# The Supply Chain Management Revolution

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*Abstract* – **Supply Chain Management has gained increasing attention in the research domain. The concept of (SCM) Supply Chain Management is complicated to interpret. The reason being, it includes numerous component flows, participants, role-players, as well as functions. Literature about SCM is spread across many functions, which differs in its scope, also it is many-a-times found to restrict to some components of supply chain management. The focus shift towards customer requirements has led to various advancements in this field. IT advances such as Big Data, Blockchain technology and IoT are revolutionizing the field of SCM. This makes it necessary to study these advances in detail. Hence this paper provides an in-depth overview of the current technological advances in SCM, further we also analyse the most influential work in this field by presenting a bibliographical analysis of the latest research papers. The paper also aims to present a literature review based on supply chain management in terms of its definitions, framework, challenges prevalent in the current industry and the development of advances in these domains.**

*Keywords: Supply Chain Management, Literature Review, Advances, Challenges, Big Data.*

## 1. INTRODUCTION

As global competition intensifies, supply chain management becomes increasingly important and requires serious research attention. Enterprises continue to face the challenge of finding ways to meet growing customer expectations with achievable costs and time. To achieve this goal, companies search / discover uncompetitive parts of their supply chain process, analyse all unmet customers, set improvement goals, and make all necessary improvements. You need to do it quickly and adapt to evolving technologies. Global market. Earlier manufacturers were the drivers of the supply chain process, managing the pace of production, distribution, networking with suppliers and finally delivering the product to customers. But now, customers are calling the shots, and manufacturers are scrambling to meet the demands and requirements of customers of variety, features, technological advances, cost, faster deliveries. In practice, supply-chain based organizations have used various tools for performance management, to support their supply chain goals and strategies. A complex performance management system includes many management processes, like identifying measures, defining targets, planning, communication, monitoring, reporting and feedback. Supply Chain Management (SCM) has varied aspects, with influences from logistics and transportation, operations management and materials and distribution management, marketing, also as purchasing and information technology (IT). This paper focuses on obtaining a simple overview of Supply Chain Management, which could be used to gain a proper understanding of the field. The study explains SCM with the help of challenges, advances in SCM such as big data, IoT, Blockchain technology etc. as well as a bibliographical review on the prominent advances in SCM along with the future scopes of SCM.

## 2. CONCEPT OF SUPPLY CHAIN MANAGEMENT

A Supply Chain incorporates all activities that are concerned with the streamlined flow of products, services etc. This is from the beginning (raw materials) to the end (finished product). It integrates various role-playing entities who, during the life cycle of the product, influence the product greatly. They include suppliers, manufacturers, distributors and consumers. SCM involves all the processes, functions, and events that are immersed in the making, sourcing, as well as distributing of the final produces/services to the consumers. Supply chains can greatly vary in length, size, and complexity level. Some facilities or organizations are most probable to have a concise Supply chain that may consist of only one, i.e. a single supplier whilst some facilities or companies might have more complex and extended Supply chains including smaller chains of suppliers through which resources are supplied. Supply Chains and Supply Chain Management are concepts that are interconnected. SCM is the administration of various supply chains.

