# Prospects of Using Blockchain Technology in the Organization of the Transportation Process and Supply Chain

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**Annotation:** The spread and formation of information technologies is a fact in the modern world. Over the past decades, this direction has determined the main trajectories of the development of the economy, industry and society as a whole, which in turn leads to enormous changes in the aspect of technological progress. The formation and development of the digital environment is one of the top priorities of most developed countries, including the Russian Federation, the USA, Germany and others. Modern technological progress is characterized by the development and formation of various information technologies that contribute to improving the rational resources' use and enhancing the competence of modern enterprises. To date, there are a huge number of applied and professional tasks, the most effective solution of which involves the use of various kinds of information technologies. This article raises the question of the relevance of using Blockchain technology, possible problems of its implementation, as well as what blockchain can give to different economy and logistics sectors. To understand how the "blockchain" works, we take as a basis the second-generation blockchain "Ethereum", which includes an updated system of smart contracts and much more. Topical issues that blockchain can solve in logistics, such as inventory and cargo tracking, authentication, transparency in supply chains, increasing the speed of cargo delivery, and the creation of a freight market, are considered. The possibility is also considered and a description of the application of this technology on the railway network of Uzbekistan is given. This technology is applicable in many sectors of the modern rapidly developing world and is able to speed up the growth of the digital economy.

*Keywords: blockchain, logistics, smart contracts, decentralized environment, supply chains, Ethereum blockchain.*

Blockchain is a modern technology that does not have a specific origin. The term's origins date back to 2008 when a person or group identifying themselves under the alias Satoshi Nakamoto published a paper that would later serve as the revolutionary technology's manifesto. The article outlines its key features and the potential for developing a decentralized system of financial settlements. It is not known for certain who may be the author of this manifesto, since the real name of the creator of this technology has not yet been disclosed. Since the creation of the first block in 2009, more than 2,000 different types of crypto-instruments based on various blockchain modifications have been created worldwide. Blockchain, for instance, makes it possible to trace a product's journey from the maker to the consumer. In this approach, every deal or transaction is documented, added to the distributed database chain as a new fragment, and given a manually assigned multi-digit numeric encryption. This fragment contains information on the network as a whole, as well as the time, date, participants,

and transaction amount. In this case, any information exchange takes the shape of a chain of blocks, each of which always carries details about the one before it. Bitcoin and blockchain are related. Blockchain technology was first used for Bitcoin, its most well-known implementation. Its transactions consist of fund transfers between users' wallets. [1-2].

**Problems of Implementing Blockchain Technology in logistics.**

Analyzing the experience of implementation and the specifics of the technology, when implementing blockchain technology and integrating it into logistics, a number of important nuances and challenges that may occur should be considered:

1) Different use of the data storage model: not all companies or systems use a single data model for collaborating on the blockchain.

2) Integration of the blockchain into the existing IT ecosystem: The integration of the blockchain into current internal software algorithms will always be a challenge.

3) Development of blockchain technology: The final task is to work directly with the blockchain. Blockchain is a brand-new technology that is evolving quickly. Future implementation issues caused by the blockchain's immediate adoption will multiply.

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4) Information Flow: Another major challenge is to manage the flow of information between different organizations in logistics. If trade is international, it becomes more complex due to the involvement of more entities in the process.

Many elements will determine if blockchain technology is flourishing in logistics. To properly integrate blockchain into its current systems, a business must take the initiative and work on each. Everyone must cooperate, increase their understanding of blockchain, and advocate for its importance. Working with rival companies to develop blockchain standards for logistics operations illustrates this. Stakeholders should put their time and effort into enhancing existing systems or initiatives that are about to go into production. Blockchain must be rebuilt for particular offerings before a company or business can use it. There is also a need for organizations to define which of their transactions will be associated with blockchain. Blockchain needs significant help possible to ensure that the technology is ready and also mature for implmentation.[1]

**Analysis of blockchain, smart contracts and how they can be applied to logistics and other fields.**

We propose to take the Ethereum cryptocurrency technology as a basis. What is Ethereum? Ethereum is a fork (a fork is a change in the rules of the network, according to which a block in the blockchain is recognized as authentic, a kind of separation, hence the name — from the English "fork". There are two types of forks in total: soft and hard. Blockchain-based and smart contract-based decentralized web services can be developed using the Bitcoin platform. As a result, we end up with a virtual computer, and everyone can equally use it. [2]

