

SUPPLY-CHAIN LOGISTICS USING BLOCKCHAIN AND SMART CONTRACTS

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Abstract - Blockchain remains one of the buzzwords in the technological world. So that all sectors are focus on concrete use cases. However, few actors can boast of having devised revolutionary solutions. For good reasons, blockchain technology is still very complex to understand. The purpose of this paper is to define the various applications of Blockchain and Smart contracts in Smart Logistics, as well as to present concrete examples of these applications. It is said that smart contracts can truly forever change the notion of physical contracts in the upcoming future.

Key Words: Blockchain, Smart contracts, Block and ledger, Logistics, Supply-chain.

Introduction to Blockchain Technology - Blockchain can be called as a revolutionary technology which has the potential to change various industries and their working mechanisms. It is an open and immutable technology which has practical aspects in various fields. A Block is simply a data structure which has three major components data, Hash of the previous block, timestamp and the transaction data. All these blocks are linked together which creates a dependency between these blocks which ensures the integrity of the whole blockchain. If there is a minor change in hash of any blocks the hash data of the next blocks will be changed as well which leads to a spiral effect where data of subsequent block is changed as well thus rendering them invalid. This is one of the reasons transactions and records on the blockchain are secure and immutable.

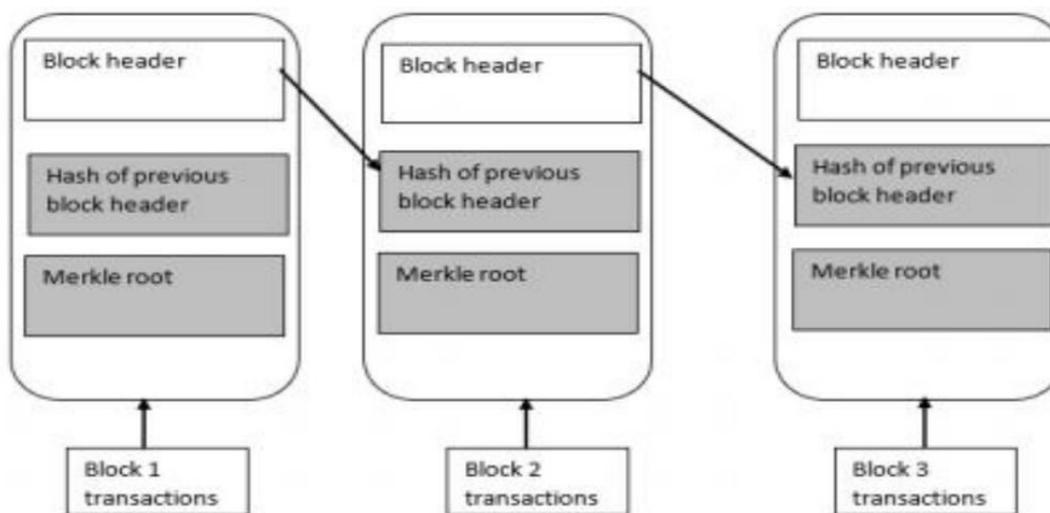


Fig 1 -Working of blockchain

Some properties of blockchain technology

Block - Transactions are combined into single blocks and in every 10 minutes a new block of about 1MB is formed. Every block consists of 4 components, Timestamp, reference to the previous Block, Summary of the included transaction and the Proof of Work that went into creating the secure block.

Mining- Mining means adding transactions records to the blockchain ledger after confirming the validity of transactions. It involves using complicated hardware which performs mathematical calculations which are used to verify transactions. These

miners verify the validity of transactions and only then they are put into secure block, miners are also rewarded with certain incentives like Bitcoins and they also get some transaction fees for every transaction that they confirm.

Proof of work– A proof of work is a requirement that expensive computations can be performed in order to facilitate transactions. Proof of work simply exists to enable a trustless consensus. A hash block can be called as proof of work.

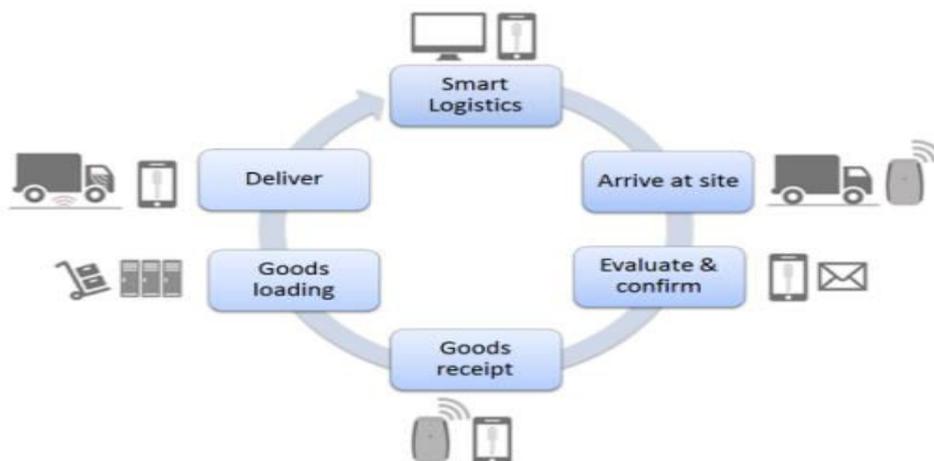
Smart Contract – A smart contract can be called as a digital agreement stored on the blockchain that is unalterable, once signed it dictates some certain logic operations that have to be fulfilled in order to perform tasks such as deposit money or data.

