

# Sustainability in Supply Chain with Blockchain: Understanding the Adoption Barriers and Scalability Solution

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**Abstract:** *The drastic increase in globalization across the globe has made traditional supply chains more complex and their management a daunting task for organizations. Blockchain Technology, which can be described as a distributed, decentralized, digital ledger that is immutable and consists of blocks to record transactions, is set to transform the Supply chain and logistics industry. Previous studies have suggested that blockchain can play a pivotal role in sustainable supply chain management. Despite regular advancements, the supply chain industry is yet to adopt and trust blockchain technology for its regular use. In this research paper, we have discussed major adoption barriers among institutions. In addition, this study illustrates a possible solution to some of the barriers especially for the sustainability and scalability of blockchain-based supply chains.*

**Keywords:** Blockchain, Sustainability, supply chain

## 1. Introduction

Over the past three decades, we have witnessed new technologies making their way into our lives. The first technology that comes into mind is the evolution and emergence of the internet as the disruptive technology, which had shaken many industries. Initially, the adoption of the internet or digitalization was slow until its real potential was discovered and recognized. The current blockchain advancement fairly takes after the beginning of web reception [1]. Like all the other sectors, the Supply chain industry has started to consider the benefits blockchain could bring in its functioning. Earlier the finance sector was the first one to view it as the technology that could have a disruptive impact in their domain. However, other sectors like Global Supply chains, agriculture, and healthcare have started to adopt blockchain technology, as its use cases are growing day by day.

The nature of global supply chains has become more complex and complicated, made out of various associations scattered across different levels and various geologies. The internet adoption had digitalized the supply chain systems with several benefits. Now blockchain technology has the same disruptive potential. Blockchain is a relatively new technology and it's in the early stages of advancements, but still, it holds diverse

and promising benefits. Blockchain innovation has all the earmarks of being an ideal answer for existing Supply chain network issues. Organizations are still in speculation of being the early adopters or whether they should give this technology time to grow, which means more cost-effective adoption. Every technology has late and early adopters.[2]

Consumers around the world are knowing the importance of a sustainable system in place. This is one of the reasons why companies are looking towards more sustainable solutions in every aspect. Sustainable supply chains are the need of the hour. Blockchain provides the solution to many supply chain issues. Blockchain technology is immutable, decentralized which can solve issues of trust between stakeholders. By the integration of technologies like IoT (internet of things), which uses radio frequency identification tags to track and trace the products, the transparency in the supply chain and traceability of products will increase. The sustainability of the supply chain includes threefold sustainability which is social, economic, and environmental. The adoption of blockchain in the supply chain industry is still a slow process. Many big companies are the early adopters and some pilot projects are being run before full-scale adoption, for instance, Maersk being the biggest logistics company has started to invest in blockchain-based solutions. Traceability and reduction of workload can be ensured by blockchain technology. Other than the undeniable worth of traceability, enormous advantages can be procured in the wording of decreased work expenses and food wastes[3].

Despite blockchain having so many promising benefits its adoption in the supply chain industry is facing some resistance. In this paper, we tried to understand the adoption barriers and challenges from a sustainable supply chain perspective. The scalability of the blockchain-based supply chain is another concern we addressed by providing an alternative solution that can solve the scalability problem. There has been a lot of discussion and researchers have provided different frameworks and theories to adopt blockchain in the supply chain industry. But still, there is a gap in this field and through this study, we have tried to make a bridge and connect some of the dots for a future reliable and sustainable supply chain management which can fully

utilize the potential of blockchain technology. In the next section, we have shown some of the work that previous researchers have done.

The rest of the paper is organized as follows. Blockchain and its evolution are discussed after understanding the previous works of other scholars. Then we provided a brief description of the Blockchain-based supply chain and its benefits. Sustainability in the blockchain-based supply chain is discussed in the following section. After that, barriers and challenges in blockchain implementation has been presented. The next section discusses potential solutions to the scalability issue in blockchain-based supply chains which is then followed by concluding remarks.

