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Original Paper

The Innovative Model of Blockchain Technology and Its Application in Promoting International Fair Trade: Design and Analysis of the IFTBOM Blockchain Framework Model

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Abstract

In this Research, researchers proposed a new framework model for applying blockchain technology, aiming to solve multiple challenges in international fair trade. Through a detailed analysis of the existing trade imbalance and market access restrictions, the paper expounds how blockchain technology can improve the transparency and fairness of trade through its core functions.

Globalization and technological progress have promoted the rapid development of international trade, but also brought many challenges. The fair-trade movement tried to provide more fair-trading conditions for small-scale producers in developing countries, but the market acceptance was not high, and consumers' cognition was limited. The purpose of this study is to explore how blockchain technology can promote fair trade practices, especially through real-time monitoring and verification of the fairness of trade activities, and how to deal with uncertainties and data changes in fair trade. The design and implementation of IFTBOM model is expected to significantly improve the global fair-trade environment, especially for small-scale producers in developing countries, and help significantly improve their economic and social conditions. By implementing these policies and practices, we can expect to achieve a fairer and more transparent trade environment in the global context.

Keywords

Blockchain technology, Fair trade, international trade, Supply chain management, Smart contracts, Data security and privacy, IFTBOM

1. Introduction

1.1 Current Situation and Challenges of International Trade and Fair Trade

In an era marked by rapid global economic growth and integration, international trade plays an irreplaceable role in the global economy. The globalization of the world economy has led to an increasingly dependence on foreign trade, with varying degrees of participation from both developed and developing countries (Alicia, 1999). In recent years, rapid economic globalization and technological advancements have driven the swift expansion of trade flows. Following nearly two decades of activism, the fair-trade movement, which advocates for alternative trading practices to guarantee fair returns, safe labour conditions, and environmentally sustainable production, is gaining momentum. Awareness and accessibility of fair-trade products are on the rise across various sectors (Hira & Ferrie, 2006). However, the rapid growth in global trade has also brought about a series of challenges, including trade imbalances, an increase in tariffs and non-tariff barriers, as well as restrictions on market access.

Fair trade aims to provide more equitable trading conditions for small-scale producers in developing countries. At its core, fair trade seeks to ensure producers receive fair compensation and promote sustainable development in the trading environment. Fair trade products typically include coffee, chocolate, sugar, and handicrafts, with their market steadily expanding over the past few decades. After fifty years of concerted effort, Fair Trade principles and practices have resonated with a wide spectrum of individuals, including consumers and producers, ranging from large corporations to small businesses, as well as governments, non-governmental organizations, and research institutions (Pauline, 2019).

Although fair trade has made some achievements in improving producer welfare and promoting environmental sustainability, it still faces many challenges. Firstly, there is limited market acceptance and consumer awareness of fair-trade products. Many consumers lack understanding of the concept of fair trade or have concerns about the higher prices of fair-trade products. Secondly, there are difficulties in enforcing and regulating fair trade standards. Different countries and regions have varying certification standards and requirements for fair trade, posing challenges for cross-border regulation and quality control.

Furthermore, there is a significant economic disparity between developing and developed countries in international trade. This economic disparity often leads to long-term trade surpluses and deficits. The gap in economic strength is detrimental to the economic development of poorer countries. Developing countries' exports tend to concentrate on low-value-added raw materials and primary commodities rather than high-value-added products. Additionally, the rules and standards in the global trade system are often dominated by economically powerful countries, putting developing countries at a disadvantage in the international market.

1.2 Overview and Development of Blockchain Technology

In recent years, the emergence of digital currency has brought greater attention to its underlying technology, blockchain. This technology is gaining prominence due to its several fundamental features, such as decentralization, timestamped data, consensus mechanisms, traceability, programmability, security, and credibility. Notably, blockchain ensures the integrity of data through its tamper-proof nature (Dong, Abbas, Li, & Kamruzzaman, 2023). A blockchain comprises a series of linked blocks housing data, each block containing digital signatures, within a decentralized and distributed network. Managed by a group of nodes in this decentralized network, blockchains establish a public and decentralized digital ledger, resistant to manipulation or control by any single node. This setup ensures a secure platform for peer-to-peer digital asset transfers, eliminating the necessity for a central authority or intermediary (Di Pierro, 2017).

In recent years, as international trade volumes continue to rise, traditional blockchain technology is undergoing updates and iterations. Despite its inherent security, blockchain technology faces numerous challenges in its development. Despite the basic security of blockchain, the technical weaknesses unique to today's technology can compromise blockchain systems. Additionally, the balance between the heart of the citizen interested in the blockchain system and the protection of user privacy should be looked after. Blockchain technology is expected to extend its outreach within the realm of supply chain management, human health, IoT, international trade, energy management and other fields. Critically there is the emerging technology such as quantum computing that may mean improvements to encryption algorithms and blockchain networks to make sure that their security is still improving.

1.3 The Importance and Application Prospects of Research

The global trade flows fast, as economic globalization undergoes a process of rapid growth in international trade and technological advances. However, this trend has also drawn several concerns, as manifested by the existence of trade imbalances, increasing tariffs, and market entry barriers. Fair trade is aimed to reach the fair payments to the workers and the sustainable development, but in the market acceptance and public preferences is still the challenge.

The blockchain technology that ensures data integrity, as an innovative solution, provides possible remedial measures for these difficulties. This technology has some core functionalities, including decentralization, timestamp data, consensus mechanism, traceability, programmability, security, and trust. This means that expanding the understanding of blockchain technology as a mechanism that contributes to the principle of fair trade can not only achieve theoretical goals but may also contribute to practice.

The aim of the presented study is to propose a dynamic system, which demonstrates how blockchain is used to the construction of the IFTBO (International Fair Trade Blockchain Optimization Model). Apart from the fact that the IFTBOM model is best to provide a fair trade verifiable and monitoring, it also solves the uncertainty of the transactions and changes in trade through the dynamic changes in data during the trade processes.

This research not only contributes to the existing research gap of the blockchain technology implementation in international fair trade but also leads to an innovated model with both theoretical implication and practical value.

