

A Literature Review on Consortium Blockchain Consistency to Improve Traceability in Food Supply Chain System

Gautam Kumar, Rithvik Keshava Bhat, Vignesh Kumaresh, Nagaraja J



Abstract: Blockchain is an evolving technology that is influencing food traceability improvements and has the potential to enhance supply chain transparency and efficiency. Incorporating this technology in the supply chain saves paperwork and expenses while also improving regulatory compliance and preventing counterfeiting. Consortium blockchain is a permissioned platform where transactions or information to be sent are governed by several organizations rather than a single one. It's safer, scalable and more efficient. This survey presents the results of a thorough examination of methodologies implemented by authors of several works on the advantages of blockchain in food supply chain, which include improved food traceability, increased collaboration, improved operational efficiencies, and simplified food trading processes.

Keywords: Blockchain, Consortium Blockchain Consistency, Food Supply Chain Management, Supply Chain Management.

I. INTRODUCTION

Supply chain management (SCM), is the method of integrating supply and demand management that includes all the activities, people, organizations, information and resources required to transport a product from conception to production for the customer to use, increasing customer value and maintaining a competitive edge. The existing food supply system lacks effective tracking, monitoring and oversight of the supplied goods. The entire distribution network is divided into numerous tiers, with processes taking months to finish at each tier due to a variety of factors, reducing the overall system's efficiency. Blockchain is a potential solution since data transparency is crucial in today's supply chain to promote confidence and collaboration among partners.

It disables the need for a central authority, by allowing data to be transacted in a decentralized and distributed manner. Due to the employment of cryptographic concepts, these transactions are safe and trustworthy. This survey on It increases efficiency in the supply chain operations by recording various transactions as blocks which are linked together like a chain. literature works explores some of the methods used to indicate the potential usage of blockchain in the Food supply chain and shows the potential directions of blockchain research.

II. LITERATURE SURVEY

A. Tianhui Meng, Yubin Zhao, Katinka Wolter, Cheng-Zhong Xu, "On Consortium Blockchain Consistency: A Queueing Network Model Approach," IEEE Transactions on Parallel and Distributed Systems (Volume: 32, Issue: 6), 08 January 2021 (Tianhui Meng, Yubin Zhao, Katinka Wolter, Cheng-Zhong Xu , 08 January 2021) [1]

This research looks at analyzing the consistency properties of consortium blockchain protocols. The proposed method can be used to assess the effectiveness of the primary steps in blockchain consensus.

In the hyperledger fabric system, the framework is used to retrieve important attributes of the blockchain network. It uses the raft consensus algorithm, which has several advantages, including increased scalability, the separation of trust assumptions from purchasing guidelines and purchasing, assistance for non-deterministic smart contracts, splitting of smart-contract programs and data over several nodes, and its use of modular consensus adoption. However, because PoW imposes a lag which controls the consensus protocol and is highly fluctuating, the proposed method is not ideal for analyzing public blockchains. The model examines the steady-state distribution of the consortium blockchain system while neglecting business waiting time and the warm-up period.

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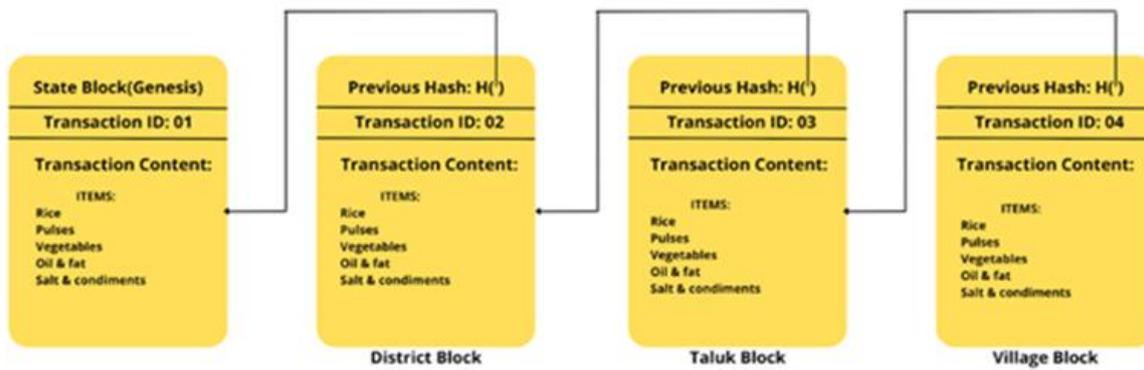


