

FinTech in Supply Chains: Post-COVID Challenges and Solutions

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Abstract: - The sensational Covid-19 and the pandemic have profoundly changed many areas and enterprises. For many entrepreneurs, it was a huge challenge to revolutionize their logistics and be able to switch over to online payment and remote delivery of goods and services in an extremely short time. The article reviews the work of logistics and supply chains both before and after Covid-19, the article introduces FinTech and the possible interaction of FinTech to improve the work of logistics and supply chains. This work aims to research the synergy of financial technologies and logistics. For this purpose, it is necessary to analyze the situation in the supply chain and FinTech sphere after the pandemic.

Key-Words: - supply chain, Covid-19, FinTech, logistics, blockchain, cybersecurity

Received: May 27, 2023. Revised: October 29, 2023. Accepted: November 14, 2023. Published: November 24, 2023.

1 Introduction

Owing to the serious pandemic due to Covid-19, logistics and supply chains have moved so far forward significantly in their development, [1]. Entrepreneurs began to allocate more and more resources for the development of logistics enterprises, especially the moments of security, remoteness, and speed. There is a lot of research about Covid-19 pandemic and supply chain development, [2]. Consumers are increasingly turning to online stores for various kinds of goods and services, but they still want to get what they need at a low price, in a short time, but of high quality. Contactless delivery has appeared during the pandemic – when the goods are left under the doors without meeting the buyer or delivery with drones, [3]. The contactless delivery also includes the newly appeared parcel machines which established trust of both consumers and entrepreneurs.

According to, [4], [5], the four main aspects of the indicator system have been identified that are important and have an impact:

- The customer aspect is a priority and affects all aspects of the balanced scorecard.
- The aspect of training and innovation – personnel with the required skills have a positive impact on human resources as well as competition.

- Internal business aspect – innovative technologies must be adopted for supply chain sustainability and good performance. However, this aspect does not have an impact on the client and their satisfaction.
- The financial aspect is an indicator that does not influence other aspects, the adaptability of the supply chain is higher than the costs.

There's no use in being very reticent about the realization and implementation of the latest technologies in the development of logistics, supply chains, and security, it can solve problems by interrupting business processes, especially in small and medium enterprises, [6]. Both entrepreneurs and developers have begun to devote more time and resources to the development and use of technological innovations, even those that immediately obviously have nothing to do with logistics or supply chains. For example, blockchain technology was originally used exclusively for cryptocurrencies, and now it already has a wide range of applications in various fields, including logistics, [7], [8]. The blockchain enables to eliminate the intermediaries in logistics, which saves time and finances and reduces the risks of various errors. This technology allows seeing all the transactions made but does not allow changing or canceling them. This gives entrepreneurs a huge advantage if the blockchain is already introduced or

in the process of being introduced into the enterprise operation.

FinTech is one of the fastest-growing areas in the financial industry. The FinTech core function is to provide access to finance and provide additional and more convenient services for both individuals and corporate clients. The technologies are the priority aspect for the financial services sector in the global financial system. FinTech involves the development of innovative solutions in the financial sector, which gives more opportunities to all parties. The FinTech rise relates to the desire of companies to gain an advantage over competitors by providing additional services and changing customer standard habits, [9], [10]. It is becoming increasingly difficult for traditional banks and financial institutions to compete with innovative companies in the financial industry, [11]. Over the past 10 years, global investments in the FinTech segment have grown more than 4 times, exceeding \$20 billion. High-tech companies in this segment focus on a certain innovative technology or process covering all areas: from mobile payments to insurance. It is worth mentioning that FinTech uses technologies working in the field of transaction security, an example – user, authentication means of user authentication or fraud protection measures against fraudulent actions, card data encryption, and their safe storage. The use of FinTech is possible in various industries, for example, there are special solutions for B2B calculations, analysis of large amounts of data, insurance, etc. In addition, FinTech is being integrated into communication services, such as the largest Chinese messenger "WeChat" which has introduced a payment service developed by Tencent. As well as digital banks have become widely used, the most prominent representative of such an example is the "Revolut" bank.

