Chapter

Supply Chain Management and Restart of Economy in Post COVID-19

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Abstract

The increase in World Trade has led to significant growth in world GDP over last 100 years particularly. Supply chains have become the major enablers of world trade and the world is connected through supply chains. Any disruptions in any part of the world has led to disruptions in supply chains and economic recessions. Crisis like Tsunamis, earthquakes, 911 terror attacks, epidemics/pandemics like COVID-19 etc. have affected the businesses worldwide. COVID-19 pandemic has precipitated economic crisis due to disruption of supply chains and suppressed demand for many products and services worldwide. International Monetary Fund (IMF) has projected global economic growth to be negative 4.9%. This economic crisis has resulted in substantial erosion of market capitalization across the globe. The impact of COVID-19 is very significant on both health of the people and economy worldwide. Almost all businesses and governments are trying its best to save people from health and economic crisis. This requires rebuilding of supply chains through appropriate configuration with reliable sources of supply, collaboration, manufacturing and distribution of goods and services. Sectors like essential items, pharmaceutical, e-commerce have started early recovery of economy. However, other sectors require suitable interventions from government, business organizations in their policies and practices and use of digital technologies for economic recovery.

Keywords: COVID-19, E-commerce, economic development, economic recovery, GDP, healthcare, pandemic, supply chain management, world trade

1. Introduction

Trade is an integral part of economic activity and development. In global economic system, countries exchange various products as well as intermediate goods/inputs. International trade creates network of economic activity which are generally called trade networks or supply chains. Supply chains are the major enablers of world trade and the world is connected through supply chains. The world economy is strongly connected and influenced by supply chains and its developments. According various industry reports/studies, the best companies are the ones which are having best Supply Chains [1]. Global competition is forcing

organizations to build suitable competencies to reduce cost and improve customer service on continuous basis. Corporations have realized that substantial cost savings and market benefits can be achieved by more effective management of their supply chains globally. Advances in information/communication systems and quantitative modeling are also being widely implemented, which provide the potential for access and analysis of comprehensive data/information from each element of the supply chain. One of the main objectives of supply chain is to link the markets, distribution system, manufacturing and allied processes and the procurement to serve its customers across different parts of the world at lower cost and higher service levels. Various developments in technologies, trade policies lead to strong economic growth of the world. Supply chains facilitated globalization of trade for a long time. Various disruptions challenged the globalization. COVID-19 crisis has led to the greatest disruption of supply chains worldwide. COVID-19 crisis not only disrupted the global supply chains and it has thrown lot of challenges to politicians, business and overall economy. COVID-19 pandemic has precipitated economic crisis due to disruption of supply chain, manufacturing activities, and suppressed demand. International Monetary Fund (IMF) has projected global economic growth to be negative 4.9%. This economic crisis has resulted in substantial erosion of market capitalization across the globe.

This chapter focus on how supply chains helped in building the economic development before COVID-19 crisis and how these will help to restart the economic development post COVID-19. We present a brief overview of supply chain management with some examples, impact of COVID-19 on supply chains and economy followed by economy recover framework, sectors and strategies.

1.1 Definition of supply chain and supply chain management

A supply chain is a system consists of people, material, transformation activities, organizations, information and resources used in fulfilling the demand for a product or service by a customer. Supply chain management deals with transformation of raw materials and components into a finished product/service that is delivered to the end customer [2]. **Figure 1** shows a typical supply chain which consists

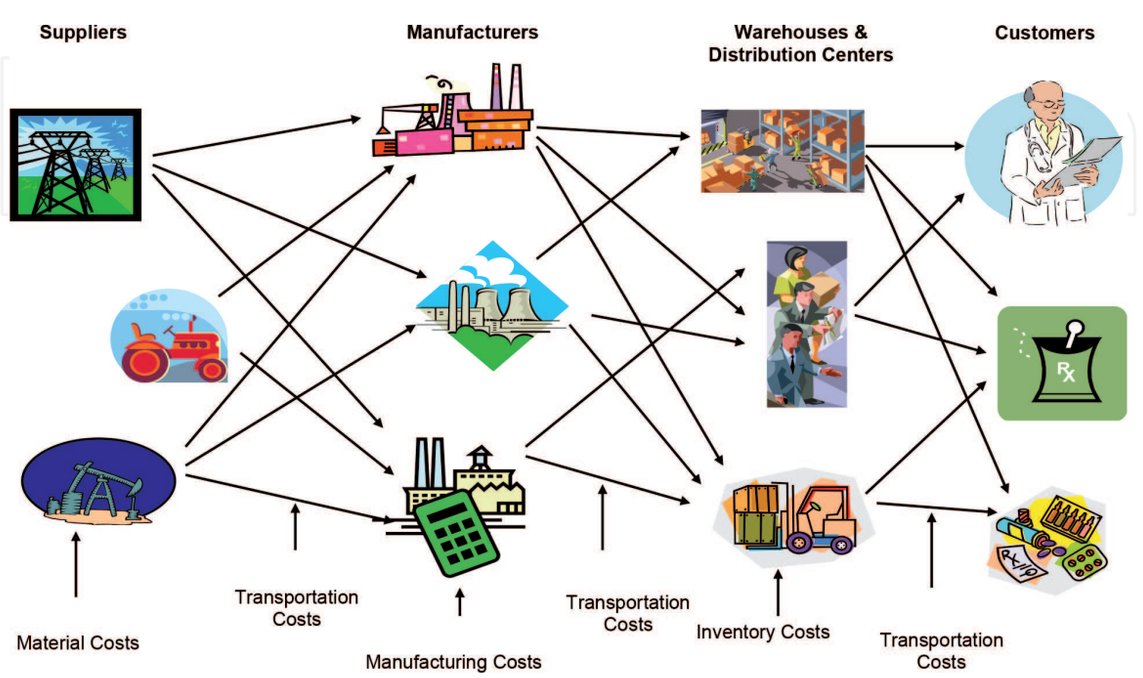

Figure 1.
A typical supply chain network [2].

of suppliers, manufacturers, distributors and final customer. These entities are connected through suitable transportation, warehousing and information sharing across the supply network.

A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer. Generally, supply chains deal with different activities, people, material, information, financial resource, knowledge & skills. **Figure 2** shows various flows that need to be managed in a supply chain. Three important aspects of supply chains include adaptability, alignment and agility. The best supply chains identify structural shifts, sometimes before they occur, by capturing the latest data, filtering out noise, and tracking key patterns [3]. The supply chain also represents the steps it takes to get the product or service from its original state to the customer [2, 3]. Supply chain management is a crucial process because an optimized supply chain results in lower costs and a faster production cycle which helps companies to remain competitive in the business landscape. Some of the important areas that requires attention in supply chains include flow optimization, coordination, risk management, sustainability, safety and security. The best supply chains aren't just fast and cost effective. They are also agile and adaptable, and they ensure that all their companies' interests are aligned [3, 4].

Supply chain management uses different approaches for efficient integration of its stakeholders like suppliers, manufacturers, warehouses, retailers such that the merchandise is manufactured and supplied to the right customer on time at correct location at correct time at minimal cost and optimal service level [2, 3]. According to Institute for supply management, the supply chain management is defined as "the design and management of seamless, value-added process across organizational boundaries to meet the real needs of the end customer. The development and integration of people and technological resources are critical to successful supply chain integration". Similarly, Supply Chain Council defines it as "Managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer". Council of Supply Chain Management Professionals defined it as "the planning and management of sourcing and procurement, conversion, and all logistics management activities".

