"A STUDY ON THE IMPACT OF BLOCKCHAIN TECHNOLOGY ON AUTOMOTIVE SUPPLY CHAIN"

PROJECT REPORT

Submitted to the School of Maritime Management,

Indian Maritime University, in partial fulfilment of the requirements for the award of degree of "Master of Business Administration" in International Transportation and Logistics Management

By

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DECLARATION

I, **ABIN BENNY** (Reg no: **1905305003**) student of School of Maritime Management, **INDIAN MARITIME UNIVERSITY – KOCHI** hereby declares that this project titles "**A Study on the impact of Blockchain Technology on Automotive Supply Chain**" submitted in partial fulfillment of requirement for the degree of "**Master of Business Administration in International Transportation and Logistics Management**" is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any degree/diploma or associate ship of any University/Institution. The information submitted is true and original to the best of my knowledge.

DATE: 28/06/2020

PLACE: COCHIN **ABIN BENNY**

SCHOOL OF MARITIME MANAGEMENT

INDIAN MARITIME UNIVERSITY

(*A central university, Government of India*)

CERTIFICATE

This is to certify that project report entitled **"A Study on the Impact of Blockchain Technology on Automotive Supply chain"** submitted to the School of Maritime Management, Indian Maritime University in partial fulfilment of the requirement for the award of the degree, MBA in International Transportation and Logistics Management is bonafide work of **Abin Benny** under my supervision. I certify further that to the best of my knowledge, the work reported herein does not form part of any project or dissertation on the basis of which a degree/diploma or award was conferred on an earlier occasion on this or any other candidate.

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I perceive this opportunity as a big milestone in my career development I will strive to use gained skills and knowledge in the best way possible, and I will continue to work on their improvement, in order to attain the desired career objectives. Hoping to continue cooperation with all of you in the future. I also thank my family and my friends for continuous support in completion of my project work.

ABIN BENNY

EXECUTIVE SUMMARY

The impact of blockchain technology on the automotive supply chain is the subject of this thesis. The blockchain is a new age of technical advancement that is gaining traction in the crypto currency world. Blockchain technology is widely recognized in supply chain management, not just in crypto currencies. The purpose of this paper is to have a better knowledge of blockchain and to highlight the benefits of blockchain in the automotive supply chain management. It also investigates how blockchain technology might aid supply chain management.

Blockchain is a distributed ledger system that has recently garnered the interest of both practitioners and academics. Several conceptual and empirical studies addressing current challenges and indicating future study areas in supply chain management have been published. This study provides a systematic review to determine how blockchain might help supply chain management. Supply chain management, finance, logistics, and security are identified as major supply chain sectors where blockchain might assist based on citation and co-citation analyses. In addition, it was discovered that the Internet of Things (IoT) and smart contracts are the most prominent developing technologies in this sector.

The findings of highly referenced and co-cited publications show that blockchain may improve supply chain transparency, traceability, efficiency, and information security. The study also found that empirical research in this subject is limited. As a result, incorporating blockchain into a real-world supply chain represents a significant future research potential. The purpose of this thesis is to gain a better understanding of blockchain and to show how it can be used to manage automotive products. It also considers how blockchain technology may aid supply chain management in the car sector.

The project is divided into six chapters. The first chapter covers the introduction, research objective and goals, study organization, and methods. A literature review

is included in the second chapter, which serves as the foundation for this study's services retailing theoretical concept. The third chapter delves into the history and concept of blockchain technology, as well as its limitations, benefits, and future prospects. The fourth chapter looks at how blockchain technology may be used to supply chain management and the automotive industry. The research findings are presented in the fifth chapter. By the end of the sixth chapter, the research has come to a close.

ABBREVATIONS

SCM	Supply Chain Management
DLT	Distributed Ledger Technology
IoT	Internet of Things
GB	Gigabytes
ICO	Initial Coin Offering
STO	Security Token Offering
DSO	Digital Security Offering
EUIPO	European Union Intellectual Property Office
OEM	Original Equipment Manufacturer
B2C	Business to Customer
B2B	Business to Business
3PL	Third Party Logistics
WIP	Work in Progress
RFID	Radio Frequency Identification Number
ERP	Enterprise Resource Planning
QR	Quick Response
NFC	Near Field Communication
RoHS	Restriction of Certain Hazardous Substances

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CHAPTER -1

INTRODUCTION

Many processes in cargo operations are typically paper-based, and before items are delivered, the receivers of the inspections must sign off with a symbol. Even when electronic technologies are utilized, numerous parties must sign off on the cargo transfer making it a long administrative procedure. The blockchain technology may be used to digitalize the supply chain in order to stream like this procedure. By digitizing the supply chain, this invention helps to save costs, control, and trace the paper trail of shipments. Blockchain can improve real estate, banking, health care, air transportation planning, and tourist transactions. This new project aims to increase efficiency, decrease human error, and lower costs.

1.1 RESEARCH AIM

The goal of this thesis is to get a better understanding of blockchain and to highlight the benefits of blockchain in the management of automotive goods. It also looks at how blockchain technology may help with supply chain management in the automobile industry.

1.2 RESEARCH OBJECTIVES

The objectives considered for thesis are:

1. To obtain knowledge about blockchain technology and to understand existing supply chain management techniques for automotive products.

2. To investigate the use of blockchain technology in the management of the automotive supply chain.

3. To look at the benefits and future possibilities of blockchain technology for managing the automotive supply chain.

1.3 STRUCTURE OF RESEARCH

Six chapters make up the project. The introduction, research goal and goals, study organization, and methodology are all covered in the first chapter. The second chapter contains a literature review, which serves as the foundation for this study's services retailing theoretical idea.

The third chapter discusses the evolution and idea of blockchain technology, as well as the limitations, benefits, and future of blockchain technology. The fourth chapter discusses how blockchain technology may be used in supply chain management and the automobile sector. The fifth chapter comprises of the findings from the research. The study comes to a close by sixth chapter by conclusion

1.4 RESEARCH METHODOLOGY

Methodology refers to the theoretical underpinnings of the philosophical assumptions that provide the foundation for how the investigation must be carried out. This emphasis will be used to explain the study design. Furthermore, the approach used in this study is justified.

The approach to issues and the search for solutions is referred to as methodology. In addition, the word methodology in social sciences refers to the technique through which research is carried out. The assumptions, goals, and areas of interest all influence the technique used in a study.

Research is the systematic examination and modification of variables in order to understand and identify the procedures that occur in certain settings. Research may alternatively be described as a collection of methods that generate data about relevant relationships and processes. Research is primarily concerned with the improvement of information that may be applied to real-world problems. To increase knowledge, researchers frequently work on existing resources. It is critical to select the most appropriate research approach for answering the study

questions. The research expands on current information in order to generate new knowledge.

Research Techniques

The research technique refers to the techniques and devices used to gather information for the study. Quantitative research, qualitative research, or mixed methodologies research must all be specified before the procedures are finalized.

Quantitative data is based on numerical facts and data that has been quantified. The qualitative data, on the other hand, is based on non-numerical facts. The type of sampling utilized is a major factor that distinguishes qualitative technique from quantitative research. The qualitative study, according to the author, includes specified sampling in order to improve data understanding in certain situations. The quantitative research, on the other hand, is based on probability sampling, which enables for statistical conclusions to be drawn.

The qualitative technique allows the study to get closer to the participants' ideas and experiences in the context. As a result, the study takes a qualitative approach, working closely with respondents to gather important data in order to meet the study's objectives.

Time Horizons

The time horizons in the research model are divided into two categories: cross-sectional and longitudinal studies, which are dependent on the amount of time necessary for the investigation. Cross-sectional studies are ones that are carried out over a set period of time. Longitudinal studies, on the other hand, are ones that are done over a lengthy period of time. Because of the time constraints, this study takes a cross-sectional method.

Data Collection

The theoretical perspective and technique are important in this thesis since they help to collect data that helps to identify high-value results. In a project, data collection is important since the quality of the data might affect the comprehension of the theoretical framework. The data gathered might be either primary or secondary.

Secondary data

Secondary data is information acquired for a separate purpose that may be used for the examination of a different aim. The data (such as documentary, multiple source, and survey) already obtained for a different reason might be reanalysed to fulfil the aims of this thesis, and this information is referred to as secondary data.

Raw data as well as published summaries are examples of this sort of data. Certain sorts of studies that compare national and worldwide circumstances are likely to rely on secondary data as a primary source of information in order to answer their research objectives. Secondary data can comprise both quantitative and qualitative data, which is typically utilized in descriptive and explanatory studies.

The data for this study came from journal publications, which were used to conduct the literature review. The articles were found on the internet on blockchain-related websites. Block chain, automotive, and automotive supply chains are among the most popular web search terms.

CHAPTER – 2

LITERATURE REVIEW

The blockchain technology will be discussed in this chapter. Blockchain is a ground-breaking technology that creates a safe mechanism to record transactions over a global network of computers. Blockchain is a bookkeeping platform or distributed ledger that guarantees data integrity, transparency, immutability, and excellence, and is best known for its use in the bitcoin system.

Blockchain technology is basically a distributed data base of records or digital events that are carried out among the parties involved. Every transaction is validated by the agreement of the system's key players. Every transaction is recorded in a secure and verifiable manner on the blockchain. The distributed ledger technology (DLT) underlies the blockchain. DLT is a database that is shared and synced over various networks and is based on a general agreement. DLT reduces security vulnerabilities by giving each participant access to the shared ledger.

Because of a lack of information about the benefits of block chain systems as well as a lack of comprehension about how and why they are needed in their industry, the implementation rate is currently relatively low. The technology of block chain is a sort of database. When compared to traditional database systems, the primary distinction is that it saves data in a unique way. Data is stored as blocks in a block chain, which are then linked together. When fresh data is received, it is entered into a new block, which is then chained with the preceding block. Block chain technology in the automotive supply chain is a soon-to-be-released technical advancement in supply chain management.

