



UNIVERSIDADE D  
COIMBRA

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**CENTRAL BANK DIGITAL CURRENCY AND  
BLOCKCHAIN APPLICATIONS IN RUSSIA**

**Project work within the academic scope of the Master's Degree in Economics,  
specialization in Financial Economics guided by Professor Pedro Miguel Avelino  
Bação from the Faculty of Economics, and by Professor António Manuel  
Portugal Duarte from the Faculty of Economics and presented to the Faculty of  
Economics of the University of Coimbra.**

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## Resumo

A trabalho de projecto de mestrado dedica-se ao estudo do potencial de desenvolvimento do blockchain e da moeda digital na Federação Russa.

O objetivo do trabalho de projecto de mestrado consiste na identificação das principais oportunidades e obstáculos à potencial utilização das tecnologias blockchain e criptomoedas na Federação Russa.

Para cumprir o objetivo colocado vê-se necessário realizar as seguintes tarefas:

- apresentar a característica geral do blockchain e da moeda digital;
- descrever a regulação legislativa das tecnologias de blockchain e da moeda digital;
- analisar as características particulares de utilização das tecnologias de blockchain e moeda digital na Federação Russa;
- analisar o papel potencial das tecnologias de blockchain e moeda digital na Federação Russa.

O trabalho tem por objeto de estudo as tecnologias de blockchain. A matéria do estudo é a potencial utilização das tecnologias de blockchain e moeda digital.

A base teórica e metodológica para este estudo das tecnologias blockchain e criptomoedas na Federação Russa foi recolhida das fontes de literatura científica, instrumentos normativos legislativos, dados de agências internacionais, fontes digitais, entre outras. Os dados usados neste estudo são os dados secundários encontrados em artigos e estudos que, por sua vez, aproveitaram-se das vantagens de acesso a fontes online, tais como charts de blockchain, CoinMarketCap, Cointelegraph, Bitcoin.com, Cryptocoinsnews e DeCenter, bem como bases de dados do Banco Central da Federação Russa. O estudo também apresenta a análise descritiva de dados e análise dos dados de séries temporais.

Estruturalmente o trabalho é composto pela introdução, quatro capítulos dedicados aos temas descritos acima, a conclusão e a bibliografia. No primeiro capítulo apresenta-se a descrição geral do blockchain, sendo avaliadas as suas capacidades tecnológicas e as áreas de aplicação. No segundo capítulo analisa-se a atitude assumida pelo estado russo perante a tecnologia de blockchain, nomeadamente através de regulação legislativa, as restrições e os problemas. O terceiro capítulo é dedicado ao desenvolvimento de criptomoedas, à utilização do sistema de pagamentos e das aplicações descentralizadas

em território da Federação Russa. O quarto capítulo dá destaque especial às principais soluções e perspectivas de desenvolvimento das tecnologias de blockchain no setor financeiro da Federação Russa.

A trabalho de projecto apresenta os seguintes contributos para a literatura científica:

1. Foi proposta a sistematização das principais oportunidades e obstáculos para desenvolvimento das tecnologias blockchain e da moeda digital na economia digital da Federação Russa. Graças ao programa “Economia digital da Federação Russa” que tem por objetivo principal garantir a implementação acelerada das tecnologias digitais na economia e segurança social, as tecnologias de blockchain, tal como outras tecnologias transversais, são as tecnologias-chave que incluem todas as funcionalidades da tecnologia distribuída de livro-razão

2. Foi avaliada a importância e as perspectivas de desenvolvimento de legislação normativa para evolução da tecnologia de blockchain e moedas digitais face à importância de utilização destas tecnologias no futuro, tanto no mercado nacional como internacional.

3. Foi feita a avaliação das consequências de desenvolvimento destas tecnologias até 2024. Esta avaliação baseou-se na descrição do impacto dos índices de liderança tecnológica, desenvolvimento económico e progresso social cuja evolução será associada à utilização da tecnologia de blockchain.

O trabalho contém 8 tabelas e 1 figura. A trabalho de projecto de mestrado tem 58 páginas.

**Palavras-chave:** Blockchain; criptomoeda; contrato inteligente; Ethereum; Masterchain

## Abstract

The Master thesis is devoted to a research of the potential development of blockchain technologies and digital currencies in the Russian Federation.

The purpose of the Master thesis is identification of main opportunities and obstacles for the potential use of blockchain technologies and cryptocurrencies in the Russian Federation.

For achievement of a goal, I attempted to complete the following tasks:

- give a general description of blockchain technologies and digital currencies;
- describe the legislative regulation of blockchain technologies and digital currencies;
- analyze the specifics of using blockchain technologies and digital currencies in the Russian Federation;
- assess the potential role of blockchain technologies and digital currencies in the Russian Federation.

Research object in the work are blockchain technology. The subject of the study is the potential use of blockchain technologies and cryptocurrencies.

The theoretical and methodological basis for this study of blockchain technologies and cryptocurrencies in the Russian Federation was collected from scientific literature, normative legal acts, data from international agencies, electronic sources and others. The data used in this study is secondary data taken from articles and studies that, in turn, took advantage of the use of online resources such as Blockchain Charts, CoinMarketCap, Cointelegraph, Bitcoin.com, Cryptocoinsnews and DeCenter, as well as the Central Bank of Russia database. This study also presents descriptive data analysis and time series data analysis.

The structure of this work consists of an introduction, four chapters addressing the four topics listed above, a conclusion and a reference list. The first chapter gives a general description of the blockchain, discusses its technological capabilities and applications. The second chapter examines the attitude of the Russian state to blockchain technology, namely through legislative regulation, restrictions and problems. The third chapter is devoted to the development of cryptocurrencies, the use of a payment system and decentralized applications on the territory of the Russian Federation. In the fourth chapter, special

attention is paid to the main decisions and prospects for the development of blockchain technologies in the financial sector of the Russian Federation.