Fig 1. General skeletal structure of Blocks for the project

B. Kay Behnkea, M.F.W.H.A. Janssen (Marijn), "Boundary conditions for traceability in food supply chains using blockchain technology," *International Journal of Information Management* 52 (2020) 101969, 25 May 2019 (Kay Behnkea, M.F.W.H.A. Janssen (Marijn), 25 May 2019) [2]

The motivation for this task is to define the boundaries of transaction confirmation data to ensure traceability. The consensus model suggests that blockchain innovations be used throughout the supply chain to maintain product visibility and improve the user experience throughout the chain. This is the main document on BCT limits, five of which total 18 food traceability limits have been identified, five of which are directly related to BCT. A large number of issues are related to management needs, interior inventory networks, and build procedures, all of which necessitate considerable formal changes in order to fully exploit discoverability. It includes the following tools: However, the problem lies in the location of touch points and rules used by different artists in the inventory network. Discovery recommends optimizing the inventory network first before using the blockchain. The boundary condition suite recommends that hierarchical changes are required before the BCT can be effectively used in legacy networks. This result may indicate why so many blockchain projects remain at the governance level.

C. Wei Yao, Junyi Ye, Renita Murimi and Guiling Wang, "A Survey on Consortium Blockchain Consensus Mechanisms," *arXiv:2102.12058 [cs.DS]*, February 2021 (Wei Yao, Junyi Ye, Renita Murimi and Guiling Wang, February 2021) [3]

The state-of-the-art solutions in consensus algorithms for enterprise blockchain are highlighted in this study. It uses an Adversary model, the study examines and contrasts the operational methods of the aforementioned and many more consortium blockchain consensus protocols, as well as their merits and limitations. The proposed system has High scalability with no tokens involving, high performance and security, also could rapidly find a malicious primary node with the implementation of dynamic addition and deletion of nodes, moreover, the system has high system throughput, fast transaction speeds with Low transaction costs, also ensures Flexible Trust, Linear complexity for message communication and validation. Although, it cannot tolerate Byzantine failure and lack in understandability. Due to the High communication volume, the efficiency of operation is low, when the number of nodes is too large it cannot deal

with closed-loop systems, and fails to prevent malicious nodes from being a primary node. There are considerably more threats to the verification nodes and can only guarantee safety if trusted nodes are adequate.

D. Bahareh Lashkari, Petr Musilek, "A Comprehensive Review of Blockchain Consensus Mechanisms," *IEEE Access* PP(99):1-1 (Volume: 9), 12 March 2021 (Bahareh Lashkari, Petr Musilek, 12 March 2021) [4]

This study compares the most recently announced consensus algorithms with the ideas of distributed ledger technology that led to the establishment of blockchain. The research presents an architectural categorization of consensus algorithms that not only allows for the examination of current consensus but also gives a structure to which further algorithms may be attached. It assesses the distribution of each proposed consensus group among the leading general blockchain platforms. The suggested method uses a communication model and is based on consensus algorithms that have high scalability, security, performance and has fast transaction speed due to the low transaction costs. Nonetheless, after the introduction of hyperledger, focus has shifted to cross-industry and open-source distributed ledger solutions that improve on the cross-complaint hybrid alternative alternatives mentioned in the consensus section. Despite the fact that many providers choose to construct consensus solutions around specific use cases, there is still a desire for consensus mechanisms that can handle a diverse set of requirements. As a result, the CHA class is predicted to produce a large variety of consensus methods.

E. Shangping Wang, Xixi Tang, Yaling Zhang, Juanjuan Chen, "Auditable Protocols for Fair Payment and Physical Asset Delivery Based on Smart Contracts," *IEEE Access* PP(99):1-1 (Volume: 7), 08 August 2019 (Shangping Wang, Xixi Tang, Yaling Zhang, Juanjuan Chen, 08 August 2019) [5]

This study examines a smart contract-based traceable framework for fair financing and physical asset allocation between merchants, customers and logistics companies. To solve network reliability issues, the proposed protocol uses blockchain. This has the advantage of being open, clear, secure and verifiable.

It uses a shopping model, existing studies do not offer customers with a comprehensive shopping model, with the majority of them focusing on payments or solely asset delivery.