**Ethereum technology**

Ethereum can be called a state machine. This means that at any time you can take a snapshot of the file system and view information about all account balances and smart contracts in their current conditions. Certain actions cause the system state to be updated, which means that all nodes also update their snapshots to reflect the change.[3-4]
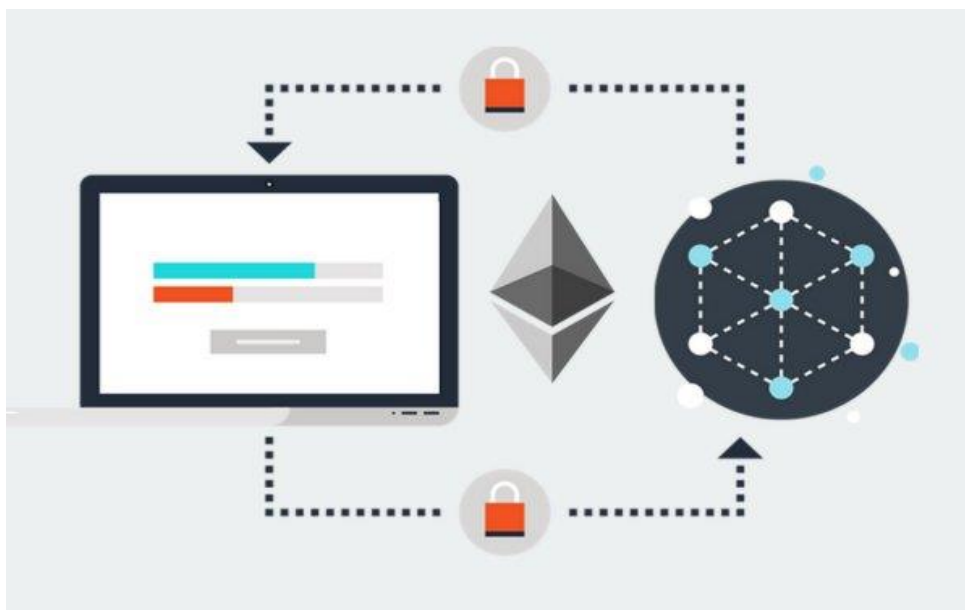


**Fig 1** - Blockchain Ethereum. Ethereum transition to another form.

Smart contracts performed on Ethereum are initiated by transactions (from users or other contracts). When a user sends a transaction to a contract, every node in the network runs the contract code and writes the output. For this, the Ethereum Virtual Machine (EVM) is used, which converts smart contracts into understandable instructions for computer.

A special mechanism called mining is used to update the state (for now). It is performed using the "Proof of Work" algorithm, very similar to the bitcoin algorithm. Next, we will look at this in more detail.[3]

What use does Proof-of-Work (PoW)serve?

PoW is an algorithm for securing distributed systems against abuse (DoS attacks, spam emails, etc.). Its core principles are the following:

 -the requirement to complete a specific, time-consuming task;

-the ability to quickly and easily verify the outcome.

PoW problems were not designed with people in mind; a computer can always solve them in a finite amount of time, but it needs a lot of processing power. At the same time, verification of the discovered solution involves significantly less time and resources. [6]

**Transactions in the blockchain and what conditions they must meet.**

From a technical point of view, a transaction in a blockchain is an atomic event allowed by the underlying protocol.

In other words, a transaction is simply an event that updates information on the blockchain. The only difference is that this change in data spectrum does not apply to a specific computer, but to all blockchain-connected devices across the planet.

Blocks store the following data:

- Transaction data: date, time, transfer amount;

-Data about the participants in the transaction: the address of the sender and recipient;

-Data about each block is a unique code (hash), thanks to which the blocks can be distinguished from each other.

**Smart contract technology**

The Ethereum system uses smart contracts, which are mathematical algorithms used to verify agreements between participants. Until the user satisfies the requirements outlined in the contract, they will not get the asset transfer. As a result, commitments are met without the need for governmental or regulatory entities.

