Transparent Supply Chains with Blockchain

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Abstract - **Supply chain operation (SCM) is a core commercial exertion responsible for moving goods and services from one point to another through colorful stakeholders. The traditional SCM is grounded on a centralized approach managed at the central headquarter, and all other sub-offices get instructions from the main office. Some major issues with present SCM systems are security, transactional translucency, traceability, stakeholder involvement, product counterfeiting, fresh detainments, fraud, and precariousness. The traditional SCM is grounded on a centralized approach. A single business headquarters and a single storehouse full of departmental directors in different areas like logistics, distribution, and procurement, and these directors are responsible for overseeing their specific position during the complete force chain. They keep track of the information in a centralized database stored hard. When the data on the record isn't salutary to the company's growth, it may be misrepresented intimately. As a result, distrust between a ventures has precipitously conspicuous, performing in advanced communication charges. Also, there's no pricing translucency in the force chain because of the mediators. Likewise, because of the high threat of data manipulation inside the adventure, the data across force chain realities is inharmonious; as a result, the product tracing procedure has been delayed. In moment's force chain, there's no translated medium to store consumers' private information. Cyber-attacks will be suitable to pierce this data, revealing important public and particular information.**

Another crucial issue is that goods only travel in one direction in moment's force chain operation. As a result, if a product is defective, the client is responsible for the consequences. SCM is a core commercial exertion responsible for moving goods and services from one point to another through a variety of stakeholders. Different groups, coffers, actions, and associations are concerned with converting raw accoutrements into completed products and satisfying consumer orders, which are appertained to as force chains. It's an connected network of pots, individualities, conditioning, information, and coffers that are included in fabricating and transferring a product or service from the dealer to the customer via a planned inflow of information, physical dispersion, and payment. It starts with the delivery of raw accoutrements to a manufacturer and stops with the delivery of the completed product or service to the consumer. Control of the sluice of products and services to maintain the quality of sensitive goods throughout the payload, exclude gratuitous charges, and more satisfy client prospects is known as force chain operation.

Keywords: Transparent, Supply Chains, Blockchain, SCM.

1. Introduction

Transparency is viewed as a supporting pillar of supply chain management (SCM). A lack of transparency involving supply chain partners and practices can contribute to corporate and government scandals. As a result, improving supply chain transparency offers potential benefits to firms across the supply chain network. Globalization of supply chains, moreover, increases the complexity of these networks and thereby also increases the need for transparency to better manage processes, product flows, financial transactions, and information exchange. Maintaining secure supply chain information networks is another key feature of supply chain strategy. The critical purpose of information security is to protect user data from being modified or compromised. Yet, transparency requires disclosing potentially sensitive information to other participants in the supply chain. This raises the issue as to whether both transparency and security can be achieved simultaneously in SCM. Blockchain applications are currently evolving from pilot trials to real world applications. According to the International Data Corporation (IDC), worldwide spending on blockchain solutions will reach $11.7 billion in 2022. This is particularly relevant to SCM, as supply chain blockchains represent one of the most promising opportunities for the implementation of the distributed ledger technology.

2. Supply chain transparency

Supply Chain Transparency and Security Transparency involve sharing information among different participants across the supply chain network. As more partners engage within that network, information availability increases resulting in greater transparency, which boosts both traceability and visibility. Traceability in a supply chain is generally the ability of the system to identify and verify

individual components including the historical state of activities. This involves tracking a product's flow and its attributes throughout the entire supply network. Traceability applies not only to the physical movement of a product but also to the information related to product quality and safety.