Satyabrata Aich and Sabyasachi Chakraboty, in an article published by IEEE on "A Review on Benefits of IoT Integrated Block chain based Supply Chain Management across Different Sectors with Case Study" in the 21st International

Conference on Advanced Communication Technology (ICACT) [2019], highlight the differences between traditional and block chain based supply chains. The essay also covers the issues that the traditional supply chain is now facing, as well as the answers that block chain technology may provide to these issues.

According to a study by Supranee S. and Rotchanakitumnuai S. [2017] titled "The Acceptance of the Application of Block Chain Technology in the Supply Chain Process of the Thai Automotive Industry," block chain technology aids in improving and solving the issue of transparency as well as monitoring supply chain operations. According to the findings, the perceived benefits of block chain technology in the automotive sector, as well as inter-organizational trust, are key elements that influence block chain's acceptability in the supply chain process. The adoption of block chain technology is hampered by inter-organizational relationships. Non-mediated power is a significant component in establishing inter-organizational trust and achieving success in this industry's technological application.

Reducing Automotive Counterfeiting Using Block Chain: Benefits and Challenges by Donghang Lu and Pedro Moreno Sanchez in the IEEE International Conference on Decentralized Applications and Infrastructures (DAPPCON) [2019] highlights the benefits and challenges of using distributed ledger technology (or block chain) to prevent counterfeiting even in the present day. It also argues that permissioned block chains, such as Hyper ledger Fabric, are a potential way to combating counterfeiting since they provide a distributed and append only ledger jointly regulated by supply chain participants themselves using a distributed consensus mechanism.

Pankaj Dutta's article "Block chain technology in supply chain operations: Applications, challenges, and research opportunities" [2020] published by Elsevier highlights current trends in block chain research in various domains of supply chain operations, examines the various supply chain functions that can be

enhanced through block chain technology, and so on. It also says that block chain has a lot of potential for changing supply chain functions.

According to Rahul Guhathakurtha's chapter "Blockchain in the Automotive Domain" in Kannan Subbiah and other authors' book "The Age of Blockchain" [2018], block chain is all about bringing transparency and efficiency into the existing systems that run the upstream and downstream supply chain and making them more proactive and predictive. The automotive block chain is a multi-tier linked block chain platform based on the concepts of scalability and interoperability that may benefit stakeholders such as manufacturers, automobile dealerships, regulators, auto financing and insurance firms, and so on.

The potential of Block chain technology for the automotive supply chain is highlighted in a paper by Kotha Raj Kumar Reddy titled "Developing a blockchain framework for the automotive supply chain: A comprehensive evaluation." The article proposes a block chain framework for digitizing and decentralizing automotive supply chain operations. The automobile industry is dealing with variable and unclear schedules; nevertheless, by incorporating Block chain technology into the automotive supply chain, a bigger shift may be predicted.

Tim Reimers presents a proof-of-concept prototype of how distributed ledger technology can be used to ensure transparency of production in an article published by the IEEE on “Integration of Blockchain and Internet of Things in a Car Supply Chain” [2019]. The block chain collects data from machines and sensors, ensures information integrity, integrates a database, and enables traceability. To illustrate the ideas of block chain and Internet of Things integration in an automobile manufacturing use case, the prototype was created using the design science paradigm.

In an essay titled "Making Sense of Block Chain Technology," published in the International Journal of Production Economics. What impact will it have on supply chains?" [2019] by Yingli Wang discusses how block networks have the potential to change supply chain operations. Using the sense-making method, we were able to gain a better understanding of how senior executives diagnose block chain symptoms and create assumptions, expectations, and knowledge about the technology, all of which will affect their future actions towards its use.

Lena Koh's essay "Block chain on Transport and Logistics- paradigms and transitions" [2020] in the International Journal of Production Research emphasizes the growing significance of a frictionless process where products and services move effortlessly across borders. Closer coordination of transportation infrastructure, including customs, airports, ports, rail, and road, is required. To meet these demands, a digital infrastructure that includes clouds, intelligence management, payment systems, and pass-porting is essential. This integration has the potential to improve trade ties while also transforming the global supply chain. It can also change how this environment's resources and skills become more collaborative in the machine economy.

An article by Paula Fraga Lamas published in IEEE on "A review on Block chain Technologies for an Advanced and Cyber Resilient Automotive Industry" [2019] discusses how blockchain can improve data security, privacy, anonymity, traceability, accountability, integrity, robustness, transparency, trustworthiness, and authenticity in the automotive industry. It also examines the enormous potential of blockchain technology in the automobile sector, with a focus on its security aspects. As a result, after evaluating the state-of-the-art and developing the major stakeholders' present issues, the applicability of blockchain is assessed. Furthermore, the paper discusses the most important use cases, since widespread blockchain adoption opens up a wide range of short- and medium-term viable

automotive applications that have the potential to disrupt the car-sharing economy and establish new business models.

Organizations, human culture, and democratic government might all be transformed by blockchain technology. Blockchain may be thought of as a public digital ledger that records all of the network's transactions. The ability to trace transactions inside decentralized databases, preventing counterfeits and thefts, is the most revolutionary aspect of blockchain technology.

Despite the fact that bitcoin is the most widely used use of block chain technology, it has the potential for a wide range of applications in both financial and non-financial industries (such as banking and healthcare sectors). The goal of this research is to demonstrate the benefits of adopting blockchain technology to manage the automotive supply chain. As a result, the focus of the debate is on the automotive supplychain in the vehicle sector.

Blockchain technology may improve the automotive supply chain management by decreasing fraud and mistakes, reducing delays due to paper work, improving inventory management, identifying issues more quickly, lowering courier costs, and increasing customer and partner confidence. The automotive supply chain plays a critical role in the car industry, since shortages and inefficient management may have a substantial influence on the industry. Because the car supply chain is a value-added chain, efficient chain management is critical. As the production, sourcing, and distribution of car units become increasingly complicated, new ideas and solutions are required to assure the sector's worldwide development.

CHAPTER -3

BLOCKCHAIN TECHNOLOGY

3.1 BLOCKCHAIN

A blockchain is a growing collection of data, known as blocks, which are cryptographically linked together. A cryptographic hash of the preceding block, a timestamp, and transaction data are all included in each block (generally represented as a Merkle tree). To get into the hash, the timestamp shows that the transaction data existed when the block was published. Because each block contains information about the one before it, they create a chain, with each new block strengthening the preceding ones. As a result, blockchains are resistant to data alteration since the data in any one block, once recorded, cannot be changed retrospectively without affecting all subsequent blocks.

Blockchains are generally administered via a peer-to-peer network for use as a publicly distributed ledger, with nodes communicating and validating new blocks using a protocol. Although forks are conceivable, blockchain records may be deemed safe by design, and they represent a distributed computing system with strong Byzantine fault tolerance.

In 2008, a person (or group of individuals) going by the name Satoshi Nakamoto created the blockchain to serve as the public transaction record for the cryptocurrency bitcoin. Satoshi Nakamoto's true identity is still unknown. Bitcoin became the first digital currency to overcome the double-spending problem without the use of a trusted authority or central server when the blockchain was invented. The bitcoin architecture has influenced other open-source apps and blockchains that are extensively utilized by cryptocurrencies. The blockchain is a sort of payment network.

Private blockchains have been proposed for corporate usage, however the marketing of such privatized blockchains without a sufficient security model has been dubbed "snake oil" by Computerworld. Others, on the other hand, have claimed that, if correctly built, permissioned blockchains may be more decentralized and hence more secure in practice than permission less blockchains. Blockchain is a method of storing data in such a manner that it is difficult or impossible to alter, hack, or defraud it.

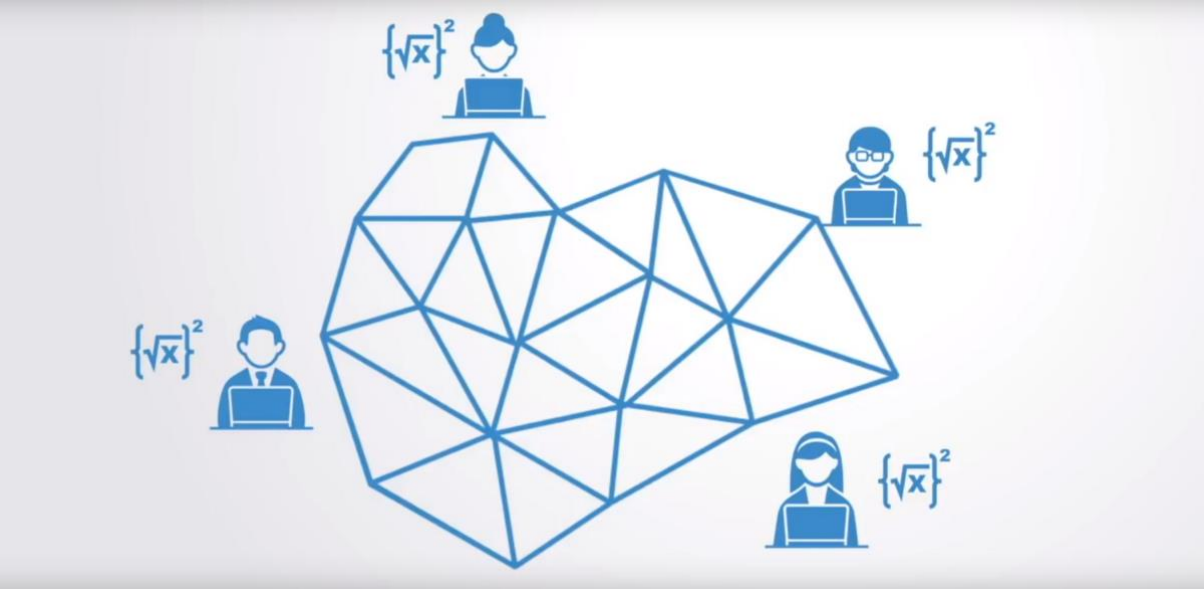

Fig 1.1 A diagrammatic representation of blockchain (Source – Google)

A blockchain is a digital log of transactions that is copied and distributed throughout the blockchain's complete network of computer systems. Each block on the chain comprises a number of transactions, and whenever a new transaction happens on the blockchain, a record of that transaction is added to the ledger of each participant. Distributed Ledger Technology is a decentralized database that is controlled by numerous members (DLT). Blockchain is a form of distributed ledger technology in which transactions are recorded using a hash, which is an immutable cryptographic signature.