## 2. Literature review

The study of blockchain-based supply chains has been an area of research that has fascinated many scholars across the world. Several industries like finance and energy have successfully utilized blockchain technology. For the supply chain, many types of research have been done, which have presented a different view on how blockchain can disrupt the supply chain industry, but without any concrete results. Many adoption frameworks have been presented by researchers based on supply chain applications in reference[4], the author highlighted some existing challenges in the global supply chain industry and trade operations. The study also highlighted the capabilities and potential of blockchain in transforming the supply chain industry. Examples of some Pilot projects were introduced and their working was analyzed. [3]highlighted some key goals like expense, quality, speed, reliability, hazard decrease, maintainability, and adaptability that blockchain can achieve in supply chains. The study presented early evidences connecting the utilization of blockchain in supply chain exercises to increase transparency and accountability. Several contextual analyses were considered at different stages of the supply chain in which blockchain can help to accomplish. The study suggested that food supply chains will be the most affected by blockchain adoption but no stable framework has come to prove it so far.[5] The study showed different tasks in supply chain blockchain can affect and affect business models.[6] The authors in this study provided how supply chain sustainability can be achieved by blockchain and industry 4.0 like IoT and as an enabler for the successful implementation of sustainability and circular economy concepts. In Reference [7], the creators utilize the technique 'attributes of innovation framework' to recognize the potential blockchain applications and present a system explaining four change stages to in this manner order the distinguished spaces of use as per their consequences for authoritative designs and cycles. [8]This study suggested that the limitations in technical infrastructure and lack of transformative changes will become an obstacle for

several 'blockchain for good' projects to attain sustainability despite them having admirable goals. [9]Reviewed previous literature and contributed by analyzing blockchain technology as a promising paradigm for sustaining supply chain operations. [10] In this study the authors proposed a model on the utilizations of blockchain technologies in sustainable manufacturing. The model gives a reference for the of blockchain technology to sustainability.

## 3. Blockchain technology and its evolution

Today as we are moving towards revolutionizing changes in different industries, most of our databases use a centralized system which is a client-server-based architecture. In these types of systems, there is a client(user) who will have the position to change or alter the information in the incorporated server. Every step in this type of architecture goes through a centralized system which in turn has a potential one-point failure. The centralized authorities possess all the control of the database. They can control and also take decisions about the number of significant consistency strategies which may be characterized on the information put away in the data set. Users' credentials will be authenticated, before they can access the data, by the centralized authorities. To conquer this sort of issue in the conventional concentrated frameworks, blockchain can be a successful arrangement.[11]

Blockchain can be described as a decentralized, immutable digital ledger that stores transactional data in terms of blocks. It is a chain of blocks linked together with cryptographic links. The linkage of Blocks makes the blockchain a tamper-proof solution to the traditional database system. Once data is stored or distributed in the blockchain by the addition of a block it cannot be modified or tempered. The validation of a new block requires authentication from a distributed system since it has no centralized controlling authority. Therefore, if a block is validated only then it can be added to the chain, hence it is called a blockchain. Whenever a block is created it produces a cryptographic hash function, which simply takes an input and creates a cryptographic string of fixed length, it helps in creating transactional hashes to encode the transactional data. Several difficult problems are solved by the programmers or so-called miners to add a block to the blockchain. The process of adding a block to the blockchain is time-consuming and requires a lot of computational power. The inclusion of a block to the blockchain follows a consensus mechanism that runs across the network. The trust factor in blockchain comes from the fact that when a chain becomes long enough it becomes harder and harder to make any changes or modifications in previous blocks. Each block added to the chain is linked to the previous block in a certain way which makes it extremely difficult to remove [12]

The early glimpses of blockchain technology came in 1991 when Stuart Haber and Scott Stornetta introduced how blocks can be connected by cryptographic chains.