This paper aims to analyze the potential of FinTech to improve logistics and supply chain management after the COVID-19 pandemic.

2 Overview of Supply Chain

The smooth operation of logistics and supply chains makes it possible to get the necessary quantity of high-quality goods at a certain time. The most common logistics rule is the 7R rule, which explains all the necessary points (Fig. 1), [12].

This rule reflects not all-important logistics principles – the "right speed" position is missing. This became relevant only when people faced closed borders due to a pandemic, and then due to military operations. It is clear that predicting a pandemic in advance is very difficult, but

experience has already been gained and several problems that arise when borders are closed have been identified, allowing us to be more prepared for such challenges next time.

The logistics variety does not negate the presence of similar problems that can be solved or at least minimize losses with the help of technology. Fig. 2 below shows the subsystems of logistics, [13]:

1. Material management has two subsystems: purchasing/supply logistics and production logistics.
2. Physical distribution has three subsystems: inventory control of finished products, decisions regarding warehouses and depots, and external transport.
3. Purchasing and reverse logistics.



Fig. 1: The 7 “Rights” of Logistic

These are the core issues that had to be faced before the pandemic and COVID-19 has further aggravated the problems, [13]:

- Late delivery of raw materials and equipment
- Lack of material
- Defective products
- Lack of real-time information
- Regulation of relations with the client in the event of problems
- Monopoly in transport modes
- Undeveloped networks of transport routes

- Weather conditions
- Lack of information exchange
- Losses under various circumstances
- Complex inventory
- Personnel shortage.

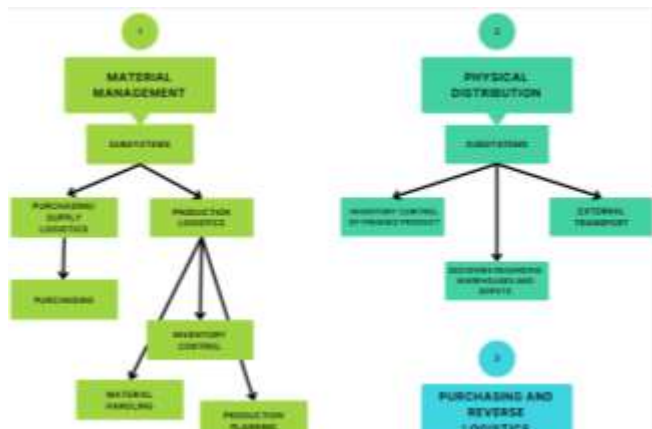


Fig. 2: Subsystems of logistics

Based on the information above, not all items can be improved, even with the means to do so. But almost all the items can be modified to minimize losses in the future.

According to, [15], there are eight key supply chain management processes:

- Managing relations with customers;
- Managing customer service;
- Managing demand;
- Order fulfillment;
- Managing manufacturing flows;
- Procurement;
- Developing and commercializing the product;
- Managing returns.

Logistics is not only the delivery of goods/services at a certain time but also a close exchange of both information flows and material. Any logistics system consists of several elements: personnel, warehouses or facilities, transport, communication, and management. Each element, except for personnel, is a tangible element of the logistics system. In the case of a standard supply chain, the following elements comprise the tangible part of the supply chain:

1. Raw material supply;
2. Raw material and product storage;
3. Production of goods;
4. Distribution and dispatch of finished products;
5. Finished product consumption.

2.1 Digitalization of Logistics and Supply Chain

With the advent of technology, people began to use them more and more to improve life quality, save time, and their convenience. COVID-19 and the pandemic forced people to develop logistics and implement the latest technologies, sparing no expense. Digitalization came to logistics and supply chains even before the pandemic, but it began to develop more rapidly during and after it, [16]. The information system in logistics consists of personnel, equipment, and software for planning, monitoring, and analyzing the operation of a logistics system (Fig. 3), [17].