This work contains the following contributions to the literature:

1. It offers a systematization of the main opportunities and obstacles for the development of blockchain technologies and digital currencies in the digital economy of the Russian Federation. Thanks to the Digital Economy of the Russian Federation program, the main goal of which is to ensure the accelerated introduction of digital technologies in the economy and in the social sphere, blockchain technologies, along with other end-to-end technologies, are key today and include all the functions of a distributed registry.

2. It assesses the relevance and prospects of the development of regulatory legislation for the development of blockchain technology and digital currencies, due to the economic importance of the further use of these technologies domestically and internationally.

3. It provides an estimate of the effects from the development of these technologies by 2024. The basis for this is a description of the impact of technological leadership indicators, economic development and social progress, the achievement of which may be influenced by the use of the blockchain technology.

The work contains 8 tables and 1 figure. The volume of the master's thesis is 58 pages.

**Key words:** blockchain; cryptocurrency smart contract; Ethereum Masterchain

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## 1. Introduction

Blockchain technology is a powerful innovation, which has serious prospects of use across many areas of activity around the world. The largest corporations from all over the world are actively studying and developing these technologies. Thus, the relevance of the blockchain will only grow. The use of blockchain technologies may contribute to making work significantly more secure, simplify the coordination of decisions, optimize the costs of organizational processes and increase management efficiency. Blockchain technologies are also the foundation of cryptocurrency systems.

The introduction of Blockchain technologies can trigger a chain reaction of changes in business models and processes, supply chains and in the relation between companies and customers in all sectors of the global economy. However, the implementation of a distributed registry technology in various industries is hindered by certain barriers, the key ones being technological, economic and social, regulatory problems and patenting problems.

This Master's work is devoted to the study of the potential development of blockchain technologies and digital currencies in the Russian Federation. The main goal is to identify the main opportunities and obstacles to the potential use of blockchain technologies and cryptocurrencies in the Russian Federation.

To achieve this goal, I attempted to complete the following tasks:

1. Give a general description of blockchain technologies and digital currencies.
2. Describe the legislative regulation of blockchain technologies and digital currencies.
3. To analyze the specifics of the use of blockchain technologies and digital currencies in Russia.
4. To evaluate the potential role of blockchain technologies and digital currencies in the digital economy of Russia.

The structure of this work consists of an introduction, four chapters addressing the four topics listed above, a conclusion and a reference list. The first chapter gives a general description of the blockchain, discusses its technological capabilities and applications. The second chapter examines the attitude of the Russian state to blockchain technology, namely through legislative regulation, restrictions and problems. The third chapter is devoted to the development of cryptocurrencies, the use of a payment system and decentralized

applications on the territory of the Russian Federation. In the fourth chapter, special attention is paid to the main decisions and prospects for the development of blockchain technologies in the financial sector of the Russian Federation.

The theoretical and methodological basis for this study of blockchain technologies and cryptocurrencies in the Russian Federation was collected from scientific literature, normative legal acts, data from international agencies, electronic sources and others. The data used in this study is secondary data taken from articles and studies that, in turn, took advantage of the use of online resources such as Blockchain Charts, CoinMarketCap, Cointelegraph, Bitcoin.com, Cryptocoinsnews and DeCenter, as well as the Central Bank of Russia database. This study also presents descriptive data analysis and time series data analysis.

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3. It provides an estimate of the effects from the development of these technologies by 2024. The basis for this is a description of the impact of technological leadership indicators, economic development and social progress, the achievement of which may be influenced by the use of the blockchain technology.

## 2. What is the Blockchain? How does Blockchain work?

The innovative blockchain technology, which was introduced to the world in 2008, was initially used as a technology platform for the first digital currency, "Bitcoin". The document, which described the technology and how it was applied, was posted in the public domain by a person under the pseudonym Satoshi Nakamoto.

The Federal Institute of Industrial Property (FIPS) in 2018 gave the following definition of blockchain (FIPS, 2018). Blockchain is a data storage logic that does not depend on a centralized server or group of servers. The technology generates and stores a list of ordered records called blocks. Each block contains a timestamp and, most importantly, a unique image (hash) of the previous block, so the technology links data blocks, eliminating the possibility of changing the data in the generated blocks without changing the entire sequence.

For better understanding the mechanism of the blockchain from the inside, let's define the hash, hash function, and hashing. A hash is a cryptographic representation of a set of information that can be compared to a fingerprint. It identifies the block and all its contents and is always unique. When a block is created, its hash is calculated immediately. Changes within a block will cause its hash to change, in other words, the hash is very useful if you want to detect changes inside the block. If the block hash has changed, it is a completely different block. The input to a hash function is an input of data of any length. It can be a word consisting of three letters or numbers, or a very long book. Next, the hash function is executed, that is, information is converted to a cryptographic code with no more than 264 bits or 64 characters. In fact, regardless of the initial size (it can be a file of any format with a size of 1 byte or 100 terabytes or higher), the output will be a fixed-length string. As a result, the output hash function is a cryptographically encrypted string of letters and numbers. Hashing is the result of a conversion performed by a hash function.

For a clearer understanding of this technology, let's consider its application in the context of cryptocurrency. Cryptocurrency is virtual money that is created on a platform based on blockchain technology. This type of virtual money is only available in digital form as entries in a distributed registry. The registry itself is subject to complex cryptographic rules. Fast speed of use and cheap costs of transferring funds between users are the main features of the cryptocurrency network.