Almost after two decades and several advancements to the field, a person (or group) named Satoshi Nakamoto made the first ever blockchain network in the year 2008[13]. In his paper he introduced a hash function method that created blocks in chains. This network was Bitcoin, the first blockchain network that revolutionized architecture. Their attempt of his was to create a distributed architecture that is decentralized and every entity has equal weightage on the information added. Since then, blockchain is widely used in every industry. It has evolved to be technology that will carve the way for a decentralized, transparent, and tamper-proof future. The technology has use cases in financial organizations, healthcare systems, supply chains, etc. Companies like Walmart and IBM are early adopters of the technology. New use cases in different fields are being explored as we move forward. The decentralized nature of this technology makes it stand out from the pre-existing databases. Blockchain works as a shared digital ledger that is distributed among several participants. Due to the distributed architecture, the authentication requires a certain consensus mechanism which mainly constitutes two methods PoW(proof of work) and PoS(proof of stake). In blockchain 1.0, which was popularized by Bitcoin cryptocurrency peer-to-peer network, the proof of work consensus mechanism is followed. Ethereum blockchain was considered blockchain 2.0 as it provided platforms for applications on its network. As the bitcoin blockchain mainly stores data in terms of transactions Ethereum, on the other hand, provides a platform for diverse types of data storage related to "finance, industry, legal, personal information, community, health, education, and governance which can be accessed and used by computer programs known as decentralized applications (dApps) that run on Ethereum" [14]. A set of pre-defined agreements which is encoded in computer code called smart contracts can be executed once the requirements are met. The Ethereum network hence provides numerous unique solutions to specific requirements. The processing power which is needed to run these smart contracts in the Ethereum network is provided by the computers connected in the open and distributed network. Also, the transactions are simultaneously stored and verified by the computers in the network. As a reward for the contribution of these computers, the owners are provided with ether tokens. Ethereum can be considered as the first shared global computer. Bitcoin, then again, is viewed as the primary bookkeeping record shared worldwide.

Due to several scalability issues and energy problems, new advancements in blockchain are continuing. Blockchain 3.0 is considered as the solution to the scalability problem of blockchain networks such as the bitcoin network. From finance to healthcare blockchain

has started replacing traditional systems across the industries. The global supply chain industry is one of the industries which has recognized blockchain technology as an innovation that can have a disruptive effect.

#### **4. Blockchain-based supply chains**

The supply chain and exchange finance industries face genuine difficulties. Globalization has made supply chains altogether more complicated, including different players from around the world and a lot of coordination among partners who don't really trust one another. While this has driven up working expenses, expanded guideline is driving up the expense of administrative compliance. Many cycles are obsolete, frequently paper-based, and supply chains experience the ill effects of an absence of straightforwardness because of information not being promptly accessible [6].

The blockchain properties of immutability, decentralization, transparency, and traceability it has disrupted the industries and changed them for the better. Supply chain and logistics are one of the major industries which can be highly influenced by blockchain technology. Supply chain management and blockchains seem to be built for each other in several ways. Blockchain can help firms achieve various SCM goals, such as those related to sustainability[3], [15], [16]. Block chain-driven innovations in the supply chain will have the potential to deliver tremendous business value by increasing supply chain transparency, reducing risk, and further developing proficiency and overall supply chain management[17]. Blockchain can significantly further develop supply chains by empowering quicker and more expense effective conveyance of items, upgrading items' recognizability, further developing coordination among accomplices, and helping admittance to financing.

Its decentralized nature and its ability to provide transparency and more meaningful indicators make it an ideal tool for monitoring and improving SCs' social performance. Particularly in the mix with other innovative progressions, blockchain can assist firms with accomplishing TBL objectives [18]. Blockchain technology has the potential to solve the many flaws in the supply chain industry from transparency to traceability of the products. In terms of traceability blockchain technology can solve the major issues of trust of customers as it can provide the exact information of the life cycle of a certain product. The trust among the actors in the supply chain along with the satisfaction of consumers is majorly tackled by the blockchain-based supply chain.

Immutable data, such as product dimensions and quality, can play a key role in addressing key issues related to product safety and sustainability. Despite the capabilities of traditional SC information systems, they are still not

able to identify products. This is mainly due to the lack of data silos. Many of the actors or participants of a complex supply chain lack complete information about the quality and other aspects of products. Blockchain technology being distributed digital ledger provides untampered information about the processes and product cycle to each of the concerned Stakeholders. This technology also tackles the so-called human errors, which sometimes becomes a huge impact on a supply chain. Supply chains will profit from blockchain creative science in various ways. From keeping a check on violations of the code and conduct to detection of fraud the blockchain technology will essentially contribute towards transparency and auditability (“the cost of global fraud was evidenced in a report by PwC [19], where it is indicated that 49% of organizations globally said they have been a victim of fraud and economic crime”).