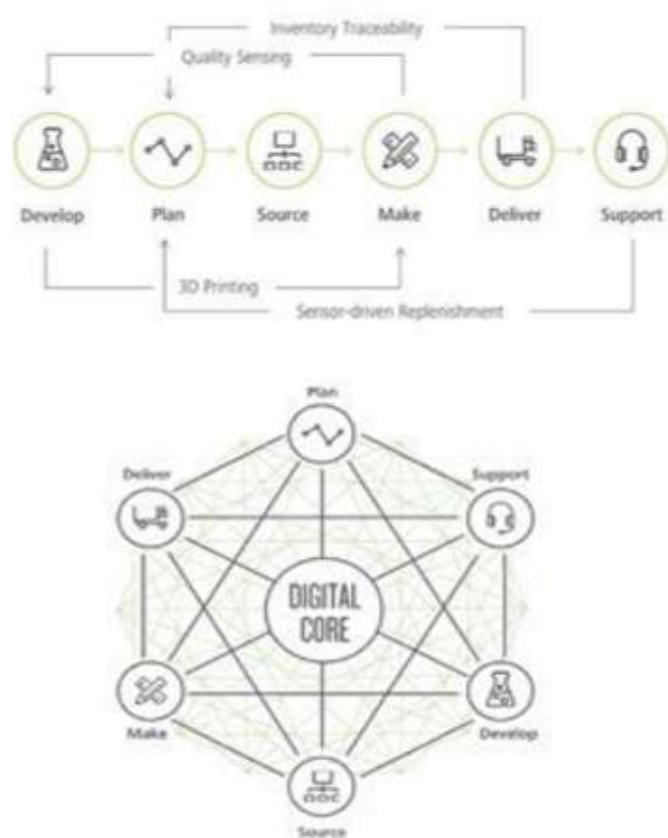


Fig. 3: The rise of digital supply chain network, [18]

Each company has its own goals and objectives for information technology introduction into the logistics system, but several key aspects of this process can be identified:

1. Communication, both between internal and external concerned parties;
2. Innovation for new products and services;
3. Automation to replace human labor to increase productivity;
4. Innovation experience is a human-oriented product;

5. Cybersecurity to keep data safe and gain customer trust;
6. Data analysis for faster data processing and statistics collection to improve products/services for customer requests.

Enterprises have been improving their competitiveness in various ways for the past centuries. These days, it's mostly automation and digitalization tools that are the catalysts for accelerating and improving business processes, as well as enabling higher productivity. When implemented innovations work properly, processes that used to take several days are realized in minutes. The reasons why businesses have started devoting a lot of resources to automation and digitalization are as follows, [19], [20]:

1. Improved visibility and transparency, especially in real-time, provide an opportunity to identify bottlenecks and delays in supply chains.
2. Increased flexibility and agility allow businesses to quickly adapt to changing conditions.
3. Optimal allocation of resources – inventory, production capacity, and transportation leads to lower costs and higher profits.
4. Sharing information with everyone in the supply chain builds trust, improves customer service, and reduces lead times.
5. The application of data analytics allows you to study the market, demand, and customer behavior, improving the performance of the enterprise.
6. Customer centricity through order tracking and convenient services increases customer trust and loyalty to the company.
7. Risk mitigation and resilience are evident in the work of digital technologies, which can predict different developments and prepare action plans in advance, increasing response to disruptions.
8. For more convenient and easy implementation of systems, it is necessary to comply with standards and their compatibility. It also improves the quality of the product.

The list of innovative technologies that are used in logistics and supply chains is already quite long (Fig. 4). The application of a particular technology in a particular enterprise depends on its area of activity, [19]. A brief overview of the major and more popular technologies in use is given below.



Fig. 4: Innovative technologies, which are used in the digital supply chain

2.1.1 Internet of Things (IoT)

The Internet of Things is a kind of digital network with real objects and the ability to track positions in real-time. The origins of this technology are in RFID – each object has its unique identifier and can connect to a network and transmit data. According to, [3], [21], technologies that are developed based on the IoT enable to:

- Measure inventory;
- Keep track of deliveries;
- Optimize routes;
- Ensure product quality;
- Predict and prevent supply chain problems and risks.

