelters and relief work, but the issues of commercial and industrial supply chain remain largely unaddressed. However, all the major stakeholders responsible for managing and regulating supply chain infrastructure and network, i.e., roads, bridges, ports, etc., are members of various committees responsible for disaster management, and they can be easily engaged in addressing the supply chain disruptions arising from natural disasters.

4 Likelihood of Natural Disasters

Flood and storm surge are more likely to occur in more frequent intervals. The likelihood of high magnitude earthquake is also high, but not as frequently as floods and storm surges, but with comparatively more damaging and longer-term disruptions. Disruptions due to cyclones are also a frequent likelihood, but more local in nature. There are also the likely risks of soil liquefaction in specific areas of Chittagong City, and along the road network linking Chittagong port. Water-logging is also a frequent and seasonal risk that can cause small scale disruptions in the supply chain.

5 Minimizing time for import would lead to overall efficiency

For the RMG sector, the import of various primary and intermediate raw materials take a longer time to receive by the manufacturing and processing units from the port to factory locations, compared to the time needed for production and transporting the finished goods from factory to Chittagong Port. Hence, reduction of time needed for receiving the imported raw materials would significantly reduce the total lead-time, and thus would help minimize the overall disruptions in the supply chain caused by natural disasters. This was evident during February-March period when import of raw materials was delayed due to onset of COVID-19 pandemic in China, the largest source of imported raw materials for the RMG industry of Bangladesh.

6 Need for alternate routes along Dhaka-Chittagong Dhaka corridor

Both road and rail transport networks are based on land, and subject to more or less the same types of risks arising from natural disasters. Hence, riverine transport solutions could be a better alternative and substitute for these land-based supply chain network at times of emergency, as has been evident from the flood-time experience of the RMG entrepreneurs during the mega floods of 1988 and 2004. At the same time, construction of diversion roads at vulnerable spots along the existing road networks is expensive and time consuming due to challenges of land acquisition and other factors. Large civil constructions of roads, highways, and bridges also have environmental and social issues to be addressed.

Ref: Study on Supply Chain Resilience of RMG Sector in Bangladesh by National Resilience Programme (NRP) Programming Division, Planning Commission, November 2020 (Chapter 8 Page No. 125-126)

11. Study on Supply Chain Resilience of RMG Sector in Bangladesh: Strategic Recommendations

Recommendation 1

Adopt plans for developing the riverine route along the Dhaka-Chittagong corridor, and initiate a feasibility study for the cost-benefit analysis. This study should take into account the following:

1. Further expansion of the existing facilities and infrastructure suitable for handling a much larger volume of cargo in containers;
2. The total container handling capacity of the riverine ports should be targeted to cover at least 60% of the combined container handling capacity of the Chittagong Port and other seaports of the country;
3. Assess the requirements and cost for keeping the river route navigable throughout the year for medium and large vessels suitable for carrying containerized cargo;
4. Construction of facilities for jetties, loading and unloading docks, storage areas, port and customs facilities;
5. Establish linkages with connecting roads;
6. Assess environmental and social impacts; and
7. Conduct cost-benefit analysis for the riverine route as compared to road and rail networks.

Recommendation 2

Department of Inspection of Factories and Establishment (DIFE) or other concerned agencies can conduct further studies with primary data to ascertain the actual risk of different elements of the supply chain of the RMG sector, as follows:

- A detailed assessment of hazard, vulnerability, and risk (HVRA) of all the industrial zones of Bangladesh should be conducted against an earthquake as well as flood, cyclone, storm surge, and waterlogging considering climate change.
- A similar HVRA study should be taken up for all transportation networks connecting the industrial hubs and different ports.
- A separate HVRA study should also be conducted for all the critical utility lines in the industrial zones which are essential for the operation of the RMG factories.
- All factory buildings in the supply chain of the RMG sector, which have not yet been assessed for structural adequacy, should be assessed and necessary remedial measures should be taken.
- Risks concerning operations of the major sea, land, and airports should be assessed and necessary contingency plans should be chalked out.

Recommendation 3

BGMEA may constitute a Disaster Coordination Cell (DCC) to engage with the member factories for information sharing and disaster preparation by performing the following activities:

- DCC will inform the factories which are vulnerable to disasters as found in the HVRA studies conducted by DIFE or other agencies.
- DCC will convey the details of flood and cyclone forecasts to the vulnerable factories and help taking preparations before the occurrence of such disasters.
- Management of the factories situated along the flood flow zones in Dhaka and Chattogram should be encouraged for relocating the factories or take other appropriate measures to reduce the risk without obstructing the flow of water along the designated channel.
- Similarly, factories at landslide and liquefaction prone zones may also be relocated.
- DCC may organize awareness programs and drills/exercises for different types of disasters, including pandemic, for the member factories.
- DCC can keep a directory of volunteers trained by the Fire Service and Civil Defense (FSCD), Cyclone Preparedness Program (CPP), and other organizations that may be available in different industrial zones for emergency response. Immediately after a disaster, DCC may seek help from the volunteers.

Recommendation 4

Make a policy decision to adopt technical standards for making all the factories and key transport infrastructure and transportation network to withstand design flood and earthquake levels as mentioned in the Bangladesh National Building Code (BNBC):

- Levels of all major road and rail network should be above 100 year return period flood levels considering the worst scenario of climate change;
- River ports should be designed considering flood induced river bank erosion;
- Future industrial zones should consider all riverine and flash floods including climate change effects;

Recommendation 5

Following specific Disaster Risk Reduction (DRR) measures should be pursued to ensure the resilience of the supply chain network of the RMG sector.

- Bangladesh Roads and Highways Department may take up a project to assess the vulnerability of the road transport network specifically from Dhaka to Chandpur against riverine flood, and riverbank erosion. For the coastal areas in the Dhaka-Chittagong corridor, vulnerability assessment should be

conducted for flash flood and storm surge. Appropriate remedial measures should be adopted for the resilience of the most important element of the supply chain of the RMG sector.

- Chattogram City Corporation should carry out a project on a priority basis to ensure proper drainage in industrial zones particularly at the waterlogging hotspots in Haliashahar and Nasirabad.
- Liquefaction due to earthquake is a major problem which is not being addressed properly. There should be a project on hazard and vulnerability assessment of seismic liquefaction and determination of suitable remedial measures both for factories and transport infrastructure;
- Although the RMG factories are presently being assessed and retrofitted, the collapse of other buildings in the event of an earthquake may cause major disruption in the urban roadways. All medium and high rise buildings which can block major urban roads, if collapsed, should be assessed and retrofitted.

Recommendation 6

Create a buffer-stock for 3-months' worth of supply for major primary and intermediate raw materials needed for the RMG and textile industry. The need for this buffer stock became evident in January-February 2020 when the Bangladeshi RMG sector experienced a bitter supply crunch of raw materials due to the onslaught of the COVID-19 pandemic in China, by far the largest source of raw materials. To prevent such shocks in the future, creating a buffer stock will require the following major tasks:

1. A separate study to identify the categories and quantities of the major primary and intermediate raw materials, e.g., cotton, man-made fibers, yarn, fabrics, chemical and dyes, accessories and packaging materials, and so forth;
2. The state trading company, Trading Corporation of Bangladesh may be made responsible for the timely import of these raw materials to be made available at the demand of the manufacturers. Alternatively, the private sector manufacturers and importers may import the required materials for the proposed buffer stock by creating a common cooperative fund. The detailed mechanism may be developed through further consultation with the private sector stakeholders and financial experts.
3. Preemptively, it can be recommended that a team of experts can be engaged jointly by the RMG trade associations, Bangladesh Trade and Tariff Commission, and Bangladesh Customs to determine the key import requirements for products and their volume for the proposed buffer stock.
4. For the proposed buffer stock to become functional, the existing regulations for import procedure, bond facilities, duty drawback, and banking need to be reviewed.

Recommendation 7

The exiting national plans, policies, and objectives for developing multi-modal transport network linking Bangladesh to regional and international supply chain networks need to be reviewed in the light of disaster resilience and alternative routes and transport modalities, under-scoring flexibility for switching between road-sea-river, rail networks and infrastructure. It is strongly recommended to review the current targets for the transport sub-sectors. At present, the National Perspective Plan already sets target for increasing the freight traffic by inland water from 5 billion freight kilometer in 2018 as the base year to 20 billion freight kilometer by 2030 (while it is from 24 billion freight kilometer in 2018 to 71 billion freight kilometer in 2030 for roads, and from 2 billion freight kilometer in 2018 to 10 billion freight kilometer in 2030 for rail), which should be increased up to 60 billion freight kilometer from 20 billion freight kilometer by 2030 for the inland waterways.

Recommendation 8

Ensure availability of disaster data by making it mandatory for all consulting firms and implementing agencies to submit all data files to the line agency/ministry with a copy of the same to the Planning Commission of the government. This should be made a part of standard operating procedure for future archiving of disaster data.

Recommendation 9

The savings in transportation and environmental costs gained through riverine mode of transport needs to be further examined in light of the trade and cargo volume forecasts based on benchmark figures of 2019.

Recommendation 10

Programs should be taken up to develop awareness of and reduce vulnerability against any other shocks caused by exogenous factors, such as, COVID-19 pandemic.

Ref: Study on Supply Chain Resilience of RMG Sector in Bangladesh by National Resilience Programme (NRP) Programming Division, Planning Commission, November 2020 (Chapter 9 Page No. 129-132)

12. Mapping Supply Chain Risk Helps to Build Resilience Supply Chain

Any risk, whether internal or external to the business, or risk arising from natural disaster/ climate change which creates an unwanted disruption to supply chain is considered as supply chain risk. Like financial risk and other key areas, supply chain risks cannot be altogether avoided, but they can be effectively mitigated.

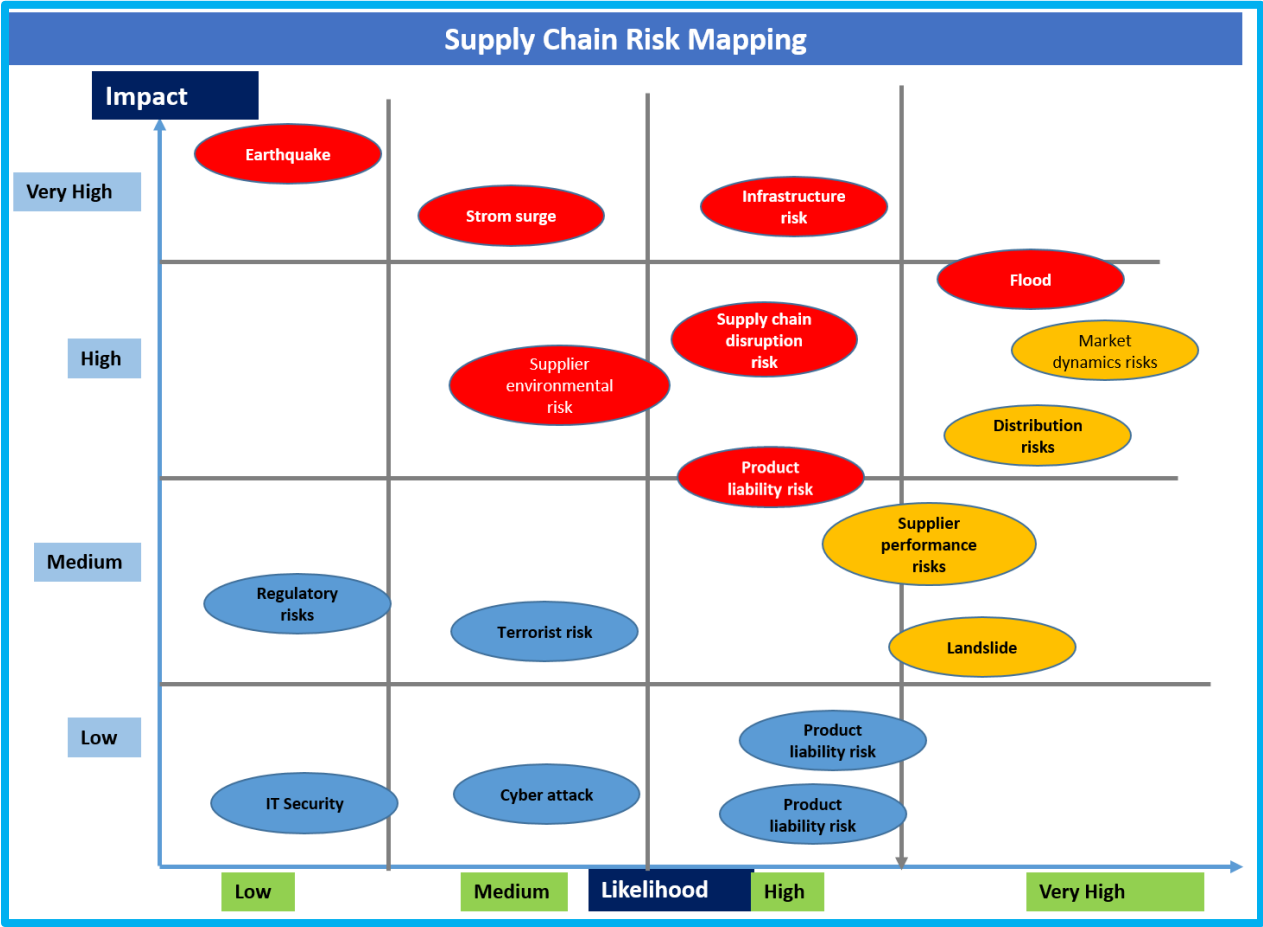
Supply chain risk has been front and center throughout the year 2020 in the wake of the pandemic. Exposure to external risks can occur both upstream and downstream in a supply chain and revolve around market, environmental and business factors.

Supply risks arise from a lack of access to material inputs needed for production. Demand risks are associated with misunderstanding the market pull for your products. They can occur from a lack of insight about purchasing trends as well as unforeseen changes to the demand landscape.

Environmental risks are when supply chain is adversely affected by economic, political, ecological or social factors. Notable examples include the China-US trade war and the COVID-19 pandemic.

Creating a risk map of your supply chain will help you track where points of concern may be emerging and provide a much higher degree of transparency. Supply chain mapping can also help you identify emerging risk areas

After reviewing the “Study on Supply Chain Resilience in RMG” and as per opinion relevant stakeholders, the following risk map has been drawn:



Besides above supply chain risk mapping, the learners may be familiar with following article related top risks to doing business in Bangladesh



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<https://tbsnews.net/economy/energy-price-shock-pollution-top-risks-doing-business-bangladesh> on 03 October, 2019,

13. Well-timed Approach and Innovation Made Significant Stride in Building Supply Chain Resilience in the Context of Bangladesh Perspective.

Bangladesh has many success stories to tell globally, particularly the stories of faster growth and prosperity. In the areas of Supply Chain, the country has proved many times to be resilient when it really required. Besides the fact that the ready-made garment industry is a key factor in the country's phenomenal success story; the other sectors demonstrated significant improvement too. We share some timely approaches that yielded results.

1. New Cargo Train Route launched Between Bangladesh and India Reduces Supply Uncertainty

In July 2020, Bangladesh and India launched a new cargo train route which would reduce the lead time for businesses of both countries and costs as well. The train carrying 50 containers of fast-moving consumer goods (FMCG) and fabrics took just three-and-a-half hours to reach Benapole in Jashore from Kolkata.



The advantage of containerization is that any exporter can move even one container (20 tons), and it is possible to aggregate traffic of various exporters and send by one train. Containerization has other benefits too, such as minimal customs checks at borders as well as safety and security of cargo.

Bangladesh imported goods worth nearly \$10 billion from India in 2019, while its export was less than \$1 billion, according to the central bank data. Majority of these trades happened through the Benapole-Petrapole border, making it a congested point.

A truck would often have to wait for 12 hours or more at each border, pushing transportation cost up by 50 percent. In June 2020, the National Board of Revenue (NBR) of Bangladesh permitted container trains on Benapole-Petrapole route to facilitate the transport of essential goods between two countries amid disruption of import and export activities owing to the pandemic.

Ref: "New cargo train route launched between Bangladesh and India" by Morshed Noman appeared in the TBS on 26 July, 2020, TBS

2. Unilever Bangladesh Ltd (UBL) Sees Massive Success through Third Party SC

The model called “Material Commend Center (MCC)” solution by UBL is nothing, but a model of supply chain management through a third party.

Under this model, the key to all the strategic work of the supply chain is in the hands of the organization. On the other hand, the non-value activities of the supply chain are accomplished through outsourcing. This model is now followed by Unilever India, Sri Lanka and Nepal. The model works for both upstream and downstream supply chains.

UBL prepared for the pandemic from the last week of January 2020. At one point, they stopped importing raw materials from China. Then they started to import from India. Once they closed, UBL re-sourced the raw materials from China, Thailand and Indonesia. The giant MNC didn't stop operation even for a day during the pandemic.



Ref: Interview with Abdul Alim, Procurement Manager, Unilver Bangladesh Ltd appeared in TBS on 22nd Nov, 2020

3. Lightening from Large Mother Vessels Saves Huge Inbound Logistics Costs for Cement Industry of Bangladesh

Although Bangladesh is a small country, the length of the coastline is more than 580 km. Chittagong port is the premier port of Bangladesh, located 15km from the open sea. The port is situated on the banks of the Karnaphului River. The draught limit of the Karnaphully River is widely known to its users.

From Anchorage to Jetty Berth a vessel needs approximate 2 hours duly compulsory piloting by Port Pilot. Vessels having a draught of 10.0 to 13.5 m usually approaches to Chittagong outer anchorage. On the other hand, draught at Chittagong port jetty ranges from 8.5 to 9.30 m.

With this draught limit, vessels laden with bulk cargo like Clinker usually cannot unload at port jetty or at other berths of the port. In order to overcome this difficulty, cement manufacturers started importing clinker by larger vessels like 40,000-50,000 t capacity and unloaded cargo at outer anchorage unto lighter vessels. The Cement industry of Bangladesh has grown manifolds over two decades based on the growing economy. Almost all raw materials including main raw materials Clinker are fully dependent on import.



Through this lightning approach at outer anchorage, the manufacturers enjoy economies of scale in ocean freight because of hiring relatively larger vessels. On the other hand, they are able to avoid acute port congestion.

Ref: <https://panoceanbd.com/chittagong-sea-port/>

4. Long Term Demand Planning with Shorter Review Interval Helped Out to Keep Pran's Supply Chain Uninterrupted

During COVID-19, consumers' buying pattern has changed rapidly. Especially for basic food, consumers were concern about unavailability. To secure their food availability they started to stock for 2-3 months. It was a great challenge for Pran's supply chain to maintain continuity of delivery of goods to consumers. On the other hand, upstream suppliers were facing logistic challenges especially labor crisis and control of movement etc. Besides, demand variability was very high.

In order to overcome this situation, Pran's supply chain had taken a strategy called "Long term planning with shorter review interval" under the concept called "6M-1W" which means planning was made for 6 months, but review had to be made every week. Where previously it was 3M/1M which means three months planning and each month review.

This strategy worked very well to cope up with market change. Besides, automation and quick adaptability with changing circumstances of sourcing during pandemic have been proved very successful. On the upstream supply side, Pran lifted 20 % extra volume of items like egg and milk to support growers at their bed times.



Ref: Article prepared by Partha Das, Head of Category, SCM of Pran Group.

14. The 12 Best Supply Chain Companies of 2020

Hugo Britt of an organization called “Thomas Insights” shared an analysis titled “The 12 Best Supply Chain Companies of 2020”. You would find various supply chain innovations how large companies have adopted.

Modern supply chains are increasingly recognized as a source of competitive advantage for many organizations, especially when their resilience is tested in times of crisis and disruption. Operational efficiency, technological innovation, and sustainability all contribute to making a best-in-class supply chain.

Criteria for inclusion in this list include:

- Demonstrating supply chain strength and agility during the COVID-19 pandemic
- Purpose-driven organizations with genuine transparency
- Flexibility to reinvent supply chain models to remain competitive
- Early adopters of digital technologies.




01




Apple

Apple has topped Gartner’s Supply Chain Top 25 list for eight years now. CEO Tim Cook has focused on **sustainability, strengthening relationships with strategic suppliers, and streamlining inventory management by cutting down on warehousing to limit overstocking**. Notably, Tim Cook was a CPO before becoming Apple’s CEO.


Apple purchases components and materials from all over the world before sending them to China for assembly. From China, products are **shipped directly to customers**. Despite its reputation for an “unbreakable” supply chain, Apple has reportedly suffered some setbacks to the iPhone 12 release due to the COVID-19 pandemic.

02		<p>Amazon has reinvented eCommerce supply-chain management. The company’s focus on high responsiveness combined with warehouse automation and robotics allowed it to transform the industry with one-day delivery, and even offers two-hour delivery with Prime Now.</p> <p>Turning away from outsourcing, Amazon is increasingly pulling logistics in-house while building massive fulfillment centers. In September 2019 Amazon purchased 100,000 electric delivery vans as part of its Climate Pledge to deliver net-zero carbon by 2030, and in 2020 the company took advantage of depressed prices during the coronavirus pandemic to expand its air fleet. In the future, customers can expect drone-based deliveries with Amazon Prime Air.</p>
	Amazon	

03		<p>McDonald’s caters to nearly 70 million customers daily in 37,000 restaurants across 100 countries. To do so, it orchestrates a huge network of suppliers, franchise owners, and service providers. The company’s “win-win” strategy is based around the notion of mutual positive outcomes for employees, franchisees, and their suppliers.</p> <p>The fast-food chain uses vertical integration — such as processing its own meat and growing its own potatoes — to increase supply chain efficiency and reduce costs. Today, McDonald’s is prioritizing environmental sustainability, starting with its packaging.</p>
	McDonald’s	

04		<p>Walmart is known for implementing cutting-edge supply chain technologies and creating unique pathways to efficiency. The retailer’s supply chain management strategies are often studied by other companies to emulate Walmart’s success.</p> <p>Walmart has shifted recently to a “ship from store” approach where customer orders are picked from stores rather than from distribution centers. With 90% of Americans living within 10 miles of a Walmart, this has enabled fast and low-cost delivery of online orders during the eCommerce boom.</p>
	Walmart	


05		<p>Johnson & Johnson’s strategy to keep the supply chain running smoothly during the 2020 pandemic capitalized on a diverse pool of suppliers to meet demand from one billion customers and patients, demonstrating true supply chain resilience.</p> <p>The company has transformed its supply chain to ensure end-to-end traceability with IoT sensors, cloud computing, and advanced AI-driven analytics.</p>
	Johnson & Johnson	

06	 L'Oréal	<p>L'Oréal's supply chain scored a 10.0 on Gartner's ESG Component Score, which indexes third-party environmental, social, and governance measures of commitment, transparency, and performance.</p> <p>L'Oréal has 150 distribution centers, delivering more than 7 billion products per year to 500,000 locations around the world. L'Oréal attributes its success to its customer-centricity and sustainability focus.</p>
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07	 Inditex	<p>Inditex is one of the world's largest fashion companies and incorporates famous brands including Zara. Through its "Right to Wear" initiative, the company has taken a leading role in transforming fast fashion from a notoriously wasteful industry into a sustainable model.</p> <p>Inditex has built an agile supply chain using AI to boost forecasting and a manufacturing strategy modeled on Just-in-Time (JIT) manufacturing.</p>
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08	 Intel	<p>Intel's recent supply chain data transformation has created a \$208 million "sense-and-respond" platform that simplifies supply chain and data pipelines, provides self-service analysis to enable decision-making, improves data quality, and provides real-time analytics.</p> <p>In the area of corporate responsibility, Intel's RISE strategy will create a more responsible, inclusive, and sustainable supply chain enabled by technology</p>
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09	 PepsiCo	<p>PepsiCo, creator of famous snack and beverage brands like Gatorade and Doritos, announced sweeping sustainability goals in 2019 that will push the company to reduce emissions and create leaner operations.</p> <p>PepsiCo is one of the major brands that grew during the COVID-19 pandemic, hiring an additional 6,000 workers in the U.S. and enhancing wages and benefits for its 90,000 U.S. employees. PepsiCo is increasingly focused on streamlining its supply chain with advanced data integration and inventory analytics including ordering algorithms.</p>
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10	 <p>Alibaba</p>	<p>Alibaba’s global eCommerce operations hit a milestone of US\$1 trillion and 35% year-over-year revenue growth in 2020, an incredible feat regardless of the COVID-19-driven eCommerce boom.</p> <p>The company increased the scope of its in-house operations in 2019 to provide better service for its 960 million global customers</p>
11	 <p>Nestle</p>	<p>Nestle has moved towards a more sustainable, eco-friendly, and socially conscious supply chain while still staying on track to achieve its goal to save \$2 billion through more streamlined operations.</p> <p>Nestle’s strategic supply shift involves limiting interaction with suppliers and consolidating manufacturing operations. Nestle has also taken steps into monitoring food journeys using blockchain technology.</p>
12	 <p>Colgate-Palmolive</p>	<p>Consumer products giant Colgate-Palmolive uses its strong supply chain to distribute its brands to more than 200 countries and territories around the world.</p> <p>The company’s sustainability efforts have led to the implementation of a supplier code of conduct, the operation of 15 TRUE Zero Waste manufacturing facilities, and other gains in the reduction of GHG emissions. Colgate-Palmolive’s recent focus on the streamlining of supplier relationships has led to more efficient product customization.</p>

Ref: Hugo Britt, The 12 Best Supply Chain Companies of 2020 <https://www.thomasnet.com/insights/best-supply-chain-companies/>

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Training on Supply Chain Resilience

Module 2: Demand Management and Its Forecast Techniques

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Preface

Demand management is the supply chain management process that balances the customers’ requirements with the capabilities of the supply chain. With the right process in place, management can match supply with demand proactively and execute the plan with minimal disruptions. The process is not limited to forecasting. It includes synchronizing supply and demand, increasing flexibility, and reducing variability. On the other hand, demand forecasting involves techniques including both informal and formal methods, such as educated guesses, and quantitative methods, and the use of historical sales data or current data from test markets.

In other words, demand forecasting in the supply chain is a process used by organizations to determine potential future requirements of customers. Forecasting means the process of predicting a future event based on historical data. Forecasting figures are usually determined by analyzing historical sales data and trends, being aware of market variations such as new trends, seasonal variations and new products that are brought into the market by potential competitors all of which can impact consumer demand. For forecasting demand, the inputs taken from sales and marketing, finance, and production. The final demand forecast is the consensus of all participating managers.

In the supply chain, forecasting can help to deal with the 'bullwhip effect' caused by the distorted flows of information up and down the supply chain. Excessive inventory quantities, poor customer service, cash flow problems, stock-outs, high material costs, overtime expenses and transport costs, which cause the 'bullwhip effect' can be avoided by accurate forecasting.

Demand management is one of the critical business processes for boosting revenues. Today, a large number of companies are focusing on developing the tools for this management. Two very important factors, namely customer retention, and company financial performance, largely depend on its management. As a result, the need to adhere to demand management best practices for improving the overall performance of the business for the end-to-end supply chain has increased. Virtually every business is based on forecasting. Not all of them are derived from sophisticated methods. However, “Best” educated guesses about the future are more valuable for purpose of Planning than no forecasts and hence no planning. Departments throughout the organization depend on forecasts to formulate and execute their plans.

Learning Objective

By the end of this training module, you will be able to:

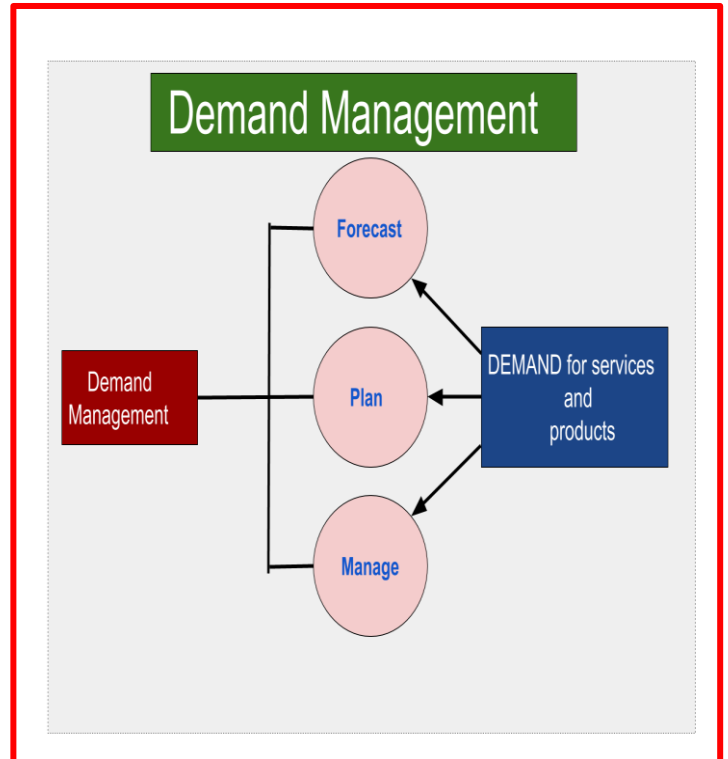
- Know demand management and its basic concepts
- Be familiar with types and characteristics of demand
- Explain Resilient Supply Chain by combating unprecedented demand volatility
- Calculate various methods of demand forecasting, Bill of Material (BOM), Material Requirement Planning (MRP) and Distribution Resource Planning (DRP)
- Describe the methods called MTS (Make-to-Stock), MTO (Make-to-Order) ATO (Assemble-to-Order), Aggregate Planning and MPS (Master Production Schedule)
- Explain how strategies may be applied in meeting demand including considering the factor arising from natural disaster
- Know about 'Bullwhip Effect' and how to minimize
- Know about Resilience Supply Chain and Business Continuity Planning (BCP)
- Describe the theory called "Dr. Hau Lee's Uncertainty Framework" including the concept of Agile Supply Chain
- Know Collaborative Planning, Forecasting and Replenishment(CPFR) and Sales and Operation Planning (S&OP)
- Know threats arising from Supply Chain's hidden costs

1. Demand Management: Definition and Key Concepts

Demand management is the supply chain management process that balances the customers' requirements with the capabilities of the supply chain. With the right process in place, management can match supply with demand proactively and execute the plan with minimal disruptions. The process is not limited to forecasting.

It includes synchronizing supply and demand, increasing flexibility, and reducing variability. The demand management process is concerned with balancing the customers' requirements with the capabilities of the supply chain. This includes forecasting demand and synchronizing it with production, procurement, and distribution capabilities.

A good demand management process can enable a company to be more proactive to anticipated demand, and more reactive to unanticipated demand. An important component of demand management is finding ways to reduce demand variability and improve operational flexibility. Reducing demand variability aids in consistent planning and reduces costs. Increasing flexibility helps the firm respond quickly to internal and external events.



1.1 A Few Words about Demand Management and Its Four Core Competences

- To forecast demand
- Process of ensuring that market demand and the company's capabilities are in synchronization
- Doing what is required to help make the demand happen
- To determine how the firm will satisfy that demand
- To recognize the sources of demand for farm's products
- Recognizing all demand for products and services to support the marketplace
- Planning and using resources for profitable business results
- Prioritizing

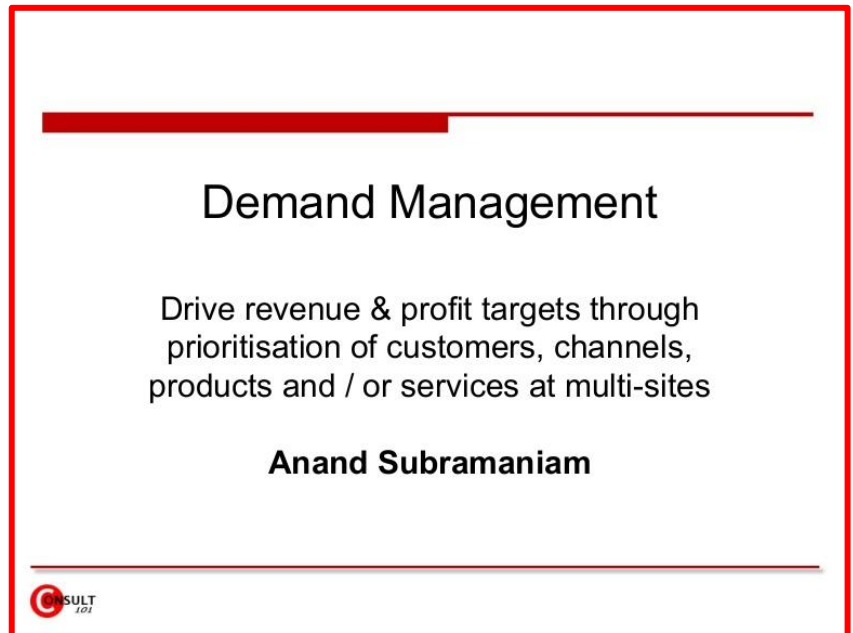


1.2 Demand Management: Basic Questions:

- What should be produced?
- Where should be produced?
- When should it be produced?
- How much should it be produced?

1.3 Benefits of Demand Management:


- Control over product availability
- Confidence of sales force and the ability to deliver products/services
- A single game plan based on the same set of numbers
- Improved ability to respond to change
- Smoother product introduction



Demand Management

Drive revenue & profit targets through prioritisation of customers, channels, products and / or services at multi-sites

Anand Subramaniam



1.4 Demand Management Challenges:

- Lack of process, to match demand and supply
- Too much emphasis placed on demand forecasts with little attention paid to collaborative effort, strategies, strategic and operational plans that need to be developed from the forecasts
- Primary emphasis should be on using demand information to create likely scenarios of the future as they relate to product supply alternatives
- Demand information is often used more for tactical and operation purposes than for strategic purposes
- Lack of communication of demand information between departments results in little or no coordinated response

1.5 Types of Demand

There are two basic types of demand. The organization should be familiar with the nature of types of demand.

1. Independent demand
2. Dependent demand

Independent demand: It is the demand for finished goods or other items and often beyond the control of an organization

Examples of independent demand: bicycle, computer, television, pizza, car or phone.

Inventory system based on independent demand:

- Re-order level systems
- Periodic review systems

Dependent demand: Dependent demand is the demand for raw materials, components and sub-assemblies that are converted into finished goods and which can be controlled by the organization.

Examples of dependent demand: Microchips in the computer, wheels on bicycle, wheel for car, the cheese on the pizza, and switch for television or mouthpiece for phone.

Inventory system based on dependent demand

- Material Requirement Planning (MRP)
- Manufacturing Resource Planning (MRP II)
- JIT
- ERP



Car is an example of **Independent** demand

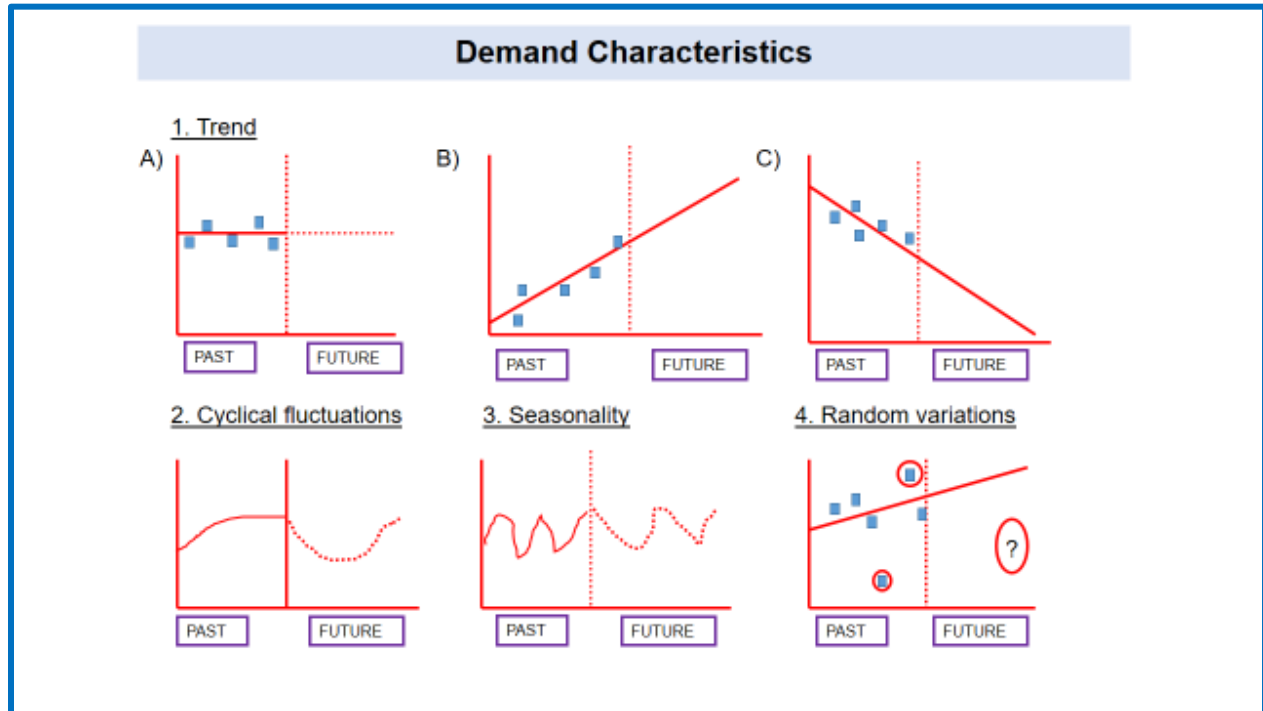


Wheel is an example of **dependent** demand

However, demand can be either be **continuous or occasional**. If occasional, then there is no real basis for forecasting requirement. On the other hand, if demand is continuous, then there is often a stream of data on past demand that can be used to forecast demand in the future.

1.6 Characteristics of Demand

Demand of items on a continuing basis are of four characteristics:



a) Trend: Trend will either be increasing, reducing or constant. However, the trend may get changed over long time.

b) Cyclical fluctuation: Demand also tends to increase or decrease over extended periods of time due to business cycles (economic recession and growth), natural calamities, economic downtrend, product life cycles etc.

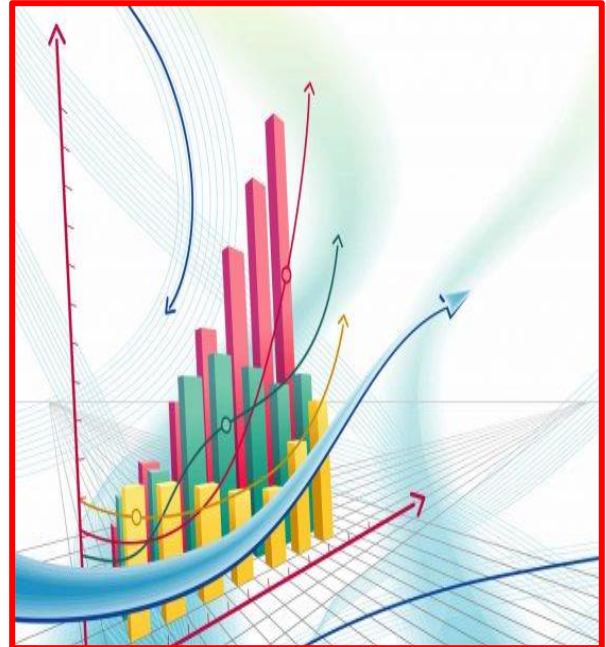
c) Seasonality: The demand of some items appears above or below the average level at certain intervals of time (e.g. hours, days, weeks, months, seasons or years). Seasonality is influenced by various factors such as weather, festivals, holiday, New Year day, the end or beginning of financial year, etc.

d) Random variations: Random variation arises when demand varies from the underlying pattern due to unforeseen seasons. Forecasting becomes easier where there is little random variation. Techniques for forecasting demand need to be able to respond to underlying changes in the level of demand, and not to occasional random events that affect demand in ways that are not generally repeated.

2. Resilient Supply Chain by Combating Unprecedented Demand Volatility

In the past few years, demand volatility has become a major focus area for supply chain managers at large. The economic uncertainties that followed the credit crisis in 2008 and subsequent events including Covid-19 have led to unreliable purchasing patterns among consumers of finished goods, particularly in developed economies. This has had inevitable consequences on demand for raw materials further up the supply chain.

While businesses have been experiencing significant shifts in demand patterns, the supply of feedstock and other key materials has become notoriously volatile in the same period. Volatile demand and volatile supply are intimately linked in a circular causal relationship. But in cases geo-politics, globalization and depressed economic trajectories in various markets have all contributed to the problem.

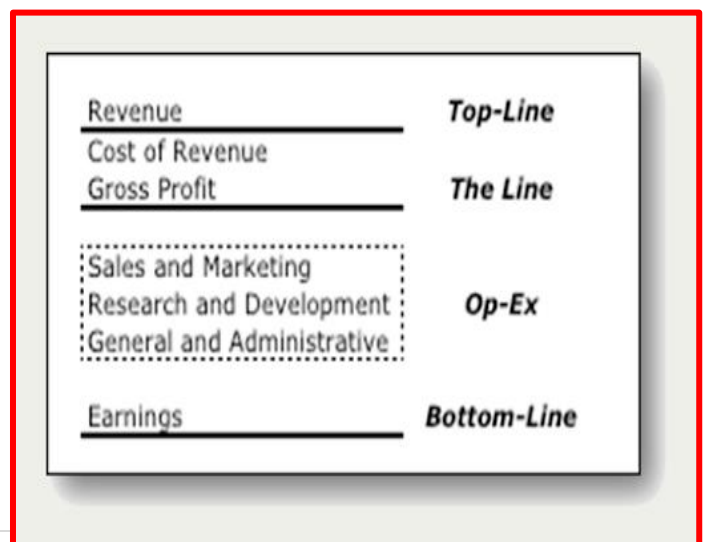


The traditional model of comparatively stable supply and demand, with tolerable amounts of unpredictability, has been overturned with greater variability on both sides of the supply chain. Securing profitability has become more challenging and addressing the lack of clarity in the demand picture is now more challenging than ever.

2.1 Demand Planning and the Bottom Line

In this climate, constructing a feasible, constrained and profitable demand plan is essential. Without accurate demand forecasting, manufacturers can only be confident in their ability to meet demand if they rely on inefficient stockpiling of inventory: The emphasis is on “just in case” processes, rather than “just in time.”

Inefficient inventory management directly increases costs by using up capacity in production and storage



facilities, and tying up capital in carrying non-productive stockpiles. Accurate inventory enables optimal production processes that minimize transitions and setups. It also empowers more efficient transportation and logistics operations in which choices are driven by cost rather than expedience.

The effects of inaccurate demand forecasting on the bottom line has now been demonstrated in **research from Triple Point Technology** (An USA based leading global provider of in-cloud and on-premise Commodity Management software). It shows that there is a dramatic correlation between investing time in developing effective demand management processes and improving forecasting accuracy. It also shows that demand accuracy can, in turn, have a major impact on business profitability.

The headline figures from the research show that:

- Businesses can experience a 17-point average improvement in forecasting accuracy when adopting best practices and new technologies.
- For every 1 percent improvement in forecast accuracy, businesses experience a drop in inventory levels between 1 and 2 percent.
- As a result, firms can benefit from a 17 to 34 percent reduction in stored inventory.

When these numbers are applied to real-world examples with real-world budgets, the results are even more stark: A company with a turnover of \$1 billion can expect savings between \$5 and \$10 million, and a company with a turnover of \$20 billion can experience savings between \$100 and \$200 million.

These numbers translate to obvious benefits to most readers. Yet there are still other, secondary benefits that accrue from improved production processes and logistics. In reality, firms of all sizes can expect savings to exceed even these impressive results.

2.2 Defining Best Practice for Demand Planning

However, process improvements require expertise and effort. Many companies claim to be doing well when using long-established internal workflows and tools. But the research from Triple Point Technology shows that industry-leading processes and best practices are in place only at very few companies. For example:

- 43 percent of survey respondents said their primary challenge when it comes to improving forecasting accuracy was driving useful collaboration within their own organizations.

- 50 percent admitted to having a weak or non-existent level of collaboration with external sources, customers and suppliers.
- 40 percent report that they are not currently leveraging the advantages of statistical modeling in their demand planning operations.

Best practices in demand management depends on a number of related functions being performed. Judging by the activities of the best-performing companies in the Triple Point survey, best practices fall into **five core areas**:

- **Trends and anomalies.** Best-in-class firms rely on a combination of statistical forecasting and collaborative market intelligence to create sales forecasts. This includes statistical forecasting based on historical sales data and external econometrics, which can reveal hidden trends and seasonality. In addition, statistical analysis of an aggregation of items that are normally difficult to forecast enables firms to look at families of items, as well as more detailed item levels, and has been shown to aid planning of production and inventory.
- **Collaboration.** The most important contributor to forecast accuracy is the collaborative forecasting process. This requires firms to bring together views from multiple sources across the enterprise, including sales personnel, product management, and customer service and production planners. It also includes forecast input from a large group of customers, ideally in electronic format, as well as visibility on their production schedules and consumption forecasts.
- **Structure and workflow.** A significant number of companies surveyed updated their forecasts on an ad-hoc basis as frequently as every day. However, because commodities businesses have relatively large shipments daily or weekly, forecasts are arbitrary and very different to predict. Focusing on the accuracy of a three-month rolling tactical forecast instead is shown to be optimal for balancing the difficulty of forecasting long horizons, while preserving the ability to plan long lead-time items. Whichever timeframe the company works with, the clear definition of roles for the various involved in the process is critical.
- **Forecast accuracy.** Most companies that routinely measure accuracy do so at the stock-keeping, unit-supply point level, and base their measurements on forecasts collected at the start of the measurement month. They also use a mean absolute percentage error (MAPE) formula that looks at absolute errors, which does not allow over and under forecasts to cancel each other out. However, when forecast processes are used to calculate safety stock levels and ensure that customer service targets are met, much higher levels of forecast accuracy are reported. Accuracy also improves when each contributor's forecast bias was identified, understood and accounted for.

- **Integration with downstream planning and scheduling.** The value of an accurate demand plan can only be realized when it is used to position a company's supply chain assets to ensure that demand is satisfied. Integrating demand signals with supply and delivery planning processes is essential. The most mature companies have a well-defined sales and operations planning (S&OP) process that takes a snapshot of the demand plan at the start of the month for performance measurement and then allows updates to be collected continuously throughout the month as better information becomes available. They also ensure that marketing and production planning teams work together to track and massage the forecast throughout the month. For firms to drive these best practices into their organizations, they need to move away from generic enterprise resource planning (ERP) systems and spreadsheets, and adopt specialist tools that are designed for the purpose and which enable demand planners to perform the following key functions:
 - Import and condition sales history data to improve data quality prior to statistical forecasting.
 - Generate statistical forecasts using a flexible, multi-tier tournament of statistical forecasting models.
 - Enable marketing, sales and operations planning personnel to view, analyze and override statistically generated forecasts.
 - Collect sales forecasts electronically from field sales personnel.
 - Track forecast additions and overrides made by marketers, sales representatives and planners so that feedback regarding accuracy and effectiveness can be used to improve forecasting abilities.
 - Monitor and measure accuracy and effectiveness for each contributor to the forecasting process.
 - Share the constrained forecast with other system modules and other corporate systems.

Once these tools are in place, businesses can expect to see an immediate and significant difference to their performance.

Current market conditions have sent demand volatility soaring to the top of the corporate agenda. Many companies recognize that the only way to attack demand volatility is to expect it, and they are adopting the best practice and advanced technical tools to deliver improvements to forecast accuracy, inventory levels and working capital.

For the rest, it is becoming increasingly clear that inadequate demand planning can do serious damage to shareholder value and overall profitability. Demand volatility is not a temporary response to the current financial climate. It represents a more profound change in the global pattern of supply and demand. Firms that are able to enter this brave new world with the right tools can do so with confidence. Those without are fighting a losing battle. The only predictable thing about their business is the inevitable and rapid loss of competitive edge.

Ref: "Best Practice Demand Planning Meets Unprecedented Demand Volatility" By John Kamal, vice president of supply chain solutions, Triple Point Technology, USA

Ref: <https://www.sdcexec.com/warehousing/article/11267412/research-shows-how-best-practice-demand-planning-contributes-to-the-challenge-of-accurate-forecasting-in-an-era-of-global-demand-uncertainty>

3. SCM, its Three Wings and Three Drivers:

Supply Chain Management has three areas/wings:

a) Supply Management: This involves developing relationship and integration with suppliers.

b) Demand Management: It uses techniques to forecast demand accurately and develop relationships with customers.

c) Logistics Management: It focuses on how members of a supply chain manage the movement and storage of their products while interacting with other members of the supply chain.

Logistics Systems and Supply **Chain has three drivers:**

a) Inventory: Inventory is a list of goods and materials, or those goods and materials themselves, held available in stock by a business. In other word, inventory is stored accumulation of material resources and physically located that are used in a transformation process and/or activated as asset. Managing Inventory in Supply Chain is a complex operation and may have a large impact upon customer service levels and Supply Chain Cost.

b) Transportation: Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer's hand. Transportation plays a key role in every supply chain because products are rarely produced and consumed in the same location. Transportation is a significant component of the most supply chain incur. Any supply chain's success is closely linked to the appropriate use of transportation.

c) Warehousing Operations: Warehousing is an integral part of Logistics and Supply Chain Management System. For most of the common people, warehousing involves just storing of the products while it involves inbound functions for storing and outbound functions of packing and shipping. The importance of warehousing in logistics management is because it helps to deliver the right products at the right place at right time. Consolidating orders assembly of components and mixing of products etc also comes under warehousing operations. It is also possible to reduce the cycle times and inventories through proper management of products at the warehouse. Through warehousing, it is possible to make the operations efficient and utilize the storage capacity to the maximum. By consolidating and accumulating operations the economic benefits can be seen in warehouse management.

4. Demand Forecasting

Demand forecasting is the activity of estimating the quantity of a product or service that consumers will purchase. Demand forecasting involves techniques including both informal methods, such as educated guesses, and quantitative methods, such as the use of historical sales data or current data from test markets.

Demand forecasting is the process in which historical sales data is used to develop an estimate of an expected forecast of customer demand. To businesses, Demand Forecasting provides an estimate of the amount of goods and services that its customers will purchase in the foreseeable future. Critical business assumptions like turnover, profit margins, cash flow, capital expenditure, risk assessment and mitigation plans, capacity planning, etc. are dependent on Demand Forecasting.



For forecasting demand, the inputs are taken from sales and marketing, finance, and production and other functions. The final demand forecast is the consensus of all participating managers. You may also want to put up a Sales and Operations Planning group composed of representatives from the different departments that will be tasked to prepare the demand forecast.

4.1 Demand Forecasting Examples

Some real-world practical examples of Demand Forecasting are –

A **leading car maker**, refers to the last 12 months of actual sales of its cars at model, engine type, and color level; and based on the expected growth, forecasts the short-term demand for the next 12 month for purchase, production and inventory planning purposes.



A leading food manufacturing company refers to the last 24 months of actual sales of its highly seasonal products like soups and mashed potatoes. An analysis is carried out at the flavor and packaging size level. Then based on the market potential, demand is forecasted for the next 12 to 24 months for sourcing of key ingredients like tomatoes, potatoes, etc. and for capacity planning and evaluating the need for external co-packing.

4.2 Importance of Demand Forecasting

Demand Forecasting is the pivotal business process around which strategic and operational plans of a company are devised.

Based on the Demand Forecast, strategic and long-range plans of a business like budgeting, financial planning, sales and marketing plans, capacity planning, risk assessment and mitigation plans are formulated.

Short to medium term tactical plans like pre-building, make-to-stock, make-to-order, contract manufacturing, supply planning, network balancing, etc. are execution based.

Demand Forecasting also facilitates important management activities like decision making, performance evaluation, judicious allocation of resources in a constrained environment and business expansion planning.

4.3 Factors Influencing Demand

- ✓ Price, if price goes up, demand will go down
- ✓ Available income, if available income increases, demand will increase
- ✓ Prices of substitute goods, if these goes up, demand will increase e.g. rice and flour
- ✓ Prices of **complementary goods**, if these goes up, demand for the item will decrease e.g. fuel
- ✓ Buyers' preferences and tastes, as these changes, demand will also vary. Preferences and tastes are affected by psychological factors, but also by others such as weather, etc.

Factors affecting demand:
Prices of related goods can affect demand

If french fry prices double, demand for ketchup will probably decline

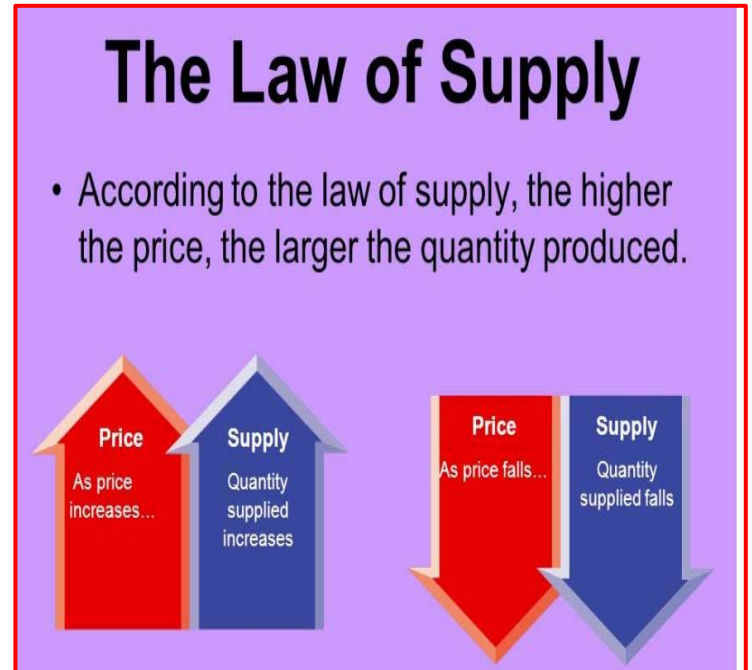
These goods are compliments
When the price of one goes up, we demand less of the other!

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- ✓ Buyers' expectations, if buyers expect future price to go up, or weather to change, or their financial situation to improve, then these expectations will also influence their demand today
- ✓ The number of buyers, if increases, demand will also grow

4.4 Factors Influencing Supply

- ✓ Price, higher price, greater supply
- ✓ Prices of inputs, if prices of inputs increases, then their profit will go down, and supply is reduced
- ✓ Technology, improvements in technology usually results in cost reductions and thus supply will grow
- ✓ Suppliers' expectations, suppliers will also have expectations, for instance regarding future market prices, weather conditions, and their own economic prospects. These expectation will influence the level of supply
- ✓ The number of sellers, if number of sellers increases, supply will also increase.



4.5 Ways of Forecasting Demand

In some case, demand can be ascertained precisely, for example it is based on firm contacts to deliver goods or services that it sells over a period of time. However, in many cases the future demand of items is not known, and it will be necessary to use forecast techniques.

The following techniques are widely used:

- **Expert opinion:** This involves consulting people with experience and expertise for their wise opinions. For example, a group of people from marketing, sales, operations and product management departments might establish a forecast of sales for a product. Eventually, this can be used to determine supply requirements.

Usually, the following approaches can be used for tapping expert opinion

- **Scenario analysis:** Under this method, a group of experts determining what they believe to be the likely demand scenario, based on certain assumptions. They (experts) identify the best and worst case scenarios, together with they also identify best case scenario(s), i.e. somewhere in between these two extremes.

Once you have scenario analysis in hand, you may decide to plan for some extra volume in case failure to supply might have severe consequences.

- **Delphi technique:** This system of forecasting involves a group of experts making predictions anonymously and independently each other. Each prediction is compared to the others and differences if any are then debated. A consensus usually appears.

- **Market testing:** This involves identifying a sample of the population that a company's product or service is aimed at, and conducting trial sales for a limited period of time to ascertain likely demand. This approach is usually used where there significant uncertainty about likely future demand.

4.6 Quantitative Analysis Techniques for Forecasting Demand

Forecasts based on quantitative analysis are basically of two types:

- Times series analysis
- Causal methods

Time series analysis: This involves a series of techniques that use past demand data to generate a forecast. Under these approaches, it is assumed that the past patterns of demand will continue in the future. These tactics are considered appropriate where conditions are relatively stable, and the historical data is of reasonable quality. These approaches may work well for short-term forecasts, but tend not to work so well for making long-term forecasts.

Some examples of these techniques are as follows:

- Moving straight averages
- Moving weighted averages
- Moving exponentially weighted forecasts
- Trend-and seasonality-adjusted forecasts

All above techniques will be explained through mathematical tables further in subsequent pages.

Causal methods: These produce forecasts by establishing a cause-effect relationship between independent variables and demand for a period.

For example:

- Demand for **candle** will be influenced by the notice stating that there will be no supply of electricity for three days due to maintenance in the transmission line.
- Long-ranges weather forecasts announcing a hot summer will influence the level of demand of **cold drink**.
- The reduction of air freight by an airline to a tourist destination may result in **additional sale** of air ticket.

If careful thought and analysis are applied in identifying the influential variables and the extent of their impact on demand, and if the forecasts for the variableness are reliable, then this method of analysis can be very useful in forecasting demand.

We will now review in more details the time series analysis techniques and casual methods as mentioned earlier. Suppose to begin with, that past data for an item has been as follows:

a. Moving straight average:

- This is the most fundamental mathematical projection technique.
- The average is based on a specified number of data points, for example, demand over each of the last twelve months or the last six months or last 5 years.
- As each new period goes by, the new data is added to the series and the oldest is dropped, to calculate the new average. This is why it is called “moving”.

Moving average method	
Period	Demand quantities
2016	10
2017	25
2018	30
2019	35
2020	50
2021? = Average	30

b. Moving weighted average:

- This is the same as the moving straight average, except that each demand figure is multiplied by a growing factor.
- As shown in the table below, the greatest weight has been applied to the most recent data, and the weighting factors have been progressively reduced as the data gets older.
- In this way, more notice is taken of recent demand, which will improve the projection if there is an increasing or reducing trend.

Moving weighted average method			
Period	Demand quantities	Quantities X weighting factors	Weighted quantities
2016	10	10x0.05	=0.50
2017	25	25x0.10	=2.50
2018	30	30x0.175	=5.25
2019	35	35x0.275	=9.625
2020	50	50x0.40	=20
2021? = Average	30	(Total weights)	=37.875

c. Quantitative analysis: Moving exponentially weighted averages

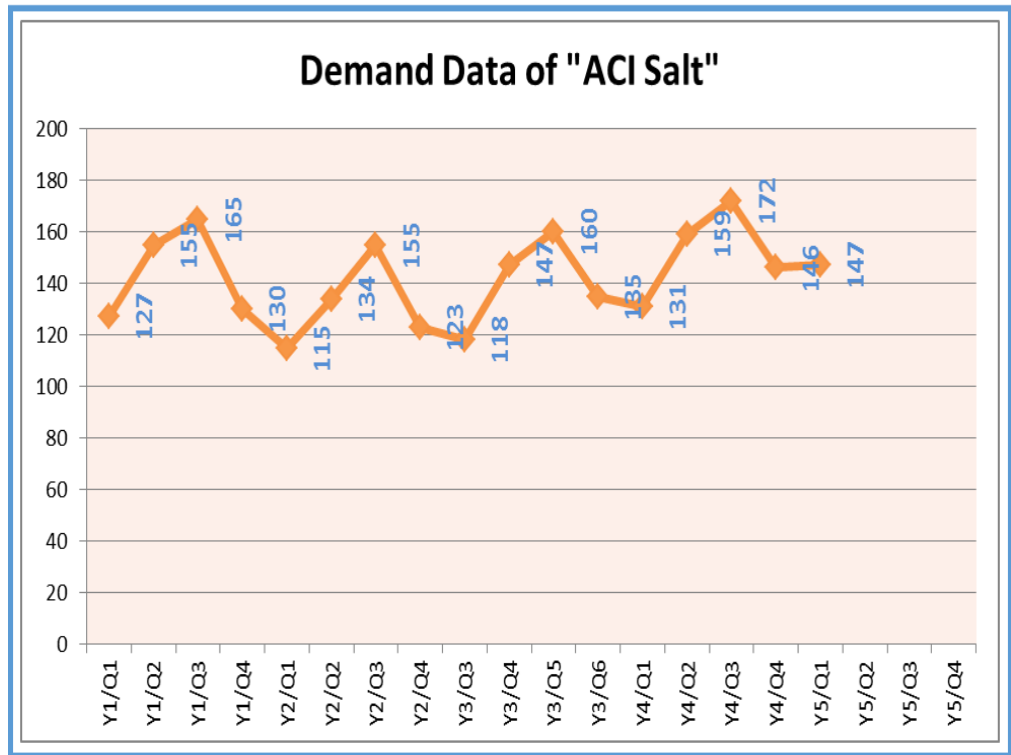
Quantitative analysis: Moving exponentially weighted averages:		
This is the same as the moving weighted average except that weights are taken from an exponential series. The main benefit of this approach is the ease of recalculating projections for each period, compared to the weighted average method.		
Under this method, the formula for making a demand forecast for a new period is as follows:		
New forecast = Past forecast + a (Past forecast error)		
Or		
New forecast = Past Forecast + a (Actual demand- Past Forecast)		
Or		
$F_{t+1} = f_t + a (d_t - f_t)$		
This formula means is that past experiences (as reflected in the past forecast error) is used to determine the next projection), tempered by the value given to a		
The value of a		
The value selected for 'a' will normally be between 0.1 and 0.4. The higher the value, the more notice is taken of recent demand. However, high values will also be more likely to produce unstable projection, which incorrectly respond to random noise in the data		
"Ft" means past forecast and "Ft+1" means new forecast		
Let us look at the example of how to apply the method of exponentially weighted forecasts. In the case illustrated below, the value given to a = 0.2. Period 1 (where the earlier demand forecast was 50) has just been completed.		
Using the recently obtained data on actual demand for the period (60), a past forecast error of + 10 has been established.		
Period (t)	1	
Past forecast f1	50	
Actual demand d1	60	
Forecast error (d1-f1)	+10	
New forecast	52*	
*Period 1: $F_{t+1} = f_t + a (d_t - f_t) = 50 + 0.2(10) = 50 + 2 = 52$		
In period 2, the previous forecast, thus, repeating the cycle. During this period, let us assume that actual demand turns out to be 72, resulting in a forecasting error of +20		
Period (t)	1	2
Past forecast f1	50	52
Actual demand d1	60	72
Forecast error (d1-f1)	+10	+20
New forecast	52	56**
Period 2: $F_{t+1} = f_t + a (d_t - f_t) = 52 + 0.2(20) = 52 + 4 = 56^{**}$		

d. Trend and seasonally adjusted forecasts:

Techniques to detect both trend and seasonality require a computer-based forecasting system. The captioned example shows quarterly demand for an item called "ACI Salt".