Different financial goods, such as partnership programs, insurance, monthly payments, trade, and logistics, can employ smart contracts.

A smart contract can be used in a straightforward manner. For instance, two people might want to gamble on the same game and play sweepstakes. The blockchain is where their wagers are kept. The smart contract verifies the outcome following the conclusion of the game and awards the prize to the victor. [4]

Such contracts will be able to readily regulate the performance of more intricate responsibilities in the future. For instance, a tenant who rents a home may have had trouble making monthly payments on time. The tenant is unable to unlock the apartment's lock because of computer software. Development opportunities are very vast. [5]

Smart contracts allow you to perform reliable and confidential transactions without the participation of intermediaries and regulatory authorities. In addition, all transactions are easily tracked on the blockchain (without specifying the participants in the transaction), they are easy to trace and impossible to reverse. The latest state of the smart contract is also on the blockchain, a copy of which is held on many nodes in the network, so the smart contract cannot be faked or deleted.

Analyzing real examples of the use of smart cards, it is necessary to note the main advantages over traditional conventional cards.

As the result shows:

- the use of smart cards has a high level of practicality, which is associated with the ability to quickly transfer an electronic document between centers and the impossibility of losing a file;

- smart cards are protected not only by law, but also by special algorithms and methods of information protection. The probability of the fact of theft or violation of the integrity of the media in smart cards is much lower than in conventional cards;

- the use of smart cards implies the possibility of payment through electronic commerce, in particular electronic or cryptocurrency accounts. This fact increases the speed and safety of operations.



**Fig 2 -** The process of asset flow in the second generation blockchain network.

**Scope of application of smart contracts.**

In the twenty-first century, it is possible to translate all kinds of paper contracts into digital smart contracts, and consequently, a wide range of potential applications appear. Three main characteristics - complete accounting of all data, eternal storage in the blockchain and reliability (no need for an intermediary) - make them an excellent tool for many sectors of the economy and in general aspects of human life. Let's look at a few use cases.

**Insurance.** When certain events occur, smart contracts automatically initiate an insurance claim, which simplifies and optimizes the process of its consideration. The blockchain can store information about the requirements, which will allow determining the amount of compensation to the insured person. This capability will speed up processing and reduce the impact of human error.

**Voting.** Smart contracts will help make voting automatic and transparent. Each contract acts as a single ballot, uniquely identifying the voter. Since the blockchain is immutable, votes cannot be tampered with.

**Supply chains.** As goods move along the supply chain, smart contracts can register ownership and confirm the responsibility for the goods of one or another person at any particular point in time. At any stage of the process, the smart contract unambiguously defines where the products should be. If any party in the supply chain misses delivery times, all other parties will know where the problem is.

**Record storage.** Many industries can use smart contracts to improve the speed and reliability of record storage. Blockchain technology can helpdigitize archives and securely encrypt and store it. In addition, access to archives can be regulated to allow only verified users.

**Ownership.** Smart contracts can store data about who owns the property rights. This is a fast and economical way to retain ownership. In addition, smart contracts provide a fast and secure transfer of ownership.[8-9]

**Analysis of blockchain implementation in the world's largest retail and logistics companies.**

**1. Inventory and tracking of goods.**

**As it is.** 90% of global trade is accounted for by international logistics, which employs all four modes of transportation (rail, road, air, and sea) and is discrete (separate, intermittent). Each link in the supply chain employs its own local accounting system at the same time, such as CRM, ERP, or another. Typically, communication between these systems takes place via an analog mode linked to paper documents: couriers, mail, facsimiles, and in-person meetings.

This method causes numerous issues, including: - A large portion of goods, containers, and vehicles are lost or not utilised because they are "out of sight" of accounting systems.

- Walmart was able to control mangoes traceability from the store's shelf to the farms where they were grown. This was possible after Walmart associated its logistics with blockchain. Thanks to blockchain this time changed from 6 days 18 hours and 26 minutes to only 2 seconds.

- It takes a lot of effort and money to remove accounting errors.

Since complicated interactions and documentation are required to verify the accuracy of information in accounting systems and at the legal level, these issues cannot be solved using the conventional method.