According to the study, if global nodes in a decentralized network are to agree, the very same consensus mechanism must be used. This approach is built on a permissioned chain with a high degree of decentralization and based on the consensus algorithm, selects realistic byzantine fault tolerance consensus methods. The proposed method uses a distributed network transaction system to assure openness, clarity, verifiability, and trustworthiness while simultaneously providing high efficiency, security, and scalability. Participants' transaction costs as well as their risks are lowered. However, the strategy does not address how consumers can assure the quality and utility of the things they buy, which is dependent on merchant credibility. As a result, our next research focus will be on the provider's reputation.

F. Miguel Pincheira Caro, Muhammad Salek Ali, Massimo Vecchio, Raffaele Giaffreda, "Blockchain-based Traceability in Agri-Food Supply Chain Management: A Practical Implementation," 2018 IoT Vertical and Topical Summit on Agriculture - Tuscany (IOT Tuscany), 07 June 2018 (Miguel Pincheira Caro, Muhammad Salek Ali, Massimo Vecchio, Raffaele Giaffreda, 07 June 2018) [6]

AgriBlockIoT, a completely decentralized tracking solution for the monitoring of the agri-food supply chain, is the focus of this system's research and development. The proposed solution, in particular, can incorporate a range of IoT sensor devices and can leverage either the Ethereum or hyperledger sawtooth publicly accessible blockchain implementations. AgriBlockIoT ensures transparent and auditable asset traceability by immediately creating and collecting critical data from IoT devices out across the supply chain and directly storing it in the underlying blockchain. It uses open provenance model and based on consensus algorithm. The proposed system could provide records that are transparent, fault-tolerant, immutable, and auditable. On the other hand, as for the future enhancements, wants to extend the performance investigation to more limited hardware designs in order to determine the feasibility of the proposed structure for applications involving real IoT devices and gateways throughout the agri-food supply chain.

G. Guido Perboli, Stefano Musso, Mariangela Rosano, "Blockchain in Logistics and Supply Chain: A Lean Approach for Designing Real-World Use Cases," IEEE Access PP(99):1-1 (Volume: 6), 16 October 2018 (Guido Perboli, Stefano Musso, Mariangela Rosano, 16 October 2018) [7]

The research and development of this system has primarily focused on the technology aspect and business process modelling of blockchain in non-financial applications, with little in the way of a systematic method for creating, verifying, and integrating the entire blockchain solution into the business strategy. This study seeks to overcome that need. To begin, it incorporates existing material in order to fill a gap in the digital strategy literature by providing a standard approach for designing blockchain technology use cases that are unrelated to financial applications. Second, it goes over the results of a fresh food delivery case study.

Furthermore, this article explores how blockchain might aid in the reduction of logistical costs as well as the optimization of operations and research challenges. It uses business process model on the basis of secure hash algorithm and consensus algorithm which renders high-longevity, performance, savings, sustainability, bullwhip effect and high-level results. The integration of the technique with business process modelling, on the other hand, will help to steer blockchain initiatives from the start. The goal of this study is to apply the methodology to additional applications. The automobile industry, in particular, will be a feasible application, with an emphasis on vehicle identity and integration for autonomous driving and data interchange.

H. Affaf Shahid, Ahmad Almogren, Nadeem Javaid, Fahad Ahmad Al-Zahrani, Mansour Zuair, Masoom Alam, "Blockchain-Based Agri-Food Supply Chain: A Complete Solution," IEEE Access PP(99) (Volume: 8), 07 April 2020 (Affaf Shahid, Ahmad Almogren, Nadeem Javaid, Fahad Ahmad Al-Zahrani, Mansour Zuair, Masoom Alam, 07 April 2020) [8]

The research and the groundwork of this system are focused on, smart contracts and associated algorithms which are provided to demonstrate the interaction of entities in the system. In addition, this effort includes smart contract simulations and evaluations, as well as security and vulnerability analysis. The proposed solution follows the trading and delivery model and uses file encryption algorithm and Elliptic curve digital signature algorithm, which usually offers an end-to-end approach for the agri-food supply chain. Ensures a reliable, efficient, and secure supply chain environment. Accountability, validity, auditability, liberty, and originality are also achieved using the proposed strategy. On the other hand, in the case of agri-food items, the proposed approach fails to incorporate refund and return mechanisms.

End-user reviews, which can be biased or fraudulent, are not stored in the reputation system. Furthermore, security evaluations focusing on attacks on reputation systems were not taken into account.

I. Haya R. Hasan, Khaled Salah, "Blockchain-Based Proof of Delivery of Physical Assets with Single and Multiple Transporters," IEEE Access PP(99):1-1 (Volume: 6), 21 August 2018 (Haya R. Hasan, Khaled Salah, 21 August 2018) [9]

All participating organizations are honest with dual trust security due to the use of the proof-of-delivery method to generate a blockchain-based proof of (Tianhui Meng, Yubin Zhao, Katinka Wolter, Cheng-Zhong Xu , 08 January 2021)distribution of physical goods by single or many transporters.