YQ	Demand
Y1/Q1	127
Y1/Q2	155
Y1/Q3	165
Y1/Q4	130
Y2/Q1	115
Y2/Q2	134
Y2/Q3	155
Y2/Q4	123
Y3/Q3	118
Y3/Q4	147
Y3/Q5	160
Y3/Q6	135
Y4/Q1	131
Y4/Q2	159
Y4/Q3	172
Y4/Q4	146
Y5/Q1	147
Y5/Q2	
Y5/Q3	
Y5/Q4	



Year/Quarter1	Demand	Centered Moving Average	Trend	Seasonal variation
Y1/Q1	127			
Y1/Q2	155		144	
Y1/Q3	165		141	143 +22
Y1/Q4	130		136	139 -9
Y2/Q1	115		133	135 -20
Y2/Q2	134		132	133 +1
Y2/Q3	155		132	132 +23
Y2/Q4	123		136	134 -11
Y3/Q1	118		137	137 -19
Y3/Q2	147		140	139 +8
Y3/Q3	160		143	142 +18
Y3/Q4	135		146	145 -10
Y4/Q1	131		149	148 -17
Y4/Q2	159		152	151 +8
Y4/Q3	172		156	154 +18
Y4/Q4	146			
Y5/Q1	147			
Y5/Q2				
Y5/Q3				
Y5/Q4				

Year/Quarter	Demand	Centered Moving Average	Trend	Seasonal variation
Y4/Q2	159	152	151	+8
Y4/Q3	172	156	154	+18
Y4/Q4	146		157	
Y5/Q1	147		160	
Y5/Q2	169		163	+6**

- ✓ By the end of the year 4- the trend column is showing demand increasing by around 3 units per quarter. We can easily imagine that this trend will continue and results in the figures shown in red above.
- ✓ We also know from the figure from the table below that the seasonal variation for quarter 2 will be +6. This value is therefore applied to the next quarter in the last column above. The final forecast for next quarter will therefore be $163+6^{**}$ = shown above.

Quarter:	1	2	3	4	Total
Year 1			+22	-9	
Year 2	-20	+1	+23	-11	
Year 3	-19	+8	+18	-10	
Year 4	-17	+8	+18		
Total	-56	+17	+81	-30	
Average	-19	+6	+20	-10	-3
Base seasonal	-18	+6**	+21	-9	0

Chart of seasonal variations

e. Demand Forecasting- Simple Linear Regression

- ✓ Simple linear regression is the most straightforward case of causal* method analysis. It can be applied when only one independent variable influences the demand for product and when the relationship is linear.
- ✓ For instance, the level of demand for a soft drink bottle will be effected by its price only. In this case formula will be:

$$D = a - \{b \times p\}$$

D= the forecasted demand (i.e. dependent variable)

a= a constant (also called intercept or alpha) which expresses the value that the dependent variable will have if the independent variable – in this case price- is equal to zero. We can assume that, as per past experience, if the bottles are given free, this would be equal to the maximum production capacity of the company. Suppose in this case it is 2 million per month.

B= the slope (or regression coefficient) which expresses the nature of the causal relationship between the independent variable. Suppose demand drops by 40000 bottles per month for every increase of \$0.10 in the price of bottle i.e. a drop of 400,000 bottles for every increase of \$ 1.

P= the price of soft drink (i.e. independent variable)

Determine what will be level of demand, if price is \$1.25:

$$D = 2,000,000 - \{400,000 \times 1.25\} = 1,500,000$$

*Causal means relating to cause and effect

f) Demand Forecasting: Multiple Linear Regression

Demand Forecasting: Multiple Linear Regression

- It can be applied when **two or more independent variable influences** dependent variable, in a linear (i.e. straight line") relationship.
- For instance, the bottling company may know from past experience that every decrease of 1 degree C in average monthly temperature (t) from a maximum temperature of 35 degree C causes demand of its soft drink to decrease by 30,000 bottles per month. It can then use the following formula to forecast demand if its price will be **\$1 per bottle** and the average temperature is exceeded to be **29 degree C** (i.e 6 degree below the maximum)
- $D = a - \{b_1 \times p\} - \{b_2 \times t\}$
- $D = 2,000,000 - \{400,000 \times 1\} - \{30,000 \times 6\}$
- D= 1420,000 bottles

g. Various Forecasting Methods in One Table

Determine forecast for periods 11 considering following methods

- Naïve forecast
- Simple average
- 3- and 5-period moving average
- 3-period weighted moving average with weights 0.5, 0.3, and 0.2
- Exponential smoothing with alpha=0.2 and 0.5

Period	Orders
1	122
2	91
3	100
4	77
5	115
6	58
7	75
8	128
9	111
10	88
11	

▪ Naive Approach: Demand in *next* period is the same as demand in *most recent* period

▪ Exponential Smoothing: Assumes the most recent observations have the highest predictive value

Time Series Problem Solution

Period	Orders (A)	Naïve Forecast	Simple Average	Simple Moving Average (N=3)	Simple Moving Average (N=5)	Weighted Moving Average (N=3)	Exponential Smoothing ($\alpha = 0.2$)	Exponential Smoothing ($\alpha = 0.5$)
1	122						122	122
2	91	122	122				122	122
3	100	91	107				116	107
4	77	100	104	104		102	113	104
5	115	77	98	89		87	106	91
6	58	115	101	97	101	101	108	103
7	75	58	94	83	88	79	98	81
8	128	75	91	83	85	78	93	78
9	111	128	96	87	91	98	100	103
10	88	111	97	105	97	109	102	107
11		88	97	109	92	103	99	98

* $107 = (122+91)/2$

** $104 = (122+91+100)/3$

*** $101 = (122+91+100+77+115)/5$

**** $102 = (122 \times 0.20) + (91 \times 0.30) + (100 \times 0.50)$

***** $116 = 122 + (91 - 122) \times 0.20$

***** $107 = 122 + (91 - 122) \times 0.50$

4.7 Demand Forecasting Process- 3 Phases

1) Past data:-Collection and analysis:

- Identify the best source of demand data
- Collect and review data
- Cleanse the data (e.g. to compensate for distortions)
- Select the forecasting method that works best
- Produce a base statistical data

2) Adding deterministic overrides:

- Identify any factor that may cause forecasted demand to need adjustment, e.g.:
- Price changes
- Competitor activity
- Technological change
- Market research into consumer/user preferences
- Determine the potential impact of these factors
- Update the base statistical forecasts taking these factors into account

3) Management action:

- Regularly check actual demand against forecasts
- Understanding the reasons for variances
- Identify and take required actions e.g.:
- Remedies to past problem
- Opportunities for improving performance or accuracy of forecasts
- Take decision to improve operations

Ref: ITC-MLS-SCP Module 2 (Old Course)

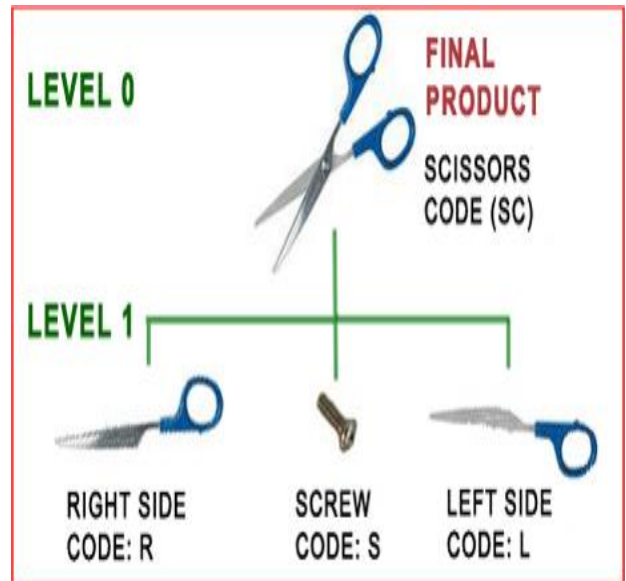
5. Bill of Materials (BOM)

A bill of materials (BOM) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, components, parts and the quantities of each needed to manufacture an end product. The different types of BOMs depend on the business need and use for which they are intended.

In process industries, the BOM is also known as the formula, recipe, or ingredients list. In electronics, the BOM represents the list of components used on the printed wiring board or printed circuit board.

BOMs are hierarchical in nature with the top level representing the finished product which may be a sub-assembly or a completed item.

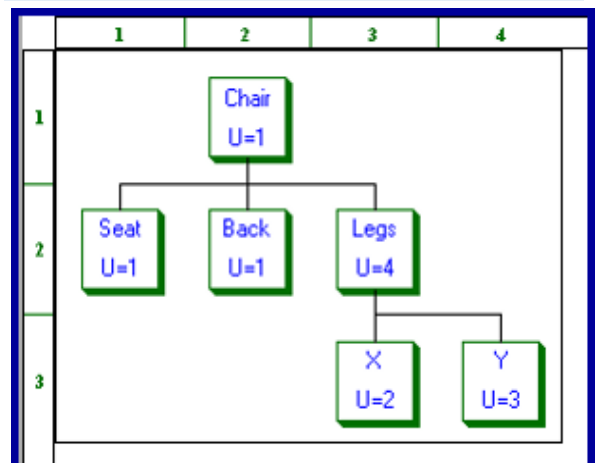
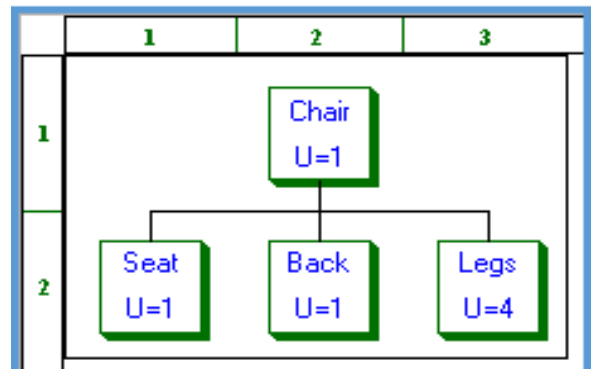
The first hierarchical databases were developed for automating bills of materials for manufacturing organizations in the early 1960s.



In order to show the make-up (in terms of the parts needed for production) we have a Bill of Materials (BOM) for the end-product (namely the chair). Below we show the BOM for the chair.

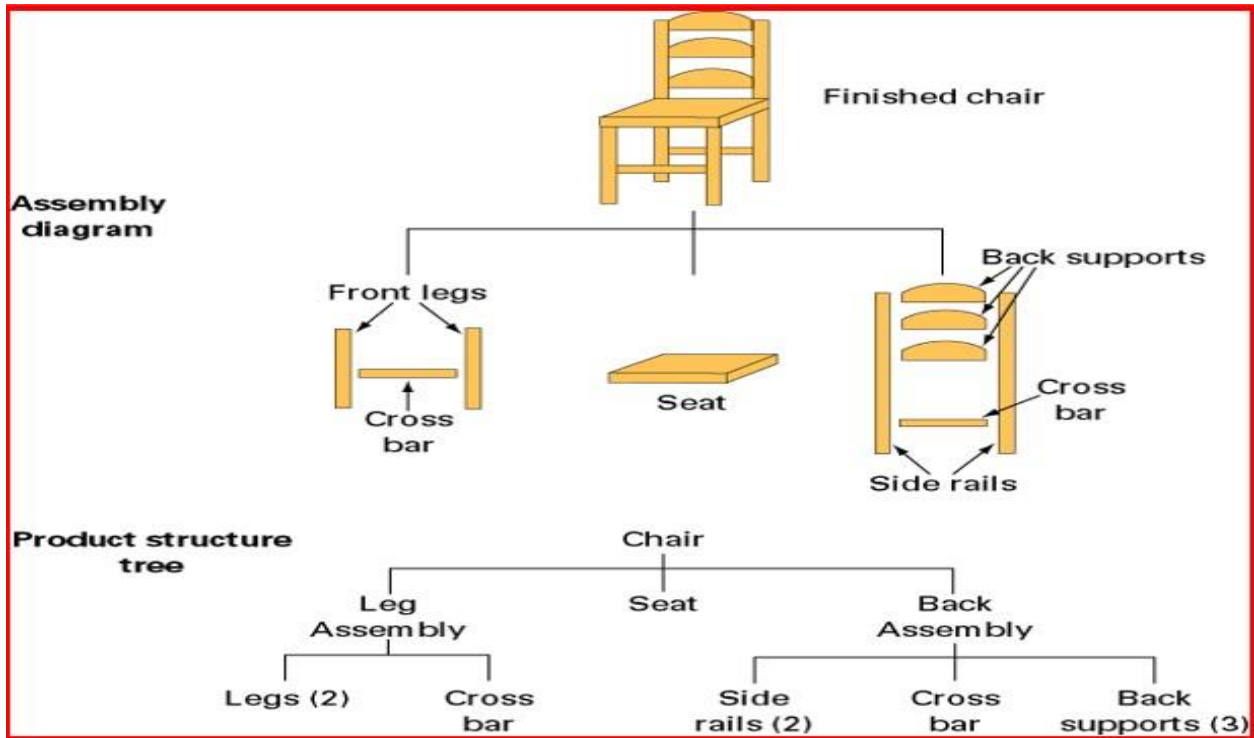
This BOM means that to produce one chair we need:

- one seat
- one back
- four legs .



Extensions

To extend our example suppose that each leg is made up from two components (X and Y). Two units of X and 3 units of Y are needed for one leg and the lead time is 1 week. Then our BOM is like---



BOM example showing cost of per item to produce a chair.

Quantity	ID#	Description	Unit Price	Total Cost
1	6TU8	Back	\$5/Unit	\$ 5.00
4	5DR	Legs	\$5/Unit	20.00
1	2PC	Seat	\$10/Unit	10.00
5	1"	Nails	\$0.50/Unit	<u>2.50</u>
Total Project Cost				\$37.50

6. Material Requirement Planning (MRP)

Material requirements planning, referred to by the initials “MRP” is a technique which assists a company especially an industry concern in the detail planning of its production

MRP is a system for planning that determines when materials should be purchased and when work orders should be scheduled to manufacture goods

MRP implies three questions:

- What material is required?
- When is the material required?
- How much of the material is required?

Inputs and Outputs of MRP:	
Inputs	Outputs
Master Production Schedule	Purchase Order (PO)
Bill of Material(BOM)	Work Order (WO)
Inventory records	Reschedule/Action Notice

Material Requirement Planning (MRP)



Suppose ABC Company receives order for 100 unit of Uni Dolls (Toy) which to be delivered in 9th week. According to BOM, the material requirement would be as follows:

Item/Part Code No. Level/Code	Description	Gross Requirements	Lead Time to Assemble or purchase
Finished Goods		Quantity	Week/s
0-001	Uni Doll	Order size = 100	1 (assemble)
Sub- Assemblies			
1-1100	Body Shell sum-assembly	1 X 100 = 100	4 (purchase)
1-1200	Wheel sub-assembly	2 X 100 = 200	1 (assemble)
1-1300	Handle sub-assembly	1 X 100 = 100	1 (assemble)
Components			
2-1200-01	Wheel Holder	1 X 200 = 200	1 (purchase)
2-1200-02	Push-on-axle	1 X 200 = 200	1 (purchase)
2-1200-03	Push –fit wheels	2 X 200 = 400	2 (purchase)
2-1300-01	Handle holder	1 X 100 = 100	1 (purchase)
2-1300-02	Rivet	1 X 100 = 100	1 (purchase)
2-1300-03	Handle	1 X 100 = 100	1 (purchase)
2-4447-18	Blind pop-rivet	6 X 100 = 600	6 (purchase)

6.1 MRP Calculation

Parts and component	Required date and order release date	Week No									Lead-time
		1	2	3	4	5	6	7	8	9	
Uni Doll 0-001	Required date									100	WO 1 week
	Order Release Date								100		
Body Shell sub assembly 1-1100	Required date								100		PO 4 weeks
	Order Release Date				100						
Wheel sub-assembly 1-1200	Required date								200		WO 1 week
	Order Release Date							200			
Wheel -Holder 2-1200-01	Required date							200			PO 1 week
	Order Release Date							200			
Push-on-Axle 2-1200-02	Required date							200			PO 1 week
	Order Release Date							200			
Push-fit-wheels 2-1200-03	Required date							400			PO 2 weeks
	Order Release Date					400					
Handle sub-assembly 1-1300	Required date								100		WO 1 week
	Order Release Date							100			
Handle Holder 2-1300-01	Required date							100			PO 1 week
	Order Release Date							100			
Rivet 2-1300-02	Required date							100			PO 1 week
	Order Release Date							100			
Handle 2-1300-03	Required date							100			PO 1 week
	Order Release Date							100			
Blind pop-rivets 2-4477-88	Required date								600		PO 6 weeks
	Order Release Date		600								

Ref: ITC-MLS-SCM Module 17 (Old Course)

7. DRP (Distribution Resource Planning): Time-bucket Matrix Display

Distribution resource Planning (DRP) is essentially a simulation system that models all expected activities involved in shipping goods through networks over a defined planning time horizon.

DRP systems ease the monitoring and control of stock movements throughout the complex supply chains that involve several links between suppliers, warehouses, factories, distribution centers and retail outlets.

DRP significantly reduces administrative works associated with transportation.

The displays and processing logic used in DRP are straightforward, and are similar to MRP in a number of ways. "Time-bucket" matrix displays are used in both systems over a systems over a planning time horizon.

DRP starts by determining demand at the lowest level and then aggregate up the chain. MRP consolidation starts at the top level, and then works down.

- Lead Time: 1 week
- Order Quantity: 500 pieces
- Time Horizon: 8 weeks
- Min. Safety Stock: 250 pieces
- Max. Stock Limit : 600 pieces

Details	Past Due	Week							
		1	2	3	4	5	6	7	8
Forecast Demand		200	210	220	200	180	200	210	160
Shipment on Order (in transit)	500		500		500		500		500
Planned Shipment Quantity		500		500		500		500	
Received Shipment Quantity		500		500			500	500	
Projected Stock on Hand	195	495	285	565	365	185	485	775	615

Delivery cancelled

ALERT

Delayed receipt

Over limit

Ref: ITC-MLS-SCM Module 11 (Old Course)

8. MTS, MTO and ATO and Resilience Supply Chain

Make-to-Stock (MTS)	Make-to stock would largely be based on independent demand where goods or services are available ex-stock or off-the-self. Examples are fast moving consumer goods e.g. groceries, cosmetics etc. This concepts are mostly applied in retail store
Make-to-Order (MTO)	Make-to order goods and services are produced according to customer requirements only after order has been received. Examples are original equipment (OEM) components for the motor vehicle industry, flexible packaging, sheet metal etc.
Assemble-to-Order (ATO)	Assemble-to order goods and services allow customization of standard item. It is a combination of make-to-stock and make-to-order. Examples are furniture manufacturers producing lounge chair and sofas where they are partially completed awaiting the customer's choice of upholstery fabric.

9. Aggregate Planning and Master Production Schedule

Example of Aggregate Planning and MPS			
Aggregate Plan	January	February	March
Total number of dolls required	1000	1200	800
Master Production Schedule (MPS)			
Plastic doll decorated with four colors	150	125	50
Plastic doll with wheels	250	150	140
Plastic doll- cowboy shaped	275	270	210
Plastic doll- dolphin shaped	325	655	400
Total	1000	1200	800

Particular	Definition
Aggregate Planning	Aggregate planning is the determination of capacity and other resources of an organization required to meet demand in the medium-term
Master Production Schedule	The Master Production Schedule (MPS) is a timetable for stating what particular item is to be made and when it is to be made

10. Strategy to Meet Demand

Four strategies to meet demand	
Level strategy	Level strategy is producing at a steady (uniform) and using inventory to meet demand. This involves building up stock during period of low demand and supplying from this stock during periods of high demand Examples: Steel, pharmaceuticals and aluminum etc.
Chase strategy	Chase strategy is matching the output rate to meet demand by varying the labor levels. It incurs additional cost in the form of overtime, hiring or laying off labor Examples: Retail store and agriculture sector where demand is seasonal
Mixed strategy	Mixed strategy is a combined strategy that covers both chase and level strategies.
Pricing strategy	Pricing strategy is a strategy to achieve level demand by adjusting prices. Examples: City hotels and car hire businesses offer low cost for weekend packages

10.1 Level Strategy to Meet Demand

Aggregate plan i.e. forecast						
Month	Jan	Feb	Mar	Apr	May	June
Demand	1600	1400	1200	2400	3600	3000

Level strategy						
The standard hours required to produce one unit of doll is 4 person-hour						
Aggregate plan by applying level strategy to meet the anticipated demand						
Month	Jan	Feb	Mar	Apr	May	June
Demand	1600	1400	1200	2400	3600	3000
Labor (person-hour)	550	550	550	550	550	550
Production	*2200	2200	2200	2200	2200	2200
Inventory (month-end)	**600	***1400	2400	2200	800	0
* 2200=550x4, ** 600=2200-1600 and *** 1400=2200+600-1400						

10.2 Chase Strategy to Meet Demand

Aggregate plan i.e. forecast						
Month	Jan	Feb	Mar	Apr	May	June
Demand	1600	1400	1200	2400	3600	3000

Chase strategy						
The standard hours required to produce one unit of doll is 4 person-hour						
Aggregate plan by applying chase strategy to meet the anticipated demand						
Month	Jan	Feb	Mar	Apr	May	June
Demand	1600	1400	1200	2400	3600	3000
Labor (person-hour)	400	350	300	600	900	750
Production	1600	1400	1200	2400	3600	3000
Inventory (month-end)	0	0	0	0	0	0

Ref: ITL-MLS-SCM: M 17 Operation Management (Old Version)

11. Natural Disaster: Strategy in Respect of Demand and Capacity


Natural disasters pose huge economic challenges to nations, communities, and corporations worldwide. Agriculture is one of the sectors most affected by natural disasters, including the increasing effects of global climate change. Specifically, the annual fluctuation in crop production as well as trade in agricultural products that affect food supply chains has been closely linked to natural disasters and extreme weather.

According to a World Bank report, the global economic losses from disasters increased 15 times from the 1950s to the 1990s (Jha and Stanton-Geddes, 2013). The report estimates that East Asia and the Pacific regions accounted for about 80 percent of the total global losses due to disasters in the first nine months of 2011. Furthermore, according to the United Nation’s Economic and Social Commission for Asia and the Pacific’s (UN-ESCAP) Statistical Database, developing regions such as Asia and Africa show faster urbanization than the developed world (UN-ESCAP, 2015). Rapid urbanization in developing countries makes them increasingly vulnerable to disasters due to the lack of adequate infrastructure planning and land management. As citizens migrate to cities, so do the market and other food value chain services also concentrate near cities.

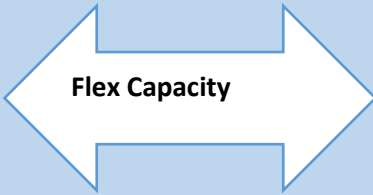
The urban population has more than doubled (increased by over 115%) in ASEAN member states between 1990 and 2015. Such demographic shift always demands for a resilient urban infrastructure and FSC. Otherwise, an unplanned or poorly planned migration of people and assets to highly concentrated places exposes them to more risks when disaster strikes.

Natural disasters affect both demand and capacity.

11.1 Strategy for Shifting Demand to Adjust Capacity

When demand too high		When demand too low
Use signage or similar approach to communicate busy days and times.		Promote sale and increase advertising to create new demand.
Offer incentives to consumers for usage during non-peak time.		Improve the service and offer to the new market segment.
Take special care for loyal or regular customers first.		Offer discount or reduce price.
Publicize peak usage times and benefits of non-peak use.		Bring changes hours of operations.
Price may be charged for the service. Discount may be withdrawn.		Bring the service near to the customers.

11.2 Strategy for Flexing Capacity to Adjust Demand

When demand too high		When demand too low
Increase time, labor, facilities and necessary equipment		Perform maintenance activities
Train cross-employees		Renovation may be made depending on situation
Engage part-time employees		Schedule vacation
Offer overtime to employees/labors		Schedule training for employees
Take necessary measure to rent or share facilities		Employees may be transferred to other units where necessary
Effort may be made to rent share equipment		
Go for subcontract		
Take initiative to enter into outsourcing arrangement		

Adapted from the article titled "Food Supply Chain Disruption due to Natural Disasters: Entities, Risks, and Strategies for Resilience" by Vangimalla R. REDDY, Shardendu K. SINGH† and Venkatachalam ANBUMOZHI‡ Research Institute of Economy, Trade and Industry"*

12. Case Study: When Demand Planning Goes Wrong: Lessons Learned from United Airlines Overbooking Issue

Lessons Learned from United Airlines Overbooking Issue

What demand planning lessons can we learn from the recent United Airlines Overbooking Issue?



The million-dollar question: "My forecasts will always be wrong. Should I over-forecast or under-forecast?"

For most service or manufacturing businesses, answering this question is often needed at one point or the other. If you over-forecast, you can have excess inventory costs, and you may end up having to employ a combination of sales and inventory strategies to get rid of excess inventory. On the other hand, if you under-forecast, then you could end up with customers who might not be able to access a service or product when they want it.

Industries that have fixed capacities such as airlines or hotels, on the other hand, tend to have a unique forecasting issue. These types of businesses sometimes have to over-forecast or overbook to make room for cancellations.

What about Forecasting in the Airline Industry?

While most people might be in dismay over the treatment of the man that was forced to leave the United Airlines flight, over-booking flights is a pretty standard airline practice. Airlines often 'over-forecast' taking into account the possibility of cancellations and people missing their flights to maximize profits and avoid having to fly an aircraft that's not filled. It costs an airline the same to operate an aircraft that is filled or half empty. Therefore, to minimize costs and maximize profitability, it's always better for the airlines to fly a full aircraft. Of course, a problem arises when the forecasted margin of error; in this case, the number of people who might cancel or miss their flights, does not follow statistical or historical events. The recent case with United Airlines is a clear example; the flight was clearly overbooked to the point that aircraft personnel didn't have a place to sit. In this case, the number of forecasted cancellations were overshot leading to the unpleasant encounter.

Many airline consumers are calling for airlines to abolish over-booking flights given the recent set of events. It, however, seems very unlikely that this would be implemented. The Ted Talk video on this below explains why in greater detail.

Demand planning lessons from the recent United Airlines overbooking issue Always have a solid contingency plan.

For most businesses relying on forecasted demand numbers, there should always be a contingency plan in place for situations when things go wrong. To do this, companies have to create different what-if scenarios and be ready in case they experience any of those scenarios. For example, for a 100-seated aircraft, with an average flight cancellation rate of 10%, there is the need to analyze different what-if scenarios that use different cancellation rates and prepare for those situations. The United Airlines situation experienced fewer cancellations than expected. An example of a contingency plan for a situation like that could include partnering with other airlines that have flights leaving around the same time to accommodate customers who might be bumped off the flight. Additionally, airlines could also factor in the number of voluntary flight bumps that they get per flight. Hence reducing the need for involuntary flight bumps in situations when flights are overbooked.

Look to reduce forecast error to a safer margin error of (+/-5%).

All forecasts are wrong. The goal of improving forecast accuracy is to improve the margin of error, therefore, reducing situations where businesses would either incur too many costs for over forecasting or have stock-outs as result of under-forecasting. Businesses should seek to be in the (+/- 5%) range when possible. This range allows for minimum impact and fewer business disruptions.

The business impact of poor customer satisfaction is amplified in a digital era.

Businesses operating in today's digital era should be aware of the impact of a disgruntled customer. The business impact of this negative experience was made visible to most of the world through various social media channels. This exposure resulted in customers calling for a boycott of United Airlines. In fact, United Airlines' market capitalization dropped by more than \$250 million as a direct aftermath.

Although the United Airlines case, is probably unusual for most businesses, having unhappy customers could impact bottom line results not in just the near term, but also in the long term. A more typical example of how a poor customer experience could affect a business is with a customer writing a negative review online. The negative review stays online forever, even after fixing the issue. Essentially, providing high service levels to your customers is invaluable and should be part of your integrated business plan.

When planning against uncertainty nothing is certain

Finally, when planning against uncertainty, nothing is certain. And because of this, businesses must be nimble and ready to respond to market changes. A time lag or the 'wrong' response could be detrimental to a business – and we can all agree that's needless to say in this situation.

Ref: <https://blog.arkieva.com/demand-planning-goes-wrong-united-airlines-overbooking/>

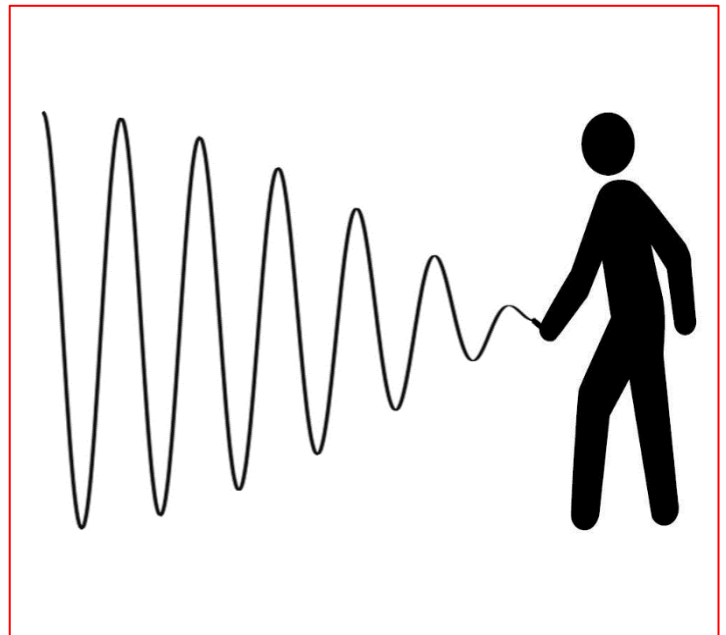
13. What is the Bullwhip Effect and How Do You Minimize it?

What is the bullwhip effect?

Imagine a person having a long whip in his hand, and if he gives a little nudge to the whip at the handle, it creates little movements in the parts closest to the handle, but parts further away would move more in an increasing fashion.

Similarly, in the supply chain world, the end customers have the whip handle and they create a little movement in the demand which travels up the supply chain in increasing fashion. As we move away from the customer, we can see bigger movements. On average, there are six to seven inventory points between the end customer and raw material supplier.

1). Everyone tries to protect themselves from stock-out situations and missed customer orders, by keeping extra inventory to hedge against variability in the supply chain. Hence, huge buffers of inventories up to six months can exist between the end customer and raw material supplier. This bullwhip effect ultimately causes the upstream manufacturers to have increased uncertainty which results in lower forecast accuracies leading to higher inventories.



To understand how to minimize the bullwhip effect. Let's take a step back and look at the definition of the bullwhip effect.

Definition of the bullwhip effect

The bullwhip effect is a concept for explaining inventory fluctuations or inefficient asset allocation as a result of demand changes as you move further up the supply chain. As such, upstream manufacturers often experience a decrease in forecast accuracy as the buffer increases between the customer and the manufacturer.

How do we minimize the bullwhip effect?

Every industry has its own unique supply chain, inventory placements, and complexities. However, after analyzing the bullwhip effect and implementing improvement steps, inventories in the range of 10 to 30 percent can be reduced and 15 to 35 percent reduction in instances of stock out situations and missed customer orders can be achieved. Below are some of the methods to minimize the bullwhip effect.

1. Accept and understand the bullwhip effect

The first and the most important step towards improvement is the recognition of the presence of the bullwhip effect. Many companies fail to acknowledge that high buffer inventories exist throughout their supply chain. A detailed stock analysis of the inventory points from stores to raw material suppliers will help uncover idle excess inventories. Supply chain managers can further analyze the reasons for excess inventories, take corrective action and set norms.

2. Improve the inventory planning process

Inventory planning is a careful mix of historical trends for seasonal demand, forward-looking demand, new product launches and discontinuation of older products. Safety stock settings and min-max stock range of each inventory point need to be reviewed and periodically adjusted. Inventories lying in the entire network need to be balanced based on regional demands. Regular reporting and early warning system need to be implemented for major deviations from the set inventory norms.

3. Improve the raw material planning process

Purchase managers generally tend to order in advance and keep high buffers of raw material to avoid disruption in production. Raw material planning needs to be directly linked to the production plan. Production plan needs to be released sufficiently in advance to respect the general purchasing lead times. Consolidation to a smaller vendor base from a larger vendor base, for similar raw material, will improve the flexibility and reliability of the supplies. This, in turn, will result in lower raw material inventories.

4. Collaboration and information sharing between managers

There might be some inter-conflicting targets between purchasing managers, production managers, logistics managers and sales managers. Giving more weight to common company objectives in performance evaluation will improve collaboration between different departments. Also providing regular and structured inter-departmental meetings will improve information sharing and decision-making process.

5. Optimize the minimum order quantity and offer stable pricing

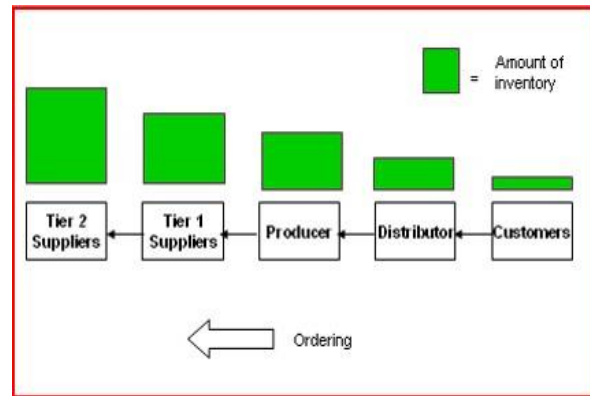
Certain products have high minimum order quantity for end customers resulting in overall high gaps between subsequent orders. Lowering the minimum order quantity to an optimal level will help provide create smoother order patterns. Stable pricing throughout the year instead of frequent promotional offers and discounts may also create stable and predictable demand.

13.1 Case Study of Bullwhip at P&G

The final customer places an order (whip) and order fluctuations build up upstream the supply chain. Distorted information, or the lack of information, is the main cause of the “bullwhip effect”, named after the way the amplitude of a whip increases.

As expected, babies use diapers at a fairly steady and predictable rate, and retail sales are quite uniform. But, P&G found that each retailer bases his own orders on his own slightly exaggerated forecast, thereby distorting the information about real demand. Wholesalers' orders to the P&G diaper factory fluctuated even more. And P&G's orders to 3M and other materials suppliers fluctuated even more.

One of the most important methods of lessening the bullwhip effect is to reduce uncertainty along the supply chain. This can be achieved by sharing information about customer demand and by using the same forecasting method e.g. by supplying EPOS data to supplier.



14. Resilience Supply Chain and Business Continuity Planning (BCP)

You may recall that Study on “Supply Chain Resilience of RMG Sector in Bangladesh by National Resilience Programme (NRP) Programming Division, Planning Commission, November 2020” emphasized to introduce BCP in both private and public sector of the country as per detail below.

“Need for a business continuity plan

It has been agreed by both the private sector business leaders and the government officials that a national business continuity plan is required to be in place to prepare for contingencies meeting the supply chain disruptions due to natural disasters. This plan may have multi sector focus, covering the specific needs for different industrial sectors, such as, RMG, agro food, jute, leather, and so forth, and needs to have a multi-disciplinary approach covering resilient civil infrastructure and storage, transportation and supply chain infrastructure and network, utility services, information sharing platform, and responsive regulatory regime for handling port and customs clearance procedure.”



Let's elaborate BCP for our overall understanding

Business continuity planning (BCP) is the process involved in creating a system of prevention and recovery from potential threats to a company. The plan ensures that personnel and assets are protected and are able to function quickly in the event of a disaster. The BCP is generally conceived in advance and involves input from key stakeholders and personnel.

BCP involves defining any and all risks that can affect the company's operations, making it an important part of the organization's risk management strategy. Risks may include natural disasters—fire, flood, or weather-related events—and cyber-attacks. Once the risks are identified, the plan should also include:

- Determining how those risks will affect operations
- Implementing safeguards and procedures to mitigate the risks
- Testing procedures to ensure they work
- Reviewing the process to make sure that it is up to date

BCPs are an important part of any business. Threats and disruptions mean a loss of revenue and higher costs, which leads to a drop in profitability. And businesses can't rely on insurance alone because it doesn't cover all the costs and the customers who move to the competition.

Understanding Business Continuity Planning (BCP)

Businesses are prone to a host of disasters that vary in degree from minor to catastrophic. Business continuity planning is typically meant to help a company continue operating in the event of major disasters such as fires. BCPs are different from a disaster recovery plan, which focuses on the recovery of a company's IT system after a crisis.

Consider a finance company based in a major city. It may put a BCP in place by taking steps including backing up its computer and client files offsite. If something were to happen to the company's corporate office, its satellite offices would still have access to important information.

An important point to note is that BCP may not be as effective if a large portion of the population is affected, as in the case of a disease outbreak.

Developing a Business Continuity Plan

There are several steps many companies must follow to develop a solid BCP. They include:

Business Impact Analysis: Here, the business will identify functions and related resources that are time-sensitive. (More on this below.)

Recovery: In this portion, the business must identify and implement steps to recover critical business functions.

Organization: A continuity team must be created. This team will devise a plan to manage the disruption.

Training: The continuity team must be trained and tested. Members of the team should also complete exercises that go over the plan and strategies.

Companies may also find it useful to come up with a checklist that includes key details such as emergency contact information, a list of resources the continuity team may need, where backup data and other required information are housed or stored, and other important personnel.

Along with testing the continuity team, the company should also test the BCP itself. It should be tested several times to ensure it can be applied to many different risk scenarios. This will help identify any weaknesses in the plan which can then be identified and corrected.

Business Continuity Impact Analysis

An important part of developing a BCP is a business continuity impact analysis. It identifies the effects of disruption of business functions and processes. It also uses the information to make decisions about recovery priorities and strategies.

FEMA provides an operational and financial impact worksheet to help run a business continuity analysis. The worksheet should be completed by business function and process managers who are well acquainted with the business. These worksheets will summarize the following:

- The impacts—both financial and operational—that stem from the loss of individual business functions and process
- Identifying when the loss of a function or process would result in the identified business impacts

Completing the analysis can help companies identify and prioritize the processes that have the most impact on the business' financial and operational functions. The point at which they must be recovered is generally known as the “recovery time objective.”

Let's look at a real life example of BCP

14.1 BCP- Case Study: German Telecom Giant Rapidly Restores Service After Fire

Among the better business continuity examples we've seen, incident management solutions are increasingly playing an important role. Take the case of a German telecom company that discovered a dangerous fire was encroaching on a crucial company facility.

The facility was a central switching center, which housed important telecom wiring and equipment that were vital to providing service to millions.

The company uses an incident management system from Simba, which alerted staff to the fire, evaluated the impact of the incident, automatically activated incident management response teams and sent emergency alerts to Simba's 1,600 Germany-based employees.

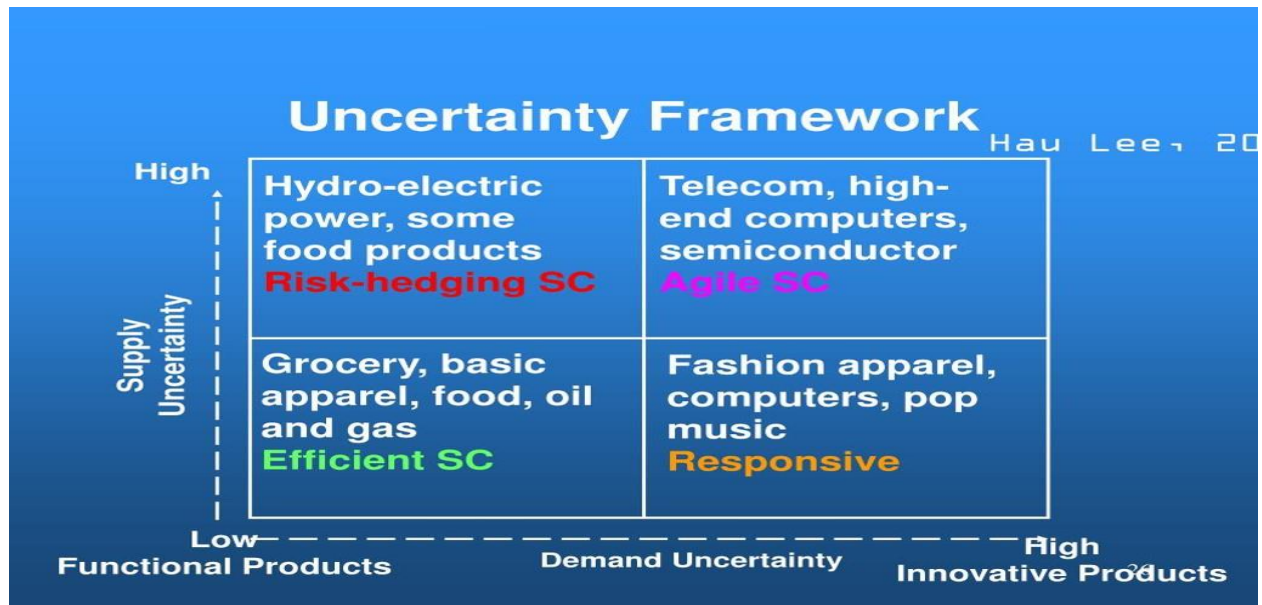
The fire did indeed reach the building, ultimately knocking out the entire switching center. But with an effective incident management system in place, combined with a redundant network design, **the company was able to fully restore service within six hours.**

Ref: 1) <https://www.investopedia.com/terms/b/business-continuity-planning.asp>

*2) Article titled “6 Real-Life Business Continuity Examples You'll Want to Read” by Tracy Rock | Dec 20, 2018
<https://invenioit.com/continuity/4-real-life-business-continuity-examples/>*

15. Dr. Hau Lee's Uncertainty Framework

Research made by Dr. Hau Lee has provided an interesting matrix to determine type of Supply Chain applicable to different organizations. Lee framed up his uncertainty framework on the basis of uncertainty of demand and uncertainty of supply. He has categorized the whole approach into four types of supply



chain as per picture below.

a. Efficient Supply Chain Strategy

Efficient Supply Chain is applicable when there are low supply uncertainty and low demand uncertainty. This strategy you can apply with functional products and/or services with stable supply chain process.

Feature of an Efficient Supply Chain Strategy:

Applies to:	Functional Products/Service with Stable Supply Chain Processes
Primary Purposes:	Supply to predictable demand with lowest possible cost while meeting quality requirement
Product and Process Design Strategy:	Maximize performance and minimize cost; build in TQM (Total Quality Management); streamlining process to eliminate non-value adding activities
Manufacturing Focus:	"Lean" manufacturing; exploit economies of scale; optimize capacity utilization; automate; use planning/scheduling software and outsource where possible
Inventory Strategy:	Lowest possible inventory and high turnover throughout the chain: Just-in-time(JIT) deliveries wherever possible
Logistics and Distribution:	Optimize efficiency and cost; eliminate unnecessary stages; continuous replenishment
Lead-time Focus:	Reduce lead-times as long as it does not increase costs

Supplier Selection:	Based on cost and Quality; reduce number numbers of supplier
Information Support:	Sharing of information amongst supply chain members on demand, inventories and capacities

b. Responsive Supply Chain Strategy

Responsive Supply Chain is applicable when there are low supply uncertainty and high demand uncertainty. This strategy you can apply with innovative products and/or services involving stable supply chain processes, e.g. the **fashion and music industries**.

Features of a Responsive Supply Chain Strategy:

Applies to:	Functional Products/Service with Stable Supply Chain Processes
Primary Purposes:	Respond flexibly and quickly to unpredictable and changing demand to avoid "market mediation" costs (excess stocks and opportunity costs due to stock outs)
Product and Process Design Strategy:	Co-ordinated design and planning; constant innovation; build-to-order/flexible "mass customization" based on modular design and common components; postponement
Manufacturing Focus:	Flexible capacity, to ramp production up or down as demand changes; excess buffer production capacity close to market to allow quick response.
Inventory Strategy:	Buffer stock- of finished products but especially pre-assembled components and parts- close to the market
Logistics and Distribution:	Optimize efficiency and speed of logistics, eliminating unnecessary stages; continuous replenishment
Lead-time Focus:	Reduce lead-times to respond quickly to demand
Supplier Selection:	Based on speed, flexibility and quality, locate supplier hubs close to assembly site
Information Support:	Accurate and time information on customers' order; sharing this of information amongst supply chain members along on inventories and capacities

c. Risk-hedge Supply Chain Strategy

Risk-hedge Supply Chain is applicable when there are high supply uncertainty and low demand uncertainty. This strategy you can apply when dealing with functional products/or services with evolving supply chain processes. These mainly include for instance, seasonal goods- where supply chains have to gear up to meet customers' needs at certain times of the year and because of this often face bottlenecks.

Features of a Risk-Hedge Supply Chain Strategy:

Applies to:	Functional Products/Service with Stable Supply Chain Processes
Primary Purposes:	Share and reduce supply chain risks by pooling and sharing resources, etc. Reduce costs and improve efficiencies only if this does not increase costs.
Product and Process Design Strategy:	Early design collaboration to maximize use of lower-risk components and processes
Manufacturing Focus:	Avoid outstanding to minimize supply risk; share facilities or expertise where necessary and feasible
Inventory Strategy:	High safety stocks, especially of low value items; share safety stocks to reduce risks and costs
Logistics and Distribution:	Pool logistics facilities to share and reduce risks; transship from locations with excess inventory to location with low inventory; use reliable 3PL/4PL services.
Lead-time Focus:	Reduce lead-times to reduce supply chain risk
Supplier Selection:	Based on supplier reliability, some alternative supplier sources; use internet trading exchanges and e-markets to globalize sourcing alternatives.
Information Support:	Share information in SC on demand, inventories and capacities; information on alternative supply sources

d. Agile Supply Chain Strategy

Agile Supply Chain is applicable when there are high supply uncertainty and high demand uncertainty. This strategy you can apply when dealing with innovative products/or services with evolving supply chain processes. These mainly include for instance, advanced high-tech consumer items like smart cellphones, and tablet computers- that may face both technical as well as physical supply uncertainties and hold ups in their supply chain processes.

Features of an Agile Supply Chain Strategy:

Applies to:	Innovative products/services with evolving supply chain processes
Primary Purposes:	Combine with strengths of both risk-hedged and responsive supply chain strategies by being responsive to changing, unpredictable demand while minimizing supply uncertainty and risk of disruptions
Product and Process Design Strategy:	Co-ordinated design and planning, build-to-order/flexible mass customization; modular design; using common components; maximize use of lower-risk components and processes ; postponement
Manufacturing Focus:	Flexible capacity, ramping production up or down in response to demand; buffer production capacity close to the market to allow quick response; avoid outsourcing and share facilities or expertise where feasible.
Inventory Strategy:	High buffer stocks, especially of pre-assembled parts close to the market; share safety stocks
Logistics and Distribution:	Optimize efficiency; coordinate replenishment; pool logistics facilities to share and reduce risks; transship from locations with excess inventory to location with low inventory.
Lead-time Focus:	Reduce lead-times to respond quickly to demand and reduce supply chain risk
Supplier Selection:	Based on speed, flexibility, reliability and quality; supplier hub close to assembly site; secure alternative supply sources some alternative supplier sources; use internet trading exchanges and e-markets to globalize sourcing.

Information Support:	Accurate and timely information on customers order; sharing this information amongst SC members along with information with inventories and capacities, information on alternative supply source.
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Ref: ITC Supply Chain Management for SMEs

16. Agile Supply Chain (ASC): Zara's Case Study Analysis



a) Introduction

Zara is a fashion label and fashion chain stores established in 1975 by the Spanish group Inditex own by Amancio Ortega. Next to Zara, the rest of the labels the groups own are Bershka, Massimo Dutti, Pull and Bear, Stradivarius, Oysho, Zara Home, Zara kinds and Uterque. During the last two decades Zara tripled its profit and stores and nowadays is ranked the third biggest retailer world-wide (Zhang, 2008).

It has 3000 in-house designers located in its headquarter in the region of A Coruña, Spain, which design over 40 000 items per year among which only 10 000 are selected for production (Li, 2009). Opposite to its competitors, more than 50% of its production is in Europe and not in Asia or South America (Bruce and Daly, 2006). According to Sull and Turconi (2008) average markdown ratio is at approximately 50 per cent, for comparison Zara sold only 15 per cent on sale.

All these facts allows Zara to expand its sales and profits over 20 per cent per year. By September 2010 Inditex group owns 4907 stores in 77 countries around the world (38 in Europe and 39 outside Europe). Zara gets the credit to be pioneer in Agile Supply Chain and most researchers explain its success with its efficient ASC (Dutta, 2002; Tiplady, 2006; Sull and Turconi, 2008; Zhang, 2008). Zhang (2008) suggests that “whole process of the supply chain in Zara could be divided into four parts: **product organization and design; purchase and production; product distribution; sales and feedback**”.

b) Product organization and design

Next to its unique models the majority of Zara's items are imitation of high-end brands. According to Zhang (2008) “the main duty of ZARA’s designers is not for product innovation, but for reorganizing fashion elements of the existed products on their purpose, transferring them into new kinds of products. They work to interpret the fashion instead of creating fashion” he says. The samples are collected from various sources, like pret-a-porters, haut couture (Dutta, 2002), moulded by culture, for example what is happening on the street, in clubs, lifestyle hotspots and fashion “flash points”, and not from a mood board or a trend prediction agency 12 months in advance of a selling season (Barnes and Greenwood, 2006).

The only place where Zara is predicting heavily the ordering of its fabrics. Fabrics are considered raw materials and need to be present before the season starts due to long lead times. Anyhow, there is still efficiency applied in this process. The fabrics are ordered uncolored and this gives flexibility to change

the color depending on the trends. As Cai-feng (2009) mentioning: majority of stock is held as “work-in-process” awaiting configuration instructions.

Zara is balancing its in-house and outsourcing activities. For example heavy labour tasks like sewing and coloring are outsourced to companies close to its headquarter, often with bad reputation for mistreating its employees and poor compensations (Dutta, 2002). On the other hand activities like design, prototyping and computer aided fabric cuts are held in-house to help agility. After clothes are assembled and return from the sewing factories, they are distributed to Zara's stores. To ensure that each order could arrive at destination punctually, laser barcode scanners, which are able to pick and sort over 80 000 pieces of clothes with an error rate of less than 0.5%, will be adopted in sorting the finished products (Zhang, 2008).

c) Procurement

Every organization purchases items, meaning, every organization requires to purchase supplies, perhaps as raw materials, components, sub-assemblies, spares, equipment, services and consumables. The procurement of these is either buying or leasing them. Procurement interacts with every single unit in the organization, going from marketing and sales to engineering, design and manufacturing, therefore is too important for the organization.

- Procurement is important for the company for a number of reasons: Materials change - The global markets and agile supply can provide various materials very briefly on different price. This affects directly the final product, making it more competitive, possible cheaper and more appealing to the customers.
- Customer demand - Lately there is a growth in companies product mix, while shortening products life cycle. A good example are Zara designs, they produce small quantities and wide variety, that way updating the shop outlook every week and cutting down on promotions and reductions.
- Price variation - The new technologies allow a product price to change couple of times a day, depending on supply and demand. The same technologies allow monitoring that process. Procurement is value adding process and not a cost center.
- Manufacturing - It is important for the manufacturing materials to be delivered on time, with the correct quality, to the correct place, in correct condition and at the right total cost.
- SCM - Supply chain management puts great emphasis on procurement, subcontracting and outsourcing - become more cost effective.

Procurement has direct connection with company profit. Every penny saved in purchasing is a profit, while every sales brings cost of sales.

In fast fashion, purchasing activities play a critical role through supplier selection and product decision-making, and indeed, buying is arguably changing from purely operational to much more strategic (Bruce and Daly, 2006). Bititci (2010) describes the difference between strategic and operational procurement in the table below.

Strategic procurement	Operational Procurement
Goals: 1.Right Place 2.Right Quantity 3.Right Quality 4.Right Time 5.Right Price 6.Right Supply	Goals: 1. Manage uninterrupted flow of materials and services 2. Manage cost of operational activities 3. Minimize inventory investment and lost
Activities	Activities
<ul style="list-style-type: none"> - Developing procurement strategy and aligning it with the overall organizational strategy - Assessing the supply market - Gathering information, identifying suitable suppliers - Selecting supplier - Negotiate company's supply contracts - Evaluating supplier - Management critical commodities - Managing relationships with critical suppliers and the rest of company - Monitoring procurement performance - Improving the procurement processes - Developing an electronic procurement systems - Implement company's best practices 	<ul style="list-style-type: none"> - Preparing forecasts with quantities and delivery times required - Collecting demands - Controlling authorization issues - Placing purchase orders - Follow-up purchase orders - Communicate with suppliers - Taking care of administration: delivery, tax and regulatory issues, invoices - Monitoring the shipments - Managing transaction with suppliers - Source items that are unique to the operating unit - Generate and forward material releases - Provide suppliers performance feedback

d) Production

Supply Chain Operations (SCO) manages three clear aspects: maximize resource used, minimize inventory and lead times. Those three directly affect pricing, customer satisfaction, and overall business values like profit, turnover, sales, etc. (Bititci, 2010). Zhang (2008) argues that production lot in Zara should be kept as small as possible, leaving the extra capacity in the products which are mostly needed in the manufacturing.

He argues that big orders will result in inventory increase. On the other hand, Tiplady (2006) highlights the raising problem that with the increased number of Zara stores around the world, lead times cannot be kept so short. The two factors in a product manufacturing are: complexity and uncertainty. Depending on those two, products fall into four categories shown below (Bititci, 2010):

	High Complexity	Low Complexity
High Uncertainty	Fitness for purpose timeliness Example: <ul style="list-style-type: none"> ● aerospace ● shipbuilding Key competences: <ol style="list-style-type: none"> 1.Product design 2.Construction 	Timeliness / Flexibility Example: <ul style="list-style-type: none"> ● cosmetics ● textiles Key competences: <ol style="list-style-type: none"> 1.Time To Market 2.Supply flexibility 3.Product design
Low Uncertainty	Value for money Example: <ul style="list-style-type: none"> ● automotive ● white goods Key competences: <ol style="list-style-type: none"> 1.Product quality 2.Supply flexibility 3.Efficiency 	Price Example: <ul style="list-style-type: none"> ● simple components ● stationary Key competences: <ol style="list-style-type: none"> 1.Manufacturing 2.Logistic productivity

Zara is producing fashion outfits, this has low complex, but high uncertainty. Cai-feng (2009) argues that uncertainty is also a characteristic of competition among organizations and will increase due to a combination of factors in future supply chain environment.

However, Zara is minimizing its uncertainty by focusing on a limited range of and basic shapes, so that it deals with a rather narrow product range. In that case even if a product does not sell well, a small number has been shipped and it is going to be markdown and replaced with new one shortly. Bruce and Daly (2006) said that “fast fashion does not apply to the whole range in stores, and as much as 80 per cent of goods may be core and basic lines, with fast fashion accounting for up to 20 per cent”.

Zara does not do different, it also has its runners and repeaters. The Zara basic label is daily commodities with no shelf life, e.g. underwear, basic t-shirts, socks, etc. and are mainly produced in China, which presume cheaper production and longer lead times. On the other hand the high-end trendy Zara labels like Zara RTF, mainly consisting of up-to-date fashion outfits are produced in Portugal and Spain, meaning higher production cost and shorter lead times, but helping fast reaction on demand.

e) Product distribution

Cai-feng (2009) said that “marketing success was based upon strong brands and innovative technologies”. Nowadays, next to them we can place ASC, which is capable of responding faster to the changeable demand. This new addition changes the business to enhance competition on time by efficient supply chain (SC). There are various ways the business can influence the SC. Delivery time influences the company image. Lack of company’s product on the shelf, turns the customer to competitor's product and around 20% never come back. In other words, short delivery times can increase market share (Bititci, 2010).

Zara is considered to be the pioneer in fast fashion, with its twice a week supply to its stores with new fashion items. For comparison, the usual times are from six to nine months (Bruce and Daly, 2006) for far east clothing industry, 4 months for an international brand and only a week for Zara (Zhang, 2008). This way Zara can react immediately on demand changes and even if an item is not salable, there are a small number of them in a store. The new items in store keep people coming back every week and find new goods to buy. It helps to keep the stores “fresh” and minimize the risk of wrong forecasting (Dutta, 2002).

ASC is critical for the fashion business success. In order to manage supply chain correctly retailers should take into consideration all possible variables. Those can be: weather conditions, specific customer requirements, shelf life, raw materials supply lead times, sales forecasts, market specific requirements, etc. (Bititci, 2010).

Zara's success is due to many reasons, e.g. efficient supply chain, efficient organization management, and one of the most important customer orientation. When the movie Marie Antoinette was released October 2006 in the cinemas and become total hit in EU and US, Zara’s stores were populated with puffy ball gowns and jackets from velvet with golden buttons (Sull and Turconi, 2008). Another example of listening to its customers' voice was after 9/11 act in New York. For a week the colorful outfits were replaced with back and dark colored clothes in Zara's stores.

Another important aspect is that rapid turnover, eliminates working capital needs, consequently number of short term loans is decreased. In that sense, the efficiency of Zara originates from a small scale in operation, small batch of production and transportation, many times of distribution in small quantities. If order is big, inventory increases and the ability to comply with customer demand decreases (Zhang, 2008).

f) Sales and Feedback

Early and constant communication between customer and supplier can ensure a better SCM. Another rule is if the customer treats his suppliers well, informs them, being involved with their process is likely that fewer issues raise and usually is a guarantee for a longtime partnership.

These facts are well known by Zara and used in its daily operations. Zara's designers gather data on sales and inventory from each of its stores on a daily basis and use this to inform their view of the situation. This process is named Shared Situation Awareness by Sull and Turnocni. It consists of three steps: observe the raw data, making sense of raw data and testing hypotheses (Sull and Turconi, 2008).

The raw data comes from quantitative and qualitative approaches. Sales and replenishment reports are examined hourly by Zara's store managers. On the other hand store managers order items themselves instead of relying on what has being sent from the headquarters.

The accuracy of their forecasting affects their compensation, which makes them more responsible. Part of the qualitative data gathering is direct customer feedback given to shop assistants daily. Another one is after shop closes, the store manager and assistants turn to a recovery team and try to recall what happened during this day, as well as sort out tried, but unsold items in fitting rooms and try to find a pattern, which can be fed to the design team.

The gathered raw data is analyzed in Zara's headquarter, where design team, fast prototyping team, market specialists and buyers sit together in tightly coupled teams. The discussions are located in three halls with open layouts: one for man, woman and children clothes. Based on feedback new designs are made, prototyped and rated by the team. Depending on the outcome, there are towed away or send to the store to test if customers will buy them.

In order to test if an item matches with the overall collection, in terms of materials, colors, fabrics, etc.; Zara's headquarter has a facility called Fashion street. It is an underground floor resembling the high streets of Milan or London, where not only windows are up to date, but also interior, lights and even background music. This is all carefully designed by architects, visual merchandisers and designers.

g) Results

The results from the Zara's case study are presented in subsections listed below. Each section begins with academic theory and continues with how Zara has implemented it.

Consumer-driven process

Agile companies can be characterized as more customer-focused (Power et al, 2001). Typical for the agile organization is to know Who is the customer?; What is his need?; Does the goods satisfy customer's needs?; How satisfied he is? (Bititci, 2010). Agile companies were also found to be using technology to promote productivity, new product development and customer satisfaction.

In that sense, Zara can be considered a typical agile company. Its success is based on the close connection between customers and designers. Through internal interfaces, Zara is gathering its information, e.g. sales, staff, leftovers analysis, complaints, and like this is aware of all answers to the question listed above.

Agility – impact on the supply chain

Agility is introduced as a response to the dynamic and turbulent markets and customer demand (Prater et al, 2001). It directly affects the supply chain and it is one of the reasons, concepts like agile supply chain and fast fashion emerged. The need of decreasing lead times and being flexible in fast fashion introduced the involvement of suppliers in the process as being crucial to their ability in order to attain high levels of customer satisfaction (Power et al, 2001).

According to Prater et al (2001) the two concepts inherent in most of the 12 attributes specifying an agile firm are speed and flexibility. Although the speed and flexibility of the supply chain affect a firm's agility, the agile manufacturing is still an important part of it. However, in order to react to the rapid change in consumer demand, Zara has developed an efficient agile supply chain, with all designers, buyer experts and management in one place and production facilities close to them, assuring full flexibility and agility.

Retailer power

While fast fashion is heaven for its target consumers, it can be hell for traditional retailers (Sull and Turconi, 2008). Retailers nowadays prefer working with agile suppliers, so they don't have to carry stock and increase inventory. Like this retailers increase their competitiveness and strength their position on the market.

Zara owns its store chain and does not franchise, in order to avoid the standard problems. On the other hand, its agile supply chain gives all the benefits listed above. The stores are precisely organized and the items differ from one to another depending on the shop manager's prediction.

Suppliers under increased pressure

Consumer needs are changing at a much more frequent pace and this reflects on the whole supply chain by putting pressure on the suppliers. The contemporary fashion industry remains highly competitive, with additional pressure for fashion companies to compete for not only on price, but also their ability to deliver newness and “refresh” product (Barnes and Greenwood, 2006). While the most of the retailers are struggling with this new situation, Zara is proven to be the pioneer in fast fashion with twice a week supply to its stores, keeping them fresh and interesting for its customers.

On the other hand, producing small quantities with numerous different outfits prevail throughout the year. These both aspects help reducing markdowns and sales outlets to one of the lowest in the industry, compared to the old fashion retailers.

Elimination of stages in the supply chain

Clothes shopping has its picks traditionally during certain periods of the year matching events like trade fairs, fashion shows, fabric events, etc., organized around a two-season approach to product ranges, with planning for product ranges based on previous sales data, starting as long as one year in advance of the selling season (Barnes and Greenwood, 2006). The number of planned seasons has significantly increased in response to consumer demand for newness, resulting in as many as 20 “seasons” per year (Dutta, 2002), for example, in Zara’s case there are more than 40 000 items designed per year. Those are continuously supplied to its stores increasing the number of “seasons” radically and breaking the traditional two-season model.

h) Conclusion

Over the last decades, Zara introduced agile supply chain (ASC) in the fast fashion industry and positioned itself third in the world retailers ranking. This came as a result of close communication between customers and its designers and the ability to ship the desired items in a week catching the sales moment.

All these prove that ASC is an aspect enhancing competition among organizations. Another lesson is that efficient production organization with a good balance between in house and outsourcing task leads to minimum lead times and increase in market share for Zara. The supply chain is not on an isolated agile process of Zara, but indeed the whole organization is agile and working very efficiently.

By using quick response, Zara aims to reduce both excess stock holding in the supply chain and risk associated with forecasting as product specifications are not finalized until closer to delivery (Bruce and Daly, 2006).

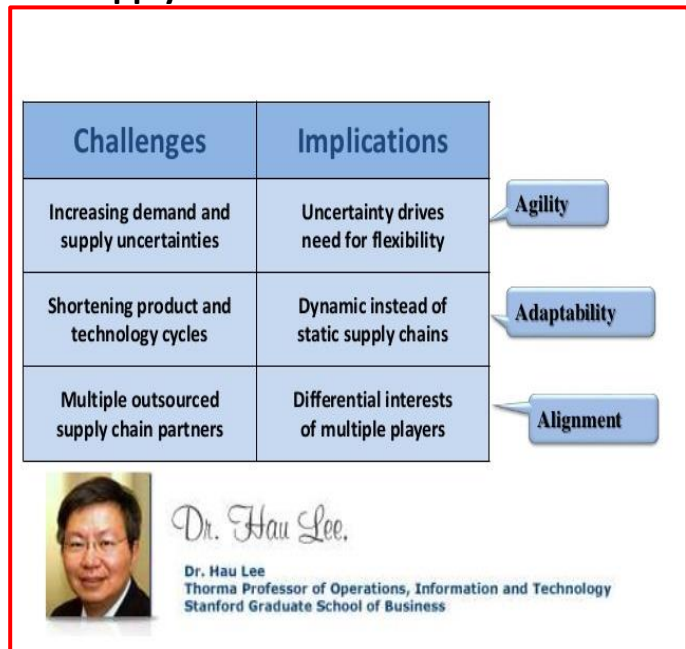
Ref: Galin Zhelyazkov, Design, Manufacture & Engineering Management; Strathclyde University Glasgow email: galin.zhelyazkov@strath.ac.uk

17. An Article on “Dr. Hau Lee’s Triple-A Supply Chain”

One of the best strategy concepts that I have encountered in recent years is Dr. Hau Lee of Stanford University’s Triple-A Supply Chain. Dr. Lee originally published his research findings in a Harvard Business Review article back in October 2004.