An increase in the performance of supply chain transactions along with the security of the supply chain network can also be enhanced by blockchain technology. For instance, any faulty invoice can cause a huge setback and loss to the stakeholders. By blockchain technology, the transparency among the stakeholders and the fact that data once stored on the blockchain is immutable makes its use case a strong point for the adoption. Most of the transactions on the blockchain are carried out as electronic transactions. This allows them to run smoothly without errors and increases system performance. Due to the complexity of validating and enforcing data integrity and security in supply chain systems, blockchain has become an integral part of the supply chain. Its decentralized nature enables it to be easily built-in. [20]. The speed with which various exercises are performed can be expanded with blockchain. For example, a quicker rate can be accomplished by digitizing actual cycles and diminishing connections and communications.

## 5. Sustainability in the supply chain with blockchain

Sustainable development in the supply chain refers to the social, environmental, and economic sustainability of blockchain-based supply chains. Sustainability in the supply chain can be described as the embedding of natural, social, or corporate administration contemplations as unrefined components are obtained, changed over to items, and conveyed to advertise. Be that as it may, the supply chain network doesn't end when the item hits the market and neither supply chain sustainability. Normally, sustainability drives incorporate recognizing the wellspring of unrefined components, guaranteeing great conditions for laborers, and decreasing the carbon impression. As one of the main objectives of sustainability is closing the lifecycle of a product, which can be realized with the help of industry 4.0 and blockchain technology. Industry 4.0

expands the degree of information sharing over the whole supply chain, which makes the lifecycle of the products more transparent and also helps in enhancing timely decision making. The sensor technology in the industry provides ease of data collection which makes way for real-time data analyzing and decision making for software tools in the network.

There is a considerable amount of curiosity among specialists and scholastics for sustainable supply chains([21]. The sustainability of supply chains is not limited to economical aspects but the social and environmental factors also. The revolutionary features of blockchain technology can affect these three main objectives of sustainability: social, economic, and environmental. The properties like data immutability, decentralization, neutrality, security, and openness of blockchain can provide with data collection, storage along with management and supporting product information in supply chain data[22] However, there are some limitations to the blockchain yet it has “the potential to mitigate some sustainability-related challenges and advance circular economy realization” [17]

Many sectors of modern times are facing the pressure of sustainability in supply chains. Consumers across the world are becoming more aware and concerned about the products they consume, especially in the food and beverage industry. Real-time food tracing can be achieved by integration of IoT with blockchain such as RFID tags are used to reach the traceability of food supply [23]. Also, events in the supply chain can be recorded by RFID tags in the agricultural sector[24]. Unethical suppliers, which cause serious social harm, are identified and along with that, counterfeits can be detected as the information can only be accessed by authorized actors.

The adoption of blockchain technology helps any organization and its supply chain from business aspects, improving their economic performance. Blockchains can bring about production network disintermediation where fewer levels bring about exchange expenses and time decrease, lessening business squander in the supply chains.[25] Human errors and transaction times are minimized as blockchain has the potential to share the change in any data instantly. Blockchain technology can ensure the authenticity and safety of the data and make it more reliable towards the prevention of malicious alteration in data which will reduce the business cost [26]. Trust factor will also improve from blockchain transparency, which will make the customer buy more products and help the firms financially.

Blockchain as a disruptive technology has the potential to add to the social sustainability of supply chains. In blockchain-based supply chains, as the information cannot be altered without the consensus of the

stakeholders, it can prevent corrupt exercises. It can make corrupt people accountable and governments can easily identify these malicious agents and act upon them accordingly. Due to blockchain traceability and transparency, human rights violations in the supply chain can be identified and a safe environment for the workers can easily be installed. Unfair assets can also be seized by governing authorities.