The objective of Supply Chain Management is in the direction to enhance quality, efficiency, and buyer satisfaction. The concern of companies in supply chain management has increased steadily since the 1980s, precisely the time when they started realising the need to cut down on cost and time and adapt to changing customer requirements with agility. This led to the integration and alignment of companies with suppliers and distributors. According to Rising in globalisation, information technology promoted the growth of SCM. The initial focus was to enhance the efficiency of the central elements of a companies' SC, but with an increase in technology, the focus was expanded to improve the efficiency of the entire Sc including suppliers, manufacturers, distributors.
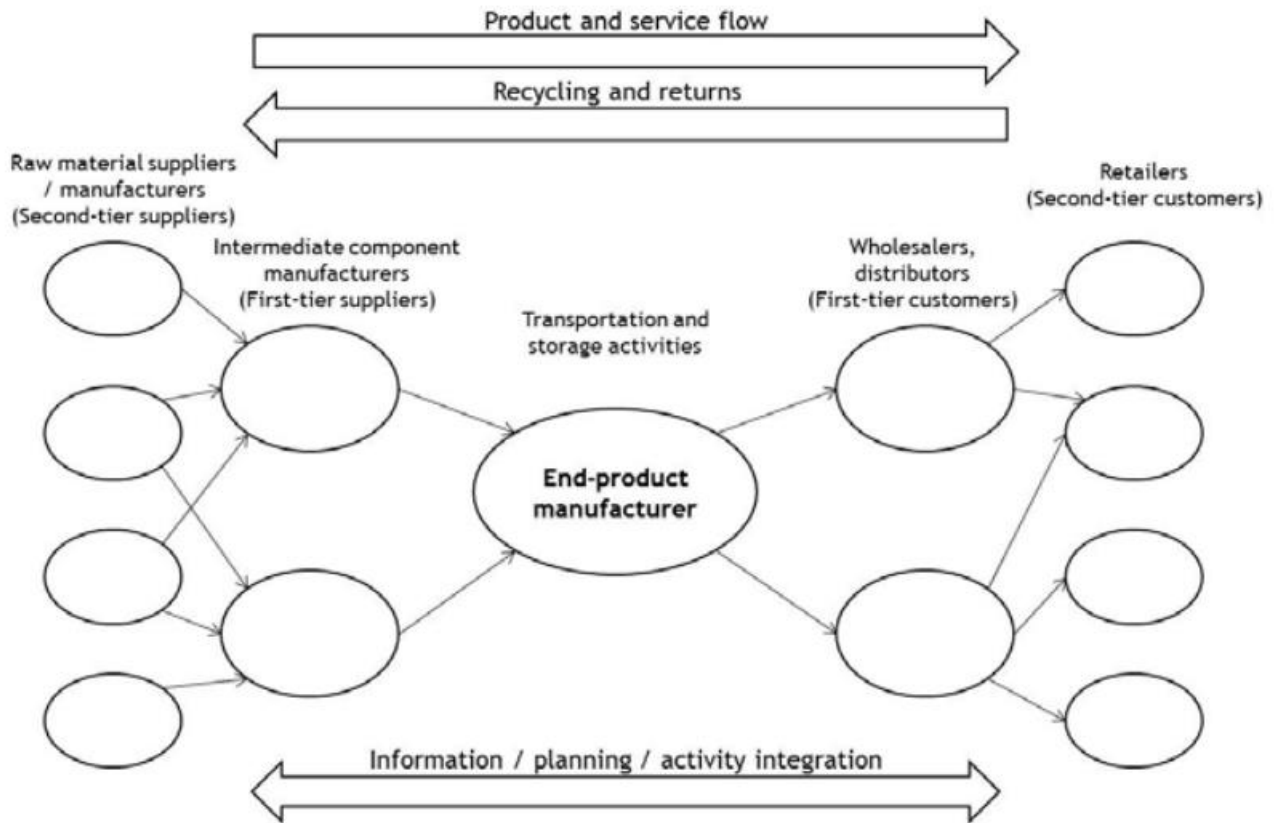
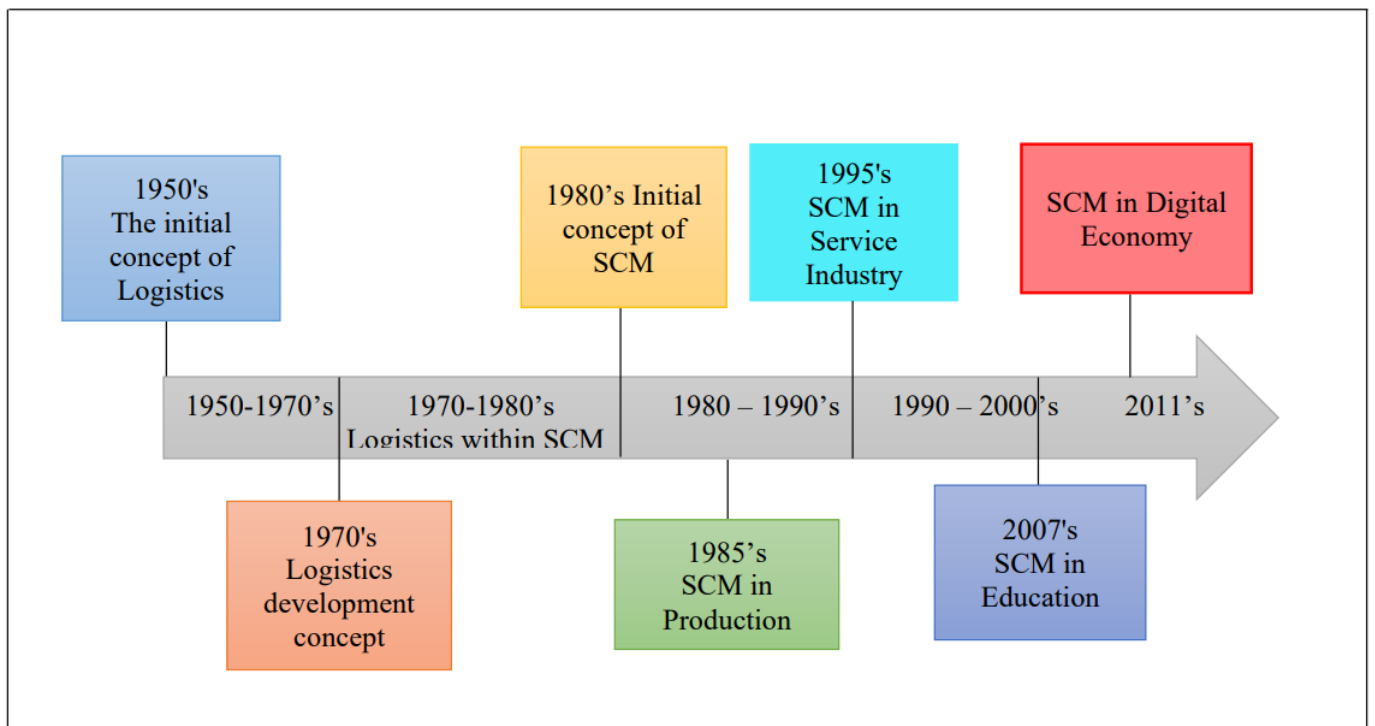Fig.1. Generic Supply Chain adapted from Wisner [10]