2. Literature Review

2.1 Application Literature of Blockchain Technology in International Trade

Increasingly motivated by the industry 4.0 conception, international trade ranks amongst the technological domains that have witnessed a remarkable upgrade because of blockchain invented to boost efficiency, make trustworthy transactional environment, and ensure security. Derindag et al. (2020), on the other hand, have researched how blockchain technology is applicable to international trade by because blockchain technology creates a shared digital and secure official account open to all the parties in trade in which those who contribute to the ledger can access. This type of transparency decreases the need for the intermediaries, this in turn will lead to reducing the cost of intermediation and increase the speed of transaction.

In addition to the already mentioned increased efficiency blockchain technology also offers a solution to several crucial operational risks and challenges that face the rapidly growing digital economy field. The writer (Aliyev, 2022) argues that even though blockchain brings associated new economic growth and easy business processes, the associated risks such as the insecurity and legality of deals among different jurisdictions among other things could come along with it. Furthermore, via points made by Aliyev regarding the functionalities of blockchain technology, it becomes evident how creation of digital trading hubs utilizing blockchain eases foreign trade operations, ultimately contributing to the region's socio-economic development.

Regarding Chang et al. (2019), the authors have conducted a thorough study of the various applications of blockchain technology that not just rely on cryptocurrencies. The blockchain technology is one of the main elements in the revolutionary advancement of which the security, transparency, and efficiency are improved in different sectors as finance, healthcare, and supply chain management.

Blockchain was the focus of Li and Chen's (2023) work through illustrating how it resolves those problems in supply chain management: transparency, traceability, and efficiency. Moreover, they did a SWOT analysis on how blockchain can address challenges in supply chain and they stressed on its prospective applications in global supply chains.

Tonkykh et al. (2023) examined the impact of blockchain technology on the financial system where decentralization, innovation and revolution are being witness for rebellion. Blockchain was explained to be able to provide financial services with new level of transparency and the key for these innovations was adopting more decentralized and updated management paradigms.

According to Zhang et al. (2023) the duo of the Internet of Things (IoT) and blockchain gives us a stronger information security and privacy some big protection than the traditional ways. Such research suggests the idea of the blockchain-based information security and privacy assurance system with the core technologies being zero-knowledge proofs (ZKP) and trusted execution environments (TEE) while the underlying concept is that individuals can verify and maintain their information at the required secured level.

Zhang et al. (2023) pointed out on how blockchain technology is solving more significant and global challenges as climate change, resource management as well as social inequality. These literatures interpret the technological capability of the blockchain technology to solve problems like these.

According to Shi et al. (2023), based on the outcome of the survey on the business leaders and analyse the data, it can be empirically confirmed that the blockchain technology developments really do have impact on how traditional businesses work.

2.2 Theoretical Basis of Fair Trade

Twenty years ago, fair trade began with the aim of enabling smallholder producers in developing countries to compete successfully in the international market. Better market access and stable prices were considered key principles for sustainable poverty reduction and the involvement of stakeholders based on "trade, not aid" (Ruben, 2008). After half a century of effort, the ideas and practices of fair trade have reached and engaged many individuals, consumers, and producers, including large and small businesses, as well as governments, non-governmental organizations, and research institutions (Tiffen, 2019). Fair trade issues are largely international political issues, with their essence transcending and crossing borders on the moral aspects of modern exchange relationships. This suggests that purchasing a product is a moral act that can enable distant strangers to enjoy a more comfortable lifestyle simply by being recognized as the "producers" of that product (Watson, 2007). Fair trade is one of the most dynamic efforts in the world, aiming to enhance global social justice and environmental sustainability through market-based social change. Fair trade connects food consumers in the global North with agricultural producers in the global South and is at the core of key efforts to reshape the global economy (Raynolds, 2007).

Fair trade is a movement aimed at assisting producers in developing countries to obtain fairer conditions and opportunities in the global market. Fair-Trade is a theoretical concept, comprising a multi-disciplinary approach that integrates elements from the fields of economics, ethics, and sociology. Here are several key theoretical foundations of fair trade: Here are several key theoretical foundations of fair trade:

Fair Trade theory points out that there is an unbalance of information in the way traditional trade is conducted internationally and this leads to reasons for market failures to take place. Either small farmers or producers from developing countries, cannot compete with the market because of lack of information on the buyer's side. Fair trade addresses this problem by providing better market knowledge and transparency to the producers, so they are enriched with proper compensation for their toil and hard work.

The fair-trade movement brings about ethical and moral consideration when discussing the issue of business practices. This is as if it is urging consumers to care about which way the products are produced and treat the workers fairly. In this regard, assisting companies which give a good wage, and the working conditions of workers are stimulated. The viewpoint offers a theoretical model of the exchange as the social good and environmental wellbeing, not only of the price/quality consideration.

Fair trade attempts to foster societal justice and economic development by assisting producers in acquiring improved returns along with the ability to connect in a better manner, which paves the way for all around development of the local communities.

2.3 The Feasibility of Blockchain Promoting Fair Trade

Sodamin et al. (2022) argue that in poorer countries, many small-scale farmers and plantation workers have been living on the threshold of poverty. These individuals are affected by increases in commodity prices and trade structures, with the resulting price pressures being passed down to the most vulnerable segments. Farmers are constrained by these structures and must comply because they have no other choice. On the consumer side of the supply chain, it is often difficult to recognize the fairness and uniqueness of agricultural products, especially in processed foods. Many organizations inform consumers about the origin and fairness of products through food labelling. Although several studies have confirmed that food labels positively influence consumers' intent to purchase food, many organizations and labels make it difficult to assess and differentiate. One technology that could potentially change the rules of the game for sustainable and fair global agriculture is blockchain technology.

Blockchain technology can support and promote the implementation of fair trade in several ways through its unique attributes. Blockchain technology provides a decentralized and tamper-proof record system where all transaction records can be publicly verified, disallowing any modifications. This means that every step, from raw material procurement to production processes to final sales, can be transparently recorded. For consumers, they can directly view the entire supply chain of a product, confirming that the product truly meets fair trade standards, such as fair wages and good working conditions.