3. Blockchain in supply managements

Blockchain in Supply Chain The creation of blockchains has been called one of the most revolutionary innovations to emerge in recent years. Several studies reported that blockchain SCM integration is still in its infancy. Researchers typically suggest that blockchains can bring specific benefits to SCM.
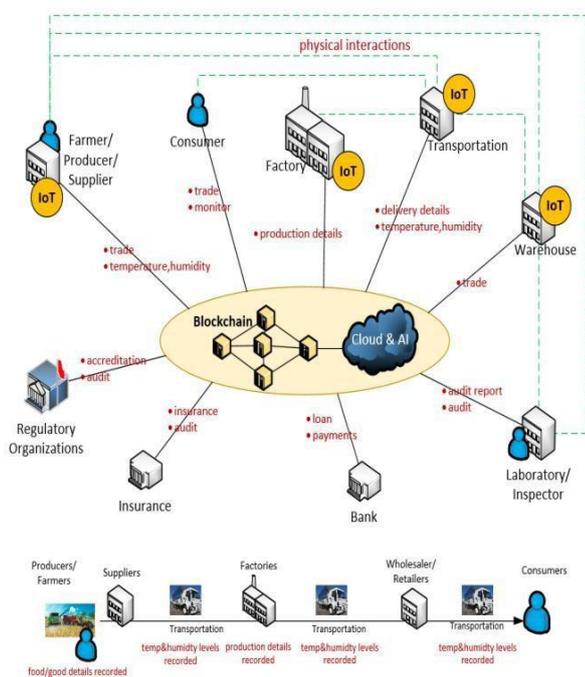

Figure 1: Participants and their roles in a typical blockchain integrated supply chain flow

4. Blockchain technology background

Original idea and building blocks of blockchain technology are coming from crypto money and date back to 1980s. Most recently, in 2008 December the article by an author nicknamed Satoshi Nakamoto titled as ''Bitcoin: A Peer-topeer Electronic Cash System'' popularized the blockchain technology. The blockchain concept consists of a combination of mathematics, crypto, computer and monetary science.

Blockchain technology, in fact, is a type of parallel and distributed computing architecture. It allows to eliminate central servers or trusted authority in digital interactions of partners. Thus it is classified as a disruptive technology which has potential to transform radically most of the processes in

our daily life. Simply, copies of the data, called ledger, are stored on thousands of computers working together, and all changes to the data are provided by consensus of partners. The parties of the system do not have to trust each other. The factors that ensure the trust among the stakeholders of the system are that changes on the stored data can only be made according to the specified rules, these changes are kept in a ledger whose content is transparently open to audit, protected by cryptographic techniques, and a copy of this chain is available to all parties. It becomes possible for digital data to change ownership like assets in the physical world.

The main consensus protocols used to ensure trust are Proof of Work (PoW), Byzantine Fault Tolerance (BFT), Proof of Stake (PoS) and Proof of Elapsed Time (PoET). The main purpose of the consensus mechanism is to ensure that proposed change requests are compatible with existing status of data and rules. Blockchain computers, called nodes, perform these validations. Cryptography is mainly used to ensure the authenticity of change requests on data and the immutability of data in the ledger by organizing modification history as blocks cryptographically connected each other. Privacy is another important issue in blockchain. Crypto is also used to ensure the privacy of the participant. High availability of the ledger is provided by keeping the entire ledger at the nodes, not at the center.

There are mainly two types of blockchain platform namely, public and private. In public blockchain anyone can send change requests to the network and can operate a node. In private blockchain, also called permissioned blockchain, both sending requests to the network and having a node is restricted to a set of actors.

5. Problems of Supply Chain and Opportunities with Blockchain

The main objectives of the supply chain are listed as cost, quality, speed, dependability, risk reduction, sustainability, and flexibility (Kshetri, 2018). Manufacturing has been globalized, leads well defined supply chain management more crucial and valuable. In today's supply chain systems, it is difficult for customers to know exactly the value of a product due to lack of transparency. In addition, investigating supply chains mostly is not feasible in case of suspicion of illegal or unethical activities.

Heavy paperwork, process costs, and slow processes are other main challenges of the supply chain. A literature survey on the research focuses on blockchain for supply chain domain shows that the supply chain domain already benefits from blockchain technology because of its four main features.
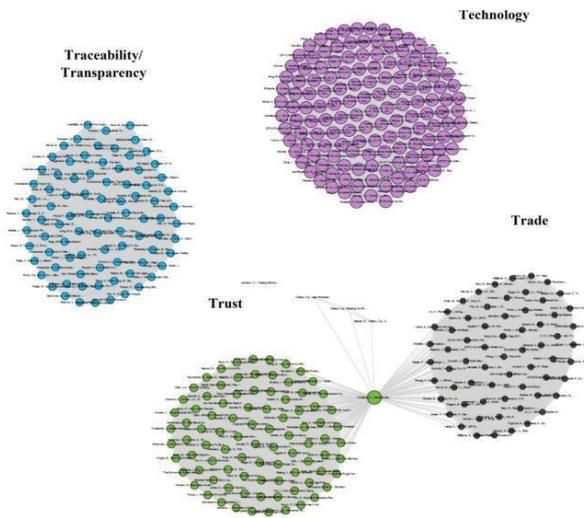
Figure 2: Research focuses in literature for deployment of blockchain for supply chain