Fig.2. Evolution of SCM [12]

## 3. A BIBLIOGRAPHIC INTERPRETATION OF SUPPLY CHAIN MANAGEMENT.

Modern science offers many different definitions of supply chain management. The definitions of SCM have many different versions but communicate similar fundamental concepts.

Table 1 -SCM Definitions [12]

| Author | Definition |
| --- | --- |
| Harjeet et al. (2016) | SCM is simply the management of goods flow, transportation and services. Supply chain management includes shelf life, storage, analysis of purchased products, and logistics of product sales. It helps you plan and carry out many of your organization's supply chain activities to establish the net value of your organization. SCM determines current market trends regarding supply and demand for goods or services and synchronizes them to assess an organization's performance. |
| Desai et al. (2016) | This paper defines Supply chain management as the integration of key business processes from end-users to original suppliers, that provide services, products and information which add value to stakeholders and customers. |
| Dias et al. (2017) | The author has the task of integrating supply chain management along the supply chain, coordinating the flow of information, materials and funds to make the supply chain more competitive and organizing units to meet the overall needs of customers. It is defined. |
| Wibowo et al. (2017) | The business process from end-user through original suppliers that provides information, services and products and also adds value for the customer and other stakeholders is defined as supply chain management. |
| Kain et al. (2018) | SCM can be defined as a system of people, organizations, activities, information and resources involved in moving products and services from supplier to customer. |
| Oelze et al. (2018) | Supply chain management combines business processes from end-users to original suppliers that provide services, products and information and also add value for customers. It has become the major source of competitive advantage for various organizations. |
| Martins et al. (2019) | The process of implementing, planning, and controlling operations of the supply chain to satisfy customer requirements as fast and efficiently as possible. It spans all movement and storage of, work-in-process inventory, raw materials, and finished goods from the point of origin to the point of consumption. |