Environmental sustainability can also be aided by blockchain technology. Blockchain technology has many applications related to environmental sustainability. Important sustainability goals can be achieved by blockchain technology. For instance, due to the tracking abilities of blockchain technology, blockchain can help reduce the recall of products. Another application of blockchain include the reduction of carbon footprint, it can help in tracing the real footprint of any product, which can determine the actual tax to be collected from the manufacturer. Recycling of products is also aided by providing incentives in form of cryptocurrency to individuals who participate in deposit-based programs. Blockchain likewise works on the effectiveness of outflow exchanging plans by lessening misrepresentation and working on the constancy of the framework [27].

## 6. Results and Discussions

This study so far has discussed blockchain and its usage in the supply chain. We have discussed how blockchain can disrupt the supply chain and provide sustainability to supply chains. However, widespread adoption of blockchain is still far away in a sustainable supply chain. In this section, we have discussed the major challenges and provided some solutions in further subparts for the sustainability and scalability of blockchain-based supply chains. Without the identification of barriers, the successful implementation of blockchain in a sustainable supply chain is difficult. The track of sustainable supply chain goes through understanding and recognizing the barriers in adoption.

### 6.1 Understanding the barriers to adoption of blockchain technology

Blockchain technology has its perks and features but still, some drawbacks need to be admitted. While blockchain technology has great technical potential but applying it supply chain still faces some practical challenges. These challenges are within supply chains, some external challenges are also there. This technology has a lot of complex structures around it, which is causing organizations to fully commit to it and change their entire structure. Organizations lack skilled workers to handle the complexity involved. Some medium or small-scale supply chains also face infrastructural barriers in the way of adoption. For example, in the agricultural sector farmers are not fully equipped to

understand the working of blockchain for instance troubleshooting and maintenance.

As the adoption of blockchain technology is increasing across the world, companies like Maersk and IBM are collectively working towards a more sustainable adoption of blockchain. Tracking of containers by using RFID technology in shipments and integrating industry 4.0 technology like IoT with blockchain-based supply chains. Still, the development of advanced platforms like IoT platforms requires a large number of investments in infrastructure and skill development. We admit that it is proving to be revolutionary in the industry to make a more transparent supply chain. But organizations with good infrastructure are facing challenges in ease of adoption. We can take Walmart as an example they are required to train about 100,000 employees and suppliers in China to be fully able to utilize its blockchain platform in China and also to ensure no additional costs to the customers simultaneously [28]. Infrastructure and technical soundness of the workers or employees is one of the major challenges that blockchain technology needs to overcome.

Another adoption barrier is intra-organizational. All the stakeholders in the supply chain need to be on the same page for the fast implementation of blockchain and its sustainability. However, sometimes organizations lack the commitment of upper management to adopt new technology. The lack of commitment can be the fear of failure or accountability. The complex nature of the global supply chain also can affect the decision of adopting any new technology, which might disrupt the already in place sustained system. The integrity of sustainability practices is affected through supply chain processes due to the absence of the executive's responsibility [29]. The conflicts within the organization among the stakeholders also cause hindrance in the wide adoption of new technology. As the new technology makes the headlines and organizations start wondering about the outcomes it may bring to their sector, brings the hesitation to be the first one to adopt or commit to new technology. The culture in an organization is also a challenge for any technology to go through. The adoption of blockchain technology can create a stir and have an enormous impact in transforming current organizational cultures [30]. The limitation in technical expertise in knowledge of blockchain technology also acts as a barrier. However, the interest in blockchain technology is growing in the market, still, the lack of developers and experts in the field is an issue [31]. If organizations want to have sustainable supply chains, then sustainability practices need to be adopted by organizations and should be added to their mission and vision [32]. The issue of absence of standard instruments, strategies, and markers causes a hindrance in the effective execution and estimation of sustainability rehearses [33] inside a blockchain climate, for a given association [34].

