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The Monitoring of Supply Chains Using Blockchain Technology, with Special Reference to Food Sectors

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ABSTRACT

The most observed part associated with supply chain companies those are facing issues and challenges like mistakes committed by human, abnormal delays in production data, information updates or sharing, be deficient with accountability, fortification, momentum with delivery of products and services, monitoring and tracking of the sources for goods and services etc. With this research paper, our study is to examine the position of blockchain in supply chain management along with the issues associated with supply chain management practices and blockchain / supply chain disadvantages. Here it has been observed that transparency with supply chain as well as chain of guardianship can be improved by the advent of blockchain technology adoption. With this paper, a model has been proposed for the Tracing of Safety in Food Supply Chain with System Design and Implementation that compares it with the available technologies in food sectors.

Keywords: Blockchain Implementation, Supply Chain Relationship, Food Safety Tracing, IoTs

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Introduction

In every sector, the enhancement of practices and supply chain roles has become a central heart of corporate processes and planning. Companies require reliable and on-time / real-time information on inventory, in-transit movements of goods and many others, to help correct supply chain management decisions (Perboli, Musso and Rosano 2018). Information and Communication Technologies (ICTs) have been quickly developed to help businesses to reach, receive, evaluate, and then make more timely decisions and anticipate consumer needs and further operations that are required (Kamble, Gunasekaran & Sharma, 2020). Thus, traceability has become one of the main issues of Supply Chain Management, i.e. the enabler of making correct and timely decisions.

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There has been gigantic interest in blockchain innovation (otherwise called appropriated record innovation) all throughout the planet and across areas (Dubey et al., 2020). Blockchain is a strong and distributed transaction network that is cohesive, resilient, transparent, and consensus-based. It was extended to situations such as smart city, the supply chain, storage and exchange of medical data, etc (Gao et al., 2018).

As of late, we've seen worldwide sanitation

difficulties, for example, the 2013 pony meat outrage in Europe (Levitt 2016), the 2017 multi-state Salmonella flare-up in the United States (Menson, 2018), and the 2017 polluted egg emergency in Switzerland, Hong Kong, and 15 EU states (Menson, 2018). These food handling concerns hurt individuals' wellbeing, yet in addition change individuals' view of the food business. Food store network the executives incorporate food handling, yet additionally misrepresentation and quality concerns (Aung and Chang 2014). Evidences of sources are urgent in complex worldwide inventory organizations and thus no enormous scope organizations are currently responsible for things like food, medication or shopper merchandise and these establishments have various weaknesses (Kim et al., 2018). For present day organizations, the ability to follow the historical backdrop of a food item and gather all data associated with its development all through the production network in a straightforward and secure way is vital (Dabbene et al., 2014).

The new blockchain innovations, which further develop production network straightforwardness, security, and toughness, show potential for defeating present food store network the executives limitations (Swan, 2015; Abeyratne and Monfared, 2016). Information on a blockchain is kept and kept up with endlessly by all members in an inventory network organization, carrying straightforwardness and trust to even the most unpredictable stock chains (Tian, 2017). For the enhancement of FSC and the facilitation of trace back for food safety and quality, the food industry use traceability systems. According to Dasaklis, Casino and Patsakis (2019), traceability is seen as a strategic instrument for improving food safety systems, raw material quality, inventory management, and as a source of competitive advantages. Detection frameworks help organizations in deciding the source and extent of wellbeing and quality control issues, just as settling them. The food global positioning framework permits the inventory network to survey the wellbeing of transient things by following their excursion from where they are developed, dealt with, or put away to where they are shipped or prepared, bringing about the making of a straightforward and valid food environment chain of records (Godsiff, 2016). The provenance and discerning of data in the food area assists with working on the quality and wellbeing of food (Saberi et al., 2019).

Problematic Areas Encountered with Food Supply Chain

It's a miracle anything gets it into our shelves at all, given the intricate web of warehouses, container ships, vehicles, and cargo aircraft that carry our food. It's a jumble of phone calls, handwritten forms, and the dreaded fax machine. Food traceability can take up millions of man-hours each year for retailers and food suppliers. Food supply networks are sophisticated enterprises that have only grown more so in recent decades. According to Steve Rogers, an IBM supply chain expert, “the basic problem with supply chains is that information is recorded in silos.” “In the previous 15 to 20 years, globalization of supply chains has only exacerbated this.”