Smart supply chain management

The term Supply Chain Management was invented more than two decades ago. The supply chain has been defined according to different contexts. Quite simply, a supply chain is a systematic grouping of the set of controlled activities from the supply of raw materials to the delivery of finished products to the consumer. The supply chain includes several necessary steps. First, acquiring the raw materials by the producer. Then, performing the required transformations. Then, finally products shipping to the end consumer. In other words, the supply chain refers to a set of processes involved in sourcing, processing, and distributing products and services. Accordingly, supply chain management makes it possible to have the right item, in the right amount, at the right time, in the right place, with the right price, taking into consideration the right conditions for the right customer. In theory supply chain seems very easy but in real practice it is complicated due to different reasons such as uncertainty, and other factors, most supply chains are known for their numerous supply/demand mismatch problems, such as excess inventories, stockouts and delivery delays, which have long been popular research topics in the business management literature. In addition, the business climate has become more competitive, customer demands are also more specific. These complexities and problems lead companies to look for solutions in order to improve their work processes as well as the adopted implementation methods. To effectively face the growing challenges, supply chains need to become much smarter, smoother and efficient.

Smart logistics

Smart logistics can be defined as the combination of traffic management structuring and navigating traffic for optimal use of traffic system and logistics management by effective usage of data. Currently global logistics systems have a multitude of product variants. In this sense, different management methods have been derived. However, ordinary logistics systems are still unable to handle even more complex situations without increasing costs or decreasing quality. To overcome these complexities a new system is required to achieve these logistics goals, while providing real-time visibility to react to sudden changes. It is no surprise that efficient logistics enables the management of the company's physical flows by including a set of activities, such as demand forecasting, sales planning, supply requirements, inventory management, materials handling packaging, order picking, and product distribution.

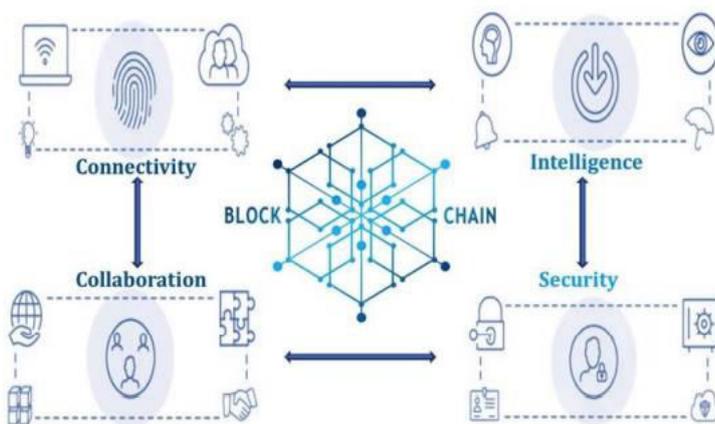


With intelligent asset tracking tools and equipment, all supply chains are becoming more efficient and effective by noting different changes:

- Significant end-to-end visibility
- Improvement of product routing
- Control and replenishment of inventories and mobile assets
- Detailed management of marketing experience.

The keys to smart Logistics

It is a huge challenge for companies to “act efficiently as possible” with so much material flowing and logistic processes there should be little friction and all processes must harmonize at best at all times. If one thing gets stuck in one place the whole interconnected systems might get disrupted as this is an complex ecosystem smart sensors and interconnected systems can be used to contribute to efficient logistics processes. The data is collected, processed in real-time and forms the decision-making base of the autonomous and controlled processes.



- **Connectivity**: A connected supply chain drives business growth through expanded and integrated digital ecosystems that unite employees, business partners, systems and objects.
- **Intelligence**: An intelligent supply chain improves the competitiveness with advanced Analytics and Machine Learning features that will optimize and automate your business operations and help you make informed decisions.
- **Collaboration**: A collaborative supply chain ensures secure and enriched collaboration by enabling employees, business partners, systems and objects to find common solutions for the benefit of all.
- **Security**: A secure supply chain ensures that only authorized people, systems and objects have access.

Smart contracts

A smart contract is an agreement between two people in the form of computer code. They run on the blockchain, so they are stored in a public database and cannot be changed. The transactions that happen in a smart contract are processed by the blockchain. Which means they can be sent automatically without a third party. The functions written in the smart contract can be invoked by any participant at any time. Transactions can be automatically sent over fixed time intervals or transactions sent in response to other transactions. This facilitates request-response type transactions, for decentralized data access within a blockchain-based system. A smart contract can also be triggered when a message is sent to the smart contract’s address.