**What will happen with blockchain.** The technology can be used to build a centralized cloud-based digital document management system that will enable supply chain partners to track the whereabouts of their products, freight, and vehicles in real time, down to the micron level.

This case is implemented by the largest companies such as Walmart, Unilever, Nestle, Provenance.

One of the first companies to see the potential of blockchain is the retailer **WalMart**, which is currently testing IBM's new technology on pork shipments to China and mango shipments to the United States. After the salmonellosis epidemic 2006, the corporation believes its adoption will enhance inventory control and guarantee the security of the goods being supplied. It took the business around two weeks to find the infection's source utilizing paper-based operations. Blockchain will make it possible to instantly obtain all the information about every batch of commodities that has been recorded into a database.

To manage its supply chains for tea, **Unilever** uses the Provenance blockchain. Over 10,000 farmers, numerous banks, shops, and shipping firms are all involved in the operation. Unilever has other blockchain projects as well.

Like **Walmart**, **Nestle** manages the supply chain of food ingredients like mashed potatoes, milk, and palm oil using IBM's Food Trust blockchain. Nestle intends to demonstrate to customers the components of its goods in this way.

**2. Verification of authenticity and quality.**

**As it is.** The worldwide counterfeit industry, which exceeded the GDP of nations like Austria or Israel in 2018, reportedly hit $450 billion in 2018, according to the Organization for Economic Cooperation and Development. Other studies indicate an annual waste of 1.6 billion tons of food, or around $1.2 trillion, of which 40% is lost due to transportation-related deterioration. CDC estimates that a sizable portion of this spoilage makes it to the consumer's plate, resulting in 130,000

hospital admissions and 3,000 fatalities in the United States alone.

**What will happen with blockchain.** Regarding fake goods, blockchain technology enables organizations to track the origin of products from the counter at a store to a particular manufacturer: a factory, a farm, a business, or a person. Because each batch of items (or each item, if it's something big and/or expensive) has an RFID tag that continuously registers their whereabouts and the interactions between supply chain partners, this data has a high degree of veracity..

RFID sensors can also measure humidity, temperature, and other empirical variables in addition to speed. Food spoilage and transportation breaches can be identified this way, and the process or individual responsible for them can be tracked down. Additionally, if a product is contaminated, for instance, with the E. coli bacteria, a blockchain-based system can trace all contaminated batches of goods and locate the source of the contamination in a matter of seconds.

Implemented:

1) Blockchain is used by **Everledger** in the diamond business. The register maintains information about the gemstone's origin, as well as its color, transparency, cut, carat weight, and certificate number.

2) **Provenance.** a "Software as a Service" initiative for gathering and verifying product provenance information. Martine Jarlgaard, The Grass Roots Farmers Cooperative, Organic, Pole and Line, Co-op, and numerous more businesses and producers utilize it on a global scale.

3) **MediLedger** uses blockchain to manage the supply chain of medicines according to EPCIS standards. By 2023, all American pharmaceutical companies are required to switch to this standard.

4) **SkyCell** has developed shipping containers for the transportation of medical supplies that require strict temperature control. Inside the container are IoT sensors connected to a blockchain in the cloud.
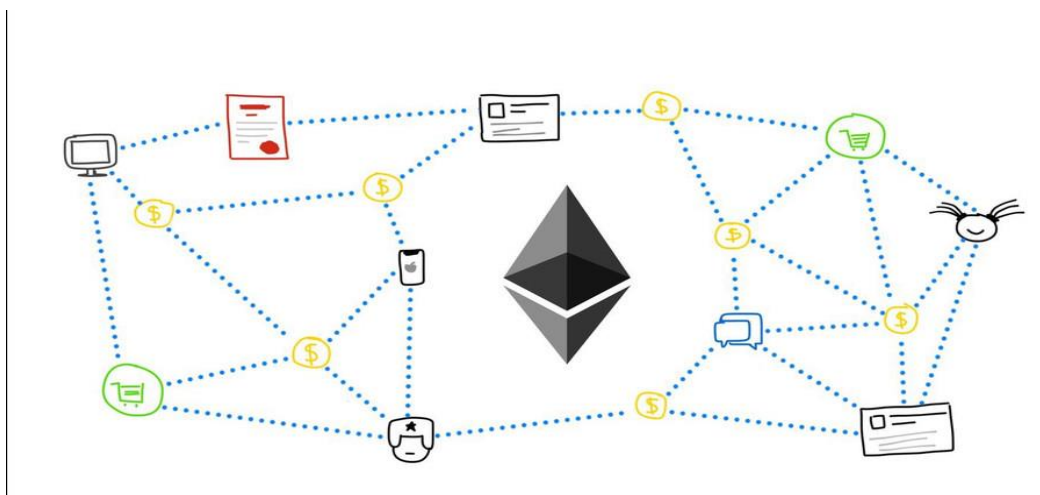