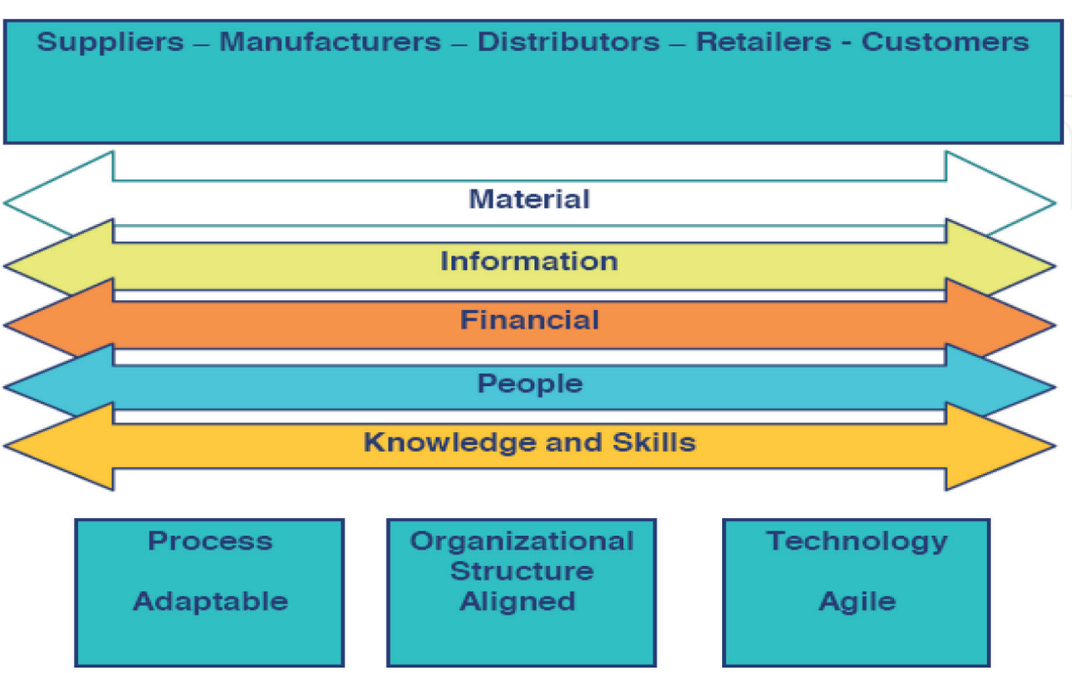

Figure 2.
Various flows in supply chain [3].

Also includes coordination with channel partners, which can be suppliers, intermediaries, third party service providers, and customers.

1.2 Supply chain building blocks

SCM is the management of a network of interconnected businesses involved in the provision of product and service packages required by the end customers. The network of interconnected businesses and comprises of three major building blocks Viz., structural, logical and informational [2, 3, 5, 6].

Structural Building Blocks include Suppliers, Manufacturing/Assembly Plants, Warehouses, Distribution Centers, Retailers/Customers, Logistics Network (inbound and outbound), Customers Orders etc. This can be visualized clearly from, **Figure 3**, a computer manufacturing company like IBM, HP, Dell etc. The relationship and their strength and number of entities drive the supply chain performance.

Logical building blocks of a supply chain include both horizontal and vertical functions of a supply chain and the same is shown in **Figure 4**. Logical building blocks include strategic, tactical and operational decisions cutting across various processes like procurement, production, sales and services. Integration of these building blocks across the supply chain network requires suitable organization structure and accountability. Both structural and logical building blocks are connected/integrated through informational building blocks.

Information building blocks focus on material requirement planning (MRP), enterprise resource planning (ERP), electronic data interchange (EDI), internet technologies, sensor networks, E-Commerce, E-Markets, E-CRM, Decision Support Software, standards etc.

1.3 Supply chain decision spectrum

Organizations involved in supply chains need to take several decisions are different levels and different processes. A typical decision spectrum is shown in **Figure 5** along with various decisions at different levels. Forecasting is one of the

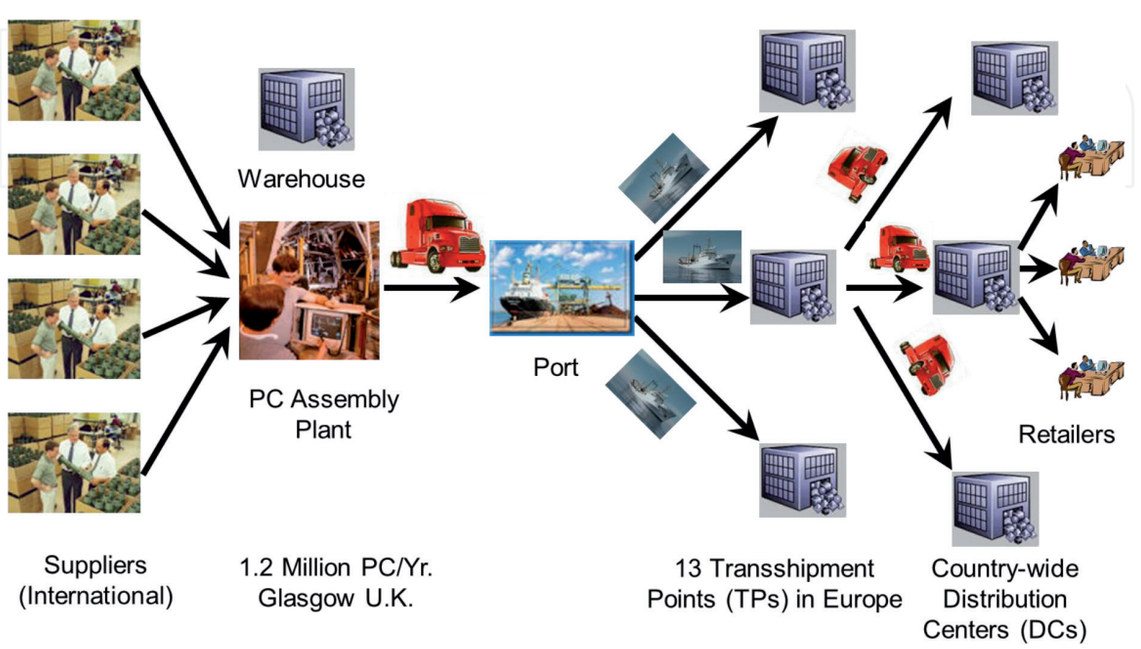

Figure 3.
Structural building blocks of a supply chain [2, 5].

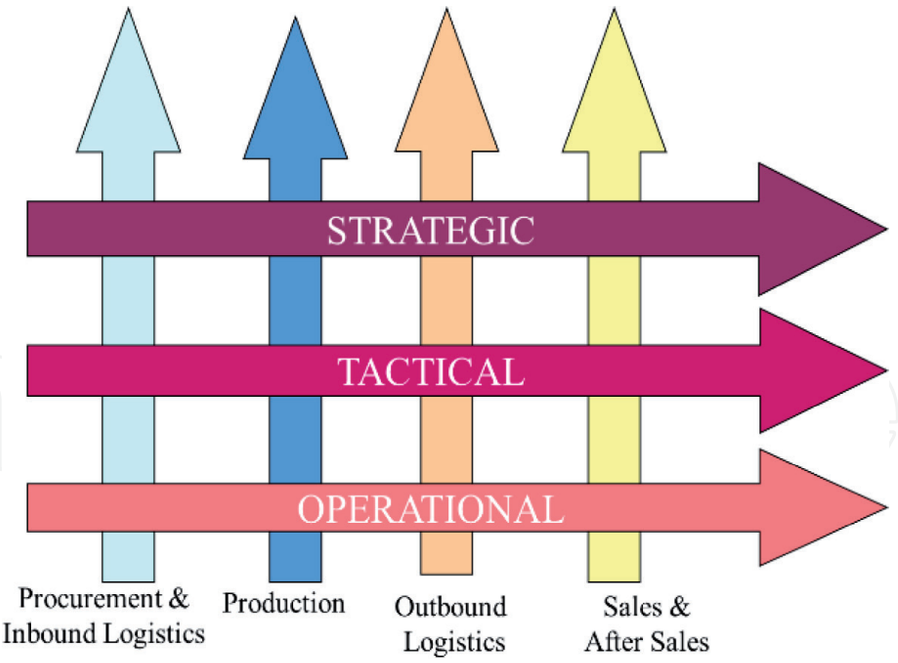

Figure 4.
Logical building blocks of a supply chain [5].

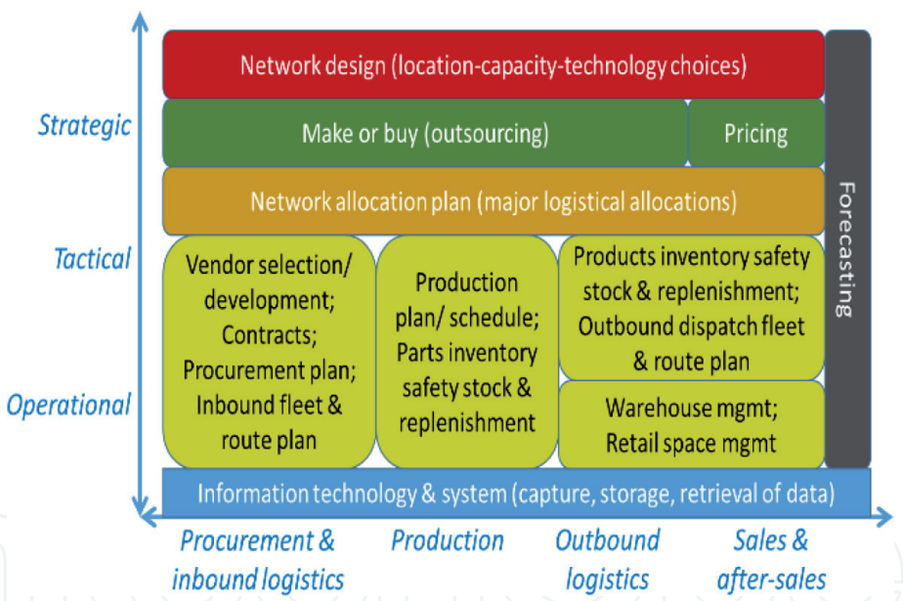

Figure 5.
Supply chain decision spectrum [5, 6].

critical inputs that affects the efficiency and responsiveness of the entire supply chain both in short term and long term.