Collaboration—or the lack thereof—is the reason why tracing a product's history takes so long in today's food safety systems. When an item leaves one producer's system and is inputted into another's, there is no traceability between the two systems. The data collection is quite linear and there's no link with another retailer's system. It's a different issue with blockchain that can boils down to networks.

Issues associated with Food Supply Chain are as following:

1. Difficult to capture the deterioration of fresh foods along with the entire supply chain

2. Difficult to handle the time and product decay

3. Limited number of players may create competition as well as uneven product demarcation

4. Discard of spoiled food products and their cost estimation

5. Difficult to assess unconventional technologies that may involve in supply chain activity.

Food quality and wellbeing are turning out to be progressively significant and neglecting to carry out severe observing and detection conventions can bring about sickness and genuine reputational harm to an organization (Aung and Chang, 2014). A few café organizations have as of late been engaged with food handling episodes, for example, the horsemeat occurrence, the salmonella scourge in peanut butter, etc (Crossey, 2017). Customers are more disposed to buy somewhere else in case they are uncertain that the food they are burning-through is protected and truly sourced, which can affect an organization's primary concern. It is always known that keeping up with food handling while offering top notch dinners to clients is a colossal assignment. A food store network contrasts from other stockpile networks in that the nature of the food material changes between the starting place and the mark of utilization (Apaiah et al., 2005). Thus, food items should be followed along the inventory network to ensure that issues like quality control, beginning data, and straightforwardness and detection are tended to. In reality, the key troubles that should be controlled to guarantee food inventory network recognition can be isolated into three classifications: specialized, administrative, and natural (Aung and Chang, 2014). The most troublesome part of food detection is trading data in a normalized design. (Moe 1998; Aung and Chang 2014). Since advanced frameworks are costly to work and keep up with, paper-based frameworks are usually utilized in numerous little and enormous associations to build detection (Karippacheril, Rios, and Srivastava 2017). Paper-based arrangements, then again, have various disadvantages. Another obstruction to food recognition is the going with costs of setting up discerning frameworks, especially for limited scope makers in helpless nations (Kelepouris, Pramatari, and Doukidis 2007; Aung and Chang 2014). The robust authoritative consumptions add a huge sum to the innovation uses. Thus, there is a requirement for savvy arrangements that can offer precise, exceptional, and believable data in a characterized limit to all food inventory network partners (Opara 2003).

Reliability of Blockchain

A blockchain is a consensus-based technique that also includes a framework for "smart contracts" and other assistive technologies. Public blockchain and private blockchain are two types of blockchain that operate under different consensus methods and serve various goals.

A blockchain is a reliable and permanent computerized information record used to follow exchanges utilizing an appropriated agreement system (Kamble, Gunasekaran, and Arha 2019; Galvez, Mejuto, and Simal-Gandara 2018). Blockchain innovation, as another business joint effort device, offers a safe, shared information organization and permits dishonest gatherings to concede to a common computerized history without the utilization of a confided in delegate

(Swan 2015; Calatayud, Mangan, and Christopher 2019). A blockchain kills go-betweens and takes out the requirement for unified position, taking into consideration quicker, more secure, and more proficient correspondence and tasks between two gatherings (Pilkington 2016). What's more, keen agreements, otherwise called programmable conventions, are utilized in blockchains to permit gatherings to concur on explicit terms. This additionally empowers for the capacity of touchy information on the blockchain in a data set that is scrambled with hash calculations, guaranteeing that the information is secure (Ahlmann 2018). A blockchain permits individuals from the inventory network to see contracts, including arrangements and administrative designated spots (Marques, Martins, and Ara ujo 2020).

Blockchain innovation permits clients to screen all exchanges promptly and progressively, and it saves and trades data across an organization of clients in an open virtual space (Wang, Han, and Beynon-Davies 2019). Each square stores the information from the entirety of the framework's exchanges throughout some stretch of time and makes an advanced impression that can be utilized to approve the data's precision and associate with the following square (Beck et al. 2016). The blockchain can have countless these squares, which are connected together (like a chain) in an appropriate direct, sequential request, with each square having a hash of the past block. Changes to the data contained in the record require endorsement from each organization hub through agreement (Calatayud, Mangan, and Christopher 2019). Subsequently, a blockchain empowers, exact and solid information for investigation, and upgraded certainty among all inventory network players. In non-esteem added exercises, blockchain innovation likewise assists with taking out human inclusion (Bibby and Dehe 2018).