Even though the concept is old now, I consider it to be extremely relevant in today’s environment. Dr. Lee contends that many companies become overly focused on cost savings and efficiency in their supply chain planning. But efficiency is not the key to success in today’s turbulent markets.

More important than efficiency are the concepts of Agility, Adaptability and Alignment (**Triple-A**).



Agility – refers to a supply chain’s ability to respond to sudden changes in demand or supply. Furthermore, it refers to minimizing disruption from unforeseen events such as natural disasters, terrorism, wars, epidemics and computer viruses. Dr. Lee recommends using techniques such as **late-stage postponement, buffer inventories and sharing of demand signals** to enable higher levels of agility.

Adaptability – refers to the ability to identify and plan for major structural changes in markets. Political, regulatory, economic, social and technological forces can dramatically transform markets in relatively short time periods. Dr. Lee recommends on-going country-level economic analysis; flexible product design models and needs analysis for ultimate consumers (rather than just immediate customers).

Alignment – refers to aligning the interests of all parties in the supply chain from suppliers and OEMs to distributors and retailers. Dr. Lee recommends that all parties have equal access to demand planning data and that economic incentives align to maximize overall supply chain performance. Instead of company-to-company competition we have now entered an era of supply-chain to supply-chain competition.

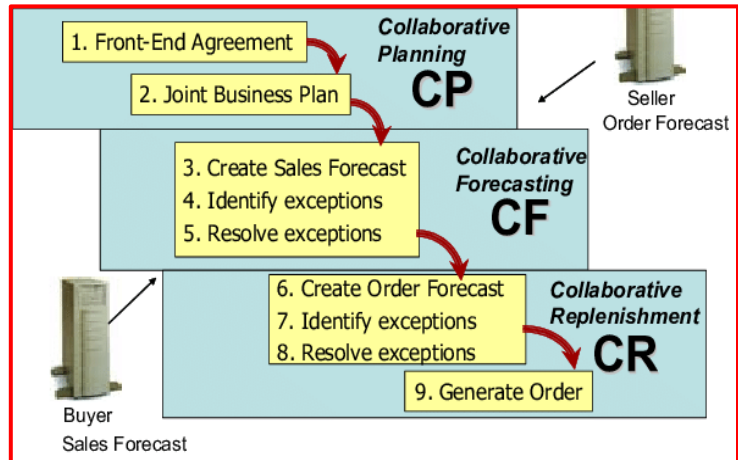
Ref: <https://blogs.opentext.com/dr-hau-lees-triple-a-supply-chain/> OpenText is the leader in Enterprise Information Management (EIM).

18. Collaborative Planning, Forecasting and Replenishment (CPFR) Can Enhance Your Capacity to Implement Resilient Supply Chain

Collaborative Planning, Forecasting and Replenishment or CPFR is a process in which your company not only collaborates and integrates planning, forecasting and other data points from within your own company—but also uses data points provided by your suppliers and your customers.

The stakeholders in CPFR are therefore:

- Suppliers
- Your Company
- Your Customers



For CPFR to work effectively, each of those stakeholders are required to buy into the concept of CPFR. Having that kind of stakeholder buy in is the only way CPFR can enhance your supply chain.

Stakeholder Buy In

Okay, yes, you get every one of the key players in your supply chain in a conference room or on a conference call or logged in to a Webex. And each one of those stakeholders—your suppliers' reps, you and your internal team and your customers' reps—agrees:

"Yes, indeed, we want to enhance this supply chain."

Your customer knows that means that they'll get on-time deliveries, quality products, fewer headaches and maybe even a cost down or two.

Your supplier knows that means less expediting, more transparency into customer demand, reduced costs and maybe even the opportunity to make an extra buck or two.

And you and your company realized—being at the center of that supply chain—that means all of those benefits:

- On Time Deliveries
- Improved Quality
- Less Expediting
- Lower Costs
- Improved Transparency

But other than nodding their collective heads—what does actual stakeholder buy in mean?

Stakeholder buy in—i.e. a commitment not only agreeing to CPFR, but to executing it—means resources will be made ready and prepared for:

- Analysis
- Strategy and Planning
- Demand and Supply Management
- Execution

Continuous Activity

CPFR isn't a one-time activity. You're not going to go through the bullets points above and when you get through with "execution", sit back and relax.

The CPFR activity is as continuous as it is collaborative.

Upon completion of "execution"—it's time to begin "analysis."

Based on the results of your analysis, you can set or reset your "strategy and planning."

Your "demand and supply management" will depend upon the strategy that you've just set (or reset).

Then it's back to "execution."

And so on.

Sounds good, you say. But it also sounds very theoretical. How can CPFR actually enhance your supply chain?

Collaboration

In order to collaborate with your suppliers and customers, you're going to need to share information. Your customers are going to have to provide forecasts. Your suppliers are going to need to share production schedules.

You'll also need to align on metrics. How do each of you measure on time delivery? Is it on time if you put on you loading dock on the ship date, but it arrives late at your customer? Is it late if you placed an order with your supplier for a shipment on December 1 but then you contact the supplier a week later and ask for it shipped on November 15?

If your customer expects you to deliver all of their orders on time (i.e. 100 percent on time delivery) and your goal is 97 percent on time delivery—you and your customer are not aligned.

Forecasts and on time delivery are just examples of collaboration on data exchange. You, your suppliers and customers are also going to have to agree on some measure of information sharing on costs, quality and production lead times.

This can sometimes be sensitive. Along with that stakeholder buy in, there needs to be an upfront agreement on what collaboration entails.

Process Driven

CPFR doesn't work if it's only done "as needed." Effective CPFR will only succeed in enhancing your supply chain if it's systematically implemented.

An optimized supply chain is one that helps you deliver your customer orders accurately and when your customers want them—and accomplish that by spending as little money as possible.

By collaborating with your suppliers and customers—especially in planning, forecasting and replenishment—you use CPFR to drive:

- Replenishment accuracy
- Stock out reductions
- Overstock reductions
- Alignment of production planning to meet customer needs

If enhancing your supply chain through process driven collaboration sounds appealing to you, then work to get the right stakeholder buy in and implement CPFR.

Ref: GARY MARION, Updated February 23, 2018 <https://www.thebalancesmb.com/how-cpfr-can-enhance-your-supply-chain-4158975>

19. Sales and Operations Planning(S&OP)

Definition:

A formal process, consisting of series of meetings, where data from various areas of business is discussed and decisions are made.

The goal is agreement between various departments on the best course of action to achieve the optimal balance between supply and demand and to meet profitability goals.

Normal Time Frame for S&OP:

Takes a monthly look at product groups at least 6- 12 months across the planning horizon.

Some companies go out as far as 18 months.

Main features:

- S&OP process begins with the creation of a demand plan for the target time period (three to twelve month horizon).
- Goal of the demand plan is to create a consensus among sales, marketing, product management, field service etc. on what will be sold and what revenue will be produced.
- Next a corresponding supply plan is created for the time period, which contains rough cut capacity plan, procurement plan etc.
- These plans are then fed into a pre-S&OP process, where solutions to address this imbalance are formulated.
- The S&OP meeting then discusses the issues and recommended solutions, reviews alternatives and makes decisions.
- The S&OP meeting is attended by senior leadership from sales, marketing, operations, finance and other operational areas.

a) Sales

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Forecast	100	100	100	120	120	120	120	130
Actual sales	90	95	85					
Difference	-10	-5	-15					
Cum. difference		-15	-30					

b) Production

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Planned production	100	100	100	110	120	120	120	130
Actual production	98	100	101					
Difference	-2	0	1					
Cum. difference		-2	-1					

c) Inventory

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Planned inventory	100	100	100	142	142	142	142	142
Actual inventory	111*	116	132					
Difference	11	16	32					

d) Comparing actual to forecast

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Forecast	100	100	100	120	120	120	120	130
Actual sales	90	95	85					
Difference	-10	-5	-15					
Cum. difference		-15	-30					

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Planned production	100	100	100	110	120	120	120	130
Actual production	98	100	101					
Difference	-2	0	1					
Cum. difference		-2	-1					

	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Planned inventory	100	100	100	142	142	142	142	142
Actual inventory	111*	116	132					
Difference	11	16	32					

*January Inventory=103

Ref: Wallace: 2nd edition Sales & Operations Planning

20. Supply Chain's Hidden Costs: An Escalating Threat Towards Resilience Supply Chain

If your purchasing team is buying from your suppliers and your logistics team is keeping track of it all and your customers are getting their orders – why is it important that you manage supply chain strategically?

Time and Money

Every link in your supply chain costs money and takes time. And if you can improve the time it takes to move your products to your customers – and you can reduce the amount of money that process costs –

But where to begin? Let's start with: How much is your supply chain costing you right now? Figuring that out can be your Boston Tea Party, your call to arms.

Start by looking as far up the supply chain that you have control over.

- Are you buying products from suppliers?
- Do you dictate who your suppliers buy their raw materials and components from (your Tier II suppliers)?

For the sake of this argument, let's say you don't have control over your Tier II suppliers. So your supply chain cost begins with your supplier purchase price.

In this case study, you purchase a product from your supplier for \$1. But that's not your total product cost.

\$1 is your starting point.

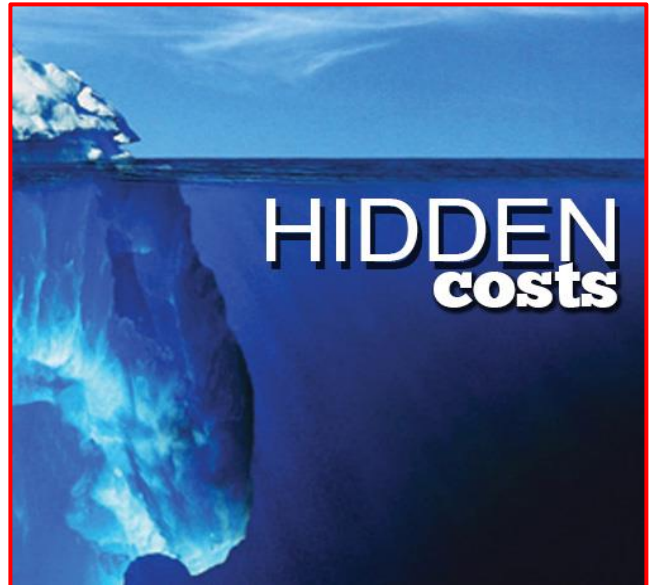
Next: Where is your supplier in relation to you? Even if your supplier is next door, there's a cost to moving that \$1 product into your warehouse. But chances are – your suppliers aren't next door.

Chances are they are in another country – and maybe in another hemisphere.

So that the cost to move your \$1 product can be significant. And that significant moving cost includes:

- Moving your product out of your supplier's factory (on a truck?)
- To the ocean port or airport (where it sits in a freight forwarder's warehouse?)
- Onto a plane or a ship and then across the planet (holy fuel surcharges!) into your country (duties, tariffs, etc.)
- And then to you (more trucks and handling).

Those freight and handling charges are also part of your product cost.



Cost of Goods or Logistics Expense?

Some finance departments like to include those transportation costs in the actual product cost of goods (i.e., they count against product margin) and some finance departments account for them separately, where they are expensed to a non-product general ledger account.

Either way, it costs your company money and time to move that product.

Your \$1 product, by the time it reaches your warehouse may now have cost you anywhere from \$1.10 to \$1.50 – just by adding in freight and logistics charges. Let's call it \$1.25.

Your product, now at \$1.25, is in your warehouse.

- Did you inspect it?
- How long does it sit there before you move it?

Every day it sits there costs you money (inventory carrying costs include warehouse rent/overhead/insurance). It's either a product that goes into production to make another part or you resell it to your customer. So either a plant work/job order or a customer purchase order will get it moving.

And Even More Supply Chain Costs

Processing job orders and purchase orders also cost money – estimates range from \$50-\$250 each. So there's probably another ten cents to fifty cents tied up in your \$1 part (inventory carrying costs, admin costs, etc.).

So that \$1 part probably really costs you anywhere to \$1.30 to the north of \$2 by the time you ship it out the door.

And that doesn't include the cost of returns. 5%-10% of returns are not out of the ordinary. Are you including those costs, too?

What a Can Supply Chain Do About This?

With thorough analysis your supply chain team realize that your \$1 product costs you a lot more than \$1. Working with suppliers, freight/logistics providers, and inventory teams, a supply chain pro sees the entire process and works to cut costs along the way.

Purchase price reductions can be worked by negotiating with suppliers, aggregating demand and working with quality teams to reduce the total cost of ownership.

Freight and logistics costs can also be negotiated and sent out for a quote.

Inventories need to be controlled and optimized (either by cycle counting or physical inventories or both).

Supply chain pros will even work with your customers to level load orders and optimize demand planning.

Where would the Continental Army have been without General Washington and where would your supply chain be without the right seasoned pro at its helm?

One final area your supply chain pro can work on – your cash flow.

Cash Flow

What payment terms do you have with your suppliers? And what payment terms do your customers have with you?

If you can negotiate the net 90 payment terms with your suppliers. Then get your customers to pay you on a credit card (who doesn't want all those frequent flier miles?) – you might actually start making money on your money.

For example, if your net 90 supplier invoices you on January 1. And then you sell the supplier's product on January 15 and your customer pays you on a credit card—you now have 75 days for that customer payment to sit in the bank and collect interest.

Those cash-to-cash metrics is also an area a supply chain can impact your bottom line.

An optimized supply chain is getting your customers what they want when they want it—and paying as little money accomplishing that as possible. Hidden costs can be lurking in throughout your supply chain but a strategic supply chain team can bring your separate colonies together and form a more perfect union (supply chain optimization and financial success).

Ref: BY GARY MARION, Updated January 21, 2020, <https://www.thebalancesmb.com/where-are-your-supply-chain-s-hidden-costs-2221232>

21. The role of IT (Information Technology) in SCM Operation Including Demand Management

Information plays a vital role in forecasting demand. Prior to 1980s the information flow between functional areas within an organization and between supply chain member partners were paper-based. The paper-based transaction and communication is slow. During this period, information was often overlooked as a critical competitive resource because its value to supply chain members was not clearly understood.

Supply chain management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers (Harland, 1996). The term was coined by Keith Oliver, a British Logistician and consultant in 1982. Thus, the use of information technology (IT) is considered a prerequisite for the effective control of today's complex supply chains.

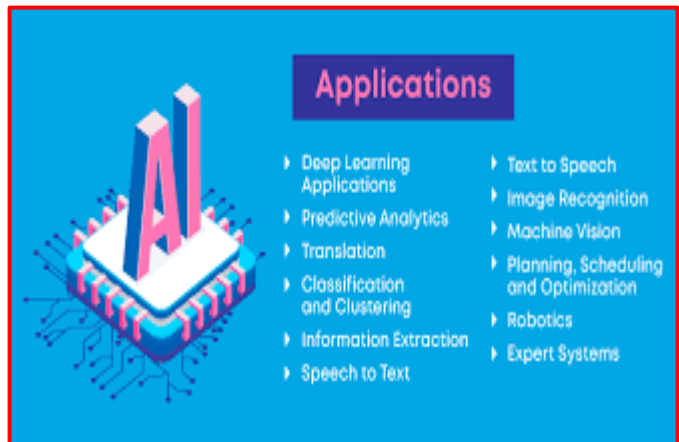
Several elements go into predicting the Present and Future of Supply Chain. But one vital unifying concept in Supply Chain is the certainty and reliability of data, which is very important in respect of overall demand management. New Supply Chain Technologies look to massively improved business connectivity, visibility, and certainty of supply chain data, in addition to the speed of information flow.

The following Supply Chain Technologies have been identified for the benefits of our learners.

1. Artificial Intelligence (AI)

Unlocking workers' potential can greatly be helped by the use of advanced computing with Artificial Intelligence to perform human-like tasks including training. Integration of Artificial Intelligence into supply chain technologies, like Voice recognition for wearable devices, would help overcome several regulatory obstacles. Also, with Artificial Intelligence the future of supply chain will be driven by continuous collaboration and seamless information flow.

Artificial Intelligence will surely do wonders in the procurement domain.



2. Automated Material Handling Systems

Automated Material Handling Systems is the control, protection, movement, and storage of products and materials through consumption, distribution, disposal, manufacturing, and warehousing. The process of Automated Material Handling Systems integrates different automated, manual, semi-automated equipment, and systems to support the supply chain process. Automated Material Handling Systems and processes are the future of improving customer service, lesser delivery time, and reducing inventory. It also reduces overall handling costs in distribution, manufacturing, and transportation.

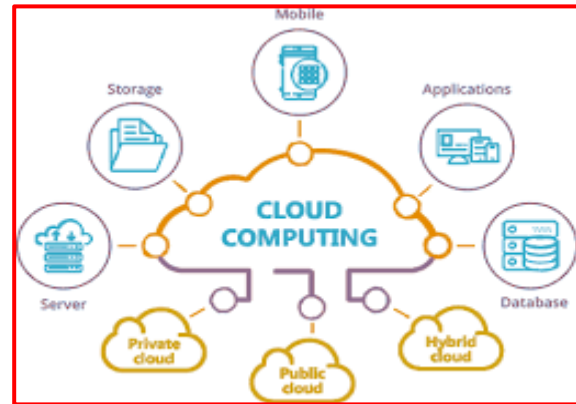
3. Bar-coding/ Automatic Identification

Automated Identification applications in the future can offer corporate data systems alongside the identification of different physical item within the supply chain in an automated manner. The real-time accessibility of products identity allows other related data to be grouped for easy access in both current and future state of the product. In supply chain operations, the extensive introduction of such systems in the future signifies a major break to improve and repair inventory management, process control, and tracing/tracking systems. These supply chain technologies may enable a total re-engineering of the supply chain, by eliminating some constraints/limits experienced today. Using simpler classification for operations, products are identified, and prospects for different sections are emphasized.



4. Cloud Computing

Cloud computing is positively impacting supply chain companies in rethinking their IT strategy. The use of Cloud computing serves as tool driving supply chain processes with reduced upgrade impact, and enabling innovative software adoption more quickly. With Cloud computing, Total Cost of Ownership (TCO) and Timing would also experience improvements. Cloud computing in the future seeks to enable easy integration and connectivity in addition to path migration for extra functionality, without having to take the “rip and replace” approach.



5. Computer Aided Design (CAD)

The idea of CAD is to plan the operation process of every manufacturing element which may comprise of parts manufacturing and components assembly. Future CAD ideas include making measurements, packaging and dispatch of finished products more efficient than ever. The whole CAD process includes a database (DB) and expert systems (ES) which permit all functional areas of computer-aided production in cooperation with an expert knowledge base (KB) operating together.



6. Computer Aided Engineering (CAE)

CAE takes care of the process involved in using computer workstation to generate and test engineering specifications. Future use of CAE involves utilizing data from manufacturing processes and material supply to make better engineering work and manufacturing task including assembly planning. With CAE, all data connected with manufacturing and executing orders are applied during the design of products crucial for assembly and manufacturing.

7. Computer Aided Process Planning (CAPP)

CAPP provides a connection between design and manufacturing in computer-integrated manufacturing (CIM) environ. CAPP finds usage in developing product manufacturing plan built on projected variables like cost, equipment availability, lead times, potential material substitution routings, production volumes, and testing requirements. The complexity of CAPP systems increases with the system size, so it is possible to assimilate knowledge sources from a large array of planned activities.

8. Computer Graphics

There is an extensive use of computer graphics in supply chain and current developments with supply chain technologies indicates it still has enormous potential. Future use of computer graphics in a supply chain includes usage as a support tool for a decision system, expert systems, group decision making, and task scheduling. The advancement and utilization in Computer Graphics production are proceeding at a relentless pace with relevant research always available.

9. Computer Network

The logistics of Supply chain involves various economic activity. The link between logistics and industrial operations in the supply chain provides a thought. Requirements for logistics supply, research development, and transport industry combine to create an intelligent network. The reasonable system in the future seeks to implement a modern computer network capable of meeting customer and organizational supply chain needs. These supply chain technologies would provide intelligent route optimization which can effectively save time in logistics handling and supply chain scheduling.

10. Databases

Big database as a term, is regularly overused, but with less than 30% estimated usage of data collected, applying analytics and data science would see a new emerging future for database relating to supply chain technologies. These untapped resources are sure to unearth patterns that would advance predictability and actionable intelligence. As more database are incorporated and leveraged into the supply chain, the better predictability accuracy will be.

11. Embedded Systems

Embedded systems make use of ICT and management strategies to provide integrated and intelligent systems in Supply Chain and Logistics. With Applications based on different processes, these supply chain technologies aim to improve entities to become flexible, independent, and fast in real-time thus creating value through reactions in intelligent ways. Embedded systems are set to develop a responsive system for solving various supply chain problems. Some benefits already attached to the use of Embedded systems include procurement and network arrangement, facilitation of links amongst buyers and suppliers, reduced transaction and cycle times, and reduced costs.



12. Environmental Control Systems

Environmental Control Systems are key to making workable supply chain strategy. These supply chain technologies cover management of all ecological impacts from your supply chain through the products life-cycles and services. Environmental Control Systems show great importance in the future of checking environmental enhancements within the supply chain and also make available several business prospects.

13. Flexible Manufacturing Systems (FMS)

FMS is a process for creating products that are adjustable to changes in the manufacturing process, both in type and quantity. Computerized and Machines systems are organized to making various parts and handling various production levels. FMS gives businesses with a benefit to rapidly alter manufacturing environ and increase process efficiency. The rate of implementation of FMS is rapidly increasing. Better flexibility audit and the conditions are suggested for future use.

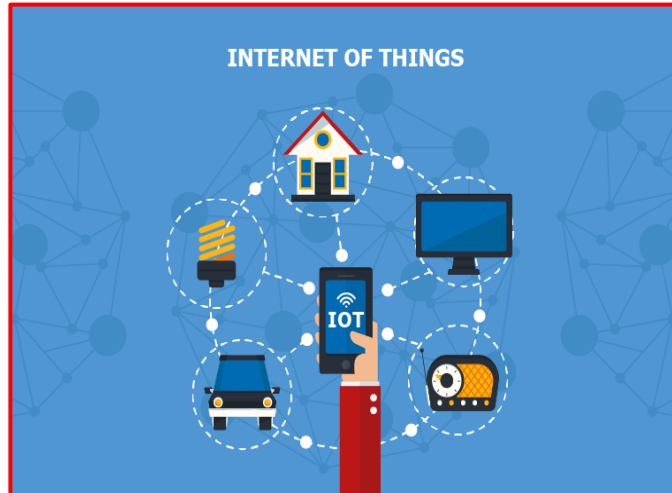
14. Internet-Of-Things (IoT)

Can Internet of Things be a force for faster growth in an increasingly digital global economy? Most people who know about this will emphatically say “Yes”. Why such optimism? The IoT can boost productivity, drive the emergence of new markets, and encourage innovation.

What is the Industrial Internet of Things? The Internet of Things is the industrial application of a network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.

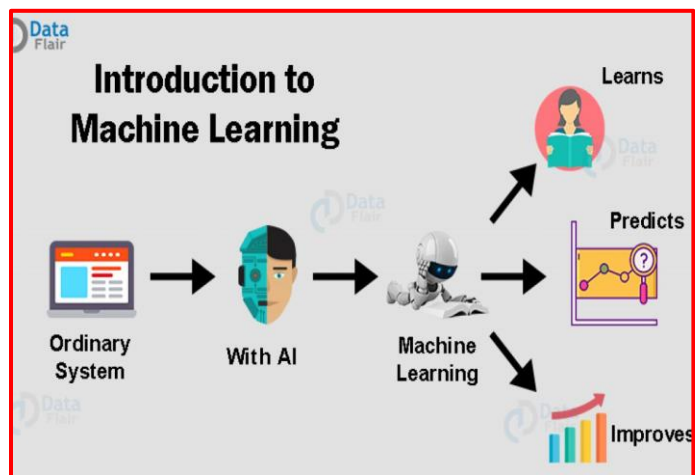
In manufacturing, connected sensor networks already monitor logistics movements and machines such as mining equipment and entire utility plants, helping organizations reduce costs through more efficient operations.

The Internet of Things is driven by an expansion of the Internet through the inclusion of physical objects combined with an ability to provide smarter services to the environment as more data becomes available. Various application domains ranging from Green-IT and energy efficiency to logistics are already starting to benefit from the Internet of Things concept. There are challenges associated with the Internet of Things, most explicitly in areas of trust and security, standardization and governance required to ensure a fair and trustworthy open Internet of Things which provides value to all of society.



15. Machine Learning

Machine learning offers computers the learning capability without being overtly programmed. Using Machine learning in the supply chain, we can computer programs teach themselves to evolve and quickly change when exposed to new sets of instructions. The evolution of using these supply chain technologies makes learning in supply chain planning inevitable. In effect, there are early examples such potential in improving both supply chain planning efficiencies and offering better optimization in supply chain decisions.



16. Material Requirements Planning (MRP)

MRP has been the most widely implemented large-scale production management system since the early 1970s, with most of the ERP system have integrated MRP logic within for Material Planning in some shape or form.

MRP is product orient, future-oriented, it involves time-phased requirement and involves priority planning in that it establishes what needs to done to meet the master schedule. MRP offers control and planning system for production, scheduling, and inventory. These supply chain technologies convert production master schedule into a detailed form. The MRP uses forecasting or actual orders to decide client demand for goods with a system of push type inventory control. Such a forecast or customer orders can tell the number of products and types bought, along with the size of the raw materials needed in making them.

17. Manufacturing Resource Planning (MRP II)

MRP II represents an extension of the features of the MRP system to support many other manufacturing functions beyond materials planning, inventory control, and BOM (Bill of Material) control. MRP II is an integrated approach to financial and operational planning for industrial businesses, which makes it close loop system. In this way, MRO was extended to support Master Planning, Rough Cut Capacity Planning (RCCP), Capacity Requirement Planning (CRP), Production Activity and Control (PAC). However, in my knowledge additional features of MRP II software mostly remain unused in practice.

18. Real-Time Process Control Systems

Control and planning of supply chain involve balancing resources and supply with market demand in a supply chain context. Real-Time Process Control Systems increases focus on supply chain optimization and significantly increased the task reputation. Competitiveness nowadays is attained by demand-driven supply chain systems, which necessitate the visibility of data and visualization. The main features of future planning and control are predictable to be made automated and intelligent control using Real-Time Process Control Systems.

19. Robotics

Every machinery process looks to Robotics for automation. Supply chain technologies applying Robotics would, in the future, become self-operating machines. The various possibilities with Robotics are still highlighted in today's world to boost efficiency. Soon Robotics would enable machines to become more suitable for automation. Particularly I think Robotics is underutilized in warehousing and we should use more of this in picking, packing and packaging.



20. Sensor Networks

Sensors Networks can eliminate manual steps from supply chain process at each stage of a production process. Such Supply chain technologies, like the addition of SKU (Stock Keeping Unit)-level visibility, has drastically reduced shortages and would provide further benefits in time to come. With the right infrastructure in place, Sensors Networks with high memory capacity and processing speeds would store and make use of data for smarter processing.

21. Wireless Communication

Supply chain technologies have been vital to enhancing product distribution for a while now. With the recent increase in Wireless Communication, automation is booming. The use of Wireless Communication would provide a smart supply chain management system for cataloging and monitoring goods in the future. Records about products would also be automatically recorded which would reduce errors in catalogs. Wireless Communication is set to become beneficial in the supply chain with a practical application of systems, like GPS and RFID, in product monitoring and safety of goods.

22. 3D Printing

3D Printing has been around for 3 decades and generally using additive manufacturing, however, commercialization at mass level still has to take off. It involves fabrication of products through the use of printers which either place layer upon layer of materials or employ lasers to burn material, resulting in a finished design.

Today 3D Printing is used within several industries such as used for making medical implants, jewelry, customized football boots, lampshades, racing-car parts, solid state batteries and customized mobile phones

23. Big Data

Although “Big Data” has become a contemporary buzzword, it has significant implications supply chain, and presents an opportunity and a challenge to most industries. What makes Big Data unique is its:

Velocity: in real time

Variety: the data varies in time and in context, and is not a fixed data model to real time

Volume: the volumes are significant and require unique approaches

Volume can occur in many ways. There is more data because, among other reasons, the data is captured in more detail via current ERP & other software packages. For instance, instead of just recording that a unit sold at a particular location, the time it was sold and the amount of inventory at the time of the sale is also captured. Moreover, long global supply chains necessitate data capture at multiple points in the supply chain. In addition, there is now a proliferation of consumer sentiment data resulting from Tweets, Likes, and product reviews on websites. Such data must be analyzed and quantified.

The rise of the Big Data is a hot supply chain trend as revealed by Google Trends. In fact the rate of interest in this term I would classify as “breakout”.

24. Blockchain

As we know in any supply chain transaction from manufacturer to buyer there are multiple copies of transactions, logistics documents, purchase orders, transportation invoices, inventory receipts, transfers and so on, which is must and create errors in the process. Blockchain in nutshell helps all of the players in an industry to store and share among parties in one place.



As described by Accenture “The purchase order, the inventory receipt and more could go into a ‘master ledger’ that everyone could write to, but then only

permitted members can read. The ledger must be tamperproof. Parties must not be able to change a transaction or falsify transactions after they have been written. Only parties writing valid transactions to the ledger can be allowed to update it, and the system should be able to verify that the partners are who they say they are. Only parties that are allowed to read a record should be able to—the transactions must be protected with security such as dual-key public encryption. This ledger system with such attributes is, of course, what is known as blockchain”.

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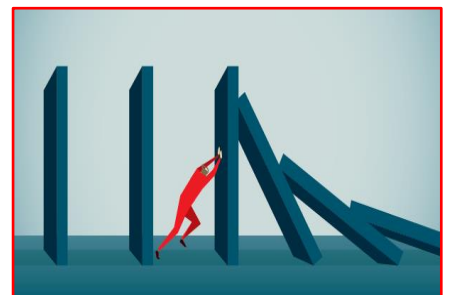


Training on Supply Chain Resilience

Module 3: Purchasing and Supply (P&S) Management

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Preface

Purchasing & Supply (P&S) is the act of buying the goods and services that a company needs to operate and/or manufacture products. A supply chain is the collection of steps that a company takes to transform raw components into the final product.

Traditionally it was thought that competitive advantage was the result of marketing and advertisement expenses and resultant procurement was not given due importance. Even in the recent past, procurement was regarded as being services to production and other functions of the company and thus it was given limited attention to issues concerned in the procurement.

But in today's competitive business world, these traditional approaches can no longer guarantee competitive advantage in all cases. Companies, therefore, have to find other means of succeeding. This is nothing but succeeding through effective utilization of purchasing and supply processes. Now managers have realized that purchasing should be considered as a key strategic business process rather than a narrow specialized supporting function to overall business strategy.

Typically, a company normally spends about 60-70% of its revenue through procurement, and if this spending is managed efficiently and effectively, the company can enhance its competitive advantage significantly. Any savings in procurement directly contribute to the company's bottom line i.e. profit of the company. To achieve the same amount of profit through marketing and sale, the company's sale may have to be increased proportionately. In most cases, this may become a difficult task for many companies.

Savings thorough procurement can be achieved by ensuring continuity of supply at the best possible TCO (Total Cost of Ownership), reducing overall lead-times, maintaining quality and durability of supply of inputs, promoting innovation in supply, improving supplier's reliability and services, maintaining optimum inventory and applying many other ways related to supply and procurement.

In a supply chain company context, resilience is defined as the ability of a supply chain entity to react to risk and return to its original state or a more desirable one. With effective application of P&S process and techniques, supply chain resilience will be more value-added and contribute to the overall objective of the organization.

Learning Objective

By the end of this training module, you will be able to:

- Know Purchasing/Procurement-Basic Concepts
- Explain types of Purchase Items on the basis of Supply Strategy
- Describe Purchasing and Supply (P& S) Process focusing Supply Chain Resilience(SCR)
- Explain how Internal Standardization reduces time and effort to develop purchase specification and help to make Supply Chain More Resilient
- Describe VE (Value Engineering)-a structural problem solving technique in the field of P&S
- Know how to specify requirement in terms of Quantity, Delivery Requirements, Supplier' Service & Responsiveness and Other Information
- Analyze the Supply Market as P&S process
- Know about supply risks caused by natural disasters
- Know how to obtain and select offers as P&S process
- Describe basis of pricing including price revision formula
- Explain about commodity price risk
- Describe tendering process, negotiation techniques and types of contract as part of P&S process
- Know about risks in international trade & how to manage them
- Describe horizontal and vertical integration that helps build SCR
- Know how to achieve cost saving through procurement: A way to SCR
- Explain vendor valuation with examples focusing SCR
- Understand green/environmental procurement towards developing Resilient Supply Chain

1. Purchasing/Procurement-Basic Concepts

In Europe: Purchasing is the strategic part of buying a goods or a service. Procurement is considered as the fulfillment of orders to secure daily's operations. Procurement normally depends on Purchasing.

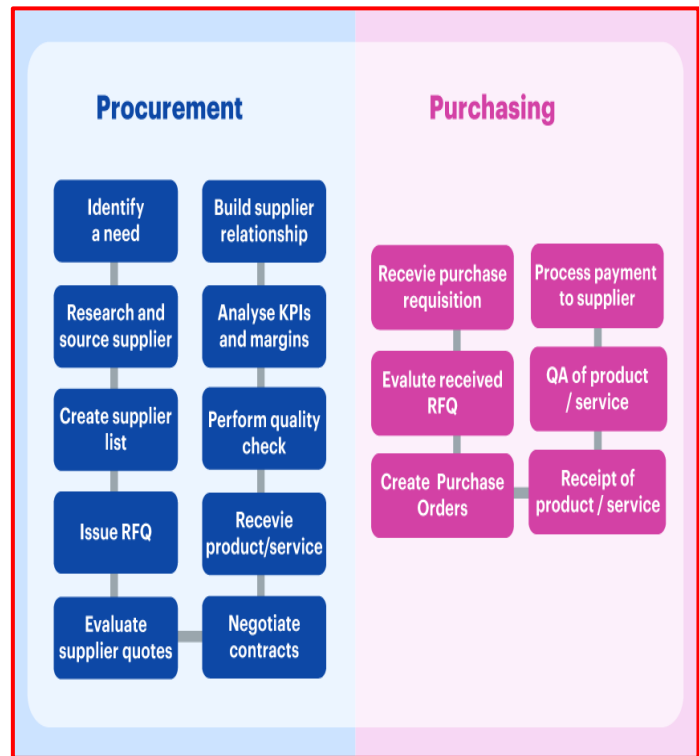
In USA: It is the other way around. Procurement is the strategic part of buying goods or a service. Purchasing is considered as transactional part of the process. Purchasing normally depends on procurement.

Purchasing: implies the monetary transaction. Thus in general purchasing describes:

- The process of buying
- Knowing the need
- Supplier selection
- Price negotiation
- Follow up ensuring timely supply

Procurement: covers a boarder array of process. These are:

- Purchasing
- Store
- Traffic
- Receiving
- Inspection
- Storage



In fact, procurement is the process starting from material requisition to material acquisition. The same concept is also called as supply management in the SCM (Supply Chain Management) context.

Four fundamental goals of Purchasing

1. Maximize Customer Satisfaction
2. Maximize Supply Opportunities
3. Minimize Supply Risk
4. Minimize Supply Cost

Ref: <https://kissflow.com/procurement/procurement-vs-purchasing>

1.1 Make or Buy (Outsourcing) Decision

- While the term outsourcing popularly refers to buying material and components from suppliers instead of making them in house, it also refers to buying materials or components that were previously made in house.
- Whether to make or buy materials or components is a strategic decision that can impact an organization's competitive position. Traditionally, cost has been driver when making sourcing decision. However, organizations today focus more on the strategic impact of the sourcing decision on the firm's competitive advantage.



- For example, Honda would not outsource the making of its engines because it considers engine to be vital part of its automobile's performance and reputation.
- Honda may outsource the production of brake drums to high quality, low cost supplier that specializes in brake drums.
- Generally organizations outsource non-core activities while focusing on core activities

Make or Buy (Outsourcing): Reasons

Reasons for Buying or Outsourcing	Reasons for making
<ul style="list-style-type: none"> • Cost advantage • Insufficient capacity • Lack of expertise • Quality 	<ul style="list-style-type: none"> • Protect proprietary technology • No competent supplier • Better quality control • Use existing idle capacity • Control lead-time, transportation and warehousing cost • Lower cost

1.2 The Make or Buy: Break-Even Analysis

Consider a hypothetical situation in which a company has the option to make or buy a component part. Its annual requirement is 15000 units. A supplier is able to supply the part at \$ 7 per unit. The firm estimates that it costs \$ 500 to prepare the contract with the supplier. To make the part, the firm must invest \$ 25,000 in equipment and the firm estimates that it costs \$ 5 per unit to make the part

<u>Costs</u>	<u>Make Option</u>	<u>Buy Option</u>
Fixed cost	\$ 25,000	\$ 500
Variable cost/unit	\$ 5	\$ 7

Annual requirement = 15,000 units

Total cost to buy = **Total cost to make**

$$\$ 500 + \$ 7Q = \$25,000 + \$ 5Q$$

$$7Q - 5Q = \$25,000 - \$500$$

$$2Q = \$ 24,500$$

$$Q \text{ (i.e. Break-even quantity)} = 12,250 \text{ units}$$

Total cost at break-even point, TC-BE = 25,000+\$5 X 12, 250 = \$ 86,250

Total cost for make option, TC-M = 25,000+\$5 X 15, 000 = \$100,000

Total cost for buy option, TC-B = 500+\$7 X 15,000 = \$ 105,500

The analysis shows that the breakeven point is 12,250 units. Total cost at the break-even point is \$ 86,250. If the requirement is less than 12,250, it is cheaper to buy.

It is cheaper to make if the firm needs more than 12,250 units.

1.3 Types of Purchasing Items

a) The organization can categorize its purchases items according to the following headings:

1. Raw Materials
2. Purchased parts or spare parts
3. Maintenance, Repair and Operation (MRO)
4. Packaging
5. Services-consulting services, utilities workers health care benefits.
6. Tools
7. Resale items
8. Equipment

b) Purchase goods or services can be classified on the basis of:

1. Requirements- which are commonly, energy, capital, raw materials etc.
2. Purchase frequency- nuts and bolts are purchased more frequently than capital machinery so rules apply to each that differs from one another.
3. Stocked items- these are items deemed necessary to have readily available either through need or aggravation of placing rush orders for low cost items

4. Physical make-up- what the product is made of or shape of the item. This may influence how we buy or how much
5. Transport type- how it comes to us may affect what quantity we order. Dedicated trucks that deliver daily will reduce the amount we order
6. Product use- internal or external use

c) Types of Purchase Item/Material categorization: SKU- Stock Keeping Unit

An individual color, flavor, size, or pack of a product that requires a separate identification number to distinguish it from other items (a measure of an item of merchandise for inventory management).

In inventory control and identification systems, it represents the smallest unit for which sales and stock records are maintained.

C.1 Importance of SKUs

Stock keeping units are highly important and commonly used in retail stores, warehouses, and product fulfillment centers. Professionals who are associated with Purchasing & Supply, Logistics, Material Management, etc. must be conversant with the importance of SKU.

The following table describes importance of maintaining SKU categorization.

Title	Particulars
Track Inventory	<p>Products that are received at a business need to be properly tracked to know how many are available.</p> <p>If the products in a warehouse or storage room have SKUs, then stock availability of each variety is easy to determine.</p>
Easier Stocktaking	<p>Stock-takes are done of a company’s inventory to ensure the stock levels of the warehouse match the stock levels of the inventory management system.</p> <p>Every product variation should have its own unique SKU. This makes for very straight forward reconciling of the stock levels.</p>
Identify shrinkage/theft	<p>One crucial aspect for any business is tracking and identifying shrinkage. This is the number of items a business cannot sell or end up missing.</p> <p>Damaged or missing items can occur anywhere along the supply chain and in a lot of cases it’s due to theft. Correct inventory management makes creates transparency and minimizes opportunity for theft.</p>
Replenish Inventory	<p>Manually managing large quantities of inventory can be difficult for a small business owner.</p> <p>Adding a SKU to every product variation means the quantity of on-hand products is easily known.</p>

	A threshold limit for items can be set that indicates when replenishment is necessary. Managing inventory with SKUs means that the level of inventory will not get out of hand.
Identify Profits	By tracking product variants with SKUs you can report, not just on the main product line, but right down to the individual variation of the product i.e. color, size, packing material. These reports help determine what variations you should invest more in and what variations you might want to discontinue.

Three pictures as given below give you an idea of how SKU categorization is maintained.



SKU - STOCK KEEPING UNIT

The diagram illustrates the components of the SKU **BLU-TEE-MED-CF26**. It features a central image of a blue t-shirt. Surrounding the t-shirt are logos for various e-commerce platforms: **Woo**, **shopify**, **ebay**, and **amazon**. Below the t-shirt, the SKU **BLU-TEE-MED-CF26** is broken down into four parts, each with an upward-pointing arrow indicating its position in the code:

- BLU**: COLOUR
- TEE**: TYPE
- MED**: SIZE
- CF26**: MANUFACTURER CODE

A **100% SATISFACTION GUARANTEE** badge is also present on the left side of the diagram.

Ref: <https://www.google.com/search>

d) Types of purchase: ABC classification on the basis of value of items

Class of Item	% of Items	% of Value
Class A	15%	80%
Class B	25%	15%
Class C	60%	5%

ABC and purchasing control efforts:

A-items

- Very careful management
- Careful estimates of future usage.

B-items

- Routine management
- Routine effort in forecasting demand.

C-items

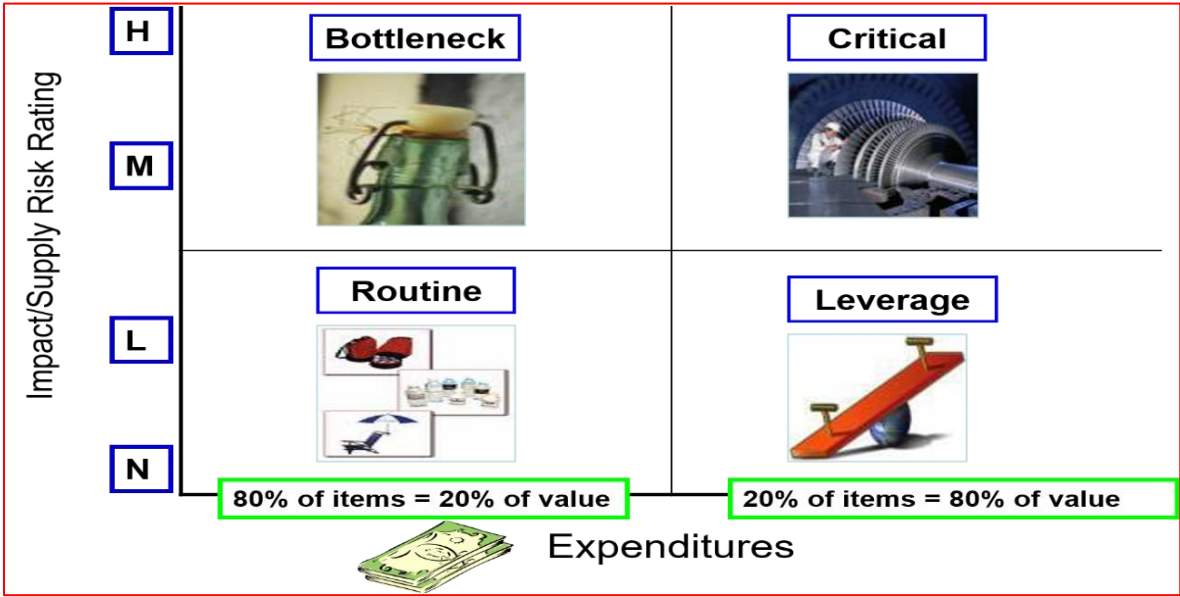
- Little effort in forecasting demand
- However, be careful for strategic items (safety stock).

e) Types of Purchase Items/Material Categorization: Few More Concepts

Title	Meaning	Basis	Main Uses
SDE Analysis	S= Scarce items D= Difficult to obtain E= Easily available	Problems faced in Procurement	Lead-time analysis and Purchasing Strategies
SOS Analysis	S= Seasonal items OS= Off-seasonal items	Nature of Supplies	Procurement/ Holding Strategies for Seasonal items like Agricultural products
Golf Analysis	G= Government Sources O= Ordinary Sources L= Local Sources F= Foreign Sources	Source of material	Procurement Strategies
XYZ Analysis	X= Items whose Inventory value is high. Y = Items whose Inventory value is neither too high nor too low. Z – Items with Low investments in them.	Value of items in Storage	To review the Inventories and their Uses at Scheduled intervals
SDE Analysis	S= Scarce items D= Difficult to obtain E= Easily available	Problems faced in Procurement	Lead-time analysis and Purchasing Strategies
SOS Analysis	S= Seasonal items OS= Off-seasonal items	Nature of Supplies	Procurement/ Holding Strategies for Seasonal items like Agricultural products
Golf Analysis	G= Government Sources O= Ordinary Sources L= Local Sources F= Foreign Sources	Source of material	Procurement Strategies

XYZ Analysis	X= Items whose Inventory value is high. Y = Items whose Inventory value is neither too high nor too low. Z – Items with Low investments in them.	Value of items in Storage	To review the Inventories and their Uses at Scheduled intervals
Summary: The various types of analysis are not mutually exclusive. They can be, and often are, used jointly to ensure better control over MATERIALS			

2. Know Your Types of Purchase Items: Basis Supply Positioning Model (SMP)



3. Purchasing and Supply (P& S) Process

The purchasing and supply function usually involves being the main point for assessing purchasing requirement, managing the interface with suppliers, placing orders, receiving purchased materials, authorizing payment, and other related activities. In other words, P&S is considered as the sourcing function of an organization involved with selection and handling of suppliers and their goods and/or services that are needed to run the organization. P&S function does not work in isolation- it works with other functions that together make up an organization efficient and cost-effective.

Ref: ITC-MLS Module 1- Strategy and Planning (New Course)

There are number of different processes and sub-processes managed by P&S function and they mainly include:

- Identify specification, needs and requirements
- Analyzing the Supply Market
- Select areas of supply and its strategy
- Identify and select suppliers
- Bidding process and Negotiating
- Preparing and Managing Contracts
- Transportation and logistics in purchasing
- Maintaining optimum inventory
- Measuring and evaluating performance

We will now explain each of these processes and relevant supply risks along with resilience techniques/strategies.

4. Identify Specification, Needs and Requirements

Specifying requirement is the process of procurement and it is important to provide the information that the suppliers require in order to reliably meet the user's expectation.

Specifying requirements and planning supply is the first step in the purchasing and supply process. If it is not done in an appropriate manner, then all subsequent stages in the process will be defective.

Determining and specifying requirements means being able to answer following questions:

What exactly is required (in terms of quality, type, size, performance, color, etc.)?

- How is the quality tested?
- What would be the quantity?
- When are they (product and/or service) required?
- Where should they be delivered?

- What would be the means of transportation?
- What type of customer support required from the supplier?
- Any other responsibilities, suppliers need to fulfill and information to provide?

In order to make the **supply chain resilient and to mitigate probable risks**, an organization needs to put special emphasis on specifying requirements. If the organization fails to specify products or services correctly, it may face a number of very damaging consequences such as:

- Your production might get interrupted because a required input was not available when needed.
- Purchased material may arrive damaged and be unusable due to inadequate packing.
- Purchased materials may contain substances that are not allowed in your country for environmental or health reasons.
- The machinery you have purchased might not perform as expected, and break down frequently.
- In case you have estimated to purchase excess quantity than you require would lead to unnecessary stock holding costs, and possibly, obsolescence and waste of resources.
- Your supplier may be unable to provide the required maintenance services and no other organization in the country is able to provide similar services. This kind of situation may cause serious disruption.

With all these points in view, if you are able to develop purchase specification correctly, your company will minimize its risk and you will have hands-on experience in handling the similar situations in the future.

a) Types of requirement:

A) Operational requirements (items needed to keep the organization running on a day-to day basis like components for production line, maintenance supplies for stationery in office)	A1) Operational requirements for production
	A2) Operational requirements for non-production
B) Capital requirements (assets that are not used on a day to day basis and which have a life expectancy of more than one year like vehicle, machinery and equipment)	B1) Capital requirements for production
	B2) Capital requirements for non-production

b) Elements of Purchase Specification

- Specifying the required product and service: (i.e. the required quality)
- Specifying the (i.e. the required quantity)

- Specifying the delivery requirements (the required time & place)
- Specifying supplier service/responsiveness
- Other information needed by the supplier

c) Product specification

The basic type of product specification is that of “implicit quality”. For example if you buy a wrist watch, you would expect that the watch will show you time, make alarm and function properly. Sometimes, we observe the concept of implicit quality is not sufficient in many cases.

There are many different types of product specifications which may be interpreted as follows:

Brand and trade name:	Using brand and trade name can be used in making product specification of items such as: <ul style="list-style-type: none"> • For commonly used item • When particular brand will differentiate your product • When quality is more important than cost
Supplier/ industry code:	A good number of suppliers and industry sectors have developed details codes that a buyer can use to specify products like: <ul style="list-style-type: none"> • Specially for simple items • To enable purchase from a particular supplier
Samples:	Sample can be used for the purpose of making specification like- <ul style="list-style-type: none"> • When it is difficult to judge quality prior to purchase • When it is easier to explain by showing the sample
Technical specifications:	A technical specification defines fully what is required. It generally includes a combination of following features: <ul style="list-style-type: none"> • Physical characteristics (dimensions, strength, etc.) • Design details • Tolerances • Material used • Processes/methods involved in production • Maintenance requirements • Operational requirements
Composition specifications	Composite specifications relate to the make-up of an item, and are generally stated in terms of: <ul style="list-style-type: none"> • Chemical and/or physical characteristics <p>Composition specifications are also used where safety or environmental concerns are important, or when the material is critical to performance.</p>
Functional and performance specifications	It is observed that these two terms are sometimes used interchangeably. However, functional specifications usually state in very basic terms what function a product is required to carry out or achieve. On the other hand, a performance specification often refers certain additional requirements in terms of how well the function is to be achieved. <p>Functional/performance specifications are appropriate:</p>

- | | |
|--|--|
| | <ul style="list-style-type: none"> • When suppliers possess greater expertise than the purchase • Where innovation is measured and valued • When technology gets changed frequently |
|--|--|

Ref: ITC-MLS Module 2- Specifying Requirement & Planning Supply (Old Course)

d) Service specifications

Services are intangible by nature and thus it is typically more difficult to specify than product. Nevertheless, specification should be as precise as possible. They should generally be stated in terms of output.

Some examples of services:

- Transport services
- Advertising and media
- Payroll administration services
- Security services
- Banking and finance related services
- Tax consultancy
- Training and learning
- Management consultancy service

5. Internal Standardization Reduces Time and Effort to Develop Purchase Specification and Help to make Supply Chain More Resilient

Standardizing internally refers to reducing the number of difficult specifications where possible. Lack of internal standardization results in increased costs for the organization. It is always preferable if engineers and designers inside the organization try to develop their own designs and specifications, rather than adopting designs or specifications used by others.

Internal standardization has many benefits that include:

It reduces the time and effort to develop specification within the company.

It supports a firm to concentrate its effort on fewer items, focus better on quality and spend more time on finding the best sources of supply.

Internal standardization allows a firm to buy large quantities of fewer items and thereby negotiate better prices with fewer suppliers.

The larger volume and interaction level with fewer suppliers result in closer communication and better understanding between buyers and suppliers.

Fewer items will need to be stocked, which will eventually reduce the need for safety stocks and thus, bring down inventory costs.

Despite many benefits of internal standardization, the only potential disadvantage is that it may reduce the range of quality options available for use.

However, the benefits of internal standardization are clear, but achieving this is not that easy. An internal standardization program should involve all the users of a particular product or service, otherwise there may be resistance to accepting the new standard which was made internally. Inevitably, some users will have to compromise.

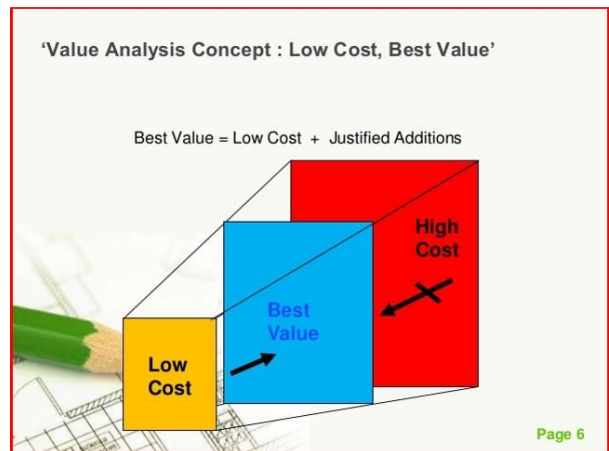
6. Value Engineering

Value engineering is a systematic, organized approach to providing necessary functions in a project at the lowest cost. Value engineering promotes the substitution of materials and methods with less expensive alternatives, without **sacrificing functionality**. It is focused solely on the functions of various components and materials, rather than their physical attributes. Value engineering is also called value analysis.

The concept of value engineering evolved in the 1940s at General Electric, in the midst of World War II. Due to the war, purchase engineer Lawrence Miles and others sought substitutes for materials and components since there was a chronic shortage of them. These substitutes were often found to reduce costs and provided equal or better performance.

For example, a bottle of dishwashing liquid that becomes slippery after some of the soap has leaked to the sides may be improved by redesigning the shape of the bottle and the opening spout to improve grip and minimize leakage. This improvement could lead to increased sales without incurring additional advertising costs.

Ref: <https://www.investopedia.com/terms/v/value-engineering.asp>



7. Resilient SC: VE (Value Engineering)-A Structural Problem-Solving Technique in the Field of P&S

Value Methodology (also called Value Engineering, Value Analysis or Value Management) is a powerful problem-solving tool that can reduce costs while maintaining or improving performance and quality requirements. In this way, it also serves the purpose of making the Supply Chain resilient.

It is a function-oriented, systematic team approach to providing value in a product or service. The value methodology helps organizations compete more effectively in local, national and international markets by:

- **Decreasing costs**
- **Increasing profits**
- **Improving quality**
- **Expanding market share**
- **Saving time**
- **Solving problems**
- **Using resources more effectively**

Checklist of Questions for Value Analysis

- Is the item necessary, does it add value or can it be eliminated?
- Are there an alternative source for the item?
- Can the item be provided internally?
- What are the advantage of the present arrangement?
- What are the disadvantage of the present arrangement?
- Could another part, material or service be used instead?
- Can specification be made less estrangement to save cost or time?
- Can two or more parts be combined?
- Can more (less) processing be done on the item to save on cost?
- Do suppliers/providers have suggestions for improvements?
- Do employees have suggestions for improvements?
- Can packaging be improved or made less costly?

Value analysis refers to an examination of the function of the purchased parts and materials in an effort to reduce the cost and/or improve the performance of those items.

The steps involved in Value Analysis:

- Select an item that has a high annual value. This can be part or material or a service
- Identify the function of the item
- Obtain answers to the questions as per the checklist shown in the previous page.
- Analyze the answers obtained plus answer to other questions that arise and make recommendation

“We design and build our own hospitals. We don’t build them fancy; rather, they are extremely functional and maximize space utilization, which brings down the cost per bed” Viren Shetty, Devi Shetty’s elder son. Quoted from Indian Magazine- Outlook Business, published on July 6, 2013.

8. Specifying Requirement: Quantity, Delivery Requirements, Supplier' Service & Responsiveness and Other Information to be Included in the Purchase Specification

a) Specifying Quantity

This chapter has been elaborated in the “Module-2: Demand Management and Its Forecast Techniques” of this training course.

b) Specifying the Delivery Requirement

- Specifying delivery times and schedules
- Specifying the delivery point
- Specifying the method of transport and packing

c) Specifying Suppliers' Service & Responsiveness

- Supplier responsiveness
- Technical support & training
- Maintenance and repair

d) Specifying Other Information to be Included in the Purchase Specification

- Contact information
- Background information
- The basis for evaluating the offers
- Applicable legal requirements



9. Analyzing the Supply Market as P&S Process

Supply market analysis involves the gathering of facts, data, observations and trends about the marketplace in which suppliers conduct business.

Markets are considered where buyers demand products or services and suppliers offer those products or services. A market exists where:

- There are two or more parties
- Each party has something that may be of value to the other
- Each part can communicate and deliver
- Each party is free to accept or reject an offer

In other words:

“A market is an arena for potential exchange” (P. Kotler)

“A market is an arena for potential exchange” (P. Kotler)



On the basis of this definition, the supply market could be defined from a **buyer's perspectives** as the arena containing potential source of supply. The supply market-although part of external environment-has a major impact on the performance of purchasing & supply function.

Value realization through Supply Market Analysis

- Reduce the total cost of purchased materials and services over time
- Identify global sourcing opportunities- low cost supplier and world class operations
- Benchmark supplier information for increased competition and enable re-negotiation with suppliers
- Help make vs. buy assessment
- Improve supplier relationship taking into account:
 - Supply base is global or local
 - Category is direct or tactical
 - Supplier is strategic or tactical
 - Market is competitive or not

Structure of Supply Market

- Identify viable source of supply
- Determine market size, quantities, international nature
- Number of supplier per category, location of suppliers
- Current and future capabilities of supplier- cost, price, technology, value added and dynamics
- The nature of supply network at Tier 2 and Tier 3 level

10. Supply Risks Caused by Natural Disasters

Natural disasters caused by climate change, earthquake, floods and others affect supply chain throughout the world in general and Bangladesh in particular. Worldwide it is observed that a surprising number of natural disasters have devastated communities around the world. From the deadly earthquake and ensuing tsunami that rocked Indonesia, to the multiple hurricanes that have struck South America, to California's raging wildfires, it seems that such disasters are becoming more and more commonplace.

Natural disasters aren't a new phenomenon, but the rate at which they're taking place isn't going to let up unless proactive action is taken, according to a recent UN report. The data explored in the UN's climate change report suggests that such disasters will continue to increase in their regularity unless more efforts are made to reduce greenhouse gas emissions.

Escalating Supply Chain Risk

The tragic consequences that natural disasters can cause to human life is readily apparent, and covered extensively by the media. What's less recognized is that natural disasters also wreak immense havoc on global supply chains, because they result in the cancellations of flights, the closure of ports, and the shutting down of highways. In this way, the delivery of raw materials, consumer goods and other components are delayed, sometimes substantially, which can seriously harm the bottom line of businesses.

For example, the catastrophic Tohoku earthquake and tsunami a few years ago resulted in a massive US\$210bn in costs for Japan. Unable to import or export needed parts, Toyota, GM and Nissan all closed down their facilities temporarily in Japan and the United States. In a similar fashion, when Puerto Rico was struck by Hurricane Maria earlier this year, the supply chains of two of the island's most important industries, pharmaceuticals and medical devices, were ground to a complete halt.



Japan earthquake and tsunami of 2011

Ref: Safeguarding the Supply Chain From Natural Disasters, by Graham Parker, SCB Contributor, December 5, 2018

Apart from the global scenario as stated herein, let's look at the gloomy picture of Bangladesh:

Bangladesh is located at the tail end of the fragile delta formed by the Ganges, Brahmaputra, and Meghna Rivers and more exposed to tropical cyclones than any other country. It also experiences about two-fifths of the world's storm surges every year.

According to the 2015 Climate Change Vulnerability Index, Bangladesh's economy is more at risk to climate change than any country. With a per capita gross domestic product, or GDP, of about \$1,220, the economic losses in Bangladesh over the past 40 years were at an estimated \$12 billion, depressing GDP annually by 0.5 to 1 percent. Especially devastating storms that come along every few years have an outsized impact – such as the 2007 cyclone Sidr, which wrought an estimated \$1.7 billion in damages, or about 2.6 percent of the GDP on top of \$1.1 billion losses due to monsoon flooding in the previous 12 months. In May 2009, 3.9 million Bangladeshis directly suffered from the impact of Cyclone Aila, which caused an estimated \$270 million in asset damage.

Two-thirds of the country is less than five meters above sea level, and floods increasingly inundate homes, destroy farm production, close businesses, and shut down public infrastructure. Erosion leads to an annual loss of about 10,000 hectares of land and weakens natural coastal defenses and aquatic ecosystems.

Fresh water has become scarcer in in Bangladesh's drought-prone northwest and in southwest coastal areas where about 2.5 million profoundly poor residents regularly suffer from shortages of drinking water and water for irrigation. Further, their coastal aquatic ecosystems have been severely compromised.

Salt water intrusion from sea level rise in low-lying plains has intensified the risk of food insecurity, the disappearance of employment opportunities for agricultural workers, and the spread of water-related diseases.

Addressing climate change is a national priority. Bangladesh is recognized internationally for its cutting-edge achievements in addressing climate change. Bangladesh has invested more than \$10 billion in climate change actions – enhancing the capacity of communities to increase their resilience, increasing the capacity of government agencies to respond to emergencies, strengthening river embankments and coastal polders (low-lying tracts of lands vulnerable to flooding), building emergency cyclone shelters and resilient homes, adapting rural households’ farming systems, reducing saline water intrusion, especially in areas dependent upon agriculture, and implementing early warning and emergency management systems.

Despite the considerable progress that the Government of Bangladesh and the Bangladeshi people have made, they face continuous challenges associated with climate change. The World Bank Group’s Climate Change Action Plan reconfirms its commitment to further increase the climate-related share of its portfolio. Already in Fiscal Years 2011 to 2015, the share of activities with climate co-benefits was at 31 percent of total IDA financing. And addressing climate change is one of the three primary focus areas in the Country Partnership Framework for Fiscal Years 2016 to 2020.

Bank funding also has supported projects in some of the poorest regions to build desalinization plants and solar-powered irrigation and solar home systems, raise the plinths of homes to protect from future flooding, and help identify livelihoods largely insulated from frequent natural disasters.

Bank financing has also enabled research on the impact of climate-sensitive diseases and the dynamics of urban flooding in the Dhaka area. The World Bank, International Finance Corporation and the 2030 Water Resources Group have also collaborated on an investment strategy for the Bangladesh Delta Plan 2100, a long-term investment program to spur adaptive management of the Bangladesh Delta.

11. Purchasing and Supply Strategy and Supply Positioning Model (SPM) as P&S Process

When an organization sets Purchasing and Supply (P&S) objectives and targets, it wishes to achieve in terms of, for instance, level of quality, innovation, continuity of supply and lead-times, supplier service and responsiveness, and total cost reduction.