Both producers and consumers can engage in transactions using blockchain technology. Blockchain can automatically execute contract terms, such as payment transfers to producers, after meeting certain predefined conditions (e.g., confirmation of goods delivery). Automated payments reduce intermediary steps, ensuring that producers receive timely and full compensation, thereby enhancing their income stability and living standards.

Once data is recorded on the blockchain, it is almost impossible to alter, greatly reducing the possibility of fraud. Consumers and regulatory bodies can more easily verify the information on product labels, such as "organic" or "fair trade," to see if they are genuine.

Blockchain allows real-time updating and sharing of information on the supply chain, thereby improving supply chain efficiency. Producers, distributors, and retailers can monitor product status and location in real-time, predict demand, reduce inventory backlog, and respond quickly to market changes. This not only enhances operational efficiency but also helps small-scale producers better plan production and sales strategies.

Blockchain platforms can support producers in establishing online discussion platforms where members can share knowledge, market information, and other resources. This network effect not only strengthens producers' market power but also promotes collective action, such as negotiating better sales terms or sharing logistics resources, thereby reducing costs, and enhancing market competitiveness.

While blockchain offers many potential advantages in promoting fair trade, addressing challenges such as technology adoption, costs, and efficiency will be crucial to fully realizing these benefits. Effective policy support, technological innovation, and industry collaboration will be key factors in achieving this goal.

2.4 Research gaps and Contributions

Although blockchain technology has been explored in international trade, its specific applications and effects in fair trade have been less studied. Previous research has mostly focused on blockchain technology itself or its applications in other fields, lacking a sufficient understanding of how it directly promotes fair trade in terms of specific mechanisms and effects.

While the international fair-trade movement aims to improve the livelihoods of producers in developing countries, there are still limitations in market acceptance and consumer awareness. These challenges are often overlooked in existing literature, or innovative solutions to address these issues are lacking.

IFTBOM improves transparency and efficiency by dynamically monitoring and verifying the fairness of a single or complex commodity in real-time, addressing uncertainty and changes in fair trade. IFTBOM can also observe whether past transactions comply with fair trade through long-term static detection of trade. Not only does this research theoretically explore how blockchain technology promotes fair trade through its key features, but it also empirically analyses and validates the effectiveness and practicality of the model. This provides new theoretical foundations and practical guidelines for the application of blockchain technology in fair trade.

This research offers a new perspective and tool to enhance fairness and sustainability in international trade, especially for small-scale producers in developing countries. This may have a great positive effect on the global fair-trade movement leading to better living standards, lowered poverty, and less inequalities among producers worldwide.

3. Theoretical Framework and Model Construction

3.1 Proposing Research Hypotheses

The fair foreign trade globally is challenged with several factors such as the security of supply chain and the traceability of the products. Complementing quantitative dynamic blockchain technology in the global trade realm gears the way to its robust compliance features in useful properties such as transparency and traceability along industries.

3.2 Key Features of Blockchain Technology and Its Relationship with Fair Trade

3.2.1 Key Features of Blockchain Technology

Decentralization: Through blockchain, who would otherwise hardly notice each other, will communicate directly, the transaction times will be reduced drastically, and institutions, that were a teller, a bank account holder, and a money changer, will no longer be needed.

Timestamped Data: Every blockchain record will be accompanied by a timestamp, which will make sure the information remains authentic and always the same.

Consensus Mechanism: except for the central node, in the blockchain network, where the data must be independently verified by each node in the network, the network would have secured several levels of security and improved the data accuracy.

Traceability: Blockchain trace the origin history of each stage of transactions, thus there is a possibility to exactly confirm the cycle from what this product is produced to who has already bought it.

Programmability: Using programs or smart contracts via blockchain it is possible to automatically execute contract's conditions, particularly to release funds into a producer's account immediately provided that the necessary conditions have already been met.

Security and Trustworthiness: With blockchain, the encryption technologies designed to prevent unauthorized access to, and modification of data is possible.

3.2.2 Relationship between Blockchain and Fair Trade

Transparency: All the details of transactions are accessible through the blockchain; thus, it is clear to consumers who established the transaction and what the conditions were. This holds true particularly with fair trade products, the most common practice of buying goods with the higher price willing that they are produce in accordance with ethical standard.

Enhancing Bargaining Power of Small-scale Producers: Blockchain platforms create an environment that facilitates producers to join market information and other resources platforms ensuring to secure the pricing conditions that are to their advantage.

3.3 The Expected Role and Theoretical Significance of IFTBOM

By integrating blockchain technology IFTBOM will be resolving the top issues on international fair trade among the two parties and building a transparent and equitable commercial environment.

3.3.1 The expected role of IFTBOM

Real time monitoring and verification of trade fairness: IFTBOM will constantly be able to monitor and verify the fairness in the trading process, doing its best to ensure that the mechanism incorporated in all transactions complies with the international fair-trade standards.

Transparency and traceability improvement: through blockchain technology, all transaction records are open and unchangeable, improving the transparency of the supply chain and the traceability of products.

Automatic execution of smart contracts: IFTBOM automatically executes contract terms through smart contracts, such as automatic transfer to producers, reducing intermediate links, and ensuring that producers receive timely and complete compensation.

Enhance the bargaining power of small-scale producers: through the blockchain platform, small-scale producers can share market information and resources, enhance their market power, and help them negotiate better sales conditions and prices.

3.3.2 Theoretical Significance of IFTBOM

Promote fair and sustainable development of international trade: The IFTBOM model supports the goal of the fair-trade movement by ensuring fair trade and enhancing the transparency of the supply chain, that is, helping small-scale producers in developing countries to obtain fairer trading conditions and opportunities.

Innovation and theoretical contribution: this model not only fill the research gap in the integration and application of blockchain technology and international fair trade in the existing literature, but also puts forward theoretical innovation and practical value, providing a new perspective and tool for the fairness and sustainability of international trade.