**Figure 3**- Correlation of blockchain with social spheres.

3. **Freight and delivery improvements.**

**As it is.** About 30 parties are involved in a typical delivery scenario, including shippers, consignees, 3PLs, carriers, government organizations, banks, insurers, and others. They exchange more than 200 paper messages—POD (delivery confirmation), invoices, and BOLs—while delivering just one batch of items simultaneously. This paperwork's maintenance fee is $300, or 10% to 15% of the shipment charge.

**What will happen with blockchain.** According to IBM, blockchain technology may save the logistics sector $38 billion annually. Smart contracts, which will mostly automate the document flow and business operations, will make this possible. The distribution registry will also

facilitate fraud detection, speed delivery, and decrease errors.

**Implemented:**

1) **Maersk,** together with IBM, started the TradeLens logistics system centered on the Hyperledger Fabric blockchain (created by the LinuxFoundation) to track shippingfreighttraffic and exchange customs and financial information between supply chain participants. TradeLens controlled around 30% of the global shipping freight business as of the middle of 2019.

2) **GSBN**. Direct rival of Maersk with an equivalent market share. Evergreen Marine, COSCO, CMA

CGM, Yang Ming, and OOCL are all involved in the project. Partner in technology: CargoSmart.

3) **VeChain.** Platform for managing logistics and the supply chain that is situated in Singapore. BMW, Renault, DNV-GL, H&M Group, and other companies use it.

4) At the end of June of this year, the port of Antwerp (Belgium), which ranks second in Europe for container cargo turnover, announced the start of a pilot blockchain initiative targeted at streamlining logistics procedures. The blockchain startup T-Mining and I will work together to conduct some trial testing.

According to reports from the port, blockchain technology can improve data exchange transparency and hasten communication between port consumers and logistics process partners. This reduces the possibility of any data manipulation as a result.



**Fig 4 -** Blockchain analytics

## 4. Launching the freight market.

**As it is.** The freight market is currently unorganized and inefficient. The issues of parties' obligation for compliance with transactions and explicit or implicit fraud are not clearly governed by any norms or laws. Additionally, this market is opaque, which frequently results in erratic swings in freight costs even when there haven't been any noticeable changes in supply or demand, as was the case at the beginning of 2019 when the market experienced a shock due to the abrupt decrease in bulk tonnage rates.

**What will happen with the blockchain.** Smart contracts and blockchain technology can be used to establish a fair market where businesses can quickly and transparently engage freight carriers. The level of responsibility of enterprises will also rise because all contract conditions will be pre-written in smart contracts; as a result, it will happen automatically rather than after protracted talks and an arbitration court ruling.

### Implemented:

Through utilizing blockchain technology, ShipChain is attempting to enhance logistics. Nearly all blockchain-based logistics systems can be connected to open-source smart contracts. These agreements are made to help logistics operations and work toward developing a decentralized freight market, error detection, and theft avoidance. Over 80% of global transportation is provided by the BiTA (Blockchain in Transport coalition) coalition, of which ShipChain is a member.

## 5. Improved transparency.

**As it is.** The low degree of verifiable information, which directly results from the industry's lack of transparency, is a significant issue in supply chains. For instance, many businesses overpay for the delivery of their goods to consumers due to the lack of transparency in the transportation cost(purchase, transportation, and storage), and "gray" schemes, smuggling, and counterfeit goods are commonplace because shippers are unable to control the delivery process.

**What will happen with the blockchain.** Each supply chain participant can examine the information for each vessel, container, and shipment at any time because all data is recorded on the blockchain, which lessens the possibility of conflicts in the paperwork of various parties.