Having a P&S strategy refers to knowing the ways you intend to achieve these supply objectives and targets. P&S strategy includes having a clear idea about issues such as:

- Number of suppliers to use
- Nature of relationship with suppliers
- Type of contract

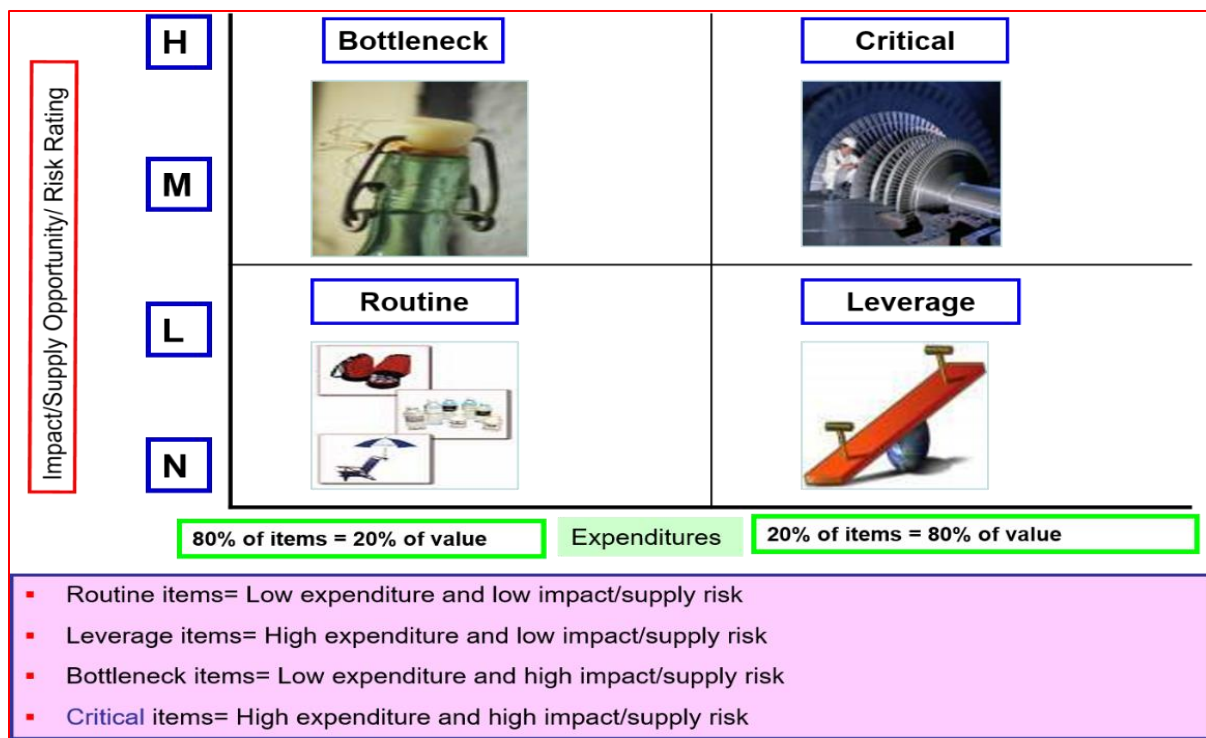
- Ideal supplier characteristics
- Types of operational strategies
- Characteristics of the individual buyer

11.1 Supply Positioning Model (SPM)

The SMP permits you to weigh the relative importance of each one your various goods and services being purchased by taking account of the following two factors:

1. Level of expenditure on the item
2. Supply impact, opportunity and risk

For better understanding, all purchases items have been placed into four quadrants as follows:



We will now describe strategy of each type of items:

11.2 Strategy of Routine Item

Characteristics	Supply strategy	
<ul style="list-style-type: none"> ▪ Many suppliers and products and services are readily available ▪ Standard item ▪ Annual expenditure is low ▪ Low risk to the organization ▪ Expenditure accounts for only a small proportion of an individual supplier's turnover 	No. of suppliers	One
	Relationship	Minimum intervention
	Type of contract	Long- term contract
	Type of supplier	<p>Able to supply as many of requirement as possible</p> <p>Responsive, therefore minimizing need for intervention</p> <p>Will continue to supply the required products for the long term</p>

11.3 Strategy of Leverage Item

Characteristics	Strategy in different cases in terms of price variability and switching cost					
	Criteria	Very high switching cost	Low price variability/ negligible switching cost	Low price variability/ relatively high switching cost	High price variability/ low switching cost	High price variability/ relatively high switching cost
<ul style="list-style-type: none"> •Many suppliers and product or service is readily available •Standard item •Annual expenditure is high •Low risk to the organization 	No. of suppliers	One	Many	One	Many	Two or three
	Relationship	Co-operative (will not exploit)	Arms-length	Arms-length (buyers-dominant)	Arms-length	Co-operative
	Type of contract	Term contract-typically long term	Spot	Term contract	Spot	Term (framework) contract-typically over medium term
	Type of supplier	Lowest cost over the contract term	Lowest cost today	Lowest cost over the contract term	Lowest cost today	Lowest cost over the contract term

11.4 Strategy of Bottleneck Item

Characteristics	Supply strategy	
<ul style="list-style-type: none"> ▪ There are few suppliers ▪ The item is high risk to the company ▪ It is a non-standard item ▪ Annual expenditure on the item is low 	No. of suppliers	One (possibly two)
	Relationship	Be a good customer
	Type of contract	Term contract (probably for a significant period)
	Type of supplier	<p>Must be particularly capable in the areas which pose the greatest risk to your company</p> <p>Will not exploit its strong bargaining position with your company</p> <p>Will continue to supply the required products for the long term</p>

11.5 Strategy of Critical Item

Characteristics	Supply strategy		
<ul style="list-style-type: none"> ▪ There are few suppliers ▪ The item is high risk to the company ▪ They are a non-standard item ▪ There are few supply alternatives ▪ Annual expenditure on the item is high 	No. of suppliers	One	
	Relationship	Partnership	
	Type of contract	Long term “partnership” contract	
	Type of supplier	<p>Must be particularly capable in those areas which pose the greatest risk to your company</p> <p>Must have ability to be a very low cost provider and/or technological leader</p> <p>Items must be core business to the supplier</p> <p>Must be financially stable</p> <p>It should not seek to exploit your company’s position</p>	

Ref: ITC-MLS Module 4- Developing Supply Strategies (Old Course)

12. Obtaining and Selecting Offer as P&S Process

There are number of ways in which the process of obtaining and selecting offers can be carried out. It depends on a number of factors; including the nature of items, the kind of relationship you are seeking with your supplier and how interested the suppliers are likely to be in your company as a potential business partner. Besides; company rules, policies and other guidelines may also influence your decision on how to obtain and select offers.

In this regard the meaning of **few important terminologies** you need to know:

- **Offer:** in a purchasing or contracting sense, means to present for acceptance or rejection
- **Tender:** specially relates to the making a formal offer in a sealed envelope, and is the terms most often used in conjunction with the formal tendering process
 - **Open tendering:** involves advertising the requirement widely in order to invite all interested suppliers that meet specified criteria to express the interest in tendering
 - **Restricted tendering:** is only available to those suppliers specifically invited to bid
 - **Two-stage tendering:** a complete technical specification is included within the invitation to tender package. This provides a way of benefiting from the suppliers' knowledge
- **Quotation:** is generally associated with semi-formal processes, and is often used to relate to the price offered against an "enquiry" or "request for quotation"
- **Bid:** is generally associated with making offers at auctions, but is also commonly used in relation to any offer made (in response to an enquiry, request for quotation, or invitation to tender)
- **Proposal:** suggests an indicative offer rather than a formal offer, and, as such, is not intended for acceptance.

12.1 Obtaining and Selecting Offers: Three Dimensions

Dimensions	Types	Brief description
1) Number of Suppliers to contract	Single supplier	For a small value purchase, it's a special agreement, or only source available
	Selected supplier	Selected from a list of approved or accredited suppliers
	Open competition	Communicating requirement to as many suppliers as possible and seeking bid
2) The criteria to evaluate offers	Based on lowest price	Lowest price
	Based on lowest total cost of ownership	Lowest cost or lowest total cost of ownership
	Based on supplier capability & motivation (value judgment)	Capability means supplier's ability to meet essential and desirable requirements while motivation reflects level of attractiveness and value of business to supplier.
3) The method to be used	Informal	Asking one or two suppliers by telephone to quote a price, and placing your orders on the spot
	Enquiry/quotation	Issuing a written (or electronic) enquiry to suppliers, inviting them to make an offer. The suppliers will then respond by sending in a written quotation
	Formal tendering	Communicating the requirement to potential bidders in a very comprehensive and well-documented manner, and following a closely prescribed method of recording and appraising offers
	E- marketplace	Public(supporting many to many relationship) and private)one to many relationship)

12.2 Criteria to Evaluate Offers

Four ways to evaluate suppliers' offers:

- **Lowest price**
- **Lowest total cost of ownership**
- **Weighting scoring**
- **Value judgment**

Evaluating offers for supply of Generator (Basis: Lowest Price)					
Supplier	Registered supplier?	Meets minimum requirements		Price (in BDT)	Selected
		Specification	Delivery schedule		
A	Yes	Yes	No		
B	Yes	Yes	Yes	200,000	No
C	No				
D	Yes	No			
E	Yes	Yes	Yes	220,000	No
F	Yes	Yes	Yes	195,000	Yes
G	Yes	Yes	Yes	212,000	No
H	Yes	No			

The lowest price is the simplest basis evaluating offers. It is based on straightforward yes/no answers to minimum requirements, followed by a straight price comparison.

12.3 Lowest Total Cost of Ownership (TCO) as Criteria to Evaluate Offers

The TCO approach attempts to qualify all costs- and revenues- associated with particular purchase. This follows the so called “cradle – to-grave” approach. This kind of analysis is mostly relevant when purchasing equipment.

- Component that generally make the TCO:
- Purchase cost
- Operating cost
- Preventive maintenance cost
- Repair cost
- Cost of disposal
- Capital cost
- Cost related to currency fluctuation
- The cost of employees' time
- The importance of the timing of costs
- Net Present Value (NPV)



13. Basis of Pricing

It is essential to make the supplier aware of the basis on which you require the offer to be priced. This helps to state whether your company or the seller **will bear the risk of cost fluctuations**.

Various types of basis for pricing:

- Fixed price
- Price with variation (or revision) formula, based on changes in the costs of materials and labor, etc.*
- Cost plus fee (where the fee may be either fixed or based on the supplier's performance)
- Schedule of rates against milestones
- Leasing, where we do not own the equipment. You get to use it against regular lease payments, but must return it at the end of the lease

A fixed price contract minimizes your company risk, while a cost-plus contract provides minimal risk to the seller.

13.1 :How to Apply Price Revision Formula: An Example*

$$P = P_o \{0.2 + 0.35(M/M_o) + 0.45(L/L_o)\}$$

Where:

P= the revised price to be paid at the future time of Purchase of the item

P_o= the item's current price

M & L= the relevant materials and labor cost indices at the future time of purchase of the item

M_o & L_o=the current materials and labor cost indices

The above formula assumes that the supplier's cost is made of: fixed costs -20%; materials-35%; labor-45%

Example: Assume current price of an equipment say USD 1,000 and after three months material cost goes up by 20% while labor cost goes down by 10%; what would be our revised price after three months:

$$P = P_o \{0.2 + 0.35(M/M_o) + 0.45(L/L_o)\}$$

$$P = \text{USD}1000 \{0.2 + 0.35(\text{USD}420/\text{USD}350) + 0.45(\text{USD}405/\text{USD}450)\}$$

$$P = \{\text{USD}1000 \{0.2 + 0.35 \times 1.2 + 0.45 \times 0.90\}$$

$$P = \{\text{USD}1000 \{0.2 + 0.42 + 0.405\}$$

$$P = \{\text{USD}1000 \times 1.025\}$$

$$P = \{\text{USD}1000 \times 1.025\}, \text{ Therefore, revised price stands USD 1025}$$

Ref: ITC-MLS Module 6- Obtaining & Selecting Offers (Old Course)

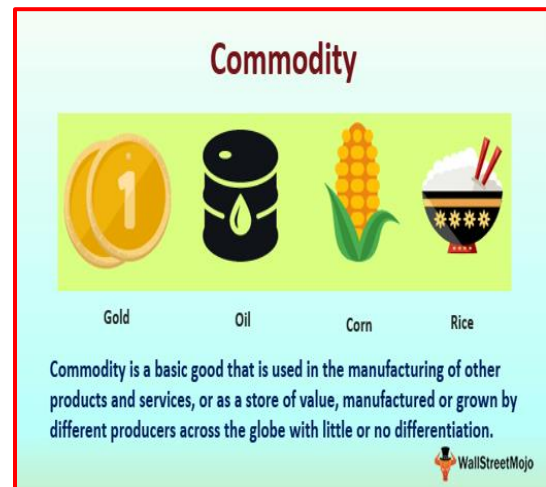
14. Commodity Price Risk

a) Definition

Commodity price risk refers to financial losses that may occur to both the consumer, and the producer when there is a change in commodity prices. A risk for the buyers is that the prices for commodities may be high. Take an example of the carpenters. They have to buy wood to make furniture. If the wood prices go up, it will also mean that the costs of buying furniture will be higher. The producers will have lower profits because there will be few buyers.

b) A Little more on what is Classification of Commodity Price Risk?

Generally, producers face the risk of low commodity prices. For instance, if in the first year of planting the prices of crops are high, the farmer plants more hoping for higher profit margins. What will happen when the prices suddenly fall? The farmer makes losses. Commodity price risk does not happen just like that. Factors including weather, technology, politics, market conditions, and seasons affect commodity prices. Financial instruments like futures and options are now in the market to control commodity price risk.



14.1 Groups Affected by Commodity Price Risk

Producers including farmers, mining companies, oil companies, and car manufacturers face price risks on their production inputs.

Consumers face price risk when the prices go up as this affects their demand for commodities.

Imposing tariffs on exports causes prices to go up. Exporters also experience hardship in the markets when this happens.

Governments face price risks, especially when it comes to revenue generation. An increase in prices causes the government to generate more revenue.

14.2 Factors Affecting Commodity Prices

a) Politics

An increase or decrease in commodity prices can occur due to political factors. In the USA, for example, manufacturers import steel and aluminum from foreign countries. In 2018, President Trump imposed tariffs on the imports. The tariffs' goal was to increase the prices of aluminum, and steel in the USA compared to other countries. China did not take this lightly. They later imposed their tariffs on agricultural products from the US. The low demand for agricultural produce from China meant the crops had to be bought by other countries. As a result, the crop prices in the US market reduced in 2019.

b) Weather conditions

Change in seasons and weather conditions largely affect the prices of commodities. Farmers harvest plenty of farm produce towards the end of summer, making prices fall in October. The fluctuation of prices during the major seasons' causes crashes in the stock market. Seasons like drought and floods temporarily lead to a hike in the prices of commodities.

c) Transportation and Storage Costs

The type of commodity will determine its storage mechanism. The commodities that have a physical form need storage spaces before distribution. The cost of storage always affects the overall price of a commodity.

d) Technology

Technology has an intense impact on commodity prices. Improvements in technology can cause the prices of a commodity to drop. Take an example of aluminum. It was a valuable metal until new procedures were developed to isolate it. Its value then dropped, and its price in the market decreased.

e) Production Costs

Capital, labor patterns, raw materials, and production tools have a great influence on the commodity's final price. If the cost of production is high, the commodity price will also be high. However, if the production cost is low, the commodity price will be low. Using hedging futures to control the prices of a commodity Futures markets protect consumers and producers against price fluctuations. A producer faces the risk of prices going down, while consumers face the risk of prices hiking. Hedging protects both parties against financial loss. Futures contracts have periods, and consumers and producers get to choose according to the risks they face. Investors, traders, speculators, and other people in the market can use the futures markets.

Ref: Commodity Price Risk – Definition by Jason Gordon <https://thebusinessprofessor.com/lesson/commodity-price-risk-definition/>

15. The Tendering Process as Criteria to Evaluate Offers

When any product or service is purchased through tendering, the process becomes much more rigorous and detailed. The key features of tendering may be narrated as follows.

- **Formality:** A highly formal process and a defined and documented procedure are followed so that whole process becomes transparent and can be audited. The entire evaluation process are recorded.
- **Ethical principles:** The whole process is based on solid ethical principles that minimize the scope of favoritism and unfair practices and allows all suppliers to be treated equally like:
 - Any additional information given to one supplier should be given to all other suppliers invited to tender
 - Any extensions granted to one supplier should be granted to al
 - Tender information provided by bidders should be treated as confidential

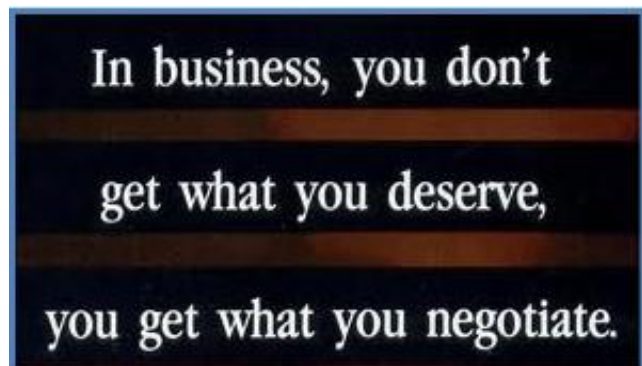
- Promoting competition: The tendering process encourages competition. To ensure competition, buyer should mention the specification in such a way that do not limit the number of suppliers that can bid
- Time and effort involved: The rigor of the tendering process- together with the fact that most tenders are for complex requirements- makes it particularly time-consuming. The effort and costs involved are correspondingly high.

15.1 The Stages in Tendering Process

01) Develop a plan for the tendering process
02) Define the basis for the tender evaluation
03) Define the minimum criteria for screening out suppliers from being invited
04) Prepare the invitation to tender package
05) Appoint the tender opening panel
06) Advertise the requirement
07) Ensure the suitability to those suppliers expressing their interest in tendering
08) Issue the invitation to tender documents
09) Confirm receipt by suppliers of your invitation to tender
10) Clarify the invitation to tender, if needed
11) Deal with any request for extensions
12) Receive and open the tender
13) Reject any non-compliant bids
14) Deal with any revised offers received after the tenders have been opened
15) Evaluate the tender and clarify these with corresponding suppliers if necessary
16) Undertake post-tender negotiation, if applicable
17) Award the contract
18) Debrief unsuccessful suppliers

16. Negotiation in the P&S Process

We all negotiate in our personal and professional lives. We need to negotiate when we are selling something, or buying something, or dealing with a project, manufacturing plan, delivery schedule, a budget, or any of a hundred other situations. In most of these cases, we are trying to resolve



differences. It appears, without being a good negotiator; sometimes it becomes difficult to resolve those differences when they are really needed.

A purchasing professional must aim to be successful in their negotiations with suppliers to obtain the best price with the best conditions for every item that is purchased. Negotiation in the purchasing process covers the period from when the first communication is made between the purchasing buyer and the supplier through to the final signing of the contract. Negotiation can be as simple as trying to obtain a discount on a case of safety gloves through to the complexities of major capital purchases.

Purchasing staff should enter all negotiations with clearly defined objectives. Without having objectives the possibility for the purchasing professional to concede on price, quality or service is significantly raised. The negotiator should enter into discussions with the vendor with precise objectives that they wish to achieve for their company. Negotiation is an important part of the role of the purchasing professional. It is a skill that is learned, and training can help purchasing staff in understanding what is needed when negotiating with vendors.

Negotiation skill will help you identify and experience many aspects of negotiating. It would assist you to gain a better understanding of the process, what to look for, what to watch out for and how to take control of the situation.

a) Skills for successful negotiation;

- Effective speaking
- Effective listening
- A sense of humor
- A positive attitude
- Respect for others
- Self-confidence
- Emotional intelligence
- Persistence
- Patience
- Creativity
- Building rapport with others
- Developing questioning and listening skill
- Defining your bottom line and ideal outcome
- Coping with different negotiation style



b) Three Phases of Negotiation

You as a good negotiator need to be aware of following three phases of negotiation:

Preparation: Needless to mention that getting prepared is one of the most important stages in negotiation. Ideally for one hour of negotiation meeting, many hours of preparation are needed. Preparing includes understanding the context of negotiation, knowing information about the market place and about other side and drawing up the negotiation objectives and strategies.

Meeting: This phase covers discussions involving testing assumptions, making proposals, analyzing options and bargaining. When discussion appear successful, the agreement is drawn and communicated to all parties about their key responsibilities.

Following-up: Under this phase, measures are taken to ensure that the agreement is implemented as stipulated. It also involves evaluating your performance in the negotiation, as well as that of the supplier. The evaluation will help you to understand whether objectives of the negotiation are met, if not, why not. It will also allow you to gain experience to negotiate better in future.

c) Price and cost analysis that helps Negotiating

Sometimes, it is observed that suppliers do not apply a careful logic to setting their price break, and by exposing this lack of logic you can strengthen your negotiation approach and save money for your company.

A price list analysis as below by reviewing the supplier's own price breaks for different order quantities helps to determine the basis of fixed and variable cost.

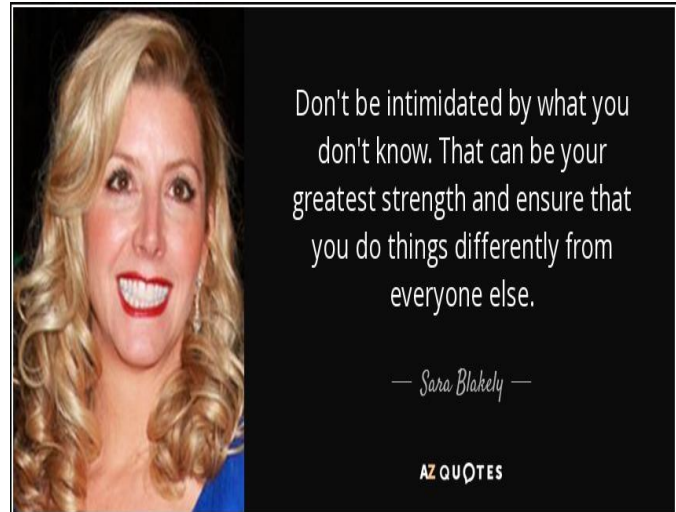
1. A single supplier offers three quantity price breaks				
A	Quantity(Q)	100	500	1000
B	Price (P)	BDT10	BDT9	BDT 7.5
2. Amount asked to be paid by the supplier for each purchase would be:				
C.	Q X P	BDT 1000	BDT 4500	BDT 7500
3. Calculation showing differences from one quantity break to another				
D	Difference in price (C)	---	BDT 3500	BDT 3000
E.	Difference in Quantity (A)	----	400	500
4. Per unit estimated variable cost (i.e. the increase in cost for every unit increase in production)				
F.	Estimated variable cost per unit (D/E)	---	BDT 8.75	BDT 6.00
5. Lowest total variable cost on the basis of lowest per unit of variable cost				
G	Lowest variable cost per unit:	BDT 6	BDT 6	BDT 6
H	Total variable cost for each production run (A x G)	BDT 600	BDT 3000	BDT 6000
6. Total cost on the fixed cost BDT 400 that has derived from the first run production				
I	Fixed Cost: (C)	BDT 400	BDT 400	BDT 400
J	Total cost (H+I)	BDT 1000	BDT 3400	BDT 6400
7. Estimated savings from negotiations				
K	Potential savings (C-J)	----	BDT 1100	BDT 1100
L	Percentage of original amount		24%	15%

Now you understand that this analysis can help you to see more clearly through the inconsistencies in the supplier's price method. Although it is a rough estimation, this approach will help you in preparing for the negotiation.

Ref: ITC-MLS Module 7- Negotiating (Old Course) Ref: MARTIN MURRAY, <https://www.thebalancesmb.com/negotiation-in-the-purchasing-process->

16.1: Negotiating Mistakes:

- Do not **underestimate** your power: Most people tend to have more power than they think. Only by making a systematic analysis of power, you can understand your strengths.
- Do not assume that the other party knows your **weaknesses**. Assume that they do not and test that assumption. You may be better off than you think.
- Don't be **intimidated** by status.
- Don't be **intimidated** by statistics, precedents, principles, or regulation.
- Do not forget that the other party is negotiating with you **because they believe there is something to gain by being there**.
- It is a common negotiating mistake to assume **you know what the other party wants**.
- It is far more prudent to assume **you do not know**, and then proceed to discover the realities of the situation by patient testing.
- If you proceed to negotiate a deal on the basis of your own untested estimates, you are making a serious mistake.
- **Never accept the first offer** — many people do. There are two good reasons not to: First, the other party probably is willing to make some additional concessions.
- If you do accept the first offer, there is a chance the **other party will have the feeling that their offer was foolish**. They may find ways to spoil the agreement later. In either case, the negotiator who takes the first offer too fast makes a mistake.
- **Never give a concession without obtaining one in return**. Don't give concessions away free or without serious discussion. A concession granted too easily does not contribute to the other party's satisfaction nearly as much as one that they struggle to obtain.



16.2: Essentials for a Negotiator

- Improve language
- Improve pronunciation
- Work on voice modulation
- Work on body language
- Read more
- Listen more
- Avoid reading or watching or listening unwanted literature, gossip, media, presentation etc.
- Interact with qualitative people
- Improve on your topic of discussion
- Practice meditation & good thoughts
- Think and speak
- Use simple vocabulary
- Do not speak only to impress someone
- Look presentable and confident



You always need to be a good listener

17. Purchasing Contract as P&S Process

Almost everyone makes contracts everyday. Sometimes written contracts are required, e.g., when buying a house. However the vast majority of contracts can be and are made orally, like buying a law text book, or a coffee at a shop.

A contract is a legally binding exchange of promises or agreement between parties that the law will enforce.

In common law jurisdictions there are three key elements to the creation of a contract. These are offer and acceptance, consideration and an intention to create legal relations.

Perhaps the most important feature of a contract is that one party makes an offer for a bargain that another accepts. This can be called a 'concurrence of wills' or a 'meeting of the minds' of two or more parties.

In other words, contracts are allocations of risks, and that allocations of risks differ from contract to contract.

a) Contract must fulfil following requirement:

- An offer
- An acceptance
- The contractual capacity of the parties
- A consideration something of value
- A legally binding relationship

In the case of both in international trade and domestic trade, a contract is more specifically a written agreement that allocates the risk and rewards of a transaction between the parties involved.

The sales contract has a legal basis which binds at least two parties: a seller and a buyer. The contract is more important in international trade due to the fact that the parties residing in different countries are subject to various legal rules affecting the making and performance of the contract.

b) Contract: Seller's and Buyers' Obligations

Seller's obligations:

- Deliver the goods or service as per specification in the contract.
- Deliver the documents related to goods or services
- Transfer of title of ownership for a product
- Assure the conformity of the goods
- In general, act in good faith and deal fairly.
- Civil liability of the manufacturer of the goods in the case of injury to persons or objects.

Buyer's obligations

- Accept the goods or services
- Pay the agreed price
- In general, act in good faith and deal fairly
- Accept civil liability in the case of injury to the person objects

18. Risks in International Trade & How to Manage Them

Businesses involved in international trade have to deal not just with risks locally but also other business development risks such as ethics, transportation, intellectual property, credit, currency, and a lot more.

These risks can obstruct the smooth running of the business, and hence, appropriate measures need to be taken to limit their effects. Here are 6 risks commonly faced by businesses involved in international trade and the effective ways to manage them.

a) Credit Risk

Counterparty or credit risk is the risk associated with not collecting an account receivable. There are numerous ways in which businesses can guard themselves against this risk while expanding to global markets.

- ✓ Take payment in full [or a decent percentage of money upfront]

Taking 100 percent of the amount owed, or a fair percentage, before rendering the services at the time of the placement of an order can be used to cut down administrative expenses and finance charges. This eliminates the risk of non-payment. Although this may be difficult for new businesses and exporters, it can be worked out with little negotiations.

✓ Letter of credit

This refers to a commitment issued by a financial institution wherein the institution agrees to pay a set amount to the service/product provider in exchange for delivery within a set timeframe. This offers protection to both the seller and the buyer. It includes a detailed description of the shipment as well as the terms of sale.

There are several other techniques available for limiting credit risk. You can try what works best for you.

b) Intellectual Property Risk

This risk involves third parties making unauthorized use of the strategic information of a business or property that affects the value of services or products offered by a business, either directly or indirectly.

These risks increase tenfold when doing business overseas because of the difficulties that exist in defeating business rights remotely. This can be avoided by registering the corporate names as well as the trademarks before signing an agreement in any country.

It will also be beneficial to constantly modify and improve your services or products to remain ahead of the competition.



c) Foreign Exchange Risk

This usually concerns the accounts payable and receivable for contracts that are, or soon would be, in force. Foreign exchange rates are in flux constantly. Hence, businesses would be forced to make conversions of the funds generated overseas at rates lower than what is budgeted.

This is the reason why it is crucial for businesses to have an appropriate exchange policy in place. This will help in –

- Stabilizing profit margins over sales made
- Mitigating the negative impact of fluctuating rates on sales and procurements
- Enhancing cash flow control
- Simplifying domestic and foreign pricing

Businesses need to identify foreign exchange risks to frame an effective policy. It is also essential to recognize the tools available for hedging these risks and carry out a comparative analysis on a regular basis for selecting the best tool available.

d) Ethics Risks

It is vital to maintain a high ethical standard when offering any product or service in a global market. Companies may face certain questions pertaining to their values at any point while doing international trade.

Social conditions and customs vary from country to country, and hence, it is necessary to be especially vigilant. You need to make sure that your foreign suppliers and partners adhere to your values and rules regardless of where they operate from.



e) Shipping Risks

Whether you are shipping goods abroad or locally, you may face issues such as contamination, seizure, accident, vandalism, theft, loss, and breakage. Before shipping any goods to the buyers, you need to be sure to have sufficient insurance.

The International Chamber of Commerce has laid down rules for each party involved in international trade and their responsibilities with regard to shipping risk. It is best to go through the rules and take necessary precautionary steps.



f) Country and Political Risks

These are risks such as non-tariff trade barriers, central bank exchange regulations, or ban on the sale of certain products in specific countries. For instance, several countries have banned products obtained from threatened animal species.

There would be certain things that would never be under your control, such as sanctions, and you must be prepared in order to overcome them. You can find more information on such restrictions by checking the official website of the Ministry of Foreign Affairs and Trade for the specific country.

✓ Exchange Control Regulations

Several developing nations operate certain exchange control regulations that are associated with the flow of money from and to their country. You need to identify if these regulations are effective in the country which you intend to trade with. This is because these can delay your payments.

✓ Prohibited Goods

You need to make sure to carry out basic research on the import/export allowances offered by the country you are interested to carry out your business in. There are many products that are prohibited or restricted in some countries.

For instance, what is acceptable in China may not be allowed in New Zealand. You need to make sure to check out all the rules pertaining to your target market in the country you are interested to carry out trade with.

Whenever you are exporting certain products, it is essential to get them verified so that they meet the requirements of the country you would be exporting to. It is mandatory to obtain an export certificate before you actually commence trading globally.

Customs will then verify the details associated with your export certificate. It is better to be familiar with all the rules that you are governed with while trading globally, rather than face hurdles at a later stage. This will help you operate your business without any hassle once you have set your roots.

Ref: By Jared Vineyard Posted September 3, 2019- <https://www.universalcargo.com/6-risks-in-international-trade-how-to-manage-them/>

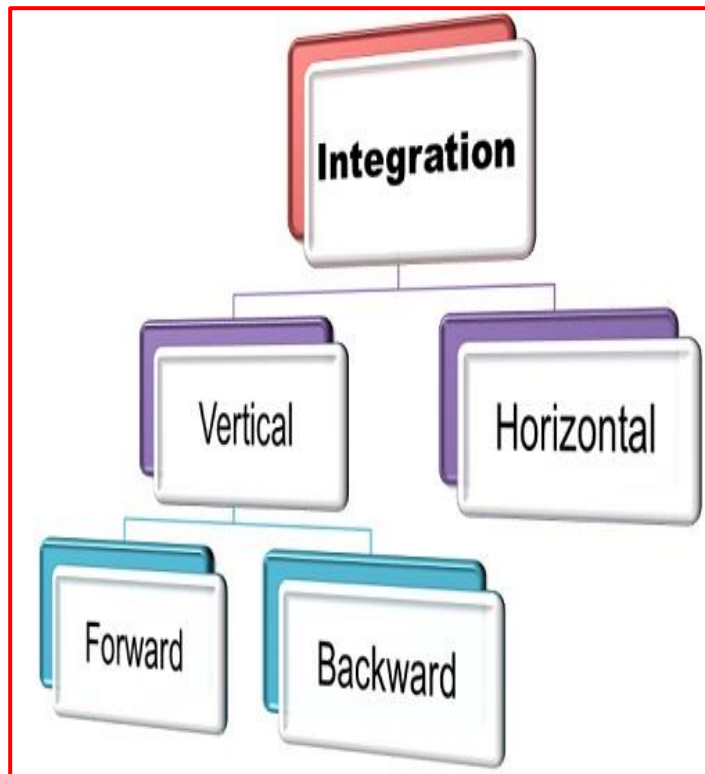
19. Horizontal Integration and Vertical Integration

a) Horizontal integration

When a company wishes to grow through a horizontal integration, it is looking to acquire a similar company in the same industry. It may be seeking to increase its size, diversify its product offerings or services, achieve economies of scale, reduce competition, or gain access to new customers or markets.

Some great examples of a horizontal integration are:

- Marriott's 2016 acquisition of Sheraton (hospitality industry),
- Anheuser-Busch InBev's (AB InBev) 2016 acquisition of SABMiller (beer companies),
- AstraZeneca's 2015 acquisition of ZS Pharma (biotech),
- Facebook's 2012 acquisition of Instagram (social media), and
- Disney's 2006 acquisition of Pixar (entertainment media).



b) Vertical Integration

A company looking to achieve vertical integration is seeking to acquire a company that operates in the production process of the same industry. It may be seeking to strengthen its supply chain, reduce production costs, capture upstream or downstream profits, or access new distribution channels. To do this, one company acquires another company that is either before or after it in the supply chain process.

- Some great examples of vertical integration include:
- Google's 2011 acquisition of smart phone producer Motorola,

- Ikea's 2015 purchase of forests in Romania to supply its own raw materials, and
- Amazon's integration into hardware by producing Kindle Fire tablets.

A company may choose vertical integration over outsourcing

b.1) Backward and Forward Integration

When it comes to a vertical integration, a company can either integrate forward or backward.

Backward integration occurs when a company decides to buy another company that makes an input product to the acquiring company's product. An example of this is if a car manufacturer acquires a tire manufacturer.

Forward integration occurs when a company decides to take control of the post-production process. An example of this is if the same car manufacturer acquires an automotive dealership.

c) Outsourcing

Outsourcing is the business practice of hiring a party outside a company to perform services and create goods that traditionally were performed in-house by the company's own employees and staff.

Outsourcing is a practice usually undertaken by companies as a cost-cutting measure. As such, it can affect a wide range of jobs, ranging from customer support to manufacturing to the back office.

Outsourcing was first recognized as a business strategy in 1989 and became an integral part of business economics throughout the 1990s.

The practice of outsourcing is subject to considerable controversy in many countries. Those opposed argue that it has caused the loss of domestic jobs, particularly in the manufacturing sector.

Supporters say it creates an incentive for businesses and companies to allocate resources where they are most effective, and that outsourcing helps maintain the nature of free-market economies on a global scale.

d) Examples of outsourcing

BPO (Business Process Outsourcing): It is a form of outsourcing which is involved with the distribution of certain business measure to other company, i.e., Service provider through a legal contract.

If BPO is done outside the country, it is termed as offshore outsourcing or offshoring and if the country involves in the outsourcing process with a neighbor country than it is called as near shore outsourcing.

Though Business process outsourcing is firmly connected with information technology, it is also known as 'Information Technology Enabled Services (ITES)'.

e) KPO (Knowledge Process Outsourcing):

Knowledge Process Outsourcing is associated with the outsourcing of high-end intelligence work. This consist of professional research containing computer alleviated simulation, analytics, engineering designs, research on finance and equity, work on a cerebral property, patent registration, legal counselling, market exploration, data mining.

Ref: <https://www.investopedia.com/ask/answers/051315/what-difference-between-horizontal-integration-and-vertical-integration.asp>

Ref: <https://businessjargons.com/expansion-through-integration.html>

20) Cost Saving through Procurement: A Way to Supply Chain Resilience

Procurement savings can be made in a number of areas within a Purchasing Department. The aim of procurement savings is to drive down procurement costs, improve supplier terms and decrease product prices.

As you go through the methods to increase procurement savings below, consider which would be the easiest methods that can make a big difference in your circumstances. Depending on what stage of cost management your organization is, some will be 'quick wins' and some others will be 'hard to win'. Focus on 'quick wins', not on implementing them all together. Every Taka that is saved through purchasing and supply goes straight to the bottom-line as profit. It is evident that the cost performance particularly cost saving is an organization towards the development of supply chain resilience.



20.1. Cost Savings: Price Reduction, Cost Reduction, Cost Avoidance and Unit Price Reduction

Price Reduction: To decrease buying price by decreasing mainly the margin associated with goods. Price reduction is simply the difference between price is paid now and price was paid in the past.

Cost Reduction: To decrease cost by improving efficiency on some elements of the transactional costs (order, follow-up, and invoice). In other words, Cost reduction means bringing down costs that have been previously incurred. A cost reduction can be per unit or overall. Examples include: pay less, use less, eliminate the use of, use a substitute item at lower cost, decrease a part of the acquisition and use cost (total cost of ownership) other than price, e.g. transportation cost, inventory cost, handling cost, quality control cost.

Cost Avoidance: Cost saving resulting from a situation where, without some action on the part of the buying organization, some form of increased cost would be incurred.

Examples would include an announced price increase that is negotiated down, substitution of a lower-cost item for the one that was requisitioned, change to lower weight packaging material to offset a transportation cost increase (if the packaging material costs less than what is currently used then there would also be a cost decrease).

Unit Price Reduction: It is a hard cost saving and in tangible in nature

In order to justify the price/cost reduction, it is important to obtain outside information about price and related information, which are mainly at various sources like:

- Prices listed in industry journals, surveys etc.
- Prices are published in internet
- Recorded prices at various commodity exchanges
- Price indication published by government agency, industry association etc.
- Quotation, price list, received from suppliers etc.
- Information obtained from informal contacts

20.2 Cost Savings: Hard Cost Savings and Soft Cost Savings

Whether a cost saving is a reduction or an avoidance, it also can be categorized as "hard" or "soft."

Hard cost saving: Less money goes out of the organization, now and/or in the future depending on whether the saving is a reduction or an avoidance.

It must be actually or potentially measurable in budget or operations reports. Hard cost savings drive acceptance by management of total cost of ownership cost saving approaches.

Soft cost saving: Often results from situations where person-time is reduced but actual bodies are not. While not measurable in budget or operations reports, such savings should be reported and tracked because they can identify opportunities for job combinations or capacity for additional duties which, if implemented may result in hard savings or improve the product in some way.

20.3 Cost Saving Techniques

A few important cost saving techniques along with examples are given below:

a) Reducing cost through better specification management- Example:1

- A company was making/using photographic paper which had four layers of chemical coating, two on each side.
- After a comprehensive research it was discovered that two layers of chemical coating were not required on the back of the paper and that a single layer of chemical coating would not affect the print quality.
- Strategies were developed to reduce the overall chemical consumption from four layers to three layers.
- To address concerns about customer's perception of quality, a pilot program was put in place to test the new paper and gather feedback.
- The pilot confirmed the effectiveness of the strategies, and thereby reduced the overall chemical consumption and category spend by 25%.



Ref: <https://www.purchasing-procurement-center.com/procurement-savings>.

b) Cost savings through specification change -Example:2

- Most people don't expect much in the way of environmental awareness from their beer company, but that hasn't stopped Anheuser-Busch from delivering.
- In his landmark text "Natural Capitalism", author Paul Hawken shines light on the fact that Busch now saves 21 million pounds of metal per year by trimming an eighth of an inch off the diameter of its beer cans.
- The best news for beer enthusiasts? "The trimming doesn't reduce the volume of beer one bit", says Hawken.



c) Cost Savings Through Variety of Reduction

It refers to the process of controlling and minimizing the range of new parts, equipment, materials, methods, and procedures that are used to produce goods or services.

Variety reduction aims to minimize the variety of all elements in the production or service delivery process. Variety adds costs to any organization and variety management and reduction can immediately benefit profitability.

The Advantages of variety reduction are well known and can mostly be assessed in terms of hard cash, taking due account of the additional cost reduction effects on associated parts and operations

The variety reduction scheme in general offers the following advantages:

1. Fewer items will mean more personalized attention and there will be fewer stock outs and service level will also improve.
2. Inventory carrying cost will come down because less inventories will be held.
3. Less procurement cost as fewer numbers of purchases for lesser number of items will have to be made. Further, since quantities per item will increase, better quantity discounts will become available and unit cost of each item will come down.



From variety of pens to --



Selected pen

d) Cost Saving: Purchasing and Cash Discount

Most suppliers offer cash discounts for prompt payment. One of the most common cash discount is '2% 10th, net 30' (i.e. '2/10 net 30')

Annualized interest rate from not taking a cash discount = $\frac{\text{Discount \%}}{100\% - \text{Discount \%}} \times \frac{365 \text{ days}}{\text{No. of days of the loan}}$

For the proposed discount, this results in the following: = $\frac{2\%}{100\% - 2\%} \times \frac{365 \text{ days}}{20 \text{ days}}$

Annualized interest rate from not taking the 2%, net 30 cash discount

$$= 0.02041 \times 18.25$$

$$= 0.3724$$

$$= 37.24\%$$

Discount offered	Supplier's payment terms	
	X% 10 th , net 30 (20-day 'loan')	X% 10 th , net 25 (15-day 'loan')
1%	18.43%	24.58%
2%	37.24%	49.66%
3%	56.44%	75.26%
4%	76.04%	100.39%
5%	96.05%	128.07%

If the calculated discounted rate is higher than the buyer's normal cost of borrowing, then the buyer should accept the discount and pay the supplier early (i.e. not accept the supplier's

Ref: ITC-MLS-SCM Module 17 (Old Course)

20.4) Cost Saving Through TCO (Total Cost of Ownership) Analysis

Example-1 (Cost Comparison between existing billing system and new billing system of a Retail Store)

Consider a hypothetical example. ABC retail is contemplating implementing a new billing system. The major components of the system will be: hardware, software, initial training, other transition costs, subsequent software upgrades, subsequent training, ongoing maintenance and operations. Salvage is zero. For simplicity, the billing system is assumed to last 3 years. ABC's finance group informs us that the forward-looking cost of capital is 15%.

You are required to make cost comparison between New Billing System and Existing Billing System by applying TCO analysis.

Costs of New Billing System in \$1,000					
Discount Factor	1.0000	0.9325	0.8109	0.7051	
	Time 0	Year 1	Year 2	Year 3	PV Costs
Hardware upgrade	1000				1000
Initial software	2000				2000
Initial training	800				800
Other transition costs	800	400			1173
Subsequent software upgrade		1000	1000	500	2096
Subsequent training		200	200	150	454
Maintenance & operation		500	600	700	1446
Total costs	4600	2100	1800	1350	8970
Costs of Existing Billing System in \$1,000					
Discount Factor	1.0000	0.9325	0.8109	0.7051	
	Time 0	Year 1	Year 2	Year 3	PV Costs
Hardware upgrade	200		100		281
Initial software					
Initial training					
Other transition costs					
Subsequent software upgrade		100	100	150	280
Subsequent training		40	40	40	98
Maintenance & operation		2000	2500	3000	6007
Total costs	200	2140	2470	3190	6667

Benefits?

Should the new billing system be implemented? The total cost of ownership (in present value) of the new system is \$8,970,000 v \$6,667,000. What we can say is that unless the new billing system allows new sources of contribution or net revenue (net of any other additional costs not identified in the analysis so far) greater than \$2,303,000, **then the new billing system is not a rational business decision.**

20.4 Cost Saving: Cost Saving Through TCO (Total Cost of Ownership) Analysis

Example-2 (Cost comparison between two suppliers in respect of purchase of TV Equipment)

Mr. Palash, Purchase Manager of ABC Ltd was instructed to buy a good number of TV equipment sets by making TCO analysis of offers that he received from two competent suppliers. Palash can not order more than **1000 units** because of his warehouse problem.

This is a critical purchase, late delivery would disrupt production and cause **50% lost sale and 50% back orders**.

Palash received following freight quotation:

Truckload (TL=40,000 lbs): \$ 0.80 per ton-mile

Less than truckload (LTL) : \$1.20 per ton-mile

Note: Per ton mile= 2000 lbs per mile

Example:

Requirement: 12000 units annually

Weight per engine :22 pounds

Order processing cost: \$ 125/order

Inventory carrying cost:20% per year

Cost of working capital:10% per year

Profit margin: 18%

Price of finished TV: \$ 4,500

Back order cost: \$15 per unit

Two suppliers have submitted quotations

Unit price	Supplier A	Supplier B
1 to 999 units/order	\$ 510.00	\$ 505.00
1,000 to 2,999 units/order	\$ 500.00	\$ 498.00
3,000+ units/order	\$ 490.00	\$ 488.00

Tooling cost	\$ 22,000	\$ 20,000
Terms	2/10, net 30	1/10, net 30
Distance	125 miles	100 miles
Supplier quality rating	2%	3%
Supplier delivery rating	1%	2%

Total Cost of Ownership (TCO) Analysis

Description	Supplier A		Supplier B	
	1. Total cost of main equipment	12,000 units X \$ 500	\$ 6,000,000.00	12,000 units X \$ 498
2. Cash discount				
n/30	\$ 6,000,000 x 10% X 30/360 = \$ 50,000.00		\$ 5,976,000 x 10% X 30/360 = \$ 49,800.00	
1/10	N/A		\$ 5,976,000 x 10% X 10/360+1% = <u>\$ 76,360.00</u>	\$(76,360.00)
2/10	\$ 6,000,000 x 10% X 10/360+2% = <u>\$ 136,666.67</u>	\$(136,666.67)	N/A	
3. Tooling cost		\$ 22,000.00		\$ 20,000.00
4. Transportation cost (22,000 lb LTL)	125 miles X 12,000 units x22 lbs x \$1.20/2000	\$ 19,800.00	100 miles X 12,000 units x22 lbs x \$1.20/2000	\$ 15,840.00
5. Ordering cost	12,000/1000 x \$ 125	\$ 1,500.00	12,000/1000 x \$ 125	\$ 1,500.00
6. Carrying cost	1,000/2 x 500x20%	\$ 50,000.00	1,000/2 x 498x20%	\$ 49,800.00
7. Quality cost	\$6,000,000 x 2 %	\$ 120,000.00	\$5,976,000 x 3 %	\$ 179,280.00
8. Delivery rating				
Back order (50%)	12,000 x 1% x 50% X \$15	\$ 900.00	12,000 x 2% x 50% X \$15	\$ 1,800.00
Lost sales (50%)	12,000 X 1% X 50% X\$ 4,500 x 18%	\$ 48,600.00	12,000 X 2% X 50% X\$ 4,500 x 18%	\$ 97,200.00
Total Cost		\$ 6,126,133.33		\$ 6,265,060.00

Ref: Principles of Supply Chain Management- A Balanced Approach by Joel D. Wisner, G Keong Leong, and Keah-Chon Tan

20.4 Cost Saving: Cost Saving Through TCO (Total Cost of Ownership) Analysis

Example-3 (Cost comparison between Non-Hybrid Car and Hybrid Car)

The process of conducting a TCO analysis can be applied in everyday life

When purchasing a car consumers often consider only one variable – sticker price – and based on the sticker price in the example to the right, Example A, the non-hybrid is the more economic choice.

	Example A (Non hybrid)	Example B (Hybrid)
Purchase price	Sticker Price: \$22,151	Sticker Price: \$23,650
Acquisition process and lifecycle costs*:		
– Depreciation	\$9,981	\$10,549
– Taxes and Fees	\$1,600	\$1,635
– Insurance Premiums	\$10,216	\$10,216
– Fuel	\$10,700	\$5,600
– Maintenance	\$3,050	\$3,050
– Repairs	\$671	\$671
– Interest on Financing	\$3,840	\$3,953
– Stimulus - Auto Assistance Ownership Amendment	\$1,500	\$1,500
Purchase price after TCO analysis	Price: \$40,058 (cost is 53 cents per mile to drive)**	Price: \$35,658 (cost is 48 cents per mile to drive)**



*End of Life Costs are not included in this example

**Cost of ownership is assumed over a five year period and 15,000 miles a year

Source: <http://www.edmunds.com/advice/buying/articles/59897/article.html>

TCO analysis indicates that the cheaper car to buy is actually the more expensive car to own and operate

21) Vendor Evaluation

Introduction

As a consumer, when you want to purchase an item, whether it is a new car or a flat screen television, you will most likely do some research on the prices of your local stores or from vendors on the internet.

When you have narrowed your search you then look at other criteria that may be important to you, like warranty or availability. Lastly, you will look at other less tangible criteria such as your previous experiences with the vendor and how their customer service was.

This behavior is exactly the same for companies when they want to evaluate the vendors in their supply chain.

Unless your company only uses one vendor for each item they purchase, there will invariably be an occasion when a decision has to be made as to which vendor gets your business. There are a number of different scenarios when this will occur, for example when the item is purchased for the first time and when an item is no longer single sourced.

Purchasing an item for the first time

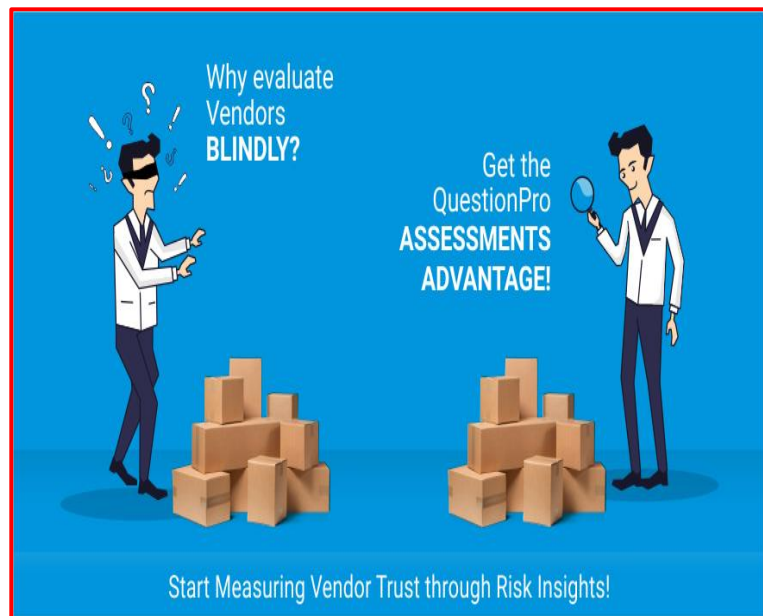
When a decision has to be made between vendors, the purchasing or supply chain department will use some vendor evaluation method to be their tool in the decision.

If the item is to be bought for the first time, the purchasing or supply chain department may have contacted a number of vendors and sent them a Request for Quotation (RFQ). Each vendor would then complete the RFQ with the information that was required, normally the price and terms.

The purchasing or supply chain department would then use these completed quotations, in conjunction with other information they have collected on the vendors, to make a short list for further evaluation or make a final selection.

The purchasing or supply chain department would evaluate the vendors based on a number of criteria they had decided upon which may include objective criteria such as price and warranty and subjective data which would include past experience with the vendor.

Based on the weighting given to these criteria the purchasing or supply chain department would be able to fairly evaluate each vendor.



Choosing Between Vendors

If the sourcing of an item has been from a single vendor but another vendor has been approved to supply the same item, a decision would need to be made on vendor selection when a requisition has been received by the purchasing or supply chain department.

Many companies use a vendor evaluation tool that allows transaction data to be analyzed to give a comparison between vendors. The vendor evaluation uses criteria that have been determined by the purchasing or department to compare vendors such as:

- Price
- Delivery reliability
- Delivery date adherence
- And the quality of the item

There are any numbers of criteria that can be used in a comparison and these are usually weighted so that important criteria are given more credence.

For example, a company may decide that the quality of the items it receives from vendors is more important than price, which in turn is more important than delivery reliability. The company would then weight these criteria so that the overall score reflects that requirement.

Conclusion

Vendor evaluation is important as it can reduce supply chain costs and improve the quality and timeliness of the delivery of items to your company. The skill in evaluating vendors is to determine which criteria are important and the weighting that these criteria are given.

It is important to remember that these criteria may be different for each item you are sourcing and possibly different between regions or countries.

Objective data is useful to compare the information that you can obtain from each purchase order and goods receipt, but sometimes the subjective data that your purchasing agents can provide such as customer service and the willingness of the vendor to accommodate your requirements is as or more important in a vendor evaluation.

Optimizing your supply chain means that you and your company are delivering your customers what your customers want when your customers want it— and doing that by spending as little money as possible. A robust vendor evaluation practice will help start that process off by guaranteeing lowest costs, highest quality and on-time delivery.

Ref: MARTIN MURRAY, <https://www.thebalancesmb.com/introduction-to-vendor-evaluation-2221400>

21.1 Vendor Evaluation: Example 1

- Weighted Point Method
- Using a Weighted Point evaluation system, purchasing can rank suppliers according to some of these criteria.

Factor	Weight	How Measured	Supplier A Rating	Supplier A Score	Supplier B Rating	Supplier B Score
Quality	40	1 = Worst 5 = Best	(3 / 5) X 40	24	(4 / 5) X 40	32
Delivery	30	1 = Worst 5 = Best	(4 / 5) X 30	24	(3/5) X 30	18
Price	20	1 = Worse 5 = Best	(2/5) X 20	8	5/5 X 20	20
Service	10	good = 100% fair = 70% poor = 40%	.7 X 10	7	1.0 X 10	10
Ttl. Points	100			63		80

21.2 Vendor Evaluation-Example 2 (Comprehensive)

Weight applied to supplier performance factors

Factor	weight
Price	40%
Quality	30%
Delivery	20%
Service	10%
Total	100%

Prices	Suppliers			Lowest price
	X	Y	Z	
	\$440	\$425	\$430	\$425
Points	97%	100%	99%	

Quantifying quality	Suppliers		
	X	Y	Z
Quantity delivered	175	200	160
Quantity defective	21	40	8
Percentage of defective items	12%	20%	5%
Points: (Percentage of usable items)	88%	80%	95%

Evaluating delivery: the basis for calculation

No. of days off schedule	Penalty for each day off schedule
1-10 days	1%
11-20 days	2%
21-25 days	3%
>25 days	4%

Suppliers	Order No.	No. of days off schedule	1-10	11-20	21-25	>25	Total	Average
X	1	4	4%	0%	0%	0%	4%	11%
	2	13	10%	6%	0%	0%	16%	
	3	0	0%	0%	0%	0%	0%	
	4	16	10%	12%	0%	0%	22%	
	Points							
Y	1	20	10%	20%	0%	0%	30%	27%
	2	8	8%	0%	0%	0%	8%	
	3	28	10%	20%	15%	12%	57%	
	4	12	10%	4%	0%	0%	14%	
	Points							
Z	1	7	7%	0%	0%	0%	7%	16%
	2	4	4%	0%	0%	0%	4%	
	3	23	10%	20%	9%	0%	39%	
	4	12	10%	4%	0%	0%	14%	
	Points							

Evaluating service

Attribute	Weight	Points (out of 100%)			Weighting points		
		X	Y	Z	X	Y	Z
Co-operation	20%	75%	80%	70%	15%	16%	14%
Response time to queries	20%	60%	70%	80%	12%	14%	16%
Precision in documentation	20%	60%	80%	70%	12%	16%	14%
After-sales service	40%	70%	35%	90%	28%	14%	36%
Total	100%	Points			67%	60%	80%

Overall supplier evaluation

Attribute	Weight	Supplier X		Supplier Y		Supplier Z	
		Points	Weighted points	Points	Weighted points	Points	Weighted points
Price	40%	97%	39%	100%	40%	99%	40%
Quality	30%	88%	26%	80%	24%	95%	29%
Delivery	20%	89%	18%	73%	15%	84%	17%
Service	10%	67%	7%	60%	6%	80%	8%
Total	100%		90%		85%		**94%

**Supplier Z has obtained the highest overall score i.e. 94%

Ref: ITC-MLS-SCM Module 12 (Old Course)

22) Purchasing & Sourcing Management in Apparel Industry

Supply Chain Management in Apparel Industry:

The supply chain is actually a complex and dynamic supply and demand network. The main purpose of the supply chain is to satisfy customers' needs and generate business profits. Supply chain management is the integration of key business processes from the original suppliers to the end-users that provide products, services, and information and add value for customers and other stakeholders. In the apparel supply chain, every organization starting from initial raw materials suppliers to apparel manufacturers purchase apparel-related products for the final consumption of end-users.



The apparel industry stands out as one of the most globalized industries in the world and it is a supply driven commodity chain led by a combination of retailers, contractors, subcontractors, buyers, manufacturer, merchandisers, subcontractors, and suppliers; each plays an important role in a network of supply chains that spans from fibers to yarn, yarn to fabrics, garments accessories, trims, packaging materials and finally made finish garments, to trading, and to marketing.

Moreover, in today's competitive environment, markets are becoming more global, dynamic, and customer driven, where customers are demanding more variety, better quality, and service, including reliability and faster delivery. Therefore, to ensure growth, it has become mandatory for the apparel industry to be more participative and adaptive.

Traditionally, supply chains are viewed as a flow line, where input enters at one end and transforms to output at the other end. This is quite static and is applicable for products that are changing less frequently.

Sourcing Management:

Sourcing is an activity that used at both tactical and strategic levels. It is concerned with what needs to be purchased, why, when and where. The concept is created to help supply chain managers and practitioners to improve, develop and implement strategic sourcing strategies. Strategic supply chain management aims to improve quality and service while reducing the total cost of purchased materials, products, and services. In other words, strategic supply management is the process of making private contracts with suppliers to achieve corporate goals as a result of the assessments in order to streamline cost and productivity.

The first step in the strategic supply process is to identify clear expectations for material, products, and services. In this step, an analysis of expenses for raw materials, finished products as well as all items to

be purchased such as yarns, fabrics, apparel accessories, trims, packaging materials, office maintenance, security items, and distribution is performed. Then, a detailed comparison of current and prospective suppliers is made and the suppliers providing the lowest total cost while meeting all other expectations are selected. In the last stage, a structure for continuous improvement is developed by designing processes that ensure regular monitoring of the performance of suppliers. Sourcing is basically determining the most cost efficient supplier of materials, production, or finished goods at the specified quality and service level.

Materials basically include piece goods that will be cut and converted into the garments. Not only does the fabric have to be appropriate and suited to the garment design and end use, but it must also be made available at the precise time when they are needed. Thus, lead-times play an important role in sourcing and placing orders for the materials required for the production.

As soon as the fabric is in the stores, then only the sourcing of the threads starts because the color of the thread must match the buyer's requirements. The ordering of the threads must be completed by the time fabric is cut ready to be fed to the sewing lines. The sourcing section of supply chain department along with apparel merchandiser plays a vital role to execute and shipment of export order successfully. Merchandiser must make sure that all approvals related to fabrics, trims, accessories and packaging materials should be coordinated with the sourcing department in a given timeframe. Fabric sourcing section of supply chain is basically engaged in determining how and where its merchandise i.e. fabric will be obtained within the scheduled time and cost.

A sourcing manager must have knowledge about all varieties of fabrics and trims in order to execute their functions effectively. The different parameters in sourcing i.e. lead time, process of fabric and trim approvals, cost of logistics and incoterms need to keep in mind while deciding the sourcing tactics for particular export order.

Sourcing Type:

There are three type of sourcing in apparel supply chain.

- In house sourcing
- Out house sourcing
- Global sourcing

In house sourcing

In-house sourcing refers to conducting an activity or operation within a company, instead of relying on outsourcing. One of the primary advantages of insourcing is control. If you keep a process, project or facility in house, you and your staff have complete control over it. If you outsource, you pass some of this control to the supplier. These strategies are used for sourcing of yarn, fabric, trims, accessories are available in your company and to meet the demand.

Out house sourcing and Global sourcing

There are many reasons why an apparel company may choose to outsource certain business functions. Some of the common reasons are reducing and controlling operating costs, sharing risks with a partner

company. If the cost of manufacturing is higher or adequate infrastructure is not available, then outsourcing or global sourcing is the popular practice for apparel industry.

Sourcing Process:

A sourcing process is used to select the best product or service for a certain category of expenditure. Unfortunately, lots of these processes are not run well, resulting in loss of large saving opportunities, delivery of poor quality products, or less favorable terms.

When selecting suppliers through a sourcing process, the buyer works in collaboration with internal customers or budget holders. Internal customers are buyer's colleagues working in other departments, such as merchandiser and marketing department, finance department or production and manufacturing. They are the ones who originally raised the need for the purchase and who will be actually transacting with the selected supplier. Internal customer involvement is usually highest (around 70%) at the specification stage and then drops to around 30% in subsequent stages.

1. Specification development

What are the needs of your internal customer i.e. the person who requires the product or service to be purchased? As a buyer, your challenge and translate these needs in specifications that suppliers can understand.

The objective of buyers at the specification stage is twofold:

- Reduce total costs
- Safeguard a competitive market at the upcoming negotiation stage

Developing specifications in its turn is a 4 step process:

- Assess Customer needs
- Assess what the market has to offer
- Develop specifications
- Define winning criteria

2. Market Assessment

Once you have a clear picture of the business requirements, your next step is to formally invite suppliers to quote for your business.

You formally approach the market via:

Request for Information (RFI)

- This is used to pre-qualify suppliers to whom you would send the RFQ.
- An RFI is usually a simple and short questionnaire for the supplier, which enables the buyer to judge if the supplier is promising and has a good chance to win the business.
- An RFI is optional. If you know the market relatively well, there is no need for an RFI.

A Request for Quotation (RFQ)

- This is a formal request to the supply market to quote for your business.

- The RFQ is a more complex document with a company presentation, bidding instructions for suppliers and detailed information about the project and requirements.

3. Negotiation

At the negotiation stage, you analyze the offers and select the most promising suppliers to negotiate with. Only then you prepare for a negotiation.

During the meeting, your goal is to clarify the terms of the offer and get additional value beyond what has been offered, this might range from a lower price, a better quality product, to improved payment terms etc. At the end of this process, you conclude the deal with the best supplier. Most suppliers build in a price concession in their first offer. In order to obtain this concession, you must:

- Build competition – To get the best results at the negotiation stage, you should have two or more credible alternatives.
- Carefully analyze all quotations to get a feel for a stretching but credible target.

4. Contract discussion

You prepare a formal contract with the supplier and you limit your companies' exposure.

Purchasing management:

The purchasing management in an apparel industry is similar to the sourcing management, but the main difference is that the sourcing management works for sourcing the yarn, fabrics, trims and accessories, while the purchasing management works for sourcing items procure from suppliers, product quality and conform right time delivery, suppliers payment and more relevant activities.

