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THE ROLE OF BLOCKCHAIN TECHNOLOGY IN ADDRESSING BUSINESS FRAUD

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ABSTRACT

Objective: This research explores the role of blockchain technology in addressing fraud in the food supply chain, with a focus on IBM Food Trust. The main objective is to evaluate how blockchain improves transparency, traceability and auditability across the supply chain, as well as its impact in reducing fraud and increasing consumer confidence.

Research Design & Methods: The methodology used was a qualitative case study, centered on the IBM Food Trust as the main platform. Data was collected through document analysis of relevant literature, annual reports, and case studies. Secondary sources, such as research papers and reports on blockchain implementation in the supply chain, using a comprehensive approach.

Findings: The research highlights that blockchain significantly reduces the time needed to track products, increases transparency, and minimizes the risk of fraud by providing an immutable record of transactions. In the case of IBM Food Trust, the time to trace products such as mangoes was reduced from days to seconds. In addition, consumers reported increased confidence in food safety and product quality due to the traceability features provided by blockchain technology.

Implications: The results indicate that blockchain technology could transform the food supply chain by enhancing efficiency, minimizing fraud, and promoting transparency. Nonetheless, achieving successful adoption necessitates addressing challenges like integration with current systems, substantial initial costs, and the requirement for stakeholder education and training.

Contribution: This research contributes to the growing body of knowledge on the application of blockchain in supply chain management. The research provides practical insights into the benefits and challenges of blockchain implementation, particularly in the food industry, and highlights its potential to drive greater transparency, trust, and operational efficiency.

Keywords: Food Trust, Blockchain, Technology, Transparency.

JEL codes: Q13, L86, O33
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INTRODUCTION

Food plays a crucial role in society and the global economy. In the UK, the average household allocates around 17% of their income to food needs (Office for National Statistics, 2020). At the European Union level, the food and beverage industry is recognized as one of the largest sectors with a turnover exceeding 1 trillion Euros in 2019 (Food Drink Europe, 2019). However, the industry faces significant challenges related to managing food safety, quality and sustainability, especially as supply lines become increasingly globalized, complex and fragmented (Akkerman et al., 2010; Routroy & Behera, 2017). The Role of Technology in Overcoming Problems In the face of these

challenges, the food industry has invested heavily in modern information systems and technology to improve the management of food products (Kamble et al., 2020; Routroy & Behera, 2017). Blockchain technology has emerged as a promising solution to solve critical issues in the food supply chain. With its ability to offer transparency, traceability, and security of immutable data, blockchain provides a much-needed solution to address the challenges in this industry (Tan et al., 2020; Zhao et al., 2019).

Several examples of the application of blockchain technology in the food industry show the great potential of this technology in improving transparency and accountability. Carrefour, as a leading food retailer in Europe, started a blockchain initiative for its poultry products in 2018 with the target of achieving full traceability by 2022 (Carrefour, 2020). Similarly, Nestlé and IBM are collaborating to monitor sustainability in their coffee, dairy, and palm oil supply chains (Nestlé Global, 2020). Hyperledger states Walmart has also successfully piloted blockchain to track mangoes and pork, and plans to fully integrate the technology in their operations (Vu et al., 2023b).

Blockchain technology offers significant advantages in food supply chain management. One of the main benefits is its ability to provide traceability, which is the tracking of products from their origin to the end consumer. In addition, blockchain supports auditability, which makes it easier to verify data transparently, and immutability, which ensures that recorded data cannot be altered or manipulated. These advantages are critical in preventing fraud and ensuring compliance with strict food safety standards. While blockchain technology shows great potential in increasing transparency and tackling fraud, its adoption in the food industry still faces challenges. Most recently, although many companies have begun to implement blockchain, the implementation is often limited to certain parts of the supply chain and is not yet fully comprehensive. Technical challenges such as integration with existing systems, implementation costs, and limited knowledge among industry players remain key barriers. Existing research gaps include the need for a more in-depth evaluation of the effectiveness of blockchain in various contexts and a better understanding of the practical challenges in its implementation (Vu et al., 2023a).