Automated ether payments are an essential component of the approach to corroborate that each unit receives the intended share of ether when delivered successfully. It also has a built-in arbitration mechanism in case in the event of a disagreement during the shipment procedure.

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This solution is economical and may be used to sell and trade tangible goods both locally and internationally. However, there is no PoD solution for selling digital assets. This ensures distributed, dependable and stable transport and automated bills for all sorts of bodily or virtual traded property.

J. Khaled Salah, Nishara Nizamuddin, Raja Jayaraman, Mohammad Omar, "Blockchain-Based Soybean Traceability in Agricultural Supply Chain," IEEE Access (Volume: 7), 20 May 2019 (Khaled Salah, Nishara Nizamuddin, Raja Jayaraman, Mohammad Omar, 20 May 2019) [10].

This task uses a food processing and track model to build soy blockchain-based traceability in the agricultural supply chain. An intermediary that leverages smart contract algorithms and improved practical Byzantine Fault Tolerance Algorithms (iPBFTs) to provide centralized permissions and to increase the integrity, dependability, efficiency, and security of transaction records. It also enables dependable and decentralized supply chain traceability. However, if the cryptocurrency is paid to the parties in a centralized way automated through smart contracts after successful physical delivery and dispute resolution of the crop or product, the proof of payment and delivery will not be automated.

K. Ahmed Alketbi, Qassim Nasir, Manar Abu Talib, "Blockchain for Government Services – Use Cases, Security Benefits and Challenges," 2018 15th Learning and Technology Conference (L&T), 25-26 Feb. 2018 (Ahmed Alketbi, Qassim Nasir, Manar Abu Talib, 25-26 Feb. 2018) [11]

This paper uses the Random-Sample Elections models to analyze the different blockchain government services such as applications, security features and the constraints. It uses the consensus algorithm which poses several advantages such as providing government services in a more cost-effective, distributed, and voluntary manner. The application of blockchain technology to create smart government services has enormous promise. While it poses some advantages, it also poses some disadvantages such as not focusing on the improvements in security and problems of using blockchain in IoT contexts.

L. Affaf Shahid, Umair Sarfraz, Muhammad Waseem Malik, Muhammad Sohaib Iftikhar, Abid Jamal, and Nadeem Javaid, "Blockchain-based Reputation System in Agri-Food Supply Chain," 34th International Conference on Advanced Information Networking and Applications (AINA), Luigi Vanvitelli, Caserta, Italy, February 2020 (Affaf Shahid, Umair Sarfraz, Muhammad Waseem Malik, Muhammad Sohaib Iftikhar, Abid Jamal, and Nadeem Javaid, February 2020) [12]

This paper uses the agri-food chain model to build a blockchain-based reputation system in agri-food supply chain. Utilizing the file encryption algorithm it maintains the trust between exchanging substances, keeps up with the trustworthiness and unchanging nature of the audits enrolled through smart contracts and gives a point by point execution examination of the proposed system in relation to the required gas. While it has some advantages, it also has some disadvantages where the outcomes show that the framework requires specific measure of holding up an ideal opportunity

to mine the exchange, however the wait time is free of information length of audits.

M. Jiang Duan, Chen Zhang, Yu Gong, Steve Brown and Zhi Li, "A Content-Analysis Based Literature Review in Blockchain Adoption within Food Supply Chain," International Journal of Environmental Research and Public Health 17(5):1784, March 2020 (Jiang Duan, Chen Zhang, Yu Gong, Steve Brown and Zhi Li, March 2020) [13]

This work uses a blockchain model based on hyperledger fabric to perform a literature review based on content analysis of blockchain adoption in food supply chains. It uses the consensus algorithms to further develop food discernibility, data straightforwardness and review effectiveness. However, this gives more experimental proof rather than hypotheses. Different food products may require difference supply chain.

N. Saveen A. Abeyratne, Radmehr P. Monfared, "Blockchain Ready Manufacturing Supply Chain Using Distributed Ledger," IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308 | Volume: 05 Issue: 09, September 2016 (Saveen A. Abeyratne, Radmehr P. Monfared, September 2016) [14]

This work uses blockchain-based model to build a blockchain-compatible manufacturing supply chain with distributed ledger. It uses the cryptographic algorithm improve the traceability in the system, maximises the transparency of system elements while maintaining data integrity and security. It also facilitates the collection of large amounts of data about manufacturing products and users and proves useful to a variety of individuals, organizations, researchers and governments. But it requires specific IT infrastructure like access to the internet.