## 4. SUPPLY CHAIN MANAGEMENT FRAMEWORK

A framework was suggested by D. du Toit et al, which is used to understand Supply chain management. Figure 3 shows the framework for the concept of SCM. This framework puts forth an overview of the various components within SCM and the interaction between these components. The main components of the proposed framework are organizational strategy, supply chain policies / guidelines, supply chain contributors, supply chain lifecycle activities, supply chain support capabilities, performance measurement, continuous improvement, and supply chain facilitators. Interactions between these components are shown by the position of the objects and the flow between them, indicated by arrows. The SCM framework shown in Figure 3 starts with the organizational strategy and then flows into the supply chain strategy, because it is essential to align the SC strategy with the organizational strategy. Because strategy is put into action through a management plan, SCM is the next object in the framework. Supply Chain strategy shows, exactly how an organisation must be designed and controlled, on the other hand SCM pinpoints specifically on the interaction between varied supply chain procedures. In this framework, SCM plans connect SC strategies to the various components of Supply Chain such as participants, LC activities, support functions. SCM is further divided into three main components: SC participants, SC life-cycle activities, and SC support functions. Participants are units or entities that perform a part or are involved in a particular Supply Chain. Life cycle (LC) activities are the basic activities, which are involved in a Supply Chain, running throughout the LC of the product. Functions that are performed throughout the different stages of the life cycle of a product, and are utilised to support and control the SC are known as Support functions. SC participants are linked to SCM plans and are involved in the life cycle activities. There is a many-to-many interaction between SC life-cycle activities and support functions. A crucial part of this proposed framework is the Performance measurement which acts as a feedback loop into continuous improvement, affecting Supply Chain strategy and management. SC enablers that act across participants, activities and functions affect different components within SCM. As per the projected framework, the life-cycle activities, support functions, the participants, and performance measurement are all greatly influenced by certain elements that help in enabling their performance, which are known as 'Supply Chain enablers'.
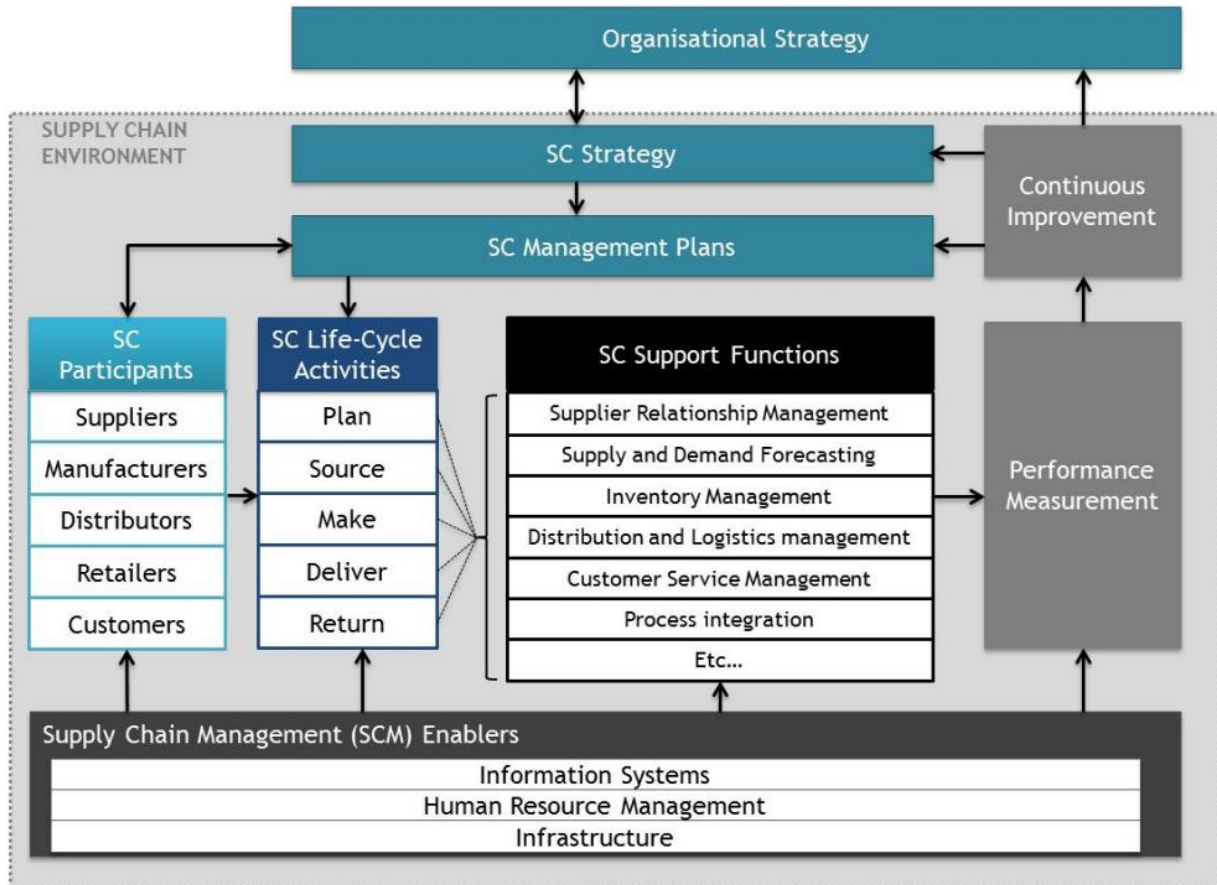
Fig.3. Proposed SCM Framework by D. du Toit et al. [11]

## 5. CHALLENGES IN SUPPLY CHAIN MANAGEMENT.

Modern Supply Chains predominantly, bring about various issues in different stages of the journey of a product like Human error, Fraud, increasing costs and limitation of quality inspections (For example, fuel costs for transportation, complex international logistics) etc., We will be reviewing some of the major technical challenges experienced by SCM systems.