IBM Food Trust is one of the innovative blockchain applications in the context of the food supply chain. The platform facilitates transparency by allowing all parties in the supply chain, from the farmer to the end consumer, to access consistent information about the product's journey. With integration of blockchain technology, IBM Food Trust creates a secure and transparent tracking system, which not only reduces the risk of fraud but also increases accountability throughout the food supply chain. This research aims to evaluate the application of blockchain technology, specifically through IBM Food Trust, in addressing the issue of fraud in the food supply chain. The main focus of this research is to understand how blockchain technology can improve transparency and product tracking and its impact on fraud reduction. This research can provide in-depth insights into the potential of blockchain technology in improving transparency and addressing fraud issues in the food supply chain. By identifying the benefits and challenges of this technology, this research is expected to provide practical guidance for companies and stakeholders in adopting and implementing blockchain solutions effectively. In addition, this study also contributes to filling existing research gaps by offering a comprehensive evaluation of the application of blockchain in the context of complex food supply chains.

LITERATURE REVIEW

Blockchain and Supply Chain

Blockchain is a distributed ledger technology that allows transactions to be recorded securely and transparently. In the food supply chain, blockchain enhances traceability, minimizes fraud, and ensures product authenticity (Kamble, S. S., Gunasekaran, A., & Sharma, 2020). Technology that allows a group of people to reach consensus on keeping a record - a "book" - without needing to submit their collective consent to a centralized authority. A public record can be kept without the need for a public authority (Markey-Towler, 2018).

Supply chain management (SCM) is a field of study that includes planning and managing all actions involved in supplier selection, procurement, and all other logistical actions. This includes working with a network of partners, agents, suppliers, third parties, and consumers (Zaman et al.,

2023). According to Irawan, 2008 supply chain management is the management of activities related to the procurement of raw materials, the transformation of these raw materials into goods in process and finished goods, and the delivery of these products to consumers through a distribution system (Putri et al., 2024). Supply chain management describes the coordination of all supply chain activities, from raw materials to customer satisfaction. The supply chain comprises suppliers, manufacturers or service providers, distribution networks, and wholesale or retail companies that deliver products or services to end consumers (Pongoh, 2016).

IBM Food Trust

IBM Food Trust is a cooperative network comprising producers, processors, wholesalers, distributors, manufacturers, retailers, and other experts collaborating to enhance transparency and accountability throughout the food supply chain (IBM Food Trust, 2024). The platform is built on IBM Blockchain technology, which allows participants to connect through a shared ledger that is decentralized and immutable. This ledger transparently records product origins, transactions, and processing information. The system allows products to be tracked all the way through the supply chain, enables secure document sharing with trading partners, and builds consumer trust in their brands. IBM Food Trust is a blockchain platform designed to increase transparency in the food supply chain. It allows every party in the supply chain to access the same information about the product's journey from producer to end consumer.

IBM Food Trust was first introduced in 2016 as a blockchain-based solution designed to connect various parties in the food industry to improve transparency and accountability throughout the supply chain. As a first step, IBM launched a trial period in August 2017 by partnering with a number of large companies in the food and beverage industry. Some of the strategic partners that joined the pilot include Nestle SA, Dole Food Co., Inc, Driscoll, Golden State Foods, Kroger Co, McCormick and Co, McLane Co, Tyson Foods Inc, and Unilever. This partnership brings together major players in the global food supply chain, enabling collaboration to test the effectiveness of blockchain technology in product tracking, improving efficiency and building consumer confidence in the authenticity and safety of the food products they consume.

METHODS

This research adopts a case study approach to analyze the application of blockchain technology in the food supply chain, focusing on IBM Food Trust as the main object. This approach is designed to gain an in-depth understanding of how blockchain technology plays a role in improving transparency, security, and efficiency in the food supply chain. Qualitative methods were used in the data collection process, with analysis of relevant documents, including IBM Food Trust's annual reports, documented case studies, and academic literature focusing on blockchain in the context of food supply chains. Secondary sources, such as research papers and reports on blockchain implementation in the supply chain, were also utilized. This comprehensive approach enabled the researcher to identify the benefits and challenges of blockchain implementation, as well as evaluate its impact on transparency and fraud risk reduction in the food supply chain.