The monthly Rising Blockchain Magazine investigated the degree of interest in this technology in other areas (Tsyglin, 2018). As it turned out, in 2018, this technology found application in 24 more industries. During the decade following its appearance, the capabilities of blockchain technology have become much broader and have gone far beyond operations with bitcoins and altcoins. Its huge potential has opened new prospects for the future development of digital technologies. But, of course, there were acute conflicts, and even “mass insanity” and multimillion-dollar scams around this technology.

For a better understanding of all this insanity and fraudulent actions, we consider a few relevant examples.

A very typical case occurred with a beverage producer "Long Island Iced Tea" in the first quarter of 2018. Due to the fact that the company decided to rebrand its company from "Long Island Iced Tea" to "Long Blockchain", its capitalization on the NASDAQ (stock exchange) increased more than four times in just one day. After the stock exchange conducted an investigation and established that the company did not actually plan to develop a blockchain, its stocks were withdrawn from trading and collapsed 10 times. The same thing soon happened with "Longfin", which announced the purchase of a blockchain startup and added the word blockchain to its name. The company's stocks increased 1342% in a few days, but the result was similar. The company was removed from the trading, this situation caused a collapse of quotations and the arrest of assets

In 2016, "Bitfinex" was the world's largest bitcoin stock exchange. On August 4, unknown people stole about 119,756 bitcoins from customer accounts, despite several levels of protection. Later it became known that the vulnerability of multiple signatures allowed the transfer of funds. There is a simple example how it works. "Bitfinex" has 2 keys, and another blockchain company, "BitGo", has a third key, and together these keys allow you to transfer bitcoins (or another cryptocurrency). Then there were speculations that the attacker probably stole the "BitGo" key and used it to sign transactions, but "BitGo" announced on social networks that none of its servers were hacked. "Bitfinex" spoke about what happened and assured dissatisfied customers that it would try to compensate for their losses. As a result, they bought back part of the tokens issued during the ICO in order to pay funds to the affected customers, but the lost money could not be tracked. "Bitfinex" continues to exchange cryptocurrencies (BTC, LTC, ETH) and traditional fiat currencies.

Another good example is the hacking of "Mt.Gox", which became the biggest bitcoin theft in history, and, unlike other cases, it was the work of highly professional

hackers using complex vulnerabilities - for several years they practiced small thefts and fraudulent schemes. The most famous of these episodes occurred in June 2011. A hacker (or a group of hackers) allegedly gained access to a computer owned by one of the auditors and used a security vulnerability to access the "Mt.Gox" servers, after which they changed the nominal value of bitcoin by 1 cent per coin. Then they withdrew about 2 thousand bitcoins. Some customers who did not know what happened conducted transactions at this low price, for a total of 650 BTC, and despite the fact that the hack hit the headlines of newspapers around the world, not a single bitcoin could be returned (Dobkina, 2018).

FIPS provides the following data related to monetary investments and the growth of blockchain technologies (FIPS, 2018a). Global investments related to blockchain technologies are estimated by analytical agencies to reach \$9.7 billion USD in 2021. The market size is calculated based on the projected revenue from implementing blockchain solutions and providing services based on it. At the same time, the average annual growth rate (compound annual growth rate) in the period up to 2022 will be from about 80%, but in a number of regions the growth rate in the blockchain industry will be much higher: Japan – 127.3%; Latin America – 152.5%.

Considering the fairly rapid development of blockchain technology, I would like to highlight the main stages of its formation:

- 1) The birth of this technology occurred in 2008, in the midst of the financial crisis.
- 2) The main stage of development occurred in 2011-2013. This period of time is marked by the emergence of new cryptocurrencies such as Litecoin and Namecoin and the appearance of the first decentralized applications.
- 3) In 2014, the first blockchain platform for smart contracts – Ethereum – was introduced, thanks to which contracts became a link between distributed registries, cryptocurrencies, various information systems and applications. The stage of promoting new platforms, various applications and active cryptocurrency trading had begun. In 2016, Japan became the first country to introduce a bill on the status of cryptocurrencies as payment means.
- 4) From 2017 to the present, we have been in a stage characterized by the recognition and regulation of this technology by Central banks. The year 2007 was awarded the title "Cryptocurrency gold rush". In 2017, the first bitcoin billionaires appeared, and new startups could collect millions of

dollars in a few days, and sometimes even in minutes, thanks to cryptocurrency crowdfunding. In December 2017, the maximum value of bitcoin was \$20,000, and for Ethereum it was \$1400.

Crowdfunding is a tool for raising money through collective financing. Using special internet platforms, anyone with a specific project idea or an existing business can try to attract the necessary funds for its development. Money can be received in exchange for a share in a business or securities, it can be borrowed for a certain period of time, or it can be crowdfunding with non-financial remuneration or charitable crowdfunding. You get money from other people or companies who were interested in your idea. Crowdfunding has benefitted from the blockchain platform that created the foundation for the Initial Coin Offerings (ICO) that have been used as vehicles for the crowdfunding. The total amount of investments requested for ICO in 2019 is more than \$4 billion USD.

According to the Central Bank of the Russian Federation, the volume of investment by the banking sector in blockchain technology in 2012-2016 amounted to \$1.4 billion USD. In 2017, another \$1 billion USD was invested in the development of the blockchain. Banks' savings from implementing blockchain in their work processes amounted to \$20 billion USD (Genkin and Mikheev, 2018).

In the report on cryptocurrency for 2018, written by Ria Mrinalini Bhutoria (Bhutoria, 2019), you can identify a number of factors that justify classifying the interest in blockchain today as global phenomenon:

- Over the past years, 2,500 patents have been filed in blockchain technology.
- In 2018 alone, the volume of investments in blockchain companies reached \$5.3 billion USD (3 times more than in 2017).
- More than 90 corporations have joined blockchain consortia.
- 70% of the world's Central banks are studying the issue of issuing national cryptocurrencies.
- About 24 countries are investing in blockchain projects today.