Blockchain in Food Sector

The theory of blockchain is emerging, and although Bitcoin's future remains uncertain (as it is for most elements of the economy), it is obvious that the blockchain has immense potential for large-scale improvements especially operating networks in the food sector and warehouse storage. (Kawa & Maryniak, 2019). Using distributed network nodes, the blockchain eliminates the probability of a single point of failure and network attacks. (Bodkhe et al., 2020)

As of late, joining blockchain and its application for inventory network working organizations in the food area can be an extraordinary advantage for a nation's economy. With the unexpected ascent of Bitcoin toward the finish of 2017, Blockchain has become a standard term. Be that as it may, a many individuals actually don't comprehend the amazing potential this innovation holds, particularly in its job in the store network and the food area digitalization development (Sunol, 2017).

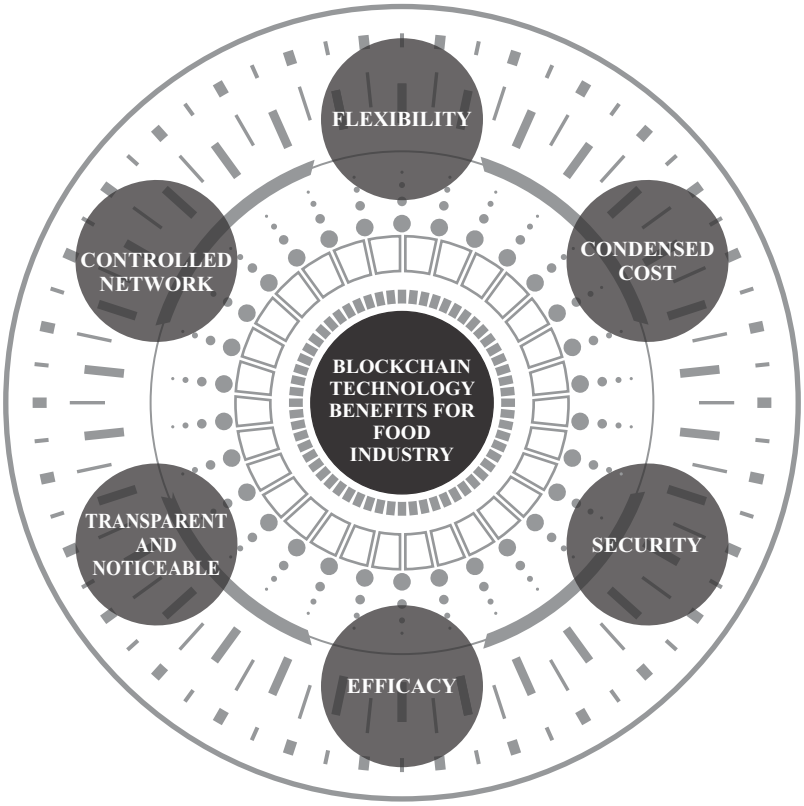

Figure 1: Benefit of Blockchain For Food Industry

"When organizations" actively (and collaboratively) manage supply chain operations and relationships to optimize customer value and achieve a sustainable competitive advantage, "one can speak about supply chain management, which is" an intensive attempt by supply chain companies to build and operate supply chains most reliably and profitably possible (Dujak, D., & Sajter, D., 2019).