This implies that if a single block in a chain is altered, it will be immediately evident that the chain has been tampered with. Hackers would have to modify

every block in the chain, across all distributed copies of the chain, if they intended to damage a blockchain system.

3.2 HISTORY OF BLOCKCHAIN

In his 1982 dissertation "Computer Systems Established, Maintained, and Trusted by Mutually Suspicious Groups," cryptographer David Chaum suggested a blockchain-like system for the first time. Stuart Haber and W. Scott Stornetta described their work on a cryptographically safe chain of blocks in 1991. They intended to create a system that prevented tampering with document timestamps. Haber, Stornetta, and Dave Bayer enhanced the concept in 1992 by using Merkle trees, which increased efficiency by allowing many document certifications to be gathered into one block.

In 2008, a person (or group of individuals) identified as Satoshi Nakamoto created the first blockchain. Nakamoto made significant improvements to the architecture by utilizing a Hashcash-like mechanism to timestamp blocks without having them to be signed by a trusted party and by establishing a difficulty parameter to regulate the rate at which blocks are added to the chain. The idea was implemented by Nakamoto as a core component of the cryptocurrency bitcoin the following year, where it acts as the public record for all network transactions.

The bitcoin blockchain file size, which contains records of all network transactions, surpassed 20 GB in August 2014. (gigabytes). From January 2015 to January 2016, the bitcoin blockchain expanded from 50 GB to 100 GB in size, and from January 2016 to January 2017, it rose from 50 GB to 100 GB in size. By early 2020, the ledger had grown to almost 200 GB.The terms block and chain were used individually in Satoshi Nakamoto's original paper, but by 2016, they had become synonymous as blockchain.

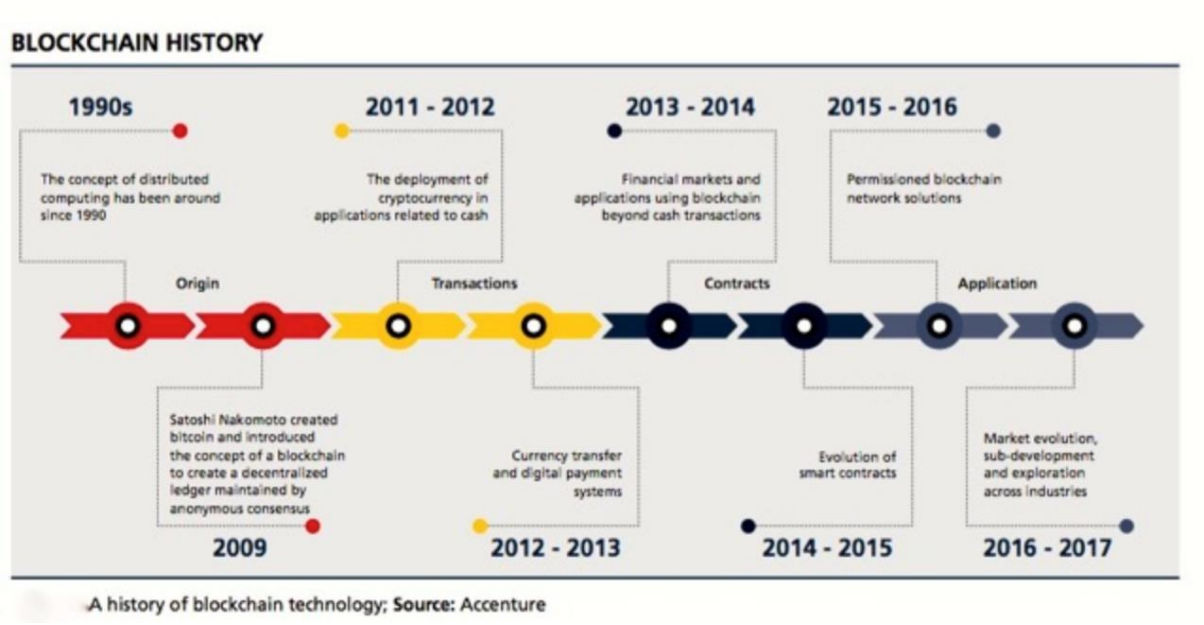

Fig 1.2 History of Blockchain Technology (Source – Accenture)

According to Accenture, a study of the diffusion of innovations theory found that blockchains were adopted at a rate of 13.5 percent in financial services in 2016, putting them in the early adopters phase. In 2016, the Chamber of Digital Commerce launched the Global Blockchain Forum, which brought together industry trade groups.

Only 1% of CIOs indicated any type of blockchain deployment within their organizations in May 2018, according to Gartner, and only 8% of CIOs were "planning or [looking at] active experimentation with blockchain" in the immediate future. According to Gartner, 5% of CIOs believe blockchain technology will be a "game-changer" for their company in 2019.

3.3 TYPES OF BLOCKCHAIN

Public blockchains, private blockchains, consortium blockchains, and hybrid blockchains are the four types of blockchain networks now in use.

1. Public blockchains

Access to a public blockchain is completely unrestricted. Anyone with an Internet connection can transmit transactions and serve as a validator for it. Typically, such networks provide monetary rewards to individuals that protect them and use a Proof of Stake or Proof of Work method.

The Bitcoin blockchain and the Ethereum blockchain are two of the most well-known public blockchains.

2. Private blockchains

Permissions are required to use a private blockchain. It is only open to those who have been invited by the network administrators. Access to participants and validators is restricted. Private blockchains are usually referred to as Distributed Ledger (DLT) to separate them from other peer-to-peer decentralized database systems that aren't open ad-hoc compute clusters.

3. Hybrid blockchains

A hybrid blockchain combines the benefits of both centralized and decentralized blockchains. The chain's exact operation depends on which parts of centralization and decentralization are employed.

4. Sidechains

A sidechain refers to a blockchain ledger that runs in parallel to the main blockchain. Entries from the main blockchain (which generally represent digital assets) can be connected to and from the sidechain, allowing the sidechain to function independently of the main blockchain (e.g., by using an alternate means of record keeping, alternate consensus algorithm, etc.).

3.4 APPLICATIONS OF BLOCKCHAIN TECHNOLOGY

Blockchain technology may be used in a variety of ways. The most common application of blockchains is as a distributed ledger for crypto currencies like bitcoin; but, by late 2016, a few other operational products have evolved from proof of concept. As of 2016, several organizations have started experimenting with blockchain technology and implementing it at a minimal level to see how it affects organizational efficiency in their back office.

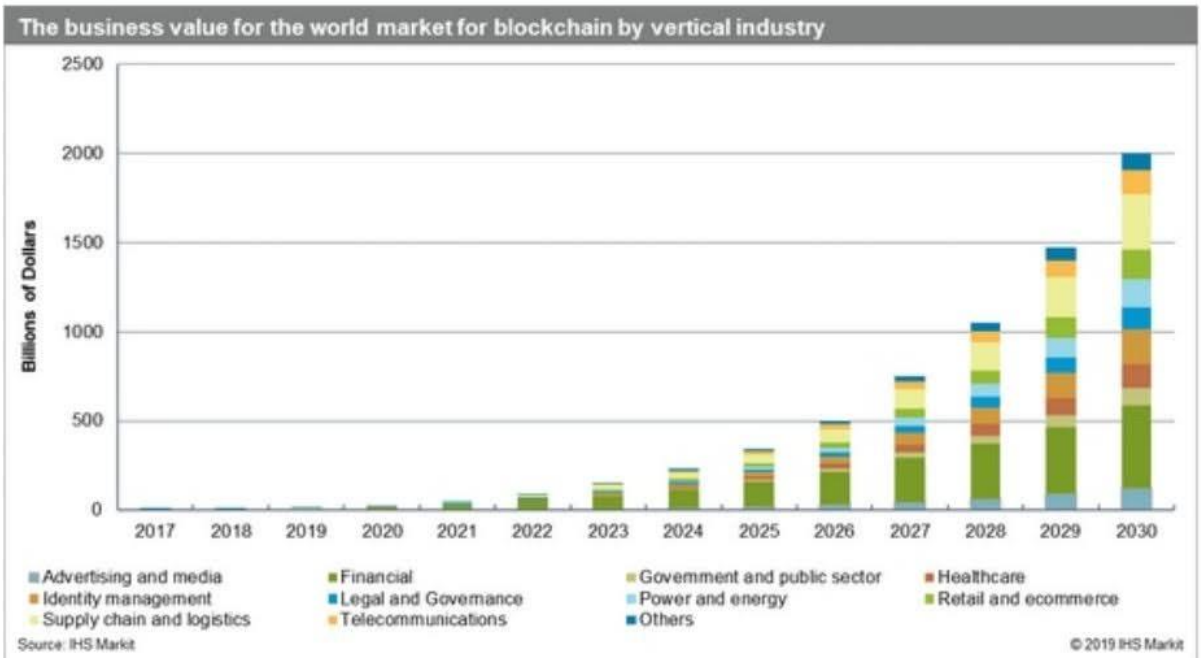

Fig 1.3 Graph showing applications of blockchain in different industries (Source – HIS Markit)

In 2019, it is anticipated that $2.9 billion was invested in blockchain technology, an increase of 89 percent from the previous year. Furthermore, according to International Data Corp, business investment in blockchain technology will reach $12.4 billion by 2022. Furthermore, according to PricewaterhouseCoopers (PwC), the world's second-largest professional services network, blockchain technology has the potential to produce more than $3 trillion in annual commercial value by 2030.

PwC's projection is bolstered by a 2018 research in which they polled 600 corporate leaders and discovered that 84 percent of them have at least some experience with blockchain technology, indicating a high level of demand and interest in the technology.