Purchasing management is one such form of management, where goods and services are acquired from a different organization or company. Purchasing management is known to help an organization to save much of the money spent when purchasing goods and services from outside. Procurement involves the process of planning, selecting suppliers, establishing payment terms, strategic vetting, and selection, the negotiation of contracts services and actual purchasing of goods. Thus, procurement is an umbrella term under which purchasing is just a component. Since procurement is an umbrella term and includes all the core business activities, it should be considered an important corporate activity.

Functioning of the Department and Procurement Process

Merchandising and Marketing Department give the tech pack and the BOM (Bill Of Materials) for a particular style to the cost management department and purchasing department and the concerned person will start the further process and for costing purposes. The in-house price like the cost involved in the production and also the price involved for a unit involved with respect to the complete procedure involved for its production is given. In the process of doing the in-house price, suppose the cost of 1000 pieces of Care Label is \$ 30 then a Taxes of 2% + 14% of exercise duty + 10% of per unit price is added as the transportation charges and this all together makes the in-house price (a hidden margin of 5% is also taken into consideration).

This breakup is given to the merchandiser by the purchasing department for the costing purpose, the cost sheet is made by the merchandisers and the order is confirmed by the buyer based on the cost sheet given by the merchandiser.

After the order is being confirmed by the buyer, the merchandiser will sit with the other concerned departments and then the exact quantity required and the breakup of the trims and accessories with respect to color, size, M OQ, etc., will be given by the merchandiser to the purchasing department in the form of a sheet which is generally followed in the industry for all the orders irrespective of the buyer.

Finally, the purchasing department receives this purchase requisition from the merchandiser, then source the right supplier for the right product for the right time. It may be mentioned that sometimes some suppliers have nominations from buyers for selected items. The apparel industry source locally and globally only for non-nominated supplier's items such as yarn, fabrics, accessories, packaging materials and trims. Once the first shot of the raw materials as a sample is sent by the supplier then the lab dips are done and are approved by the buyer.

As per PO, supplier gives PI (Proforma Invoice) to purchasing department. Purchasing department and accounts and finance department approve the PI and finishes all related works. Purchasing department gives approved PI and necessary papers to the commercial department for LC (Letter of Credit) or TT (Telegraphic transfer) opening. After opening of LC or TT, the commercial department informs purchasing department. The purchasing department informs suppliers for their LC or TT. They collect their LC or TT from their advising bank.

Supplier delivers the goods to the store department at the right time. After receiving the goods from the supplier, the store department rechecks quantity and quality through an inspection process specified by the buyer. In case of any deviation, the supplier usually replaces the item.

The store department also keeps track of all the quantities received in-house timely. Suppliers submit their documents for payment to the purchasing department. The purchasing department confirms their payment finish internal process. Suppliers collect approved documents from the purchasing department and submit to the respective bank and get paid. The goods are generally received in breakups as suggested by the merchandiser according to the requirements stated by the planning and the production department.

The purchasing department follows up with the supplier for deliveries as and when the merchandiser asks for the new set of the materials. The increasing use of sourcing, purchasing and procurement strategic practices dramatically changes the way products develop. These changes scenario makes the industry more efficient to fulfil customers' demand in a defined cycle time, and at comparative costs.

The strategy of sourcing the raw material for garment manufacturing depends upon the parameters like lead time, cost and quality. The international laws of tariffs and trade affect these strategies strongly. Apart from these conditions; sourcing decisions are made based on domestic market conditions, cost benefits, international market situation, relation between the respective countries and political stability of the country. Well-managed procurement ensures that supplies of the required quality are available at the right time, at the right place and at the right price.

*Ref: MD. WALID HOSSAIN, MSS in Economics, DCS, PGDSCM, CSCM, SUPPLY CHAIN DEPARTMENT
NEW ASIA GROUP.*

23. Green/Environmental Procurement Towards Developing Resilient Supply Chain

23.1 A Quick Introduction to Green Procurement

"A business' green procurement policy should strive to purchase products and services that have less negative impact on the environment. Environmental considerations forms part of the evaluation and selection criteria, which could cover, depending on goods and services to be purchased, their manufacture, transport, packaging and disposal."

"Sustainable Development" was the key concept of the 1992 Earth Summit in Rio, as governments and international organizations committed themselves to take action to protect the environment as in integral part of long-term economic development. Environmentally-responsible consumption and production is seen as an essential part of the strategy to improve environmental quality, reduce poverty and bring about economic growth, with resultant improvements in health, working conditions, and sustainability, and is highlighted in Chapter 4 of Agenda 21. In particular, organizations were called upon to exercise leadership in the promotion of environmentally sound goods and services.



In many developing countries public procurement of goods and services forms the major part of government expenditure. Economic activity of such magnitude has far-reaching implications and governments, international organizations, and donors have a responsibility to take the environmental impacts of their activities into account. A move towards favoring goods and services whose manufacture, use and disposal is conducted with a view to environmental impacts not only has direct environmental benefits, but also sends a strong message to manufacturers and suppliers that the issue is taken seriously.

Since Rio, the response of the private sector has been impressive, with many multinational organizations developing effective environmental management policies. Green procurement (also called 'environmentally responsible procurement') is now no longer new to Europe, North America, and developed countries. The public sector has lagged behind somewhat, although many local authorities in developed countries have now introduced environment management systems which include procurement policies.

Two Approaches to Green Procurement

Business has evolved two approaches to integrating environmental considerations into procurement decisions. These can be termed a "**Product Approach**", which examines goods and services and attempts

to rate them according to environmental impacts, and a **"Supplier Approach"**, which looks at the supplier (preferably a manufacturer or service provider) and rates the organization as a whole.

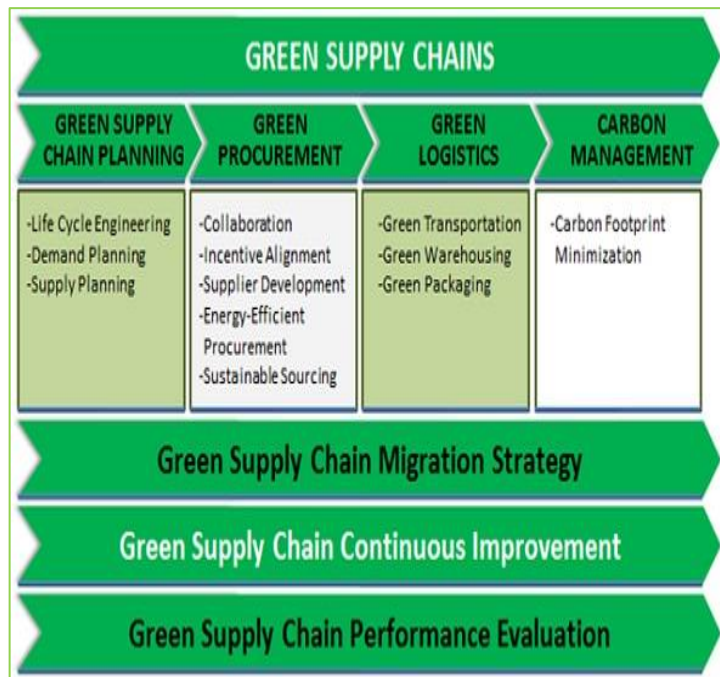
Companies employ both approaches with differing degrees of thoroughness. Some devote considerable resources to environmental "policing", sending environmental auditors to carry out in-depth examinations of suppliers, operations and supplies, whilst for others it is little more than a token gesture.

A Product Approach typically uses the tools of life-cycle analysis and total cost analysis to attach an environmental rating to a proposed purchase. Supplier Approaches seek ways to rate companies and suppliers according to their overall environmental performance, typically using questionnaires and outside audits and rating systems, such as Environmental Management Systems.

Both approaches have associated advantages and disadvantages, depending on the procurement patterns of the organization involved and the degree of centralized oversight that a particular funding or UN agency wishes to exert.

Integration with existing procurement regulations

Green procurement does not seek to re-write the book on procurement, but merely to add an environmental dimension to the decision-making process. The standard purchasing criteria, of price, quality and availability, remain paramount. The environmental impacts of a good or service procured can be seen as part of the "quality" criterion.



Whilst every organization should establish a list of items which they will not purchase, green procurement should not normally be seen as being prescriptive, and restrictive to procurement staff.

There will be occasions where a product's exceptionally competitive price will be an over-riding factor in a procurement decision, despite negative environmental factors. On the other hand, there will be occasions where a product's negative environmental impact, or particular environmental advantage, prove to be decisive in a procurement decision.

The importance of a green procurement policy is that procurement staff are asked to consider environmental impacts, and are allowed to make decisions accordingly. It can make a significant difference to an organization's environmental performance, as well as send a powerful message to businesses that the environment is taken seriously.

23.2 Green Procurement: Just More than Just 3-Rs!

The 3Rs, "Reduce, Reuse and Recycle" is quite well known, but is it enough? Do we need a larger and deeper outlook at the global environment, and the impact that urban areas are having on it? A quick scan of a dictionary showed a number of "R"s that we need to look out for, listed below in alphabetical order. Many are, of course, interrelated and address similar approaches to environmental management.

Note that the word "resource" is used in a very broad sense and can include both living and non-living/natural and man-made resources of an urban environment. It can be a practice, an attitude, or a convention. In explaining the different Rs, lifestyle issues, consumption patterns, green consumerism, and community participation issues were taken into account.

It's a fun way to rethink and redo the basic 3 Rs! And find even more Rs in the descriptions!!

RECLAIM: Improve, get back and/or make operational once again, wasted or degraded resources - for example, in the case of degraded or unusable land or derelict buildings.

RECONSIDER: Used in relation to sustainable living: reconsider the need for a wasteful living lifestyle, the overuse of resources and redundant materials -- in order to have a minimum impact on the environment.

RECOVER: Salvage or recoup the usefulness of a resource. Also bring a resource back to its original or improved functioning state.

REFORM: Improve on a resource -- remove and rectify its misapplication or misuse. Change attitudes and practices in its use, so as to preserve and protect the resource.

REFUSE: Used in the sense to reject or not accept a lifestyle that is wasteful, over consumes, and destroys the environment. Can also be 'refuse to create refuse'!

REGENERATE: Invest in a resource to improve, revive and rejuvenate it. Regenerate a resource to make it useful once again.

REGULATE: Control and restrict resource use with prescribed rules and norms -- particularly in the case of non-renewable resources. It can also include the management and monitoring of such resources to prevent misuse and degradation.

RELINQUISH/RENOUNCE: Relinquishing or renouncing refers to giving up the use of certain goods or services that produce a negative environmental impact. Sometimes it may also mean the giving up of a personal 'convenience' for the good of the environment.

REPAIR: Quite simply, machines and technologies that are in a bad condition or in a state of deterioration (uses more resources and emits) more waste than normal) need to be repaired to make it more efficient with less environmental impacts.

REPLACE: In some cases, resource crunching, wasteful goods and technologies have to be replaced by more appropriate and productive alternatives, which are less energy intensive too.

RESOLVE: Resolve refers to taking a decision, making a resolution, to change our ways and lifestyles, so as to have a small 'footprint' on the earth -- resolve to consume less resources.

RESPECT: Maintain a healthy and humble respect for the environment. Understand its fragility and vulnerability to indiscriminate use and abuse. Also respect and understand nature's 'backlash' in such cases!

RESTORE: Reinstall and return to the environment the resources that were taken from it. Restoring also refers to the return of resources to its natural state.

RESTRICT: Curtail and control the indiscriminate and wasteful use of natural resources. It can also mean the confinement of resources use within levels below which it can be regenerated and regulated.

REWARD: Highlight good practices in sustainable resources use; create incentives and prizes for good behavior. In a negative sense, penalize and fine inappropriate and wasteful lifestyles.

RECONDITION: An example of recycling - to disassemble and clean products recovered in factories and reassemble them after changing some parts. Quality assurance is processed as required and reconditioned products and units are shipped to the market as the same products and units as those recovered.

REMANUFACTURING: Remanufacturing calls for the disassembly of products and removal of a large number of parts that can be used as parts in other new products.

23.3 Green Procurement Guidelines

A company can, as a part of its strategy to green its procurement process, consider some of the following approaches:

Supplier focus (with emphasis on environmental performance of supplier)

Product and Service focus (including environmental specifications)

Lifecycle Analysis (internal analyses, or utilizing LCAs completed by outside groups).

The implementation of such procurement objectives can include, for example - creating awareness of environmental impacts; developing guidelines for green procurement; rethinking material requirements and consumption; reducing the use of hazardous materials; improving energy efficiency of purchased materials; reducing pollution and noise levels; using recycled materials, or recycling waste.



Examples of Green Procurement Guidelines

Green procurement policies and guidelines not only target consumers buying products, but also companies and businesses sourcing parts, materials and sub-products to create their own final products. A survey of procurement policies of consumer groups and companies (for their supply chains) illustrate the following examples for the greening of procurement:



- Create an environmental management system (EMS) or acquire an external certification regarding the company's EMS, for example those under the ISO 14000 series.
- Do not use substances prohibited or banned by law in the manufacturing process, for example materials that could damage the ozone layer (under the UN's Montreal Protocol), including the use of hazardous or toxic substances (under the UN's Rotterdam, Stockholm and Basel conventions).
- Where necessary, respond to an information request or survey of chemical substances contained in a purchased material, part or product.
- Ensure that companies and their suppliers are legally compliant with a country's environmental laws and regulations.
- Carry out life-cycle environmental impact assessments of material extraction, manufacturing processes sale, use and disposal of products (including air, water, ground, and noise pollution)
- Undertake climate change measures within the company on mitigating and adapting to climate risks and impacts.
- Implement efforts and contributions to global environmental conservation (for example, GHGs reduction, water consumption, waste generation, management of chemical substances, material resource consumption, packaging and packaging materials, etc.).
- Focus on biodiversity conservation as a part of a company's activities, including preservation of natural ecosystems.
- Institute proper procedures for information disclosure, particularly to consumers and suppliers.
- Implement energy conservation efforts to reduce energy use, run manufacturing processes efficiently, and save energy,. Such efforts should include increased use of renewable energy sources such as solar, wind, hydro or bio energy.
- Have a clear 3R policy to reduce, reuse and recycle materials and products in its entire life-cycle.
- Where relevant, a company or its suppliers carry out environmental audits, assessments or surveys to understand their extended impacts on the environment throughout the lifecycle of the products they produce.

Under these guidelines, a business can introduce measures to increase the utilization of recycled materials and the purchase of more environmental friendly equipment (for instance, computes with a high Energy-

Star rating, or computers with higher percentage of recyclable materials). The gradual phasing out of the energy inefficient machines is one method by which to reduce to energy consumption and can be achieved through these green procurement guidelines.

In order to ensure the effective implementation of these guidelines, a business can carefully consider existing procurement practices in order to evaluate where the major environmental impacts lie. Methods can then be sought to integrate environmental considerations into its purchasing practices. These can be designed to fit with existing procurement methods, and to act as a support tool for purchasing staff. The policy, procedures and practices should not be designed to prohibit the purchase of any goods - merely to favor goods that are environmentally friendly. Other factors of quality, price, delivery times, etc., still remain paramount in purchasing decisions.

23.4 Green Procurement: Some Product-specific Examples

Asbestos

A business does not purchase or use materials containing crocidolite or amosite asbestos. Where necessary, appropriate safety measures can be taken where no practical alternative materials are available.

Pesticides and Agro-Chemicals

A business manages potentially-hazardous chemicals in a manner that minimizes the use of pesticides and agro-chemicals, whilst maintaining acceptable standards of public health and agricultural production, and also minimizes the risk of unintended environmental contamination in transport, storage, use and disposal. This policy can be backed up with strict guidelines, detailing pesticides to avoid, procedures for pesticide selection, application and disposal. In principle, use of pesticides and chemicals can be prohibited, unless sanctioned by a qualified, on-site specialist.

Ozone-Depleting Substances

A business should not purchase which contain, or use in their manufacture, substances controlled under the Montreal Protocol. Goods with less ozone-depleting potential should be preferred. This policy should be backed up by appropriate and strong technical guidelines. Knowing how to identify products which are likely to contain, or use in their manufacture, controlled ozone-depleting substances, can form part of the procurement staff training course.

Office Paper and Equipment

A business should purchase and use recycled paper, produced with environmentally-friendly bleaching methods, and environmentally-friendly computer equipment.

Ref: <https://www.gdrc.org/sustbiz/green/a-procurement.html>

24. Terrorism: A Growing Threat to Supply Chain

Terrorism is a reality that, unfortunately, requires our growing attention in the supply chain world. Terrorism, in its broadest sense, describes the use of intentionally indiscriminate violence as a means to create terror or fear to achieve a political, religious, or ideological aim. This violence can take on many forms, including cyber terrorism, and can have dire consequences to the supply chain.



Terrorism is a global problem that strikes locally. The net result of the horrible tragedy of 9/11 was a wake-up call to all Americans about the threat of terrorists groups. After the attack to the World Trade Center and the Pentagon on September 11, 2001, companies are starting to realize that the threat of terrorism is affecting their ability to operate and successfully carry on their business.

Not only several firms have been directly hit by the destruction of the Twin Towers, having their offices inside those buildings, but almost every supply chain was affected by the closing of US airspace grounding of the planes and by the closure of the borders that immediately followed. Ford, for example, had to shut down five of its U.S. plants, partly because it could not get enough parts from suppliers in Canada.

The result was a 13 percent drop in production in that quarter (Andel, 2002). The U.S. Government response not only affected business operations in the aftermath of the attack, but it is still influencing international shipments through new regulations, thus extending the impact to global firms. The U.S. Customs is now strongly encouraging importers and freight carriers to certify their sources and assume responsibility for cargo security (Custom-Trade Partnership against Terrorism)

Nature of disruptions due to terrorist attacks:

Disruption	Description
Disruption in supply	Delay or unavailability of materials from suppliers, leading to a shortage of inputs that could paralyze the activity of the company.
Disruption in Transportation	Delay or unavailability of the transportation infrastructure, leading to the impossibility to move goods, both inbound and outbound.
Disruption at Facilities	Delay or unavailability of plants, warehouses and office buildings, hampering the ability to continue operations.
Freight breaches	Violation of the integrity of cargoes and products, leading to the loss or adulteration of goods (can be due either to theft or tampering with criminal purpose, e.g. smuggling weapons inside containers).

Disruption in communications	Delay or unavailability of the information and communication infrastructure, either within or outside the company, leading to the inability to coordinate operations and execute transactions.
Disruption in demand	Delay or disruption downstream can lead to the loss of demand, temporarily or permanently, thus affecting all the companies upstream.
Disruption in supply	Delay or unavailability of materials from suppliers, leading to a shortage of inputs that could paralyze the activity of the company.
Disruption in Transportation	Delay or unavailability of the transportation infrastructure, leading to the impossibility to move goods, both inbound and outbound.
Disruption at Facilities	Delay or unavailability of plants, warehouses and office buildings, hampering the ability to continue operations.
Freight breaches	Violation of the integrity of cargoes and products, leading to the loss or adulteration of goods (can be due either to theft or tampering with criminal purpose, e.g. smuggling weapons inside containers).
Disruption in communications	Delay or unavailability of the information and communication infrastructure, either within or outside the company, leading to the inability to coordinate operations and execute transactions.
Disruption in demand	Delay or disruption downstream can lead to the loss of demand, temporarily or permanently, thus affecting all the companies upstream.

From the point of view of the supply chain, the consequences of a terrorist act on places such as airports, ports, and railroads are not much different from the ones caused by natural disasters. Therefore the preparations should be similar.

The difference is that some of these areas don't have contingency or emergency plans for natural disasters because risk varies according to regions. So, these areas should make a thorough risk analysis similar to other areas' natural disaster plans, and also put it in place in the case of terror threats.

Corporations should include in their risk analysis not only areas subject to natural disasters, but also the ones with **high risk of terror attacks**. They must include actions such as diverse footprint, secondary suppliers for the same components, emergency changes on factories set up. These actions are used to compensate losses/disruption of the supply chain flow.

Furthermore, real-time data acquisition, big-data analysis, and effective planning are the key to fast reaction times for corporations once an attack/disaster happens. The sooner the corporation takes action in order to mitigate disruption, the less its flow will be affected. If an airport is closed, it is important to be the first one to know and the first one trying to move the cargo through alternate routes/intermodal.

In order to protect the supply chain from disruption, the necessary security can be classified in three groups as follows:

Supply Chain security measures:

Area	Basic Initiatives	Advanced Initiatives
Physical security	<ul style="list-style-type: none"> • Access control, badges, etc. • Gates, guards, camera systems, etc. 	<ul style="list-style-type: none"> • Background checks • Test of security by an external firm attempting to break in
Information security	<ul style="list-style-type: none"> • Hardware: firewalls, dedicated networks, etc. • Software: intrusion detection, antiviruses, passwords, etc. 	<ul style="list-style-type: none"> • Conduct Audits • Education and training for IS security
Freight security	<ul style="list-style-type: none"> • Inspections • Joint initiatives with Government as applicable • Cargo seals 	<ul style="list-style-type: none"> • Procedures, audits and certification • Industry initiatives • GPS, RFID, e-seals, biometrics, smartcards, security sensors, etc.

In view of the above fact, needless to mention that terrorism is considered together with many other risks affecting the supply chain, thus allowing us to use various techniques to manage the threat. Every supply chain and every company should identify the most effective and efficient way to protect itself, reducing the risk exposure without affecting cost effectiveness and without over-reacting to the disruptions suffered in the past. This may be the one more agenda for the enterprises of Bangladesh in the days ahead.

References:

- 1) *Terrorism and Supply Chain: A Growing Threat of Supply Chain Terrorism*, <https://cerasis.com/supply-chain-terrorism/>
- 2) *A Supply Chain Response to Global Terrorism: A Situation Scan* by Yossi Sheffi and James Blayney Rice, Massachusetts Institute of Technology, and Fedirico Caniato, Politecnico Di Milano.

25. Ethics in Procurement

Ethics is the basis on which most of the procurement related principles, such as fairness, integrity, and transparency, are based. Professional standards of ethical conduct, no matter what the organization, contain typical characteristics, including commitments to:

- Behave honorably in all aspects of work and professional activity.
- Conduct oneself in such a manner as to maintain trust and confidence in the integrity of the acquisition process.

- Avoid “clever” practices intended to take undue advantage of others or the system.
- Uphold the organization’s standards and policies and all relevant legislation.
- Avoid conflicts of interest.

a. Potential areas of risk in the procurement cycle:

Some potential areas of risk **relating to ethics** in the procurement cycle are listed in the table below.

Area of risk Explanation and examples	Area of risk Explanation and examples
Budgeting	Fraud and corruption must be paid for from somewhere. Lack of proper budgetary control, for example when all funds are not allocated to a specific purpose, can provide the necessary funds.
Financial approval policy	Without regular audits and strict management controls, there are opportunities for fraudulent use of a person’s own levels of authority, or of misusing someone else’s.
Perceived need	Requirements can be invented or falsified.
Specification development	Specifications can be written to favor a specific supplier. Clarifications on specifications can be provided to one of the invitees only during the tendering process.
Evaluation criteria	Evaluation criteria can be written, or amended, after receipt of offers to favor a particular supplier.
Pre-qualification	This process can be used to limit the field of competition to give a favored supplier an advantage.
Invitation to tender/sourcing	This process can be used to give the illusion of competition where it does not really exists by inviting tenders from companies who are known to be unsatisfactory, or by not sending out complete specifications to all tenders at the same time etc.

Why ethics... ...why now?

- Ethics are more important to employers and consumers than ever before
- Poor actions taken by individuals can result in financial and reputational loss, and even legal proceedings
- Serious breaches in supply chains are hitting the headlines more and more often
- You want to do the right thing.

Offer evaluation	Fraud at this stage occurs mainly when objective evaluation criteria have not been agreed in advance. It can also occur where technical staff is able to use their specialist knowledge to mislead other members of the evaluation team.
Negotiation	Favored suppliers can be assisted or given useful information during negotiations.
Contract award	There are opportunities for fraud by the supplier either through deliberately fraudulent acts or through buyer incompetence.
Post award changes to specifications	This allows suppliers to increase profits, particularly when awarded the contract on an attractively low offer price.
Goods receipt	Examples are: Allowing under-deliveries of goods or non-performance to specifications, or drafting false goods inward notes; deliberate over ordering; allowing inventory to dwindle so that emergency orders at a higher price will have to be processed.
Invoice certification	Deliberate overcharging, backdating orders to allow benefit from price changes, paying twice, failing to insist on or monitor retentions.
Decentralized procurement organization	In decentralized organizations the responsibilities are delegated to a large number of people, and it is difficult for the central procurement function to exercise total control and to be aware of what is going on in the decentralized units. Although decentralization can often improve efficiency and reduce costs, it can also increase the risks of corruption.

b. Potential warning signs of unethical practices

There are some typical signs that may indicate or warn of unethical practices. These include, but are not limited to the following:

- Deviations from correct procedures
- Overcharging by the supplier
- Poor record keeping
- Missing files
- Poor or no separation of duties (for example, the same person issues the order and approves the payment)
- Poor control (for example, only one person signs a contract)
- Buyer’s extravagant life style
- Buyer’s frequent absence from the office
- Excessive entertaining by suppliers
- Resistance to audit
- Reluctance to delegate
- Excessive secrecy
- Dictatorial management style
- Unnecessary meetings with suppliers

- Not allowing other staff to deal with certain suppliers
- Established suppliers' reluctance of entering competitive tendering
- Supplier cartels.

Ref: UN Procurement Practitioner's Handbook

c. Code of Ethics

The International Federation of Purchasing and Material Management (IFPMM) is the entity grouping purchasing & supply professional association world-wide. It has developed a code of ethics that can serve as model for all purchasing & supply personnel, shown below.

**International Federation of Purchasing and Material Management (IFPMM)
Code of Ethics**

Precepts

Members shall not use their authority or office for personal gain and shall seek to uphold and enhance the standing of the purchasing and material management profession by:

- A. Maintaining an unimpeachable standard of integrity in all their business relationship both inside and outside the organization in which they are employed.
- B. Fostering the highest standards of professional competence amongst those for whom they are responsible.
- C. Optimizing the use of resources for which they are responsible so as to provide the maximum benefit in their employers.
- D. Complying with the letter and the spirit of:
 - The laws of the country in which they practice.
 - The Federation's 'guidance' or professional practice as outlined below and as may be issued by the Federation from time to time.
 - Contractual obligations.
- E. Rejecting and denouncing any business practice that is improper

Guidance

In applying these precepts, members should follow the guidance set out below:

'A. **Declaration of interest.** Any personal interest which may impinge or might reasonably be deemed by others to impinge on a member's impartiality in any matter relevant to their duties should be declared to their employer.

B. **Confidentiality and accuracy of information.** The confidentiality of information received in the course of duty must be respected and should not be used for personal gain; information given in the course of duty should be true and fair and not designed to mislead.

C. **Competition.** While considering the advantages to the member's employer of maintaining a continuing relationship with a supplier, any arrangement which might, in the long term, prevent the effective operation of fair competition, should be avoided.

D. **Business gift.** To preserve the image and integrity of both the member and employer, business gifts should be discouraged. Gifts, other than items of very small intrinsic value should not be accepted.

E. **Hospitality.** Moderate hospitality is an accepted courtesy of a business relationship. However, the recipients should not allow themselves to reach a position whereby they might be deemed by others to have been influenced in making a business decision as a consequence of accepting such hospitality. The frequency and scale of hospitality accepted should not be significantly greater than a recipient's employer, through the recipient's expense account, would be likely to provide in return.

When in doubt of what is acceptable in terms of gifts and hospitality, the offer should be declined or advice sought from the member's superior.

Ref: International Federation of Purchasing and Material Management. Secretariat: Rockhgasse 6 P.O. Box 131, A-1014 Vienna, Austria – phone++ 43(1) 533 86 38 78 Fax: ++ 43(1) 533 86 36 79 secretariat@ifpmm.org

26. A2Z Procurement for Savings

This is an **A to Z** list of savings tips for **Purchasing** and those working in related fields.

This **A to Z** is aimed at a tactical purchasing level, and there will also soon be an additional A to Z for more strategic levels of Procurement and Category Management.



If you are currently working with a purchasing team that is **savings focused**, this is a great list to keep everyone thinking about opportunities for savings...

Aggregation of orders - Aggregating similar order requests from all departments, sites, branches of your organization. This will increase your negotiation leverage when going to market, plus it will save on other costs such as freight and processing due to aggregation of requests.

Bulk Quantities - Where economical, the higher the order quantity the more leverage you have in negotiation. Why by a quantity of one, when you can buy three for a bigger saving.

Cost Avoidance - Avoiding a supplier's price increases through good negotiation or other tactics.

Discounts. Can you get a discount off the supplier's list price?

End Users of the goods/services can assist greatly in ways to make savings. For example, they may be able to advise on the lowest acceptable quality or specifications to meet the needs and compliance, and this can mean reducing spend.

Feedback - Offer feedback to unsuccessful suppliers in a quotation process. This will allow the supplier to work on their weaker points and potentially offer a more competitive quote the next time round.

Good invoice price checking process by the purchasing officer to ensure savings achieved are being correctly invoiced by the supplier. This is especially important if the purchasing officer doesn't get the invoices (e.g. invoices go through internal accounts or stores). An example of an issue is where the purchase order price is being adjusted in the system to match the supplier's invoice.

Have a good understanding of supplier's costs. This can reveal areas to make savings. Remember that 'Cost' is a real number, whereas 'Price' can be partially made up.

Information Accuracy and Completeness - Make sure you have the full details of a requirement before moving forward with a procurement. This will make it easier to gain quotes from multiple suppliers, and increase potential to make a saving.

Justify purchasing decisions with an evaluation process (quick or extensive evaluation depending on value/risk level), so you consider price and all other factors (e.g. freight cost, lead time, meets technical specs etc.) and therefore make quality decisions. You don't want to make a decision for a less expensive item, when the freight cost will override those savings. Total Cost!

Keep an eye out for ways to improve your purchasing processes. A simple change in the way you operate can have a significant impact for a company.

Logistics - look for savings to be made in the freight and handling of your purchase orders.

Market Price - Has any drop in market price (e.g. steel) allow for a reduced price for goods or services.

Negotiate prices and supplier costs to achieve best possible savings! And don't forget good internal negotiation with stakeholders and peers, otherwise your savings initiatives may never come to fruition.

Overcome objections from personnel who want to keep buying from their regular supplier despite paying a premium (Maverick Spending). Show them the potential savings so they understand the costs of their decisions.

Purchasing cards - low spend/low risk purchases, saving money on processing time such as raising purchase orders. Note that the exception to this is where the purchase is for catalogued materials, as they usually need to be tracked in an inventory system.

Quotes from at least 3 suppliers for medium to higher value purchases. Also referred to as a Spot Buy. It can also be worth getting Spot-Quotes from transport companies when paying for a larger freight movement of an order, even if you already have rates in place.

Reduce Specification: e.g. if you can get brand names removed from requests, this can open up the market for more suppliers to provide a quote.

Suppliers are the experts! Ask the supplier for their advice on how savings can be achieved, they may offer up helpful ideas. For instance they may appreciate a forecasted usage of a particular item, which will allow them to offer better pricing.

Terms of Payment: e.g. by paying quicker (e.g. 15 day account instead of 30), will the supplier offer a discount? Ensure that your company can meet these agreed payment terms.

Utilize existing contracts where possible to reduce leakage.

Vendor Relationship - working closely with your suppliers can realize benefits such as shorter lead times, priority access to stock, and other value adds etc.

World-Wide Sourcing - Where appropriate, source quotes globally as well as locally.

EX stock items available on the supplier's shelf are a good target for getting a better price, as opposed to situations where the supplier has to order goods into the country.

Why **pay premium** when a lower specification will do the same quality job?

Zero Purchase - Does it really need to be purchased? Identifying a need NOT to purchase is close to a 100% saving on the goods or services.

Thanks for reading and hopefully this can assist you and your purchasing team.

Be sure to check out more upcoming **A to Z** lists including a Procurement list, and Supply Chain list.

www.ProcurementCourse.com

27. Glossary of Procurement Terms

Some important 'Glossary of Procurement Terms' are given below:

RFI (Request For Information)

Formatted document sent by the buyer to collect general information from vendors to analyze if they could potentially be selected.

RFP (Request For Proposal)

Formatted document sent by the buyer to collect specific information from a potential supplier on a specific proposal or demand. The RFP should set out your requirements in as much detail as possible. However, you should give vendors the room to maneuver in using their own expertise to provide the best solution for your needs.

RFQ (Request For Quotation)

Formatted document sent by the buyer to collect pricing information for a certain good (quality, quantity) from a selected potential supplier.

Auction

Process in which a seller proposes a good or a service to sell at a proposed starting minimum price, while the potential buyers show their interest in good or service by increasing this given starting price to be sure to get the deal. The auction is closed when there are no longer buyers to increase the last proposed price.

Reverse Auction

Process in which a buyer proposes to buy a good or a service. In a limited time frame, sellers have to decrease their selling price to propose the best offer. In fact, auction ends when nobody is willing to supply the item (s) at a lower price, and winner is the latest bidder.

Field Purchase Order

A document used to order goods from a supplier for purchases limited to a certain dollar amount with purchasing authority delegated by a central procurement office.

Purchasing Price

Price the buyer is ready to pay for a good. This buying price corresponds to the suppliers selling price.

Purchasing Cost

Cost of the transaction for a good: it corresponds to the purchasing price plus elements of transactional costs.

Cost Breakdown Analysis

Process to build up and to understand the different elements which compose the cost of a good or a service (labor, investment, utilities...).

TCO (Total Cost of Ownership)

Methodology to set a complete cost along the life of the product (including end of life, training, maintenance...).

Value

The value is (associated to all tangible elements) plus intangible costs (expertise, satisfaction, fit, ...). It is equal to "Customer Satisfaction" / "Cost".

Price Reduction

To decrease buying price by decreasing mainly the margin associated with goods.

Cost Reduction

To decrease cost by improving efficiency on some elements of the transactional costs (order, follow-up, invoice).

Cost Avoidance

To avoid some costs by modifying technical specifications (over quality, over quantity, ...).

KPI's (Key Performance Indicators)

Set of indicators permitting to track results (price, lead time, quality, ...).

Sourcing

Process to identify, qualify and select new suppliers.

Supply Chain

Series of operations that provides goods or services though to end customers.

Value chain

Activities though which a firm develops a competitive advantage and creates shareholder value. Purchasing is one contributor to value chain.

Purchasing Process

This process mainly includes 6 mains steps. The definition of needs, the analysis of the supplier market, the definition of the purchasing strategy, the selection of the suppliers, the Negotiation, the contract deployment and Supplier Development.

Transactional purchasing**Operational purchasing****Tactical purchasing**

Purchasing which is only a support function dealing more with administration (ordering, tracking, invoicing) than strategy.

Downstream purchasing

Is the management of the purchasing process once the specifications are frozen (or the needs /requirements are defined).

Strategic purchasing

In opposition to transactional purchasing. To be involved in the definition of requirements, the client's satisfaction, the value creation process.

Upstream purchasing

Similar to EPI.

EPI (Early purchasing involvement)

Purchasing staff being involved in the definition of requirements to avoid risks and cost.

Benchmarking

Process to identify the best in class, to analyze the best in class, to understand why he is the best and to understand what we have to implement to improve ourselves.

To be the benchmark

To be the reference.

ESI (Early supplier involvement)

To have suppliers participating at the very early stage of the process to contribute in the definition of requirements.

Best in class

The company who is considered as the best in realizing one given activity or a given practice (whatever the sectors).

A Seller's or Supplier's market

A market which is favorable to the suppliers (the demand is greater than the supply).

A Buyer's or User's market

A market which is favorable to the users (the supply is greater than the demand).

Switching Point

When the demand corresponds to the offer, then the price starts changing its trend (from increasing to decreasing and vice versa).

Porter 5 Forces Analysis

Framework to assess supplier market dynamics by looking at competition amongst suppliers, likelihood of new suppliers entering the market, availability of substitute products or services, bargaining power of suppliers of inputs, and bargaining power of buyers.

Core Business/Core Activities

What the companies consider as the key strategic elements of the company that cannot be outsourced.

Make or Buy Criteria

Criteria to support the decision of making or buying (cost, innovation, capacity, capability, core business).

Outsourcing

Outsourcing means buying something which was previously made or provided in-house.

Vertical integration

Vertical integration means making or providing something internally which was previously bought externally.

Differentiate Between Cost control and Cost Reduction?

Cost Control - a method whereby costs are managed and monitored to ensure they do not grow beyond the projected amount. Cost Reduction - a method whereby costs are reduced from the projected amount.

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- International Federation of Purchasing and Material Management. Secretariat: Rockhgasse 6 P.O. Box 131, A-1014 Vienna, Austria – phone++ 43(1) 533 86 38 78 Fax: ++ 43(1) 533 86 36 79
secretariat@ifpmm.org
- www.ProcurementCourse.com
- Almost all pictures have been collected through <https://www.google.com/search>



Training on Supply Chain Resilience

Module 4: Logistics, Inventory, Transportation and Warehouse Management

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Preface

"Logistics means having the right thing, at the right place, at the right time". Logistics is a relatively new word used to describe very old practices like the planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.

Regarding Inventory, it is defined that Inventory is a list of goods and materials, or those goods and materials themselves, held available in stock by an enterprise. In other words, inventory is stored accumulation of material resources and physically located that are used in a transformation process and/or activated as asset. Please keep in mind, "It's easy to turn cash into inventory, but the challenge is to turn inventory into cash".

On the other hand, transportation is the movement of people and goods from one location to another. Transport is performed by various modes, such as air, rail, road, water, cable, and pipeline. The field can be divided into infrastructure, vehicles and operations. With increased specialization and globalization, production is being located further away from consumption, rapidly increasing the demand for transport.

Warehouse is an establishment that stocks goods for sale to customers/consumers or gathers materials for the purpose of using as an input for production processes. Effective Warehouse Management system can maximize the servicing of orders on time and in full, minimize the cost of warehouse, and maximize inventory turnover (i.e. minimize the time that materials stay in the warehouse). While effective warehouse management system is in place, organization can minimize response time to demand, and errors in dispatches. It also helps to preserve quality, value and security of stored items.

Supply Chain Resilience means the ability of a system (supply chain) to return to its original state or move to a new, more desirable state after being disturbed. It is difficult or nearly impossible to develop Supply Chain Resilience without effective application of logistics, inventory, transportation and warehouse management systems.

Today you need to reduce your company's costs, improve your customer service quality, and increase the synchronization of activities throughout your supply chain. You need to look for cost benchmarking tools that can identify opportunities to generate savings in your logistics, inventory, transportation, warehousing, and other relevant operations. You must optimize Supply Chain Management, Freight Transportation, and Logistics Services.

Needless to mention that Supply chain resilience is receiving increased attention in the business, as well as in the academic press. In this increasingly competitive global business environment; the quality of logistics, inventory, transportation and warehouse operations and their costs effectiveness can make the difference between the success and failure of business ventures.

Learning Objective

By the end of this training module, you will be able to:

- Know logistics and its operational and strategic responsibilities including 3PL and 4PL
- Be familiar with “Logistics: Physical Flow” approach and three stages of logistics
- Explain inventory, its types, stages and related issues
- Describe the cost of not holding inventory
- Explain lead-time management and enhancing ability to be resilient
- Know about inventory replenishing system including EOQ
- Explain the concept “Supply Chain Resilience: Safety Stock to Combat Uncertainty”
- Know about inventory stocktaking & audit, inventory turnover and inventory valuation
- Explain how to build SCR by creating a buffer-stock for 3-months’ worth of supply needed for the RMG and textile Industry
- Know about transportation and related issues including modes of transportation
- Be familiar with the study on Supply Chain Resilience in RMG: Review of Supply Chain Development Plans at the National Level
- Prepare cost comparison between two modes of transportation
- Make vehicle cost analysis towards development of resilience capabilities
- Describe about study on Supply Chain Resilience in RMG: Review of supply chain development plans at the national level
- Know about warehouse and related issues
- Be familiar with safety at warehouse and green concept of warehouse

1. Logistics and Related Issues

"Logistics means having the right thing, at the right place, at the right time." Logistics is a relatively new word used to describe very old practices like the planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.

Logistics refers to the entire process of transferring products from producer to consumer, including storage, transport, transshipment, warehousing, material-handling and packaging, with associated exchange of information.

Providing the right amount of material:

- in the right condition
- at the right place
- at the right time
- in the right position
- in the right sequence
- for the right cost
- by using the right methods.

1.1 Operational Responsibilities of Logistics

- Interface delivery of goods between suppliers, transport operators and company users or customers
- Schedule and organize the supply of inputs to manufacturing operations and determine the most economic load size
- Organize picking and packing and ensure labeling, cleaning, sorting and arranging of goods according to purchase specifications
- Organize transport in compliance with requirements and regulations
- Track in-transit products, analyze performance and recording of deliveries
- Organize the handling and inspection of goods at the points of loading, unloading, delivery and unpacking
- Administer the delivery documentation by complying with credit and contract terms
- Liaison with shipping agents and port and custom authorities to ensure completeness of the documentation and timeliness of deliveries. Organizing customs clearance where-applicable- depending on the contract terms
- Ensure compliance throughout logistics process with product handling and safety requirements
- Organize "back-loads" – i.e. the use of vehicles otherwise returning empty- wherever possible to maximize transport efficiency
- Arrange return of packing, transporting and controlling products to suppliers or send for re-cycling

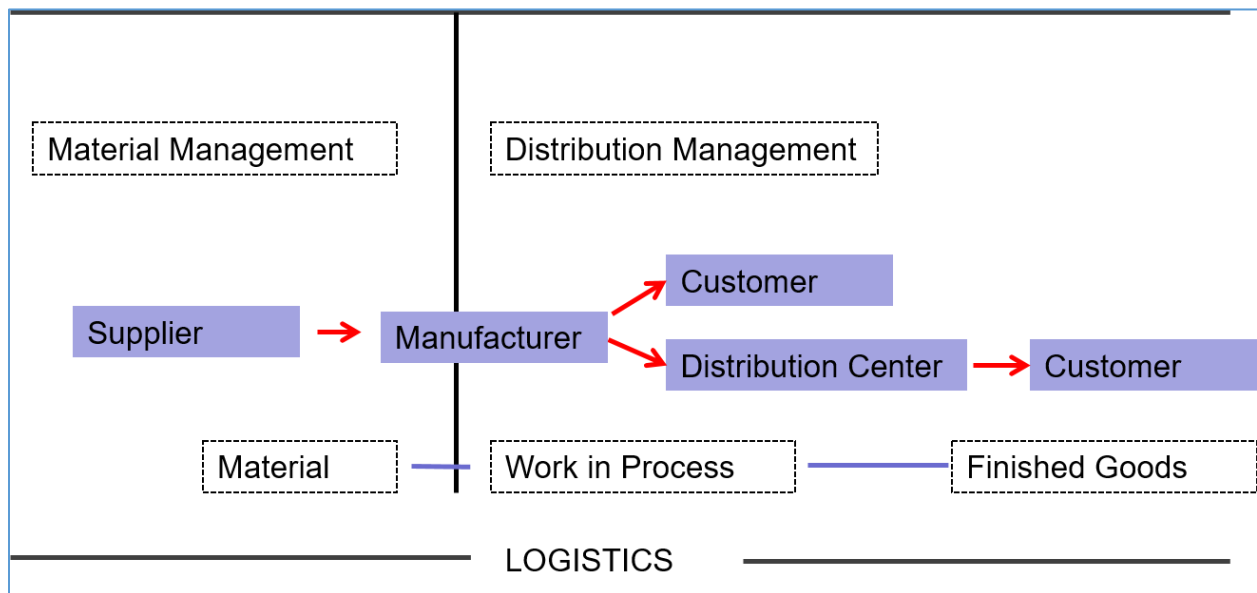
1.2 Strategic Responsibilities of Logistics and Emphasis on Resilience Supply Chain

Logistics issues affect virtually every dimension of corporate strategy including strategy on resilience supply chain. Logistics play an important role in business planning and business strategy. Logistics performance, advice on technical matters and realistic capability and process evaluation are important in the following situation:

- In merger, acquisition and divestments
- In the consolidation or separation of divisions within the same company or group of companies
- In new product launches
- When planning extension into new market segments, retail operations and geographical areas, and for sourcing supplies from new markets
- In the choice of location for new manufacturing plants and warehouses
- In the negotiation of service level agreements (SLAs) with customers
- In cases of fluctuating fuel and other resource costs and during times of high inflation and civil unrest
- When considering the implementation of interest-based activities requiring rapid response times in the inbound and outbound movement of goods
- When considering increase resilience and reduce the likelihood of risk events occurring
- In promoting logistics as a core competences of the company

Ref: Quantifying the Supply Chain Resilience, By A.P. Barroso, V.H. Machado, H. Carvalho and V. Cruz Machado

1.3 Logistics: Physical Flow



The physical distribution of products flows through a variety of geographically placed distribution points. The distribution points could include the manufacturing facilities, distribution centers, wholesalers and retailers, or distribution of goods may flow directly to the customer or through various levels as shown above.

Logistics includes the activities of acquiring material (procurement), moving material through the manufacturing environment (manufacturing of products), and distribution (getting the products to, or close to, the final customer).

1.4 Three Stages of Logistics

Inbound logistics	<ul style="list-style-type: none"> ▪ It involves the transportation of goods from suppliers to the purchasing organization’s operation or warehouse. ▪ Organization must know precisely the point when and where they must assume responsibility – in terms of costs and risks.
Internal distribution (also known as material management)	<ul style="list-style-type: none"> ▪ This process involves the movement of materials and components within a firm, including the breaking down of bulk loads into composite smaller shipments for onward distribution to store, production lines or retail outlets. ▪ All supplied materials may not be owned by the organization, some of them may be for sample, license, consignment, lease or rental agreements.
Outbound logistics	<ul style="list-style-type: none"> ▪ This relates to the flow of distribution and transportation from the organization to a subsequent customer, either another stage in the production process, a retailer, or some other supply chain member.

Companies require to integrate their approach to logistics by linking these operational stages to ensure that together they serve to achieve the organization’s corporate objectives as effectively as possible. At the level of supply chain, member enterprises must also closely link up their logistics processes.

2. Third Party Logistics (3PL) to Build Supply Chain Resilience

Supply chains are subjected to more risks than ever, which are numerous and constantly evolving, and derive both from within and outside of the company. Avoiding such risks or reducing their negative effects is a challenge for today management. Nevertheless, some risks cannot be avoided and with today’s complex global supply chains, fragmentary solutions and specific initiatives are no longer enough to cope with the multifaceted nature of risks. In some cases, companies are unable to focus their core areas by handling complex logistics (main area of the supply chain) services. Thus, it is advisable to engage 3PL to undertake logistics services where possible so that companies especially large companies can concentrate their specialized areas.

The main features of 3PL:

- 3PL stands for “Third Party Logistics” involves the use of an outside company to take some or all of a company’s logistics activities.
- 3PL providers cover transportation or warehousing.
- Modern 3PL providers offer a range of services, and relationship are relatively longer and viewed as partnership or strategic alliances:
- Advantage: Companies who use 3PL providers can focus their activities on their real strengths with the knowledge that the 3PL providers are providing excellence in logistics with the latest information and technological advancement in the field.

- Disadvantage: There are chances of losing contact with the customers, when 3PL provider takes the responsibility of distribution of the products. This can eventually result in the loss of essential market information and of control over the both supplier and customer knowledge.

Ref: Quantifying the Supply Chain Resilience, By A.P. Barroso, V.H. Machado, H. Carvalho and V. Cruz Machado

2.1 Services Offered by Third-Party Service Providers

- Basic Services:
 - warehouse management
 - order processing
 - order fulfilment
 - transportation carrier selection
- Value-added Services:
 - shipment/order consolidation
 - import/export customs
 - logistics information systems (EDI, reporting)
 - fleet management/operations (e.g. cross-docking)
 - product assembly/installation
- Logistics Integrators:
 - full responsibility for key supply chain operations
 - replenishment/order-filling policies
 - product returns
 - customer spare parts inventory replenishment
 - rate negotiation

2.2 Risks of Out-Sourcing Logistics

- Co-ordination costs
- Loss of internal logistics management capabilities
- Biased choice of service providers
- Leakage of sensitive data and information
- Service degradation
 - Less reliable? Longer order cycle time?
 - Emergency response?
- Loss of control and representation
- Reduced contact with final customer
 - 3PL for outbound logistics interact with your customers, you become less visible to your customers

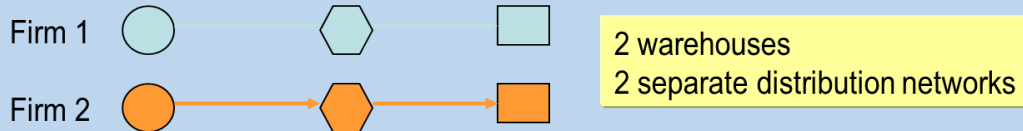
2.3 Why 3PL Can Achieve Economy of Scale & Provide Better Services?

• Consolidation is the key!

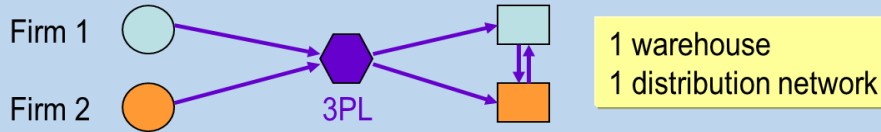
Example: 2 independent firms, 2 independent supply chains

Consider 2 scenarios

Scenario 1: The firms perform their own logistics functions



Scenario 2: A 3PL takes care of both firms' logistics functions



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3. 4PL (Fourth Party Logistics)

4PL “Fourth Party Logistics” providers take the concept of 3PL a stage further. 4PL providers offer all the services related to managing the supply chain for another organization. The 4PL provider undertakes not only the logistics operations but also the coordination of entire supply chain.

Difference between 3PL and 4PL:

- 3PL providers are asset based while 4PL are information based and use information both operationally and strategically to coordinate and manage the supply chain.
- Indeed there may be several 3PL providers managed by one large 4PL provider, the 3PL providing the physical materials management and distribution while the 4PL uses information to optimize the entire supply chain process.



4. Inventory- Definition

- Inventory is a list of goods and materials, or those goods and materials themselves, held available in stock by a business.
- In other word, inventory is stored accumulation of material resources and physically located that are used in a transformation process and/or activated as asset.
- In Accounting: An Asset comprised of all materials, supplies, finished goods or goods in some stage of processing that are owned by a company, whether located physically on the premises of that company, in transit, or in the hands of a distributor who has them on consignment.

“It’s easy to turn cash into inventory, but the challenge is to turn inventory into cash.”

“Inventory is a very expensive asset that can be replaced with a less expensive asset called “information”. In order to do this, the information must be timely, accurate, reliable, and consistent. When this happens, you carry less inventory, reduce cost and get products to customers faster.”

J Dvid Viale

4.1 Inventory and Working Capital Cycle (or order- to- cash received cycle)



WORKING CAPITAL CYCLE

WORKING CAPITAL CYCLE (calculated in days) refers to the time taken by an organization to convert its net current assets and current liabilities into cash. The shorter the working capital cycle, the faster the company is able to free up its cash stuck in working capital and vice versa. The 4 key elements of WCC are cash, receivables (debtors), payables (creditors) and inventory (stock).

$$\text{WORKING CAPITAL CYCLE} = \text{INVENTORY TURNOVER DAYS} + \text{DEBTORS TURNOVER (IN DAYS)} - \text{CREDITOR'S TURNOVER}$$

SHORTENING OF WCC

1. Reducing the credit period given to customers
2. Increase sales to reduce time taken to convert inventory into sales
3. Increase credit period from supplier of the raw materials.

SOURCES OF SHORT TERM WC FINANCING

1. Line of Credit
2. Trade Credit
3. Factoring
4. Short Term Loans

eFinanceManagement.com

4.2 Types of Inventory

Normal Inventory: This is inventory required to support the normal replenishment process under conditions of certainty. If demand and lead times are consistent, normal inventory is what the organization needs to meet customers demand at a given point in time. This type of inventory should generally be as close to zero as possible. However, this may not happen due to transportation, production or distribution economics of scale.

Safety Inventory: Surplus inventory that a company hold to protect against the uncertainty in demand, in lead-times and in quality of supply.

Pipeline Inventory: Inventory moving from point to point in the material flow is called pipeline inventory. This type of inventory will either belong to the shipper or to the customer depending on the terms of sale.

Speculative Inventory: This type of inventory is held other than meeting current demand. For example, the company may decide to buy and stock more than it needs in the event that it forecasts that prices of material will rise or supplier offers lower price if a large quantity is purchased at one time.

Seasonal Inventory: This type of inventory is accumulated in advance of significant selling session. If the majority of sales occur in relatively short projects of time, companies may stock seasonal inventory to stabilize production over a more extended period of time and maintain labor force capacities.

Dead Inventory: Dead or excess inventory is normally considered that exist for more than 12 months. No one wants this type of inventory, but it is held for a variety of reasons. Sometimes to meet occasional need of customers, it is kept as a gesture of goodwill.

4.3 Stages of Inventory

Three common stages:

- Raw-material inventory: inventory that is stored before it is used in the production process
- Work-in-process inventory: partially finished inventory that is within the production process
- Finished product inventory: inventory of product ready to be sold

There is one more common store item i.e. consumables - for example, fuel and stationery.

4.4 Reasons behind Inventory

- Demand forecast error
- Unpredictable or late deliveries from suppliers
- Minimum supplier order quantity
- Supplier delivery interval
- Stocking methodology
- Reorder interval & quantity
- Strategic stocking
- Purchase price advantage
- Lead-times offered to customers are shorter than suppliers' lead-times
- Consignment stocking
- Minimization of delivery costs
- Pipeline inventory
- Anticipation or precautionary stocks

4.5 The Cost of Not Holding inventory

We should aim to optimize the level of inventory, not to minimize, because the costs of running out of supply can be as high as keeping too much of any one item.

Costs associated with running out of stock are:

- Loss of sales from delay in supply
- Loss of goodwill
- Delayed payment from customers if orders are not delivered on time and in full
- High transport cost to ensure quick supply
- Disruption of production process
- Purchasing of small volume supplies at higher prices than usual to satisfy short-term shortages
- Quality differences if components are sourced from outside of the normal supplier network



- Cost of stock-out can be done using a formula like this:

$$CS = (NDOS \times AUSPD \times PPU) + CC$$
- Where,

$$CS = \text{Cost of a Stock out}$$

$$NDOS = \text{Number of Days Out of Stock}$$

$$AUSPD = \text{Average Units Sold Per Day}$$

$$PPU = \text{Profit Per Unit}$$

$$CC = \text{Cost of Consequences}$$
- Suppose 10 units of an item (say **cycle**) are sold per day. Profit is figured out say BDT 500/cycle. In last month there were five days stock-out situation. Due to this stock-out situation, cost of consequence loss has been assumed BDT 10,000/- . What would be total CS:

- $CS = (NDOS \times AUSPD \times PPU) + CC$
- $CS = (5 \times 10 \times 500) + 10,000$
- $CS = 25,000 + 10,000$
- $CS = 35,000$



Cost of Consequences:

- Cost of Consequences generally will apply only to stock-outs of raw materials or subassemblies, not finished goods.
- These consequences includes costs associated with a production line that has been idled or must be switched over to accommodate another process due to the stock-out.
- They can also include penalties payable to customers for failure to deliver on time.
- Most experts agree that carrying costs - the downside of having extra inventory - are 18 - 35% of an item's value for a year. This translates to 0.05% to 0.1% per day. Though profit margins are certainly tight in this economy, getting a sale is many times more profitable than avoiding inventory carrying costs.



4.6 Factors in Determining Inventory Quantity:

There are many factors that will determine in fixing quantity of inventory like:

Demand: When planning is made, an organization needs to be able to determine the likely demand over a given period of time. Demand generally changes over a period of time, as a result of evolving requirements. If an organization does not try to determine demand as carefully as possible, then quantities in inventory are like to be deviate substantially from what is actually needed. Customer demand may be ascertained in advance or it may be random, with historical data used to estimate average customer demand and variability, measured as the standard deviation. Stock replenishment systems require estimates of demand in order to calculate requirements in the supply lead-time and to determine safety stocks and order quantities.

Lead-times: An organization needs to consider the replenishment lead-time, i.e. how long it will take to get the product to the customer once an order has been placed. If lead-times are known, then it is easy to calculate inventory levels and minimum inventory levels to be kept. If replenishment lead-times are not known, then inventory levels will be higher throughout the supply chain.

Range and variety of products: The number of your product range will influence in ascertaining the quantity of inventory to be held. If you have a wide range of products, your inventory levels will tend to be higher than a small range of products is produced. The variety of components used in products that are manufactured has an impact on inventory levels. Shared components and delaying in customization of products will lead to variety reduction, and thus lower levels of inventory.

Required service level: In inventory management, service level is the expected probability of not hitting a stock-out during the next replenishment cycle or the probability of not losing sales. The service level is determined in a company by the level of stocks. Therefore, the safety stock level must be high enough to cover vendor's delivery times, sufficient enough to cover customers' demand, but not so high that your company loses money because of high carrying costs. If longer period is allowed to satisfy an order or requisition, the level of service will usually be higher. The service will closely be linked with safety stock.

INVENTORY MANAGEMENT, SERVICE LEVEL AND SAFETY STOCK by Alin Constantin RĂDĂȘANU, alin.radasanu@ropharma.ro

ITC-MLS-SCL Modules 2, 10 and 11 (old course)

5. Lead-time Management and Enhancing Ability to be Resilient

Building a resilient supply chain should include a lead time reduction program. The lead time reduction program enhances responsiveness of the chain, limits (or even lowers) the landed cost of goods when duplicating sources, and supports fact-based decisions where to put safety stocks.

Lead-time is an important factor for customer satisfaction. Typically customers want goods or service as fast as possible with minimal effort.

For manufacturing and assembly the concept of Lead-time is married to and has a direct relationship with the amount of inventory that exists at different points in the overall supply chain.

If Customer Lead-time is less than: Material Lead-time, Production Lead-time, or Cumulative Lead-time it will result in the holding of inventory within the supply chain at some or all points. Variation and inconsistency will often compound this issue – it will cause the holding of stock or inventory to mitigate risks in the supply chain.

Ref: <http://bciglobal.com/en/the-benefits-of-lead-time-reduction-in-building-resilient-supply-chains>

• A **lead time** is the period of time between the initiation of any process of production and the completion of that process. Thus the lead time associated with ordering a new car from a manufacturer may be anywhere from 2 weeks to 6 months.

• Composite lead-time comprises three issues:

- Buyer's internal lead-time
- Supplier's lead-time
- Logistics delivery lead-time



• The more time invested in a product or service, the more money is involved.

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Time is THE resource

1. "Once it has gone, it has gone, it will never to come back"
2. "What separates good and poor managers is how they manage time"
3. "**Time is a budget item**"
4. "Unless suppliers get their act together on lead times, then simply, we will change supplier"
5. "Who should pay, for unreliable lead times?"



5.1 How Do You Reduce Lead-time?

- Hold stock, ideally the right stock.
- Vertical integration – the ability to source, manufacture and assemble internally. Suppliers can be vertically integrated or our business could become more vertically integrated.
- Reduce Cycle Times, thus reducing Production Lead Times. For example, a focus on setup reductions and Quick Changeover (QCO); Line Balance Activities etc.
- Have good equipment and employee availability. Solid Total Productive Maintenance (Preventative Maintenance, Autonomous Maintenance etc.). Robust quality systems in place. Proper staffing levels.
- Reduce supplier Lead Times. Focus on long lead time components – source local; supplier business improvements etc.
- Suppliers/vendors hold stock e.g., stocking agreements.
- Line of Balance (LOB) supplier monitoring
- Have accurate forecasting, planning and scheduling.
- Good supplier performance and quality. Stable strategic suppliers. A focus on supplier development can be beneficial to help with this.
- Reduce product and component variation and obsolete low runners.
- Change shipping methods – faster, more frequent shipments.

- Vendor Owned Inventory (VOI); Vendor Managed Inventory (VMI); Consignment Inventory etc.
- Electronic Data Interchange (EDI) and electronic procurement
- Business Process Re-Engineering (BPR)
- Industry and government initiative: Efficient Consumer Response (ECR)


a) What is the impact?

- Reduced Lead Times can mean reduced inventory and more cash on hand for the businesses. In several aspects it means less risk, exposure and management of materials.
- One main exception would be a reduction in Customer Lead Time. If Customer Lead Time reduces it can mean winning more business and at the same time holding higher stocking levels; especially if there is a variance between the Customer Lead Time and the Cumulative Lead Time (or the Production or Material Lead time specifically).
- Although not all inclusive it is hoped that this quick overview provides some useful insight on the importance of Lead Time.

Ref: Article titled "What is Lead Time, why is it important, and how do you reduce it?" by Roland Lester, Vice President Operations at Winnebago Industries (<https://www.linkedin.com/pulse/what-lead-time-why-important-how-do-you-reduce-roland-lester/>)

ITC-MLS-SCL Module 11 (old course)

b) Few Methods are Given Below as to How to Reduce Lead-time

b.1) Line of Balance (LOB)						
Example LOB- Shirt Supply						
LOB helps to reduce safety stocks for items with long supply lead-times and significant risk of late delivery. Under LOB , key monitoring stages are established by mutual agreement or understanding.						
Qty in dozens	Stages of production and delivery					
	W1-Order fabric	W2-Rceive fabric	W3- Receive button	W4- Cut & stitch	W5- Dispatch	W6- Shirt deliv
900	Third lot - 200 dozens: LOB at the					
800	of end of Week 6					
700	Second lot - 300 dozens: LOB at the end of Week 6					
600						
500						
400	First lot - 400 dozens: LOB at the end of Week 6					
300						
200						
100						
In the above example, when the first lot of 400 dozens arrives on time, the respective buyer will want to know about the status of the second lot and third lot. If the buyer sees that the second lot completes 4 th stage and the third lot completes 2 nd stage, there will be no possibility of delay in lead-time.						

b.2) Vendor Managed Inventory (VMI)

- It involves the buyer outsourcing its inventory operation to the supplier. Very often it is used where the suppliers or vendors have some particular expertise which are not always manageable at the buyer's site.
- Under a VMI agreement, a supplier takes full responsibility for maintaining stock of its products at a customer's facility.
- When establishing a VMI agreement, the supplier and customer must agree on:
 - The specific products that will be covered under the VMI agreement.
 - "Acceptable availability" of these products at the customer's site and the corresponding investment required by the customer.
 - Usually the supplier and customer will agree on a "service level,"
 - How often the stock of these products will be replenished.

The automatic return of material that is no longer needed by the customer.



Picture shows a typical Wal-Mart Supercenter in Madison Heights, Virginia, U S A



- VMI is one of the successful business models used by Wal- Mart.
- According to Waller, Johnson and Davis (2001) continuous replenishment or supplier-managed inventory was popularized in the late 1980's by Wal-Mart and Procter & Gamble (P&G). VMI became one of the key programs in the grocery industry's "Quick Response"
- Medical supplies to the hospitals is a good example of VMI

b.3) Electronic Data Interchange (EDI) and Electronic Procurement

EDI includes the electronic operation of technical and commercial transactions between companies.

The invention of the internet- and particularly browser technology and XML languages- has greatly improved the flexibility and affordability of EDI formats and processes. The benefits of this system are lead-time and inventory reduction, improved accuracy of data transfer and reduced administrative costs.