Procurement & Inbound Logistics include two major components via., (i) managing procurements and (ii) manufacturing procurements. Managing procurement tasks comprise of control of inventory, development of quality standards, price negotiation, purchase of goods and services, financial purchases, aligning purchase to the company ethics and policies and disposal of waste. It also assists the organization to formulate strategies regarding criteria to choose suppliers for the company. The company can benefit from waste reduction and preservation of environmental assets, biodiversity and other finite assets. Manufacturing procurement efficiently manages the suppliers for the raw material with focus to obtain cheaper and quality raw materials.

Production Plan include safety stock and replenishment decisions and based on trends and market dynamics. If the production activities aren't planned properly there is high chance to face the issues such as shortage of stock and heavy inventory. During COVID-19 sudden lockdown was imposed across the globe which has hit the production lines badly because of unexpected gap between demand and supply for essential products.

Outbound Logistics include demand management and order fulfillment. It takes care of fulfillment of demand of goods and services of customers at right time and quantity with better responsiveness. Demand management helps in understanding important aspects of customer demand by better forecasting of requirements and enhanced visibility across the supply chain. It also assists in enhance customers' service, managing and improving inventory levels, enhance inventory planning and optimize promotion and trade planning, develop sales or demand forecasts. The main objectives of order fulfillment are to effectively help in faster order processing, faster order delivery to the customers' and frequent fulfillment of products. Network designing and process designing are two components of order fulfillment which assists an organization in meeting its order fulfillment goals while minimizing the delivery costs.

Order fulfillment also takes into consideration of networking strategies such as allocating inventories in the physical buildings, transportation strategies such as trying new processes and carriers and making changes in the distribution centers. Therefore, the order fulfillment considers cross-functionality of the organization which builds coordination among main suppliers and customers.

Sales & Post Sales service takes care of needs of the supply chain stakeholders like dealers wholesalers and retail outlets. Decent long-term relationships with the retailer and wholesalers, frequent inventory inspection/management and capturing customer feedback are key components to understanding the demand of the product in the market.

There are two major aspects to be considered in post-sales. They are Customer relationship management (CRM), customer service management (CSM). CRM helps in understanding how to provide tailor-made products and services to meet the needs and demands of a customer. CRM through supply chain network and through the delivery of products builds competitive edge of a company against their competitors. The main responsibility of a customer service management lies in refining the relationship with the customers. Customer service management in the SCM building blocks effectively focus on managing customer service on the basis of customer's preferences, tastes, and perceptions to deliver best of products and services.

1.4 Principles of supply chain management

Making rational decisions in the context of supply chain management is a complex one. To help managers decide how to proceed, [7] have suggested the following seven principles which were based on the stories of successful organizations in business. These principles include the following [7]:

1. Customer segmentation based on their needs

2. Logistics network customization

3. Observe market demand and plan accordingly

4. Postponement or delayed differentiation of product closer to the customer demand

5. Strategic sourcing

6. Use of SC wide technology strategy

7. Use of channel wide performance measures

Principle 1: Adapt supply chain serve customers based on their needs.
Principle 2: Use customized logistics network to serve requirements at lower cost based on segment.
Principle 3: Observe the market trends and plan to meet the demand across the supply chain consistently with suitable forecasts and optimal allocation of resources.
Principle 4: Use postponement or delayed differentiation in meeting the uncertain demand of the customer with better speed/response.
Principle 5: Use strategic alliances for sourcing of various raw materials/inputs at lower cost and better quality.
Principle 6: Use supply chain-wide technology strategy that supports multiple levels of decision making and gives a clear view of the flow of products, services, and information.
Principle 7: Use channel-spanning performance measures to measure success in fulfilling the end-user demand efficiently and effectively.
Many organizations around the work have benefited by using these principles and able to meet the customer demand effectively and profitably by strengthening their supply chains. Further, organizations have pursued various initiatives like integration of supply chain activities and these have resulted in improved asset utilization, reduced cost, and created competitive advantage on one hand and improved revenues on the other hand.

1.5 Performance measures of supply chains

Measuring supply chain performance is one of the most difficult tasks in business due to involvement of many stakeholders and different types of activities that they perform in different geographic locations and contexts. However, both industry practioners and researchers have evolved different performance measures which are based on cost, quality, delivery, efficiency, sustainability etc. Some of the mainly used performance measures include delivery performance to request, upside production flexibility/material availability, total supply chain costs, Cash-to-Cash Cycle Time, return on investment, inventory turns, fill rate, customer service level, revenue growth etc.

2. Methodology

In this study, we have adopted a generic method for literature search and industry practices in the area of supply chain management in different sectors, reports on economic development, global value chains, world trade and reports on COVID-19. Literature search has been carried out using key words like COVID-19, Supply Chain Management, economy recovery, world trade, global value chain, world GDP, healthcare from the databases like PubMed, Google Scholar, EBSCO, ENKI, ABI Info, etc. The search does not include other databases. Apart from these we have also used information regarding various stimulus packages and sectoral specific schemes for economic recovery in different countries. We have used the information from firms like McKinsey, The Economist, Gartner Inc., World economic forum, World

trade organization etc. The author's own research and consulting experience in the area of supply chain management and healthcare management. Apart from these we have also gathered the information from experts from different fields like policy makers, industry practitioners, consultants, medical physicians from healthcare sector at global level. We have excluded country specific details in the study.

3. Supply chain ecosystem and frameworks

Supply chains are in practice for a very long time in different forms facilitating the trade [5]. After world war II (WW-II), the importance of supply chains has increased significantly and from 1960s its influence has increased duo to developments in computers and information technology. Further, post 1990s due to advent of internet technologies and globalization of trade, the importance of supply chains has increased many fold and the GDP of the world has increased significantly [5, 6, 8] and the same is given in Section 3. Supply chain ecosystem and framework is brief described in the following sub sections.

3.1 Supply chain ecosystem

Figure 6 shows various stakeholders and their relationship in the context of supply chain ecosystem [9]. Supply chain ecosystem is a complex network connecting various stakeholders through suitable technology platforms and incentive systems. This include logistics service providers like third party, forth party logistics providers, reverse and returns, inbound and outbound. Transportation modes would include roadways, railways, airways and seaways. Other services like warehousing, courier and freight services and material handling. SC ecosystem would include platforms, software across different industry verticals like automobile, fast consumer goods, industrial goods, energy, health and other services.

SC platforms are very critical and include connectivity management, application management and data management. Connectivity management include WAN, Wi-Fi, Hotspot, Bluetooth, RFID etc. Due to increase in complexity of SC network, the importance of software has increased significantly and most of the activities

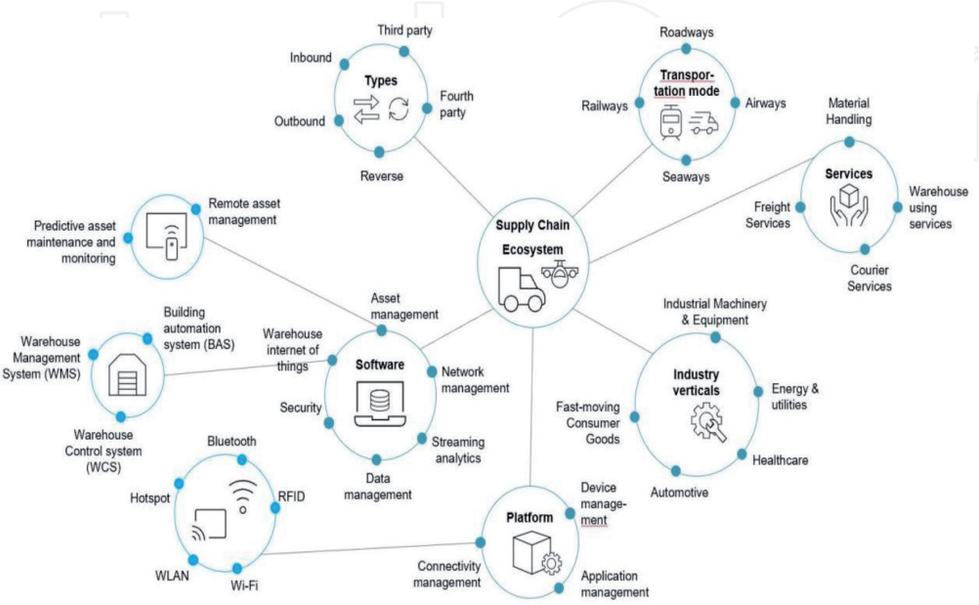

Figure 6.
Supply chain ecosystem [9].