RESULT

Implementation of IBM Food Trust

IBM Food Trust applies blockchain to record every step of a food product's journey, from the farmer to the end consumer. With this system, information regarding product origins, processing and delivery is transparently and irreversibly recorded. The results of the IBM Food Trust implementation show a significant positive impact on transparency, efficiency and safety in the food supply chain. By utilizing blockchain technology, IBM Food Trust enables real-time tracking of products from the production stage all the way to the consumer, thereby improving the ability to detect problems in the supply chain more quickly (Rogerson & Parry, 2020). For example, in the case of contaminated food tracking, the time to identify the source of the problem is reduced from several

days to just a few seconds, enabling faster product recalls and reducing health risks for consumers. Here are the key advantages of applying blockchain to the IBM Food Trust.

Table 1. The main advantages of applying blockchain to the IBM Food Trust

Main Advantages	Description
Real-time Tracking	Enables direct traceability of food products from producer to end consumer.
Product Traceability	Product information is securely and irreversibly recorded, covering origin, processing and delivery.
Transparency	All parties in the supply chain can monitor data transparently, reducing the risk of fraud and product counterfeiting.
Efficiency and Security	Blockchain reduces transaction time and the role of intermediaries, and increases the speed of recalling contaminated products.

Some participating companies, such as Walmart, reported significant improvements in operational efficiency. Walmart, after adopting the system, was able to trace the origin of mangoes in just seconds, which previously took up to seven days. In addition, major companies such as Nestlé and Unilever have also managed to strengthen consumer trust by offering full visibility into the origin and quality of their products through this platform.

The Impact on Fraud

The blockchain technology implemented by IBM Food Trust has reduced the risk of fraud in the food supply chain. Blockchain provides tremendous visibility at every step of the food supply chain by providing a decentralized, immutable, and open record of every transaction and process that takes place (Li et al., 2021). This technology increases transaction transparency by providing information that is accessible to all relevant parties, from the producer to the end consumer, ensuring that every product can be traced in detail. Thus, every party along the supply chain can know the origin, location, and status of food products in real-time. In addition, blockchain also helps improve food safety, due to the ability to immediately identify and recall contaminated or unsafe products before they reach consumers.