In the data reported in Table 1 we can see the fast growth of investment in blockchain companies in the period from 2014 to 2018.

Table 1. Global investment in «Blockchain» companies

Year	2014	2015	2016	2017	2018
Investments (millions of USD)	700	800	880	1,450	5,290

Source: compiled by the author based on: Tech Think Tank // Mind Smith. – 2019. – P. 17

In 2018, FIPS identified a number of the most capacious sectors in terms of investment in the blockchain economy in 2018 (FIPS, 2018b). In the first place is the financial sector – \$745 million USD, the second place is taken by transport and logistics – \$510 million USD, and the third place is held by the production and resources sector – \$448 million USD. In the near future, a significant increase in investments in blockchain technologies related to the fields of energy, healthcare, public administration, education, management, Internet Commerce and tourism is expected.

Currently, the second most popular and functional group of blockchain applications is that of smart contracts. A smart contract is a digital agreement between two parties that can make commitments through blockchain technology. The two parties do not need to know each other, and do not need the participation of an intermediary, which in turn reduces operating costs. This type of contract uses trusted protocols. Users of this technology need not worry about the correct performance of obligations, because if the conditions are not met at all points, the contract is simply canceled.

The first blockchain of this type – Ethereum – was launched in 2015 and two years later, smart contracts created a real stir. Now there are dozens of developments on the market and ready-to-work blockchain platforms that function using decentralized applications.

Education is one example of the use of this technology. In this case, it allows you to exclude the possibility of forging diplomas, cheating about reputation and leaving fraudulent reviews. Education can become much better and cheaper using smart contracts. As a concrete example of the market for the application of this technology, we can cite the educational Internet platform Tutellus, successfully launched in 2013, as an example. This type of contract between the student and teacher is based on the fact that there is an online platform that pays you for learning, and the teachers' salaries directly depend on the success of the students. A high level of knowledge, a manifestation of a high level of activity and interest during training: all these indicators are mandatory factors for earning STUS tokens (internal platform token). In turn, this serves as a strong motivation for

teachers since the level of their earnings depends on the level of activity and earnings of the student. Participants in the Tutellus ecosystem will be not only students and teachers (teachers will also be paid for in tokens), but also employers. The more actively a student earns tokens, the more noticeable the student becomes for a potential employer.

The founders of the Tutellus platform note that the project is aimed at solving several problems of modern education:

- The high cost of training.
- Low motivation of students to acquire knowledge.
- Low pay for teachers and
- unemployment caused by the weak connection of the traditional education system with the labor market.

To help understand the advantages of smart contracts as opposed to traditional contracts, we constructed Table 2 with a description of the main characteristics of traditional and smart contracts.

Table 2. Advantages of smart contracts

Comparison area	Traditional contracts	Smart contracts
Completion of the transaction	1-3 days	Minutes
Money transfer	By hand	Automatic
Escrow agent	Necessary	Maybe you don't need it
Cost	Expensive	Orders of magnitude cheaper
Presence	Physical	Virtual
Signature	By hand	Electronic
Lawyer	Necessary	Maybe you don't need it

Source: compiled by the author based on: Genkin and Mikheev (2018, p. 109).

When speaking about the blockchain technology, there is one main issue that cannot be ignored. Why exactly has blockchain attracted so many entrepreneurs, developers, scientists and enthusiasts around the world? What inspired users of this technology to separate it from cryptocurrencies and develop numerous projects in the public and corporate sector?

Key features of the blockchain that distinguish it from all previously created analogues:



- Decentralization of information storage and processing processes.
- Provable immutability of data.
- Transparency of operations.
- Irrevocability of transactions.
- Ability to anonymize participants.
- No need for trust.
- Maintaining the work by the participants themselves.

The main feature and main difference between the blockchain and traditional payment systems is that it does not have a single governing body that can send or delay transactions at will, generate or destroy tokens, as well as implement other measures to regulate the network. A token is a unit of accounting that is not a cryptocurrency intended to provide a digital balance in some asset; in other words, it serves as a "substitute for securities" in the digital world. Tokens represent the entry in the register, distributed in the blockchain. Thanks to this, no one can block transactions in the blockchain, freeze funds in the wallet or confiscate them.

One of the main issues on the topic of blockchain is the mechanism of its operation from the beginning to the end. Lee and Law (2018) described the process performed in the system, which can be divided into three main groups:

1. Creation of the wallet.
2. The execution of a transaction.
3. The issue of cryptocurrencies.

1. Creation of the wallet. In order to create your own wallet, you must follow a sequence of actions. The essence of this wallet consists of generating a private key and calculating a public key based on it. If the purpose of the wallet is to transfer cryptocurrency, the user must provide the public key to the sender. Since users in the system are anonymous, in this case the public key serves as the card or account number. The private key is known only to the site owner and represents a password, without which it is impossible to make a transfer.

For better understanding how these keys work, let's look at them in more detail. In order for the users of the blockchain platform to control the access to the cryptocurrency in their wallet and safely perform any operations with assets, they have a set of keys. These keys are divided into public and private keys.

Only the wallet owner has the right to know the private key. This key has a certain combination of characters that give access to the cryptocurrencies stored in the account. Only the owner of the private key has the right to move and spend coins. The main functions of this key are cryptocurrency storage and digital signature of transactions. And without a private key, it is impossible to create a public key.

The public key is available to each user of the system. It consists of a unique set of characters that include various letters and numbers in a chaotic order. This key serves as the address of users to which other users of this system can send cryptocurrency. It is also an encryption object when the browser accesses the server.