Supply chain participants	Current limitations	Blockchain impact
Producer	Lack of ability to prove the origin and quality metrics of products transparently	Benefits from increased trust of keep track of the production raw material and value chain from producer to consumer
Manufacturer	Limited ability to monitor the product to the final destination. Limited capabilities of checking quality measured from raw material.	Added value from shared information system with raw material suppliers and distribution networks
Distributor	Custom tracking systems with poor collaboration capabilities. Limited certification ability and trust issues.	Ability to have proof-of-location and conditions certifications registered in the ledger.
Wholesaler	Lack of trust and certification of the products' path.	Ability to check the origin of the goods and the transformation /transportation conditions.
Retailer	Lack of trust and certification of the products' path. Tracking of products between consumers and wholesalers.	Ability to handle effectively the return of malfunctioning products.
Consumer	Lack of trust regarding the compliance of the product with respect to origin, quality and compliance of the product to the specified standards and origin.	Full and transparent view on the product origin and its whole journey from raw material to final, purchased product.

Table 1: How blockchain can improve the existing limitations of supply chains

In order to give an idea how blockchain might impact the needs of supply chain actors, we quoted Table 1 from literature. It presents Litke (2019)'s summary on how blockchain responds to the limitations that the actors of supply chains encounter today. other application areas. Employing blockchain in supply chain processes provides transparent, decentralized, secure, faster and low cost transactions. By eliminating unnecessary third parties and covering more daily life processes in digital systems minimizes paperwork. Blockchain establishes trust among trading partners. Making more detailed data available in blockchain, improves supply chain monitoring ability and safety. This reduces insurance risks. Smart contracts and automated payments are game changer. They add efficiency and remove bureaucracy especially in insurance, and traceability. They also allow escrowed payment by keeping money until terms of the deal are met and agreed, and then releasing automatically.

Blockchain technology, in fact, provides missing infrastructure the cutting edge technologies need. Thus, increasing focus on providing integration and cooperation with technologies such as Artificial Intelligence, Big Data Analytic, Cloud Computing and IoT will help to realize advanced supply chain systems.

Now, there has been a considerable increase in the need for SC's fairness, security, and efficiency. The stakeholders have begun to demand a more transparent SCM process. End users want to know the complete information on the provenance of the items. To address such a problem, a tamper resistant tracking method must be created. Infrastructure decentralization and the development of a trust layer for business logic may be revolutionized using BC technology. BC is an immutable, permanent record system created by covering encrypted information in chronological order. Decentralization, traceability, tamper-proofing, and cryptographic security are all important elements of the BC system. Besides, smart contracts can be created, permitting transactions to be done safely between commonly un-trusted parties. Smart contracts are a type of digital contract or agreement. When a certain goal is fulfilled, a smart contract can be configured to do a task without the participation of a third party. BC can also support automatic payments, quality control, and stakeholder trust, among other things. Real-time data handling with monitoring and regulating data in a virtual environment, less paperwork, increased efficiency with faster response times, increased supply chain visibility, and reduced geographic limits are several advantages of adopting BC in supply chains. It also reduces the risk of SCM attacks.

6. Comparisons with the Existing Surveys

Several industries outside of finance, such as the supply chain, are among the most extensively discussed BC applications. BC technology is ideal for addressing supply chain concerns. The possibility of adopting BC technology in SCM has been a topic of investigation, and several reviews have been published so far that gives an overview of the current situation and a research path forward. Motivated by these facts, we have reviewed various supply chains in the proposed survey. This section compares state-of-the-art works that focus on the BC and SCM and their integration.

1) Conclusions

Blockchain is widely regarded as one of the important technology in many industries. It improves trust, transparency, traceability and security in the supply chain. The purpose of this literature is to focus on the usage of the blockchain in the supply chain.

2) Contributions

This paper investigates the current status of BC technology implementation in various supply chain network areas. We comprehensively surveyed the application of BC in Food and Health supply chain networks. This study makes several significant contributions, including theoretical advances related to the adoption of BC in the supply chain.

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