1. Insubstantial Granularity of Data: One of the most common and basic barriers experienced by SCM is poor handling of data as a result of the vast amount of data generated throughout manufacturing to consumption of a product, referring to network scalability, storage scalability and transactional data. Dealing with the assortment between manual data handling and digital data handling is a prime challenge. How to store and process a myriad of unstructured, heterogeneous data is another issue faced by SCM systems as conventional hardware tools impact the efficiency and effectiveness of the system. Access to data is pivotal for effective decision making, taking comprehensive measures against complexities of SCM systems and implementing successful risk mitigation strategies. Especially, in light of Covid - 19, lack of data has led to the implementation of failed strategies in general management due to incomplete insights. Data Handling is crucial as it exposes the weaknesses and vulnerabilities of the system. Execution of Cloud-based storage mechanisms can help resolve some of the above-mentioned issues, as it provides unlimited virtual storage and flexible access to data. A Blockchain can contribute remarkably by providing a networked and decentralized database to overcome network and storage data scalability by using consensus mechanisms and establishing a general agreement between the nodes, permitting free-flowing immutable data.

2. Quality Control and Customer Expectations: The unceasing emergence of pseudo, pirated products and recent quality scandals divulge the significance of Product Quality Control. Acquiring quality control solutions at targeted costs has been a pre-eminent goal in the modern Supply Chain industry. The traditional centralised tactics cannot overcome three fundamental causes: costs and limitations of quality inspections, information asymmetry in production processes and self-interests of supply chain members that lead to poor quality products and unsatisfied customers. Quality Control also plays an imperative role in ethical SCM, as unsafe practices can contribute towards negative environmental impact. Successful SCM delivers their customer demands, however, managers often face a cusp dealing with changing customer expectations. Predicting buyer behaviour and responding competently is a perennial issue faced by SCM. Revolutionizing the Supply chain with advanced technological aspects can help eliminate some of the issues and boost the performance of the chain. This explains the subsequent shift as more and more industries are adapting to IoT based measures which ensure forecasting of the overall business. Sensors placed on products from manufacturing to delivery

could provide productive data enhancing the ability to make accurate decisions regarding demand and distribution of inventory.

3. Catastrophic Events: In the past two or three decades, Global supply chains have been exposed to a vast range of catastrophes (including natural disasters, economic crises, astronomical events like meteor hits etc.), with little or no predictability causing collateral damage. The onset global pandemic; Covid-19 is the most contemporary example of the challenge faced by systems around the world today. Such events demand a proactive approach and holistic framework by organisations to take countermeasures against disruptive events. Organisations should equip themselves with risk management strategies like; Business Continuity Management (BCM) and Enterprise Risk Management (ERM) and develop recovery measures to lessen the impact. BCM seeks to lay out a systematic approach to extend the continuity of operations in the event of a crisis. It focuses on safeguarding the interests of stakeholders, brands and reputation by predicting possible threats and impacts and creating organisational resilience.

## 6. ADVANCES

Companies are nowadays targeting to enhance their performance in the industry, in terms of adaptability, cost, traceability, trust, delays and variety, thus the Supply Chain Management (SCM) has now become the concept of concern due to the ever-increasing customer demands in terms of value, quality etc. SCM influences numerous day-to-day and economic activities. SCM has been considered as a major strategy for incorporating suppliers and consumers, to enhance responsiveness and flexibility of manufacturing and service organizations. Optimum design of the supply chain is, therefore, an urgent and critical matter of concern for SCM researchers and specialists. SC systems are now approaching the era of intelligent/smart supply chains, novel creation of networks that feature collaboration and visibility features to affect the system dynamics, such as demand uncertainty or supplier failure. Supply Chain Systems are more focused on achieving their local goals/objectives rather than the global organization goals. Hence, centralized management approaches are proving to be less accurate and are being replaced with decentralized approaches of management, in which every involved participant improves its performance. A decentralized management approach guarantees that there is no singular resource that controls the entire system. Thus, to satisfy and adapt to changing customer expectations and needs, the following are some of the technological advancements in SCM.