2. The execution of a transaction. The transaction processing mechanism can be described in several steps:

1. New transactions are sent to all servers in the decentralized network.
2. Each server combines incoming transactions into a fixed-size block. It is not guaranteed that all servers in the network will receive transactions, but if most of the servers accept transactions, they will be included in one of the blocks.
3. Each server tries to calculate the hash of the received block that would satisfy the current network complexity.
4. After finding the necessary hash, the block is sent to all servers in the network. If the server skips blocks for some reason and gets the next ones, the missed ones will be requested from the network automatically.
5. Servers agree to write a block to the chain only if all transactions in it are executed correctly. After receiving consent, the block is saved to the blockchain.

3. The issue of cryptocurrencies. The next and final stage is to work on a new block in our blockchain. At this stage, the hash of the previous block is used as input data. For example, if several blocks were created and received at the same time, the chain will branch. But only a competing branch can be continued, and the second part of it is canceled. As a result, the longest chain becomes the true chain.

The process of issuing the coins (tokens) in a classic block chain can be compared to mining, which has received the name of mining. Cryptocurrency mining is a process of performing complex mathematical calculations to find the only correct hash of a new block. For completing this task, miners receive a reward in the form of a certain number of coins.

The cryptocurrency issue also has its own algorithm of operation, which can be divided into the following three steps:

1. The unit is constructed after waiting for confirmation of the transaction. This block must meet strict cryptographic rules. The chronological sequence of blocks is provided by using the hashes of previous blocks when calculating each current block.
2. The block is sent to all network members for review.
3. After the unit was included in the blockchain, the miners take their reward.

For a visual description of the process, see Figure 1.

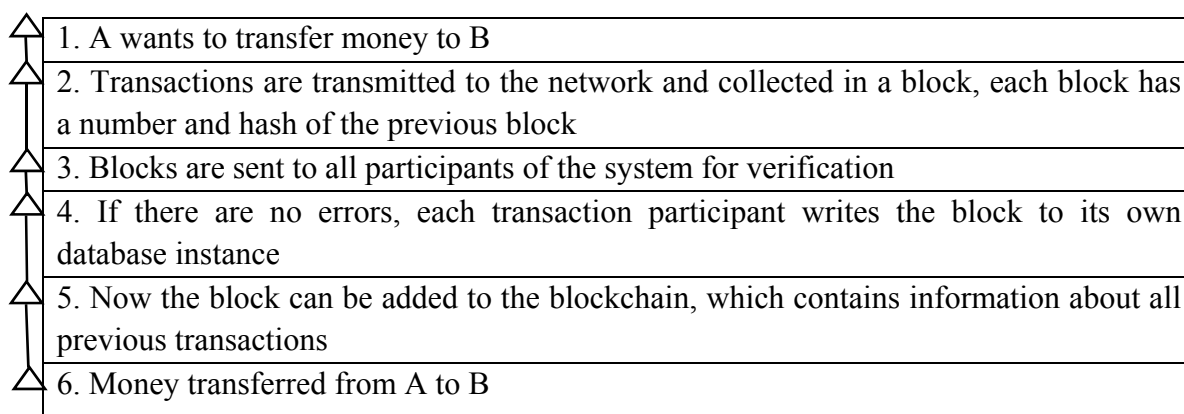


Figure 1 – How the blockchain works in the case of cryptocurrency

According to Tabernakulov and Koifmann (2019), there are three main levels in the development of blockchain applications, namely: blockchain app versions 1.0, 2.0 and 3.0.

- "Blockchain 1.0" includes the creation and development of cryptocurrencies, a blockchain whose main task is to protect against attacks from third parties, using cryptography. Version 1.0 covers cryptocurrencies that have every chance to become an alternative replacement for real currencies.
- "Blockchain 2.0" is a model of "smart contracts" that work with various types of financial instruments. Such a contract is a digital protocol and can automatically execute pre-defined transaction processes, without the need for third parties to participate.

- "Blockchain 3.0" is an app that goes beyond the sphere of finance, monetary settlements and markets, it has a direct place in public administration, culture and art, as well as extends to health, science and education. If we consider the platform in practice, an example is the register of land or real estate. Considering the "Blockchain 3.0" platform more broadly, we can conclude that an intermediary can be excluded from any business process. In order to understand the main differences in the transition from the "Blockchain 2.0" platform to the "Blockchain 3.0" platform, consider Table 3.

Table 3 – Main differences when switching to the "Blockchain 3.0" platform

Characteristic	Blockchain 2.0	Blockchain 3.0
Main scope of application	Cryptocurrencies, ICO	Apps outside of cryptocurrencies
Investors and horizons	Speculative money and enthusiasts. Quick refund waiting times: weeks-months	Technology companies money, long-term investments for years
Transaction cost	High	Low
Access	Public	Combined
The time of the transaction	High, depending on the load of the shared network	Low and regulation – depends upon the availability of resources

Source: compiled by the author based on: Tabernakulov and Koifmann (2019, p. 51-55).

Blockchains can be divided into the following types: open, closed, and combined. Their comparative characteristics are presented in table 4.

- Open blockchain – a type of blockchain where there is no restriction on reading blocks, and there is also no supervisory authority (a liberal type of system management).
- Closed blockchain – a type of blockchain where there is direct access to the data that forms the organization's ecosystem, and where there is a controlling authority. The essence of the blockchain as a distributed registry is missing, which creates a vulnerability of the network from hacker attacks and "distortion" of transaction blocks (information), and breaks the main principle of the blockchain – trust in the system.