Various people acknowledge that blockchain advancement will significantly influence organizations and social orders once it makes an overall association, allowing individuals, affiliations, and machines to execute with each other without trusting in each other or use pariah confirmation (Wang et al., 2019). Blockchain is currently a term of standard innovation. What's more, it is exceptionally astonishing, that many didn't yet open the capability of this forthcoming tech, particularly in the Warehouse Management Digitalization development. There are three great features in Blockchain: Transparency, Accessibility, and the main one, Security, of course. It also keeps the data decentralized, which means that the data is processed on each computer. Practically, for someone to alter even one data record, all the connected computers must be given access at the same time. To build blockchain technology through industries, it is an ingenious innovation that can enable an immutable distributed, transparent, safe, and auditable ledger to be facilitated(Fosso Wamba et al., 2020). In terms of nature, Blockchain is decentralized and has incredible supply chain management opportunities (Sunny et al., 2020). For example, the use of cutting edge Big Data investigation in production network the executives can assist with further developing dynamic for all exercises across the inventory network (Fernández-Caramés et al.,

2019). IoT, thought about the main subject of this century, is perhaps the most advertised advancements alongside Blockchain. IoT's essential point is to interface the actual world to the advanced world and associate it. The interaction includes gathering genuine information, gathering total information into information, and assisting clients with settling on decisions. New information can be changed consequently in the records when Blockchain is joined with IoT. For the entire food area the executives organization, this makes check exceptionally direct. Blockchain will serve to give more noteworthy character validation in the public authority area and upgrade trust in vote tallying, in this way working with the majority rule measure. (Cole et al., 2019). Nonetheless, in view of the curiosity of this subject, blockchains face comparative troubles to SCM as far as creating a consensual definition. (Queiroz et al., 2019)

They are the procedures used in the company's development of a product/service. It is important, however, to associate these business processes with a company's overall capabilities. In order to control the supply chain, technical skills must be established by a company. A dynamic structure responsible for the market circulation of agricultural goods is the agricultural supply chain. Food protection will now benefit from the transparency of technology, relatively low transaction costs and instantaneous implementations. Generally, for global financial networks, the stable and decentralized functionality of the blockchain is used, but it can easily be applied to contracts and activities such as global supply chain tracking. A blockchain is an appropriated records record as scrambled squares" (more modest datasets) or a public chronicle, everything being equal, or advanced occasions completed and traded among taking part parties that can be checked in the future whenever. Every exchange in the public record is checked by most of the majority of the framework's individuals, and subtleties can be erased once added. Food authentication, a mechanism by which compliance of foods with their product descriptions can be checked, otherwise fraud, is another crucial point in the inherent food supply chain. In the context of precision farming, information and communications technology (ICT) can be further applied in the context of a blockchain infrastructure in order to allow new farm systems and e-agricultural systems (Antonucci et al., 2019). For farmers, researchers, governments, customers and other stakeholders, the steady rise in food falsification, which has caused large economic losses and undermined consumer confidence, has become a pressing issue. In order to identify and resolve sources of contamination in the food supply chain worldwide, the surveillance and authentication of the food supply chain to recognize provenance is important. By using blockchain technology to store chemical analysis data in chronological order, one way to solve traceability problems and ensure accountability is so that they cannot be manipulated afterwards '(Galvez et al., 2018). From the horizontal view of an interconnected supply chain, organizational competency is enhanced. In terms of logistical systems, organizational competence is strengthened, including a company's willingness to provide services such as just in time and inventory management and make goods readily accessible to consumers. In addition, it helps to rapidly transition to the logistics network to satisfy demand. The focus of the network viewpoint is on the relationship in the enterprise between different parties. Coordination plans and efforts are strengthened by the expertise, capital and strengths of individual organizations.(Saragih et al., 2020)