The figures below illustrate some of the costs and time advantages achieved by organizations using an integrated internet

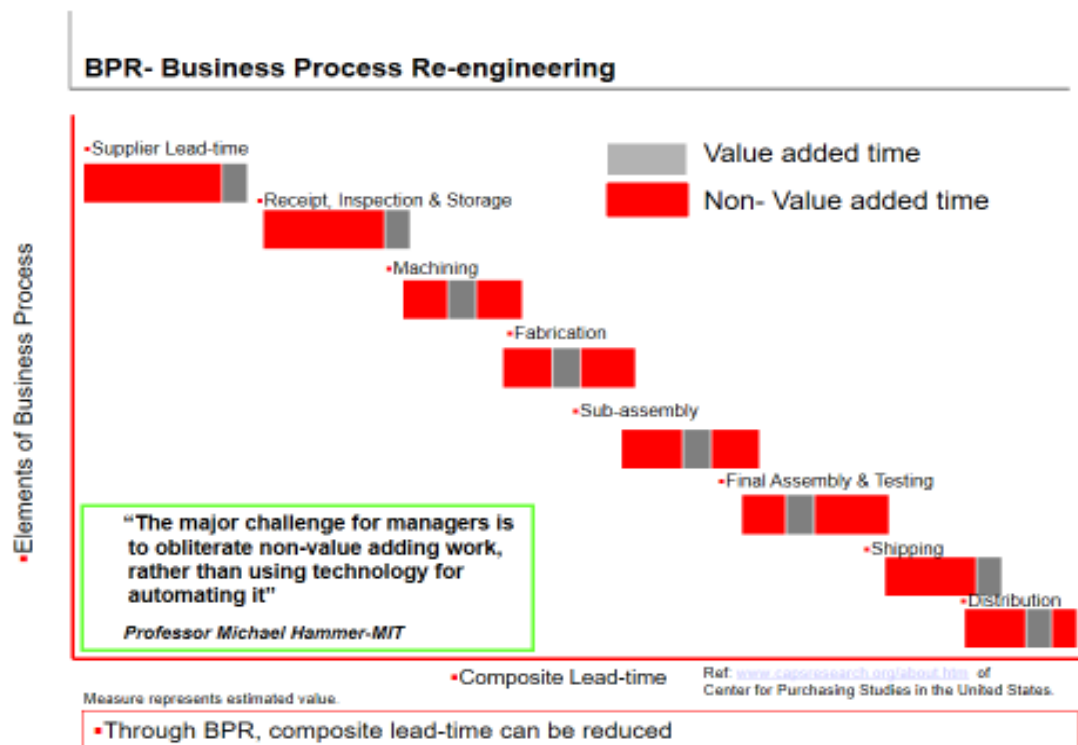
Transaction steps	Industry average	E-Procurement
<ul style="list-style-type: none"> ▪ Sourcing and related issues ▪ Selection of suppliers & order preparation 	<ul style="list-style-type: none"> ▪ 5 to 20 days ▪ 2 to 4 hours 	<ul style="list-style-type: none"> ▪ 1 day ▪ 0.5 hours
<ul style="list-style-type: none"> ▪ Internal approval of orders ▪ Sending orders to suppliers ▪ Confirmation of order by suppliers ▪ Checking status of orders ▪ Delivery confirmation by supplier Follow-up 	<ul style="list-style-type: none"> ▪ 1 to 3 days ▪ Fax: 1 hour ▪ 4 hours to 1 day ▪ Fax: 4 to 8 hours ▪ Fax: 1 hour ▪ Fax: 1day 	<ul style="list-style-type: none"> ▪ 1 to 2 hours ▪ Seconds ▪ Seconds ▪ 10 minutes ▪ 1 minute ▪ 10 minutes
Total time	▪ 8 days 4 hours	▪ 1 day 3 hours

b.4) Business Process Re-Engineering (BPR)

BPR makes the way for composite lead-time reduction.

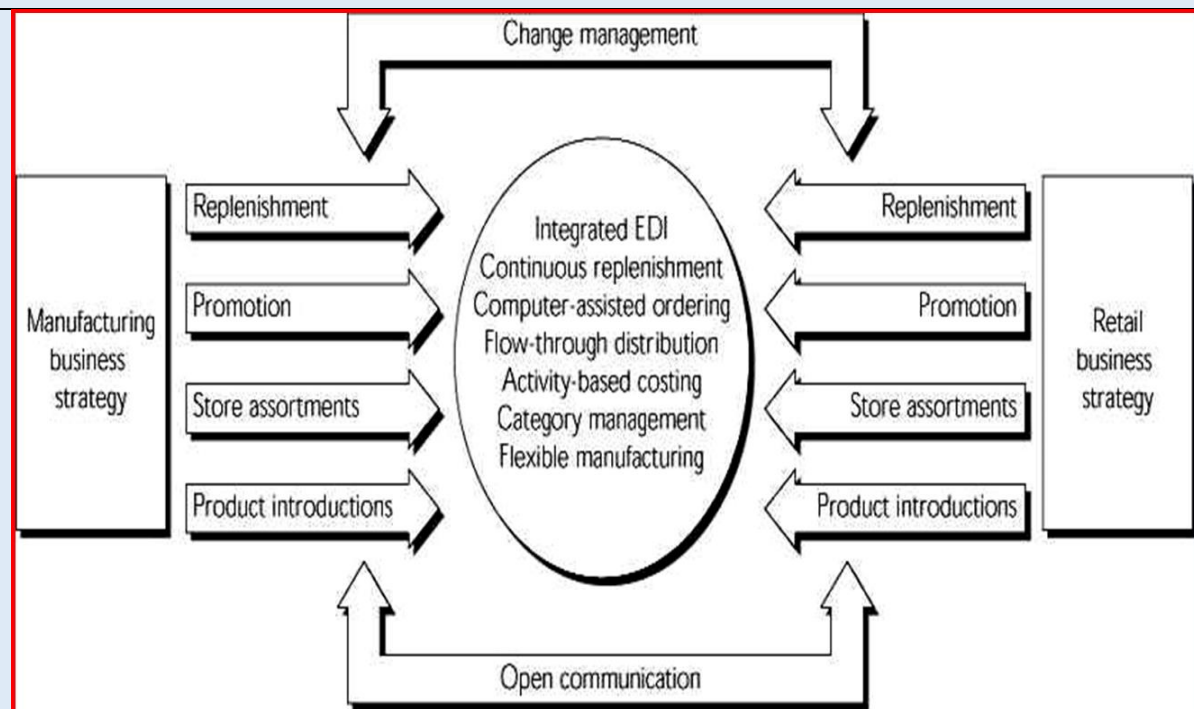
Various internal lead-time and supplier lead-time include delayed from activities that do not value the activity. These activities are considered “non-value activities” or “invisible waste”. BPR attempts to eliminate these types “non-value activities” or at least reduce them to a minimum.

The following figures illustrates some of the invisible wastes. The same type of wastes may also take place at various functions your own company.



b.5. Efficient Consumer Response

- Efficient consumer response (ECR) is a supply chain management strategy which attempts to address the inefficiencies that have led to excessive inventory and unnecessary costs at all levels within the grocery industry supply chain.
- Prior methods of inventory replenishment were order driven, relying on retailers and wholesalers to predict demand.
- ECR is demand driven, initiating the manufacture and shipment of goods based on consumer purchase activity.
- ECR reduces the cycle time from purchase to replenishment, reduces the cost of warehousing excess inventory, and assists retailers, wholesalers, and manufacturers in determining the optimum product mix.
- ECR is dependent upon the efficient and timely sharing of data along the supply chain beginning with sales information collected at a point-of-sale terminal.



Efficient Consumer Response: Broad Operating Capabilities Tailored to Each Unique Partner

6. Inventory Replenishing System

The aim of an effective inventory replenishment system is to maintain a suitable balance between the costs of holding stock and the particular service requirement for customers.

The need for this balance can be illustrated by considering the disadvantages of low stock levels (which should provide very low costs) and high stock levels (which should provide a very high service).

There are mainly three types of inventory replenishment system:

- Re-Order Level System (fixed order quantity, variable order interval)
- Periodic Review System (fixed order interval, variable order quantity)
- Demand Driven Lean Supply System (orders placed in the precise quantity and time required for production)


6.1 Inventory Replenishment System: Re-Order Level System

Re-order level systems - formula:
Where...
$\text{Re-order level (ROL)} = \text{Demand in the lead-time} + \text{Safety stock (S)}$
$\text{Demand in the lead-time} = \text{Rate of demand/usage (Rd) (e.g., per week or per day)} \times \text{Lead-time (L) (e.g., in weeks)}$
Example: If rate of demand per day is 200 tons and average lead-time is 10 days and company decides to keep 3 days usages as safety stock; what will be the Re-order level quantity?
Therefore, Re-order level would be = (200 tons X 10 days) + (200 tons X 3 days) = 2,600 tons.
Re-order level system is based on the concept " Fixed quantity, variable interval ".

6.2 Inventory Replenishment System: Periodic Review System

Periodic review systems - formula to calculate the order size:
$\text{Order size} = (\text{Demand over the review interval} + \text{demand to cover lead-time}) - (\text{Actual stock}) - (\text{Pipeline stock}) + (\text{Safety stock})$
Example: If rate of demand per day is 200 tons and average lead-time is 10 days, and company decides to keep 3 days usages as safety stock, review interval becomes 15 days, and currently actual stocks are 900 tons and 800 tons are in pipeline; what will be the Re-order quantity? Therefore, Re-order level would be = (200 tons X 15 days) + (200 tons X 10 days) – (900 tons) – (800 tons) + (200 tons X 3 days) = 3,900 tons .
Periodic review system is based on the concept " Fixed interval, variable quantity ".
In a periodic review system, the basis for determining the order size (which varies each time) is therefore the (fixed) review interval.

6.3 Demand- Driven Lean Supply System

<p>Demand- Driven Lean Supply System</p> <p>Both the frequency of ordering & the quantity of items ordered are driven by data on demand from the production line that is passed directly to suppliers.</p> <p>Requirements to apply effective JIT system:</p> <ul style="list-style-type: none"> • Production process of the company runs smoothly • Supply lead-times are short & respond rapidly to changes in production requirements • Suppliers are responsible to the quality and quantity control of products 	
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7. Economic Order Quantity (EOQ)

The model was originally developed by F.W. Harris in 1913, though R.H. Wilson is credited for his in-depth analysis of the method. EOQ is a model that defines the optimal quantity to order that minimizes total variable cost required to order and hold inventory. By following EOQ, you would be able to minimize the sum of ordering costs and the inventory carrying costs to cover the demand for a particular period. Too many orders will incur excessive ordering costs, while too few orders will cause high inventory holding costs.

In order to make EOQ, we need to make balances of two sets of costs:

- Inventory holding costs
- Ordering costs

Cost associated with inventory

- Ordering costs
- Price discount costs
- Storage and handling costs
- Stock out costs
- Working capital costs of inventory
- Obsolescence costs
- Production inefficiency costs
- However, in most cases, while we calculate, we consider following three types of expenditures as inventory holding costs:
 - Working capital cost
 - Storage cost
 - Obsolescence risk costs
- We also consider following two types of expenditures as ordering costs:
 - Administrative costs of placing the order
 - Communication costs (with suppliers, trans. and other related parties)

7.1 Holding and Ordering Cost Calculation

$$\text{Holding cost (H)} = (P) \times (I) \times (Q/2)$$

In which:

P = Unit purchase costs (i.e. price plus transport and other delivery cost)

I = Inventory carrying cost (expressed as a percentage of P)

Q/2 = Average inventory (the order quantity divided by 2)

$$\text{Ordering costs (O)} = (Co) \times (D/Q)$$

In which:

Co = Cost per order

D/Q = The number of orders in the period (i.e. the demand over the period divided by the order quantity)

$$\text{Total cost} = \frac{PiQ}{2} + \frac{CoD}{Q}$$

7.2 Deriving the EOQ Formula

Deriving the EOQ formula

As Q is the quantity per order and D is the demand over the period,
the average inventory = $\frac{Q}{2}$ and the number of orders $\frac{D}{Q}$

The inventory holding cost (H) = (purchase cost) x (% carrying cost) x (average inventory)

Therefore, $H = \frac{PiQ}{2}$

The ordering cost (O) = (the cost per order) x (the number of orders)

Therefore, $O = \frac{Co \times D}{Q}$

Since EOQ will be found where the inventory holding costs are equal to the ordering cost, i.e.

$$\frac{PiQ}{2} = \frac{Co \times D}{Q} \text{ or } Q^2 = \frac{2CoD}{Pi} \text{ and therefore } Q = \sqrt{\frac{2CoD}{Pi}}$$

7.3 EOQ Calculation

Cost of adopting plans with different quantities

Order Quantity	Holding Cost/ Carrying Cost $PiQ/2$	+	Ordering Cost CoD/Q	=	Total Cost
50	25		400		425
100	50		200		250
150	75		133		208
200	100		100		200
250	125		80		205
300	150		67		217
350	175		57		232
400	200		50		250

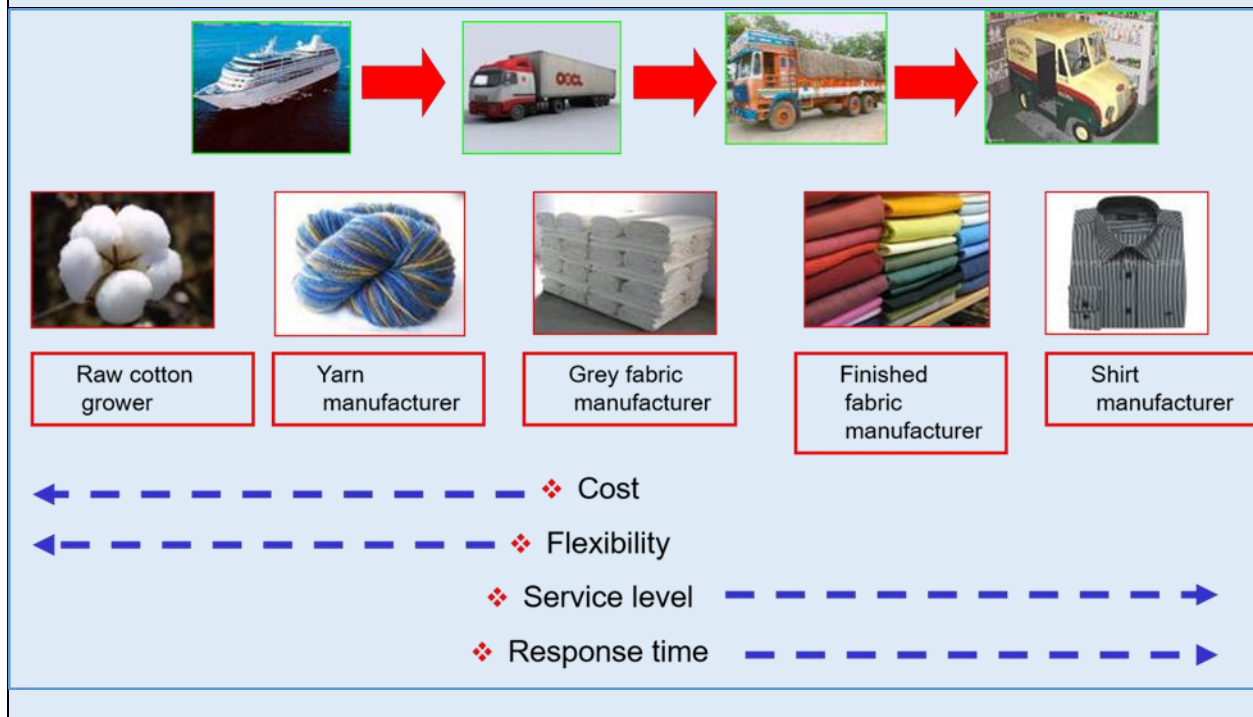
$\text{Total cost} = \frac{PiQ}{2} + \frac{CoD}{Q}$	<ul style="list-style-type: none"> ▪ Demand (D) = 1000 units per year ▪ Unit purchase cost (P) = \$5 ▪ Inventory carrying cost (i) = 20% ▪ Cost per order © = \$20 	<p>Minimum Total Cost</p>
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8. Inventory in the Supply Chain

Customer requirements and different supply response strategies will have an impact on where inventories are held in the supply chain. For example, if immediate customer response and high service levels are required, inventories will tend to be held further downstream (i.e. end users or consumers) in the supply chain, close to the end customer.

In case cost reduction and greater supply flexibility and customization are the customers' highest priority, then inventories will tend to be held further upstream (i.e. suppliers, suppliers' suppliers and growers) in the supply chain.

It is to be noted that overall inventory throughout the supply chain be managed effectively, wherever it is located. For the sake of resilient supply chain, this technique may very useful. In the example below, there will less financial impact if a portion of inventory is kept at upstream stages- like instead of keeping stock of readymade garments(i.e. finished shirt), you can keep equivalent stock of finished fabric or grey fabric.



9. Supply Chain Resilience: Safety Stock to Combat Uncertainty

Supply chain risks are increasing in number and frequency, affecting the normal operation and stability of the supply chain and hence the ability of supply chains to fulfil commitments. Therefore, supply chains must be resilient to risks to overcome their vulnerabilities and to react effectively to its negative effects. Uncertainty in demand and lead-time may create vulnerabilities. Maintaining safety stock helps to overcome this type of vulnerabilities.

9.1. Safety Stock Calculation

Safety Inventory: Surplus inventory that a company hold to protect against the uncertainty in demand, in lead-times and in quality of supply.

Safety stock due to uncertainty in lead time:

- $\text{Safety stock} = (\text{Maximum lead time} - \text{Normal lead time}) \times \text{Consumption rate}$

For example, the daily usage rate 400 units, which requires average lead time 20 days. Sometimes, due to transport or other difficulties, it takes 23 days to reach.

- So safety stock = $(23 \text{ days} - 20 \text{ days}) \times 400 \text{ units} = 1200 \text{ units}$

Safety stock due to uncertainty in demand:

- $\text{Safety stock} = (\text{Maximum rate of consumption} - \text{Average rate of consumption}) \times \text{Lead time}$

For example, the demand varies from 375 units to 425 units, we can determine the safety stock.

- So safety stock = $(425 \text{ units} - 400 \text{ units}) \times 20 \text{ days} = 500 \text{ units}$

Ref: <https://www.intechopen.com/books/applications-of-contemporary-management-approaches-in-supply-chains/quantifying-the-supply-chain-resilience>

10. Inventory Stocktaking and Audit

Stocktaking serves to detect any difference between stock records and physical inventory.

Purpose of stocktaking:

- Financial reporting (mainly performed to prepare year-end accounts and insurance audits)
- Security and avoidance of fraud
- Ensuring that inventory replenishment are based on accurate stock data
- Ensuring the most efficient and effective use of space
- Ensuring that stored items are not deteriorated
- Showing up temporary accumulation of stock items in and undesignated storage areas

Perform a “Stock Count”

What is it?	Physically counting each item in the inventory
When is it done?	In the beginning of each month recommended
Who does/do it?	A designated person or group of person

All stock must be accounted for. Everything that comes in and goes out must be recorded.

Primary objective of inventory check

- Existence
- Right
- Accuracy
- Realizable value

10.1 Methods of Stocktaking

Two main methods used in stock taking are ‘continuous stocktaking’ and ‘periodic stocktaking’.

a. Continuous stocktaking (cycle counting) or sometimes it is called perpetual inventory checking

A more frequent form of stock taking is called cycle counting. Cycle counting involves a continuing audit of inventory items. This utilizes the classification of inventory items from the ABC analysis. The important steps of cycle counting are:

Count the inventory items.

- Verify the records.
- Document the inaccuracies.
- Trace the causes of the inaccuracies.
- Take remedial actions.

The frequency of cycle counting depends on the classification of the inventory items like:

“A” class items may be counted once a month

“B” class items may be counted once a quarter

“C” class items may be counted every six months

Perpetual inventory or continuous inventory describes systems of inventory where information on inventory quantity and availability is updated on a continuous basis as a function of doing business.

b. Periodic stocktaking

Periodic stocktaking means counting all stocked items at the same point in time (generally at the end each financial year).

It would be advantageous if this kind of stocktaking takes place on a non-working day, to avoid interfering with normal operations. It also meets accounting needs by counting everything.

However, because of the volume of work involved- typically over one or two days or more- incompetent or untrained counter/stock taker may perform the counting tasks, with the risk of inaccurate counts. For better outcome, third party agency may be engaged

Because of the disruption caused by stock counting procedures, the periodic count is often only undertaken annually. Resultantly a whole year may pass before discrepancies are identified.

10.2 Accuracy in Stocktaking

Some tolerance may be allowed for deviation between the physical count and the inventory/accounting record. For example, the following tolerances may be applied with the consent of management:

“A” class items: +/- 1%

“B” class items: +/- 3%

“C” class items: +/- 5%

After completing stocktaking exercise, companies should re-check a sample of stock items chosen at random to examine if the stock count has been accurate.

This test should be made in both directions for different items. For example, 25 items from the records and checking to see if the physical count agrees with these records. Following this, 25 items can be selected from the warehouse and checked to see if the counted items agree with the inventory records.

If an inaccuracy is discovered, a further sample of ten items chosen at can be checked again. If this sample proves to have been accurately counted, it may be assumed that first error was unique and the original stock count can be accepted. If further inaccuracies are detected, the source of error should be determined and the stock completely re-counted under more tightly controlled supervision

10.3 Conducting a Stock Count: Cut-off period

One of the most important aspect of all methods of stock counting is the control of inventory movements during what is considered as the “cut-off” period. This is the period during which counting of an inventory item is actually taking place.

When accounting records are kept in physical books, the book pages are actually cut off or obliterated under the last entry before counting began, so that the figures cannot be changed.


During counting period, stock may be delivered and removed. However, the records will not be updated until counting is finished. In the case of continuous stock counting, any such movements must be recorded separately by the counting team. The inventory records are then updated when counting is finished

10.4 Hazards in Cycle Counting

Cycle counting is not always a panacea. Things can and do go wrong and produce a lot of cost and effort with little result. Among the hazards:

- **Insufficient Staffing**--This results from under-estimating the number of counts required when the program is initially planned.
- **Diversion of Effort**--To the rest of the organization, cycle counting seems to accomplish little of immediate importance. Cycle counters become a convenient source of staff for all sorts of odd jobs. Over time the practice of borrowing cycle counters dilutes the effort and reinforces the perception of non-accomplishment.
- **Ignoring Error Creation**--Error prevention is always more productive than correction. Some systems create errors so fast that it is impractical to cycle count enough for high accuracy.
- **Insufficient Training**--Cycle counters need training on counting properly and on resolving discrepancies. Others in the organization need training to support the program.
- **Motivation**--Cycle counting tends to be boring and specific means should be employed for recognition and rewards.

11. Inventory Turnover

<p>What is inventory turnover?</p> <p>Turnover measures the number of times you use or sell your average investment in inventory.</p> <p>How is inventory turnover calculated?</p> <p>It is calculated by dividing annualized cost of goods sold of inventory (i.e., what you paid for the material you sell) by your average investment in stock inventory (i.e., what you paid for the material in stock in your warehouse or store).</p>	
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<p>Example:</p> <p>If your annual cost of goods sold is \$6 million and your average inventory investment is \$1 million, you would achieve six inventory turns.</p> <p>Keep in mind that every time you turn your inventory you have an opportunity to earn a profit.</p> <p>So, if you achieve six inventory turns, you experience six opportunities to earn a profit from every dollar invested in inventory.</p>	<p>Generally calculated as:</p> $= \frac{\text{Sales}}{\text{Inventory}}$ <p>However, it may also be calculated as:</p> $= \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}}$
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12. Valuation of Inventory

- Inventory valuation is the monetary amount associated with the goods in the inventory at the end of an accounting period.
- The valuation is usually based on the costs incurred to acquire the inventory and get it ready for sale.
- The method for valuing inventory depends on how the stock is tracked by the business over time.
- A business must value inventory at cost. Since inventory is constantly being sold and restocked and its price is continually changing, the business must make a cost flow assumption that it will use frequently.
- There are three widely accepted methods of inventory valuation as follows:

a) **First-In, First-Out (FIFO):** In the FIFO method, items issued are valued based on the cost of the oldest units in the inventory from which the issued material could have been drawn up until these are exhausted. Valuation then passes on to the next most oldest, and so on.

b) **Last-In, First-Out (LIFO):** In the LIFO method, items issued to production are valued based on the cost of the most recent units received, until these are exhausted. Valuation then passes on to the next most recent, and so on.

c) **Weighted Average Costing (WAC):** In this method, an average value is calculated for each unit in stock. It is calculated by adding together the value of inventory already in stores together with the value of any new units introduced, and dividing by the total quantity of inventory.

12.1 Which Inventory Valuation Method Is Best

Choosing the right inventory valuation method is important as it has a direct impact on the business's profit margin. Your choice can lead to drastic differences in the cost of goods sold, net income and ending inventory.

There are advantages and disadvantages of each method. For example, the LIFO method will give you the lowest profit because the last inventory items bought are usually the most expensive while the FIFO will give you the highest profit as the first items in stock are usually the cheapest.

To assess the method which is best for you, you need to pay attention to changes in the inventory costs.

- If the inventory costs are escalating or are likely to increase, LIFO costing may be better. As higher cost items are considered sold, it results in higher costs and lower profits.
- In case your inventory costs are falling, FIFO might be the best option for you.
- For a more accurate cost, use the FIFO method of inventory valuation as it assumes the older items that are less costly are the ones sold first.

As a business owner, you need to analyze each method and apply the method that reflects the periodic income accurately and suits your specific business situation. You may also consult with your top management about regulatory issues/practice applicable in this regard.

Ref: <https://www.freshbooks.com/hub/accounting/inventory-valuation>

13. Create a Buffer-stock for 3-months' Worth of Supply Needed for the RMG and textile Industry

“Study of Supply Chain Resilience on RMG sector in Bangladesh” has recommended to take attempt of maintaining buffer- stock of major primary and intermediate raw material to combat relevant crisis.

Quote:

Create a buffer-stock for 3-months' worth of supply for major primary and intermediate raw materials needed for the RMG and textile industry. The need for this buffer stock became evident in January-February 2020 when the Bangladeshi RMG sector experienced a bitter supply crunch of raw materials due to the onslaught of the COVID-19 pandemic in China, by far the largest source of raw materials. To prevent such shocks in the future, creating a buffer stock will require the following major tasks:

- A separate study to identify the categories and quantities of the major primary and intermediate raw materials, e.g., cotton, man-made fibers, yarn, fabrics, chemical and dyes, accessories and packaging materials, and so forth;
- The state trading company, Trading Corporation of Bangladesh may be made responsible for the timely import of these raw materials to be made available at the demand of the manufacturers. Alternatively, the private sector manufacturers and importers may import the required materials for the proposed buffer stock by creating a common cooperative fund. The detailed mechanism may be developed through further consultation with the private sector stakeholders and financial experts.
- Preemptively, it can be recommended that a team of experts can be engaged jointly by the RMG trade associations, Bangladesh Trade and Tariff Commission, and Bangladesh Customs to determine the key import requirements for products and their volume for the proposed buffer stock.
- For the proposed buffer stock to become functional, the existing regulations for import procedure, bond facilities, duty drawback, and banking need to be reviewed

Unquote:

Let's explain the pros and cons of this initiative:

Usually this kind of initiative is taken by the government. A buffer stock scheme is a government plan to stabilize prices in volatile markets. This requires intervention in buying and selling.

A buffer stock is a system or scheme which buys and stores stocks at times of good harvests to prevent prices falling below a target range (or price level), and releases stocks during bad harvests to prevent prices rising above a target range (or price level).

Prices for agricultural products are often volatile because:

- Supply can vary due to the weather.
- Demand is inelastic
- Supply is fixed in the short term
- See: Why are prices of agricultural goods volatile?

Buffer stock schemes aim to:

- Stabilize prices
- Ensure the supply of food
- Prevent farmers/producers going out of business because of a drop in prices.

Advantages of Buffer Stocks

- Stable prices help maintain farmers' income. A rapid drop in prices can make farmers go out of business, which leads to structural unemployment.
- Price stability encourages more investment in agriculture.
- Farming can have positive externalities e.g. helps rural communities. A drop in price could cause a negative multiplier effect within rural areas.
- Target prices help prevent excess prices for consumers and help reduce food inflation. This might be important for households living in poverty, who may struggle to pay high prices during years of shortage.
- It helps to maintain food supplies and avoid shortages.
- It is possible the government could make a profit from a buffer stock scheme. If it buys during a glut and sells during a shortage, it can make a profit.

Problems of Buffer Stocks

- Cost of buying excess supply could become quite high for the government and may require higher taxes.
- Minimum prices and buffer stocks could encourage oversupply as farmers know any surplus will be bought. It could even encourage excess use of chemicals to maximize yields because farmers know any excess supply can be sold – even if the market doesn't want it.
- Government subsidy to farmers may encourage inefficiency amongst farmers. There may be less incentive to cut costs and respond to market pressures.
- Some goods cannot be stored in buffer stocks, e.g. fresh milk, meat etc.
- Government agencies may have poor information e.g. what price to set, how much to buy? Is there really a surplus? In practice, it can be difficult to know whether there is a surplus until later in the year.
- Administration costs of the scheme.
- Minimum prices for foodstuffs may require tariffs on imports.
- Globalized markets. Agriculture is a globalized market. If some countries form a buffer stock scheme and buy excess supply, they may find that other countries 'free-ride' on their efforts to keep prices high and undercut them.


- Are buffer stocks designed to help producers or consumers? Often agricultural buffer stocks are aimed at providing minimum prices and minimum incomes for farmers

Ref: https://www.economicsonline.co.uk/Definitions/Buffer_stock.html

Ref: <https://www.economicshelp.org/blog/glossary/buffer-stocks>

Ref: Study of Supply Chain Resilience on RMG sector in Bangladesh

14. Case Study: Wal-Mart

Case study: The Wal-Mart effect													
<ul style="list-style-type: none"> ▪ In 1987, Wal-Mart had a market share of just 9 percent but was 40 percent more productive than its competitors as measured by real sales per employee. ▪ By 1995, it commanded a market share of 27 percent and had widened its productivity edge to 48 percent. ▪ Competitors began to adopt Wal-Mart's innovations in earnest in the mid-1990s. ▪ From 1995 to 1999, Wal-Mart improved its own productivity by an additional 22 percent 	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">EXHIBIT</p> <p style="text-align: center;">Follow the leader</p> <p style="text-align: center;">Sales per employee,¹ \$ thousand</p> <table style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>1995</th> <th>1999</th> </tr> </thead> <tbody> <tr> <td>Wal-Mart</td> <td>148</td> <td>181</td> </tr> <tr> <td>Kmart</td> <td>109</td> <td>133</td> </tr> <tr> <td>Sears</td> <td>87</td> <td>118</td> </tr> </tbody> </table> <p><small>¹In real 1996 dollars. Source: Compustat; US Bureau of Labor Statistics; US Census Bureau; McKinsey analysis</small></p> </div>		1995	1999	Wal-Mart	148	181	Kmart	109	133	Sears	87	118
	1995	1999											
Wal-Mart	148	181											
Kmart	109	133											
Sears	87	118											
<p>Managerial innovation</p> <p>Wal-Mart's productivity edge stems from managerial innovations that improve the efficiency of stores. Employees who have been cross-trained, for instance, can function effectively in more than one department at a time.</p>													
<p>Information technology investments</p> <p>Wal-Mart was among the first retailers to use computers to track inventory (1969), just as it was one of the first to adopt bar codes (1980), EDI for better coordination with suppliers (1985), and wireless scanning guns (late 1980s). These investments, which allowed Wal-Mart to reduce its inventory significantly and to reap savings, boosted its capital productivity and labor productivity.</p>													
<p>Key Messages</p> <ul style="list-style-type: none"> ▪ Maintain an adequate inventory at all time to ensure uninterrupted service. ▪ Don't let any item run out before re-order. ▪ Never order more than your storage space can hold. Never order more supplies than you can use before they are expired. ▪ All items in the inventory must be accounted for and recorded. ▪ Always inspect new shipment before accepting 													

15. Case Study: Procter & Gamble (P&G)

Improved concept in inventory management



- Procter & Gamble's inventory investment is close to \$7 billion, or about 0.1% of world inventory. P&G is very interested in reducing this investment. There are two fundamental approaches to achieving this. One is to predict sales more accurately and the other is to improve supply by compressing the manufacturing cycle and optimizing inventory. Procter & Gamble is doing both.
- By using the most current demand information at the most granular level, P&G has reduced forecasting error by more than 30%, decreasing safety stock by more than 10% and reducing waste. P&G is continuing to invest in improving efficiency, by exploring using POS data to improve forecast accuracy as well as looking at predicting freight movements at a very granular level.
- On the supply side they have done some things that are more frequently associated with the electronics and automotive industries. For example, P&G implemented late stage product differentiation with detergents.
- By producing a batch of detergent, then having the ability to add scent, fabric softener and/or bleach as it is put in bottles, they benefit both from smaller batch sizes, and hence more frequent runs, and have the ability to rapidly align production with sales. They have compressed material lead times and are able to produce any product on any day, eliminating waste by producing specific products only when demand is confirmed

16. Inventory Management: Few More Tips

01	<p>If your system is not performing up to this potential, be sure you have implemented each of the following characteristics of good inventory management:</p> <ul style="list-style-type: none"> ▪ Protect your company against theft – Make sure that the people in your warehouse belong in your warehouse. Pilferage is a larger problem than most distributors realize. ▪ Establish an approved stock list for each warehouse – Most dead inventory is "D.O.A" (dead on arrival). Order only the amount of non-stock or special order items that your customer has committed to buy ▪ Assign and use bin locations – Assign primary and surplus bin locations for every stocked item. All picking and receiving documents should list the primary bin location (in either characters or a bar code)
02	<p>Record all material leaving your warehouse</p> <ul style="list-style-type: none"> ▪ There should be appropriate paperwork for every type of stock withdrawal. Under no circumstances should material leave the warehouse without being entered in the computer. Eliminate "no charge/no paperwork" material swaps. Product samples should be charged to a salesperson's account until they are either returned to stock or charged to the customer.
03	<p>Process paperwork in a timely manner</p> <ul style="list-style-type: none"> ▪ All printed picking documents should be filled by the end of the day. Stock receipts should be put away and entered in the computer system within 24 hours of arrival.
04	<p>Set appropriate objectives for your buyers –</p> <ul style="list-style-type: none"> ▪ Buyers should be judged and rewarded based on the customer service level, inventory turns, and return on investment.
05	<p>Determine the most advantageous replenishment path for each item in each warehouse – Assign one of these "paths" to each item in each warehouse:</p> <ul style="list-style-type: none"> ▪ Distributive purchasing – The warehouse replenishes stock with a purchase order issued directly to the vendor. ▪ Central Warehousing – The stock of one warehouse is replenished with a stock transfer from a central warehouse. ▪ Cooperative Purchasing – Several branches "pool" their needs and issue one vendor purchase order in order to meet the vendor minimum order within a reasonable amount of time.

06	<p>Make sure every employee irrespective of rank and grade is aware of the cost of bad inventory management – Inventory loss through theft, breakage, or loss must be paid for with net profit dollars.</p> <p>If your net profit before taxes is 5%, it takes \$2,000 in new sales to make up for a \$100 merchandise loss!</p> <p>Implement a comprehensive cycle counting program.</p> <p>A good cycle counting program can replace your traditional year-end physical inventory.</p>
<ul style="list-style-type: none"> ▪ 07 	<ul style="list-style-type: none"> ▪ Establish goals for customer service, inventory turnover, and return of invest for minimum 2 years ▪ Compare with actual results in every months ▪ Control dead and excess inventory (excess inventory is normally considered that exist for more than 12 months) and take following procedures: <ul style="list-style-type: none"> ○ Transfer excess stock to another branch that needs item ○ Return the stock to the vendor ○ Substitute surplus inventory for lower cost items ○ Lower the price and sell ○ Donate excess stock to NGOs ○ Throw it out, take the “write-off” for your financial statement, and free up room in your warehouse

17. Transportation

Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer’s hand. Transportation plays a key role in every supply chain because products are rarely produced and consumed in the same location. Transportation is a significant component of the most supply chain incur. Any supply chain’s success is closely linked to the appropriate use of transportation.

Transportation is what allows products to move from point of origin to point of consumption throughout the supply chain, and is thus responsible for creating time utility and place utility.

Overall Transportation Objectives

Use large vehicles: With larger vehicles, we can take the advantage of economies of scale.

Utilize full vehicle capacity: It is always better if vehicles carry a full load or at least nearly a full load of material.

Minimize idle time: It is desirable to keep the vehicles busy doing useful work for the maximum possible time so that, it can minimize idle time.

17.1 Means of Transportation

There are generally four means of transportation:

- Trucks
- Railroad
- Water transport
- Airways

However, need to consider three more means of transportation:

- Pipeline
- Conveyor belt or cable transport
- Web

Modes of transportation

- **Trucks:**
 - Flexible, on-time, low loss and damage, tracing, accuracy and wide. geographical coverage.
 - Weather and traffic conditions can delay shipments.
 - Still heavy price competition.
- **Railroads:**
 - Inexpensive for carload lots
 - requires more packing material or must allow for rough handling.
 - Somewhat slow.
 - Freight forwarders, piggyback truck, and double stack containers offer cost savings for users.
- **Water transportation:**
 - Ideal for heavy, low-value non-perishables, but has high fixed costs.
 - Weather can be a problem.
 - Containerization and improved ports allow for expansion in new products and markets.
- **Airways:**
 - High costs, so only suitable for high value or urgent or perishable items.
 - Weight and locations limited.
 - Saves inventory holding costs.
 - Important in international trade.



- elines:
 - Slow but dependable, continuous flow of liquids or slurries.
 - Harder to establish today due to government regulations.
- Cable transport



It is a broad mode where vehicles are pulled by cables instead of an internal power source. It is most commonly used at steep gradient. Typical solutions include aerial tramway, elevators, escalator and ski lifts; some of these are also categorized as conveyor transport. Example: Approximate 17 kilometer long belt conveyor at Lafarage Surma Cement Plant, Chhatak, Bangladesh.



17.2 Cost Comparison between Two Modes of Transportation

Item: Electronic Equipment			
Yearly requirements		By Sea: 68 tons	
		By Air: 66.3 tons	
Volume of each shipment(sea/air):		2.5 m3/ton	
Average value/kg of the goods		\$20	
Basis for calculation		Air	Sea
1	Door-to-door lead-time	9 days	41 days
2.	Annual interest rate	15%	15%
3	Number of shipment per year	40	10
4	Supplier's average yearly awaiting shipment	0.8 tons	3.4 tons
Logistics cost per kg		Air(\$)	Sea(\$)
1	Freight rate	2.05	0.40
2	Packing	0.03	0.20
3	Local transport in the supplier's country (up to FOB)	0.05	0.15
4	Insurance	0.06	0.30
5	Tied up capital during the voyage	0.07	0.40
6	Ordering costs	0.03	0.02
7	Local transport in the buyer's country	0.03	0.25
8	In transit warehousing	0.10	0.45
9	Tied up capital in stock (before and after shipment)	0.30	1.15
10	Total cost per kg:	2.72	3.32

17.3 Vehicle Cost Analysis and Development of Resilience Capabilities

Transportation costs can be a substantial part of a company’s overall logistics spending. If you analyze options for transport using different vehicle sizes, it is useful to take a sample of each class of vehicles and- form its costs and performance characteristics- build up a table of operational costs per ton-km or per cubic meter-km of goods transported. With this analysis, you would find that carrying goods by small car costs about eighteen times higher than carrying them by a large truck. There are ample opportunities to save costs if companies attempt to larger cars than small where possible and contribute towards the development of its resilience capabilities.

Seven types of basic cost:

- Cost of depreciation
- Cost of drivers/operators
- Fuel cost
- Insurance cost
- Maintenance and repair cost
- Road & vehicle taxes
- Miscellaneous expenses

a. Cost of depreciation: The cost of depreciation depends on the value of the vehicle and the length of the depreciation period. Depreciation is the progressive loss of value of a vehicle over its useful life (depreciation period), at the end of which its residual value becomes zero.

Cost of depreciation									
Vehicle class	Vehicle price (inBDT)	Payload		Unit depreciation cost(in BDT)		Km per year	Km over 5-year life	Unit dep cost over 5 years(in BDT)	
		in m3	in tonnes	per m3	per tonne			per m3-km	per tonne-km
Small car	800,000.00	2.00	0.60	400,000.00	1,333,333.33	30,000	150,000	2.667	8.89
Van	1,200,000.00	5.20	1.25	230,769.23	960,000.00	40,000	200,000	1.154	4.80
Medium truck	1,500,000.00	40.00	12.00	37,500.00	125,000.00	90,000	450,000	0.083	0.28
Large truck	3,500,000.00	70.00	25.00	50,000.00	140,000.00	120,000	600,000	0.083	0.23

BDT 800,000/2= BDT400, 000
 BDT 800,000/0.60= BDT1, 333,333.33
 BDT 400,000/150,000= * BDT 2.667
 BDT 1,333,333.33/150000= **B DT 8.89

b. Cost of drivers/operators: Drivers' wages vary from country to country. Their cost will also depend on how efficiently they are used.

Unit fuel cost								
Vehicle Class	Consumption km/litre	Payload		Load carried yearly		Cost of fuel of one litre (in BDT)	per m3-km (in BDT)	per tonne-km (in BDT)
		in m3	in tonnes	in m3-km	in tonnes-km			
Small car	16	2.00	0.60	32.00	9.60	60.00	1.88	6.25
Van	12.5	5.20	1.25	65.00	15.63	60.00	0.92	3.84
Medium truck	3.2	40.00	12.00	128.00	38.40	60.00	0.47	1.56
Large truck	2.5	70.00	25.00	175.00	62.50	60.00	0.34	0.96

16 km/liter X 2 m3 = 32 m3-km
 BDT 60/32.00 = * BDT1.88 per m3-km
 16 km/liter X 0.60 tonnes = 9.6 tonnes-km
 BDT 60/9.60 = ** BDT 6.25 per tonne-km

c. Fuel cost: It varies depending on operating conditions (e.g. the state of the road, traffic levels, etc.).

Cost of driver								
Vehicle class	Km per year	Payload		Load carried yearly per cost of one		Driver's salary per year	per m3-km (in BDT)	per tonne-km (in BDT)
		in m3	in tonnes	in m3-km	in tonnes-km			
Small car	30,000	2.00	0.60	60,000.00	18,000.00	180,000.00	3.00	10.00
Van	40,000	5.20	1.25	208,000.00	50,000.00	240,000.00	1.15	4.80
Medium truck	90,000	40.00	12.00	3,600,000.00	1,080,000.00	264,000.00	0.07	0.24
Large truck	120,000	70.00	25.00	8,400,000.00	3,000,000.00	300,000.00	0.04	0.10

Monthly salary of drivers:

- Small Car's driver: BDT 15,000/month
- Van Car's driver: BDT 20,000/month
- Medium Truck's driver: BDT 22,000/month
- Large Truck's driver: BDT 25,000/month

30,000 km X 2 m3 = 60,000 m3-km
 BDT 180,000/60,000 m3-km = * BDT 3 per m3-km
 30,000 km X 0.60 tonnes = 18,000 tonnes-km
 BDT 180,000/18,000 tonnes-km = ** BDT 10 per tonne-km

d. Insurance cost: This cost remains usually fixed regardless of the distances worked annually.

Insurance									
Vehicle Class	Km per year	Payload		Load carried yearly per cost		Vehicle price (inBDT)	Insurance- 2% of price	per m3-km (in BDT)	per tonne-km
		in m3	in tonnes	in m3-km	in tonnes-km				
Small car	30,000	2.00	0.60	60,000.00	18,000.00	800,000	16000	0.2667	0.89
Van	40,000	5.20	1.25	208,000.00	50,000.00	1,200,000	24000	0.1154	0.48
Medium truck	90,000	40.00	12.00	3,600,000.00	1,080,000.00	1,500,000	30000	0.0083	0.03
Large truck	120,000	70.00	25.00	8,400,000.00	3,000,000.00	3,500,000	70000	0.0083	0.02

BDT 16,000/60,000= * BDT 0.2666 per m3-km
 BDT 16,000/18,000= ** BDT 0.89 per tonne-km

e. Maintenance and repair cost: It increases relatively for larger vehicles

Maintenance cost									
Vehicle class	Km per year	Payload		Load carried yearly per cost of one		Vehicle price (inBDT)	Maintenance- 5% of price	per m3-km (in BDT)	per tonne-km (in BDT)
		in m3	in tonnes	in m3-km	in tonnes-km				
Small car	30,000	2.00	0.60	60,000.00	18,000.00	800,000	40,000.00	0.6667	2.22
Van	40,000	5.20	1.25	208,000.00	50,000.00	1,200,000	60,000.00	0.2885	1.20
Medium truck	90,000	40.00	12.00	3,600,000.00	1,080,000.00	1,500,000	75,000.00	0.0208	0.07
Large truck	120,000	70.00	25.00	8,400,000.00	3,000,000.00	3,500,000	175,000.00	0.0208	0.06

BDT 40,000/60,000= * BDT 0.6667 per m3-km
 BDT 40,000/18,000= ** BDT 2.22 per tonne-km

f. Road & vehicle taxes: Taxes vary from country to country. It usually remain fixed regardless of distances worked annually, except for highway tolls and bridge tolls. It is generally related to vehicle size. Economies of scale is applicable.

Tax									
Vehicle class	Km per year	Payload		Load carried yearly per cost of		Vehicle price (inBDT)	Tax- 1% of price	per m3-km (in BDT)	per tonne-km (in BDT)
		in m3	in tonnes	in m3-km	in tonnes-km				
Small car	30,000	2.00	0.60	60,000.00	18,000.00	800,000	8000	0.1333	0.44
Van	40,000	5.20	1.25	208,000.00	50,000.00	1,200,000	12000	0.0577	0.24
Medium truck	90,000	40.00	12.00	3,600,000.00	1,080,000.00	1,500,000	15000	0.0042	0.01
Large truck	120,000	70.00	25.00	8,400,000.00	3,000,000.00	3,500,000	35000	0.0042	0.01

BDT 8,000/60,000= * BDT 0.1333 per m3-km
 BDT 8,000/18,000= ** BDT 0.44 per tonne-km

g. Miscellaneous expenses: These can be significant on long trips.

Miscellaneous cost									
Vehicle class	Km per year	Payload		Load carried yearly per cost of		Vehicle price (inBDT)	Maintenance- 2.5% of price	per m3-km (in BDT)	per tonne-km (in BDT)
		in m3	in tonnes	in m3-km	in tonnes-km				
Small car	30,000	2.00	0.60	60,000.00	18,000.00	800,000	20000	0.3333	1.11
Van	40,000	5.20	1.25	208,000.00	50,000.00	1,200,000	30000	0.1442	0.60
Medium truck	90,000	40.00	12.00	3,600,000.00	1,080,000.00	1,500,000	37500	0.0104	0.03
Large truck	120,000	70.00	25.00	8,400,000.00	3,000,000.00	3,500,000	87500	0.0104	0.03

BDT 20,000/60,000= * BDT 0.333 per m3-km
 BDT 20,000/18,000= ** BDT 1.11 per tonne-km

Total Cost																
Vehicle class	Depreciation		Cost of driver		Cost of fuel		Cost of insurance		Cost of maintenance		Tax		Miscellaneous cost		Total cost	
	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km	per m3 km	per tonne km
Small car	2.6667	8.8889	3.0000	10.0000	1.8750	6.2500	0.2667	0.8889	0.6667	2.2222	0.1333	0.4444	0.3333	1.1111	8.9417	29.8056
Van	1.1538	4.8000	1.1538	4.8000	0.9231	3.8400	0.1154	0.4800	0.2885	1.2000	0.0577	0.2400	0.1442	0.6000	3.8365	15.9600
Medium truck	0.0833	0.2778	0.0733	0.2444	0.4688	1.5625	0.0083	0.0278	0.0208	0.0694	0.0042	0.0139	0.0104	0.0347	0.6692	2.2306
Large truck	0.0833	0.2333	0.0357	0.1000	0.3429	0.9600	0.0083	0.0233	0.0208	0.0583	0.0042	0.0117	0.0104	0.0292	0.5057	1.4158
															17.6833	21.0516

- These figures are only illustrative, and presented mainly to give an idea of the order of magnitude of the economies of scale that can operate between different classes of vehicles.
- These overall figures noticeably illustrate the cost differences between large and small vehicles. They show that, for instance, carrying goods by small car costs about (i.e. 8.9417/0.5057) eighteen times more than carrying them by large truck.

17.4 Evaluation Transportation Choices

Characteristics of Mode	Mode of Transportation				
	Air	Pipelines	Highway	Rail	Water
Speed (1=fastest)	1	4	2	3	5
Cost (1=highest)	1	4	2	3	5
Loss and Damage (1=least)	3	1	4	5	2
Frequency *(1=best)	3	1	2	4	5
Dependability (1=best)	5	1	2	3	4
Capacity+ (1=best)	4	5	3	2	1
Availability (1=best)	3	5	1	2	4

*Frequency: number of times mode is available during a given time period.
+Capacity: ability of mode to handle large or heavy goods.

18. Review of Supply Chain Development Plans at the National Level:

Unreliable transport infrastructure and lack of related facilities cause delays and may also create quality concerns. Good transport infrastructure will expedite transport and delivery lead-times and will provide you greater flexibility.

You, as a learner need to know what supply chain development plan has been taken at the national level of Bangladesh. Every detail of “Review of Supply Chain Development Plans at the National Level” has been elaborated in the **study on Supply Chain Resilience of RMG Sector in Bangladesh (Chapter: 5 Page No. 53 to 69).**

18.1 Road Master Plan (RMP) by RHD

In 2009, the Roads and Highways Department (RHD) prepared the Bangladesh Road Master Plan (RMP). It followed the direction provided by the National Land Transport Policy (NLTP), which was committed to the government to developing a long-term plan. This master plan was intended to guide road sector investment over the 20 years. It has been compiled based on a thorough diagnosis of the following issues of the RHD road network and potential challenges:

- Roads and bridges are continuously damaged from a lack of adequate maintenance and vehicle overloading.
- Continuing traffic growth that will exceed the capacity of many National Highways within the next 20 years.
- A mix of motorized and non-motorized traffic, and encroachment onto roads, leading to high accident rates.
- The country’s rural centers are not fully connected with the main road network.
- The large number of rivers that are still crossed by ferries hampers smooth movement of traffic.

The objectives of the master plan are to set out a comprehensive investment program that will:

- Protect the value of RHD’s road and bridge assets;
- Improve the connectivity of the road network;
- Enhance and develop the strategic road network to meet economic and traffic growth targets;
- Improve the Zila Road network to enhance connectivity to the country’s growth centers;
- Improve road safety and reduce road accidents;
- Provide environmental and social protection; and
- Outline the institutional improvements required for RHD to deliver the above.

In order to address growing demand of traffic RMP identified projects as a list of candidate projects for appraisal. Status of preliminary identified projects is also shown in Table 18.1 In their report, RMP identified 4.780 km of National Highways and Regional Roads that required maintenance. The RMP has also identified 16 Upazila headquarters which were not connected to district headquarters by Zila Roads and estimated 356Km of new Zila road. In addition, 126 narrow bridges were identified for replacement.

Table 18.1: Status of Identified Projects under Road Master Plan 2009 as of 2019

Road ID	Section Name	Improvement Type	Targeted Opening Year	Status
N1	Dhaka – Chittagong	Widening to 4 lanes	2010	Completed
N3	Tongi – Mawna	Widening to 4 lanes	2015	Not Commenced
N102	Mynamati – Brahmanbaria	Repair and removing unsafe bends	2010	Completed
R280	Sylhet – Sunamganj	Repair and removing unsafe bends	2010	Completed
N8	Dhaka – Mawa	Widening to 4 lanes	2015	Under Widening
N1	2nd Meghna and Meghna Gumti Bridges	New Bridge(s)	2013	Completed
Ni-N3 Link	Dhaka Eastern By-pass	New Road	2015	Completed
N8	Padma Bridge	New Bridge	2015	Under Construction
N8-N5 Link	Dhaka Western By-pass	New Road	2016	Feasibility Study Completed
R750/Z7503	Narail to Jessore	Upgrading and widening to 4 lanes	2015	Not Commenced
N4	Dhaka - Tangail	Widening to 4 lanes	2015	Completed (almost)
N706	Jessore - Benapole	Widening to 4 lanes	2020	Not Commenced
N2	Dhaka – Bhairab	Widening to 4 lanes	2020	Not Commenced
N5	Dhaka - Baniajuri	Widening to 4 lanes	2020	Not Commenced
N1	Chittagong By-pass	New Road	2020	Completed
N1-N106	Kumira - Hathazari	New Road	2013	Not Commenced
N1	Chakaria to Chittagong	Widening to 4 lanes	2020	Not Commenced
N6	Baneshwar - Bhelpukur	Widening to 4 lanes	2025	Not Commenced
N8	Lebukhali Ferry Replacement	New Bridge	2025	Under Construction
	Dhaka Outer Orbital Road	New Road	2024	Not Commenced
	Dhaka-Chittagong Expressway	New Road (Tolled)	2020	Not Commenced

Source: Economics Circle, Roads and Highways Department (RHD), 2019

A total number of 153 development projects including one Technical Assistance (TA) projects have been included in the Annual Development Program (ADP) of Roads and Highways Department for FY2019-2020. Table 18.2 shows the major ongoing projects under Roads and Highways Department (RHD).

Table 18.2 Status of Major Development Projects by RHD

SL	Name of the Projects	Status
1	Construction of 3rd Karnaphuli Bridge	Completed
2	Construction of 3rd Shitalakhya Bridge at Bandar Upazila	Ongoing
3	Construction of Bridge over Payra River on Barishal-Patuakhali Highway	Ongoing
4	Support to Joydevpur-Debogram-Bhulta-Madanpur Road (Dhaka Bypass)	Ongoing
5	Cross-Border Road Network Improvement Project	Ongoing
6	SASEC Highway: Alenga-Hatikamrul-Rangpur Highway into 4-lane	Ongoing
7	Improvement into appropriate Standard of Jessore-Khulna National Highway	Ongoing
8	Improvement into appropriate Standard of Jessore-Benapole National Highway	Ongoing
9	Improvement into appropriate Standard of Hemayetpur-Singair-Manikganj Regional Highway	Ongoing
10	Improvement of Ashuganj River Port-Sarail-Dharkhar-Akhaura Highway into 4-lane	Ongoing
11	Improvement of Feni-Noakhali National Highway into 4-lane	Ongoing
12	Improvement of Kumilla (Thomson Bridge) – Noakhali (Begumganj) Regional Highway into 4-lane	Ongoing
13	Widening of Alenga-Jamalpur National Highway into 4-lane	Ongoing
14	Improvement of Hathazari-Rowjan National Highway into 4-lane	Ongoing
15	Improvement into appropriate Standard of Gobindaganj-Ghoraghat-Birampur-Fulbari-Dinajpur Regional Highway	Ongoing
16	Construction of the 2nd Katchpur, Meghna, Gomoti and Rehabilitation of existing Bridges	Completed
17	Technical Assistance for Sub-regional Road Transport Project Preparatory Facility (SRTPPF-2)	Ongoing

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2019-2020

A list of ongoing donors assisted projects in the Annual Development Program (ADP), 2019-2020 is shown in Table 18.3.

Table 18.3 Ongoing Donor Assisted Development Programme for RHD, 2019 - 2020

SL	Name of the Projects	Source of Finance
1	Construction of 3rd Karnaphuli Bridge	Kuwait Fund
2	Construction of 3rd Shitalakhya Bridge at Bandar Upazila	Saudi Arab
3	Construction of Bridge over Payra River on Barishal-Patuakhali Highway	Kuwait Fund
SL	Name of the Projects	Source of Finance
4	Greater Dhaka Sustainable Urban Transport Project (BRT Gazipur Airport)	AFD, ADB, GEF
5	SASEC Road Connectivity: Improvement of Joydevpur-Chandra-Tangail-Alenga Road into 4-lane	AFD, ADB, OPEC
6	Construction of 2nd Katchpur, Megna, Gomoti and Rehabilitation of existing Bridges	JICA
7	Western Bangladesh Bridge Improvement	JICA
8	Cross-Border Road Network Improvement Project	JICA
9	SASEC Highway: Alenga-Hatikamrul-Rangpur Highway into 4-lane	ADB
10	Improvement of Ashuganj River Port-Sarail-Dharkhar-Akhaura Highway into 4-lane	LOC
11	Technical Assistance for Sub-regional Road Transport Project Preparatory Facility (SRTPPF-2)	ADB

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2019-2020

18.2. Rural Road Master Plan by LGED

In 2005 LGED prepared a Road Master Plan with an objective to ensure accessibility enhancement throughout the country. Emphasis has been given to connect growth centers, markets, ghats and union parishad complexes. It assumes that improvement in accessibility will give more market potential to agriculture products and hence play a role in poverty reduction. The LGED Road Master Plan does not have the geographically identified road for construction and improvement rather they set recommended selection criteria for road network improvement:

- Route selection will be based on network approach and no scattered road-link should be selected.
- Basic rural road master plan network will consist of the road links connecting Growth Centres with Upazila HQs, Growth Centre to Growth Centre, and Growth Centre to higher road system (NH, RH or ZR).
- All these links will be single main connection, shortest route and not necessarily be limited within Upazila or district boundary and maximize community benefits.
- Road links connecting Union HQ to Upazila HQ, Union HQ to Growth Centre, Union HQ to Rural Markets, and one Union HQ to another Union HQ will be part of Rural Road Master Plan.
- Road links connecting maximum number of Rural Markets, villages and other socioeconomic infrastructure like schools, hospitals, etc., of the area will get preference.
- The partially developed route will get preference over the newly proposed route under the master plan to maximize immediate benefit.

18.3. Bangladesh Railway

Since 2009 Bangladesh Railway has newly constructed 330.15 km rail line, 91 station buildings, 295 bridges and converted 248.50 km railway track into Dual gauge track.

Furthermore, 1,335.23 km railway track, 644 bridges, 177 station buildings, 430 passenger coaches, 277 wagons have been rehabilitated. To address the shortage of rolling stocks 20 MG locomotives, 26 BG locomotives, 270 passenger coaches and 20 sets DEMU, 165 BG and 81 MG tank wagons, 270 Flat wagons and 30 Brake vans have been procured.

Table 18.4 shows the major projects under Bangladesh Railway.

Table 18.4 Status of Major Development Projects by BR

SL	Name of the Projects	Status
1	Construction of Double Line Track from Tongi to Bhairab Bazar Including Signaling	Completed
2	Remodeling of Khulna Railway Station & Yard and Development of Operational Facilities of Benapole Railway Station	Completed
3	Track Doubling Between Laksam and Chinki-Astan	Completed
4	Construction of Pachuria-Faridpur-Bhanga Sections of BR	On going
5	Construction of Single Line Dual Gauge (DG) Railway Track from Dohazari to Cox's Bazar via Ramu and Ramu to Gundum near Myanmar	On going
6	Rehabilitation of Kalukhali-Bhatiapara Section and Construction of Kashiani-Gopalganj-Tungipara New Rail Line	Completed
7	Construction of a New Railway Line from Ishurdi to Dhalarcha Via Pabna	Completed
8	Construction of 2nd Bhairab & 2nd Titas Bridges with Approach Rail Lines	Completed
9	Construction of Khulna Mongla Port Rail Line	Ongoing
10	Upgrading of Signaling at 11 Stations Between Ishurdi and Darsana	Completed
11	Construction of 3rd & 4th Dual Gauge Line in Dhaka Tongi and Dual Gauge Double Line in Dhaka-Joydevpur Section of BR	Ongoing
12	Construction of Dual Gauge Double Rail Line and Conversion of Existing Rail Line into Dual Gauge Between Akhaura and Laksam	Ongoing
13	Padma Bridge Rail Link Project	Ongoing
14	Bangabandhu Railway Bridge Construction	Ongoing

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2019-2020

A list of ongoing donor assisted projects in the Annual Development Program (ADP), 2019- 2020 is shown in Table 18.5.

Table 18.5 Ongoing Donor Assisted Projects by BR, 2019 – 2020

SL	Name of the Projects	Source of Finance
1	Construction of dual gauge single track Dohazari –Ramu-Cox’s Bazar and Ramu to Gundum	ADB
2	Construction of Khulna to Mongla Port	India
3	Rehabilitation of Kulaura-Shahbajpur railway section	India
4	Construction of 3rd & 4th Dual Gauge Line in Dhaka Tongi and Dual Gauge Double Line in Dhaka-Joydevpur Section of Bangladesh Railway	India
5	Construction of Dual Gauge Double Rail Line and Conversion of Existing Rail Line into Dual Gauge Between Akhaura and Laksam	ADB, EIB
6	Construction of Dhaka-Narayangan dual gauge double line parallel to exiting track	DRGACF
7	Procurement of meter gauge and broad-gauge passenger carriages	ADB
8	Padma Bridge Rail Link Project	China
9	Procurement of 200 meter gauge passenger carriage (meter gauge)	China
10	Bangabandhu Railway Bridge Construction	JICA
11	Procurement of 20 meter gauge locomotives and 150 passenger carriage	UDCF
12	Construction of Khulna-Darsana double line	China
13	Construction dual gauge railway track from Shaheed M Mansur Ali Station to Bogra	LOC

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2019-2020

Bangladesh Railway prepared the master plan for 2010-2030, which is being updated with ADB assistance in response to the recent government emphasis on the railway sub-sector. The Railway Sector Master Plan (2010 to 2030) was approved in 2013. The plan referred to the needs in the following areas: (i) further investment in track, signaling, rolling stock, and maintenance; (ii) development of prospective lines with standards compatible with neighboring countries and the Trans Asian Railway network’s design standards; (iii) focus on multimodal integration with road and inland water transport system on major corridors as well as improvement of railway infrastructure facilities for traffic efficiency; (iv) better management of continuing traffic growth that will exceed the capacity of some corridors in the next 20 years; (v) focus on containers, and

commuter and inter-city services, in view of the potential of local passenger services; (vi) rehabilitation of the large number of old bridges which requires double tracking; and (vii) regaining full capacity of workshops by modernization and rehabilitation.

18.4. Inland Water Transportation

There are about 24,000 km of waterways in Bangladesh. They are of varying nature and have differing hydraulic characteristics. For convenience, the rivers are grouped in four separate divisions, a brief description of which is given below:

- **The Braided Rivers:** The large rivers of Bangladesh, such as the Ganges, Jamuna, Padma, and lower Meghna fall in this category. In the monsoon seasons or the high-water periods their discharges cover the entire riverbed, often overtopping the banks and flooding adjacent areas. In the winter seasons or the low water periods, the reduced discharges cause the river to bifurcate into a number of branches that meander within the high-water banks.
- **The Tributaries:** Rivers such as the Surma, Barak, and Atrai perform the task of collecting the discharges from the local catchments and feed the main rivers. These generally fall in the ‘meandering river’ category.
 - **The Distributaries:** These are the rivers branching out from larger rivers e.g. the Lakhya and the Arial Khan River. Their water levels depend upon the discharges received from the Mother Rivers. Generally, their confluences at the offshoots and outfalls are problematic for navigation due to silt deposition and formation of shoals caused due to transitional changes in cross-sections.
 - **The Tidal Rivers:** These Rivers are located mostly in the southern part of the country and are dominantly tidal in character. Examples are the Pashur, the Karnaphuli, etc.