Enhance the overall efficiency and security of the international trade system: improve transaction efficiency and credit through smart contracts and real-time cargo tracking and protect data security and privacy by using the encryption features of the blockchain.

In conclusion, the design and implementation of IFTBOM is expected to have a significant impact on improving the global fair-trade environment, especially for small-scale producers in developing countries, which can significantly improve their economic and social conditions.

3.4 IFTBOM Running Process

The running process of IFTBOM is as follows:

Authentication: The user or participant first needs to be authenticated in the system. This ensures that each party in the transaction is credible and can legally conduct transactions.

Access Platforms: After authentication, the user can access various trading platforms, which may be marketplaces, exchanges or any other blockchain network platform that supports trading.

Transaction Enquiry: Consumers ask producers for specific information about their products in detail on the platform. This may involve enquiring about the conditions of production, the status of the service or the goods, etc.

Transaction Fairness Assessment: Before a transaction is made, the system will assess the fairness of the transaction. This may involve an assessment of price, terms and conditions and other transaction parameters to ensure that all aspects comply with international fair-trading standards.

Smart Contract Confirmation: Once the terms of the transaction have been confirmed as fair, a smart contract will be created and confirmed. Smart Contracts are self-executing contracts where the terms of the contract are written directly into the code.

Smart Contracts Exchange Trading: The parties to a transaction will trade based on smart contracts, which may involve the exchange of assets, payments, and other related operations. Blockchain ensures transparency and non-tampering of transactions.

Real-time status of goods: Blockchain technology allows all relevant parties to view the status of goods in real time. This includes logistics information, inventory status and other important data.

Sign for the Goods: Once the transaction is executed, the recipient of the goods will need to sign for the goods to confirm their delivery. This triggers the payment conditions in the smart contract.

Smart Contracts Exchange Trading: Signing for the goods triggers the payment conditions in the smart contract. The smart contract will make a cash transaction based on the real-time exchange rate.

After-sales/evaluation: After the transaction is completed, the system provides after-sales service and evaluation mechanisms so that participants can evaluate the transaction process and results.

The entire operation of IFTBOM emphasises the use of blockchain technology to promote fairness in international trade, thereby providing a transparent, secure, and automated trading environment. Blockchain, as the underlying technology, improves the efficiency and credibility of international transactions through smart contracts and real-time cargo tracking.

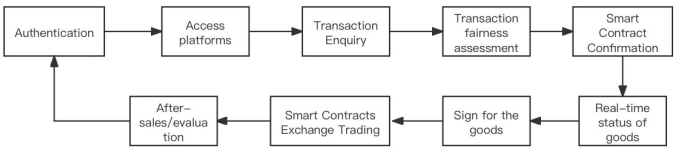

Figure 1. IFTBOM Running Process

3.5 Blockchain Technology Security for International Fair Trade

The IFTBOM blockchain model aims to address some of the core issues in international fair trade through its technical features, and to ensure the security and fairness of transactions through these technical features.

Non-transparent supply chain issues:

Blockchain feature: transparency. Blockchain provides a high degree of transparency through its distributed ledger feature, where all transaction records are publicly available, and each node keeps a complete transaction history.

Technical advantage: supply chain traceability. Transparency allows all supply chain activities - from raw material sourcing to finished product distribution - to be traced and verified.

Safety and security: Increased regulatory and audit capabilities. A transparent supply chain allows regulators and consumers to monitor and audit supply chain activities more effectively.

High middleman cost issues:

Blockchain features: decentralisation. Blockchain technology reduces the reliance on traditional intermediaries in transactions, allowing participants to interact directly.

Technological advantage: lower transaction costs. Decentralisation reduces additional fees and commissions as transactions can be made directly between buyers and sellers.

Safety and security: direct communication between producers and consumers. Instead of managing quantity, this decentralized model lies on direct communication between producers and consumers, improving trust and collaboration.

Delayed payment issues:

Blockchain characteristics: Smart contracts are contracts that once conditions are met, their terms are self-executed immediately.

Technological advantage: the decisive edge of real-time payments. Smart contracts can have the function of spending money in a predetermined way, but the payments will be processed when the specified conditions are met.

Compliance is difficult to verify the problem:

Blockchain characteristics: It is impossible to alter the data that has been recorded on the blockchain, resulting in the invariability and non-certain said data.

Technical advantage: transparent compliance verification. This is thanks to the recording of the record that cannot be changed, thereby allowing compliance to be checked at any time, and this ensures that all transactions at hand are following the rules and regulations.

Security: Authenticity and reliability of transactions. This immutability confers a high level of trust in transaction records, making the compliance verification process more reliable.

Fairness of trade is difficult to assess issues:

Blockchain features: dynamic capture and static analysis. Blockchain can capture transaction data in real time and analyse it on an ongoing basis.

Technological Advantage: Real-time assessment of trade fairness. Every aspect of a transaction can be instantly monitored and assessed to ensure that all transactions are fair.

Safety and security: Every back-trade is assessed for fairness. This ensures that transactions are not just fair at the start, but that this standard is maintained throughout the process.

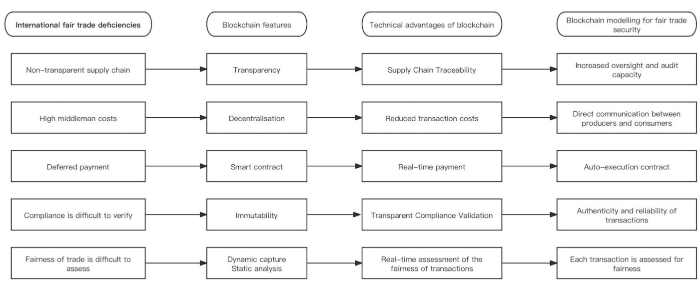

Figure 2. Blockchain Technology Security for International Fair Trade

3.6 Issuance and Verification of Identity

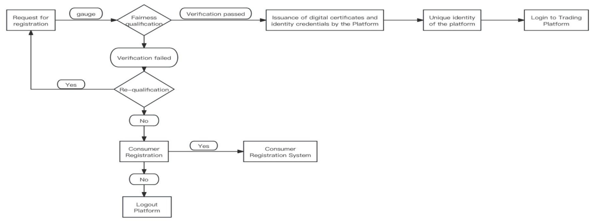

Figure 3. Producer Authentication

Producer authentication in IFTBOM lies at the heart of guaranteeing the success of the project. Authenticity is what makes trading safe and meets the conditions of a fair trade. This is the initial delicate stage that results in creating the trust transition among all transacting parties in the platform. Verified status ensures that producers are not deceitful and practices transparency. In return, the reputation of the platform will increase, and the trust among consumers and trading partners will also be build. In the process of going through identity verification sensors, fraudulent operating may not be a problem anymore, and the transactions executed on the system will be fully secure and safe. The precision of the identification turns out to be an efficient mean of protecting the rights of underprivileged suppliers and poor countries. In the establishment of identity of producers, platforms can add policies or parameters that will favour this.