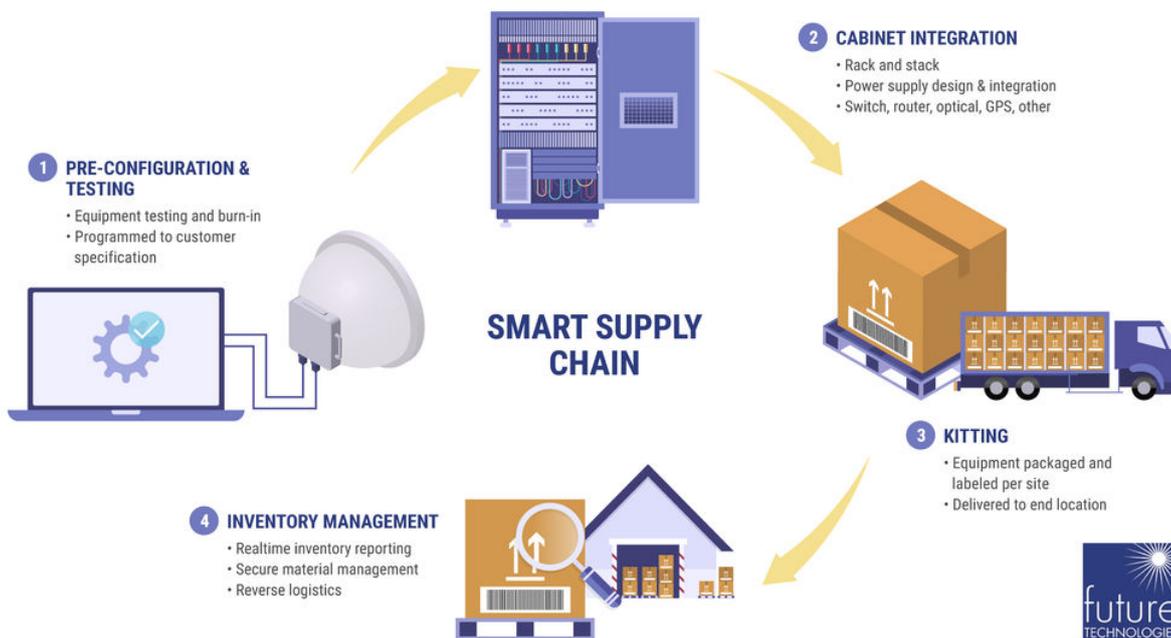


Smart Contracts can also be used to perform various functions within a blockchain network, such as

- Allowing storage space for application-specific information
- Providing utility to other smart contracts
- Allowing ‘multi-signature’ transactions, whereby a transaction is only carried out when a majority or a required percentage of participants agree to sign it
- Enabling automated transactions triggered by specific events.

Blockchain and Smart contracts in smart Logistics

Typically, smart logistics is defined as by the use of sensors, RFID tags, wireless devices, gps devices, IOT, AI and cloud computing. This technological revolution and data collection components have highlighted the issue of data security and the reliability of communications. Blockchains transparency and authenticity help tackle the issue of risks and data exposure in some manner. Blockchain offers lots of potential for improving the logistics process, usually with the trend towards smart logistics, and the use of communication and information technologies at all levels of the supply chain. One of the most important aspects of the blockchain application is its interface with the physical world, which requires the appropriate hardware and technology. This explains the massive surge in the use of smart devices in the supply chain industry which is growing exponentially. The use of Blockchain technology in the field of smart logistics remains rare, following its new appearance, its low popularity, and its complexity for the majority of people and organizations. The first real application in the logistics field was announced in April 2015: Everledger start-up which uses Blockchain to fight fraud in diamond supply chains which turned out to be quite successful



Management

The Blockchain integration in smart logistics allows the improvement and efficiency of logistics processes, which in-turn affects the management, and will make the supply-chains even more agile. The data collecting and its transmitting in near real-time gives managers clear visibility of the operating status of the whole processes and allows them to make timely decisions depending upon the situation. We can adopt blockchains, particularly smart contracts, to achieve sustainable supply chain management objectives. An example of blockchain application for IoT systems is to distribute messages between devices in a chain where each message is treated similarly to a transaction. Smart contracts are rules stored on blocks, capable of arranging financial arrangements and ensuring that sufficient funds are available for projects and that everyone is paid on time. Smart contracts influence network data sharing between supply chain participants and continuous process improvement. Thus, they provide a connection for transactions between different currencies or mix them from multiple sources in the global supply chain in a secure and fast manner.

Conclusion

The purpose of this paper was to determine Blockchain and smart contracts trends and applications in smart logistics, as well as to present concrete examples of these applications in the industry. As far as smart logistics are concerned, blockchain-based technology is still a subject of research studies. In fact, there is an enormous interest in Blockchain applications and hence numerous companies are researching on them for their multiple use cases in the industry. Blockchain can handle logistics tasks it can be used to track purchase orders, order changes, freight documents, and it can help in information sharing about logistic process and delivery. The blockchain technology has huge potential for development and application in the smart logistics sector, presenting challenges for further research.



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