In turn, the use of the IoT provides transparency, flexibility, and traceability of supply chains as it enables real-time monitoring. This allows to control and optimize the network and improves the efficiency of supply chain management. But before you can integrate technology into logistics, you need to make sure the systems are compatible. Unfortunately, there are a few problems in integration, as there is no single logistics system for all parties, and each of them uses its own, as well as there are no standards of technical compatibility, which greatly complicates the process of implementation of innovations, [21].

2.1.2 Blockchain

Another very high-profile technology that is being used in almost every field is blockchain. The world learned about this technology through cryptocurrency and then began to think about how else the technology could be used, gaining some advantage. Blockchain is now being used in a huge number of cases and a wide variety of fields (Fig.

5), such as logistics and supply chains, warehouses, the energy sector, business processes, voting processes, etc., [3], [8], [22], [23].



Fig. 5: Blockchain real-world use cases, [24]

The name makes it clear that it is a chain of blocks, but the advantage of blockchain is that the connection between these blocks is almost impossible to break (Fig. 6).

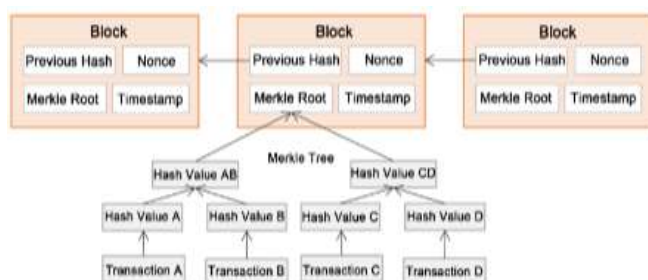


Fig. 6: The structure of the blockchain, [21]

Blockchain is a decentralized technology, meaning that there is no single manager in the system. All stakeholders are involved in the blockchain and each of them has the right to add a block (transaction), but to realize a transaction, it is necessary to get confirmation from all participants in the chain. Only then is the block with the transaction added to the chain, receiving its unique cryptographic hash. Each unit contains, [7]:

- Version number,
- The hash of the previous block,
- The hash of all transactions in this block,
- Block creation time,
- Bits and nonce for mining.

Another advantage of blockchain is that the blockchain is impossible to change or delete. This allows all parties in the system to see what is happening and how it is happening, i.e., there is transparency and therefore increased trust between

stakeholders. Of course, after the emergence of such technology, hackers became active and tried to disrupt the blockchain, [7], [13].

In logistics and supply chain, blockchain is very much in demand as it helps optimize logistics and improve supply chain operations. The use of blockchain in logistics systems is possible in the following ways, [24]:

- Tracking the product from production to the end consumer;
- Confirmation of the authenticity of the goods by means of embedded tags or chips;
- Optimization and automation of processes at various stages and under certain conditions;
- Simplifying the inventory process, it is even possible to automatically order new items when a certain inventory level is reached;
- Reduce costs and time by speeding up the information exchange process and reducing data duplication;
- Shared management of data and processes as needed, increasing trust and reducing risk.

Major enterprises have actively started to explore the adoption of blockchain in logistics. So, the well-known logistics company Maersk and the IT company IBM have launched a pilot project for tracking goods and digital documentation. Tetra Pak, a well-known company, was one of the first to try out the platform. But still, the adoption of a technology like blockchain raises some challenges, [7], [13]:

- Incompatible with the current system;
- Scaling problem, as the blockchain has to Process a huge number of transactions;
- Lack of trained staff and experts;
- Lack of standards;
- Implementation, maintenance, and training costs.

An enterprise looking to adopt blockchain needs to be prepared for business process changes, and financial and time costs, and there needs to be confidence that everyone in the supply chain is ready for the change and will adhere to established processes, [3], [24].

2.1.3 Artificial Intelligence and Big Data

Artificial Intelligence is programs and systems for performing various tasks that require human intellectual abilities. The development of such systems is mainly based on machine learning and neural networks. A program or system created based on artificial intelligence allows one to partially or

completely replace a human in such processes as, [3], [26], [27], [28]:

- Data analysis;
- Decision-making;
- Performing tasks that require human intelligence;
- Generating leads.

Big Data is all about processing and analyzing huge amounts of data that could not be processed efficiently manually. This technology allows you to collect, store, analyze, and visualize data to identify patterns and trends in decision-making, [26], [27].