The waterways of Bangladesh display a high water and a low water flow period. The low water period usually takes place from November to April every year, the lowest water levels usually occurring in the months of February-March. During this time not only water levels fall but also shoals appear in the channels restricting smooth navigation. The current classification in use was introduced in 1989. It divides the inland waterways into four hierarchical classes as shown in Table 18.6. The classification was made principally according to the least available draft (LAD).

18.6 Classification of Inland Waterway

Class	Indicated draft (m)	Length (km)	%	Classification Criteria
I	3.6	683	11	These are major transport corridors where LAD of 3.6 m is required to be maintained round the year.
II	2.1	1,000	17	These link major inland ports or places of economic importance to Class-I routes.
III	1.5	1,885	32	Being seasonal in nature, it is not feasible to maintain higher LAD throughout the year.

IV	<1.5	2,400	40	These are seasonal routes where maintenance of LAD of 1.5 m or more in dry seasons is not feasible.
Total		5,968	100	

Source: Bangladesh Inland Water Transport Master Plan, 1989.

Despite its importance, IWT has received little attention in the last few decades with limited resources allocated to its development. It receives only 4-7 percent of total transport sector funding. Current problems faced by the IWT sector include lack of funding allocated to maintenance of waterways other than ferry crossing routes and consequently inadequate dredging maintenance. There are only two donor assisted projects. A total of 20 development projects of BIWTA were included in the ADP including two donor assisted projects. Table 18.7 shows the major development projects.

Table 18.7 Status of Major Development Projects for Inland Waterway

SL	Name of Projects	Status
1	Dredging of Madaripur-Char Muguria-Tekerhat-Gopa launch route	Completed
2	Construction of Ashuganj ICT	Ongoing
3	Dredging of 12 number important river route	Ongoing
4	Capital dredging of 53 river route	Ongoing
5	Bangladesh Regional Waterway Transport Project 1 (BRWTP1)	Ongoing
6	Procurement of 35 dredger and ancillary equipment	Ongoing

Source: Annual Development Programme (ADP), Programming Division, Planning Commission

As mentioned in the above section IWT has given little attention to develop and maintain water transport by the government as well as donor agencies. There are only two foreign financing projects since 2010. The Bangladesh Regional Waterway Transport Project 1 (BRWTP1) funded by the World Bank aims to improve the navigability and year-round safe transport for passengers and cargo along the Chittagong-Dhaka-Ashuganj river routes. This will help shifting traffic away from heavily congested roads along these routes. The other project is construction of Construction of Ashuganj ICT. Table 18.8 shows the donor assisted projects under BIWTA.

Table 18.8 Ongoing Donor Assisted Major Development Projects for Inland Waterway

SL	Name of Projects	Source of Finance
1	Bangladesh Regional Waterway Transport Project 1 (BRWTP1)	WB
2	Construction of Ashuganj ICT	India

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2019-2020

This Plan under the Ministry of Shipping and Planning Commission has an overall aim to revive inland water transport. As most IWT vessels are from the private sector, the Master Plan focuses on infrastructure requirements over a 20-year period (2009-2029).

The main policy directives are:

- Reclassification of inland waterways network, maintaining a core network
- Vessel controls and establishment of a Vessel Design Institute
- Development of inland river ports and launch landing stations
- Network maintenance with emphasis on dredging works
- Support container transport from seaports due to limited capacity of road and rail
- Improvement of regional traffic via waterways to support trade
- Improvements to country boat usage including registration and awareness programs
- Safety improvements through enforcement, training/education, overloading controls , etc.

The Master Plan sets out a guideline for rehabilitation and maintenance of existing facilities and developing new ones over a twenty-year period (up to 2029), in phases. It is found from the ADP implementation and master plan documents that BIWTA mainly follows ADP implementation schedule (see Table 18.9).

Table 18.9 Status of Major Projects under BIWTA Master Plan, 2009 - 2029

SL	Name of Projects	Present Status 2020
1	Waterways network (project for improving navigability and network efficiency)	Ongoing
2	Dredging of waterways (continue to maintain waterways by dredging)	Ongoing
3	Inland river ports (constructing, maintaining and operating)	Ongoing
4	Launch landing station (constructing, maintaining and operating)	Ongoing
5	Container transport (constructing ICT and its operation)	Ongoing
6	Cross border IWT traffic (Bangladesh Regional Waterway Transport Project 1)	Ongoing
7	Safety (procuring safety aid)	Ongoing

18.5. Sea Port

Chittagong Port dominates Bangladesh’s export-import with more than 90 percent of freight. Considering the enormous importance of Chittagong Port on total economy of the country, the present government has taken massive development programs to improve the efficiency in the operating activities of the Port. To maintain navigability in front of jetty pontoon, outer bar area and at Karnaphuli navigational channel, an average of one million cubic meter of maintenance dredging is being performed usually on yearly basis.

In parallel, the government is planning and implementing other ports, namely, Payra Port, Bay Terminal, Miresarai Port an annex of Chittagong Port, and another deep seaport.

In the area of Chittagong Port Authority (CPA), a significant part of development spending came from its own budget surplus²⁸. As such, CPA can finance its development needs without any financing constraint. However, some study projects were initiated with donor funding, for instance, the Strategic Master Plan for Chittagong Port and Chittagong Port Trade Facilitation Project (CPA Component) by ADB. Table 18.10 shows the status of major development projects by CPA.

The Master Plan facilitates Chittagong Port Authority to outline some of the options that are available to increase efficiencies and to provide additional throughput capacity at the port to cater for the projected growth in port tonnage over the next 25-30 years. The Master Plan intends to prepare a phased plan of port development based on different scenarios including among others hinterland access, navigability, intermodal connectivity at the port (road, rail and inland waterways), development of terminals and jetties.

Table 18.10 Status of Major Development Projects by CPA

SL	Name of Projects	Status
1	Strategic Master Plan for Chittagong Port by ADB	Completed
2	Chittagong Port Trade Facilitation Project (CPA Component)	Completed
3	Construction of Backup Facilities Behind Berth#4 and 5 of New Mooring Container Terminal	Completed
4	Installation of Vessel Traffic Management Information System (VTMIS)	Completed
5	Procurement of 51 number Container and Cargo Handling Equipment	Completed
6	Procurement of Equipment for New Mooring Container Terminal (NCT)	Ongoing
7	Construction of Patenga Container Terminal (PCT)	Ongoing

Source: Chittagong Port Overview, 2017-18.

Table 18.11 Status of Major Projects under the Strategic Master Plan (2015 - 2045) for Chittagong Port 2009 - 2029

SL	Name of Projects	Present Status 2020
1	Construction of Multi-purpose Terminal (MPT)	Not started
2	Karnaphuli Container Terminal (KCT1)	Ongoing
3	Improving Capacity of New Mooring Container Terminal (NCT1)	Ongoing
4	Improving Capacity of New Mooring Container Terminal (NCT2)	Ongoing
5	Construction of Bay Container Terminal (BCT)	Not started
6	Construction of Terminal at Laldia	Not started
7	Construction of Floating Crane	Not started

8	Procurement of Security related Equipment	Not started
9	Procurement of Cargo and Container Handling Equipment	Not started

Source: *Strategic Master Plan for Chittagong Port Authority, 2015 and Chittagong Port Overview, 2017-18.*

18.6. Land Ports

There are a total of 23 land ports. Among them, Benapole, Bhomra, Burimari, Akhaura, and Nakugaon Land Port are being operated in-house by the management of Bangladesh Land Port Authority (BLPA). On the other hand Sonamosjid, Hilli, Teknaf, Banglabandha and Bibirbazar land ports are being operated on Build Operate Transfer (BOT) basis. Under the South Asia Subregional Economic Cooperation (SASEC) development project construction of warehouse, road pavement, transshipment shed and drainage system in Benapole and Burimari Land Ports are being completed by financing from ADB and ongoing Bangladesh Regional Connectivity Project-1 (improving of security management of Sheola, Bhomra, Ramgarh, and Benapole land port) funded by the WB. However, there is no master plan of BLPA only the Annual Development Program (ADP) and Seventh Five Year Plan FY2016FY2020, General Economic Division, Planning Commission only indicated that government is also taking steps to strengthen the land ports to facilitate trade with neighbors.

Bangladesh's relative cost advantage from being a low labor cost producer is diminished by poor performance in trade facilitation. For example, Bangladesh manufacturers' 'Order to Delivery Cycle' is 35 to 50 percent longer than many of their competitors. Trade-related infrastructure is inadequate, and border crossing times at some land ports are measured in days, rather than hours. A significant proportion of Bangladesh's international trade procedures are still paper-based and continue to be managed manually, causing delays for border clearance and hampering private sector competitiveness. Table 18.12 shows the status of major development projects by LPA.

Table 18.12 Status of Major Development Projects by LPA

SL	Name of Projects	Status
1	SASEC Road Development Project: Improvement of Benapole and Burimari Land Port	Completed
2	Development of Bhomra Land Port	Completed
3	Development of Nakugaon Land Port	Completed
4	Development of Tamabil Land Port	Completed
5	Development of Shonahat Land Port	Completed
6	Development of Belunia Land Port	Ongoing
7	Bangladesh Regional Connectivity Project-1 (improving of security management of Sheola, Bhomra, Ramgarh, and Benapole land port)	Ongoing

Source: *Annual Development Programme (ADP), Programming Division, Planning Commission, 2016-2017 & 2019-2020.*

There are only two donor assisted projects currently being implemented under BLPA (see Table 18.13).

Table 18.13 Ongoing Donor Assisted Major Development Projects for Land Port

SL	Name of Projects	Source of Finance
1	SASEC Road Development Project: Improvement of Benapole and Burimari Land Port	ADB
2	Bangladesh Regional Connectivity Project-1 (improving of security management of Sheola, Bhomra, Ramgarh, and Benapole land port)	WB

Source: Annual Development Programme (ADP), Programming Division, Planning Commission, 2016-2017 & 2019-2020.

18.7. Civil Aviation Authority of Bangladesh (CAAB)

At present Civil Aviation Authority, Bangladesh (CAAB) operates three international airports and seven domestic airports and two Short Take-Off and Landing (STOL) ports. Out of these, eight airports are in operation. Due to insufficient passengers, no flight is operating at two other domestic airports and two STOL ports. There is no master plan on air transport in Bangladesh and airport related activities are based on the Annual Development Program (ADP) and Five-Year Plan. To address the capacity constraints to the expansion of international and domestic air services, the government has adopted a phased implementation plan for adding air service infrastructure support. The government also intends to upgrade the airport at Cox's Bazar to an international level to promote tourism. Table 15.14 shows status of major development projects by CAAB.

Table 18.14 Status of Major Development Projects by CAAB

SL	Name of Projects	Status
1	Expansion of operational and passenger facilities of Hazrat Shahjalal International Airport (HSIA)	Ongoing
2	Development of Cox's Bazar Airport into international airport for operation of wide-body airport.	Ongoing
3	Enhancement of Cargo aircraft parking facilities at Shah Amanat International Airport (SAIA).	Ongoing
4	Strengthen existing runway at Shah Amanat International Airport (SAIA).	Ongoing
5	Strengthen existing runway at Osmani International Airport, Sylhet.	Ongoing
6	Construction a new airport at Southern region of the country	Ongoing

7	Improvement of quick communication system between the reverie and costal belt of southern zone of the country and capital city especially in the time of natural disaster.	
8	Detail feasibility study for construction of Bangabandhu Sheikh Mujib International Airport (BSMIA)	

Source: (a) Seventh Five Year Plan FY2016-2020, General Economic Division, Planning Commission and (b) Annual Development Program, 2019-2020.

Hazrat Shahjalal International Airport (HSIA) had been failing to cope up with the increasing number of flights and passengers. To expand the cargo handling capacity, a cargo village was constructed. Then in order to increase the passenger handling capacity, the terminal building would be extended, in 2 phases, which is expected to serve for next 20 years³⁰. The Expansion of HSIA (1st Phase) is funded by JICA. There is only **one donor** assisted project at present, which is shown in Table 15.15.

Table 18.15 Ongoing Donor Assisted Major Development Projects for HSIA

SL	Name of Projects	Source of Finance
1	Expansion of operational and passenger facilities of Hazrat Shahjalal International Airport (HSIA)	JICA

Source: Annual Development Program, Programming Division, Planning Commission, 2019-2020.

18.8. South Asia Sub regional Economic Cooperation Operational Plan (2016 - 2025)

In 1996, four of the South Asian Association for Regional Cooperation (SAARC) members—Bangladesh, Bhutan, India, and Nepal—formed the South Asian Growth Quadrangle (SAGQ) to accelerate economic development in the four countries. SAARC endorsed SAGQ in 1997 at the SAARC Summit held in Male. At the request of SAGQ, ADB launched the SASEC program and supported it through several regional technical assistance projects.

Since 2001, SASEC has been promoting regional cooperation in initially six sectors: transport; energy and power; environment; tourism; information and communication technology; and trade, investment, and private sector cooperation. In 2011, SASEC started to concentrate on three sectors—transport, trade facilitation, and energy— focusing on projects that were identified in the SAARC Regional Multimodal Transport Study (SRMTS) and the SAARC Regional Energy Trade Study (SRETS). The results of cooperation in these three sectors have been noteworthy, with a number of key cross-border constraints being gradually reduced. In 2014 the Maldives and Sri Lanka joined the SASEC partnership, further widening the opportunities for economic links and cooperation in the sub-region. Myanmar joined SASEC in 2016, further enhancing the economic links between South and Southeast Asia.

As of July 2016 40 SASEC projects totaling \$7.7 billion had been completed or were being implemented. Transport infrastructure across all modes are being upgraded and expanded to address critical bottlenecks and support trade routes. A SASEC trade facilitation strategy is being implemented, which includes reforming policies, regulations, and institutions to modernize customs consistent with best international practices, assessing standards and conformity, and making practical arrangements for cross-border and

transit transport. SASEC is working to improve both accesses to energy as well as security in the region by developing essential energy infrastructure, promoting intraregional power trade to reduce costs and dependence on imports, and developing clean energy resources.

Strategic Objectives

- The overarching goal of SASEC is to increase trade and economic cooperation within South Asia, create links to East Asia and Southeast Asia, and promote sustained and inclusive economic growth through regional cooperation. This goal will be achieved through the following strategic objectives:
- Enhancing physical connectivity through multimodal transport systems that are aligned more closely with the development of markets.
- Following a comprehensive approach to transport and trade facilitation that will expand the current focus from land-based to sea-borne facilitation, to complement investments in multimodal networks.
- Enhancing electricity trade, this will lead to an expanded and diversified energy supply to meet energy needs and secure power reliability.
- Promoting synergies between economic corridors being developed in individual SASEC countries and optimizing development impacts of these economic corridor investments through improved cross-border links.

Potential SASEC Transport Projects:

Table 18.16 show a list of potential SASEC transport projects which focus on the development of international economic corridors among SASEC nations, and will focus on the following operation priority areas:

- Operational Priority 1: Reinforcing existing value chains and developing new valuechain linkages between in-country corridors.
- Operational Priority 2: Upgrading key transport and trade facilitation infrastructure to improve connectivity between in-country corridors.
- Operational Priority 3: Designing appropriate institutional mechanisms to serve as platforms for coordination and collaboration among the government and various stakeholders involved in ECD.

Table 18.16 List of Potential SASEC Transport Projects

Priority	Name of Projects	Indicative Funding Source
Road 1 (a)	Completion of Dhaka–Chittagong National Highways (N 1)	Government
	Construction of new four-lane Katchpur, Megna, and Gumti Bridges (N1)	Government, JICA

	Construction of the new Padma Bridge and immediate approach roads (AH1)	Government, others
	Four-laning of roads between Benapole and proposed new Padma Bridge (AH1)	NF
	Four-laning of Joydevpur–Elenga–Hatikamrul–Rangpur–Burimari and/or Banglabandha National Highway (N4, N5)–	ADB
	Four-laning of Dhaka (Katchpur)–Narsingdi–Sarail–Sylhet–Tamabil National Highway (N2)	ADB
	Four-laning of Paturia–Nabinagar	NF
	Construction Dhaka–Chittagong Expressway	PPP, design supported by ADB technical assistance loan
1 (b)	Rehabilitation of the Baraierhat–Heako–Ramgarh Highway	NF
	Upgrading of link road Sarail–Brahmanbaria N1-N2	NF
	Chittagong–Gundum (for future access to Myanmar)	JICA
1 (c)	Four-laning Chittagong Port Access Road	ADB
	Four-laning Jessore–Mongla Port highway	NF
Rail		
2 (a)	Third and fourth track Dhaka–Tongi and double tracking Tongi–Joydevpur	India
	Dedicated rail bridge parallel to Bangabandhu bridge	JICA
	Construction of Padma Bridge rail links	NF
	Double tracking Joydebpur–Ishurdi section	NF
	Conversion to dual gauge on the Dhaka–Chittagong	ADB
Priority	Name of Projects	Indicative Funding Source
	Construction of Bogra–Sirajganj dual gauge rail line	NF
	Procurement of rolling stock	ADB
	Double tracking Khulna–Parbutipur	NF
2 (c)	Double tracking Tongi–Bhairab Bazar	ADB
	Second bridges at Bhairab Bazar and Titas	India
	Double tracking Laksham–Akhaura link	ADB/EIB
	Chittagong–Cox Bazar Rail link	ADB
	Construction of rail link to Matarbari and Maheshkhali Power Plant and Deep-Sea Port	ADB

	Construction of second rail–road bridge on Karnapuli River	KEXIM
	Khulna–Mongla Port railway	India
Port	Karnaphuli Container Terminal at Chittagong Port	NF
3 (a)		
3 (b)	Development of Sonadia Port	NF
	Additional container handling equipment at Chittagong	Port
3 (b)	Development of Sonadia Port	NF
	Additional container handling equipment at Chittagong	Port
Inland Waterways	Assessment of the development needs of inland waterways development of Inland Clearance Depots at Khanpur	World Bank; PPP
4		
Air	Upgrading of runway at Dhaka Airport	NF
5	Development of new passenger terminal	JICA
	Improvement of parking aprons at Dhaka Airport	JICA

Ref: Study on Supply Chain Resilience of RMG Sector in Bangladesh (Chapter 5: Page 53-69)

19. Eighth Five Year Plan (July 2020 to June 2025): Transport and Communication Development Strategy

Learners are requested to go through 8th Five Year Plan (Par 2, Chapter 6: Page 281-398) to be familiar with progress and strategy in respect of development of transport sector.

Transport and Communication Development Strategy mentioned in 8th Five Year Plan

19.1 OVERVIEW

In today's globalized economy, low-cost and efficient transport service is a major determinant of the competitiveness of the economy that influences trade and investment flows both internally within a country and externally. Efficient transport system also impacts on the pattern of regional development within a country and the location of poverty. Development of an efficient and low-cost transport network is, therefore, a key determinant of the ability to achieve the growth and poverty targets of PP2041.

Recognizing the important role of transport, Bangladesh has put top priority to the development of its transport network. Bangladesh witnessed rapid growth of transport sector since independence. The overall annual growth rate was nearly 8.2 per cent for freight transport and 8.4 per cent for passenger transport. Even so, the demand for transport services continues to grow very fast, especially as the economy gets internally integrated and economic transformation away from agriculture and rural

economy to urban-based industrial and modern services gathers speed. The relative roles of transport modes are evolving with road transport continuing expanding to dominate because of its inherent technical and cost advantages.

Transport system in Bangladesh comprises a number of distinct modes and services, notably railways, roads, road transport, land ports, inland water transport, coastal shipping, airports and airlines. Roads and inland water transport are the dominant means of transport carrying more than 90% of total traffic generated in the country. Although other modes like railway, coastal shipping would play a greater role, roads and IWT would continue to dominate the transport landscape in the foreseeable future. Presently there are about 55,000kms of paved roads; 2,877 route-kilometres of railways, 3,800 km of perennial waterways which increases to about 6,000 km during the monsoon, 2 seaports, 3 international airports (i.e. Dhaka, Chittagong and Sylhet) and 8 domestic airports.

Public sector is mainly responsible for development and maintenance of transport infrastructure in Bangladesh. The public sector is involved in transport operations in road, railways, inland water transport (IWT) and ocean shipping alongside the private sector. In the road transport and IWT sub-sectors, the private sector is dominant.

In ocean shipping, however, public sector still predominates, although the private sector has considerably increased its role in recent years. Recently private sector has also become important operator in air transport, both domestic and international. Involvement of the private sector in railway operation, however, is very limited.

19.2 TRANSPORT SECTOR PROGRESS UNDER THE 7FYP

GDP growth targets of the 7FYP and goals of improved living standards called for a vibrant and effective transport network. Securing improvement in the transport system was, therefore, a major strategic objective of the 7FYP. The transport sector vision for the 7FYP was to develop an efficient, sustainable, safe and regionally balanced transportation system in which various modes complement each other, interface³⁸² appropriately and, where possible, provide healthy competition to each other. Special emphasis was placed on the introduction of modern technology for increasing capacity and improving quality and productivity of the system, development of the two seaports with smooth transport links to Dhaka, establishment of effective railway linkages between the east and west zones of the country, integration of road, rail and inland water transport, and participation in global and regional transport connectivity initiatives that help to develop the land route links between South Asia and East Asia through Bangladesh.

On the investment side, a conscious decision was taken to prioritize transformational transport infrastructure projects that helps modernize the Bangladesh transport network so as to improve the mobility of goods and services across the nation, facilitate international trade, reduce cost and improve competitiveness. These transformational projects are highly capital intensive, are multi-year in nature, and require strong supervision to avoid cost over-runs and delays. Recognizing the special challenge posed by growing urbanization and urban traffic congestion, the 7FYP sought to introduce Mass Rapid Transit (MRT) starting with the capital city Dhaka and its adjoining, with a targeted completion of MRT Line-6 (the first elevated Metro Rail of Bangladesh) in December 2022. Mindful of the resource constraints and high investment costs, the 7FYP strategy was to combine ADP allocations with a strong public-private-partnership (PPP) effort. The plan also intended to improve the inter-modal transport balance with

greater emphasis on rail and inland waterways that are low cost in nature and are environmentally friendly compared to other mode of transport. The importance of transport, especially air transport, for tourism was recognized with a focus on improving inter-district airline connectivity. Efforts were also to be made to improve resource mobilization through the introduction of user charges and fees for a range of public transport services including road user charges, port fees, inland water and rail fares.

The objectives and strategies of the 7FYP for the transport sector were sound. The emphasis on intermodal transport coordination, development of the national highways, inter-city connectivity, regional connectivity, lowering the cost of trade logistics and improving transport network asset maintenance are all well placed. The idea of instituting road user charges and sensitivity to environmental sustainability is also appropriate. Similarly, the strategy to improve incentives for private sector participation in both transport sector service and infrastructure development is well placed.

Consistent with the 7FYP strategy, the transport sector received high priority in budget allocation. The ADP allocated resources for all major projects in line with the 7FYP strategy and priority. Significant new transport infrastructure has been added over the plan period for roads and bridges. Services have expanded for all modes of transport. Private participation in air transport has grown significantly and most large cities are now connected with air services. These are major achievements that laid a strong foundation for consolidation under the 8FYP.

19.2.1 Progress with Road Transport

A good road network is a critical infrastructure requirement for rapid growth. It provides connectivity to remote areas; provides accessibility to markets, schools, and hospitals; and opens up backward regions to trade and investment.

Highways and district roads: The Roads and Highways Department (RHD) is solely responsible for the development, maintenance and management of arterial highway network in the country with a vision to provide seamless mobility through building sustainable, safe & quality road infrastructure and integrated modern transport system for achieving desired socio-economic development. A well-planned and sustainable road transport system has already played a unique role to achieve the government target set for Vision 2021. Presently, RHD manages about 21596 km of roads out of which 18% per cent is national highway, 20% is regional highway, and 62% is zila highways (Table 6.1). The roads expansion program during the 6FYP and the 7FYP was guided by the Road Master Plan 2010-2030. The focus of RHD program in the 7FYP was less on expansion of total road network length and more on enabling better traffic mobility on heavily used inter-city road corridors. Thus, the emphasis was to increase the capacity of heavily trafficked roads by widening them to four lane/six lane along with service road for local traffic. This was a sound strategy aimed at maximizing the benefits and better use of the road network. Progress with completion of major Road Sector Mega Projects is shown in Box 19.1.

Table 19.1: Various Categories of Roads under RHD (in km)

Year	National Highway	Regional Highway	Zila Road	Total
2016	3813	4247	13242	21302
2017	3813	4247	13242	21302
2018	3813	4247	13242	21302
2019	3906	4281	13207	21596
2020	3944	4883	13536	22363

Box 19.1: Progress on Mega Projects under RHD

- Four laning of Dhaka-Chittagong road, Dhaka-Mymensingh road, and Dhaka Mawa Expressway is complete.
- Dhaka -Tangail 4 lane Highway expected to be completed in 2021.
- Work on Elenga-Rangpur road network underway.
- Work on Dhaka-Sylhet road has not started yet.
- Upgrading of the Madanpur-Joydevpur road to 4- lane through PPP underway.
- Dhaka-Chittagong expressway feasibility study completed.
- Work on the Hatirjheel-Demra Expressway underway
- Work on the Gabtoli-Nabinagar Expressway underway.
- Upgrading into 4-Lane of Ashuganj River Port-Akhaura Landport Highway; Feni-Noakhali National Highway; and Comilla-Noakhali Highway underway.
- Construction of 4-Lane Payra Bridge over the river Payra on Barisal-Patuakhali National Highway underway.
- Work on 17 Bridges including Kalna Bridge under Cross Border Road Network Improvement Project underway.
- 82 Bridges under Bangladesh Bridge Improvement Project underway.
- Work on 317-kilometer border road in the Hill Tracts districts of Bandarban, Rangamati and Khagrachari is underway
- Construction of Itna-Mithamoin-Ashtogram Road Project is completed.
- Father of the Nation Bangabandhu Sheikh Mujibur Rahman Highway (Sylhet-Bholaganj Road) is expected to be completed by FY2021.

Source: RHD

The Bridges Division: The Bridges Division is responsible for implementation and maintenance of bridges and tunnels of 1500 m or more, flyover/overpass, expressway, causeway and ring road etc. As noted, during the 7FYP a strategic decision was taken to put emphasis on the major transformational projects many of which are under the Bangladesh Bridges Authority (BBA), Bridges Division. The major on-going projects during the 7FYP are: Padma Multipurpose Bridge Project; Dhaka Elevated Expressway PPP Project; Support to Dhaka Elevated Expressway PPP Project; Bangabandhu Sheikh Mujibur Rahman tunnel under the river Karnaphuli; Dhaka-Ashulia Elevated Expressway; and BRT (Gazipur-Airport) (4.5 km elevated section) along with Bangladesh Bridge Authority taken initiative for Feasibility study of construction of Subway in Dhaka city and feasibility study for construction of bridges on Putuakhali-Amtoli-Borguna road over the river Paira, on Bakergong-Baufal road over the river Karkhana, on Bhulta-AraihazarBancharampur road over the river Meghna, On Barisal –Bhola road over the river Kalabadar and Tetulia and Borguna-Patharghata road over the river Bishkhali.

The projects are being implemented on a fast-track completion program and are expected to be completed by June 2022. The construction of the most important Padma Bridge is scheduled to be

completed in June 2021. The first underwater tunnel of Bangladesh named Bangabandhu Sheikh Mujibur Rahman Tunnel (Karnaphuli Tunnel) is expected to be completed by 2022.

Rural roads: The importance of rural road connectivity to market centres (rural and urban) was preserved in the 7FYP. The LGED has developed the rural transport infrastructure based on long term Master Plan (2005-2025). The progress during the 7FYP is summarized in Table 6.2. A major focus of LGED was on improving the quality of the rural road network by paving of existing road and reconstruction of damaged paved road. Each year on average about 5000 km road has been upgraded and 30000 meters bridge/culvert has been added. The focus on rural road quality is appropriate in view of damage caused by monsoon rain and flooding. Rural road connectivity has played an important role in helping productivity of rural activities and reducing poverty

Table 19.2: Development of Rural Transport Infrastructure under LGED

Component	FY2015-16	FY2016-17	FY2017-18	FY2018-19	Total
Earthen road (km)	-	-	-		32500
Paved road (km)	4813	5220	5300	4663	19996
Bridge/culvert (m)	28500	29000	29500	9933	96933

Source: Ministry of Finance, Bangladesh Economic Review 2019

The performance of roads and bridges subsector in relation to targets set during the 7FYP is shown in Table 6.3. Overall, the physical targets were met, which is commendable. Progress was also made to improve the safety of road transports. Under the United Nations Decade of Action for Road Safety 2011-2020, RHD is working to reduce road accident fatalities by 50% within the year 2020. The five pillars of road safety are road safety management, safe road and traffic, safe motor vehicles, cautious road users and the implementation of post-accident activities. Accordingly, RHD has formulated the National Road Safety Strategic Action Plan (NRSSAP) 2017-20, which is being implemented in accordance with the road safety related targets set forth under SDG. However, notwithstanding good progress, a major constraint in the road and highways subsector has been implementation capacity that has contributed to project completion delays and cost overruns. Further efforts are needed to strengthen implementation of road safety measures.

Table 19.3: Roads and Highways Targets for the Seventh Five Year Plan (2015/16-2019/20)

Physical Activities	Unit	7FYP Targets	Actual Performance
Construction of 4 lane roads	km	300	393
Construction of roads other than 4 lanes	km	340	350
Improvement/ Rehabilitation of roads	km	2,500	4925
Construction of Flyover/Overpass	meter	7,000	7580
Construction of bridges/culverts	meter	14,800	24254
Reconstruction of bridges/culverts	meter	6,800	6830

Source 7FYP and Ministry of Road Transport & Bridges

19.2.2 Progress with Railway Services

The improvement of rail communication was accorded high priority in the 7FYP. The Railway investment program was guided by the Railway Master Plan 2010-2030 that was approved in 2004 and updated in 2017. It also drew inspiration from the National Integrated Multimodal Transport Policy (NIMTP) of 2013. A total of 230 projects with TK 5537 billion were taken up in the development plan, which included construction of new line, procurement of rolling stock for passenger and freight, and rehabilitation of existing railway station and signaling system. Implementation of the development plan has yielded significant improvement in the overall performance of Bangladesh Railway in terms of service delivery (both passenger and freight) (Table 6.4). However, the financial performance is an area where further attention will be needed.

Table 19.4: Overall Performance of Bangladesh Railway in the 7FYP

Fiscal year	Passenger km (million)	Freight Ton-km (million)	Total operating revenue (Tk in million)	Total operating expenses (Tk in million)
2013-14	8134	677	8000	16010
2014-15	8711	693	9350	18080
2015-16	9167	675	9040	22290
2016-17	10040	1052	1300	28350
2017-18	12883	1236	12760	29180

Source: Ministry of Finance, Bangladesh Economic Review 2019

19.2.3 Inland Water Transport (IWT)

Inland Water Transport (IWT) is an extremely energy efficient, environmentally clean and economical mode of transport. But it has not been able to realize its full growth potential partly because of the excessive attention to the road sector. Bangladesh has about 14,000 km of waterways (rivers/canals) of which about 5,968 kms remain navigable during monsoon and 3865 km of rivers/canals are navigable during the dry season. The water transport network of the country not only caters to the inland movement of freight and passengers but also plays an important role in the transportation of import and export items through the ports of Chittagong and Mongla. During the monsoon season when roads become impassable, riverboats are the only mode of transport for an important part of the Bangladesh's rural population. The country boat plays significant role and provides for about 50% of the total employment in the transport sector as a whole. They are also the main mode of transport in the south coastal areas where the road network is little developed. Currently, most of these waterways suffer from navigational hazards like shallow water and narrow width of channel during dry weather, siltation, bank erosion, absence of infrastructure constrained by the absence of proper surface road links to facilitate the smooth transit of cargo.

Recognizing the high potential of inland water transport, the Government completed an Inland Water Transport Master Plan (IWTMP) in 2009. This was a comprehensive study of the major constraints and made very useful recommendations on reforms and investments. However, implementation has not progressed much. The 7FYP sought to push forward these reforms by placing strong emphasis on IWT. The 7FYP strategy emphasized 4 key elements: development of new waterways and navigability of existing channels; focus on operations and maintenance and establishment of landing stations and river ports for bulk cargo and containers; digitization of services related to IWT system; and facilitating maritime education and training. Progress with implementation of the 7FYP strategy has been mixed due to a

number of constraints including inadequate resources, high-cost dredging operations to improve navigability of river routes, institutional weakness and inadequate inter-agency coordination. The 8FYP will seek to offset these constraints and improve the role of inland water transportation to improve the inter-modal balance, reduce transport cost, and protect the environment.

19.2.4 Shipping Subsector Progress

With the expansion of international trade, the importance of shipping as a major source of non-factor service (NFS) export earnings has increased. Bangladesh presently has a huge deficit on the NFS account that could be lowered substantially through the expansion of international cargo shipping capabilities. The prospective returns to this investment are high. The Shipping industry is managed and regulated by the Department of Shipping (DoS). The DoS is a regulatory body under the administrative control of the Ministry of Shipping. It administers maritime and shipping laws of the country. It deals, among others, safety, security and prevention of marine pollution through implementation of maritime laws and regulations.

On the operation side, majority of shipping business is operated by the Bangladesh Shipping Corporation (BSC), a state-owned, autonomous corporation in Bangladesh. There are also private shipping operators. The BSC owns a number of ships and oil tankers, and also charters sea-going vessels from other operators. The vessels are used to carry ready-made garments and other export items, and also to import crude oil and other commodities from abroad.

The 7FYP sought to expanding shipping capacity, improve automation and increase export earnings. Earnings from shipping have grown from \$ 300 million in FY2015 to \$500 million in FY2019, but this is far below potential and the gap between Bangladesh earnings from shipping freight and payments to the rest of the world is huge. Some of the main constraints include inadequate shipping capacity, shortage of resources, inadequate technical capabilities in an environment of changing global technology in shipping, staffing problems and management. So, stronger efforts are needed to make this an important source of export earnings. The 8FYP will put emphasis on boosting the role of international shipping and will emphasize on commercial viability

Table 19.5: Shipping Sector Performance in the 7FYP

Development activities	7FYP Target	7 FYP Achievement
Procurement of ships.	Procurement of 6 new vessels (3 new Product Oil Tankers and 3 new Bulk Carriers of about 39,000 DWT each).	All six vessels have constructed, launched and taken delivery. All vessels are now in commercial operations worldwide.
Procurement of Cellular Containers	Procurement of 4 Nos. cellular Container vessel of about 900-1200 TEUs each.	4 Nos. cellular Container vessel of about 1200-1500 TEUs each is likely to be acquired from G to G through Danish loan assistant.

Computerization of the overall activities.	Automation programmes to computerization of the overall activities of Bangladesh Shipping Corporation (BSC).	Automation programmes to computerization of the overall activities of BSC has been done in different aspect/segment: i) Implementation of e-Nothi. ii) Online shareholder’s dividend distribution (BEFTN) iii) Online payment system iv) Digital attendance system
Increase earnings from international shipping	No target set	Yearly earnings from shipping increased by 8% per year from \$300 in FY2015 to \$500 in FY2019

Source: Bangladesh Shipping Corporation

19.2.5 Progress with Civil Aviation

The demand for air services has grown substantially during the last two decades because of increase in per capita income, exports of worker services and expansion of tourism. The Civil Aviation Authority of Bangladesh (CAAB) functions as the regulatory body for all aviation related activities, serving as the custodian of all airfields and allied facilities including air navigation facilities. It is now maintaining 3 international airports and 7 domestic airports and 2 Short Take-Off and Landing (STOL) ports. Out of these, 8 airports (3 international and 5 domestic) are in operation. Due to inadequacy of passengers, no flight is operating at 2 other domestic airports and 2 STOL ports.

Hazrat Shahajalal International Airport (HSIA) at Dhaka is the busiest airport in Bangladesh through which 80% of the total air traffic flow takes place. The airport has a capacity of handling 8 million passengers annually, and in the meantime it is already saturated. Air traffic volume has increased at 8% during last 3 years. In 2019, it handled 13.09 million passengers, and 0.412286 Million tonnes of cargo. Average aircraft movement per day is around 260 no. of flights. The opening up of air traffic to private domestic carriers has also paid dividends in terms of quality and frequency of air services. With growing income, the demand for international and domestic air services continues to grow. The existing terminal and runway are not A380 or B747-8F compliant. It has become necessary for upgrading and expanding HSIA, to meet the growing air traffic demand and to accommodate Code F Aircraft (A380, B747-8F)

The 7FYP adopted a comprehensive strategy to strengthen the operational capabilities of existing facilities and develop new airports. The main elements included: (i) Expansion of operational capabilities at HSIA; (ii) Conversion of the Cox’s Bazar Airport into international airport with capabilities to operate wide-body jets; (iii) Enhancement of cargo facilities at the Chittagong Shah Amanat International Airport (SAIA); (iv) Strengthen runway infrastructure at SAIA; (v) Strengthen runway at the Sylhet Osmani International Airport (OIA); (vi) Construction of a new airport at the Southern region of Bangladesh; (vii) Improvement of communications system between the coastal belt airports and the capital city of Dhaka and (viii) Complete feasibility study for the construction of the Bangabandhu Sheikh Mujib International Airport (BSMIA).

Progress shows mixed performance, especially in the area of new airports. The capacity of HSIA has been substantially expanded and its layout and service quality has significantly improved. The air cargo handling capacity has expanded. The quality and safety standard for air traffic management has increased. Progress was also made to expand and upgrade facilities at the Chittagong and Sylhet airports. Facilities at the local airports have expanded that has enabled handling of a growing volume of domestic air traffic and services to private airlines. Inter-district air traffic management has also improved along with better communication facilities with Dhaka HSIA. The feasibility study for BSMIA has not yet completed and progress in converting Cox’s Bazar domestic terminal to international terminal has lagged. The proposed construction of a new airport in the Southern region of Bangladesh has also not happened.

The major constraints faced by the Ministry of Civil Aviation and Tourism include procurement problems, project implementation capacity constraints and financing, especially in the matter of negotiating foreign transactions. The efficiency and service capacity of the national air carrier, Bangladesh Biman, has increased but the performance remains much below the competitors from the major competitors like Qatar Airways, Emirates and Thai Airways. As a result, earnings from BB are much lower than true potential.

19.2.6 Maritime Ports Subsector Progress

The maritime port sector plays an important role in the country’s development, especially growth of GDP through sea borne trade. Total tonnage of sea borne trade is presently over 45 million tons, growing over 10 per cent per annum. Chittagong and Mongla are the only two sea borne trade ports in Bangladesh, although the functioning of a third port, the Payra Port, is underway.

Chittagong Port Authority: The Chittagong Port is the principal maritime port and handles about 92% of the country’s sea borne export and import trade. As a port it acts as the linkage between the inland and sea transportation of goods. In future the port may also provide international transit facilities to neighboring countries mainly Nepal, Bhutan and other eastern states of India.

During the 7FYP, the Chittagong Port Authority (CPA) achieved enormous progress in cargo and container handling as well as in development works (Table 19.6). The CPA carried out capital and maintenance dredging to keep the navigability of the Karnaphuli channel in expected level.

Table 19.6: CPA Traffic Performance in 7FYP

Fiscal Year	Projected Traffic				Actual Traffic			
	Import (Mill M Ton)	Export (Mill M Ton)	Total (Mill M Ton)	No. of Containers (In TEUS)	Import (Mill M Ton)	Export (Mill M Ton)	Total (Mill M Ton)	No. of Containers (In TEUS)
2015-16	46.67	6.04	52.71	2,051,759	58.32	5.97	64.29	2,189,439
2016-17	49.45	6.35	55.80	2,256,935	66.46	6.71	73.17	2,504,476
2017-18	52.23	6.64	58.87	2,482,629	78.05	7.00	85.05	2,809,352
2018-19	54.76	6.94	61.70	2,730,801	83.11	6.85	89.96	2,919,023
2019-20	57.00	7.24	64.24	3,003,981	--			--

Source: Chittagong Port Authority

A major strategy of the 7FYP was the expansion of CPA operational capacity to meet the growing demand. Major progress has been made. The CPA also procured 150 cargo and container handling equipment

including 10 Ship to Shore Gantry Cranes to cope with the ever-growing demand. The CPA expanded its 389 container holding capacity from 37,000 TEU's to 50,000 TEUs facilitate trade, the Government and CPA encouraged private sector to establish ICD (off docks) to ensure door-to-door services. During 7FYP plan two new private ICDs were established. Presently, a total 18 private ICDs are in operation.

In the meantime, CPA has extended its port limit up to Kutubdia in the South and Sitakunda in the North. As a part of its extended logistic support, CPA procured one Tug boat (3200 BHP), one seagoing low freeboard harbours Tug boat (2000 BHP) and two mooring launch. CPA increased its permissible draft from 9.14 meter to 9.5 meter and permissible length 186 meter to 190 meters during the 7FYP. The CPA has completed the construction of one CFS (Container Freight Station) shed, one car parking shed and one Custom Auction Shed to enhance its operational capacity. The construction of the Patenga Container Terminal (PCT) project is underway and it is expected to become operational by June 2021. The Chittagong Port Expansion project has been planned to increase the yard facilities of Chittagong Port. The project location is near the Bay Terminal and within the land area acquired for by Terminal. Moreover, the government of Bangladesh with the Japanese support will implement 34 projects in Maheshkhali-Matarbari area to accelerate the pace of economic development in Bangladesh. Besides, deep sea port with coal-based power plant, special economic zones, coal jetty and LNG terminals will be built in Matarbari. Upon completion of the Matarbari Port Development Project, which is being implemented under the Chattogram Port Authority, it will be treated as a commercial hub of the region.

The CPA has continued its leadership role in terms of being amongst the most financially profitable public authority during the 7FYP (Table 19.7). Overall, the CPA performed very well during the 7FYP, meeting or exceeding its planned targets and sets an example for other state-owned enterprises (SOEs) to emulate.

Table 19.7: CPA Financial Performance during the 7FYP (Tk. billion)

Year	No. of Ships Handled	Revenue Income	Revenue Expenditure	Revenue Surplus
2015-16	2875	20.3	10.7	9.6
2016-17	3092	24.1	13.5	10.6
2017-18	3664	26.6	13.9	12.7
2018-19	3699	29.3	15.9	13.4

Source: Chittagong Port Authority

Mongla Port Authority (MPA): Mongla Port, the second gateway of Bangladesh is the eco-friendliest seaport of the country. The port is well-protected by the largest mangrove forest, the Sundarbans. Since 1950, Mongla Port Authority is functioning as an international sea port. It has substantial unused capacity and has huge potential advantages in terms of turn-around time. The Mongla port is also capable of facilitating trade between north-west part of Bangladesh, Nepal, Bhutan and places adjacent to the Indian border.

In view of its great potential to provide an alternative shipping route to the heavily congested Chittagong Port, efforts were made in the 7FYP to expand the traffic through the Mongla Port. Through a major dredging project, the navigability issue was addressed that increased the water depth of the outer bar of the Passur River, enabling vessels with drafts over 10 meters to berth at the port. This investment allowed a rapid expansion of port activities. Total cargo handling expanded at an average pace of 20% per year, growing from 4.5 million metric tons to 11.3 million metric tons in FY2019.

Payra Port Authority (PPA): The Payra Port Act 2013 established the third sea port of Bangladesh located on the bank of the Ramnabad Channel in Kalapara, a sub district of Patuakhali. The main task under the 7FYP is project implementation, using a phased approach. Limited scale operational activities of Payra Sea Port started on August 13, 2016 developing some basic infrastructures and transferring the goods through sing barges by inland waterways. The Payra Port Authority has already implemented a Service Yard of 48 acres of land connected by 4 lane road to National Highway. This Service Yard consists of RCC Service Jetty, various Supporting Buildings, Water Treatment Plant, Warehouse etc. Some 6,500 acres of land is under acquisition for development of core port infrastructures. Among those amount of land 3,100 acres has already been acquired. It is expected that by 2023 Payra will be fully operational as an international sea port through completion of capital dredging project and constructing at least three terminals with 12 berths and channel depth (CD) of 10.5 m. According to the “Traffic Forecast Study Report” prepared by Royal Haskonning DHV, total volumes of cargos are projected to grow at Para Port from 11.1 million MT in 2021 to 33.6 million MT in 2025. As per long-term plan, it is expected that by 2035 the Para Port will be able to function with at least 14.0m CD through a second phase capital dredging and capacity to handle about 89.8 million MT cargos and 5.1 million TEUs container.

Bangladesh Land Port Authority (BLPA)

Bangladesh Land Port Authority (BLPA) was established in 2001 under the Bangladesh Land Port Authority Act 2001 as a statutory regulatory body with a vision to expedite and facilitate export-import activities through land ports. Bangladesh Land Port Authority started its activities through declaration of 12 land ports in 2001. Afterwards, 12 more land customs stations have been declared as land ports. At present, total number of land ports are 24. Among them, Benapole, Bhomra, Akhaura, Burimari, amabil, Nakugaon and Sonahat Land Port are being operated by own management of BLPA. On the other hand, Sonamasjid, Hilli, Teknaf, Banglabandha & Bibirbazar Land Ports are being operated on Build Operate Transfer (BOT) basis. With a view to start operation of the remaining land ports, the process for acquiring land along with the construction of necessary infrastructures are going on. The remaining lands ports will be developed and operated by government own management.

In view of the growing importance of land port-based trade with India, the 7FYP put emphasis on improving the capabilities of the various land ports through better facilities and staffing and improving efficiency and turn-around time through digitization. Considerable progress was made. The Sonahat and Tamabil land ports have been developed with a cost of Tk. 110.00 crore and they started their operational activities. Also, improvement & modernization of Benapole & Burimari Land Ports has been completed under SASEC Road Connectivity Project with assistance from ADB. Construction of modern warehouses, transshipment shed and improvement of roads & yards, drainage system and other necessary infrastructure have been developed under this project. To enhance connectivity and trade with neighboring countries, BLPA has taken steps for development of Sheola and Ramgarh land ports along with extension & modernization of Bhomra and Benapole Land Ports with a cost Tk. 693 crore with the financial assistance of World Bank. This is an on-going project which is expected to be completed by June 2023. BLPA has taken initiatives for upgrading of remaining land ports. Necessary steps have already been taken for digitalization of land ports.

As a result of these efforts to expand and upgrade the land ports in the 7FYP, the total trade (exports and imports) passing through land ports was 34.26 lac metric tons in FY2009. It grew to 216.63 lac metric tons

in FY2019, indicating an average yearly growth rate of 29 %. The revenue income of BLPA was Tk. 26.74 crore in FY2009. This expanded to Taka 210.93 crore in FY2019. The revenue growth was particularly large in the last 5 years, growing by 31.2%.

19.2.7 Urban Transport

Rapid urbanization in Bangladesh during the last few decades increased transport demand quite significantly leading to manifold increases in the number of motorized and non-motorized vehicles on city streets. The increase in the number of vehicles relative to road facilities has led to severe congestion on roads and deterioration in urban environment. Such trends are likely to continue as further urbanization takes place.

In urban areas, road transport system is the main means for carrying passengers and commodities. However, all urban centres face major traffic congestion due to the absence of Mass Rapid Transit (MRT) options. Among the six city corporations, Dhaka is confronted with the most serious transportation problems. The transport sector of the city is comprised of many different modes of travel-both motorized and nonmotorized-often using the same road space – resulting in a high level of operational disorder, which significantly diminishes the efficiency and effectiveness of the existing transport uses.

To address the urban transport challenge, the 7FYP undertook a major initiative to develop a long-term plan. A Revised Strategic Transport Plan (RSTP) was prepared by Dhaka Transport Coordination Authority (DTCA) for greater Dhaka area. In RSTP, a series of rapid rail transit and rapid bus transit options are proposed to address the massive congestion problem of Dhaka and its adjoining areas. The Dhaka Mass Transit Company Limited (DMTCL) has been established for construction, operation & maintenance of the Mass Rapid Transit (MRT) Lines/Metro Rails in Dhaka city and its adjoining areas. The Government has formulated a Time-bound Action Plan 2030 in order to establish a state-of-the-art Network of public transport system to be implemented by Dhaka Mass Transit Company Limited (DMTCL) consisting of 6 Mass Rapid Transit (MRT) or Metrorail Lines covering the distance of 128.741 Kilometres (67.57 kilometres elevated and 61.17 kilometers underground) having 104 Stations (51 elevated and 53 underground) in Dhaka and its adjoining areas. Based on this action plan, the targeted completion of the first elevated Metro Rail of Bangladesh, known as MRT Line-6, has been set for December 2022. Substantial progress of construction works of four more MRT Lines (Line-1; Line-5: Northern Route; Line-5: Southern Route and Line-2) are also underway within the 7FYP (Table 6.8). Work has also started on the first of the three proposed rapid bus transit (BRT) alleviated expressway. The first BRT route (BRT Line 3) is scheduled for completion in CY2020. While these are all excellent initiatives, a major challenge is their time completion. Progress was also made in addressing road safety and enforcing traffic laws and regulations. Besides, Bridges Division has undertaken a feasibility study project for the construction of subway across 238 km covering the entire Dhaka city. The study will be completed by June 2021. Nevertheless, given the massive traffic management challenge, there is a long way to go.

Table 19.8: Progress with Dhaka Urban Mass Rapid Transit Options

MRT/BRT	Length (km)	Type	Completion Date	Project Status	Source of Finance
MRT Line-6	20.10	Elevated	2022	Under Construction	JICA & GoB

MRT Line-1	31.241	Elevated (11.369 Km)	2026	Detail Design on-going	JICA & GoB
		Underground (19.872 Km)			
MRT Line-5: Northern Route	20.00	Elevated (6.50 Km)	2028	Basic Design On-going	JICA & GoB
		Underground (13.50 Km)			
MRT Line-5: Southern Route	17.40	Elevated (4.60 Km)	2030	Appointment of Consultant is at final stage	ADB & GoB
		Underground (12.80 Km)			
MRT Line-2	24.00	Elevated (15.00 Km)	2030	Full Scale Study on-going	G2G(Japan) through PPP method
		Underground (09.00 Km)			
MRT Line-4	16.00	Elevated	2030	G2G through PPP Method	Underway
Total	128.741 [Elevated 67.57 km and Underground 61.17km]				

Source: Ministry of Road Transport & Bridges

19.2.8 Transport Sector Issues and Challenges during the 7FYP

Overall substantial progress was made in improving the transport network, especially in the area of road network, Sea and Ports, and Railways. Progress was somewhat slow in inland water, airport and Bridges. This progress was facilitated by adequate allocation of financial resources. As a result of the priority accorded to transport, financing was not a constraint. A useful way to assess this progress and its adequacy in relation to the competitiveness of the Bangladesh economy is to compare the progress with competitors. The World Economic Forum (WEF) publishes on an annual cycle updates of global competitiveness ranking for countries based on a global competitiveness index (GCI) and the associated infrastructure quality rankings. The latest GCI and Infrastructure Quality rankings are available for 2019. These are shown in Table 19.9.

Table 19.9: Bangladesh's Global Competitiveness Index and Infrastructure Quality 2019 (Scores out of 100; Number of Countries 141)

Country	Global Competitiveness		Transport Infrastructure		Quality of Roads	Quality of Railway	Quality of Ports	Quality of Air Transport
	Score	Country Ranking	Score	Country Ranking	Ranking	Ranking	Ranking	Ranking
Bangladesh	52.1	105	42.1	100	108	65	92	109
India	61.4	68	66.4	28	48	30	49	59
Turkey	51.6	108	64.9	33	31	56	41	34
Pakistan	51.4	110	51.1	69	67	47	70	93
Sri Lanka	57.1	84	57.7	50	76	72	68	72
Thailand	68.1	40	56.8	53	55	75	48	73
China	73.9	28	68.9	24	45	24	52	66
Vietnam	61.5	67	52.2	66	103	54	83	103

Source: The Global Competitiveness Report 2019, World Economic Forum.

Comparisons with past rankings show that Bangladesh has gained in overall competitiveness ranking and especially transport infrastructure performance ranking. This suggests that the progress made in the FYP in transport infrastructure has helped improve its global competitiveness. However, other competitors have performed more strongly in improving the transport infrastructure services. Bangladesh does well in the area of railway services, but relative performance falls short of performance in other countries that compete with Bangladesh in the export market, especially the RMG competitors in China, India, Pakistan, Sri Lanka, Turkey and Vietnam.

A review of performance in the 7FYP shows that there are a number of areas where greater policy attention will be needed in the 8FYP.

Implementation capacity constraint: A major challenge that continued during the 7FYP has been the implementation capacity constraint. Consequently, while projects have started, completions have lagged behind. Progress in implementation has been most serious in the road and bridges sub-sector where project implementation delays and cost over-runs have lowered the economic rate of return for many investments. In civil aviation subsector, project completion has suffered from procurement and international financing negotiation constraints.

Transport sector policies: On the policy front, progress on PPP based transport network development has lagged behind the target. The PPP activities have shown some recent signs of recovery, which is encouraging. But stronger efforts are needed to fast track, the idea of introducing cost recovery from road users through the institution of a well-designed road user charges still remains to be made effective. In railways, progress with capacity expansion and service efficiency improvements has not been matched with tariff increases and cost recovery, which has led to the inability of railways to cover operating costs.

Inter-modal balance: Improvement in rail performance has improved the inter-modal transport balance but the inadequate progress with expanding water transport services remains a major concern. IWT is a lowcost mode of transportation and greatly facilitate inter-city transportation while lowering the pressure on the high-cost road transportation. Importantly, the inland water transport is the most environmentally friendly transport mode, yet its shares in passenger and freight services are small and falling. The challenges faced by IWT are manifold including the issue of navigability, inadequacy of safety standards, inadequate of port facilities, weak finances and management problems. A strong push will be needed in the 8FYP to unlock the full potential of this great transport asset.

Efficiency of port use: In response to growing demand, the government has sought to increase port capacity by launching the Pyra port and a program to expand the Chittagong Port. These are important. Yet, despite efforts, the Mongla Port remains under-utilized. Progress in addressing the CD issue of the Passur River through strategic dredging is a welcome move, but stronger efforts are needed to enhance the use and productivity of this underutilized asset through strategic planning and greater resource allocation. Opening up the port to neighboring countries is a smart move, but this must be facilitated by coordinated investments to enable the full use of the potential of the Mongla port.

Port to factory connectivity: The further acceleration in growth under PP2041 and the 8FYP and the associated diversification of the export basket will require strong improvements in trade logistics related

to factory to port movements and timely inflow of imports of capital machinery and intermediate imports from ports to factory gate. The capacity and efficiency of the sea- and airport services and the ease of internal transportation are critical to the success of the export diversification strategy, for the ease of procuring imported inputs, and for transporting goods and services from the production centres to the consumption centres.

Upgrading of airport services: Rapid growth in income has generated a huge demand for air transport services at the national and international levels. Bangladesh also has good prospects for strengthening its tourism capabilities. Bangladesh civil aviation has made important progress during the 7FYP but there is a large unfinished agenda that remains to be addressed. The airport capacity for both passenger and freight need urgent upgrading. Project implementation constraints have slowed capacity expansion. Upgrading of airport services will be an important challenge for the 8FYP.

19.3 8FYP VISION FOR THE TRANSPORT SECTOR

The 8FYP Vision for the transport sector is linked to the PP2041 Vision that envisages a Bangladesh where:

- There is seamless flow in passenger and goods traffic and transport facilities are available on demand.
- People have efficient choices between different modes of transport facilities at affordable cost and time.
- All transport services are provided competitively with no barriers to entry and exit for service providers.
- There is strong inter-district and inter-regional connectivity with neighboring countries for passengers, goods and services with choices of alternative transport modes.
- The safety standards are well established and the transport system is accountable through legal provisions for full compliance with safety standards.
- Urban traffic flows are well managed through a combination of Mass Rapid Transit (MRT) /Metro Rail Network, BRTC Double Decker/Articulated Bus Service and private options that balance commuter needs for easy transit with avoidance of massive congestion.
- All parking and traffic laws are enforced with appropriate sanctions for non-compliance irrespective of political or administration connections.
- Developed seaports to cope with International Maritime Transport Sector.
- 3R (Rail, Road and Riverine) intermodal connectivity to support the hinterland connectivity of all ports of Bangladesh.
- Road safety issues (loss of lives and damages of wealth due to road accidents) arising out of use of motor vehicles and human traffic in roadways are well resolved.
- Crash data are timely and rightly managed through integrated and well managed digital system.
- Vehicle road worthiness (fitness) is well tested through automated vehicle inspection centres.
- Road users are well aware of safe use of road ways.
- Motor vehicles drivers are well trained to negotiate safe drive.

The PP2041 converted this Vision into a broad long-term strategic framework with long-term goals and targets. The 8FYP goals, targets, strategy, policies and investment program are all inter-linked with PP2041.

19.4 8FYP TRANSPORT SECTOR TARGETS

The transport sector PP2041 Vision is very challenging in the context of the present situation but is very much consistent with the transport environment in a high-income economy. Consistent with that Vision, the transport sector targets of PP2041 are also very demanding. As a first step towards realizing the PP2041 transport sector vision, the 8FYP draws on the PP2041 targets and outlines the first phase of the four-phased medium-term program targets. The related targets are indicated in Table 6.10. The targets show both the massive growth in the demand for transport services to meet the needs of a growing and transforming economy and major changes in inter-modal transport that is needed to improve the efficiency and cost-effectiveness of the transport system. For domestic travel, the balance of transport services changes in favour of rail and inland water and away from the excessive reliance on the road network. This happens for both passenger movements and freight, but especially for freight. Port and air traffic capacities are projected to grow rapidly to meet the growing demand from higher GDP growth. Urban transport changes are particularly dramatic as Mass Rapid Transit (MRT)/Metro Rail Network transit options are introduced initially in the capital city of Dhaka and its adjoining areas. Additionally, it is expected that as the roadways expand, quality of road infrastructures gets improved, road worthiness of on road vehicle fleets are ensured both mechanically and environmentally, drivers are well trained and road users are well aware of safe uses of road way

Table 19.10: 8FYP Transport Sector Targets

Indicators		FY2019 (base Year)	FY2025
Passenger Traffic (billion passenger kilometres)	Roads	169	246
	Inland Water	16	23
	Railways	10	15
	Total	195	284
Freight Traffic (billion-tonnes kilometres)	Roads	24	31
	Inland Water	5	7
	Railways	2	3
	Total	31	41
Air Traffic (million passengers / million tons)	Passenger	13.09	14.63
	Freight	0.41	0.50
Sea Port Cargo Traffic (million numbers /million tonnes)	Container	2.9	3.6
	Tonnes	98.24	122
Urban mass transit	No. of cities	0	1
Transport Infrastructure quality	Country ranking	100	80
	Score	42	47
Road safety accident death rate by country (WHO 2018)	(Per 100,000)	14.43	13.0

Source: GED Projections.

19.5 TRANSPORT SECTOR STRATEGY FOR 8FYP

The transport strategy for 8FYP will build on the lessons of experience of the implementation of the 7FYP and the PP2021. An important priority will be to address the implementation gaps of the 7FYP strategy. The other priority will be to address the major institutional constraints that have hampered implementation of transport projects. A third priority is the reform of the PPP strategy with a view to achieving stronger progress under the 8FYP. Finally, one of the important lessons of the 7FYP is that Bangladesh needs to be more strategic about identifying major transport projects and then allocating resources accordingly. The priority should be what is deemed as transformational infrastructure investment. This initiative already started under the 7FYP. The 8FYP will further reinforce it to ensure the timely adoption and completion of the highest priority transport projects.

Strengthening long-term planning and priority setting: The physical targets for the transport sector are large as reflected in Table 6.5. These involve large investments and strong implementation capacity. Both are scarce in Bangladesh. So, careful planning and priority settings are critical elements of the 8FYP transport strategy. Bangladesh has experience in developing long-term transport planning. For example, the road network expansion program is guided by the 2004-2024 Road Sector Master Plan; there is a Rural Road Master Plan of 2005-2025 that guides the expansion of rural roads; an Inland Water Transport Master Plan was completed in 2009 that provided a 20-year investment program; the railway master plan 2010-2030 was approved in 2005; and the National Integrated Multimodal Transport Policy was approved in 2013. The implementation of these plans has been uneven and halting. Building on these plans and implementation experiences, a fresh look will be taken to develop a long-term Transport Sector Master Plan 2041 (TSMP 2041) with international technical assistance. There are several good practice transport planning and development experiences in East Asia, especially Japan, Korea and China. Bangladesh can learn from these experiences. The TSMP 2041 will focus on the major transport investments for Bangladesh for the 2021-2041 periods, provide a picture of the optimal inter-modal transport balance, and identify priorities and a phased approach to their development.

Creating balanced inter-modal seamless transport facility: While roads will continue to dominate the transport network, land constraints, social disruption, environmental concerns and unit cost considerations will require a much more balanced development of the transport network with greater emphasis on inland water transport and railways. Both these modes are under-utilized. The 8FYP will give priority to developing these modes to reduce the pressure on roads and also to strengthen inter-modal coordination. The Port to factory gate connection and vice versa via river routes, for example, can be a major improvement in trade logistics. These and other options to improve the intermodal transport balance will be adopted based on an integrated transport planning process that will be regularly updated to reflect the changing traffic dynamics.

Strengthening implementation capacity: Implementation constraints slowed down the implementation of many large transport projects causing cost overruns and delays in project completion. This reduces the quality and rate of return for these investments. The government has put top priority to timely completion of all on-going projects. The 8FYP will further strengthen this by closely monitoring completion of all large transport projects, ensuring timely release of funds, linking new investment approvals to the record of project implementation, improving procurement policies, paying greater attention to project design before project approval, ensuring project implementation readiness as an important criteria for project

approval, and strengthening capacities of line ministries and public agencies through improvement in technical capacities based on training and also through recruitment of special skills from private sector on contractual basis. For large and complex projects, international competitive bidding process will be followed and emphasis will be given for turn-key project contracts with strict monitoring and penalty clauses for timely delivery of projects in agreed quality and price.

Ensuring sustainable financing of transport infrastructure: The massive expansion in transport infrastructure implied by the targets set in Table 6.5 will require huge investments. In the 7FYP the government put top most priority to the development of transport infrastructure and provided adequate funding from the budget. Owing to implementation capacity constraints, funding was often not fully used. As noted above, the 8FYP will assign priority to strengthening implementation capacity. Nevertheless, the volume of funding required is massive and would average around 5% of GDP per year over the FY2021-FY2025 periods. Such large funding cannot be provided by the budget alone. The government recognized this early on and identified Public-Private-Partnership (PPP) initiatives as an important source of transport infrastructure financing during 7FYP. As noted, this initiative has been slow to start. Although this has gained some momentum in recent years, the full potential of the PPP initiative remains to be seen. To achieve sustainable financing of this large transport infrastructure programme, the 8FYP will seek to sharply strengthen the PPP initiative with quality international level staffs and address required legal and

Incentive issues to draw international financing from best possible sources. Attention will be given to proper risk-sharing between public and private sectors in developing financing plans and performance standards, drawing on the lessons of good practice experience.