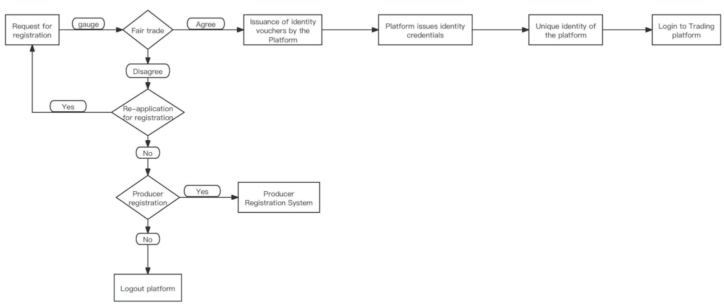

Figure 4. Consumer Authentication

On blockchain IFTBOM systems, the feature of consumer authorization is just as implementing.

Consumer detection allows for elimination of identity theft and fraud, akin to that, and ensures the data transferring to be highly safe against fraudulent activities. It refers to the point where both ends of a transaction agree on each other, creating a safe and effective transaction mix. Respectively, what is disclosed during this process is utilized by the platform to meet the AML and KYC principles, as well as the other applicable laws and regulations. It should be kept in mind to obliterate harming activities. Through authentication, it can guarantee that users will be able to access a full range of services and help whenever any difficulty arises for them. As an instance, in the case of a conflict over a transaction the adopted identity can speed up the resolution process.

Smart contracts are self-determined according to the conditions and rules written in advance but will only be activated when a target identity that proves the accuracy of that execution is present.

Consumer authentication ensures that the smart contract can correctly identify the parties to the contract. By ensuring that each party involved in the transaction is credible, the authentication mechanism helps to promote and maintain a fair-trading environment. Through authentication, you can restrict or prevent illegal transactions, such as goods that are prohibited from being sold to specific countries or individuals.