Artificial intelligence and Big Data interact frequently and closely because artificial intelligence constantly needs to learn and improve, and it does so by analyzing big data. This consensus helps to automate processes, optimize resources, and improve accuracy, speed, and efficiency in various fields, including logistics. In supply chain management, the alliance of artificial intelligence and Big Data can improve the following processes, [3], [16], [26], [28]:

- Demand forecasting and the ability to plan inventories, preventing shortages or oversupply of goods;
- Optimization of routes, considering various (necessary) factors;
- Automation of warehouse operations (sorting, packing, shipping);
- Cargo monitoring;
- Strategic and tactical decision-making;
- Document processing;
- Market analysis (analysis of demand, offers, competitors).

3 FinTech Review

The term "FinTech" stands for "financial technologies" and represents approaches and methods for more convenient implementation of financial services. The FinTech startups dominate in the space of already established markets due to customer-friendly solutions developed from scratch and not burdened with traditional systems. The FinTech allows financial service consumers to carry out various operations with funds – from money transfers to direct payment for purchases on the Internet. The classical banks shall transform under the influence of new trends in FinTech developments. The development of digital financial technologies is conditioned by the achievement of such goals as, [29], [30]:

- enabling the competitive conditions in financial markets;

- providing more affordable and high-quality financial services, as well as increasing their list;
- reducing the risks and costs in the financial sector;
- provision of security and stability during the operation of FinTech tools.

The FinTech involves:

- software;
- mobile applications;
- business models, etc.

The use of FinTech can be divided into several categories covering different areas:

- personal finance;
- payments;
- lending;
- investment services;
- safety.

3.1 FinTech Application

FinTech covers a wide range of companies using the software to provide financial services. The financial technology companies are usually characterized as startups created to disrupt the existing financial models, and as larger financial corporations which are less integrated with technology. However, larger corporations are increasingly aware of the need for software solutions and are turning to financial technologies to expand and improve their financial service proposals, [10].

As mentioned above, FinTech is used in a wide variety of transactions for lending, payments, transfers, savings, investment, insurance, optimizing business models, and creating a more accessible service for the client both at large banks and at narrow-focused financial companies. The financial technologies in the digital economy are most often used in the following areas, (Fig. 7):

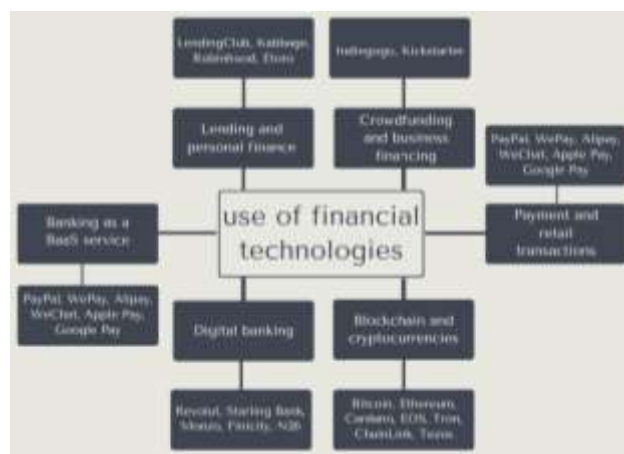


Fig. 7: Use of financial technologies

In the field of lending and personal finance, financial technologies are used in:

- P2P lending;
- robo-advising (robotic investment advice);
- financial planning programs and applications;
- social trading;
- algorithmic exchange trading;
- target savings services.

Regarding payment and retail transactions, it is worth mentioning:

- online payment services;
- online transfer services;
- P2P currency exchange (transfers between individuals);
- B2B payments and transfers (transfers between legal entities);
- cash desks and terminals in the "cloud";
- mass payment services.

The companies rely on various information when insuring consumers, considering what traditional banks have never considered, and providing more people with access to personal and business capital. All this could never have happened without powerful computer systems, software, and data processing specialists who can get this thing straightened out.