- Combined blockchain – a type of blockchain in which identification occurs in the network, as well as allowing customers to access the part of network related to certain disclosure groups, for example, viewing their own and/or other people's transactions and/or only headers, while there is a supervisory authority that can access the full information. The advantages of this type of blockchain are more reliable protection from hacker attacks, and the presence of a supervisory authority, which is very important for the state, as it prevents the receipt of income by criminal means and the financing of terrorism.

Table 4 – Comparative characteristics of blockchain types

	Type of blockchain		
	Open	Closed	Combined
Description	Identification is missing	Identification of network members	Identification of network members
	There is no restriction on user participation	Access to the network for a narrow circle of people (access to data is completely restricted and not transparent to customers)	Access to the network, stipulated by certain rules (for example, the network client can only view their transactions)
	There is no controlling authority	There is a controlling authority	There is a controlling authority

Source: compiled by the author based on Babkin et al. (2017, p. 9-22).

So, what do you need to create your own blockchain? Let's define the main tasks and architecture.

Before developing your own blockchain, an ordinary user or team of users should clearly understand what the blockchain is for and what budget you can allocate for its capital. For this technology to work successfully, you first need to define the range of technical tasks. To choose the right blockchain, technical specialists first need to determine the types of transactions and how each of them will work. For classification, it is convenient to use traditional server resources: CPU processor, RAM memory, network traffic, and storage. In addition to transactions, blockchain scenarios are of great

importance: how many transactions from how many accounts should the network process per unit of time (Prilutsky, 2020).

When developing its own blockchain, the user needs to choose a virtual machine to execute the code. That will be the main basis of the project. Currently, the user has three options to choose from:

1. The first option is a specialized virtual machine (VM). This type of machine has its limitations and is used only with smart contracts. Examples of this platform are EVM (Ethereum) and TVM (TON). The result of their work is the most predictable, safe and most accurately calculates the resources needed to process transactions.

2. The second option is a standard virtual machine. Web Assembly in EOS and Parity Substrate (Polkadot) are examples of this type of machine. If you compare WebAssembly (WASM) and JavaScript, the first is the most productive. Both serve as web standards that are used to create code that runs on the client side. In theory, any language is suitable for smart contracts under WASM, but low-level languages are the best examples for creating a blockchain, since the main task is to optimize as much as possible. C, C++ and Rust are the best languages for achieving optimization.

3. The third option is a native code that serves to process transactions. Native code is a command system (language) of a particular computer (machine language). Hyperledger Fabric and Cosmos are examples of native code. This type of code is used when the code that processes the transaction is actually embedded in the node. A node is any computer connected to the blockchain network. The main advantage is high functionality, and the main disadvantage is the low level of security and the determinism of transaction processing.

The occurrence of errors and their correction, changing the functionality of the system and the need to add something new, are all issues that occur during the operation of this system. So an important step when choosing a blockchain is the way to update the contract code. These problems can be solved in the following ways:

1. Application of custom smart contracts. Smart contracts in Ethereum, EOS, TON, Parity Substrate (with the WASM or EVM module of user smart contracts) are examples of such contracts. This scheme helps the developer to create one smart contract or several that are connected into a complex system. The purpose of the scheme is that the renewal and placement of the contract can be performed without interaction with network validators.

2. The second option is to use the runtime code, which is controlled by validators. Examples of runtime platforms are Parity Substrate and Application in Cosmos. This scheme is one big smart contract that processes all types of transactions. When validating the code, validators vote to apply the changes. If everything is in order with the code, then the new logic begins to work. Developers have the opportunity to create runtime code from a set of ready-made modules.

The next important step is planning launch and network support. This is the stage when the user has chosen the blockchain and is now about to launch it. We outline the main steps when starting the blockchain:

1. The first step includes the choice of implementation and assessment of labor costs. The developer has a number of tasks, which include an assessment of risks and labor costs for the implementation of the project. The developer should not forget about the limitations of specific solutions. It may already be tested in real conditions or may be under development.

2. The second step is necessary for a test run and large-scale testing of the network. Network testing is a test of blockchain operability with the number of validators close to reality. If the blockchain implies 100 validators, you need to make sure that the network is operational under load.

3. The third step is to launch a test network (testnet). Developers use testnet to try out solutions that will work on the main network. All the functionalities of the main network should be present in the test, and client applications should support both networks. Due to the accuracy of smart contracts, testing of work products can be carried out with 99% accuracy, with real balances of real users.

4. The fourth step includes defining the procedure for adding validators of the main network (mainnet). The main problem is that usually independent companies act as network validators, so it is almost impossible to bring them together and make them perform synchronously. All procedures should provide for an arbitrary scenario for validators, taking into account their geographical distribution and the degree of unpreparedness.

5. The launch of the main network is the fifth step and almost final. The start of mainnet should be accompanied by active monitoring. It is desirable that summary information from all validators be presented in one service, so that the project team will be able to more actively respond to problems on the network.

6. The final step is based on the support and updating of the code, since even after the launch of the main network the team's work is not interrupted. The base code is also evolving, and it accumulates important bug fixes and optimizations. These changes must be transferred to the project and the blockchain node code updated in a timely manner.

Although the development and launch of the blockchain is quite expensive, the actual operation can pleasantly surprise participants with security, self-regulation, and the ability of the network to maintain operability and accuracy of transaction execution in difficult conditions.

Today, blockchain technologies can be evaluated as a unique phenomenon in history, which does not have traditional economic restrictions. This is the reason why there is currently no comprehensive description of the areas and ways of using blockchain technologies, as well as the imposed restrictions and problems that need to be considered and overcome for the successful implementation of blockchain. Due to the lack of a legal framework, there are many doubts, because to have confidence in new technologies that became available on the market relatively recently, you need to meet certain standards, at least state ones. Blockchain can be considered the foundation for currency, goods, security, or even a store of value, so it is important to give a precise definition that will determine its classification and highlight its legal aspect.