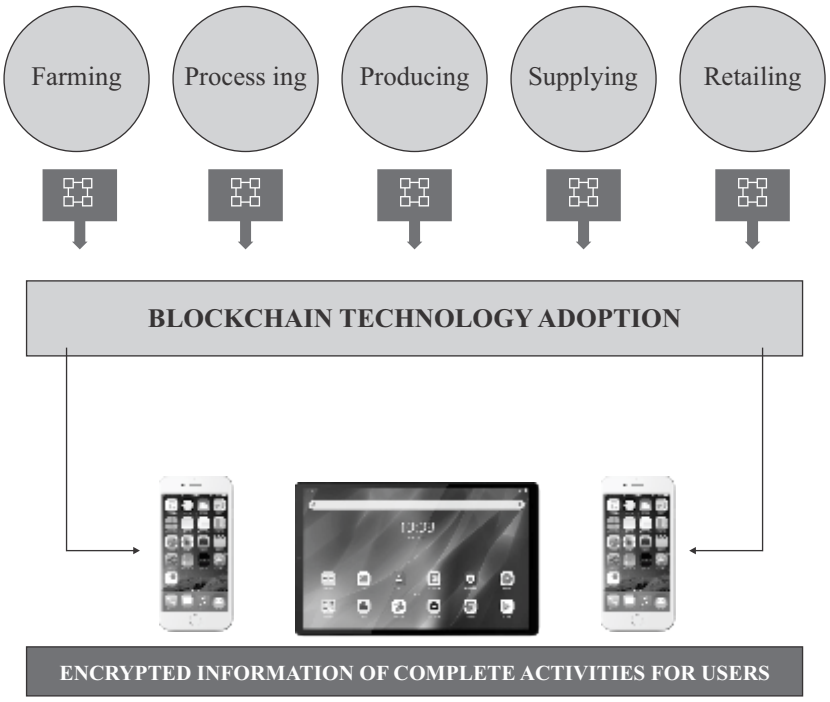

Figure 2: Tracking of Complete Information with Food Supply Chain Using Blockchain

Tracking Of Food For Better Safety & Security

Forthcoming Yiannas, previous Vice President of Food Safety at Walmart, says, "Individuals talk about the food inventory network." "Notwithstanding, it's anything but a chain; rather, it is a modern organization." When a food-borne illness episode happens, it may require days, if not weeks, to find the source. At the point when specialists can't pinpoint a solitary ranch or homesteads, the public authority regularly encourages purchasers to stay away from things developed around there (similar to the case with romaine lettuce from Yuma, Arizona), or even to stay away from the item class by and large. Further developed discernible entities could save lives by permitting firms to react all the more rapidly and keep up with ranchers' jobs by just unloading item from harmed fields that likewise brings about further developing food framework straightforwardness along with firm recognition.

For years, no one had been able to figure out how to create a (traceability) system for the complete food supply ecosystem. Because of its focus on trust, immutability, and transparency, we thought blockchain technology would be a good fit for this situation. Mostly suppliers are now utilizing new labels and thus using a web-based interface to upload their data.

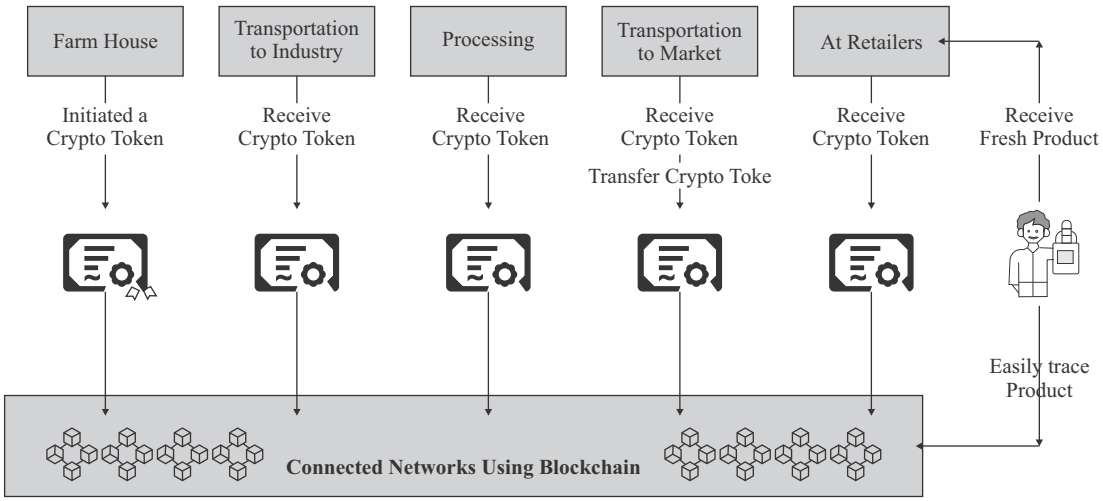

Figure 3: Tracking of Quality of Food with special reference to Consumer Using Blockchain

The idea behind this concept is to use culinary items as tokens. For each new batch of an ingredient generated, a new token is issued. Such token ownership is carefully tracked and documented. In addition to token transfers, the system supports token splitting and packaging into a finished food item. Assume for the moment that our goal is to keep an eye on an agricultural-based food supply chain. Five key characters in the suggested scenario may be distinguished. The farmer comes first because he has the power to produce tokens, each of which can be used to represent an actual ingredient. The ingredients need to be transported to the factory after manufacture.