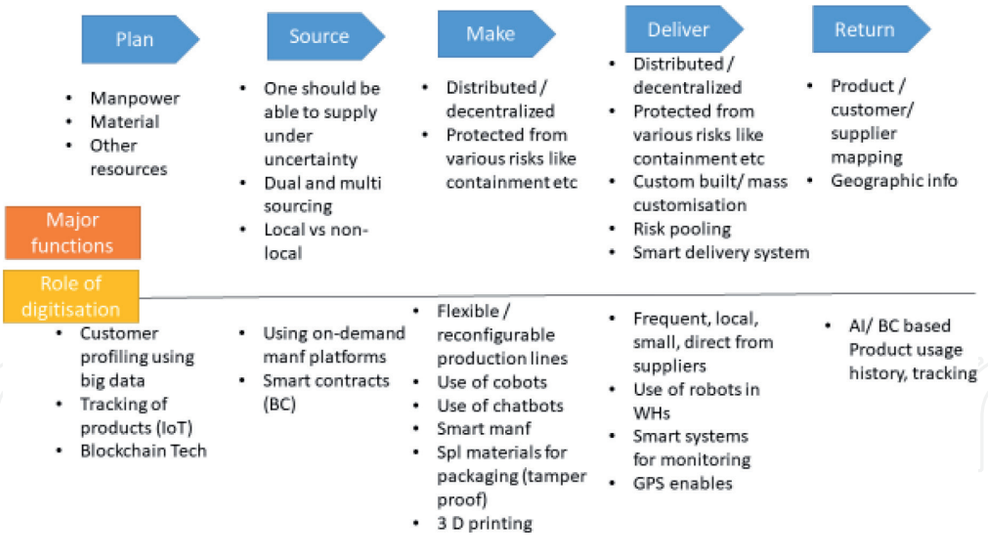

Figure 7.
SCOR model with traditional and digital focus [10].

are managed through software tools. Software management in the context of SC include network management, streaming, data management, security, internet of things, asset management, asset maintenance, warehouse management, building management, fleet management etc. Advances in information and communication technologies like GPS has further improved the performance and control of supply chain activities. Due to rich data and advances like Artificial Intelligence (AI), Machine learning (ML) are facilitating in more rational and timely decisions across the supply chain.

3.2 SCOR model

Supply Chain Operations Reference (SCOR) model is very widely used industry standard model developed by supply chain council in 1996 [10]. SCOR model follows a hierarchical structure and has three levels. Level 1 include five process types viz., plan, source, make, delivery and return. The elements of SCOR model is shown in **Figure 7** along with major functions and role of digitization at each stage of the supply chain. Level II include process categories which defines the configuration and level III include process activities in terms of inputs and outputs and performance measures. SCOR model employs five performance measures: reliability, responsiveness, flexibility, costs and asset management. In summary, the traditional SCOR Model has five processes, five performance measures and three levels describing SC comprehensively. Due to technological advancements in data capturing and analysis tools, the digitization across SC has attracted many stakeholders in improving the supply chain performance significantly. Digitization of supply chain functions at each stage is also shown in **Figure 7**. The most interesting and important element is handling of returns across various industry verticals. Returns in the supply chain have assumed significance due to electronic commerce industry. Of late, AI and Blockchain technologies are playing a critical role in managing the returns across various industry verticals by tracking the product usage history and other relevant information.

SCOR model covers the following activities:

- Covers all interactions of **customers** from order entry to final invoice/ payment.

- All transactions related to **product** (good or service) from supplier end to final customer, including product, spares, other equipment, software etc.

- All interactions of the **market** from demand aggregation to demand fulfillment for each customer/order.

SCOR model allows environmental measures like carbon emissions, air pollution, liquid and solid waste, percent recycled waste etc. SCOR model connects emissions to the processes at source and provide a structure for measuring environmental performance and improvement areas. The hierarchical nature SCOR model allows strategic environmental footprints to be translated to specific activities and targets.

3.3 Healthcare value chain capabilities model

Though the supply chains are widely used in manufacturing industry to start with, subsequently the supply chain concepts and practices have been applied in other sectors including healthcare industry, pharmaceutical, food and agriculture, ecommerce, humanitarian, disaster relief etc. Healthcare is changing at an unprecedented pace, due to the impacts of technology, cost pressures from both payers and patients who are seeking quality care. Healthcare organizations including providers, retailers, distributors and wholesalers, manufacturers. Some of the organization who have adopted supply chain practices include Johnson and Johnson, Cleveland Clinic, Mercy, CVS Health, McKesson, Novo Nordisk, Medtronic, Stryker, Roche, Pfizer, Owens and Minor etc. For example, Mayo Clinic has improved the care delivery and reduction in cost by collaborating with its suppliers and adopting digital technologies in its operations. **Figure 8** shows the framework suggested by Gartner in respect of healthcare organizations with a main objective of improving the human life at sustainable costs as well as quality. This model has five major processes viz., patient focus, collaboration, network visibility, cost to serve and change management supported by fundamental capabilities covering all the processes [11].

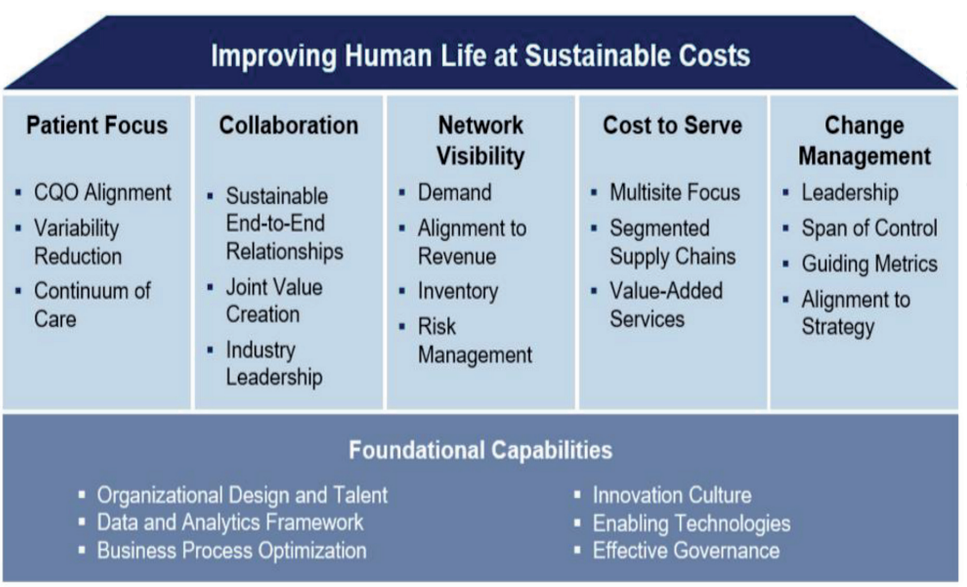

Figure 8.
Healthcare value chain capabilities model [11].

3.4 Sectoral specific supply chains

Due to inherent advantages and capabilities of supply chains, many organizations across different industry/business verticals have adopted supply chains and benefited immensely. Some of the major sectors include automobile, food and agriculture, e-commerce, healthcare including hospitals, pharmaceuticals, diagnostic services, medical devices etc., defense and government, energy and power, oil and gas etc. Supply chains of e-commerce, food and healthcare is briefly explained in this section.