### 6.1 Blockchain

In recent times, blockchain is mostly referred to as a cryptocurrency or digital money such as Bitcoin, Dogecoin, ripple etc. but in practice blockchain applications are not limited only to cryptocurrencies or finance. Blockchain is a decentralized digital ledger. Ledgers are used to keep a record of important things, financial or something else. Blockchain is nothing but a database or in other words, a collection of information stored on a computer system. To explain this further, we can imagine that the blockchain is a collection of blocks or nodes. These nodes are connected, all the transactions are stored throughout the network. If there is a new transaction or if there is even a slight change in any of the transactions, then it gets verified immediately through the consensus of the nodes. Information cannot be altered, added, or removed without this consensus. This makes blockchain fraud-proof. In a supply chain, this kind of system (decentralization) may provide a much better foundation of trust as well as benefits due to the absence of a centralized authority. Similarly, blockchain could further be used to record the activity logs, ownership of assets etc. further, Blockchain also holds an immense contribution to a supply chain, as Blockchain ensures information continuity and traceability. This is due to its irrevocable and immutable nature, which helps to share important information among stakeholders so that products and information can be tracked without risk. In addition, blockchain's transparency makes it easy to access large amounts of data generated in the supply chain. This also increases supply chain visibility. Blockchain in supply chain management also accounts for its security. It makes the entire system extremely safe and reliable. This is because new blocks are sorted linearly and chronologically, this means that each block gets added to the end of the blockchain. After a block is added to the chain, it is very difficult to alter the contents of the block unless the majority reached a consensus to do so, thus making the blockchain-enabled supply chain extremely safe. Suppliers can also make use of blockchain to record the origin of the raw materials that they have purchased, this allows the companies to verify the authenticity of their products. Thus, blockchain in SCM truly can be a game-changer in the supply chain domain.

### 6.2 Internet of Things (IoT)

Internet of things is used to connect various devices through a network in order to sense and collect data around the world on the internet to process various intelligent applications with the aid of embedded systems, artificial intelligence (AI), various software and sensors. In this network of all the connected devices, each device has a unique identity and will work in harmony with others. The role of the IoT platform for an organization is to enable devices / objects to observe, recognize, and understand situations and surroundings without relying on human help. Devices connected through the internet of things possess the ability to transmit data between themselves devoid of any interaction between them. A traditional supply chain faces many challenges like lack of visibility, lack of flexibility, Lack of trust of security amid stakeholders and many more. Integration of IOT in the supply chain network may help to solve many of such challenges that the traditional networks face. IOT helps improve the efficiency of SC networks by connecting links between information flow and material flow at various stages of the SC network. For instance, if we consider the automotive supply chain, the main goal of the manufacturing plant is to deliver the parts at the right time and to maintain an optimum inventory. This is only possible if there is a good coordination amongst 3rd party logistics, transportation organisations, and multiple tiers of suppliers. These coordination processes are often enhanced by making use of the IoT integrated blockchain systems. Such a system utilises smart IoT sensors and numerous smart devices, which have the

ability to track the location/whereabouts of parts as well as their quantity along with all the other useful information in real time. This advancement leads to various other improvements and benefits for the manufacturing supply chain, such as improvement in material and information flow, tracking system of goods as well as a planned production schedule. Similarly, the suppliers also greatly benefit from this as they experience reduction of faulty orders, improved inventory and inventory level, reduction in warehousing costs etc. the above explanation was in the context of incoming logistic services to the plant. Next, we will consider the benefits of IoT in the supply chain of outbound distribution services. The main goal of the manufacturing plant is to distribute outbound vehicles to all dealers and importers at the right time, while effectively coordinating many third-party logistics and transportation companies. All of this can be achieved using the IoT integrated blockchain system. As mentioned earlier, the system uses IoT sensors and many smart devices that can be used to track vehicle location and other important details in real time. This improvement leads to many benefits to the manufacturing plant itself. This means that the system can achieve just-in-time logistics, improvement in inventory controls as well as reduction in damaged vehicles. At the same time, dealers and importers also get the benefit by getting a lead time reduction in build to order vehicles and a reduction in warehouse cost. Thus we can say that the integration of the internet of things and blockchain can eliminate the problem and make the system more efficient and trustworthy.