3.7 IFTBOM Usage Process

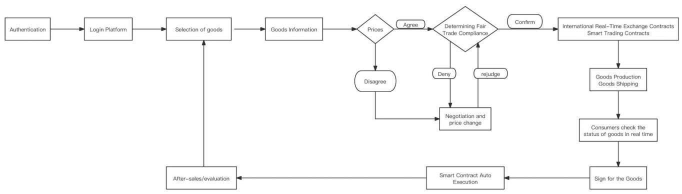

Figure 5. Consumer Usage Process

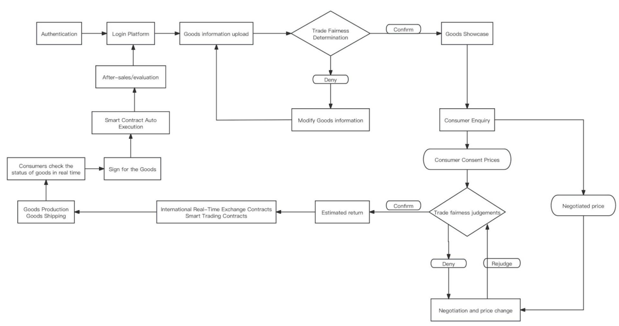

Figure 6. Producer Usage Process

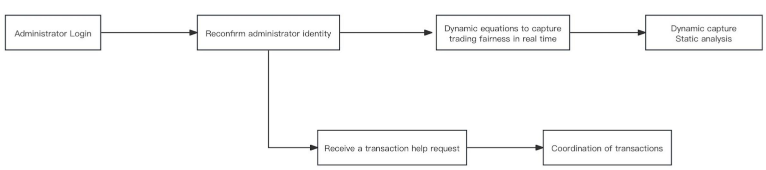

Figure 7. Regulatory Platform Usage Process

3.8 IFTBOM Security Framework

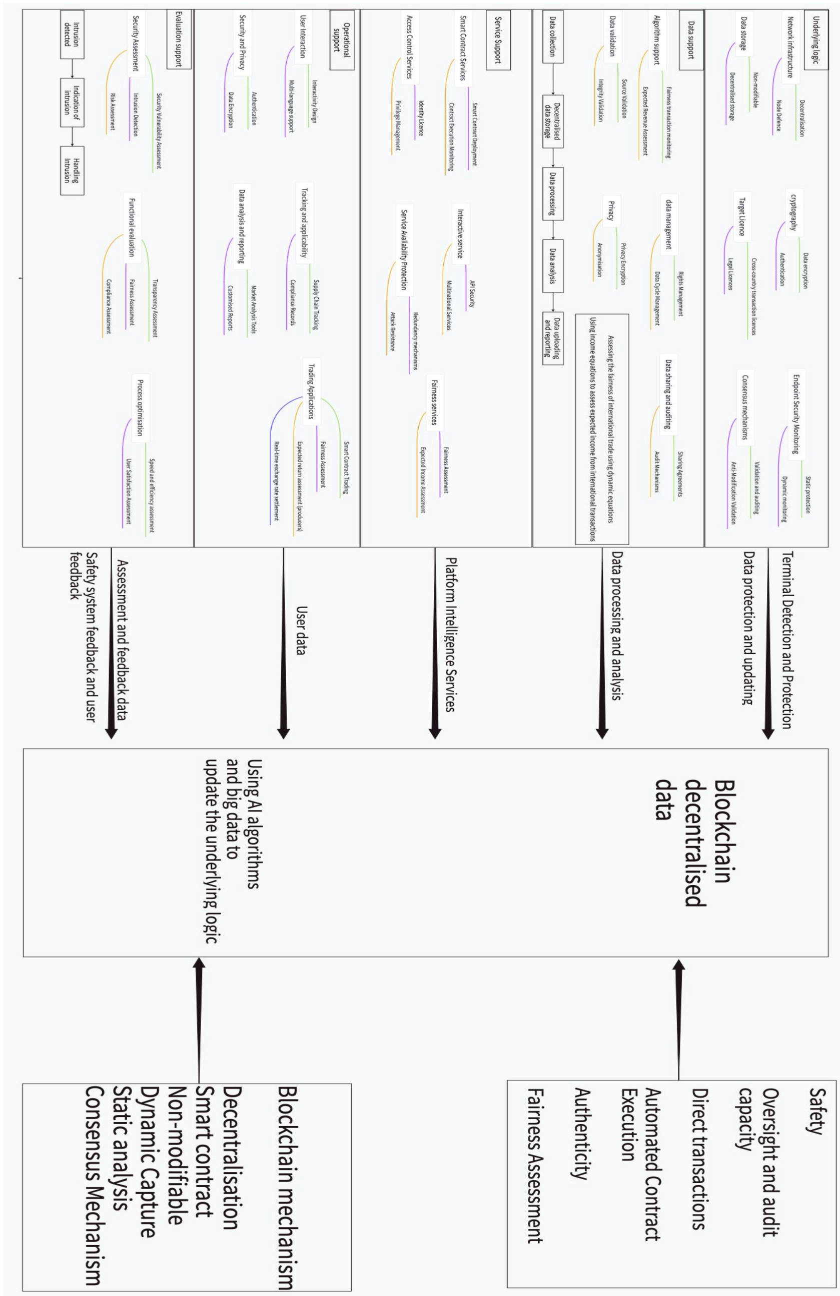

Figure 8. IFTBOM Security Framework

3.8.1 Underlying Logic

The underlying logic of IFTBOM can be summarised in a few core components and the links between them.

Underlying logic: This is the cornerstone of the model and determines the principles and rules by which the blockchain operates.

Network infrastructure: This emphasises Decentralisation and Node Defence. In a decentralised system, information is not stored on a single central server, but is distributed across multiple nodes, each of which is involved in the verification and transmission of data, increasing the system's security and resistance to attack.

Data storage: Data stored on the blockchain is non-modifiable. Decentralised storage is used to ensure that data cannot be altered once written, guaranteeing the data's immutability and durability.

Cryptography: The blockchain model uses data encryption in the data transmission and storage process to ensure the security of the data in the transmission process and ensures the reliability of the identity of the participating parties through the authentication mechanism.

Target Licence: Involves cross-country transaction licences and legal licences, pointing out that the use of blockchain in international trade needs to comply with the laws and regulations of different countries and regions.

Endpoint Security Monitoring: Includes both static protection and dynamic monitoring, emphasising the continuous monitoring of network endpoints to protect network endpoints from unauthorised access and data leakage.

Consensus mechanisms: This is one of the core mechanisms of blockchain, including Validation and auditing and Anti-Modification Validation. In blockchain, every transaction requires confirmation from most nodes in the network, and the validity and consistency of transactions and data are guaranteed through consensus mechanisms.

3.8.2 Data Support

Accurate data will be an essential asset and may be an assurance of good work demonstrates the transparency of the trade process.

Algorithm support:

Fair Trade Monitoring: The computerized supervision systems with the goal of revealing whether the involved parties are treated fairly and can also look for differences pertain to pricing problems or other abnormalities that could indicate that the trading is being unfair.

Expected Revenue Evaluation: Through algorithms which can either be used for forecasting or evaluation, making sure that the predictions of revenue are unbiased to prevent scams and uncertainties.

Data validation:

Source verification: It refers to this part that makes it possible to receive input from different sources as legitimate or trustworthy. In blockchain, this might mean the data has to regularly come from trustworthy or verified nodes or organizations before it can be in the blockchain.

Integrity verification: After data gets collected, its integrity is to be verified immediately. This procedure involves several steps that include first proving that the original document has not been altered or falsified. It must then be submitted to the blockchain for verification.

Data collection:

Distributed data storage: The data gathered is kept in individual storage on nodes of the blockchain, this guarantees that the system is not fail proof or controlled by a few or most people which is what enables it to be a fair and strong system.

Use of such elements together will, most probably, significantly improve the openness and equity of trade both on the national and global levels.

3.8.3 Service Support

The main purpose of the service is to make transactions secure, fair, and protected by advanced technologies, including smart contracts and access control.

Smart Contract Services:

Smart contract deployment: The same channel enables developers to come up with and execute smart contracts on the blockchain. A smart contract is the one set to be automatically executed, with respective protocol terms stipulated directly in the code. By The end of the day, this will be their basic success factor as they aim to decentralized operation and enforcement of transactions in absence of any middlemen.

Contract execution monitoring: Compliance is achieved through implementing automated testing and control of smart contracts to ensure they complete as intended.

Access Control Services:

Identity permit: This is an option to circumvent fraud and secure all the user on the platform and it further makes sure all the participants are legal and compliant.

Permission management: It is possible that this system controls authorization and permissions at different levels throughout the entire IT infrastructure. Take a case of where certain users may be entitled to undertake a role of observing operations but cannot alter them.

Interactive services:

API security: Security of API is important as well as for that to be able to stop non-authorized access and data leakage.

Cross national service: The service serves multiple countries and assumes the minds of adhering to various country's regulations and enables international transactions.

Service availability protection:

Redundancy mechanism: To avoid service unavailability the module of redundancy has been enabled in the system. It thus ensures that in case one part fails, another part from the system that can replace it is readily available.

Defending against attacks: Network security protection is vital for the preservation of the network's authenticity. This function is targeting to make sure that the network can withstand a wide range of attacks from different sources.