### 3. Blockchain in the Russian Federation

#### 3.1 Government attitude and definition

Over the past few years, the potential use of blockchain technology and cryptocurrencies in the Russian Federation has been of a special nature. At the moment, special attention is being paid to compliance and measures to combat corruption and money laundering. The Central Bank of the Russian Federation and the Ministry of Finance of the Russian Federation are the main institutions that deal with these issues.

In February 2016, the Central Bank of Russia (the Bank of Russia) set up a working group for analyzing and evaluating the prospects for using new financial technologies, including blockchain technologies. In July 2016, at the International Financial Congress, the Central Bank announced the creation of a blockchain consortium "FinTech" together with ten major banks in the country, including the NSPK (National Payment Card System), Sberbank, Gazprombank, VTB, Otkritie, Alfa-Bank, QIWI, to conduct a comprehensive study of blockchain technologies and their capabilities.

In its presentation for 2020, the Bank of Russia highlighted the main key areas of financial technology development:

- Legal regulation of financial technologies, including consumer protection and personal data security.
- Development of digital technologies in the financial market and development of digital infrastructure.
- Transition to electronic interaction between the Bank of Russia, the Government, market participants and their clients.
- "Regulatory sandbox" for experimenting with innovative financial technologies, products and services. In this case, the regulator is the Bank of Russia, which together with the participants in the experiment is studying how the new technology works and whether it is necessary to change the regulation in the future. The regulatory sandbox serves as a tool for creating working conditions where banks and companies can test new innovative technologies and services in a limited environment without risking violating financial laws.

- Cooperation within the framework of the Eurasian Economic Union and the development of a single payment space for member states.
- Ensuring technological security and sustainability in the implementation of financial technologies.
- Development of human resources in the financial market. The main reason for the appearance of this program is the critical situation that has recently developed in the human resources market due to the lack of specialists who can implement the functionality of financial market companies (Bank of Russia, 2020).

Russia has created favorable conditions for the development of financial technologies. The introduction of new technological solutions for the development of the Russian financial market and the promotion of digitalization of the Russian economy are the main goals in this area.

The first edition of the Blockchain and Cryptocurrency Regulation for 2019 says that the Russian Civil Code has recently been amended to introduce the concept of "digital rights", although there are still no laws directly regulating cryptocurrencies (Dewey, 2019).

The Civil Code of the Russian Federation provides the following definition of digital rights: "Digital rights are recognized as such in the law of obligations and other rights, the content and conditions of which are determined in accordance with the rules of the information system that meets the criteria established by law" (The Civil Code of the Russian Federation, 2019).

Russian lawmakers have been working on a set of laws regulating a special category of digital rights – so-called "digital financial assets" - to try to regulate tokens and coin offerings and transactions with these assets.

Federal Law No. 419059-7 defines a "digital financial asset" in the Russian Federation as follows: a digital financial asset is property in electronic form created using cryptographic means. Ownership of this property is verified by entering digital records in the register of digital transactions. Digital assets include digital currency and token. Digital financial assets are not legal means of payment in the Russian Federation (Committee of the State Duma on the financial market, 2018).

As with cryptocurrencies, there is currently no law specifically related to blockchain technology. However, the authorities do not perceive blockchain negatively. On the contrary, the use of blockchain technologies for the formation and implementation of "smart contracts" is of great interest for Russia. The Civil Code has recently been

amended to apply smart contracts. However, in many respects, Russia remains a traditional market where physical documents are required.

The intersection of the interests of the state, municipal administration, and big business is the basis for the formation of a digital society and digital economy in Russia. The growing interest of the population in information services also plays an important role. Today, virtual money (cryptocurrencies), the issue of which is based on blockchain technologies, is the main problem in the development of the digital economy and digital society in Russia.

The role of blockchain technologies in the digital economy is to perform all functions related to storing, changing and accessing data (those functions that in centralized systems were traditionally performed by an intermediary server), as well as the functions of interaction between users (Voronov and Chasovskikh, 2017).

State regulation of cryptocurrencies is absent in Russia, as well as in most countries of the world. In this regard, it can be predicted that the expansion of their application areas will lead to unforeseen threats and risks, but their overcoming will contribute to the development of the digital economy (Manakhova, 2015).

The former Russian Finance Minister Alexey Kudrin considers blockchain technologies revolutionary, but with the caveat that the state (government) does not match the level of such technologies. One of the reasons for this discrepancy is the legal framework that prevents the introduction of blockchain technologies. For example, a number of financial documents, in particular contracts, must be kept on paper for 75 years (Petrov, 2015).

Blockchain technologies allow expanding the capabilities of existing software systems that support the functioning of the Russian Federation's electronic Government system. According to the Russian Ministry of Communications and Communications System project e-Government 2020, adopted in 2016, the use of blockchain technologies in software complexes that support the activities of government agencies is identified as one of the main trends in the development of modern information systems in public administration. At the same time, this project no longer contains specific explanations or recommendations for the use of these technologies, which directly negatively affects the information technology development of Russian government agencies and inevitably limits the positive potential of using blockchain technologies for Russian citizens (Davidson, Filippi and Potts, 2016).