3.5 Electronic commerce supply chains

Electronic commerce (e-commerce) supply chains have gained significant importance due to ability of supply chains in meeting the customer service and low cost. Many companies like Amazon, flipkart, Alibaba etc. have demonstrated the power of supply chain in their business operations. **Figure 9** shows typical supply chain network of e-commerce supply chains. **Figure 10** shows a macro view of supply chain management at Amazon [Amazon.com]. e-commerce supply chains are more robust compared to others mainly due to its ability to manage the disruptions during crisis like COVID-19. Particularly during COVID-19 crisis, Amazon, flipkart and other e-commerce companies were able to maintain the continuity of supply in spite restrictions like lockdowns, social/physical distance and limited time operations, shortage of manpower etc. These companies are able to recover fast due to its resilience and responsiveness capability. This can be seen from the latest trend in the share price of e-commerce and food supply chain companies.

3.5.1 Food supply chains

A typical food supply chain with food safety information system and quality assurance system is shown in **Figure 11** [14]. The food supply chain includes farm/

Figure 9.
E-commerce supply chain [12].

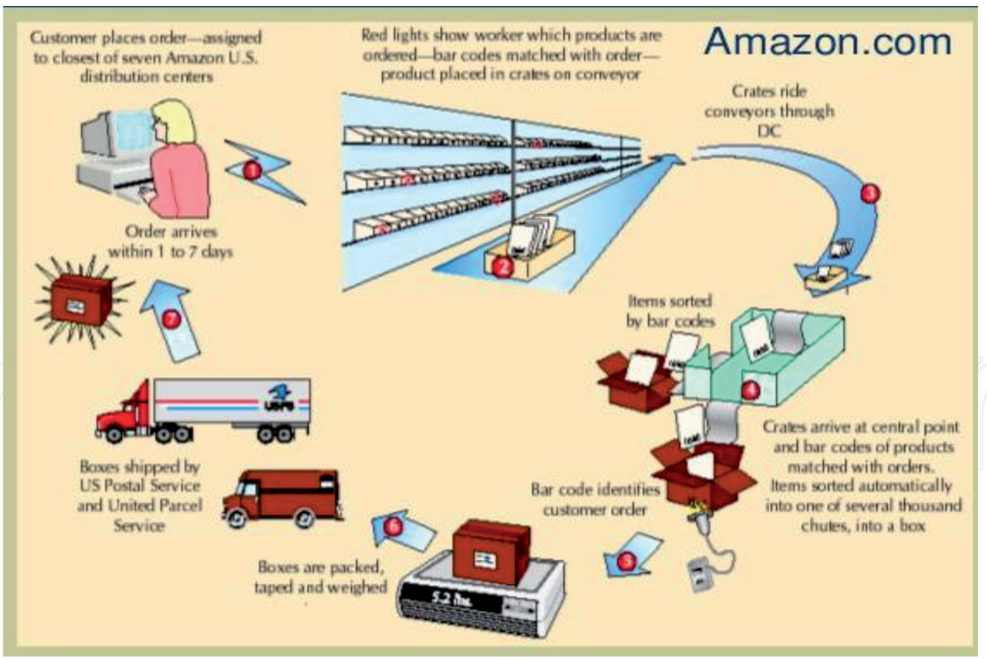

Figure 10.
Amazon supply chain [13].

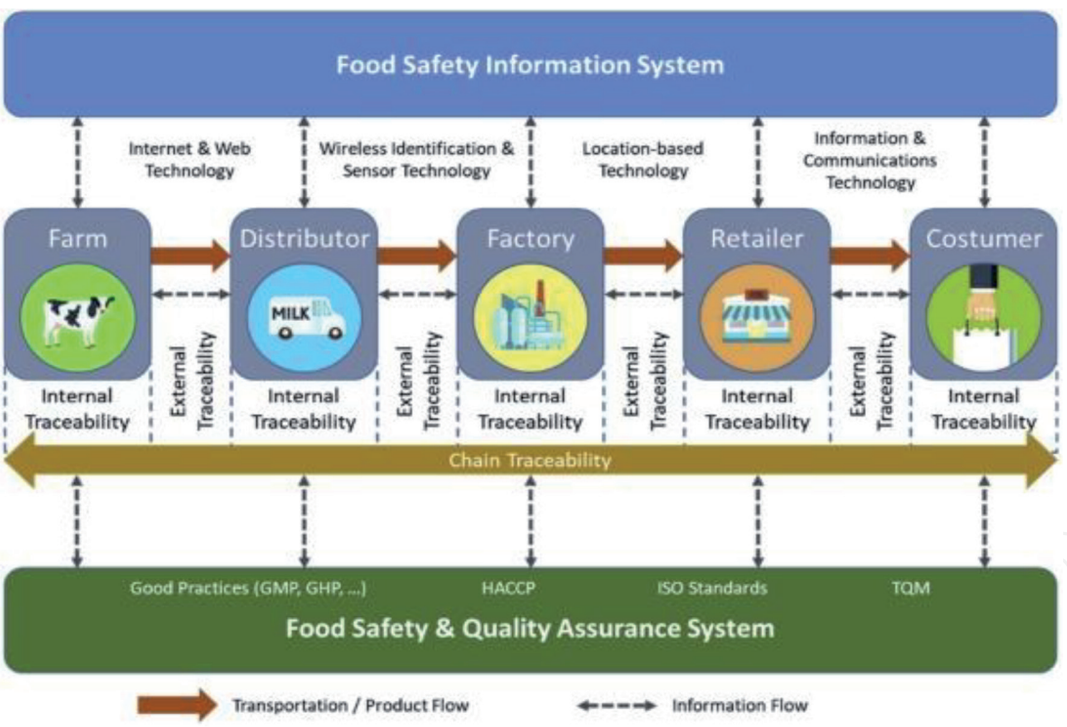

Figure 11.
Food supply chain [14].

farmer, distributor, factory, distributor/retailer and final customer. In case of food supply chains the most critical issue is food safety across the supply chain. These supply chains focus very heavily into food safety and traceability at each stage of the supply chain mainly at interfaces. Food supply chains uses information and communication technology widely. Quality and Compliance of standards across food supply chain is very critical and makes use of advanced technologies like RFID, temperature controls, GPS enabled systems for tracking and traceability. It follows standards like good manufacturing practices, ISO standards and TQM etc. [14].

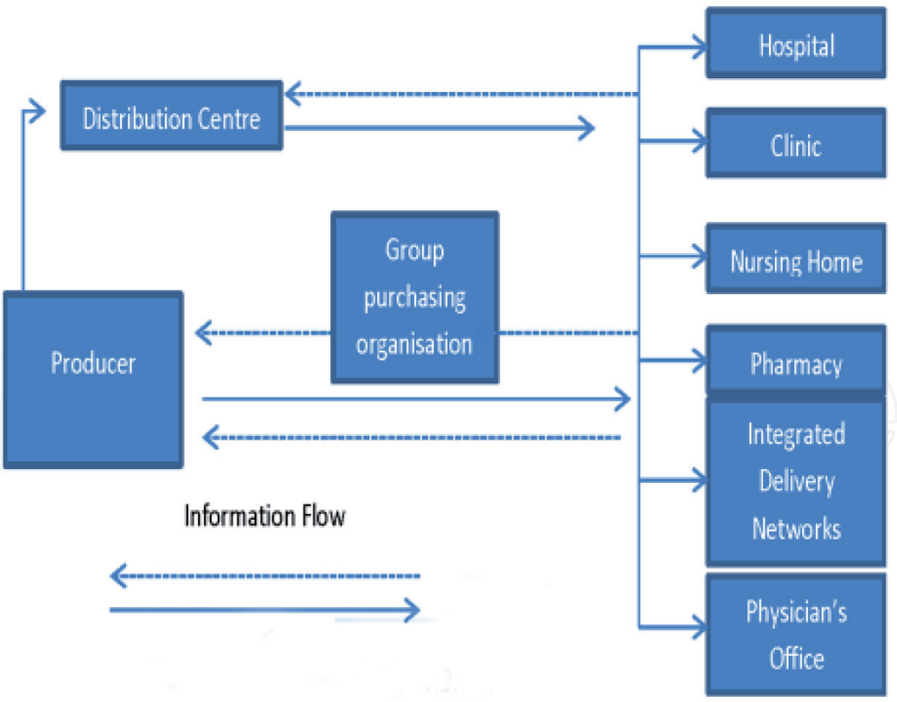

Figure 12.
Elements of healthcare supply chain [15].