Blockchain technology is transparent and open can become a barrier for some stakeholders in a supply chain. Some stakeholders may not be fully committed to sharing their privacy policies and information on a blockchain which can become a huge fallback in the sustainability of the blockchain-based supply chain. In a supply chain of organizations, inter-organizational barriers are challenging. The supply chains have different partners collaborating on a certain product. Some products are assembled by a manufacturer and require products made by other companies for the finished product. The sharing of information could be facilitated by the blockchain-based supply chain. There are challenges in sharing information between supply chain partners, particularly when combining information technology and sustainability practices [34]. However, information sharing and transparency is a requirement for evaluating the sustainability of the supply chain. The vacillating to uncover information from specific assistants may confine the full benefits of embracing blockchain development and hinder compelling execution of this advancement [35].

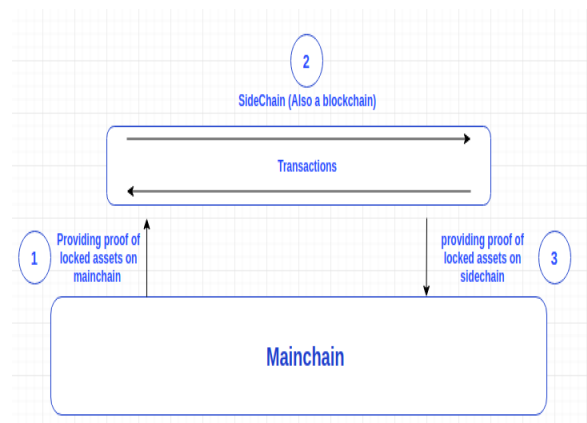
System-related barriers along with scalability issues is also a barrier for the blockchain adoption. Earlier blockchains like bitcoin had scalability issues and the transaction speed was really slow as compared to VISA or PayPal which are much faster than bitcoin and Ethereum. Also, the cost of implementing blockchain by small and medium-based supply chains is not feasible and creates barriers to its adoption. External barriers like policies, regulations and government recognition of a decentralized system are also a challenge for blockchain technology. The sheer lack of the willingness of the policymakers and regulatory authority in recognizing the benefits of blockchain technology and creating policies of fair use is a big issue [36]. Governments are unclear about their approach and policies towards blockchain technology, some of the decisions by certain governments have caused a problem for wider usage of blockchain technology.

Security issues are one of the major concerns in new-age technology. Challenges like attacks and hacks in the bitcoin network are highlighted in some studies [37]. Although, solutions are being discovered still the effectiveness of these solutions is still an aspect to explore.

**6.2 Discussion and propositions**

There is no doubt that blockchain technology as an immutable, decentralized digital ledger has the potential to disrupt any sector of today's world. The major concerns are related to being this technology more accessible to small and medium industries, which may not have the infrastructure to be able to adopt this technology even they want to adopt it. Blockchain technology is yet proportional up and overwhelms the

world business sectors. While its latent capacity is perceived internationally, blockchain innovation has been kept down by its innate impediments. The major test that limits blockchain adaptability today is the speed of its exchanges. The scalability issue is one of the major concerns in the adoption of small or medium-based supply chains. Many solutions to the scalability problem are proposed and some of them have readily tackled the problem as well. One such solution which can solve the issue of scalability of the blockchain-based supply chains is sided chains. Sidechains are more modest blockchains that run corresponding to the principle blockchain or primary chain. They carry on like parts of the primary chain. During activity, they move resources for and from the fundamental chain to diminish clog and work with adaptability. Doing your exchanges on a side chain can fundamentally expand the blockchain's TPS (Transactions per second). The larger supply chains which have several small supply chains can implement side chains to their structure. It can increase the transactional speed of the blockchain and aid in the issue of some stakeholders in the supply chain not fully sharing their policies as side chains only update the main chain once periodically. By this, the sustainability of supply will also keep intact and customers satisfaction along with the cost-effectiveness of the organizations and partners involved can be achieved. The security of side chains cannot affect the main chain as it has its miners and infrastructural structure. Once permission is granted from the main chain side chains can execute transactions without causing any extra burden on the main chain. Since some large-scale supply chains like car manufacturers require different body parts and assemble them for example, they will have a supplier of a music system or tire supplying company. Some of the companies in the supply chain may feel resistant to sharing their information completely, side chains can be used here on the main blockchain of the company. And only authorized personnel would be permitted to initiate any transaction or trade.