### 6.3 Big Data

Nowadays there is enormous amounts of data being generated every-day. It has been predicted that the amount of data collected will keep increasing in the coming years in this digital era. Hence the term "Big Data" has been coined. The world generated/created more than 1ZB of data within the year 2010, and 7ZB of data per year by 2014 [13]. The main reason for such an enormous rise in data is due to diverse devices employed in the industrial enterprise of supply chain networks, which include smartphones, computers, devices, sensors. All of this data gives rise to new possibilities to obtain more value. We can hence define Big data as extremely large sets of data or fast growing amounts of data from different sources that present industrial organizations with a variety of storage and analysis issues. Big data in SCM promises a very positive impact as supply chains will be able to take more strategic and data-oriented decisions. Big data serves as an instrument to analyse supply chain risks and measuring the supplier performance with extremely high accuracy. Big data also enables the organization to identify and focus on credible areas for optimization. Big data can be utilised by organizations in various ways to optimize their supply chains, by using big data to predict crime, i.e. making the supply chain secure and transparent. Further data can also be used to prepare an efficient operational shift planning to achieve appropriate staffing for maximum output and good process quality. Big data in supply chain can also avoid the "out of stock" condition and increase customer satisfaction. Customer retention analysis can be also carried out using big data to maintain good customer relations and to increase customer trust. Creation of new business models or products becomes easy by using big data analysis along with expansion of existing product lines. Even with all these benefits of big data, it still seems to be a relatively unexplored asset that the industries can still make use of if they have the correct tools and technologies.

## 7. A BIBLIOGRAPHIC REVIEW ON BLOCKCHAIN AND IOT INTEGRATED SUPPLY CHAINS.

In this section, we present the most influential papers in the recent years, mainly focusing on Blockchain and IOT integrated supply chains.

**Xiuying Chen et al, 2020** elaborates on the current scenario of Internet of Things and block chain as well as their development trends, further the paper also talks about the advantages and mechanisms of integrating IoT and blockchain in supply chain management to assess its efficiency, challenges and bottleneck areas which may require optimization. Finally, the paper presents few ways to optimize the integration of blockchain and Internet of Things in intelligent services ecosystem in supply chain management. According to the authors, IoT and Blockchain are greatly contributing towards the transition from traditional supply chains to intelligent/ digital networks. These digital supply chains provide the organization with much more transparent, secure, fast and agile results. These technologies have the ability to greatly improve the product quality, efficiency of operations (for the stakeholders) and delivery speeds. The mentioned technologies also promise a scope for innovations as well as provide the organizations with sustainability in its operations. The authors also find that the existing supply chain technologies are truly facing many challenges mainly of information asymmetry and product quality due to the multi-agents of the supply chain. The authors also propose that the characteristics of blockchain such as traceability, decentralization, security etc. can actually solve the bottleneck issues encountered by IoT. Finally, the authors propose a need to strengthen the infrastructure and application of IoT and blockchain to optimize supply chains. **Hanqing Wu et al, 2019** identifies Supply chain management as a very crucial part of the supply chain industry. The paper throws light on some of the major challenges of the current supply chain management systems, such as lack of information sharing, unreliable product tracing, non- transparency, long delays or difficulty in retrieving data etc. with features like decentralization, traceability, transparency, the authors believe that blockchain technology can seriously tackle these issues and can prove to be a solid solution for the existing traditional supply chains. The paper puts forth an analysis of potential opportunities as well as new requirements along with principles to design blockchain based supply chain management systems. The authors also discuss the crucial challenges in terms of data retrieval, throughput, control of access, scalability as well as provide us with a thorough review on the solutions. The paper also presents a in depth case study on designing a blockchain based food traceability system. The case study provides more insights on ways to tackle the above-mentioned technical challenges in practice. The paper also describes the main requirements of the application of blockchain in SCM finally summarizing the existing work on blockchain in SCM. The experiments conducted in this paper analyse the performance of the system in terms of