3.5.2 Healthcare supply chains

Healthcare supply chains are more complex than other supply chains due to presence of many stakeholders and responsiveness requirements. A typical healthcare supply chain is shown in **Figure 12**. Healthcare supply chains poses several challenges due to stringent regulatory requirements, safety and security and quality requirements. In spite all these challenges, many healthcare organizations benefited by adopting supply chain management approaches. According to Gartner study [11] on top 25 healthcare supply chains, top 5 organizations include Johnson and Johnson, Cleveland Clinic, Mercy, CVS health and Duke University Health system. Many of these organizations are using best practices like collaboration, digitalization, robust processes that are aligned with the overall objective as well as the elements listed in healthcare value chain capabilities model. The major strengths of healthcare supply chains include agility, alignment, adaptability, resilience and responsiveness. These organizations follow people, process and technology solutions in the care delivery. Of late, many healthcare organizations particularly using AI and Blockchain technologies for personalized care in large scale. Telemedicine and home care is growing very fast due to COVID-19 crisis where supply chain is very critical. Some of the organizations are using drones for delivery of medicines, pathology samples, food and equipment. Many start-ups also emerging in healthcare by bridging the gap predominantly through digital technologies and supply chains.

3.6 Supply chain configurations (hub and spoke model, centralized vs decentralized SC)

Supply chain network structures and its configuration is very important in achieving the performance of supply chains. Predominantly used supply chain structures in the practice include centralized and decentralized [2] or Hub and spoke model. **Figure 13** shows typical structure of centralized and decentralized supply chains. Centralized systems are more efficient and are generally used for

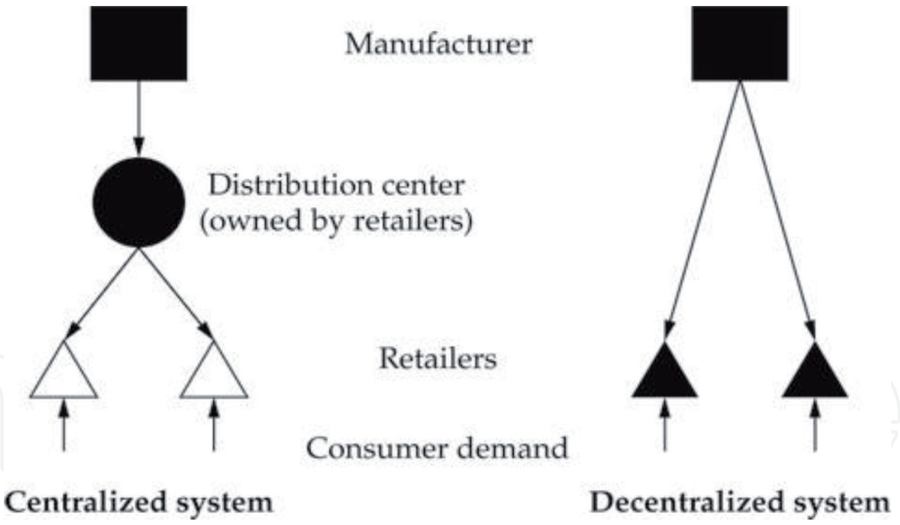

Figure 13.
Centralized and decentralized supply chain system [2].

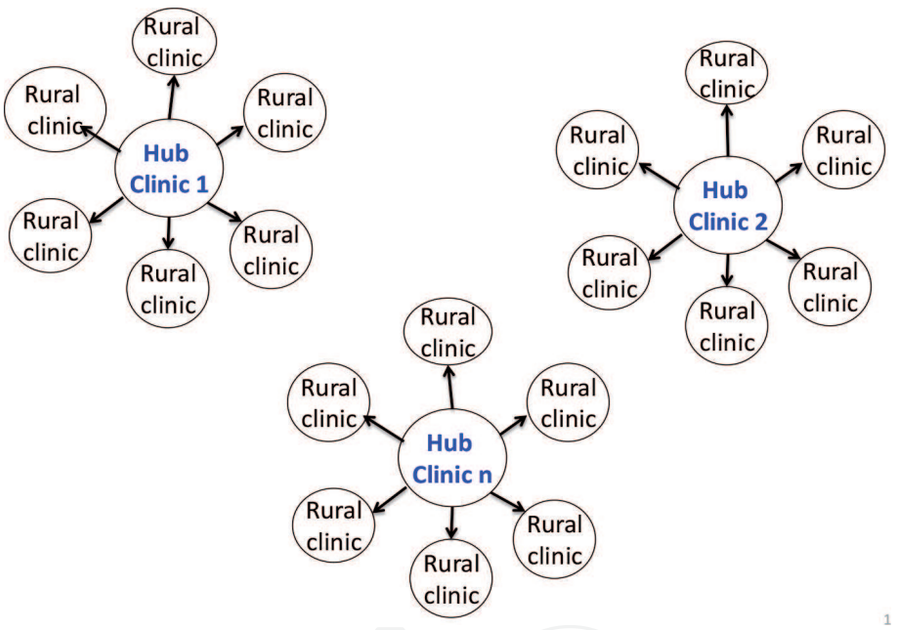

Figure 14.
Hub and spoke model of a healthcare start-up [16].

high volume low value commodities like steel, cement, automobiles, computers etc. where cost is important. Whereas decentralized systems are predominantly used in e-commerce, healthcare and other services where responsiveness is most important. Hub and spoke models are predominantly used is both product and service organizations. A typical hub and spoke model of a Start-up delivering health services in Rural areas in India is shown in **Figure 14**. Generally, the Hubs are equipped with more resources that can help serving the customers located spoke level. Typically, these share many resources and innovate through collaborative mechanism and employ multi skilled people and technology to improve the efficiency and reach.

4. Relation between economic development and global value chains

Supply chains have contributed significantly for the world trade for many years. Further, supply chains have facilitated the globalization of trade. **Figure 15**, shows

the world trade over last four decades [8]. There is a sensitive relationship between economic development and supply chain because efficient management of the supply chain can reduce costs, maximize customer value, and maximize competitive advantage. It entails effective coordination and control of linked sectors, departments, systems, and organizations. According to a study by world economic forum, reducing supply chain barriers could increase world GDP better over import tariffs. Further, the study shows that 50% reduction in supply chain barriers can increase world trade by 14.5% and world GDP by 4.7% and these gains are more evenly distributed across various countries and also it can generate more employment [17].

Global trade has increased owing to adoption of liberalization and globalization as national economic policies by several countries in post-Soviet era (post 1992). Global GDP has also expanded in tandem with global trade. An analysis of global merchandise trade and global GDP at market exchange rates with 2008 as base years shows coupled growth in global GDP and global trade as depicted in **Figure 16** [18]. Due to emergence of global value chains, the global trade is shifting fast. This can

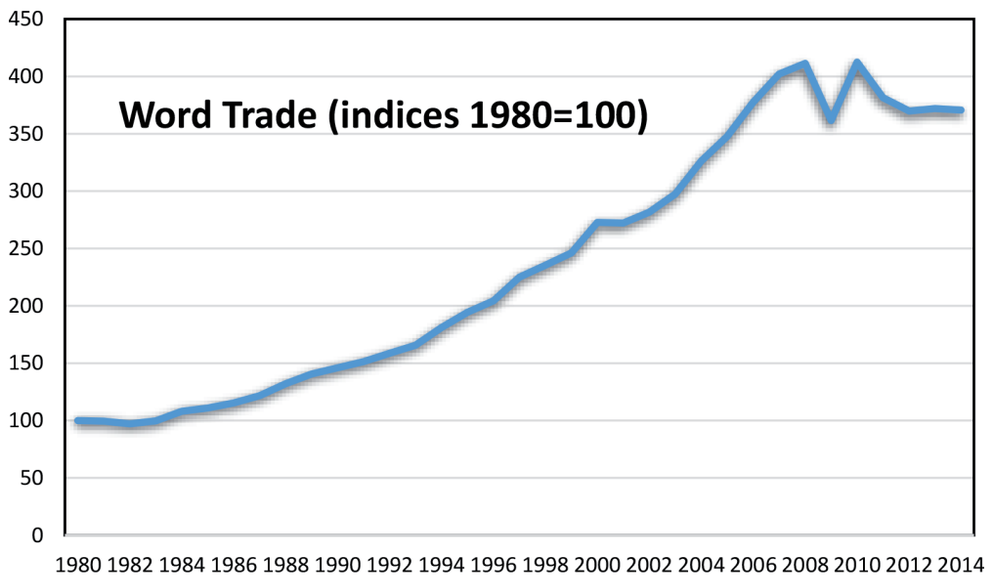

Figure 15.
World trade-exports [17].