As a result, there is a second actor involved in transportation. The farmer must transmit the token during the trip, and the transport actor must receive the token. Then, when it is delivered to the factory, the process is repeated with the factory receiving the token that was originally sent by the transport actor. The final retail store, i.e. the final player in this chain, is required to receive the finished product, which in our system is a group of tokens. The consumer is the system's ultimate user, who is unrelated to the preceding chain but who can and must be able to access it. The consumer can generate a view of all the transactions and the actors involved, from the farmer to the grocery store, simply using their smartphone to scan a QR code on the finished product. The full procedure is shown in figure

Use of IoT and Blockchain in Food Sector

The IoT is perceived as perhaps the main spaces of future innovation and is acquiring immense consideration from a wide scope of enterprises. The utilization of blockchain and IoT for viable execution of "item bring the executives back" would improve the converse coordination works on including social mindfulness and enactment rules. Green assembling has been addressed to be the future as it assists the organization with welling the climate over the long haul. Among others, various improvements have been made that focused to have vigorous flexibly bind frameworks to productively deal with the developing requests of different supplies, considering the hidden prerequisites and principle difficulties, for example, adaptability, explicitly protection and security, of different business organizations. '(Shahzad et al., 2020)

Consolidating blockchain with integral innovations, like huge information, distributed computing, and AI can additionally expand the adequacy of blockchain's applications in SCs and their effect on by and large friendly, ecological, and affordable manageability. Blockchain innovation, related to IoT, will permit a wide range of execution situations to help clearness in the worth chain and increment B2B certainty. IoT and Blockchain innovations, when coordinated, can work on the usefulness and adequacy of mechanical inventory chains. (Rejeb et al., 2019) Blockchain can fundamentally profit the ranchers and other oppressed areas of society by diminishing the intermediates in question and further develop straightforwardness all the while. Blockchain-based digitization can be utilized in the two plants just as creature natural ways of life. A dynamic structure involving a multitude of "stakeholders" such as producers, processing plants, manufacturers, retailers, and customers is the food supply chain. One of the key factors contributing to food fraud is "knowledge asymmetry" between stakeholders'(Mao et al., 2018). The agriculture supply chain (ASC) resembles any purchaser item flexibly chain that incorporates the providers, driving firms, clients, and conveyance accomplices(Kamble et al., 2020).

Management of the supply chain (SCM) is the management of the whole production, flow of goods, data, and finances, and supervises the operations before they are converted into finished products or meet their final destination. That is the backbone of trade. The excess cost of supplying the commodity to the consumer is minimized by handling the supply chain. A fair, well-managed supply chain is very important for the smooth running of every company. (Dwivedi et al., 2020) The centralization of information inside private storehouses held by different members through the interaction represents various difficulties for the SCM, for example, food squander between stages, the requirement for trust among partners frequently connected to their believability, the absence of straightforwardness of information progressively mentioned by partaking associations and customers, etc(Baralla et al., 2019).

Blockchain has arisen as a promising innovation for an endeavor plan. A Supply Chain Management (SCM) system can likewise be reached out to a few jobs, like coordination, quality confirmation, stock administration, and determining (Song et al., 2019). Store network Management (SCM) is a functional design that improves on the strategy for starting, putting together, and dealing with the store network measure in a suitable and ingenious way. (Aliyu et al., 2018).

Literally, its an organizations responsibility to examine the advantages of a solution that links participants in the food supply via a shared, permission record of data from the food chain. Organizations must educate themselves about the effects on the effectiveness of the supply chain, brand trust, food safety, sustainability, food freshness, food fraud, and food waste.

"People want to know, quite rightly, where ingredients they give to their baby have come from. We wanted a product in which trust meant something."