Since 2016, individual adoption of blockchain technology has risen dramatically. There were more over 40 million blockchain wallets in 2020, according to data, compared to about 10 million blockchain wallets in 2016.

1. CRYPTOCURRENCIES

Blockchain technology is used to record transactions in most crypto currencies. The bitcoin and Ethereum networks, for example, are both built on the blockchain technology. On May 8, 2018, Facebook announced the formation of a new blockchain group led by David Marcus, who was formerly in charge of Messenger. Libra (formerly known as Diem), Facebook's proposed crypto currency platform, was publicly unveiled on June 18, 2019.

Silk Road, a criminal organization that operated on Tor, accepted crypto money as payment, and the US federal authorities confiscated part of it through blockchain research and forfeiture.

The legality of people or banks possessing crypto currencies is a grey area for governments. China uses blockchain technology in a variety of businesses, including the creation of a national digital currency in 2020. Western countries, like the European Union and the United States, have launched similar programs to support their respective currencies.

2. SMART CONTRACTS

Smart contracts built on the blockchain can be partially or entirely performed or enforced without the need for human intervention. Automated escrow is one of the most important features of a smart contract. The blockchain network executes

the contract on its own, eliminating the requirement for a trusted third party (such as a trustee) to function as an intermediary between contracting organizations. This might minimize friction between entities when transferring value, allowing for more transaction automation. Smart contracts based on blockchain technology, according to a 2018 IMF staff debate, might decrease moral hazard and improve efficiency.

Smart contracts based on blockchain technology, according to an IMF staff debate from 2018, might minimize moral hazards and improve the usage of contracts in general. "However, no viable smart contract systems have yet developed," says the report. Their legal status was uncertain due to their lack of popular use.

3. FINANCIAL SERVICES

Many banks have indicated interest in adopting distributed ledgers for use in banking and are working with firms developing private blockchains, according to Reason, and this is happening quicker than predicted, according to a September 2016 IBM research.

This technology appeals to banks because it has the ability to speed up back-office settlement procedures. Banks like UBS are establishing new blockchain research labs to investigate how blockchain may be used in financial services to improve efficiency and save costs.

Blockchain, according to Berenberg, is a "overhyped technology" that has a high number of "proofs of concept" but still faces significant hurdles and has few success stories.

Bitwala introduced Europe's first regulated blockchain banking system in December 2018, allowing customers to handle both bitcoin and euro deposits in one location while maintaining the security and convenience of a German bank account. SolarisBank, a Berlin-based bank, is hosting the account.

Mojaloop was created to provide financial assistance to those who reside in places where banks are underserved. It is beneficial to migrants who send remittances.

Stocks are also being tokenized, with some cryptocurrency exchanges now issuing so-called "stock tokens."

Initial coin offers (ICOs) and a new kind of digital asset known as Security Token Offerings (STOs), also known as Digital Security Offerings, have both been made possible by the blockchain (DSOs). STO/DSOs are used to tokenize traditional assets like business shares as well as more inventive ones like intellectual property, real estate, art, or individual items. They can be performed privately or on a public, regulated stock market. There are a number of firms in this sector that offer compliant tokenization, private STOs, and public STOs.

4. VIDEO GAMES

CryptoKitties is a blockchain game that was released in November 2017. In December 2017, the game made news when a cryptokitty character - a virtual pet - was sold for more than $100,000. CryptoKitties also shown scalability issues for games on Ethereum by causing substantial congestion on the Ethereum network, accounting for around 30% of all Ethereum transactions.

5. SUPPLY CHAIN

Several attempts to use blockchain in supply chain management have been made.

Precious commodities mining- The origins of diamonds and other valuable commodities have been tracked using blockchain technology. The Wall Street Journal stated in 2016 that Everledger, a blockchain technology startup, was teaming up with IBM's blockchain-based monitoring service to track the origin of diamonds and guarantee that they were mined responsibly. The Diamond Trade Company (DTC) has been working on a diamond trading supply chain solution named Tracr since 2019.

Food supply- Retailers and customers can now monitor the provenance of beef and other food goods from their origins to stores and restaurants using blockchain technology. As of 2018, Walmart and IBM were conducting an experiment to utilize a blockchain-backed system for supply chain monitoring for lettuce and spinach, with Walmart administering all blockchain nodes and the IBM cloud hosting them. One of the advantages mentioned is that the technology might allow for quick tracing of tainted products. Some researchers doubt that the majority of customers will be interested in this capacity.

Software development- Hyperledger Grid, a blockchain effort of the Linux Foundation, was launched in 2015 with the goal of developing open components for blockchain supply chain services.

6. ANTI- COUNTERFEITING

By linking unique IDs to items, papers, and shipments, and preserving records linked with transactions that cannot be faked or altered, blockchain might be used to detect counterfeits. However, it has been suggested that blockchain technology be complemented by technologies that create a solid link between actual things and blockchain systems. The EUIPO launched an Anti-Counterfeiting Blockathon Forum with the goal of "defining, testing, and implementing" a European anti-counterfeiting infrastructure. To authenticate certificates, the Dutch Standardisation Organisation NEN employs blockchain in conjunction with QR codes.

7. HEALTHCARE

The Wall Street Journal stated that Ernst & Young was developing on a blockchain to enable companies, governments, airlines, and others monitor those who have undergone antibody testing and may be resistant to the COVID-19 pandemic in 2020. A blockchain was also used by hospitals and merchants to track essential medical equipment. Furthermore, blockchain technology was

utilized in China to reduce the time it took for health insurance payments to be made to providers and patients.

3.5 LIMITATIONS OF BLOCKCHAIN TECHNOLOGY

The world will alter as a result of blockchain technology. However, in order to comprehend what it has to offer, we must first comprehend its drawbacks.

1. Blockchain is not a Distributed Computing System

The blockchain is a network that runs on nodes. The blockchain's quality is determined by the quality of the nodes. Bitcoin's blockchain, for example, is robust and encourages nodes to join the network. The same cannot be said for a blockchain network in which nodes are not compensated.

This indicates that it is not a distributed computing system in which the network is not reliant on the nodes' activity and cooperation. A distributed computing system, on the other hand, works to guarantee that transactions are verified according to the rules, that they are recorded, and that they have the transactional history for each transaction. Each of these acts is comparable to blockchain, but none of them have the same level of synergy, mutual aid, or paralleling.

While blockchain is clearly a distributed network, it lacks the characteristics that make a distributed computing system so valuable to businesses.

2. Scalability Is An Issue

Blockchains are not as scalable as their centralized counterparts. Usually in the Bitcoin network, the transactions are delayed due to network congestion. This issue is connected to blockchain network scalability concerns. In simpler words, the more individuals or nodes that join the network, the greater the likelihood of it slowing down.

However, the way blockchain technology works is changing at an accelerating rate. Scalability alternatives are also being incorporated with the Bitcoin network

with the proper growth of technology. The answer is to conduct transactions off-chain and just store and access data on the blockchain.

Aside from that, new approaches to scalability exist, such as permissioned networks or adopting a different architectural blockchain solution, such as Corda.

All of these alternatives, however, are still inferior to centralized systems. When you compare the transaction speeds of Bitcoin versus VISA, a significant difference is visible. Bitcoin now has a transaction rate of only 4.6 transactions per second. VISA, on the other hand, can process 1700 transactions per second. This implies it can process 150 million transactions per second in a single day.

Finally, we may argue that blockchain may not be ready for real-world applications yet. It still requires a lot of work before it can be used in everyday situations.

3. Some Blockchain Solutions Consume Too Much Energy

Bitcoin was the first to use blockchain technology. It employs the Proof-of-Work consensus mechanism, which entrusts the heavy work to the miners. The miners are rewarded for solving difficult mathematical tasks. The enormous energy consumption renders these difficult mathematical problems unsuitable for real-world applications.

The miners must solve issues every time the ledger is updated with a new transaction, which requires a lot of energy. Not all blockchain systems, however, function in the same way. Other consensus methods have successfully handled the problem. Permissioned or private networks, for example, do not have these issues since the number of nodes in the network is limited. They also employ efficient consensus procedures to establish consensus because there is no requirement for global consensus.

However, when it comes to the most prominent blockchain network, Bitcoin, there is still a problem that has to be addressed.

To summarize, permissioned networks are energy efficient, but public networks might require a significant amount of energy to remain functioning.

4. Blockchain Cannot Go Back — Data is Immutable

Immutability of data has always been one of the blockchain's major drawbacks. It is obvious that it benefits a variety of systems, including supply chains, financial systems, and so on. The blockchain networks operate is having immutability that can only exist if network nodes are spread evenly.

Another issue is that data cannot be deleted after it has been written. The right to privacy belongs to everyone on the planet. If the same individual uses a digital platform based on blockchain technology, however, he will be unable to delete the trail from the system when he no longer wishes it to be there. In other words, there is no way he can erase his traces without jeopardizing privacy rights.

5. Blockchains are Sometimes Inefficient

There are several blockchain technologies available right now. There are a number of inefficiencies in the system, such as the blockchain technology utilized by Bitcoin. One of the major drawbacks of blockchain is this.

First and foremost, was inefficient at storing data, which might cause storage issues for numerous nodes that desire to join the network. Clearly, there must be a better method to manage this, given nodes must copy data everytime it is modified. Furthermore, as additional transactions and nodes are added to the blockchain, its size rises. If it continues to expand, the entire network will be slowed. This isn't ideal for business blockchains, since it's critical that the network be both fast and safe.

With the aid of other blockchain technologies, inefficiencies are gradually being reduced. Lightning networks are also being used by Bitcoin to address inefficiencies.

6. Not Completely Secure

Other systems are less safe than blockchain technology. This does not, however, imply that it is not totally secure. The blockchain network may be hacked in a variety of ways. Let's take a look at them one by one to see whether they make sense.

51 percent attack: A 51 percent attack occurs when an entity gains control of 51 percent or more of the network nodes, resulting in network control. They can change the data in the ledger and double-spend as a result of this. This is feasible on networks where miners or nodes may be controlled. This indicates that private networks are more resistant to 51 percent attacks, but public networks are more vulnerable.