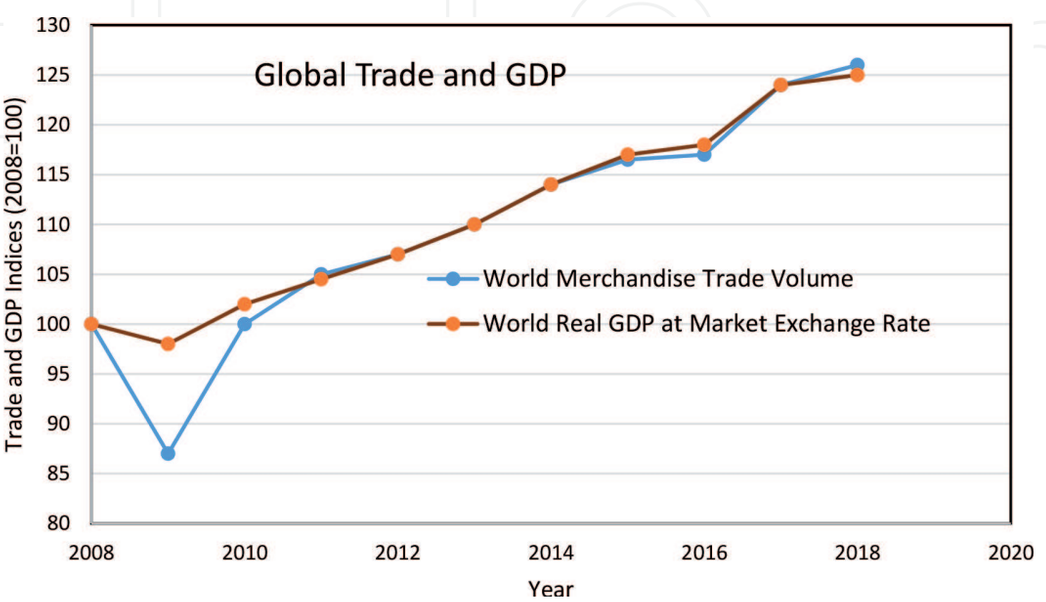

Figure 16.
Relation between global trade and GDP [8, 18].

be seen from **Figure 16**. Expansion of global GDP and its correlation with global trade increases the importance of worldwide network of production of goods. A study done by [8] suggests that contribution of intermediary goods in global trade of manufactured goods was more than that of finished goods during 2001–2008 and 2009–2014. This conclusion supports the existence of complex Global Value Chains (GVC) [19]. Furthermore, as per the available data, 57% of the global trade in 2015 was constituted by trade of intermediate goods [18]. OECD TiVA database shows that the Asian economies have the highest growth rates of contributions in GVCs [20].

Due to increasing network of global supplies, patterns in global trade have shifted from 'trade in goods' to 'trade in value added' and 'trade in tasks' [19]. The Global Value Chain (GVC) Framework has emerged due to shifting pattern of global trade. It focusses on expanding and strengthening supply chain and value generation therein. Both developing and developed economies get benefited by participation into GVC [8]. Participation into GVC provides an exposure to the global best practices, technological know-how, and competence development. These result in higher economic growth and development [21].

4.1 Supply chain and global value chain (GVC)

GVC framework provides a strategic overview of global supply chain and integration of different characteristics of complex supply networks into GVC would provide a holistic perspective of various methodologies- operational and strategic [17]. Development of robust supply chain management practices have strengthened GVCs thereby easing cross-border movement of goods. It promotes domestic manufacturing and consumption. These in-turn result in growth of national GDPs. Therefore, to boost global economic growth promotion of global trade is essential. Sustenance of rapid growth in global trade is a function of participation of various countries into GVC which requires a robust supply chain management. From this analysis, it can be concluded that, development in supply-chain practices have contributed substantially to global economic growth.

World class organizations like Walmart, Apple, P & G, Amazon, IBM, Toyota, General Motors, Best Buy, Marks & Spencer's, Zara, Sports goods companies, mobile companies, food chains have gained significantly by adopting supply chain practices in their business. Similarly, healthcare organizations like CVS Pharma, Cleveland clinic, Narayana Health of India, pharmaceutical companies, medical device and equipment companies and many others have gained significantly.

5. Impact of COVID-19 on supply chains

In 2019 the United States imported a staggering four $52 Billions of goods from China. COVID-19 crisis has created historical disruption to global supply chains. COVID-19 crisis has affected health of people, business and overall economy at global level. COVID-19 crisis is a wake-up call for supply chains and one way it created de-globalization of business and supply chains. Over dependence on one country like China had proved to be very disrupted at times of pandemic. Bloomberg reported in March 2020 that electronic makers are past the point of no return in the gradual migration from China. Further, the Chinese trade (both domestic and international) transactions dropped by around 56% in the mid- February 2020. Similarly, US, UK and Europe also gone through a drop of 26% in April 2020 and touched 17% in late April 2020. Sourcing from India it is recommended an

incremental approach in bringing all Indian suppliers i.e., carefully select some low-risk and high reward programs to try out in India while maintaining Chinese base.

Due to COVID-19 crisis companies have fallen into one of two categories those that do not do anything hoping such a deception will not ever happen again those firms that heed the lessons of this crisis and make investments in mapping their supply networks so that they do not operate blind when the next crisis strikes, these are the ultimate winners. Some of the major challenges faced by supply chains due to COVID-19 include the following [22, 23]:

- Lack of visibility due to higher levels of SC network complexity
- High uncertainty on both supply and demand end
- Limited production flexibility
- Limited financial flexibility

In several countries consumer surveys show a likelihood of greater spending on groceries and less spending on discretionary categories. According to McKinsey study on marketing and sales survey conducted in Italy, Spain, UK and US during March, 2020 reveals that except groceries (grown around 18%) other sectors like quick service restaurants, restaurants, footwear, apparel, jewelry, accessories, furnishing and appliances have recorded negative growth ranging from 50–85%. Among all sectors, restaurants are the worst affected.

Another important incident of 2011 Tsunami in Japan can also help the business organizations around the world to learn important lessons. After the 2011 earthquake and tsunami had devastated north-east in Japan it led to the application of a new methodology that was developed that enables a sophisticated way to understand the exposure to risk associated with unlikely events such as COVID-19 pandemic. The ability of the supply chain to recover from the disaster should be considered by the supplier as a performance factor of the supply chains.

6. Economy recovery sectors and strategies

6.1 Recovery framework

McKinsey [22] has suggested the following three step framework for rapid recovery:

1. **Identify and prioritize actions** based on clear understanding and demand patterns of activities that can capture revenues quickly (B2B and B2C- multiple SCs) and opportunities need to be continuously updated

2. **Act with urgency** judicious allocation of resources to the activities prioritized to capture the growth. Engage new partners and new channels (online and offline), reallocation of resources to safe places quickly and reconfiguring the SC, shifting the promotional sales etc.

3. **Develop a rapid-fire agile operating model** - speed of decision making and agile teams (market insights, cash liberation, growth, digital market and post Covid-19 growth)

6.2 Recovery sectors

According to some of the major studies by McKinsey, Economist and others [22–24], the early starters of economy include health care including pharmaceuticals, medtech, diagnostics, hospital and home care services, telehealth/telemedicine, essential items, food and agriculture, FMCG, 3D printing, internet of things (IoT), AI/ML, robotics, smart systems, e-commerce industry. COVID-19 has put the medtech industry at center stage with unparalleled demand for diagnostic test PPE, ventilators, and critical medical supplies. McKinsey [22, 23] has built a detailed model of COVID-19 impact on medical procedures mainly for the United States on the Europe which is used to create a model for predicting the potential impact on medical device sales in consumables and implants. The models consider two broad scenarios for COVID-19 case growth V shape recovery and W shape recovery. In V shape recovery, it is estimated that the material procedures decline by around 70% in the second quarter and up to 45% in third quarter when compared to 2019. It is expected to see a rapid ramp up for the next three forth to catch up on delayed elective procedures. Whereas in W shaped recovery, procedures would decline by 69% and 45% in the second and third quarters respectively.

Telehealth potential has been realized after the COVID-19 crisis and telehealth consumer adoption has increased from 11% in 2019 to 76% in 2020 in US along. Approximately $250 billion or about 20% of all Medicare Medicaid and commercial OP office and home health spend could potentially be virtualized with the help of telehealth. Similar trend has been observed in many countries worldwide.

6.3 Recovery strategies and actions

It will not be that easy for many organizations to have a detailed analytical understanding of demand variability at local and national level. However, *stress testing* of supply chains with different scenarios with viable product demand and procedures will be very critical for managing the current scenario. Some of the methods suggested to overcome the impact on supply chains [22, 23, 25] includes the following:

Develop a high-risk supply chain disruption-monitoring and response program for countries impacted by the virus and the potential supply chain exposure from Tier 1 and below.