- Chris Tyas, Global Head of Supply Chain, Nestlé

For example, a clue about how blockchain technology operates and how well it progresses, the biggest challenge is how to set up a technology for field employees, farmers and others who will gather data and input it into the blockchain. Innovative tools for data entry on pervasive smartphones, with the backend in the cloud, are expected to allow farmers and field workers to insert data to a blockchain distributed ledger

through their smartphones that will track all data and makes it accessible in a matter of minutes instead of days. With the backend in the cloud, revolutionary tools for data entry on ubiquitous smartphones are supposed to enable farmers and field workers to enter data from their smartphones into a blockchain distributed ledger that records all data and makes it available in a matter of minutes instead of days (Aliyu et al., 2018). Blockchain technology enables users to concurrently and in real-time analyze all transactions, ensuring accountability, protection, authenticity and audit ability. Together with other transformative technologies such as IoT and AI, Blockchain will enable stakeholders to retrieve the high-quality data needed to make more informed choices (Chandra et al., 2019). In this unique organization, globalization, various administrative arrangements, and differing social and human movement in production network networks make it practically difficult to break down information and oversee hazard. Wasteful exchanges, misrepresentation, pilferage, and powerless stock chains add to a more noteworthy deficiency of certainty and consequently a requirement for better trade of information and check.

Proposed Tracing Model for Safety in Food Supply Chain with System Design and Implementation

On the basis of product type, weight & claim, the proposed model holds three traceability options for searching/tracing products in supply chains using blockchain. The segregation is on the basis of *weight, product and claim* as shown in Figure 3. Initially *products can be traced* using group search or with bulk search. In *weight based search*, it can be traced using asynchronous or synchronous weights. And in *claim based search*, it can be traced using date wise or identity wise traceability options. Here traceability is purely dependent upon the needs, stake holders choice, transactions, quality of data etc.

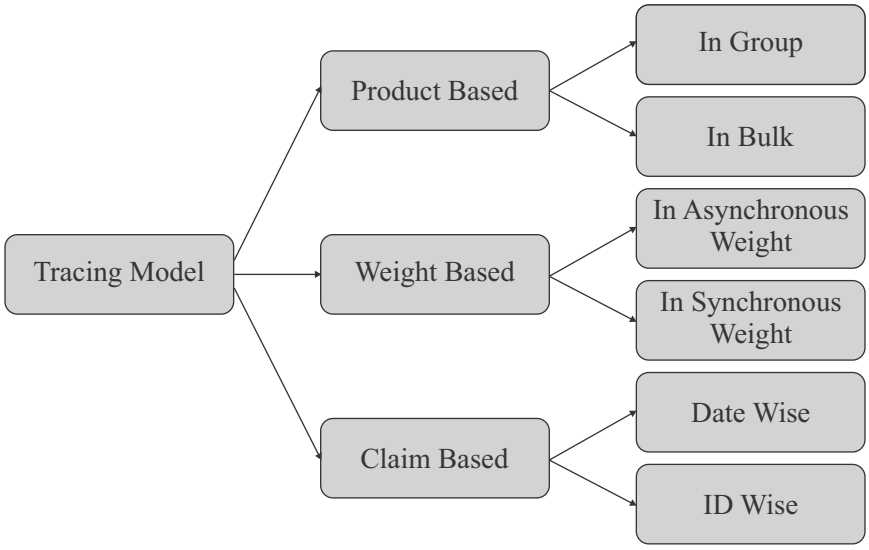

Figure 4: Tracing Model for Safety in Food Supply Chain with System Design and Implementation

Here, traceability helps verify a product's integrity across the supply chain, but it's a difficult process to maintain. Code-carrying and non-line-of-sight technologies are examples of technological solutions for monitoring and recording the transit of commodities. At both the item and case levels, serialized bar code identification with a numeric and alpha-numeric code format is a cost-effective technique. The information included therein can also be linked to production information such as product quality and time to market.

Blockchain has become one of the most promising current technical trends due to its disruptive presence and integration with IoT. Companies can use this combination of technology to develop interactions with their primary business stakeholders, particularly present customers, as well as attract new ones. For instance, it is anticipated that enterprises in the food and pharmaceutical industries may suffer significant financial losses as a result of a range of supply chain concerns. Counterfeiting, stolen goods, grey market, fraud, and product recalls are among them. As a result of these considerations, supply chain stakeholders are moving toward more openness and traceability. Blockchain is a promising answer, at least for trust and traceability issues, because it promises immutability, transparency, security, and fault tolerance.