This can currently be impractical for some remote providers of raw materials. Digital profiles need to be constantly updated, either manually or by an automated system.

Smart contracts need to be implemented and integrated into the system to incentive the blockchain and accelerate the progress of business processes. In addition, the performance of such systems can be a bottleneck in the implementation of the proposed solution.

O. Muhammad Shoaib, Ming K. Lim, Chao Wang, "An integrated framework to prioritize blockchain-based supply chain success factors," Industrial Management & Data Systems 120(11):2103-2131, October 2020 (Muhammad Shoaib, Ming K. Lim, Chao Wang, October 2020) [15] This work uses taxonomic model to build an integrated framework for prioritizing blockchain-based supply chain success factors. The motivation behind this review is to recognize and focus on variables that can have a significant impact on the execution of blockchain-based supply chains through an integrated structure. Previous studies have not tried to focus on these variables in order to get the most out of the compiler's information. You can identify key success factors for blockchain-based supply chain technology. However, no solution has been identified to find barriers / obstacles to a successful implementation of blockchain technology.

PAPER NAME	AUTHOR	MODEL USED	ALGORITHM	ADVANTAGES	LIMITATIONS
The Supply Chain Has no Clothes: Technology Adoption of Blockchain for Supply Chain Transparency	Francisco et al., (2018) (Kristoffer Francisco and David Swanson, January 2018) [16]	Conceptual model	-	Provides guidance for adoption and use of supply chain traceability for end users.	Does not provide guidance for steps to foster technology adoption.
Blockchain Technology in the Food Industry: A Review of Potentials, Challenges and Future Research Directions	Rejeb et al., (2020) (Abderahman Rejeb, John G. Keogh, Suhaiza Zailani, Horst Treiblmaier and Karim Rejeb, October 2020) [17]	Blockchain-based Business models	Consensus algorithm	Food traceability is improved, collaborative partnerships are strengthened, operational efficiency is increased and food trade operations are sustained.	Doesn't cover all of the research papers on blockchain technology that have been published in the FSC environment.
Blockchain Technologies in Logistics and Supply Chain Management: A Bibliometric Review	Rejeb et al., (2021) (Abderahman Rejeb, Karim Rejeb, Steve Simske and Horst Treiblmaier, 7 October 2021) [18]	Iterative optimization model	Louvain algorithm	Presents a structured review and provides depth to blockchain research in logistics and SCM.	Presents a static and historical view that must be updated on a regular basis to keep up with recent developments in blockchain deployments in logistics and supply chain management.
Blockchain-based Solution for Proof of Delivery of Physical Assets	Hasan et al., (2018) (Khaled Salah, Haya R. Hasan , June 25 - June 30, 2018) [19]	-	Smart contract algorithm	High integrity, reliability, immutability, accountability. Allows for the trading and tracking of products and this does away with the requirement for a third party.	Confidentiality and privacy were not discussed.
Understanding blockchain technology for future supply chains: a systematic literature review and research agenda	Wang et al., (2018) (Yingli Wang, Jeong Hugh Han and Paul Beynon-Davies, December 2018) [20]	Governance model	-	A thorough and integrated overview of academic and practice literature is presented. Categorized into descriptive, conceptual, predictive and prescriptive studies.	Technical countermeasures are not involved.
The acceptance of blockchain technology in meat traceability and transparency	Sander et al., (2018) (Fabian Sander, Janjaap Semeijn, Dominik Mahr, 19 March 2018) [21]	-	Partial least squares algorithm	Allows for peer-to-peer transactions and improved traceability	The majority of meat traceability studies are outmoded and no in-depth research conducted.

III. CONCLUSION

In this paper, we looked at blockchain as a developing technology that is influencing food traceability and has the ability to enhance supply chain visibility and efficiency in this research. Using this technology in the supply chain reduces paperwork and costs while also ensuring regulatory compliance and combating counterfeiting. Consortium blockchain is a permissioned platform in which transactions or data to be transferred are managed by multiple organizations rather than a single one. It's more secure, scalable, and efficient. The results of a systematic review of methodologies used by authors of several works on the expediency of blockchain technology in the food supply chain, such as enhanced food traceability, improved collaboration, operational effectiveness, and expedited food trade processes, are presented in this survey.

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