response time of user registration, data query and submission. **Si Chen et al 2017** describe the importance of quality management in supply chains. The authors further argue that even though extensive study and research in this field has already been done, still the currently used technologies still have difficulties to resolve problems due to the lack of trust in supply chains. They explain the main reasons for this as challenges of traditional supply chain, like information asymmetry and limitations of quality inspections. Thus, the authors claim that blockchain is definitely a very promising technology that can be considered to tackle these issues. Now the paper discusses how exactly to improve the supply chain quality management mainly by implementing the blockchain technology. Further the paper proposes a framework for blockchain enabled supply chain quality management. The paper puts forth a blockchain based SCQI frame work as well as a case study on a laptop supply chain framework based on blockchain. Finally, the paper discusses about the future research directions. **Satyabrata Aich et al 2019** claim that blockchain integrated with IoT framework of a supply chain has the ability to provide a solution for all the challenges/ difficulties faced by traditional supply chain systems, by improving the efficiency of SC networks and making the system clear/transparent thus reducing the violation of the code of conduct throughout the network. These properties thus help the stakeholders to efficiently trace their products throughout the networks. The paper highlights the main differences between conventional and blockchain and IoT enabled Supply chains in various sectors of the industry like automotive, pharmaceutical, retail etc. the paper explains the current issues faced by these industries using conventional supply chain frameworks, and also suggests the solutions for these problems using blockchain based supply chain frameworks. Finally, we can see that the supply chain, which is based on the integrated blockchain of the Internet of Things, has the ability to eliminate all problems and make the system more reliable and efficient. Finally, based on the seafood industry supply chain and the advantages of incorporating blockchain into the network, a case study is proposed. This article will help industry professionals identify the benefits of blockchain-based supply chain systems and help them achieve excellent results in real life. **Safia NASIH et al 2020**, presents a brief overview on the enhancement of supply chain management by the integration of blockchain. The paper also explains the simple meaning of supply chain management and its challenges. The authors claim that blockchain possesses the ability to improve the integrity of containers in supply chains based on ports. **Y. Wang et al 2019,** proposes a solution to use IoT sensor devices that leverage the blockchain technology to reduce the various operational costs in pharmaceutical supply chains. Further **M. Francisconi et al** says that the use of this technology (Blockchain) leads to a more accurate risk analysis, increasing the efficacy of the customs inspections and consequently decreasing the process lead-time. The paper further adds that the use of blockchain in supply chain can also result in the increase in the accuracy of information flow. **M. Eljazzar et al 2018** proposes two major benefits of integrating blockchain and supply chain management. They say that the advantage is mainly data transparency and sharing of resources. Thus, making the point of discussion very clear. **Sidra Malik et al 2019,** focuses on the challenges such as integrity and traceability claiming them as the major issues of complex supply chains existing currently across the world. The authors say that even if blockchain has the ability to overcome these problems by providing tamper proof audit trail which are mainly supply chain events and data related to the product life cycle (PLC), it does not effectively solve the problem of trust which is associated with the data. The writers suggest a reputation system approach to solve these issues. The paper describes a Trust chain which is a 3 layered trust management framework, which employs s consortium blockchain to track the interactions which happen between the supply chain participants. It also assigns reputation and trust based scores dynamically, based on these interactions. The novel feature of this arrangement is firstly, the reputation model evaluates the trustworthiness of different entities based on the various observations made on the numerous supply chain events. as well as the quality of commodities is evaluated. The system uses smart contracts ensuring efficient, secure, transparent and automated calculation of reputation scores and finally it also has minimum overheads in terms of throughput and latency when it is compared to a traditional blockchain based supply chain. Thus, this paper proposes a trust management framework for blockchain based supply chain applications, which effectively addresses the above discussed issue.

## CONCLUSION

The concept of Supply Chain Management is complex in nature expanding across various components, activities, functions, multiple disciplines. The literature and various definitions make the study of various interlinked components within SCM confounding. Over the time, many different researches and experts have given out various definitions for SCM to simplify the understanding. This paper attempted to review some of these definitions. SCM framework aims at incorporating dominant themes and concept within SCM, various frameworks have been developed considering all the interpretations, SCM frameworks and Categorisations in other disciplines. It has various characteristic features that promote its use in research as well as in practice.
Over the recent years, global market has become customer driven and companies are essaying to meet the customer requirements. This shift of focus to customer requirements has led to various advances in the field of SCM. Blockchain technology, IoT, Big Data are IT advancements revolutionizing SCM and enabling to achieve the goals of adaptability, cost reduction, traceability, customer trust, and variety. This paper puts forth a review on these recent advances and also analyses the most influential contributions made to this field by providing a Bibliographic review mainly focusing on Blockchain and IoT in supply chain management. This paper also seeks to provide a comprehensive review of the concept of Supply Chain Management, its definitions, framework, challenges prevalent in the field and the various advancements that are efficiently revolutionizing the field of SCM by consolidating and summarising the research done in the field.

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