Increased logistics openness will:

- facilitate micro-level control of the delivery process, reducing fraud and mistakes;

- enable the parties to see proof of the counterparty's previous behavior, including delivery and payment delays;

- minimize the chance of documentation contradictions, such as when the sender and recipient incorrectly interpret delivery times.

**Implemented:**

**Provenance** developed a BaaS solution that improves openness in the supply chain, provides all participants—including consumers—access to crucial information, and will enable just compensation for logistics process participants in the event of legal or contractual violations.[1]

**Table 1** - List of enterprises implementing blockchain

| Company | Department | Blockchain solution |
| --- | --- | --- |
| Walmart | Retail Trade | utilizing blockchain technology to trace the flow of goods from producers to stores. |
| British Airways | Travel industry | Implementation of blockchain for managing flight data and confirming traveler identity |
| Maersk | Sea shipping | To track the movement of goods between ports |
| BHP Billiton | Mining industry | Using blockchain technology for supply chain management |
| Tencent | E-commerce/retail trade | Account authentication and tax compliance solution |
| Toyota | Auto industry | Planning to use blockchain technology to improve autonomous driving technology |
| UnitedHealthcare/Humana | Health care | Using blockchain technology to improve physician directories and to ensure accurate completion of insurance claims |
| UPS | Delivery | Blockchain logistics solution for monitoring and managing logistics |
| Baidu | Search giant | Using blockchain to improve intellectual rights management |
| Samsung | Technology | Using blockchain technology to improve supply chain management when it comes to electronics supply |
| FedEx | Delivery | Working on a blockchain solution to resolve disputes with clients |
| Alibaba | E-commerce | Using blockchain technology to track luxury items on e-commerce platforms |
| AIA Group | Insurance | Launched first-of-its-kind bank insurance to exchange policy data |
| Metlife | Healthcare | Using blockchain technology to store patient medical records for insurance purposes |
| Facebook | Technology | Investigating the use of blockchain to enhance user privacy and data security |
| Ford | Cars | Using blockchain technology to enhance mobility technologies |
| Prudential | Insurance | Introducing a blockchain-based trading platform for small and medium enterprises |
| Apple | Technology | Blockchain time stamping technology with a patent |

| Nestle | Trade | Tracking infant food goods using blockchain technology in supply chain management |
|---|---|---|
| Google | Technology | Exploring the application of blockchain technology to enhance the privacy and security of cloud services |

## Conclusion

Blockchain is a 21st century technology that is finding and can find application in many sectors of the economy. Its application, as well as its development will contribute to the improvement of both economy and technological processes in supply chains. We also cannot exclude that there are a number of problems in implementing this technology in transportation process management, such as the use of different data storage models, its integration into the existing IT system. And before using it, participants of the transportation process should determine what business operations will be conducted in the blockchain network.

To implement this technology in the CIS countries, it is necessary to: retrain and train personnel, optimize the field of information technology, it is necessary to create a single digital ecosystem on the basis of which all participants in the transport services market, including regulatory authorities will work, it is necessary to develop existing and create new transport corridors with the use of modern technologies in order to speed up the transportation process.

Blockchain is a new technology that requires careful study in order to be ready for use in the transportation process and implementation in government systems.

As a result of the analysis, it can be seen that companies that start using the blockchain technologies studied in the article have the opportunity to significantly increase the efficiency of the transportation process. In particular, through the use of smart cards instead of conventional paper cards, the time of banking transactions is significantly reduced, and the level of documentation security is also increased. In addition, thedigitalization of this area can completely eliminate paper document management for electronic, which will also affect the increase in the level of efficiency of organizations due to the speed of operations and savings on employees.

However, this is not the only advantage of using blockchain in logistics. Throughout this article, the author cited numerous examples that confirm the effectiveness and rationality of using this technology in the field ofstudy. Based on all this, it should be noted that although blockchain technology is a relatively new and understudied concept, its potential exceeds expectations and the current level of development many times over. Thus, in the modern world it is necessary to increase the amount of intellectual and material resources directed towards the development of this technology, in particular, in the organization of the transportation process and supply chain.

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