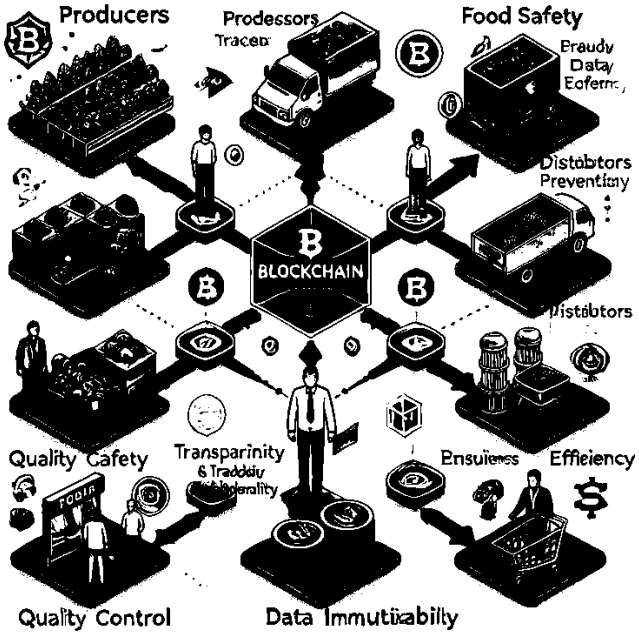

Figure 1. The advantages of using blockchain

In terms of quality, blockchain enables full traceability of products, ensuring that every process, from production to distribution, is carried out according to established standards. It also provides a huge advantage in reducing fraud, especially in the food industry, where issues such as false claims about product origins or ingredient content are common. With blockchain, any information inputted is permanent and cannot be manipulated, minimizing the potential for fraud. Finally, blockchain also plays an important role in reducing food waste. With full visibility into stock and distribution, it can help optimize inventory management, prevent expired or damaged products before they reach consumers, and reduce losses along the supply chain. Overall, blockchain creates a more efficient, secure, and trusted ecosystem across the food supply chain. Blockchain brings sweeping changes to the food supply chain by providing unprecedented visibility at every stage of the process. The technology allows every participant in the supply chain, from producers to consumers, to access transparent and accurate data regarding the origin, status, and journey of a product.

According to Li et al. (2021), blockchain improves transaction transparency, food safety, and product quality, and significantly reduces food fraud and waste. The technology allows any information entered into the system to be permanent and immutable, creating a more secure and reliable environment throughout the supply chain. Blockchain serves as an effective tool to mitigate food safety threats and prevent fraud. Esfandiari (2022) stated that with blockchain, the tracking of goods along the supply chain becomes highly transparent, and the data stored in the system cannot be altered, providing extra protection against data manipulation and crime in the food distribution process. This is an important solution for the food industry, which often faces risks related to product quality and safety. On the other hand, the transparency offered by blockchain in the food supply chain helps to increase consumer confidence. Rogerson & Parry (2020) stated that this technology enables detailed tracking of product origins, allowing consumers to ensure the authenticity of the products they purchase and avoid counterfeit goods. This in turn increases customer trust in the brands and products they consume.

In addition, blockchain improves traceability and auditability in agricultural supply chains. Kamble, S. S., Gunasekaran, A., & Sharma (2020) explain that this technology not only enables easier product tracking but also helps reduce the number of middlemen involved, thereby minimizing the potential risk of fraud. With more transparent and accurate audits, every step in the supply chain can be effectively monitored, increasing efficiency while reducing the risk of crime. Bumblauskas et al. (2020) also noted that blockchain not only improves traceability but also drastically reduces the risk of product loss along the global food supply chain. In a complex global scenario, where multiple parties are involved in food distribution, blockchain is instrumental in creating a more reliable and integrated system, helping to reduce product loss due to errors or damage during delivery. Overall, blockchain brings significant changes in improving transparency, security, and trust across the global food supply chain. While blockchain offers many benefits, here are some challenges to its implementation:

Table 2. Blockchain challenges and implementation

Implementation Challenges	Description
Adoption by All Parties	The challenge is to ensure that all entities in the supply chain, from smallholders to large distributors, can adopt the platform. Smallholders may face difficulties due to limited resources and technology, while large distributors require customization with existing systems.
Implementation and Infrastructure Costs	The initial cost of implementation, including investment in technology infrastructure, hardware, system integration, and employee training, is an obstacle, especially for SMEs. These costs are difficult to bear for small companies that may not benefit immediately.
Knowledge and Expertise Limitations	Many parties in the supply chain, especially farmers or small suppliers, do not have sufficient technical expertise to operate blockchain. Lack of knowledge can slow down the adoption of the technology, so ongoing training and technical support programs are necessary.

The table above identifies three key challenges faced in the implementation of blockchain technology through the IBM Food Trust platform in the food supply chain. First, adoption by all parties is the biggest challenge, especially in ensuring that all entities, from smallholder farmers to large distributors, can use this technology. Smallholder farmers are often limited in terms of access to technology, financial resources, and digital infrastructure, while large distributors with complex supply chain management systems require customization to integrate blockchain into their systems. These challenges require strong cross-sector coordination so that all parties can connect to the platform and enjoy the benefits of transparency and efficiency offered by blockchain technology. Second, implementation and infrastructure costs are prohibitive, especially for small and medium-sized enterprises (SMEs). While IBM Food Trust offers a more affordable solution compared to other platforms, the initial costs for technology infrastructure, hardware purchases, and employee training remain burdensome. This is even more difficult for SMEs with limited budgets, especially when the benefits of using blockchain may only be seen in the long run. Third, limited knowledge and expertise in blockchain technology is a significant barrier. Many parties in the supply chain, particularly farmers and small suppliers, do not have sufficient understanding to utilize this technology effectively. The technical complexity of blockchain can create resistance to change and slow down the adoption process. For this reason, a comprehensive training program and ongoing technical support are needed so that all parties can overcome these challenges and operate the blockchain platform optimally.