This is because, with multiple stakeholders, competing agendas, and several third-party intermediaries, global supply chains are highly dynamic and problems that blockchain is well suited to solve. Blockchain can be used in the logistics industry in two main ways, namely to drive productivity and allow new business models. (Heutger & Kückelhaus, 2018)

The global economic structure relies on the production, preservation, and dissemination of vital documents by individuals and organizations who trust other institutions (Beck et al., 2017). As a conceivably problematic innovation coordinating highlights of a decentralized 'trustless' information base, blockchain innovation takes into consideration worldwide scale exchanges and cycle disintermediation and decentralization among various gatherings. A few early use cases epitomize blockchain innovation prospects and concerns. Perhaps the most well-known cases incorporates Maersk and its joint effort with IBM through blockchains for its oceanic compartment the executives. In this getting more exact and dependable landing charges joined to compartments, billions in reserve funds could happen. Key data about a given item and its status on the blockchain organization can be signed into each production network player (Saberi et al., 2019).

In several industrial fields, including the logistics and supply chain markets, blockchains draw the interest of stakeholders. Blockchain technology can effectively contribute to recording every single commodity in its supply chain flow, contributing to tracking orders, receipts, and payments, while uniformly and transparently tracking digital assets such as warranties and licenses (Litke et al., 2019).

Future Challenges

There are a number of prerequisites and problems that must be met for any technology to be beneficial. The data at the source must be correct in the case of Blockchain Technology. To use the technology, all partners in the chain must agree. All actors in the value chain would have to provide data, which would necessitate active collaboration on what data to collect, how to capture it, and how to combine it into useful product data that customers can understand. Especially at the point when the expense of putting resources into a

blockchain data stage is controlled inside a specific reach, it can work on the dependability of new items, yet in addition limit the conduct of camouflage and work on the benefit and by and large execution of the primary members of the new food internet business production network. As a result, some effort would be put into correcting the data before it was entered. With its highlights, for example, alter safe information, detectability, data sharing, savvy agreements, and agreement systems, it can upgrade inside and outside components like food quality and wellbeing issues, store network associations, inventory network joint effort and mix, real client experience, and data innovation, guarantee the security and control of item quality in the new food web based business store network, accomplish recognizability of co-ordinations data, advance the improvement of the nature of connections among undertakings, and accomplish asset incorporation and advantage dissemination. The difficulty for food corporations would be to do a thorough examination of the data to be submitted.

Conclusion

An inventory network starts with unfinished assets and gets done with a completed item that will be served to a customer as there are various intermediates in the middle. We for the most part have confidence in the products and the firm that makes it or offers the types of assistance, particularly in the time of Industry 4.0, blockchain holds the possibility to dispose of the requirement for trust without expecting anybody to know reality. Blockchain technology allows for secure data storage with privacy and administration built in. The primary goal of blockchain technology is to provide security as well as to maintain and regulate routine tasks. Transparency with supply chain as well as chain of guardianship can also be improved by the advent of blockchain technology. Utilizing blockchain, all members are answerable for scattering exact data where retailer might monitor the current limit of makers and be straightforwardly associated with put in new requests utilizing the whole detectable framework, which takes into consideration the assortment of significant information, i.e. conveyance time, parcel size, capacity and transportation conditions. To catch total and steady information across different gatherings and send the information to the Blockchain, IoT gadgets should be carried out all through the food store network. It is the duty of all participants in a blockchain to disseminate accurate information. Through the use of the entire traceable system, which enables the collection of the pertinent information, such as delivery time, lot size, storage and transport conditions, the retailer can keep an eye on the current production capacity of the producers and be connected directly to place new orders.

In order to collect thorough and consistent data from numerous parties and send the data to the blockchain, IoT devices must be placed across the food supply chain. IoT devices can collect data for every packet (pallet) of merchandise, not just a sample, and provide answers to where, when, and what queries regarding supply chain events. The supply chain can be transformed by the effective use of IoT and blockchain technologies, providing manufacturers and merchants with the chance to prosper in their respective fields. Future research can look at how blockchain technology is being adopted in different supply chains and contribute to the advancement of knowledge in terms of innovation and technological advancement.

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