3.6 FUTURE OF BLOCKCHAIN

Transparency, traceability, and sustainable trade are all factors that customers consider when selecting their supply chain and logistics suppliers. The sector's digital transformation is an apparent answer for improving visibility of performance in key areas, but outdated systems and manual processes make this a difficult path. Historically, these are industries that have struggled to integrate their networks and capture clean data, both of which are critical when adopting a more tech-driven business model.

The digital transformation is already yielding advantages, such as lower transaction costs, but data integration remains a challenge.

The ability to execute transactions swiftly and authenticate the production, transmission, and reception of a specific exchange of value is becoming

increasingly important for corporate success. Transparency and integrity are required to make supply chains robust, which is exactly what blockchain technology can provide.

Blockchain, also known as distributed ledger technology, has been around for a while, but like many new technologies, it takes time and experimentation to figure out how to effectively use it. Regardless, it was just a matter of time until it entered the logistical mainstream. It has the unique capacity to safely and permanently record transactions between parties as a technology, which means that if the industry can clean up its data, a completely new and more efficient method of working may emerge.

Blockchain in action

Walmart is focusing on food safety, monitoring, and traceability via blockchain. It has previously conducted testing utilizing this technology to track food goods from Mexico and China, such as mangoes and pigs. Walmart can ensure quality and food condition throughout transit by using sensors to monitor temperature in a blockchain system.

Unilever, Nestlé, and Dole all use similar techniques. Last year, it took specialists two months to track down the origins of a salmonella outbreak in Mexican papayas, thanks to blockchain technology. If a blockchain system had been in place at the time, such processes would have been shortened to seconds.

Meanwhile, the world's largest retailer is adopting blockchain-based technology. Lynx, a subsidiary of Alibaba, has revealed that blockchain has been successfully integrated into its cross-border logistics operations. Their system can maintain track of all important information about an imported consignment, including manufacturing details, transportation methods, customs, inspection, and even third-party verification.

While large corporations such as Amazon, Maersk, and Microsoft can afford to invest substantial sums in blockchain development, there are a slew of smaller tech firms devoted to realizing blockchain's full potential. In many situations, it is smaller start-ups that attract the attention of larger corporations, who then embrace their technologies. Looking at the big picture may teach you a lot.

Citizens Reserve, a California-based start-up, has announced the launch of Zerv Network, a permission-based blockchain technology aiming at becoming a "operating system for the supply chain." The network aims to allow frictionless transactions across all major actors in the supply chain, including manufacturers, suppliers, distributors, retailers, and consumers, thanks to an asset-based token.

Commercial process automation is also gaining popularity. Libelli, a startup, is working on a blockchain system that will function as an escrow agent between buyers and sellers. This method establishes a smart contract mechanism that eliminates the need for third-party companies such as banks and the standard letter of credit documentation. Services like Libelli can now uncover most inefficiencies in logistics and supply chain, particularly in product traceability, supplier payments, transportation, and contract bids.

ShipChain is a blockchain-based tracking startup that set out to create a complete solution. The system keeps track of items from the time they leave the plant to the time they arrive at the customer's doorstep.

A blockchain-based system records relevant data from all stages of the supply chain. Once defined circumstances are satisfied, the system may execute smart contracts; for example, once a delivery driver confirms a successful delivery, the system can immediately label the item as done and assign a new task to the driver.

Continuing the transformation

The physical product supply chain is one of the most important sectors where blockchain may make a major difference. Blockchain can facilitate an efficient

flow of data and cash from each stakeholder at each stage of the chain by placing assets first. This can enable fundamentally new methods of working and provide visibility and control over each supply chain that is just not possible in centralised environments where data must be sent from one environment to the next.

Transformation, on the other hand, is never simple, especially in the context of increasingly complicated supply chains involving many manufacturers, processors, and distributors. To promote adoption and offer advantages to supply chain players and end consumers, it will take collaborative participation and industry-level actions.

CHAPTER-4

BLOCKCHAIN IN AUTOMOTIVE SUPPLY CHAIN

4.1 AUTOMOTIVE SUPPLY CHAIN

In the past, logistics outsourcing in the automobile sector was confined to working with stand-alone transportation and warehousing service providers to move their products and materials abroad and inbound. The steady shift toward increased operational efficiency, just-in-time inventory procedures, and long-term supply contracting systems has altered logistics and supply chain management, as well as their outsourcing methods.

Several major integrated 3PLs now provide a variety of new value-added services, such as packaging, labeling, system support, and inventory management, among others. The increased sophistication in the demand for a wide range of automotive parts, the quality and stringent inventory requirements, and overall sophistication in the global logistics and supply chains has seen a sea change in the last two decades in particular, thanks to the scaled-up presence of Japanese and European firms in the automotive as well as in some key component industries.

With new cross-functional supply chain organizations such as Mahindra Logistics, TVS Supply Chain Solutions, TKM Global, TCI Supply Chain Solutions, TML Distribution Company Ltd, and others, new economies of scale have resulted in enterprise-wide technology platforms bringing together company-wide data and beginning to remove the old functional silos.

A single automobile comprises around 30,000 unique pieces, counting even the tiniest screws that go into the car manufacturing process. Hundreds of mechanical, electrical, and electronic sub-assemblies are outsourced from hundreds of component manufacturers/suppliers throughout the country and

around the world, in what amounts to one of the most complex supply chain network operations. Large global OEMs such as Toyota, Hyundai, and Renault, as well as Indian automakers such as Maruti, Mahindra & Mahindra, TVS Motors, and Bajaj, have made significant progress up the value chain in the previous decade or so.

High model turnover, rapidly changing end-user features, and rapid-fire modifications in automotive design, powertrain (engine), and fuel systems all result in continual renewal and refurbishment of supply chains that connect manufacturers with their supplier/vendor networks. For example, China is currently India's top supplier of automobile components. In reality, China accounts for about a quarter of India's car component imports.

South Korea and Germany come in second and third, with 13 percent and 12 percent, respectively. Concurrently, the Indian automobile industry's automotive component supply chains today cover numerous nations across the world and must be handled across great distances.

Both of these supply chains have varying levels of market risk, financial exposure, and working capital requirements in order to maintain the required inventory levels. As a result, the automotive components supply chain functions as one of numerous levels in the overall operation of the automotive supply chain. It does, however, account for the majority of automotive supply chain operations in terms of complexity and market worth. The component supplier universe includes a wide range of players, including OEM-owned captive manufacturing units, contract manufacturers working under OEM production and supply agreements, and independent suppliers who may or may not be part of the OEM's vendor network but meet the latter's quality and other technical specification standards.

The auto component industry in India is highly skewed, with a small number of large organized players well integrated into the OEM value chain, while the vast majority of auto component manufacturers are in the SME and unorganized sectors, primarily catering to aftermarket demand via a large number of stockists and dealers.

Significantly, the automotive spare parts logistics and SCM is segmented in terms of inbound supply chains that connect to automotive OEMs, as well as OEMs' outbound B2C supply of spares/parts to the Aftermarket segment, where parts are continuously replaced as part of regular maintenance, repair, and refurbishment services, under warranty services. The supply chains of auto component manufacturers thus include both B2B and B2C channels of market distribution.

Both of these supply chains have varying levels of market risk, financial exposure, and working capital requirements in order to maintain the required inventory levels. With hundreds of stockists and dealers competing, the aftermarket automobile parts industry is highly fragmented. The auto component industry's overall structural deficit in attracting new investment and development is due to its high degree of unpredictability and difficulties anticipating demand for components.

The problems of managing an on-site parts logistics and SCM operations to constantly feed the assembly lines, with the conclusion of its procurement cycle, are also issues for automobile manufacturers. In-bound and on-site supply chain management is a seamless activity that must be tightly coordinated and synced in order to maintain not only inventory flow to assembly-line activities but also to do so on a just-in-time basis, lowering inventory costs. Even the loss of a single critical just-in-time component might stifle or halt the production process. This necessitates a high degree of coordinated SCM planning as well as a dynamic inventory replenishment strategy.

New integrated automotive logistics and SCM solution providers have come in with their suite of services and turnkey installation of their systems at this point in the automotive value chain. Partnerships with OEMs and other manufacturers for logistics and supply chain solutions are expected to grow into new modalities of partnership contracts and service agreements. While OEMs aim to exit supply chain management entirely, automotive logistics giants will come in and fill new functional responsibilities such as inventory planning, production scheduling, warehousing, and so on.

Automotive manufacturers are increasingly resorting to new business models for partnering with integrated logistics and supply chain management partners that can function as a one-stop shop for virtual ownership and administration of the whole train of incoming and outgoing logistics.

The post-production phase currently presents yet another unique challenge for OEMs and other manufacturers, in what is known as finished automotive logistics, involving multi-modal logistics services such as road hauliers, railways, and shipping (car carriers vessels) services for both domestic and export markets. The majority of domestic finished automobile logistics for fulfilling domestic demand is transported by road, with a minor fraction additionally transported by railways. Because domestic car demand is rising at an exponential rate, road transportation of automobiles has reached a point of saturation, and there is ample rationale for railroads to step in to fill the vacuum.

Even inland waterway vessels have been utilized to move automobiles in recent years. Huge cross-docking yards for parking high numbers of export cars are available in the seaports of Chennai, Mumbai, and Mundra, which handle large amounts of automobile export.

With the automotive manufacturing increasingly becoming automation-driven, involving robotic manufacturing and assembly operation, the automotive

manufacturers are increasingly turning towards new business models for engaging with the integrated logistics and SCM partners, who can act as one-stop solution for virtual ownership and management of the entire train of inbound and outbound logistics and supply chain management, including on-site in-plant logistics, warehousing and distribution activities.