DISCUSSION

Blockchain plays an important role in increasing transparency in the food supply chain by providing features such as traceability, auditability, and immutability. This technology allows all data related to the movement and processing of food, from producer to consumer, to be recorded in a decentralized and permanent system. This minimizes the possibility of manipulation or fraud that often occurs in the food industry. Traceability allows every party in the supply chain to trace the origin of food products in real-time. According to research conducted by Carrefour and IBM Food Trust, blockchain is able to monitor the movement of products from the field to the consumer's table, so any changes or handling of the product can be tracked easily. This creates greater consumer confidence, as they can be assured of the safety and quality of the products they are purchasing.

Blockchain's auditability allows third parties to verify transactions or data stored within it. Each time a product moves from one entity to another, this information is automatically recorded and can be audited by authorities or customers. This creates a more transparent and accountable supply chain. Immutability, or data permanence, ensures that once information is entered into the blockchain, it cannot be altered or manipulated. This feature is crucial in preventing fraud, as irresponsible parties cannot modify data regarding the origin, quality, or delivery of food products. By incorporating these features, blockchain helps reduce fraud throughout the food supply chain. A study showed that this technology can minimize human error and prevent data tampering, such as falsifying product origins or making false quality claims. Ultimately, it increases consumer confidence in the products they consume, as they can transparently track product information.

IBM Food Trust's case study for tracking fresh products such as mangoes and pork. Before using blockchain, the process of tracking mango products took up to seven days. After blockchain was implemented, the tracking time was significantly reduced to just a few seconds. This shows that blockchain can improve traceability and efficiency in the supply chain. In addition, customers also have more confidence in product safety as every process can be tracked and verified in real-time (IBM, 2018). Blockchain has demonstrated its potential to enhance transparency, integrity, and trust in food supply chain information. IBM and Walmart are expanding their collaboration to include major companies such as Dole, Nestlé, Tyson Foods, and Unilever (IBM, 2017). This traceability is crucial in addressing food safety issues, including contamination, pesticide residues, and bioterrorism threats. Walmart's blockchain implementation is designed to solve business challenges such as improving time efficiency, reducing costs, and increasing revenue (Burkitt, 2014). For broader adoption, every participant in the supply chain, from farmers to retailers, must recognize the value of this system (Doyle, 2014). Blockchain allows participants to record, verify, and track products along the supply chain, providing them with better control over their brand and

business while enabling more advanced data analysis. The technology allows traceability down to the individual product level. Walmart selected IBM's blockchain solution because it integrates with existing systems, utilizing Hyperledger to enhance traceability (Burkitt, 2014). They also implemented a three-pronged approach in China, which includes food safety education, academic collaboration, and supply chain analytics to identify vulnerabilities (Lindell, 2016). The pilot project aims to address systemic failures in the food supply chain and restore public confidence in food safety.

Nestlé has partnered with IBM to utilize blockchain technology to track the supply chain of coffee and milk, with the goal of ensuring the sustainability and authenticity of these products. The results demonstrated that blockchain enhances auditability throughout the production and distribution processes. By enabling clear traceability of product origins, Nestlé has strengthened consumer trust, particularly in products marketed as sustainable. Consumers can view the product's journey from farm to retailer, which helps improve their perception of transparency and product quality (Nestlé Global, 2020).