Fair service:

Fairness assessment: Verification of transaction fairness is the point where all types of ethical questions arise in international trade, when it is extremely difficult sometimes to say whether a certain activity is good or bad.

Expected Revenue Assessment: T Assessment: the economic actors must evaluate current and future activity which involves predicting or verifying the expected revenue of the transactions.

3.8.4 Operational Support

Operational support duties are to guarantee the correct running of and efficiency of international transactions.

User interaction:

Interaction design: This implies system construction with user-centric approach, ensuring the system's intuitive and can be easily navigable. It speeds up the international trade operations, which can reduce errors and increase efficiency.

Multilingual support: International users are a portion of the audience to which the platform is intended to appeal. This is imperative because of the globalization of trade.

Security and Privacy:

Identity verification: T Such an approach would guarantee that only people with a right to access the system can do it, which is crucial in preserving the integrity as well as confidentiality of Trade information.

Data encryption: Protection of data by encryption is key feature for confidentiality and security, where are only in legal hands sensitive information.

Tracking and applicability:

Supply chain tracking: The importance of the tracking of the chain of goods helps attain openness and answerability in global trade.

Compliance records: Making and keeping record of compliance with international trade rules.

Data analysis and reporting:

Market analysis tools: The technology and innovations that are used to analyse the market trends and data are key resources for those trading and making informed decisions.

Customized reports: The ability to produce personalized reports has the effect of making it possible to make better decisions and in the process achieve a superior awareness of your business trading contexts' activities in depth.

Trading application:

Smart contract trading: One of the important outcomes of trading with smart contracts is that a standardized trade agreement or contract can be created and enforced by code itself, which reduces need for intermediaries and may be one of the requirements for automation and cost reduction.

Fairness assessment: The evaluation of fairness in trade makes it possible that all the parties get equal opportunities.

Expected Return Assessment (Producer): This capability can allow such manufacturers with a close estimate on their expected return, an aspect that can help them plan better on their finances and risks.

Real time exchange rate settlement: Exchange rates in real time play a role here and the settlement of transactions at the current exchange rate can prevent all the parties from the consequences of the fluctuating exchange rate and promote the trade at the fair and equal conditions.

3.8.5 Evaluation Support

Evaluation support seeks to ensure the comprehensiveness, justice, and security of the system.

Security assessment:

Intrusion detection: This feature covers an essential security measure which is the system's ability to identify unauthorized access attempts to a network.

Risk assessment: Risk assessment may among other things involve evaluating the existing system of risk viewing possible vulnerabilities within it and the risks they bring to the organizational security hence enabling an early intervention process.

Functional evaluation:

Transparency assessment: As transparency is a basis of fair-trade market, this analysis is becoming the pivotal factor for exploring and controlling mechanisms of operations carried out in the blockchain.

Fairness assessment: This criterion assesses whether a blockchain approach and its algorithms place all the transaction at an equal level for all parties.

Compliance assessment: This is to ensure that the trade system is in accordance with the international trade laws, rules and codes conducted in the system, which is fundamentally important for the efficacy and good performance of the system.

Process optimization:

Speed and efficiency evaluation: Such section highlights the speed and functionality required from blockchain networks that crucially depend on the system of transactions processing with these characteristics.

User satisfaction assessment: Investigate the acceptance of the system by the consumers (retailers and regulatory agencies) through face-to-face comments and to figure out if the responses are good or not.

3.9 Trade Fairness Assessment Model

3.9.1 Define Variables

A mathematical model that will help to analyze the fairness of international trade should account for and measure indicators acquired from many dimensions. This model will consist of many constituents like economic, legal, social, environmental, technological, transparency, and integrity, each will be evaluated by narrow-class sub-indicators. This model was involved in the following steps of its design:

Economic Factors (E)

Fair Pricing (E1): Assess the market prices locally relevant enough to deal with market supply and demand as well as the quality of goods or service not being crushed by dumping or price manipulation. With the e-trade, there will be equitable competition in the marketplace.

Market Access (E2): Look if trading parties face easy access to a market and matter whether unjustifiable barriers are present or not. In equal new sector and small market economies, providing fair access to market reflects balanced multilateral trade and global economic growth.

Trading Conditions (E3): Use the ones in agreements between the partners like the shipment, the payment, and the return procedure to identify the reasonableness of them to make sure that the rights for both parties are shielded.

Legal Factors (L)

Compliance with International Laws (L1): Determine whether the best practices of trading encompass obedience of the rules of international companies and agreements, including WTO, bilateral and multilateral ones. This refreshes the situation and makes the environment more confined and predictable.

Intellectual Property Protection (L2): Ensure that intellectual property rights traded, especially patents, trademarks, and copyrights, is observed and protected to avoid spreading counterfeit and pirated wares which are the key elements for innovation and fair trade the world over.

Social Factors (S)

Labor Standards (S1): Examine whether production procedures comply with internationally recognized labor rights standards, e.g., don’t have child labor, keeping worker safe, upholding acceptable working conditions etc. By so doing the health of the workers and the productivity of the organization are improved.

Social Responsibility (S2): Evaluate whether public corporations uphold CSR, stimulate community development, engage in fair trade, and maintain business transparency in operation. This could be used as a means of a company's moral obligation and the society's welfare.

Environmental Factors (V)

Environmental Impact (V1): Make a critical evaluation of the environmental impact of trade activities, ranging from resource consumption, release of wastes, and ecosystem deterioration. Environmental footprint must be minimized in the pursuit of sustainable trade.

Sustainable Practices (V2): Evaluate whether companies are utilizing environmental-friendly production techniques and sourcing, for instance, exploiting renewable energy and biodegradable materials which in return support global ecological conservation and sustainable development.

Technological Factors (T)

Technology Compliance and Security (T1): Consider that the technology used in the trade operations follows international standards and security regulations, that include privacy and cybersecurity.

Technological Transparency (T2): Evaluate whether there is the industry of technology and systems being transparent to users who mainly are consumers or users.