A few firms employ the Lead Logistics Partnership (LLP) model to satisfy all of their logistics and supply chain management demands. Ford India, for example, which formerly used a 3PL outsourcing model, has switched to an LLP with Penske Logistics. Ford Motor Company has also entered into an LLP arrangement with DHL Supply Chain for its European operations. TCI SCS is one of India's major LLP service providers, having Toyota, General Motors, Tata Motors, Maruti Suzuki, and two-wheeler manufacturers Bajaj Auto and Hero Motocorp among its clients.

TVS SCS collaborates with some of the world's major car manufacturers and Tier 1 suppliers. LLP serves as a template for collaborative manufacturing, with the LLP handling not just the physical flow of materials but also the whole supply chain iteration sequence, including spare parts distribution, point of use feeding, value-add assembly, kitting, and sequencing, among other things.

Aspirant SCS providers, such as TVS SCS, are currently serving to a wide range of sectors that require integrated supply chain solutions. As the LLP concept catches on with more automotive OEMs and the supply chain becomes more complex, we could see the emergence of pure play Automotive LLPs taking on the collaborative business space in a big way. As automotive OEMs focus more vertically on R&D, non-polluting engine drives and propulsion fuels, other powertrain and dashboard innovations that transform the concept of vehicle use, we could see the emergence of pure play Automotive LLPs taking on the collaborative business space in a big way.

4.2 ISSUES IN AUTOMOTIVE SUPPLY CHAIN

The automotive supply chain, which manufactures automobiles, trucks, and other vehicles, is one of the world's most complicated. It's also getting increasingly global, second only to the electronics industry in terms of worldwide suppliers, manufacturers, and other third parties. Globalization adds a level of complexity to the automotive supply chain that requires car manufacturers and brands to come up with viable solutions.

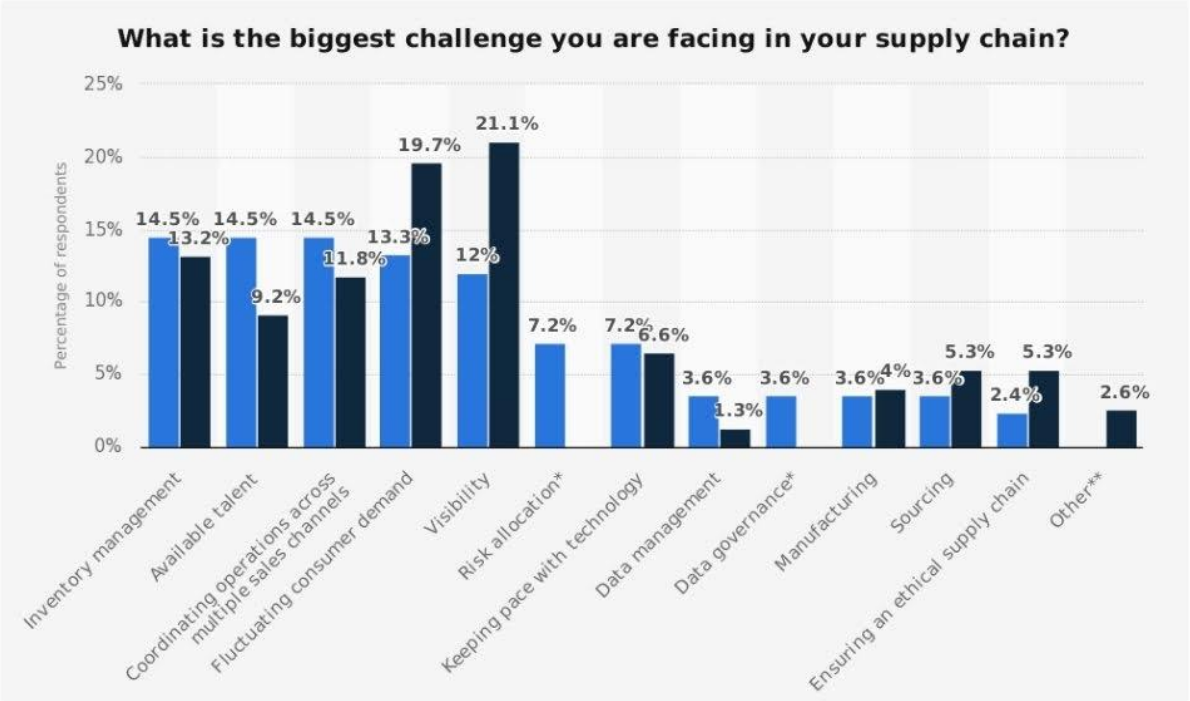

Fig 1.4 Challenges faced by supply chains (Source – Google Scholar)

Globalization isn't the only thing causing problems for car suppliers and manufacturers. The vehicle supply chain network for raw materials, parts, and completed vehicles is impacted by changes in production methods, customer expectations, and new, disruptive developments. Internal and external pressures force automotive supply chain managers to save costs, improve manufacturing and distribution, and guarantee that parts and products reach the right people at the right time.

1. Delays in automobile manufacturing are caused by poor visibility and routing of parts.

Around 30,000 separate pieces make up the average car. Each of the components is either made in-house or purchased from a third-party supplier. The manufacture and delivery of key components can be slowed by a single segment of the supply chain, resulting in the production line being shut down.

Any disruption in the seamless manufacture and distribution of automobiles implies inventory shortages and revenue loss as automakers and brands migrate toward just-in-time manufacturing. To simplify components manufacturing and delivery, automotive supply chain managers must be able to collaborate effectively with thousands of manufacturers and suppliers.

2. The Automotive Supply Chain is Significantly Disrupted by External Factors

The automobile industry's worldwide character makes it extremely vulnerable to external political, economic, environmental, market, and other issues. Tariffs, trade agreements, and political maneuvering may all affect the cost of importing and exporting components and cars. Large portions of the automotive supply chain can be disrupted by natural catastrophes. Changing consumer expectations, such as the transition to more electric vehicles and improved fuel efficiency, are causing purchase patterns to alter.

Automotive supply chain managers need to be aware of these risks as soon as possible so that they can assess the potential effect and plan accordingly.

3. Automotive manufacturers' profitability is harmed by a lack of visibility and high fixed and variable costs.

Throughout the supply chain, automotive manufacturers have significant fixed and variable costs.

- Investments in machinery, automation, and production lines are among the costs.
- Employee retirement and pension plans
- Research, development, and other forward-thinking tasks
- High staff pay owing to technical skills and unionization
- Commodities expenses for steel, aluminum, rubber, textiles, and other raw materials

Third-party costs from automotive suppliers, manufacturers, and logistics providers for running machinery and maintaining a healthy and safe working environment. Because these costs may have a major influence on pricing points and profit margins, it's critical to have insight into fixed and variable expenses.

4. Poor manufacturing results in product failure and recalls.

Automobile recalls have been a problem for certain vehicle manufactures in recent years. A lack of supply chain management and auditing can lead to quality concerns, resulting in cars that don't function as intended. This hurts businesses' reputations, reduces income, and leads to inefficiency and waste.

4.3 BLOCKCHAIN IN AUTOMOTIVE SUPPLY CHAIN

The 90% of the difficulties experienced by the car supply chain may be alleviated by incorporating blockchain technology into the supply chain.

The openness provided by distributed ledgers in the automobile sector may help ensure that production, shipping, and suppliers all view the same supply chain, making the insertion of counterfeit components almost impossible. Furthermore, multiple blockchains could be used to manage the massive amounts of data generated and monitored on a daily basis by automotive manufacturers and suppliers: one blockchain could contain vehicle component bills of lading, another could contain quality-inspection records created during the

manufacturing process, and yet another could store WIP information for each vehicle assembly from start to finish.

Smart contracts may also be incorporated in manufacturing blockchains to release purchase orders automatically at specific stages of the production process. Contracts might be automatically granted to the provider with the most inventory on hand, which would improve supply chains.

Blockchain technology, among other emergent digital breakthroughs, appears to be gaining momentum in a variety of industries. In the next years, the potential of Blockchain supply chain growth for the automobile sector will be evident.

Fig 1.5 Applications of blockchain in Supply Chain (Source – Google)

Getting to Know Blockchain

In essence, blockchain technology has laid the groundwork for a new kind of internet. It allows for the transfer of digital data but not its duplication at the same time. For a better understanding of the protocol, imagine a Google spreadsheet exchanged thousands of times over a computer network. Consider that the network updates this spreadsheet on a regular basis, and you have a good sense of what blockchain is. Add features of blockchain to the spreadsheet, such as an

immutable ledger, consensus process, cryptographic encryption, and so on. It's a brilliant innovation that, if employed as the underlying infrastructure, has the potential to transform the whole automotive supply chain.

4.4 ADVANTAGES OF BLOCKCHAIN IN AUTOMOTIVE SUPPLY CHAIN

1. Streamlined Administration

The use of blockchain technology speeds up administrative supply chain procedures, lowers extra expenses, and ensures transaction security. By eliminating supply chain middlemen and intermediates, fraud risks are reduced, the commodity is duplicated, and money is saved. Instead of relying on EDI, customers and suppliers may coordinate payments inside the supply chain utilizing crypto currencies. With proper record keeping, it would also boost production and decrease the risk of missing items.

2. Trust and Security

For smooth operations, numerous actors in complicated supply chains must be trusted. If a producer distributes his goods via suppliers, for example, he should be able to rely on them to maintain factory safety requirements. When it comes to regulatory compliance, such as custom enforcers, trust is also important. The irreversible function of blockchain in the supply chain effectively prevents tampering and builds trust. By storing data across its network, the blockchain eliminates the risks associated with centrally managed data.

Its infrastructure is devoid of core vulnerabilities that hackers may exploit. We all have security worries when it comes to the internet these days. We all use the "Username / Password" method to protect our online identities and properties. Encryption technology is utilized by blockchains as a security measure.

The reason for this is because of the public and private ‘keys.' On the blockchain, a user's address is represented by a 'public key' (a lengthy, randomly generated string of digits). Cryptocurrencies transferred over the network are still associated with that account. The 'private key' functions similarly to a code that grants access to the owner's digital assets. The data is incorruptible once it is stored on the blockchain. If this is correct, it would also need the printing of the private key and the creation of a physical wallet to protect digital assets.