Developing and implementing key policies for ensuring quality and reliability of transport services: Despite progress, the global ranking of the quality of overall transport infrastructure and individual components is low, which lowers the global competitiveness of Bangladesh and is an important constraint to export diversification and foreign direct investment. The 8FYP will place a strong emphasis on improving the quality of transport infrastructure and related transport services. Several constraints reduce quality relating to inadequacy of O&M, lack of service standards, weak safety standards and monitoring, poor accountability for service quality and inadequate monitoring of transport sector related environmental standards. The 8FYP will seek to adopt a number of policies to improve infrastructure and service quality. A proper road user charge will be developed that also accounts for congestion, risk of traffic accidents and environmental pollution and implemented in a phased manner. These resources will be used to improve the maintenance of roads, bridges and highways. The government has already taken a number of policy initiatives to reduce road accidents and enforce them with legal sanctions for non-compliance and liability for accidents. These will be rigorously enforced. Safety standards for inland water transport, rails and airlines will be reviewed and strengthened as appropriate and fully monitored with legal provisions for noncompliance. Environmental considerations will be given emphasis in developing transport network including roads. Fossil fuel will be priced efficiently and consideration will be given to the introduction of a carbon tax. Clean energy transport options such as electric inter-city trains, electric elevated Mass Rapid Transit (MRT)/Metro Rail and Underground MRT/Metro Rail, electric buses, electric cars etc. will be promoted. Service standards will be set for port clearings and rail services in terms of timeliness, online user-friendly ticketing and clearance documentation options, and in-transit services.

Vehicle exhaust emission standards will be set in line with similar standards as of neighboring/ similar countries. Policy initiatives will be taken to establish automated vehicle fitness test centres. Considering,

motor vehicle driver as a key player, drivers training along with mass road safety awareness programmes will be performed on priority basis.

Strengthening management capabilities and efficiency of public transport authorities: The proper implementation of the proposed transport infrastructure strategy will require substantial institutional reforms in the transport sector. A particular challenge is to build a quality staff that combines civil servants with special technical skills and strategic professional staff. Another challenge is to establish accountability for performance. This is a generic challenge for overall public administration during the 8FYP as noted in Chapter 2 Part 2 of the Plan dealing with public administration and governance issues. Several initiatives introduced during the 7FYP are underway to strengthen public administration including better staff recruitment, training, incentives and performance evaluation. These initiatives will be further strengthened during the 8FYP. Over time, as Bangladesh develops and improves the education and skill base of the labour force, the quality of public administration will also improve.

19.5.1 Sub-sectorial Strategies

Strategy for road transport

The specific targets for the road and bridges subsector are shown in Table 6.11. The main elements of the

8FYP strategy for road transport are briefly highlighted below.

Table 19.11: RHD Physical Targets for the 8FYP

Physical Activities	8FYP Targets
Construction of 4/6/8 lane roads	550 km
Construction of new roads lane	150 km
Improvement/ Rehabilitation of National Highways	1800 km
Improvement/ Rehabilitation of Regional & Zila Highways	12,700 km
Construction of bridges/culverts	37,500 meters
Reconstruction of bridges/culverts	4,100 meters
Construction of Flyover/Overpass	11,000 meters
Construction of Rigid Pavement	375 km
Weigh Bridge/ Axle Load Control Station	30 number

Source: Road Transport and Highways Division

Strengthening project implementation capacity: The top most priority is to strengthen implementation capacity by focusing on the implementation of core transformational projects under RHD and ensuring their timely completion (Table 6.2). Considerable scarce national resources are tied up in these huge capital intensive projects and their timely implementation is critical to ensure that the economy benefits

from these projects as planned and to avoid cost over-runs. Project implementation capacity of the RHD will be strengthened through project implementation capacity of the RHD will be strengthened through organizational expansion, employment of qualified engineers & project professionals, through training and technical assistance. Project progress will be reviewed at the Ministerial level on a monthly basis and a 6- month basis at the NEC level.

As stated in perspective plan, RHD will actively participate in Transport Sector Master Plan 2041. Accordingly, RHD Road Master Plan 2009-2029 has to be updated & harmonized with these national policy documents for ensuring the proper identification of transformational projects that will achieve the best value for public money.

Consolidation and upgrading of the National Highway Network: The PP2041 Strategy calls for consolidating and upgrading of the National Highway Networks through multi-laning of existing highways, by establishing access-control long-distance expressways, and by creating service lanes to ease connectivity to local roads. Consistent with this strategy, the first priority would be to ensure the timely completion of the above-mentioned national highways and ensuring that these roads provide the required service road connectivity to local roads. New 4-laning highway project up gradation will be undertaken selectively based in implementation capacity and available resources.

Road damage control and ensure efficient use: National road networks are a national asset that needs to be efficiently used with minimum damage. Accordingly, strict axle load control policy would be established and enforced to reduce road damages caused by overloading. Attention will be given to develop quality infrastructures with hallmark attribute of high-speed mobility facilities. The target would be to achieve 80-110 kmph design speed with a level of Service 'B' for 900 kilometres of important highway corridors, which are now operating merely at 30-35 kmph. For achieving this, the strategy would be to optimize the intersections to be conflict free on major economic corridors. To ensure better riding quality, the share of Fair to Good road surfaces will be increased from 81% to 90% for overall RHD Road Network. Bypasses around towns would be planned and provided as access-controlled expressway type facilities with entry/exit at predetermined locations. For longevity of road infrastructures, sustainable as well as innovative technologies will be adopted. For example, concrete pavements are encouraged to use in waterlogged sections of highways.

Establishing road connectivity with major development points: Connectivity with South Asian regional highways, the economic zone areas, ports, airports, power stations, inland water transport facilities, rail stations and rail freight centres and major tourist resorts is essential to maximize the benefits of the highways system. These factors are already playing an important role in the selection of road network development projects. The emphasis on these linkages will be further sharpened during the 8FYP.

Lagging district connectivity: The poverty discussion in Chapter 4 of Part I showed huge gap in the poverty incidence of districts. One important factor is the inadequate connectivity of the lagging districts with the growth centres in leading districts. So, ensuring inter-district connectivity for all districts that are not connected through the national highway system is an important priority. This can be achieved by upgrading existing roads and bridges and where necessary by creating new expansions. The RHD Road Master Plan would be used as the guiding document for prioritizing the replacement of PSB, Narrow Bridges & Vulnerable Bridges. As indicated in PP2041, all inter-district roads would eventually be upgraded to at least 4-lane facilities. For prioritizing this task, the updated Road Master Plan should be the starting point.

Investment program for the district roads for the 8FYP will seek to keep this consideration as a priority. Additionally, to reduce the risks of accidents, there should be a separate lane for slow-moving vehicles.

Ensure highway and inter-district road side services: To ensure proper use and comfort of road users, the 8FYP will put emphasis on creating highway and inter-district facilities to provide restroom and food facilities for travellers and essential services such as gas stations, emergency repairs, for facilitating highway mobility. While the private sector will make the investments, government policy will facilitate through land allocations, necessary permits and security facilities.

Upgrade Zila and Upazila roads: The lagging districts are also constrained by inadequate connectivity between Zila and Upazila roads. So, the upgrading of all zila and upazila roads to facilitate easy transport connectivity between production and consumption centres is an important priority in PP2041 and for the 8FYP. This will also motivate and influence location decisions for manufacturing enterprises and facilitate labour mobility. These roads would be at a minimum 2 lanes, but in some areas where traffic pressure is intense, they would require 4-lanes ensuring enough load bearing strengths. To incorporate the non-RHD roads with inadequate pavement sub-structures/road geometry, handed over/transferred to RHD road network, will be given priority for upgrading to appropriate level & standard as per RHD specifications. The on-going effort to upgrade the sub-standard RHD Zila Highways to appropriate level & standard will be continued throughout the 8FYP.

Up-grading of rural roads: This is an on-going program and its implementation will be further intensified under the 8FYP. The PP2041 target is that all village roads would be converted to asphalt standard with at least one lane to facilitate rural mobility of passengers and products. The 8FYP will make major efforts to push this important investment consistent with available funding. The road connectivity will be a major investment for reducing poverty, improving human development, and promoting rural investment in micro and small-scale non-farm enterprises.

Improve road maintenance: O&M of highway, bridge, culvert and roads are a high priority strategic element for the road sector. Financing is always a constraint. The development and implementation of a well-designed road user charges will be instrumental in providing resources for road network upgrading and maintenance. For maintenance of different road network components like highways, bridges, culverts and other road furniture, modern technologies and innovative approaches need to be introduced in order to ensure best value for money. For highways and major bridges, the use of tolls will provide funding for O&M. The 8FYP will place emphasis on implementing both these policies through focused studies to determine the proper road and toll user charges based on economic principles as well as affordability concerns.

Strengthen road safety: As noted, the 7FYP took some major policy initiatives to improve road safety consistent with SDG targets. The full and proper implementation of the National Road Sector Safety Action Plan (NRSSAP) 2017-20 will be an important priority for the 8FYP. Furthermore, in accordance with SDG Target no. 3.6 the number of fatalities due to road traffic accidents on national highways will be reduced by 25% at the end of 8FYP.

Bus route Rationalization: To bring discipline in public transportation (Bus) sector Dhaka Transport Coordination Authority (DTCA) takes an initiative to implement bus route rationalization and company based bus operation in Dhaka city.

Integrated Traffic Management: In order to reduce traffic congestion in Dhaka city through intersection improvement, Intelligent Traffic System (ITS) is being implemented by DTCA. Pilot operation will be started very soon. Under this project, the following Action Plans and Manuals will be prepared by the Japanese expert team which will be finalized based on the information obtained after setting up ITS.

1. Intersection Improvement Manual
2. Guideline for Operation and Installation of Traffic Signal System
3. Guideline for Operation and Installation of CCTV System
4. Comprehensive Traffic Control System Plan
5. Action Plan for Road Traffic Safety Programmes for Drivers and Pedestrians
6. Action Plan for Design and Enforcement Mechanism of Road Traffic Regulation

Strategy for the Bridges Division

The strategy for the Bridges Division will be basically similar to that under Road Transport Division. Given the highly capital intensive and high-cost nature of the underlying investments that often involve international contracts and financing including PPP, the three most strategic considerations that will guide the Bridges Division's work program in the 8FYP are:

1) Timely completion of all on-going projects: There are 7 transformational projects in different stages of implementation including the Padma Bridge; Dhaka Elevated Expressway PPP Project and the linked PPP based Support to Dhaka Elevated Expressway Project; the Bangabandhu Sheikh Mujibur Rahman tunnel; the Dhaka-Ashulia Elevated Expressway; and the Bus Rapid Transit (BRT) Gazipur-Ashulia 4.5-kilometer elevated expressway Feasibility Study for the Construction of Subway in Dhaka City. These are all expected to be completed by CY2022.

All efforts will be made to ensure their timely completion. A new project was approved at the ECNEC meeting on March 10, 2020, at a total cost of Tk 1,042 crore for the construction of a 1,690 meter long bridge over the Paira River on Kachua-Betagi-Patuakhali-Lohalia-Kaliya road as part of the development of road communication network in southern region of the country.

2) Turnkey project contracts for internationally funded projects: Given the fact of capacity constraints leading to delays and cost overruns for these expensive projects, the government will increasingly adopt a strategy of negotiating project implementation for all donor-funded projects on a turnkey basis. The contracts will have specific performance criteria to prevent delays and cost over-runs.

3) Sharply expanded PPP capabilities: The capabilities to negotiate PPP projects involving domestic and foreign funding will be sharply strengthened through upgrading of the PPP cell with internationally qualified and experienced staff.

The Bridges Division has identified a number of new high priority transformational projects for the 8FYP including Railway Bridge over the Jamuna river, Barisal-Bhola bridge. These project proposals will be reviewed carefully for possible adoption in the 8FYP and beyond depending upon a proper review of the quality and relevance of these projects for our development, availability of funding, and implementation

capacity. To conserve resources and avoid cost over-runs the policy of not adopting new expensive projects until satisfactory progress with implementation of on-going projects is firmly established.

Strategy for Railway Development

The 8FYP will build on the progress achieved under the 7FYP. Buoyed by this success, the Bangladesh Railways has adopted ambitious development targets to play its dynamic role in the Bangladesh development. The targets for the 8FYP are shown in Box 19.2.

Box 19.2: Bangladesh Railways Target for 8FYP

- Construction of 798 km new rail line.
- Implement dual gauge double tracking of 897 km to increase line capacity.
- Rehabilitate/ Upgrade 846 km existing rail line.
- Construct 9 important railway bridges
- Procure 160 locomotives to enhance the efficiency, ensure reliability & punctuality of running trains and to introduce new trains.
- Procure 1704 passenger coaches and 2000 wagons to improve passenger service quality
- Procure adequate equipment to modernize railway maintenance
- Modernize Railway Workshop and other infrastructure.
- Improvement level crossing gates, other infrastructures and rolling stocks
- Construct new ICDs
- Modernize signaling system of 222 stations to ensure safety.
- Increase efficiency and improve performance of Bangladesh Railway
- Ensure full operational cost recovery by FY2025.

Source: Bangladesh Railways (BR)

To expand capacity and improve service, the BR has updated its Master Plan to align it in line with the PP2041 Vision and also aligning with the government's plans & policy statements like 7th Five Years Plan, Vision 2021, Delta Plan 2100 etc. to enhance operational capacity, increase market shares and improve its services. The updated master plan (July 2016-June 2045) is divided into six phases of five years each. A total of 230 projects with an estimated cost of BDT 5, 53,662.00 crore is included in the railway master plan. The targets of the 8FYP shown in Box 19.3 are consistent with the second phase implementation of the approved master plan. The implementation of the associated investment and operational programmes of the BR during the 8FYP will be guided by the following strategic considerations that are consistent with the PP2041

The railway expansion program envisaged in Box 19.2 will be undertaken with due regards to projected demand for passenger and freight services with a view to maximizing the use of associated capacity expansion. A critical outcome of the expansion program should be to ensure a higher market share of railways in passenger and freight traffic as envisaged in Table 19.1.

- Connectivity to regional train services involving neighboring countries will be a priority.
 - Introduction and/or up gradation of modern signaling system with relevant safety measures of international standard and introduction of a proper telecommunication system.
 - Introduction of mechanized track maintenance system.
 - Strengthen O&M practices following internationally recognized safety standards.
 - Introduction of high-speed train for passenger transportation for connection among important cities.
 - Reduction of turnaround time for the port bound freight trains.
 - Introduction of a modern train management system with the Centralized Traffic Control System.
 - Redevelopment of stations for smooth flow and comfortable experience of passengers as also with ensuring cleanliness and hygienic environment.
 - Ensuring safety and comfort to the passengers and freight transport.
 - Up gradation of railway human resources aimed at commercializing services.
 - Redesign of coaches to enhance travel comfort and safety.
 - Lower port turnaround, loading and unloading times.
-
- Competitive pricing, ease of ticketing through online purchase and timeliness of service with a view to making a profit.
 - Increased capacity on key corridors.
 - Increase new train service based on demand.
 - Development of new modern Inland Container Depots with the increasing number of block train to carry container from port to destination.
 - Ensure railway connectivity to every district of Bangladesh.
 - Reconstruction, modernization and extension of missing links for national, regional and Trans Asian Railway Network.
 - Development of dedicated freight corridors.
 - Introduction of Commuter Train Services for reducing traffic jam in megacities.
 - Introduction of electric traction in Bangladesh Railway.
 - Development of new Workshops. Procurement of modern equipment for rolling stocks maintenance.
 - Introduction of Intermediate Block System and Installation of Automatic Train Supervision (ATS) including Automatic Train Protection (ATP) with existing CBI and CTC system in the selected corridors.
 - Creation of two additional zones and four additional divisions in Railway for better and effective management of railway services.
 - Improved custom clearance arrangements for inter-regional services with neighboring countries.
 - Quality transfer facilities to road transport.
 - Strengthen business planning to capture a higher market share of passenger and freight traffic including special services for tourist and high-end users.
 - Up gradation/construction of railway training academy.
 - Bangladesh Railway to act as a multi-modal transport operator.
 - Railway tariffs will be modernized so as to cover full operating cost by FY2025.

Strategy for Developing Inland Water Transport (IWT)

The geography of Bangladesh connects almost all 64 districts to each other by an interconnected system of major and minor rivers. The major rivers, in turn, provide convenient access to the sea. This massive internet of water connectivity if properly harnessed and nurtured can provide a major development advantage for Bangladesh. The Bangladesh Delta Plan 2100 (BDP2100) examined in detail the constraints faced by the IWT and laid down a detailed strategy and policy framework for unleashing the true prospects of the IWT subsector. Consistent with BDP2100 and the PP2041 strategy, the 8FYP will seek to harness this potential for both passenger and cargo traffic. The main elements of the strategy for inland water transport include:

- Establish priority routing based on potential passenger and freight traffic flows and develop those navigability improvements and river port infrastructures.
- Sharply improve the navigability of river routes through strategic dredging, river training, and bundling as emphasized in BDP2100.
- Give priority to inter-regional river connectivity to facilitate trade, commerce and tourism.
- Integrate IWT with other transport modes to maximize the benefits of IWT.
- Strengthen river transport safety standards by setting proper standards and ensuring full compliance. Particular attention would be given to ensure the river-worthiness of vessels, adequacy of safety equipment including radio communications, and compliance with passenger load regulations.
- Vessel worthiness licensing would ensure minimum service facilities and standards of all vessels.
- Bangladesh Inland Water Transport Authority (BIWTA) will be strengthened with technical staff and qualified inspectors to administer all licensing functions efficiently and on time. Special attention will be given to governance improvements.
- The capacity of BIWTA to undertake hydrological surveys, conduct river training and implement dredging operations will be expanded through upgrading the managerial and technical staff and international training. Side by side, the private sector will be invited to participate in these operations on a PPP basis.
- Given the large need for resources, a proper balance between the public and private sector will be maintained. Much of the infrastructure will be provided by the public sector but most of the passenger and freight services will be provided by the private sector. ADP allocations will give priority to the development of IWT infrastructure.
- River port facilities will be sharply improved with modern service standards for passengers, docking and unloading services for cargo including container cargo, storage facilities and security and rescue services. International river ports of call will also provide customs and inspection services as relevant.
- Pricing policies for passenger and cargo will be commercially determined with a view to enabling a reasonable rate of return on investment.

Strategy for Shipping

The main objective of the shipping sub-sector during the 8FYP is to expand the capability of the Bangladesh Shipping Corporation to handle a larger share of the Bangladesh international trade than presently. Bangladesh international trade has been growing and linked to that shipping demand has grown manifold. Yet the BSC capacity to provide efficient shipping services has been limited. Given the need to diversify the sources of export earnings, the export diversification strategy of the 8FYP envisages

a growing share of Non-factor exports in total exports. An important component of that are earnings from shipping. To achieve this target, the BSC has to be modernized with an expanded fleet, competent management and quality staff. A combination of purchase and lease operations will be used to expand fleet capacity. Through the Chittagong Marine Academy, Bangladesh produces internationally qualified merchant navy professionals who are in demand in international shipping lines. The 8FYP will strive to encourage these qualified personnel to seek employment in BSC fleets at internationally competitive salaries. BSC management will be upgraded with technical competent and business-oriented professionals to be able to handle international shipping consignments efficient and effectively. Staff training will be emphasized. In international shipping private sector may also be encouraged to participate.

Strategy for Air Transport

The growing demand for domestic and International air and cargo traffic calls substantial investments in construction of new airports, expansion and modernization of existing airports, improvement in connecting infrastructure (road, metro, sea link, etc.) and better airspace management. The performance in the 7FYP was mixed owing to financing and implementation capacity constraints. The 8FYP will seek to substantially strengthen and upgrade the air transport industry as Bangladesh seeks to attain UMIC status. Consistent with PP2041 strategy, the 8FYP will adopt the following strategies to deal with the emerging situation in the aviation sector:

- Build a new international airport to serve the growing air traffic demand of the country.
- Upgrade and modernise all existing airports by creating additional runways and taxiways; augmenting gate and apron capacity to accommodate more aircraft; increase terminal capacity to accommodate more passengers; improve ground traffic management and ancillary aviation processes to ensure quick aircraft turnarounds; improve air traffic and air space management practices and new radar technology; and provide complementary services such as fuel supply, passenger and luggage handling, warehousing, workshop facilities, hangars etc.
- Strengthen security in the airport through the introduction of a modern and smart security system.
- Upgrade non-operational air-strips in the places of economic significance such as ports, tourist places and industrial clusters.
- Strengthen land transport connectivity to the airports to maximize the benefits of air services.
- Establish a specialised air cargo terminal to handle growing air cargo volume and reduce congestion and delays. This will particularly benefit urgent shipments of exports and imports.
- Upgrade air navigation services (ANS) to build seamless air space with expanded capacity and safety. Future ANS infrastructure would move towards greater integration and automation with the implementation of state-of-the-art technologies.
- Improve maintenance, repair and overhaul facilities and services to save cost and time in a highly competitive market.
- Strengthen human resource development in this skill-intensive and competitive line of business.
- Attract private sector participation in airport development.
- Institute appropriate cost recovery policies for airport services. Airport like seaport is a commercial enterprise and will be run and managed on a commercial basis.
- Strengthen the performance of the national carrier Bangladesh Biman through professional management and technically qualified staff who understand the airline business with a view to operating BB as a truly commercial enterprise and earn sizable profit.

Strategy for Maritime Port Development

The trade to GDP ratio is projected to expand further substantially during the 8FYP, requiring strong attention to expanded and efficient port services. The Chittagong Port Authority has built up a strong record of performance improvement including financial performance that sets it apart from other SOEs. Even, so the global trade logistic performance comparison shows that the efficiency of port services is lower than in competitor countries thereby lowering trade competitiveness. The 8FYP will put strong emphasis on further improving the efficiency of the port performance to improve the competitiveness of the Bangladesh economy. Specifically, the 8FYP strategy for the maritime port subsector would involve the following steps.

- Emphasis will be placed on removing all the constraints to the use of the Mongla Port to its full capacity through a combination of investments in strategic dredging and investments in port equipment and facilities to support expanded and efficient cargo handling.
- The investment programmes for the expansion of Chittagong Port capacity will be fast tracked along with other investments for expanding container traffic handling and management.
- Completion of minimum 16.0 meter draft deep sea port at Matarbari, Cox's Bazar.
- The investment programmes for the Pyra Port will be fast tracked for speedy completion of all required physical work to enable service by 2022.
- Each port would focus on the improvement of productivity – both ship berth-day and gang-shift output further through modernisation, induction of more sophisticated equipment in handling cargo, etc.
- Handling operations in selected areas will gradually be outsourced/ privatised for injecting more competition and increasing output.
- Efforts would be made for full mechanization of cargo handling operation and movement in major Ports.
- The storage area in the ports will be expanded.
- Formulation of Private Sector Port Policy.
- Efforts would be made to reduce pre-berthing detention and to improve turn -time of vessels through minimization of both port and non-port related factors.
- Required dredging to allow handling of bigger shipping will be carried out.
- Terminal capacity for handling higher cargo off-loading will be expanded.
- Capacity to handle large container traffic will be expanded by constructing deep water-container hub ports.
- Inter-modal transport connectivity with ports will be ensured for speedy forward transport to the final destination of imports as well as easy transit factory gate to port for exports.
- Modern cargo handling techniques would be introduced to improve port performance in the major ports, particularly in the dry bulk cargo, conventional and unitized general cargo trades.
- Port service efficiency and productivity will be enhanced by introducing of state-of-the-art technology/internet to implement integrated Port Operations System and to move towards paperless regime so as to reduce dwell time and also reduce transaction cost to the users. The major areas where such automation is aimed at include: Vessel Traffic Management System (VTMS); Information Technology in Scientific Application, the Cargo/Container handling operations and non-operation area; Surveillance System and Safety & Security System; and Electronic Commerce (EC)/Electronic Data Interchange (EDI).

Strategy for Land ports

Given their importance for regional trade with neighbors, especially India, the 8FYP will seek to build on the progress made in the 7FYP and further improve the quality and lower transaction costs of land port freight. The upgrading effort of exiting land ports with modern facilities and use of digital technology will continue. Freight clearing time lines will be reduced through governance improvements, stronger supervision, reduction in paper work and use of ICT. Land port clearance procedures in Europe and North America will be studied to see how these experiences can be used to improve land port efficiency.

Strategies for Urban Transport Development

The main objective of the 8FYP urban transport strategy will be to support sustainable urban development. The strategy for urban transport would aim at reducing the traffic congestion and to improve the environment, improving transport and traffic infrastructure so as to meet existing and potential demands, and developing an integrated and balanced system in which all modes (motorized and non-motorized) can perform efficiently and each mode can fulfil its appropriate role in the system. The main elements of an urban transport strategy are:

- Completion of Mass Rapid Transit (MRT) Metro Rail, both elevated and underground rail, initially in Dhaka City and its adjoining areas.
- Provision of Bus Rapid Transit (BRT) that is characterized by dedicated lanes for rapid movement of buses for all divisional cities.
- Provision of large electric bus/pollution free bus operated by BRTC phasing out other small buses from the cities for rapid movement in all divisional cities.
- Creating special lanes for pedestrians and cyclists.
- Promoting high efficiency and alternative fuel vehicles.
- Introduce Intelligent Transportation Systems (ITS) initially in Dhaka and then extend to other metropolises. The major application areas of ITS technology include electronic road pricing, traffic management, integrated ticketing systems for different public transport modes, and traveller information. By 2031, all the major cities and the national highway networks of Bangladesh should be brought under Intelligent Transportation Systems.
- Strengthening linkages with cities and towns around Metropolitan Areas through Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT /Metro Rail). The emphasis would be placed on coordinated development of land use and transportation planning in order to facilitate access to such basic necessities as workplaces and socio-economic facilities.
- Commercial parking facilities will be encouraged through private investment. All parking regulations will be strictly enforced with penalties for non-compliance.
- Time of day use restrictions will be introduced in heavily congested roads. Consideration will be given to introduce entry fee during peak hours for heavily travelled roads.
- The emphasis would be given on the introduction of pedestrian roads in Dhaka City and then extend to other Metropolises.

Ref: 8th Five Year Plan (Part 2, Chapter 6: Page 381-398) under the title "TRANSPORT AND COMMUNICATION DEVELOPMENT"

20. Draft Perspective Plan 2021 - 2041 (PP 2041)

Major issues of the draft perspective plan 2021-2041 are outlined in Table 20.17.

Table 20.17 Perspective Plan (2021 - 2041) Transport Sector Targets

Indicators	Transport sub-sectors	FY 2018 (base year)	FY 2021	FY 2030	FY 2041
Passenger traffic (billion Passenger km)	Roads	169	246	2,072	4,215
	Inland Water	16	23	252	843
	Railways	10	15	203	562
	Total	195	284	2,527	5,620
Freight traffic (billion freight km)	Roads	24	31	71	177
	Inland Water	5	7	20	74

Source: Draft Perspective Plan (2021-2041), General Economic Division, Planning Commission, 2019, Table 9.1, page 130.

Indicators	Transport sub-sectors	FY 2018 (base year)	FY 2021	FY 2030	FY 2041
	Railways	2	3	10	44
	Total	31	41	101	295
Air traffic (million passengers/million tons) Cargo traffic (million numbers/million tons)	Passenger	11	14	38	122
	Freight	0.3	0.5	1.3	4.2
	Container	2.2	3.6	12.5	48.2
	Tons	86	122	417	1,612
Urban mass transit Infrastructure quality	No of major cities	0	1	8	All major cities
	Country ranking	120	118	60	40
	Score	2.8	2.9	4.0	5.0

Ref: Study of Supply Chain Resilience on RMG sector in Bangladesh

21. Warehouse

A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, custom, etc.



Warehouses are normally equipped with facility of loading docks to load and unload trucks; or sometimes are loaded directly from railways, airports, or seaports. They also often have cranes and forklifts for moving goods.

Some warehouses are completely automated, with no workers working inside. The pallets and product are moved with a system of automated conveyors and automated storage and retrieval machines coordinated by programmable logic controllers and computers running logistics automation software.

Objective of Warehouse

- Maximize completion of orders on time & in full (OTIF).
- Minimize the cost of warehouse operations.
- Maximize inventory turnover (i.e., minimize the time that materials stay in the warehouse).
- Minimize response time to demand & errors in dispatches.
- Preserve the quality, value & security of the stored items.
- Ensure a balanced flow of materials needed to keep the business running
- Organize and account for the receipt & issue of materials

The warehouse must be:

- located in the right place
- organized to allow:
 - efficient delivery and placing
 - cost-effective use of its space
 - adequate access to stored materials
 - security from theft and weather
 - flexibility to deal with the various items.

Within the warehouse, stock must be:

- put into known places and
- in known order
- so that it can be:
 - retrieved quickly and in the right quantity
 - rotated properly (ex. first-in, first-out).

Warehousing activities:

- receiving goods
- identifying goods
- sorting goods
- dispatching goods to storage
- holding goods
- picking goods
- preparing shipments
- dispatching shipments.

21.1 Function of Warehouse

The warehouse function is concerned with physical handling of raw materials and component parts until they are used in production process. The warehouse is a point in the logistics system where a firm stores or holds raw materials, semi-finished goods or finished goods for varying period of time.

Holding goods in a warehouse causes stoppage or interruption to the flow of goods, which in turn adds cost to the products. But while adding to the cost, warehouse can add more value than cost to a product.

The warehouse serves several value-adding roles in a logistics systems and makes trade-off areas.

Value-adding roles	Trade-off areas
<ul style="list-style-type: none"> ▪ Consolidation ▪ Product mixing ▪ Service ▪ Contingency protection ▪ Smooth operation 	<ul style="list-style-type: none"> ▪ Transportation ▪ Order filling ▪ Lead times, stock outs ▪ Production

Warehouse: Description of Value-Added Activities

Consolidation: It means collecting smaller shipments to form a larger quantity in order to realize lower transportation rates.

Product Mixing: Companies frequently turnout a product line that contains a large number of different products, based on size, shape and other variations to meet customer order in involving product line mixtures. A product mixing warehouse for a multi-plant product line leads to efficient order filling.

Cross-docking: It involves movement of goods directly from receiving dock to shipping dock to eliminate storage expense. Under this system, products from different suppliers are received in a warehouse and instead of being stored, they are moved across the warehouse area to waiting trucks for movement to particular customers.

Service: Another function of warehouse is to provide service to customers. Having goods available in a warehouse when a customer places on order, particularly if the warehouse is in a reasonable proximity to customers, usually lead to customer satisfaction.

Contingency protection: Protection against contingencies such as delays in transportation, vendor stock outs or strikes by truck operators.

Smoothen operation: Another warehousing function is to smoothen operations or decouple successive stages in the manufacturing process. Seasonal demand and the need for a production run long enough to ensure reasonable cost and quality are example of smoothing.

Trade-off areas:

The basic warehouse decisions are made in trade-off frame work. The criterion of total cost (including the service impact on lost sales) is used to make the decisions.

For examples, customer service can be improved by having many warehouses because products are located closer to the customers, but the warehousing, inventory and possibly transportation cost would be higher. The total cost will be the determining factor.

21.2 Centralization vs. Decentralization of Warehouse

- Just as globalization has encouraged to rationalize production into fewer locations to have advantage of economics of location as well as economics of scale, the trend in warehousing has also shifted towards the centralization of inventories.
- Because consolidating inventory into fewer locations can substantially reduce total inventory requirement, multinational companies have amalgamated their national warehouse into regional distribution centers which can serve much wider geographical market.
- However, from the customer service point of view, locating inventories strategically near the customer or point of production but managing and controlling them centrally is becoming increasingly recognized as advantageous.
- This is the idea of “virtual” or “electronic” inventory in which the firm uses information regarding inventories and demand to achieve the inventory reduction which the firm would have achieved through centralization of inventories while retaining a greater flexibility by localizing or decentralizing inventory.

Following factors may be considered to decide whether to have centralized or decentralized warehousing system:

Factor	Centralized	Decentralized	Remarks
Substitutability	Low	High	If product substitutability is high, a decentralized system is recommended . This would reduce lost sales resulting from stock out or long lead times.
Product value	High	Low	If value of products stored is high, centralized warehouse is recommended .
Purchase Size (or volume)	Large	Small	Small quantity purchases favor decentralized warehousing .
Product Line	Diverse	Limited	A firm having a diverse product line (i.e. a large number of product varieties and sizes) will find that centralized warehousing is beneficial because of reduced overall inventory levels and the resulting inventory carrying cost.
Special Warehouse	Yes	No	If a firm’s products are perishable and require special warehousing requirements such as control temperature and humidity , it is suggested to have fewer warehouses.
Customer Service	Low	High	If a firm wants to have high levels of customer service , then it is recommended to have decentralized warehousing .

21.3 Warehouse Location and Acquisition Considerations

- Proximity to suppliers & Customers
- Availability to essential services
- Capacity of the site for future expansion
- Drainage and security
- Clear & certain road or rail access
- Taxes & investment incentive, if any

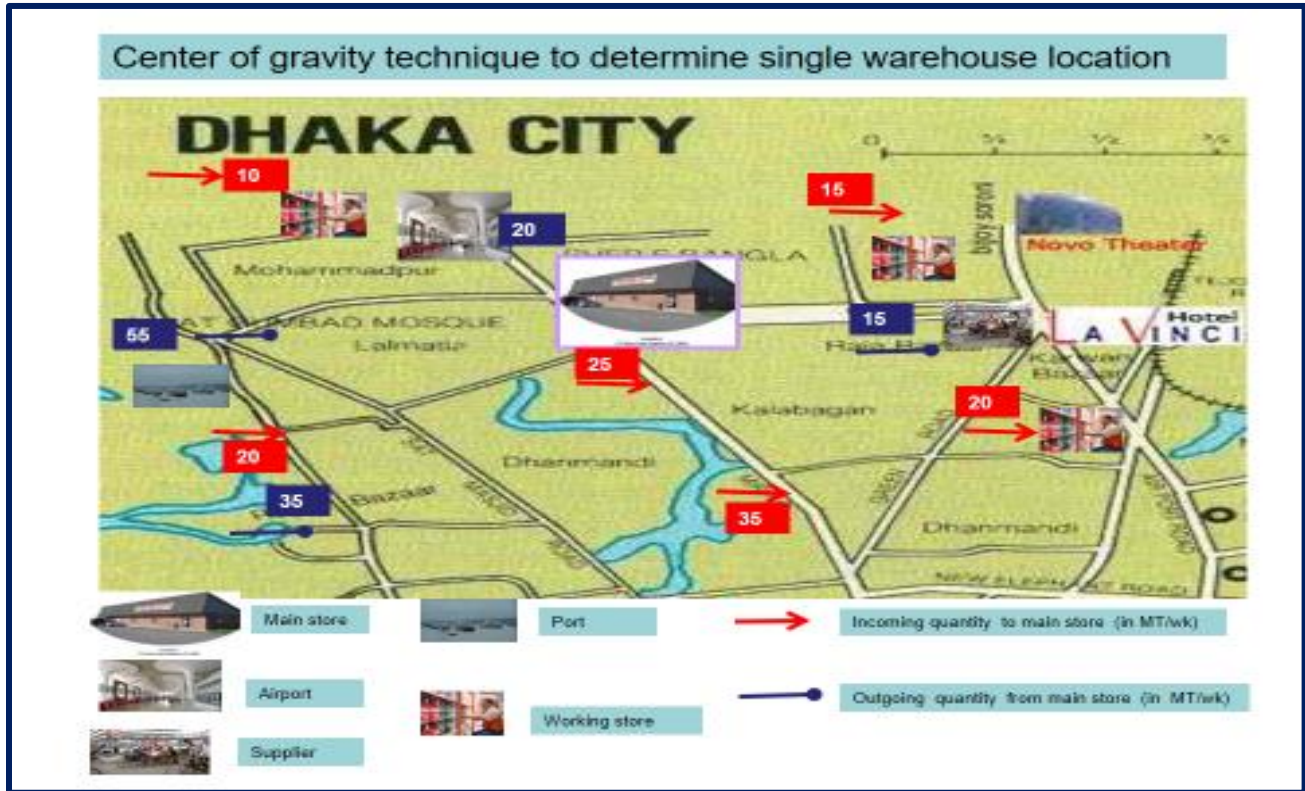
Acquisition options

- Purchase of existing warehouse
- Self-build - land purchase
- Rental
- Outsourced warehouse services
- Build, Own, Operate or Tax-free zone

Locate your warehouse considering your goal

Goal	Location	Demand
Balance and buffer	Near the manufacturer	Monthly/quarterly replenishments of stocks
Accumulate and consolidate	Central to production locations	Weekly/monthly orders
Rapid response	Close to customer	Daily

21.4 Center of Gravity Technique to Determine Single Warehouse Location



This method is suitable for determining the general location of single warehouse. Basically, this method involves giving physical “weights” to each supply and/or destination center (e.g., airport, port, supplier, customer, etc.), each weight being proportional to the quantity of goods supplied or required by the

Location Evaluation							
Factor	Weighting	Location A		Location B		Location C	
		Scale 1-5	Score	Scale 1-5	Score	Scale 1-5	Score
Market/Customer (40)							
Proximity to Market	10	3	30	4	40	3	30
Customer base	20	3	60	4	80	4	80
Competitors	10	4	40	5	50	5	50
Suppliers (25)							
Proximity to Suppliers	15	3	45	4	60	4	60
Transport Cost	10	3	30	2	20	3	30
Environment (15)							
Energy Costs	10	3	30	4	40	4	40
Water	5	5	25	4	20	5	25
Site (10)							
Site Construction Cost	5	3	15	5	25	4	20
Labor Cost	5	3	15	5	25	4	20
Local Government (10)							
Rates/Taxes	5	3	15	4	20	5	25
Incentives	5	2	10	5	25	3	15
Total	100		315		405		395

corresponding center. By testing these various points through a process of approximation, the best location is found where the weights on either side of the nod balance each other out.

In the map above, assume that the location shown for the main warehouse represents the balance of weight shown.

Ref: ITC-MLS-SCM Course-Module 10 (Old Version)

21.5 Warehouse: Location Evaluation

Location B appears as a suitable site for warehouse.

21.6 Warehouse Design and Efficiency

Design parameters	Traditional warehouse	Automated warehouse
Height of eaves	10 meters	18~32 meters
Storage	-Pallet in lanes -The goods dictate the stacking height -Wide aisles for forklift turning circle	-Fully automated storage and retrieval -Storage height independent of goods -Very narrow aisles for picker-stackers
Equipment	Pallet racking	Multi-depth and purpose-built
Interior space	Standard “box” according to site	Operation dictate the design
Store space utilization	50% to 70%	Above 95%

22. Safety at Warehouse

Safety in Materials Handling at Warehouse

Since about two-third of general causes of accidents are directly related to materials handling, safety in materials handling is a major concern of managers/executives related to warehouse, inventory, production etc.

The considerations for safe handling of materials are as follows:

1. Install adequate guards and safety devices on handling equipment
2. Keep handling equipment in good operating conditions
3. Replace manual handling by mechanized handling for difficult hazardous handling activities
4. Do not permit the handling equipment to be overloaded or operated beyond rated capacity
5. Keep aisles clear and uncluttered
6. Avoid congestion of materials
7. Maintain adequate lighting
8. Maintain floors in good conditions
9. Provide good house keeping
10. Stack materials carefully
11. Train operators in properly operating handling equipment
12. Highlight handling hazard or danger zones

23. Green Warehouse and Supply Chain Resilience

The green initiatives or green supply chain management (GSCM) facilitate optimization in enterprises functions, reduction of waste and cost rendering the operation competitive, profitable and ability to continue or sustainable.

Developing the green initiatives or GSCM requires an elaborate system factoring in all the supply chain processes. They include planning for procurement, production, packaging, and product sales and marketing, logistics, warehouse operation and product life management. Through the initiative of building a green warehouse, you may contribute to the process of resilience supply chain.

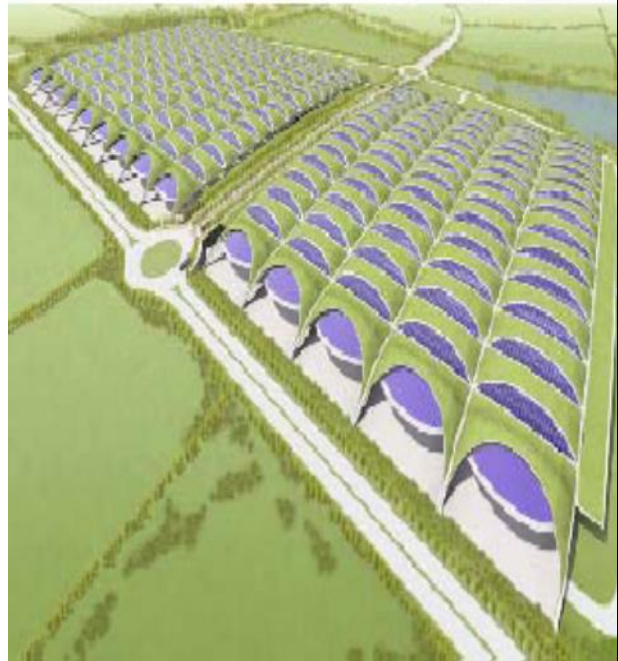
Green Warehouse

Sustainable green warehouse can be defined as the cluster of technological and organizational solutions designed for the efficiency of warehouse processes by maintaining the highest social standards and minimizing the effect on nature in terms of financial efficiency

Issues we must consider:

- **Materials and pallets:** New materials other than wood for pallets seem to last longer, are stronger and more easily recycled.
- **Paperless Tracking:** The logistics sector uses a ton of paper, but as their IT systems become better, things are now being tracked electronically, without much paper involved.
- **RIFD Initiatives:** Radio Identification Tags are great, but these tags have to be recycled and reused?
- **Solar power:** Warehouses are perfectly suited for solar power due to the large amount of roof space. Now that solar panels are more efficient and less costly, this is a must for any green warehouse plan.
- **Hydrogen cell Fork Lifts:** If we are truly worried about CO2 emissions and the air quality for the workers in warehouses why not move to hydrogen cell forklifts.
- **Lighting:** The use of LED ultra-low wattage light bulbs, some as low as 3 watts or less.

Ref: <https://ideas.repec.org/p/sek/iacpro/4106594.html>



24. Glossary

Inventory Related Glossary

ABC analysis: Also called Pareto analysis or the rule of 80/20, is a way of categorizing inventory items into different types depending on value and use.

Average Inventory: The average inventory level over a period of time. Implicit in this definition is a "sampling period" which is the amount of time between inventory measurements. For example, daily inventory levels over a two-week period of time, hourly inventory levels over one day, etc. The average inventory for the same total period of time can fluctuate widely depending upon the sampling period used.

Bin: 1) A storage device designed to hold small discrete parts. 2) A shelving unit with physical dividers separating the storage locations.

Break-Bulk: The separation of a consolidated bulk load into smaller individual shipments for delivery to the ultimate consignee. The freight may be moved intact inside the trailer, or it may be interchanged and re-handled to connecting carriers.

Bonded Warehouse: Warehouse approved by the concerned authority and under bond/guarantee for observance of revenue laws. Used for storing goods until duty is paid or goods are released in some other proper manner.

Book Inventory: An accounting definition of inventory units or value obtained from perpetual inventory records rather than by actual count.

Code: A numeric, or alphanumeric representation of text for exchanging commonly-used information. For example: commodity codes, carrier codes.

Consignment: (1) A shipment that is handled by a common carrier. (2) The process of a supplier placing goods at a customer location without receiving payment until after the goods are used or sold.

Consolidation: Combining two or more shipments in order to realize lower transportation rates. Inbound consolidation from vendors is called make-bulk consolidation; outbound consolidation to customers is called break-bulk consolidation.

Consolidation Point: The location where consolidation takes place.

Consolidator: An enterprise that provides services to group shipments, orders, and/or goods to facilitate movement.

Dangerous Goods: Articles or substances capable of posing a significant risk to health, safety, or property, and that ordinarily require special attention when transported. See also Hazardous Goods.

Deadhead: The return of an empty transportation container to its point of origin.

Dead Inventory: No one wants this type of inventory but it is held for a variety of reasons. Say if company expects demand may create after long time or it may cost more to dispose of than it does to keep. Sometimes to meet occasional need of customers, it is kept as a gesture of goodwill.

Finished product inventory: inventory of product ready to be sold

Goods: A term associated with more than one definition: 1) Common term indicating movable property, merchandise, or wares. 2) All materials which are used to satisfy demands. 3) Whole or part of the cargo received from the shipper, including any equipment supplied by the shipper.

Gross Weight: The total weight of the vehicle and the payload of freight or passengers.

Hazardous Goods: Articles or substances capable of posing a significant risk to health, safety, or property, and that ordinarily require special attention when transported. Also called Dangerous Goods.

Hazardous Material: A substance or material which the Department of Transportation has determined to be capable of posing a risk to health, safety, and property when stored or transported in commerce.

Inspection Certificate: A document certifying that merchandise (such as perishable goods) was in good condition immediately prior to shipment.

Insurance: A system of protection against loss under which a number of parties agree to pay certain sums (premiums) for a guarantee that they will be compensated under certain conditions for specified loss and damage.

Insurance Certificate: A document issued to the consignee to certify that insurance is provided to cover loss of or damage to the cargo while in transit.

Normal Inventory: This is inventory required to support the normal replenishment process under conditions of certainty. If demand and lead times are consistent, normal inventory is what the organization needs to meet customers demand at a given point in time. This type of inventory should generally be as close to zero as possible. However, this may not happen due to transportation, production or distribution economics of scale.

Receiving Dock: Distribution center location where the actual physical receipt of the purchased material from the carrier occurs.

Raw-material inventory: inventory that is stored before it is used in the production process

Short Shipment: Piece of freight missing from shipment as stipulated by documents on hand.

Shrinkage: Reductions of actual quantities of items in stock, in process, or in transit. The loss may be caused by scrap, theft, deterioration, evaporation, etc.

Split Delivery: A method by which a larger quantity is ordered on a purchase order to secure a lower price, but delivery is divided into smaller quantities and is spread out over several dates to control inventory investment, save storage space, etc.

Safety Inventory: Surplus inventory that a company hold to protect against the uncertainty in demand, in lead-times and in quality of supply.

Speculative Inventory: This type of inventory is held other than meeting current demand. For example, the company may decide to buy and stock more than it needs in the event that it forecasts that prices of material will rise or supplier offers lower price if a large quantity is purchased at one time.

Seasonal Inventory: This type of inventory is accumulated in advance of significant selling session. If the majority of sales occur in relatively short projects of time, companies may stock seasonal inventory to stabilize production over a more extended period of time and maintain labor force capacities.

24/7/365: Referring to operations that are conducted 24 hours a day, 7 days a week, 365 days per year, with no breaks for holidays, etc.

24/7: Referring to operations that are conducted 24 hours a day, 7 days a week.

Truckload Lot: A truck shipment that qualifies for a lower freight rate because it meets a minimum weight and/or volume.

Unit of Measure (UOM): The unit in which the quantity of an item is managed, e.g., pounds, each, box of 12, package of 20, or case of 144. Various UOMs may exist for a single item. For example, a product may be purchased in cases, stocked in boxes, and issued in single units.

Weight Break: The shipment volume at which the LTL charges equal the TL charges at the minimum weight.

Work-in-process inventory: partially finished inventory that is within the production process

Weight Confirmation: The practice of confirming or validating receipts or shipments based on the weight.

Weight-Losing Raw Material: A raw material that loses weight in processing.

Weight Unit Qualifier: The unit of measure that the user wants to see for weight.

Wharfage: A charge assessed by a pier or dock owner against the cargo or a steamship company for use of the pier or dock for the handling of incoming or outgoing cargo.

Wall-to-Wall Inventory: An inventory management technique in which material enters a plant and is processed through the plant into finished goods without ever having entered a formal stock area.

Warehouse Related Glossary

Air Cargo: Freight that is moved by air transportation.

Arrival Notice: A notice from the delivering carrier to the Notify Party indicating the shipment's arrival date at a specific location (normally the destination).

Bill of Lading (BOL): A transportation document that is the contract of carriage containing the terms and conditions between the shipper and carrier.

Break-Bulk: The separation of a consolidated bulk load into smaller individual shipments for delivery to the ultimate consignee. The freight may be moved intact inside the trailer, or it may be interchanged and re-handled to connecting carriers.

Bonded Warehouse: Warehouse approved by the concerned authority and under bond/guarantee for observance of revenue laws. Used for storing goods until duty is paid or goods are released in some other proper manner.

Backhaul: The process of a transportation vehicle returning from the original destination point to the point of origin. The backhaul can be with a full, partial, or empty load. An empty backhaul is called deadheading. Also see: Deadhead

Carrier: A firm that transports goods or people via land, sea, or air.

Carrier Assets: Items that a carrier owns (technically or outright) to facilitate the services they provide.

Claim: A charge made against a carrier for loss, damage, delay, or overcharge.

Code: A numeric, or alphanumeric representation of text for exchanging commonly-used information. For example: commodity codes, carrier codes.

Consignment: (1) A shipment that is handled by a common carrier. (2) The process of a supplier placing goods at a customer location without receiving payment until after the goods are used or sold.

Consolidation: Combining two or more shipments in order to realize lower transportation rates. Inbound consolidation from vendors is called make-bulk consolidation; outbound consolidation to customers is called break-bulk consolidation.

Consolidation Point: The location where consolidation takes place.

Consolidator: An enterprise that provides services to group shipments, orders, and/or goods to facilitate movement.

Dangerous Goods: Articles or substances capable of posing a significant risk to health, safety, or property, and that ordinarily require special attention when transported. See also Hazardous Goods.

Deadhead: The return of an empty transportation container to its point of origin. See Backhaul.

Inbound Logistics and Outbound Logistics: Goods either “come into” or “leave” a business. Inbound Logistics is applied for the transport, storage and delivery of goods that “come into” a business from a manufacturer.

The opposite is of course Outbound Logistics, which involves goods that “leave” the business to the client.

Goods: A term associated with more than one definition: 1) Common term indicating movable property, merchandise, or wares. 2) All materials which are used to satisfy demands. 3) Whole or part of the cargo received from the shipper, including any equipment supplied by the shipper.

Gross Weight: The total weight of the vehicle and the payload of freight or passengers.

Hazardous Goods: Articles or substances capable of posing a significant risk to health, safety, or property, and that ordinarily require special attention when transported. Also called Dangerous Goods.

Hazardous Material: A substance or material which the Department of Transportation has determined to be capable of posing a risk to health, safety, and property when stored or transported in commerce.

Inspection Certificate: A document certifying that merchandise (such as perishable goods) was in good condition immediately prior to shipment.

Insurance: A system of protection against loss under which a number of parties agree to pay certain sums (premiums) for a guarantee that they will be compensated under certain conditions for specified loss and damage.

Insurance Certificate: A document issued to the consignee to certify that insurance is provided to cover loss of or damage to the cargo while in transit.

Integrated Carrier: An airfreight company that offers a blend of transportation services such as air carriage, freight forwarding, and ground handling.

Integrated Logistics: A comprehensive, system-wide view of the entire supply chain as a single process, from raw materials supply through finished goods distribution. All functions that make up the supply chain are managed as a single entity rather than managing individual functions separately.

Intermediate Destination: A stopping point for a shipment prior to the final destination.

Less-Than-Container load (LCL): A term used when goods do not completely occupy an entire container. When many shipper's goods occupy a single container, each shipper's shipment is considered to be LCL.

Less-Than-Truckload (LTL) Carriers: Trucking companies that consolidate and transport smaller (less than truckload) shipments of freight utilizing a network of terminals and relay points.

Logbook: A daily record of the hours an interstate driver spends driving, off duty, sleeping in the berth, or on duty but not driving.

Logistics: The process of planning, implementing, and controlling procedures for the efficient and effective 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. This definition includes inbound, outbound, internal, and external movements.

Logistics Channel: The network of supply chain participants engaged in storage, handling, transfer, transportation, and communications functions that contribute to the efficient flow of goods.

Non Vessel Operating Common Carrier (NVOCC): A firm that offers the same services as an ocean carrier, but which does not own or operate a vessel. NVOCCs usually act as consolidators, accepting small shipments (LCL) and consolidating them into full container loads. They also consolidate and disperse international containers that originate at or are bound for inland ports. They then act as a shipper, tendering the containers to ocean common carriers. They are required to file tariffs with the Federal Maritime Commission and are subject to the same laws and statutes that apply to primary common carriers.

Port: A harbor where ships will anchor.

Port of Discharge: Port where vessel is off loaded.

Port of Entry: A port at which foreign goods are admitted into the receiving country.

Port of Loading: Port where cargo is loaded aboard the vessel.

Radio Frequency Identification (RFID): The use of radio frequency technology such as RFID tags and tag readers to identify objects. Objects may include virtually anything physical, such as equipment, pallets of stock, or even individual units of product.

Refrigerated Carriers: Truckload carriers designed to keep perishables good refrigerated. The food industry typically uses this type of carrier.

Reverse Logistics: A specialized segment of logistics focusing on the movement and management of products and resources after the sale and after delivery to the customer. Includes product returns for repair and/or credit.

Receiving Dock: Distribution center location where the actual physical receipt of the purchased material from the carrier occurs.

Shipper: The party that tenders goods for transportation.

Shipper-Carriers: Shipper-carriers (also called private carriers) are companies with goods to be shipped that own or manage their own vehicle fleets. Many large retailers, particularly groceries and "big box" stores, are shipper-carriers.

Shipping: The function that performs the tasks for the outgoing shipment of parts, components, and products. It includes packaging, marking, weighing, and loading for shipment.

Short Shipment: Piece of freight missing from shipment as stipulated by documents on hand.

Shrinkage: Reductions of actual quantities of items in stock, in process, or in transit. The loss may be caused by scrap, theft, deterioration, evaporation, etc.

Split Delivery: A method by which a larger quantity is ordered on a purchase order to secure a lower price, but delivery is divided into smaller quantities and is spread out over several dates to control inventory investment, save storage space, etc.

Straight Truck: Straight trucks do not have a separate tractor and trailer. The driving compartment, engine and trailer are one unit.

Subhauler: A subhauler drives a tractor under contract for a company. Usually a subhauler is an owner/operator or a small company.

24/7/365: Referring to operations that are conducted 24 hours a day, 7 days a week, 365 days per year, with no breaks for holidays, etc.

24/7: Referring to operations that are conducted 24 hours a day, 7 days a week.

Tariff: A tax assessed by a government on goods entering or leaving a country. The term is also used in transportation in reference to the fees and rules applied by a carrier for its services.

Third Party Logistics: Outsourcing all or much of a company's logistics operations to a specialized company.

Third Party Logistics Provider (3PL): A firm which provides multiple logistics services for use by customers. Preferably, these services are integrated or bundled together, by the provider. These firms facilitate the movement of parts and materials from suppliers to manufacturers, and finished products from manufacturers, and finished products from manufacturers to distributors and retailers. Among the services they provide are transportation, warehousing, cross docking, inventory management, packaging, and freight forwarding.

Traffic: A department or function charged with the responsibility of arranging the most economic classification and method of shipment for both incoming and outgoing materials and products.

Traffic Management: The management and controlling of transportation modes, carriers, and services.

Trailer: The part of the truck that carries the goods.

Trailer Drops: When a driver drops off a full truck at a warehouse and picks up an empty one.

Trailer on a Flat Car (TOFC): A specialized form of containerization in which motor and rail transport coordinate. Synonym: Piggyback.

Transit Time: The total time that elapses between a shipment's pickup and delivery.

Transportation Management System: A computer system designed to provide optimized transportation management in various modes along with associated activities, including managing shipping units, labor planning and building, shipment scheduling through inbound, outbound, intra-company shipments, documentation management (especially when international shipping is involved), and third party logistics management.

Transportation Mode: The method of transportation: land, sea, or air shipment.

Transportation Planning: The process of defining an integrated supply chain transportation plan and maintaining the information which characterizes total supply chain transportation requirements, and the management of transporters, both inter- and intra- company.

Transportation Planning Systems: The systems used in optimizing assignments from plants to distribution centers, and from distribution centers to stores. The systems combine moves to ensure the most economical means are employed.

Truck Stop Electrification (TSE): Provides power outlets at truck parking spaces in which truck drivers can simply plug in, and turn off their engines, rather than idle their truck engine.

Truckload Carriers (TL): Trucking companies which move full truckloads of freight directly from the point of origin to destination.

Truckload Lot: A truck shipment that qualifies for a lower freight rate because it meets a minimum weight and/or volume.

Unit of Measure (UOM): The unit in which the quantity of an item is managed, e.g., pounds, each, box of 12, package of 20, or case of 144. Various UOMs may exist for a single item. For example, a product may be purchased in cases, stocked in boxes, and issued in single units.

Weight Break: The shipment volume at which the LTL charges equal the TL charges at the minimum weight.

Weight Confirmation: The practice of confirming or validating receipts or shipments based on the weight.

Weight-Losing Raw Material: A raw material that loses weight in processing.

Weight Unit Qualifier: The unit of measure that the user wants to see for weight.

Wharfage: A charge assessed by a pier or dock owner against the cargo or a steamship company for use of the pier or dock for the handling of incoming or outgoing cargo.

Transport Related Glossary

Air Cargo: Freight that is moved by air transportation.

Arrival Notice: A notice from the delivering carrier to the Notify Party indicating the shipment's arrival date at a specific location (normally the destination).

Bill of Lading (BOL): A transportation document that is the contract of carriage containing the terms and conditions between the shipper and carrier.

Break-Bulk: The separation of a consolidated bulk load into smaller individual shipments for delivery to the ultimate consignee. The freight may be moved intact inside the trailer, or it may be interchanged and re-handled to connecting carriers.

Bonded Warehouse: Warehouse approved by the concerned authority and under bond/guarantee for observance of revenue laws. Used for storing goods until duty is paid or goods are released in some other proper manner.

Bin Card: The bin card provides the current records of the receipts, issues and the balance of materials in the simplest form .It gives very quick idea of the particular type of material binned in the card. It is quantity record for reference. However, the bin cards don't consider the value of materials.

Claim: A charge made against a carrier for loss, damage, delay, or overcharge.

Code: A numeric, or alphanumeric representation of text for exchanging commonly-used information. For example: commodity codes, carrier codes.

Consignment: (1) A shipment that is handled by a common carrier. (2) The process of a supplier placing goods at a customer location without receiving payment until after the goods are used or sold.

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Inbound Logistics and Outbound Logistics: Goods either "come into" or "leave" a business. Inbound Logistics is applied for the transport, storage and delivery of goods that "come into" a business from a manufacturer.

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Goods: A term associated with more than one definition: 1) Common term indicating movable property, merchandise, or wares. 2) All materials which are used to satisfy demands. 3) Whole or part of the cargo received from the shipper, including any equipment supplied by the shipper.

Gross Weight: The total weight of the vehicle and the payload of freight or passengers.

GRN: (Goods Receiving Note) Goods Received Note is a record of goods received from suppliers, and the record is shown as a proof that ordered products had been received. Moreover, the record is used by the buyer for comparing the number of goods ordered to the ones delivered.

Hazardous Goods: Articles or substances capable of posing a significant risk to health, safety, or property, and that ordinarily require special attention when transported. Also called Dangerous Goods.

Hazardous Material: A substance or material which the Department of Transportation has determined to be capable of posing a risk to health, safety, and property when stored or transported in commerce.

Inspection Certificate: A document certifying that merchandise (such as perishable goods) was in good condition immediately prior to shipment.

Insurance: A system of protection against loss under which a number of parties agree to pay certain sums (premiums) for a guarantee that they will be compensated under certain conditions for specified loss and damage.

Insurance Certificate: A document issued to the consignee to certify that insurance is provided to cover loss of or damage to the cargo while in transit.

Radio Frequency Identification (RFID): The use of radio frequency technology such as RFID tags and tag readers to identify objects. Objects may include virtually anything physical, such as equipment, pallets of stock, or even individual units of product.

Refrigerated Carriers: Truckload carriers designed to keep perishables good refrigerated. The food industry typically uses this type of carrier.

Receiving Dock: Distribution center location where the actual physical receipt of the purchased material from the carrier occurs.

Shelf Life: The amount of time an item may be held in inventory before it becomes unusable. Shelf life is a consideration for food and drugs which deteriorate over time, and for high-tech products which become obsolete quickly.

Shipping: The function that performs the tasks for the outgoing shipment of parts, components, and products. It includes packaging, marking, weighing, and loading for shipment.

Shrinkage: Reductions of actual quantities of items in stock, in process, or in transit. The loss may be caused by scrap, theft, deterioration, evaporation, etc.

Split Delivery: A method by which a larger quantity is ordered on a purchase order to secure a lower price, but delivery is divided into smaller quantities and is spread out over several dates to control inventory investment, save storage space, etc.

24/7/365: Referring to operations that are conducted 24 hours a day, 7 days a week, 365 days per year, with no breaks for holidays, etc.

24/7: Referring to operations that are conducted 24 hours a day, 7 days a week.

Tariff: A tax assessed by a government on goods entering or leaving a country. The term is also used in transportation in reference to the fees and rules applied by a carrier for its services.

Third Party Logistics: Outsourcing all or much of a company's logistics operations to a specialized company.

Third Party Logistics Provider (3PL): A firm which provides multiple logistics services for use by customers. Preferably, these services are integrated or bundled together, by the provider. These firms facilitate the movement of parts and materials from suppliers to manufacturers, and finished products from manufacturers, and finished products from manufacturers to distributors and retailers. Among the services they provide are transportation, warehousing, cross docking, inventory management, packaging, and freight forwarding.

Unit of Measure (UOM): The unit in which the quantity of an item is managed, e.g., pounds, each, box of 12, package of 20, or case of 144. Various UOMs may exist for a single item. For example, a product may be purchased in cases, stocked in boxes, and issued in single units.

Unitization: In warehousing, the consolidation of several units into larger units into larger units for fewer handlings.

Unitize: To consolidate several packages into one unit; carriers strap, band, or otherwise attach the several packages together.

Unplanned Order: Orders which are received that do not fit into the volumes prescribed by the plans developed from forecasts.

Wall-to-Wall Inventory: An inventory management technique in which material enters a plant and is processed through the plant into finished goods without ever having entered a formal stock area.

WAN: Wide Area Network.

Warehouse: Storage place for products. Principal warehouse activities include receipt of product, storage, shipment, and order picking.

Warehousing: The storage (holding) of goods.

Warehouse Management System (WMS): The systems used in effectively managing warehouse business processes and direct warehouse activities, including receiving, putaway, picking, shipping, and inventory cycle counts. Also includes support of radio frequency communications, allowing real-time data transfer between the system and warehouse personnel. They also maximize space and minimize material handling by automating putaway processes.

Weight Break: The shipment volume at which the LTL charges equal the TL charges at the minimum weight.

Weight Confirmation: The practice of confirming or validating receipts or shipments based on the weight.

Weight-Losing Raw Material: A raw material that loses weight in processing.

Weight Unit Qualifier: The unit of measure that the user wants to see for weight.

Wharfage: A charge assessed by a pier or dock owner against the cargo or a steamship company for use of the pier or dock for the handling of incoming or outgoing cargo.

Ref: Glossary of Supply Chain Terms <https://www.inboundlogistics.com/cms/logistics-glossary/> and Google search

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