When it comes time to FinTech, the number of players and services is large, mainly concerning the more basic aspects of financial services, including banking, investing, borrowing, and saving. It also finds its application in mortgage applications, and even in the purchase of insurance, thereby providing consumers with many new opportunities.

3.1.1 Peer-to-Peer Lending (P2P)

The banks have long been the only option for borrowers, but for those with low creditworthiness or those who want to simplify the process, FinTech has presented another option. After the financial crisis, banks refused to provide loans, blocking many consumers' access to the lending market. FinTech companies armed with a different way of assessing risk have stepped in to meet the pent-up demand.

Peer-to-peer lending (P2P) allows individuals to obtain loans directly from others, excluding a financial institution as an intermediary. The platforms that promote P2P lending have significantly expanded its use as an alternative method of financing. P2P lending is also known as "social lending" or "crowd lending".

At first, the P2P lending system was seen as providing access to loans for people who would be

rejected by ordinary institutions, or as a way to consolidate student loan debt at a more favorable interest rate. However, in recent years, the P2P lending platforms have expanded their scope. Most of them are now aimed at consumers who want to pay off credit card debt at a lower interest rate. The housing improvement loans and car loans are now also available on P2P lending platforms.

Considering P2P lending, the following terms can be distinguished (Table 1):

Table 1. The terms of P2P lending

Terms	Description
P2P Platforms	The platform connects borrowers directly with investors. The platform also sets rates and conditions and approves transactions.
P2P-lenders	These are individual investors who want to get more profit from their cash savings than a bank savings account gives.
P2P-borrowers	These are people who are looking for an alternative to traditional banks or a better rate than banks offer.

The P2P lending operation takes place on the platform and begins with the investor. The investor opens an account on a website and deposits a monetary amount, which will be distributed on loans. The prospective borrower publishes a financial profile that has been assigned a risk category determining the interest rate that he/she will pay. Most platforms have a wide range of interest rates depending on the applicant's creditworthiness. The rates for applicants with a good credit history are often lower than the rates of comparable banks, whereas the rates for applicants with a sketchy credit history can be much higher. The prospective borrower can review the offers and accept one. Some candidates split their requests into blocks and accept several offers. Money transfers and monthly payments are processed through the platform. The process can be fully automated.

3.2 Digital Technologies in the FinTech

The advanced technologies also take place in the FinTech developments, the most promising are artificial intelligence (AI), Big Data, Robotic Process Automation, and Blockchain, [30].

FinTech began to develop rapidly, based on the trend, which opened new opportunities for users (Fig. 8).



Fig. 8: FinTech in 2021: Top predictions and trends, [32]

3.2.1 Artificial Intelligence

Artificial intelligence algorithms can be used to make forecasts of the situation on the stock market and to analyze the economic situation. AI is used to collect and generate information on the most frequent actions of clients and provides financial institutions with a better understanding of their clientele. Another tool created based on AI is chatbots used by banks for customer information support.

3.2.2 Big Data

In most cases, the financial sector uses Big Data for making forecasts on client investments and market changes and for forming updated strategies and portfolios. Big data is also used to prevent fraudsters, help banks segment marketing strategies, and optimize the company's activities.

3.2.3 Robotic Process Automation

This is an AI technology whose operation is focused on automating specific repetitive tasks, for example, entering data into information systems that do not require special skills. RPA helps in processing financial information, such as accounts payable and receivables, more productively than manual processing, and with fewer errors.

3.2.4 Blockchain

A distributed database consisting of blocks for recording and storing information. Each block contains a specific type of data about the operation performed by the user. Blockchain was developed directly for solving FinTech tasks. Blockchain systems can be much cheaper than existing platforms, as they eliminate a whole layer of overhead associated with authentication. The confirmation procedure is performed by all network participants simultaneously in a distributed registry system. This so-called consensus process reduces the need for intermediaries who are involved in the

operation and charges a participation fee. Such intermediaries in the financial services sector are those who transfer money, make decisions on contracts, and tax transactions, store information, etc.