3. Better data management

Automotive supply chain managers may utilize blockchain to solve a variety of supply chain issues, such as maintaining complicated databases and tracking items and services. Another benefit is that it is a considerably less corruptible and automated alternative to centralized databases.

A blockchain-based automotive supply chain management system provides for accurate record-keeping and provenance tracking in the field of monitoring and testing products and services, as product information is available via integrated sensors and RFID tags.

Blockchain can track a commodity's journey from its beginnings to its current location. Furthermore, this type of precise provenance monitoring may uncover fraud at any point of the supply chain.

The automotive supply chain is a large and dynamic industry with many actors, ranging from components suppliers to manufacturers to sellers. A assessment of existing infrastructure and business processes, as well as solutions that respect privacy, confidentiality, and authorization permissions, are all part of delivering genuine customer value. Blockchain has the potential to be an excellent solution. Automotive manufacturers may utilize blockchain to defend their trademarks against counterfeit goods and create customer-centric business models.

4. Countering Component Counterfeiting

Falsified goods are a significant source of worry for vehicle manufacturers. The global demand for counterfeit replacement parts is estimated to be in the billions of dollars. Such items may pass through the supply chain either directly or indirectly. They might also obtain them from OEM and aftermarket vendors. False replacement parts are untrustworthy since their quality typically deteriorates and they frequently appear to malfunction. End-users are inevitably disappointed, and their confidence in the brand is eroded. Using blockchain technology to combat counterfeit goods is proving to be a huge success, since it allows for precise identification and digital representation of replacement components. The framework is made clearer by digital spare parts recognition, which may be shared across network members.

5. Augmented Inbound and Outbound Logistics

The automotive supply chain will be more efficient thanks to inbound logistics and blockchain-based manufacturing enabled by blockchain smart contract technologies. Individual components of an incoming supply chain are now difficult to analyze and error-prone.

Coordination between multi-tier suppliers, third-party logistics, and transportation firms via the production site is critical to the supply chain's performance. Businesses can assure the availability of reliable and real-time information from multiple sources by adopting blockchain. Individual parts should be checked for status, amount, and location by those involved.

The outbound supply chain, like the inbound supply chain, is a complicated web of manufacturers, suppliers, importers, and dealers. These participants also lack a common data-sharing methodology, making it difficult for them to communicate information. A blockchain-based decentralized architecture can

improve accessibility and accountability, resulting in faster transactions and shorter settlement times.

6. IoT and Blockchain Technology

According to Gartner, blockchain will enable the worldwide movement and annual monitoring of 2 trillion dollars in products and services by 2023. However, without the help of integrated IoT systems, this expansion is improbable. Track-and-trace precision and scalability improve as a result of combining IoT's real-time tracking and decentralized distributed ledger blockchain, enhancing the efficiency of the automotive supply chain.

Both ideas work together to improve the dynamic interactions within the automotive supply chain. While this appears to be a nice idea, further research may be required to determine how these activities will be carried out. Every supply chain has incoming logistics and outgoing deliveries. These terms refer to the components of a product as well as how the completed product is delivered to end users.

4.5 IMPACT OF BLOCKCHAIN ON AUTOMOTIVE SUPPLY CHAIN

The following are the impacts of implementing blockchain technology on automotive supply chains.

1. Faster, Cheaper Transaction Settlement

Companies are continually and significantly investing in order to achieve quicker transaction settlement. By automating its payment settlement operations in 1999, GE saved $1.8 billion. When an unidentified European carmaker used digital buy cards, they saw a 75–80% decrease in order processing time, a 50% reduction in processing expenses per purchasing transaction, and a 5–12% increase in purchasing costs.

On the other hand, time-consuming cross-border payments, which are common in many supply chains, cost the system $1.6 trillion every year. This all goes to illustrate that supply chain financial efficiency reaps concrete, considerable advantages, while disregarding efficiency reaps a high price. The blockchain enables transaction settlement to be completed more quickly by:

a) Processing peer-to-peer payments without the need of a third-party,

b) Automatically and instantly updating ledgers, and

c) Executing both sides of a transaction at the same time. Fewer middleman fees, the comparatively low cost of processing power, and fewer reconciliation procedures all contribute to lower costs when paired with transaction speed.

2. Audit Transparency

When Lumber Liquidators was exposed by 60 Minutes in 2015 for selling Chinese-made laminate flooring with formaldehyde levels 20 times higher than California's statutory "safe" threshold, it was apparent that they had a significant supply chain management problem. Their stock would eventually plummet from roughly $52 to under $16, with their inadequate supply chain control serving as the cause.

Other supply chain breakdowns are more serious; in the aftermath of Hurricane Maria in 2017, at least 10,000 containers of food, water, and medication remained stranded at the island's Port of San Juan, with multiple supply chain breakdowns impeding their delivery.

Supply chain auditing is an important activity for companies who want to avoid such breakdowns in the first place. Clear auditing methods are essential for streamlining supply chain operations to achieve sustainability and cost savings. Determining the audit's methodology and scope may be difficult, and strategic errors can be costly.

While a good audit relies significantly on the auditor, thoroughly exploring and scrutinizing a supply chain necessitates the use of the appropriate tools. The blockchain is interoperable, and when used across a supply chain, it may provide a clear picture of inefficiencies while retaining pseudo-anonymity for each account. Auditors can conduct their work more cost-effectively and comprehensively with this mix of accessibility, openness, and reasonable anonymity, and the blockchain can be just the instrument to find and remove inefficiencies without interrupting the flow of everyday supply chain activities.

Finally, the blockchain may assist supply chain auditors in making better judgments about which suppliers to audit, where to spend auditing resources, and what recommendations to make based on their findings.

3. Tracking Social Responsibility

Consumers have spoken, and they expect businesses to deliver things without making them feel bad. Consumers expect businesses to take action on social and environmental concerns, according to 86% of respondents. They're also willing to do their part, with 81 percent saying they'll make personal sacrifices to solve social and environmental concerns, implying that they'll choose companies that align with their values. 66 percent of consumers, including 73 percent of millennials, are ready to pay more for a “sustainable brand” goods.

Though millennials are unlikely to see all of the $30 trillion that baby boomers are expected to pass to them, companies would be well to embrace provenance for socially responsible production techniques today to market to an awakened generation with new money. The capacity of the blockchain to track items' movement through a supply chain creates a record that gives simple access to each individual product, showing that the product's road to shelf was not created on the backs of children or via other immoral means. Make no mistake: millennials will be rushing in with avocado toast in hand.

4. More Accurate, Usable Costing Information

Costing data that is accurate Inadequate technology and software, according to 39% of supply chain managers questioned, is a barrier to meaningful costing information, while 30% mention opposition from accounting and finance employees to upgrading systems as another reason supply chain costing systems suffer. The demand is real: according to one research, 88 percent of businesses have significant cost-cutting targets, yet only 17 percent of them are met. Given that data system disconnect costs about $223 billion each year, technology is at the heart of these costly data issues. Another issue that supply chain managers experienced while trying to enhance their cost estimation and forecast methodologies was an over-reliance on external financial systems.

Each of these problems may be solved by implementing blockchain technology, providing that all parties are ready to adapt. The adequate technology supply chain manager's desire for a single, shared record of costing information on which costing data can be stored and accessed would represent the necessary break from external financial records systems to an interoperable one to which all necessary parties have access and oversight would be represented by a single, shared record of costing information on which costing data can be stored and accessed.

5. Better Shipping Data

The immediate influence of delivery accuracy and punctuality on a brand cannot be overstated. According to one poll, 89 percent of consumers are concerned about receiving a product late, and 83 percent are concerned about the goods being damaged. Given that 94 percent of consumers blame retailers for poor delivery, 47 percent of respondents said they wouldn't shop at a retailer again after a bad shipping experience, and that demand for fast, low-cost delivery is at an all-time high, the need for more accurate, real-time shipping data is greater than ever.

In one poll, just 12% of supply chain managers thought their maritime supply chain partners were “very effective” in collaborating and sharing data, while 32% said they were only “somewhat effective.”

90% of respondents stated real-time data access and improved information sharing tools are needed to enhance this, with 82 percent saying the industry needs to increase supply chain visibility. Naturally, the blockchain's shared, decentralized ledger technology is ideal for the task, since it provides a consistent method of recordkeeping that is accessible to all supply chain participants and can be updated in real time. Whether it's raining, hailing, sleeting, or snowing, blockchain technology will ensure that deliveries arrive on schedule and that items are on the shelves when they need to be.

6. Preventing Compliance Violations

The cost of compliance in shipping is expensive, and staying on the right side of the law is difficult, yet disregarding those expenses can result in outrageous fines. Weatherford International Ltd., a Texas oil firm, was fined the largest-ever penalties for non-compliance relating to shipping in 2013 when it was discovered to be shipping to sanctioned nations including Cuba and Syria. The fine is $100 million, which includes a civil penalty of $50 million, a monetary penalty of $48 million, and a criminal fine of $2 million.

The web of regulation that governs supply chains — particularly those that are international in nature — is intricate, as evidenced by Europe's REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) and RoHS (Restriction of Hazardous Substances), a proposed conflict minerals framework, and China's Due Diligence Guidance for Responsible Mineral Supply Chains. A breach of American trade compliance rules can result in a civil penalty of up to $1 million, 20 years in jail, and extra fines of up to $250,000 per transaction.

The more data supply chain managers have, and the easier it is for them to check into what their suppliers are doing and how they're doing it, the more likely they are to avoid these high penalties for noncompliance. The blockchain is the decentralized, interoperable record that supply chain managers not only want, but also must in order to avoid large penalties and perhaps jail time.

7. Provenance

Only 17% of businesses will not be exploring or implementing supply chain automation by the end of 2018. Given the importance of provenance to customers, distributors, and retailers, blockchain technology's capacity to capture every transaction on a permanent record, whether financial or a physical exchange, is a huge plus.