Transparency and Integrity (C)

Supply Chain Transparency (C1): Involves the entire chain from raw material procurement to the final sale of products, evaluating the accessibility and traceability of information. High transparency helps consumers and regulatory agencies ensure the compliance of products and processes.

Anti-Corruption and Integrity (C2): Evaluate whether effective measures are taken to prevent corrupt practices such as bribery and fraud in trade, and whether companies and government agencies have high standards of integrity records. This is crucial for maintaining a healthy and fair market.

3.9.2 Formula Construction

The score S_I of each main indicator I is calculated from its sub indicator score s_{ij} and corresponding weight w_{ij}:

$$S_I = \sum_j w_{ij} \times s_{ij}$$

Then, the total trade fairness index ***TFI*** can be calculated by the weighted sum of the scores of each main index and its weight w_I:

$$TFI = \sum_I w_I \times S_I$$

The model is verified and adjusted through historical data and real-time monitoring. The machine learning algorithm is used to continuously optimize the weight and scoring criteria to improve the accuracy and reliability of the model.

The model can not only provide producers and governments with accurate assessment of trade fairness, but also promote broader trust and cooperation through the transparency and security of the blockchain. The entire model provides a comprehensive and accurate assessment of the fairness of international trade by integrating these multidimensional indicators. Block chain technology in this case ensures that data is securely verified and unchanged thus avoiding any possibility of data being tempered with. This consequently increases the credibility and practical effectiveness of the model.

4. Conclusions and Recommendations

4.1 Research Restrictions

IFTBOM model like many others has innovation and practical value but it does have some inherent research limitations.

Complexity of technology implementation: A blockchain technology is bristling with features yet its complexity in the real-life application may prove hindrance in the widespread use of it. For instance, numerous tech rollouts are technology dependent and demand a good level of technical skills and financial support in the beginning.

Market acceptance and consumer awareness: consumers' willingness to buy trade fair products is not that high, that could affect the way IFTBOM are perceived and the number of people that would be involved.

International cooperation and regulatory consistency: disparities in blockchain technology mode and certification standards at various countries and zones could have strong impacts on implementing and supervising the model if market linkages are not clear and transparent.

4.2 Policy Suggestions and Practical Application

4.2.1 Policy Suggestion

Strengthen international cooperation: in view of the differences in blockchain technology and fair-trade standards in different countries and regions. Therefore, it is suggested that the international community should strengthen cooperation and develop unified blockchain technology applications and fair-trade standards to promote fair trade practices worldwide.

Government support and regulation formulation: The government should provide necessary policy support and legal framework to promote the development of blockchain technology and the implementation of fair trade. This includes providing financial subsidies, tax incentives and technical support, and formulating relevant regulatory policies to ensure the safe and effective application of technology.

Education and training: To improve consumers' and producers' awareness of fair trade and blockchain technology, the article suggests implementing extensive education and training programs to improve the public's understanding and acceptance of these concepts.

4.2.2 Practical Application

Supply chain management: Blockchain technology can be implemented in management of supply chain. It enables consumers to follow-up the supply chain while ascertaining that the products they get meet fair trade requirements by using a decentralized and anti-tamper proof tagging system for their transactions.

Application of smart contracts: By doing the automation of smart contract, the transaction terms can be automatically performed which may include automatic payment to producers, representation of intermediate links, efficient work, and lower cost of services. On the international business sphere this process can be implemented on the spot especially the cross-border payments and transactions.

Transparency and traceability improvement: Through blockchain technology, all parties can view the status and location of goods in real time, thus improving the transparency and efficiency of the supply chain and enhancing consumers' trust in product quality and fair-trade standards.

The policy suggestions and practical application part provides specific strategies and methods for how to promote international fair trade through blockchain technology, and emphasizes the role and responsibility of governments, enterprises, and international organizations in promoting this process. By implementing these policies and practices, we can expect to achieve a fairer and more transparent trade environment in the global context.

4.4 Research Summary

This research proposed an innovative model called IFTBOM (International Fair Trade Blockchain Optimization Model), which aims to promote the realization of international fair trade through blockchain technology. The study discussed in detail how blockchain technology can provide possible solutions to many challenges in international fair trade through its key features such as decentralization, data timestamp, consensus mechanism, traceability, programmability, security, and credibility.

4.4.1 Summary of Main Contents

4.4.1.1 Current Situation and Challenges of International Trade and Fair Trade:

International trade plays an irreplaceable role in the global economy, but the rapid growth of global trade has also brought challenges including trade imbalance, tariff increase, market access restrictions and so on.

Fair trade aims to provide more equitable trading conditions for small-scale producers in developing countries, but its market acceptance is limited, and consumers have insufficient understanding of the concept of fair trade.

4.4.1.2 Overview and Development of Blockchain Technology:

Blockchain technology has attracted attention due to its decentralized, data tamper proof and other characteristics, and is suitable for enhancing the transparency and security of transactions.

Although blockchain technology is intrinsically secure, the limitations of modern technology may lead to system vulnerabilities, and it is necessary to find a balance between protecting user privacy and transparency.

4.4.1.3 Construction and Application of IFTBOM Model:

The IFTBOM model combines blockchain technology, which can monitor and verify the fairness of trade activities in real time, and deal with uncertainties and data changes in fair trade.

The model automatically executes contract terms through smart contracts, which enhances the efficiency and fairness of transactions.

4.4.1.4 Policy Suggestions and Practical Application:

Strengthen international cooperation and formulate unified blockchain technology application and fair-trade standards.

The government should provide policy support and legal framework to promote the development of blockchain technology and the implementation of fair trade.

Improve consumers' and producers' awareness of fair trade and blockchain technology through education and training.

4.4.2 Conclusion

The research shows that the application of IFTBOM model can create a fairer and more transparent trade environment worldwide. In addition, the implementation of the model is expected to have a significant impact on small-scale producers in developing countries, significantly improving their economic and social conditions. However, to fully realize these advantages, it is necessary to solve the challenges such as the complexity of technology implementation, market acceptance and consumer awareness, which requires the joint efforts and international cooperation of the government, enterprises, and international organizations.

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