The challenge of implementing blockchain technology through the IBM Food Trust platform is closely tied to efforts aimed at enhancing transparency in the food supply chain. Blockchain has the potential to improve traceability and auditability at every stage of the supply chain, both of which are crucial for maintaining the safety and quality of food products. However, a significant hurdle lies in the adoption of this technology at various stages, particularly among smaller players such as farmers and suppliers who may lack access to the necessary technology and infrastructure (Menon & Jain, 2021). For example, small farmers may struggle to integrate this technology into their simple operations, while large distributors will have to adapt their complex systems to connect with blockchain platforms. In addition, the success of blockchain implementation in increasing transparency and trust largely depends on the extent to which this technology can be well integrated in the supply chain digitization process. This includes efficiency in data processing, real-time tracking, and transaction automation resulting from the use of blockchain. For example, in a blockchain trial by Walmart and IBM Food Trust, traceability of products such as mangoes and pork was quickly identified, from the field to the supermarket shelf, demonstrating how blockchain can assist in the rapid response to food safety issues and product recalls.

Blockchain also has the potential to enhance supply chain performance by reducing the role of intermediaries, accelerating transaction times, and lowering administrative costs. With features such as smart contracts, many activities that previously required third-party involvement can now be automated, thereby increasing overall efficiency (Kamble, S. S., Gunasekaran, A., & Sharma, 2020). For example, within the IBM Food Trust, smart contracts facilitate the automation of payments once products reach specific milestones, reducing delays in payment and the delivery of goods. While blockchain technology has the potential to enhance transparency and sustainability, another significant challenge is the complexity of integration and system efficiency. Many companies, particularly those in the small to medium-sized sector, may lack sufficient resources to effectively implement a blockchain system. This implementation requires substantial investments in digital infrastructure and training for users (Chandan et al., 2023). For instance, in the global food industry, Nestlé and Unilever encountered challenges in integrating blockchain into their existing supply chain systems, primarily related to technology customization and employee training across various locations.

Additionally, while blockchain can reduce fraud and increase visibility, the challenges of implementation costs and coordination among the parties involved continue to be significant obstacles (Li et al., 2021). The costs associated with establishing blockchain infrastructure, training employees, and adapting legacy systems can be prohibitive, particularly for smaller companies. In some cases, parties involved in the supply chain may also be hesitant to share data openly due to concerns about business competition or distrust in the new technology. Overall, implementation examples like IBM Food Trust demonstrate how blockchain can enhance transparency, trust, and efficiency in the food supply chain. However, broader adoption still requires policy support, technological adjustments, and appropriate financing to overcome these challenges and ensure that all stakeholders in the supply chain can effectively utilize blockchain technology.

CONCLUSION

IBM Food Trust has demonstrated how blockchain technology can enhance transparency and combat fraud in the food supply chain. With its ability to track products in real-time and provide immutable information, blockchain helps reduce fraud and increase consumer confidence. This research indicates that the implementation of blockchain technology, particularly through the IBM Food Trust platform, has significantly contributed to transparency, traceability, and efficiency within the food supply chain. Features such as real-time tracking, auditability, and immutability have improved food safety, reduced the risk of fraud, and expedited the recall of contaminated products. Furthermore, the technology decreases dependence on intermediaries, thereby enhancing operational efficiency and bolstering consumer trust. However, blockchain adoption still encounters challenges, primarily related to implementation costs, infrastructure, and limited technical expertise across various parties in the supply chain. Additional challenges include the uneven adoption of the technology by all stakeholders, ranging from small farmers to large distributors, as well as the need for better integration with existing digital systems. While blockchain holds significant potential to enhance transparency and sustainability, successful adoption relies on cross-sector coordination and supportive policies.

The results of this study have several important implications for the food industry. First, the adoption of blockchain in food supply chains can provide a competitive advantage for companies that prioritize product safety and quality. Second, blockchain can strengthen the relationship between consumers and producers by offering a higher level of transparency, which, in turn, increases trust in brands. Third, governments and regulatory organizations can leverage this technology to mitigate food safety risks and address fraud issues within global supply chains. To overcome the challenges associated with blockchain implementation, it is recommended that companies in the food supply chain increase their investment in training and education on blockchain technology, develop strategies for seamless integration of the technology into existing systems, and provide technical and financial support for all parties involved in the supply chain, particularly small and medium-sized enterprises (SMEs) and smallholder farmers.

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