Any large organization can have multiple supply chains according to their needs and the scalability issue of these supply chains can be easily dealt with side chains that will be directly linked to the main chain. This will

improve the transactional speed of the main blockchain, which help in reducing the cost for a sustainable supply chain.

As the global supply chains are moving towards the adoption of blockchain, the role of so-called middlemen and trade unions, which sometimes become the cause of lack of transparency and audibility in supply chains, will be removed. Blockchain has the potential to make the jobs of actors such as TPC organizations immaterial. Because of blockchain-drove detectability and straightforwardness [38] [39] of worth chains, concerned gatherings don't have to depend on TPCs. For instance, the payment in some supply chains will be directly transferred to the concerned farmers when their items are assessed and sold. On consideration of above discussion, we suggest the following

P1. The role of regulatory authorities and trade unions will eventually reduce by blockchain transparency and straightforwardness which will move towards sustainable supply chains.

The systems based blockchains can likewise be utilized to make a SC map with exchange and data streams, by which the most vulnerable connections, just as dangers and dangers implied, would be broke down[40]. Food contamination and the disease occurring from food can be taken as an example. Any particular batch of faulty products can be pointed out and taken out of circulation easily by their barcodes. The entire product line will not be called back by the retailers. Other products from the same batch can also be located by this. One such instance can be observed from Walmart, they found out that a product can be traced as fast as 2.2s. This will help in reducing the workload, which will reduce the labour costs and save crucial supply chain time. Also, the customer's satisfaction demanding sustainability would be reached. The above discussion suggests the following

P2. Blockchains' ability to detect minor faults and to detect the violations in sustainability standards in supply chains will result in reaching the desired standards of Supply chains.

By reducing the effects on the environment by technology will eventually create value for society and companies. Energy cost saving and dangerous regulations will develop cost leadership in context with environmental taxes. According to a corporate viewpoint, the improvement of green shrewd agreements prompts a cutthroat advantage in various ways. Investment funds on energy costs and hazard relief in setting with forthcoming ecological charges support cost initiative. A change in client prerequisites toward feasible assistance arrangement and bringing interest up in-store network disclosure and life cycle-arranged supply chain network evaluation make new business openings and backing separation

methodologies. This brings us to the following suggestion

P3. The Short and along with mid-term smart contract adoption will lead to an environmental bounce back impacts due to disproportional asset utilization.

## 7. Conclusion

The way to a worldwide supply chain network the board structure depending on blockchains goes through many stages and many difficulties that must be confronted. In this paper, we have comprehensively analyzed the adoption barriers and challenges that blockchain adoption is facing in Sustainable supply chains. We additionally distinguished the general significance of blockchain innovation for sustainability in supply chains. In our study, we recognized the scalability issue blockchain technology may bring to supply chains and provided a side chain-based solution to overcome this issue. Blockchain being transparent, immutable, and distributed have lots of potential in supply chain management. If the adoption barriers are studied carefully, we can see blockchain-based supply chains which are sustainable and scalable in use. Adoption barriers include social barriers which include trust issues, workplace balance, inappropriate exploitation of lower-level workers among many. Additionally, the specialized obstacles identifying with blockchain gathering are consolidated and many come from blockchain technology immaturity. Any framework-related issues of blockchain technology, which can restrict its reception. Through this study, we have made that could be adopted by firms to implement blockchain in the supply chain. By achieving scalability and understanding the adoption barriers it will aid in sustainable solutions or supply chains. Although blockchain technology has many use cases, we believe that it is just the beginning of a new innovative world with everybody having equal say. In a world in which people can trust each other, customers can see from where their product is produced, from where its ingredients are supplied. A beginning of a more transparent and open world. The advancements in blockchain have still not shown their complete potential. Blockchain scholars and practitioners should work with organizations to access the shortcomings for better implementation. Transdisciplinary efforts will be required to fully understand the implications of blockchain technology in supply chain networks. Essentially, taking into account that the broader usage of blockchain innovation for business purposes has as of now begun and maintained by some driving associations, like IBM, Boeing, Microsoft, and SAP. Post-execution accomplishment and dissatisfaction factors of this advancement can in like manner be tended to in future exploration

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