Assign high-risk weighting to suppliers and sub-tiers from emerging and developing countries with less developed healthcare systems that are less prepared.

Conduct a contract review to understand any financial implications of not being able to deliver supplies to manufacturing locations and customers.

Special attention for balancing of supply and demand, building suitable safety stocks are essential for business continuity, particularly with the unpredictable volatility of supply chain functions.

Identify various opportunities at supply side and diversify suppliers to ensure manufacturing capacity and raw material availability.

Establish a robust risk management models to monitor and prepare for shortages in material, manufacturing capacity and work closely with supply chain stakeholders particularly with critical suppliers.

Implement and utilize enhanced risk management, including scenario planning to create preemptive action plans.

Review the New Product Introduction process and utilize design measures to discover or develop alternative sources and routes in order to diversify your value chains. At the same time, analyze cascading implications of changes in volumes, quality and markets.

The most common approach is to use the bill of materials and focus on key components.

Some of the major actions suggested by McKinsey for economy recovery [23] is given below.

- **Strategy:** Reposition the bran, Mergers and Acquisitions, Networked Ecosystems, create a new demand planning system.

- **Productivity:** Take initiatives such as Marketing, improving sales productivity, Inside sales, data analytics for performance management.

- **Digital channels:** Use scaled digital sales & services, E-commerce, Digital marketing etc.

- **Customer experience & insights:** This can include, customer experience, Personalization, improved CRM, creating value proposition through suitable products, Analytics-driven sales and distribution, revenue pricing and promotion optimization.

Some of the actions suggested for recovery of medtech industry [22] include the following.

Accelerate capacity of equipment like PPE, Ventilators, other surgical items etc. that is essential to save the lives of critical COVID-19 patients.

Maintain capacity of equipment used in COVID-19 treatment or that requires replacement such as CT machine dialysis equipment or ECMO machines etc.

D*eprioritisation* of equipment not useful in COVID-19 treatment such as MRI surgical and mammography equipment and etc.

Supply chain management and reliability: More than 90% of global annual medical device exports come from countries that are now in some form of quarantine. There for Medtech company should consider activating supply contingency plans repositioning inventory to areas of greatest need and making all reasonable attempts to protect the health and safety of workers on the manufacturing floor.

Preserving cash: according to the McKinsey benchmarking analysis the potential for a rapid 3–5% increase in cash flow could be shown additional changes to production like just-in-time inventory pooling and rationalization, and standardization can free up more cash. These initiatives should be rigorously tracked in conjunction with appropriate cash controls and customer considerations.

Resource relocation and portfolio strategy: Now is the time to establish processes that can anticipate market demand and shift staffing as needed to quickly accommodate changes this would require increased investment in cross training the employees as well as new processes to rapidly scale up support services.

The company is required to fundamentally rethink the supply chain network and key suppliers as they were already facing pressure to localize in certain markets, after the crisis it will continue to be important for the companies to consider how to balance these pressures that can impact local supplies with potential desires for greater flexibility in capacity. These adaptations could include building more agile organizations, speeding time to market and aspiring to "absolute benchmarks" for product design and development and manufacturing efficiency.

Some of the lessons learned from fast food service organizations like KFC, McDonald etc. include the following which are based on digitalization:

- **Co-creation:** use of user generated content with apps like radio KFC, RJ hunt and design your own bucket challenge.

- **Unique Experience:** the simple equation is (cutting edge technology + ingenious ideas = unique experiences) Example, interactive campaigns.

- **Feedback fanatics**- the secret to a great relationship is listening KFC ensure that every feedback was listen to and addressed.

Strengthening healthcare's supply Chain.

These are the five specific capabilities that can have a dramatic impact on performance of the healthcare supply chain [26]:

1. Better segmentation of products, markets and customers.

2. Greater agility to reduce cost and increase flexibility.

3. Measurement and benchmarking.

4. Alignment with global standards.

5. Collaboration across the healthcare value chain.

How to address the shortage and improve the safety?

Supply chain issues create opportunities for counterfeiters and gray market vendors threatening patient safety and cutting into revenues of legitimate companies. Supply chain security breaches are increasing by an average of 33% every year not only in the emerging markets such as China, India & Brazil but also in the developed world. Better supply chain processes are central to increasing patient safety. Therefore, it is recommended that adopting a common global data standard and upgraded grading supply chain processes could/counterfeiting in half returning up to $15 Billion to $30 Billion in revenue to legitimate companies to reinvest in further improvements to patient care.

Building a new healthcare supply Chain

Organizations can learn from the experience of laptop manufacturer in Indian who can accept an order and deliver a customized computers to a European customer in almost a week. Other organizations like pharmaceutical and medical equipment companies can adopt two broad approaches based on internal factors and external factors. Internal factors include – segmentation, agility, measurement while the external factors include- alignment & collaboration [27].

Segmentation: Companies such as pharmaceutical and medical device generally follow one size fits all type of supply chains which are proved to be disastrous particularly during pandemic times. Best companies address these problems by segmenting the supply chains according to the nature of product and customers demand and preferences by developing suitable forecasting, production and distribution strategies for each category.

Agility: This refers to building and operating supply chains that can better respond to demand shifts due to occurrence of unexpected disruptions in the business. The approaches include cross functional process, understanding of demand and supply scenarios and circumstances, effective communication and transparency across the supply chain.

Measurement: Generally, FMCG companies use data driven metrics such as manufacturing index for producing appropriate quantity of stock keeping units (SKUs) across countries and plants. Organizations also uses commercially available benchmarking tools and approaches for guidance and identification of opportunities along with supply chains.

Alignment: Refers to building of a cost effective supply chain that could align around global standards that support data interchange processes and capabilities to reduce the errors etc.

Collaboration: Many successful organizations collaborate in areas where they have a strength and share the benefits. Collaboration focus on (i) *Selection of partners for the potential value of the collaboration; (ii) capabilities and willingness to act as a team; (iii) dedicate resources to collaboration and involve senior leadership in it; (iv) jointly manage performance and measure impact; (v) start out with a long-term perspective.*

According to [25], the supply chains needs a stress test in terms of time to recover (TTR) and time to survive (TTS). TTR is the time it takes for a particular player/stakeholder (supplier, manufacturer, distributor, retailer etc.) in the supply chain to restore full functionality after disruption. TTS is the maximum duration that supply chain can match supply with demand after facility disruption. TTS also estimate each measure under different scenarios of business and Identify its ability to recover from the disaster. Organizations need to have a backup plan when TTR of a stakeholder or facility is greater than its TTS. This helps the organization in quantifying the cost of disruptions and prepare mitigation plans for the most critical parts of the supply chain [25].

At macro level, the economic recovery requires actions such as government stimulus, digitalization, advance technologies like 3D printing, up-skilling/multiskilling of workforce, restructuring of supply chains with better resilience and response, collaboration/alliances, facilitating innovation by start-ups, strengthening research collaboration between government, industry and academia is also very critical for faster recovery.

7. Conclusions

There is a strong relationship between world trade, GDP and supply chain investments around the world during last more than two centuries starting from 1800. As globalization has increased, the world's supply chains have become substantially more interconnected. Moreover, as emerging market economies have steadily come to account for a greater proportion of global GDP, goods often have more stages to pass through before reaching the end consumer.

During last seven decades (starting from 1960s) the economic growth of the world is very significant and also seen many disruptions like Tsunamis, 911 Terrorist attacks, pandemics like COVID-19. Among all the COVID-19 crisis is more significant in terms of health and economy. COVID-19 has led to nearly 5% negative growth of world economy. From national lockdowns to closed airspace and borders, Covid-19 has resulted in unprecedented disruption to the mechanics of most economies, regardless of their size or stage of development. In particular, the erection of these barriers has placed a major strain on the world's supply chains, including essential linkages relating to food and medicines. COVID-19 also created tension between major economies of the world and disrupted global supply chains significantly. Supply chain leaders face pressure to rethink traditional distribution and supplier models. For example, Amazon looks to strengthen its healthcare influence through the expansion of services in the medical supply chain, industry stakeholders are reconsidering traditional hospital-supplier relationships. Data, analytics and technology are playing an increasingly important role in supply chain strategy. A 2018 Global Healthcare Exchange survey [28] showed roughly 60 percent of respondents indicated data and analytics were the highest priority areas for improvement. These changes and trends have pushed the role of supply chain

management into new territory. Now, supply chain leaders are positioned to help lead their organizations to higher levels of customer service with more efficient models [29, 30]. To ensure success amid this changing environment, business leaders including healthcare organizations should place an emphasis on technology, business practices and customer service.

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