4 FinTech Interaction with Supply Chain

As mentioned at the beginning, Supply chain management is the management of three flows: material, information, and financial. Having studied the development of these two areas, there is a proposal to consider the synergy of financial technologies and logistics, [29]. This synergy allows buyers, [32]:

- simplified procurement process;
- financing on favorable terms;
- reduced processing at the administrative cost;
- enhanced working capital using extended accounts payable.

FinTech solutions have a significant potential to provide some important opportunities, [33]:

1. For improving working capital, supply chain finance, and administration.
2. For facilitating equipment, real estate, and inventory to finance.
3. For providing facilities to international businesses.

The challenges that the logistic service providers face and the FinTech provides solutions for that are, [33]:

1. The problem of sending an invoice on time;
2. Reduces invoice processing time;
3. Reduces the dispute cases in the invoices;
4. Providing working capital for payment;
5. Providing working capital for growth purposes;
6. Customers' payment delay;
7. Shortage of cash for payment, etc.

There are already some FinTech startups that have influenced standard logistics business models, for example, [34]:

- JD Logistics;
- ShipChain;
- Streamline Worldwide;
- Provenance;
- Accord Network;
- Everledger;
- Digital Asset Exchange Chain;
- TShock;
- BWHEX;

- SumUp.

Creating a single trusted system for logistics, using FinTech and blockchain, will improve supply chain management and security. To create a system, it is necessary to initially analyze the business processes and needs of supply chain participants, [22]. Whether it is a completely newly developed system or an application of a system that will be implemented into an existing system, either way, the process of creating a system requires a comprehensive approach in several steps, (Fig. 9):



Fig. 9: Necessary steps to create a system

The system's creation contains the following steps:

1. Research and planning – it is important to define the aims and objectives of this system. Develop a strategy and implementation plan based on the needs of customers and supply chain participants.
2. Choosing Blockchain platform – it is necessary to choose a suitable Blockchain platform: public or private Blockchain, type of consensus, and data structure.
3. Development of smart contracts – according to the rules and conditions develop smart contracts which will automate operations in the systems.
4. FinTech integration – choose the necessary FinTech technologies such as online payments, electronic wallets, etc.
5. Design interface – it is important to develop a friendly and comfortable interface for customers.
6. Integrate IoT – for cargo tracking and monitoring it is necessary to integrate IoT and collect required data.
7. Ensure security – to minimize possible cyberattacks, it is worth taking care of security in this system, using encryption and authentication mechanisms.

8. Testing – to check the correctness of the system, it is necessary to test the system using various scenarios and simulations of real situations.
9. Implementation – to implement the system, monitor performance, and start using it. After that try to expand functionality.
10. Training and support – for the effective use of the system it is necessary to teach personnel and users to use the system correctly. The system needs to be supported.

5 Conclusion

With the advancement of technology, logistics, and FinTech have stepped forward significantly, but people must evolve in terms of technology as well. Unfortunately, the lack of educated people in the field of innovative technologies leads to a slowdown in the development and implementation of innovations. One of the tipping points that has caused people to come to their senses a little bit is Covid-19. It was during and after the pandemic that logistics businesses began to intensively explore the latest technologies that help improve system performance and efficiency, as well as reduce costs and resources during their application.

Of course, to implement systems based on new technologies, the security, interoperability, and resource cost issues of the process must be addressed.

At the moment, there are various startups, [34] both in the field of FinTech and logistics, but there is no such complex yet, that has further improved the efficiency, security, and transparency of the system, eliminating a large number of problems, including the human factor.

This article was created to continue work in the future on the development of a real system that will simplify and improve the operation of supply chains, using fintech, blockchain, and other innovations in the world of technology. This system will be reliable and transparent for all participants, and will also help get rid of unnecessary intermediaries, which will lead to savings in waste.

The article contains basic information on several areas - logistics, supply chains, fintech, and some of the latest technologies. An algorithm for creating a system where all this should be connected is also described. With the development of technology comes not only advantages but also problems. Before digital systems, there were problems with the cost of resources (time, effort, finances), which led to errors. Now the problems are mainly in vulnerabilities and failures of systems and

equipment. There is also a frequent snag in the compatibility of systems in each area, which is what prompted the development of one unified system to minimize problems.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare.

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