The physical benefit of provenance is apparent, whether in art, food service, medicines, or elsewhere: in England, overseas shoppers were willing to spend 22% more for British-made items. Even uncommon provenance merits, such as the capacity to establish that a celebrity formerly owned a piano or desk, may boost an item's value by as much as 15%. Consumers want provenance today more than ever, whether for ethical reasons, fear of counterfeit goods, health concerns, support for homegrown companies, or other reasons, and the blockchain gives us the means to meet that need.

8. Reducing Human Error

According to one auditor, the average shipper loses $50,000 to $150,000 per year due to human mistake in the invoice process, and this is only one link in the supply chain where unnecessary expenditures might occur. Manual supply chain management systems are famously prone to human mistake. A 2% mistake rate, or 20 cells in a 200-cell Excel spreadsheet, is common for even the most meticulous and competent data entry. The logistics sector's margins are already poor, if they exist at all, generally ranging between -1 and 8%.

In the year following a supply-demand disruption, companies affected by supply chain mistake reported an 11 percent rise in expenses, a 14 percent increase in inventory, and a 7% loss in revenue, demonstrating the importance of avoiding human error in supply chain operations. Blockchain supply management solutions are intended to decrease reliance on people by automating transactions, recordkeeping, data input, and inventory monitoring systems in a faster and more cost-effective manner, even before accounting for the expenses saved by eliminating unavoidable human errors.

9. Automation

A transparent supply chain generates predictable cash flow. A single advanced industry supplier generated $75 million in free cash flow after automating its inventory planning procedures. According to a survey of 337 global manufacturing executives, 33% are unsatisfied with their digital supply chain transformation's pace, while 94 percent feel supply chain visibility tools are a significant driver of good change. In fact, 95% of the executives polled believe that even more supplier procedures will be automated in the next five years.

The links are obvious: supply chain visibility is connected to productivity, and automation helps supply chain managers to process data at a faster rate, resulting in more visibility. The blockchain is one of the most dependable, sophisticated, and secure ways to automate supply chain operations, and it plays a key role in reducing waste and keeping more cash on hand at any given time.

10. Automated Purchasing and Planning

One IT business cut end-to-end processing time in half by automating 95 percent of their order-to-ship procedures. Because they had more information on hand sooner, they were able to arrange goods and coordinate parts of the supply chain more accurately as a consequence of faster processing. There's a reason why 66 percent of supply chain managers want sophisticated supply chain analytics: in a

consumer market where orders must be completed almost quickly and product shelf life is short, analytics equals significant cost savings.

That's why, according to one poll, 44% of respondents are upgrading their Enterprise Resource Planning (ERP) systems to improve supply chain visibility. The blockchain is another another way to unify and therefore extend the supply chain record, increasing the speed and depth with which information is transmitted to assist managers in making more educated, cost-effective purchasing decisions.

11. Reducing Counterfeit Goods

As if the $4.2 trillion predicted to be siphoned from the worldwide economy by counterfeit and pirated goods wasn't bad enough, the 5.4 million jobs expected to be jeopardized by the global black market by 2022 is a pinch of salt in an open sore. While the United States Customs and Border Patrol put in the effort, seizing 31,000 counterfeit items in 2016, no human power can match the insomniac nature of counterfeiters and peddlers of counterfeit goods.

The cost of manually screening $11 billion worth of overseas products entering the United States each day is simply too high. Individual items may be traced more accurately along the supply chain with the use of QR, NFC, or RFID tags registered on an interoperable blockchain ledger, guaranteeing that the product on the shelf or in the customer's hands comes from a respectable provider. When blockchain is used in conjunction with end-to-end supplier logs and workflow monitors, there will be fewer loopholes through which counterfeit items may enter the consumer supply chain.

12. Enforcing Tariffs and Trade Policies

The US Department of Justice has charged a subsidiary of Chinese aluminum producer China Zhongwang of evading $1.5 billion in import taxes. Furthermore, the estimated $200 billion in American commercial secrets stolen by Chinese

firms each year demonstrates the utter disdain for international regulations. This demonstrates why $50 billion in tariffs on Chinese-made goods have been imposed, as well as the necessity for more reliable trade supervision mechanisms.

Even if tariffs are imposed, the practice of funneling a large number of items via a non-sanctioned country, placing a "Made in Vietnam" tag on them, and avoiding increased prices is just too easy. Those who suggest the blockchain as a way to track all items from their original maker using an immutable record of transactions think that under such conditions, tax and regulatory evasion in international commerce will be far less common.

CHAPTER – 5

FINDINGS

From the analysis of the impact that the blockchain technology can bring in the supply chain especially in the automobile sector the findings are as follows:

1. There is an emerging growth of technological adoption in the supply chain.
2. Blockchain is one among the major technology adopted by many global giants in their supply chain.
3. Since, the automotive supply chains are very much complex in nature, the adoption of the blockchain technology has minimised the complexity.
4. In an automotive supply chain, the number of participants involved in a single transaction is numerous which piles up the data to be stored. With the help of blockchain proper data management is an ease.
5. The blockchain provides traceability and transparency into the supply chain which reduces the counterfeiting of goods.
6. Efficiency and accuracy can be incorporated into the supply chain with the help of blockchain.
7. Due to the specialized coding system in blockchain data manipulation and unauthorized access to the database is prevented which ensures more accurate information.

CHAPTER-6

CONCLUSION

Due to the extreme tremendous developments in blockchain technology, blockchain might provide a solution to many of the industry's current challenges within one to two years. Companies must assess their strategic goals, identify which blockchain technologies are most suited for them, and choose how to invest in order to reap the potential advantages.

The COVID-19 epidemic has claimed many lives and wreaked havoc on the worldwide economy. Our supply networks have also exposed flaws as a result of it. Not only have businesses had to locate new suppliers when their Asian sources shut down, but for the first time in decades, the Western world has suffered widespread shortages of critical consumer packaged products. The use of blockchain technology has the potential to reduce the impact of pandemics.

Blockchain, when combined with other breakthroughs like additive manufacturing, artificial intelligence, and the Internet of Things, has the potential to solve long-standing issues that make delivering goods to customers so sluggish and expensive, especially during times of crisis. Today's supply chains are intricate, involving the transportation of goods through trucks, aircraft, boats, and trains. Too many parties rely on a jumble of paperwork and middlemen to conduct commerce, making the whereabouts and possession of items a mystery.

Individuals and organizations may manage and exchange their assets digitally for the first time in human history. They will redefine global trade and the way we exchange value as a result of this. Operations, logistics, procurement and purchasing, transportation, customs and border control, trade finance and insurance, manufacturing, and inventory management will all be transformed as

a result of this. At every level and in every position, global supply networks are ripe for disruption.

The book Supply Chain Revolution highlights what CEOs should be doing right now to prepare their companies for the inevitable decentralization that is coming. Executives and entrepreneurs will find ideas and possibilities to discuss with their stakeholders and choose the best way to engage in the blockchain revolution.

BIBLIOGRAPHY

BOOKS:

1. Nick Vyas, Aljosja Beije, Bhaskar Krishnamachari (2019) “Blockchain and the Supply Chain -Concepts, Strategies and Practical Applications” , Kogan Page
2. Don Tapscott (2020) “Supply Chain Revolution How Blockchain Is Transforming the Global Flow of Assets” , Barlow Book Publishing
3. Remko I. van Hoek, Matthew A. Waller, Remko van Hoek, Marat Davletshin, Brian Fugate ·(2019) “Integrating Blockchain Into Supply Chain Management - A Toolkit for Practical Implementation” Kogan Page
4. Anthony M. Pagano, Matthew Liotine · (2019) “Technology in Supply Chain Management and Logistics - Current Practice and Future Applications” , Elsevier Science
5. Martin Christopher · (2016) “Logistics & Supply Chain Management” , Pearson Education Limited

WEBISTES:

1. https://www.atato.com/2020/06/10/blockchain-and-supply-chain-what-is-the-big-deal/
2. https://www.disruptordaily.com/blockchain-use-cases-supply-chain-management/
3. https://www.blockchain.com/
4. https://medium.datadriveninvestor.com/how-is-blockchain-technology-impacting-the-automotive-industry-728875a7c940
5. https://www.blumeglobal.com/learning/supply-chain-challenges/
6. https://www.sigmagrp.co.uk/blockchain-the-future-of-supply-chain-management/

7. https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/consumer-business/deloitte-cn-consumer-blockchain-in-the-automotive-industry-en-180809.pdf
8. https://101blockchains.com/history-of-blockchain-timeline/
9. https://yorksolutions.net/the-future-of-blockchain-technology/#:~:text=Blockchain%20is%20an%20emerging%20technology,still%20mixed%20about%20its%20potential.&text=By%202022%2C%20at%20least%20one,to%20more%20than%20%243.1%20trillion

GLOSSARY

Blockchain – A growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp and transaction data.

Crypto currency – A digital asset designed to work as a medium of exchange that uses strong cryptography to secure financial transactions, control the creation of additional units, and verify the transfer of assets.

Supply chain – It is the network of all the individuals, organizations, resources, activities, and technology involved in the creation and sale of the product, from the delivery source materials from the supplier to the manufacturer, through to its eventual delivery to the end user.

Automotive supply chain – The supply chain in which automotive sector is the industry is known as automotive supply chain.

Distributed Ledger – Is a consensus of replicated, shared, and synchronized digital data geographically spread across multiple sites, countries, or institutions.

Encryption – The process of converting information or data into a code, especially to prevent unauthorized access.

Ledger – Written or computerized record of all the transactions a business has completed.

Logistics – The management of the flow of things between the point of origin and point of consumption in order to meet requirements of customers or corporations.

Smart contract – Also known as a crytpcontract, is a computer programme that directly controls the transfer of digital currencies or assets between parties under certain conditions.

Smart property – Is a ownership of person that is controlled using a bitcoin via the blockchain network.

Cryptography – A method of protecting information and communication through the use of codes so that only those for whom the information in intended can read and process it.