The trend of implementing blockchain in information systems that support the activities of government agencies should be supported at the strategic level within the direct activities of the Ministry of Communications of the Russian Federation. At the same time, there is already a positive experience of implementing a distributed data storage system in the Russian Federation. A pilot project organized by the Ministry of Economic Development of the Russian Federation on the use of blockchain technologies to monitor the reliability of information from the Unified State Register of real estate managed to conduct the first registration of rights to share in the construction of housing in the Leningrad region (Sukharevskaya and Kantyshev, 2018). There are plans to transfer all records of real estate transactions in Moscow to the blockchain system. The positive potential from the introduction of blockchain technologies can be assessed right now:

- Carrying out of registration actions did not require the participation of third parties.
- Registration was performed using smart contracts that do not allow external users to modify data without confirmation from all participants, which reduces the risk of unfair correction or data theft.
- Processing time for registration information has been reduced from 15 days to one hour.
- The average transaction costs for Rosreestr decreased. Rosreestr in Russia is a Federal Service that performs the functions of state registration, cadastre and cartography.

For Russia, the full potential of using blockchain technologies in public administration is just opening up. To achieve successful results, specific agencies – potential users of blockchain technologies – should be more open to implementing pilot projects (Rostec, 2017). Thanks to the introduction of blockchain technologies in information systems, public authorities can significantly increase the speed of processing current transactions, which will have a positive impact on the attitude of Russian citizens to public services and to public authorities in general. It should be noted that the positive experience of implementing and testing blockchain technologies will allow Russian government agencies to obtain an information product that would be in demand in the global information market, thus Russian companies serving these systems can earn a significant profit on the transfer of this technology to the world community, which will have a positive impact on tax revenues. To accelerate the implementation of these

technologies, it is necessary to fix the introduction and use of blockchain as the main data storage technologies in the strategic documents for the development of information systems in the Russian Federation.

The successful application of blockchain technologies in public administration will allow the Russian Federation to strengthen the competitive advantages of the entire public administration system, which will undoubtedly affect the effectiveness of the internal policy, the attitude of citizens to the government and allow Russian companies associated with the IT sector to get access to government orders in the field of creating, developing and implementing the latest blockchain technologies.

Experts identify several key obstacles that hinder the introduction of blockchain technology in Russia:

- There is no legal framework and well-established mechanisms for interaction between participants in the process.
- There is no legal regulation of approaches to data protection used in blockchains.
- Problems with scalability in large high-load systems. When creating the blockchain, developers limited the block size to one megabyte, which means that blocks larger than one megabyte will be automatically rejected by the network as invalid. This is a security measure that should prevent DDoS attacks from hackers creating large and even unlimited block sizes to paralyze the network. However, this solution has an adverse long-term effect on the network's overall throughput. The current limit of one megabyte block size correctly processes three to seven bitcoin transactions per second. The problem is that this is no longer enough for the network, and the number of users continues to grow, which makes the situation worse.
- There is no single arbitrator that everyone trusts, while in state systems the state itself acts as the arbitrator (Rostec, 2018a). Blockchain technologies work on the basis of users themselves, miners who create new blocks and earn money from it, and application developers themselves. The technology is developed on the principle of anonymity, which makes the system not the most reliable for the population in terms of law and consumer protection. Therefore, society needs a single arbiter who can

control and regulate this technology, thereby giving certain answers to the simplest questions.

The business community is taking the initiative to create coordination centers, consortia and working groups in Russia, which will be designed to stimulate the development and remove obstacles to the adoption of blockchain technologies. For example, in August 2017, the Federal Agency for Technical Regulation and Metrology (Rosstandart) announced the formation of a new technical committee for standardization "Software and hardware for distributed registry and blockchain technologies".

The company "National information systems" ("NAINS") took the initiative to create this type of Committee (Rostec, 2018b).

According to experts, it is the digital economy and, in particular, the development of blockchain technologies that may contribute to giving Russia an undeniable advantage in comparison with other countries, and Russia has all the chances to become a world leader in the implementation of blockchain technologies. Among the competitive advantages that will allow Russia to make a leap in this direction is the availability of personnel (the presence of a relatively large body of successful mathematicians and talented programmers in the country). Today, Russia is one of the centers of the crypto community and an active space for implementing projects and accumulating expert knowledge about the crypto world. Many successful crypto projects in the world involve Russian-speaking specialists (Perekopsky and Seydak, 2017).

An interesting fact is that among the five largest ICO in 2018, there are two Russian projects. "Telegram" took second place. On the basis of the messenger, the Telegram Open Network blockchain ecosystem is being built, payments within which will be made based on TON tokens. The creators raised \$ 1.7 billion at the stage of closed pre-sale for institutional investors, which led to the decision to refuse to conduct a public offering of tokens. "Vostok" is in fifth place. This is a project that is aimed at implementing projects by large businesses and state institutions. Sberbank and Rostec (State Corporation for Assistance to Development, Production and Export of Advanced Technology Industrial Product Rostec) subsidiaries are already listed among the project partners. "Vostok" raised \$ 120 million from private investors to create a large-scale corporate blockchain platform.

In 2017, the role and significance of Russia and Russian projects in the global ICO market changed radically. In 2017, Russia ranks second in the ranking of countries in

terms of ICO fees, although the lag behind the US is significant. The reader can find additional information in EY (2017), namely in Figure 2. Nevertheless, Moscow is the leader of the ranking of cities by the number of ICO projects, and St. Petersburg is also in the top (6th place).

In the world today, it is difficult to find a successful crypto project (outside of China) which does not have Russian-speaking specialists (including Ukrainians and Belarusians). Just look at the names of employees of such projects as Bancor, BitShares, and IOTA to make quite definite conclusions about their country of origin.

### 3.2 Cryptocurrency regulation in Russian Federation

In the modern world, virtual money or digital currencies have a legal regulation problem that has not been studied for quite some time. The number of cryptocurrencies in the world increases significantly every year. If in March 2018 there were 1,649 names of cryptocurrencies, today there are 2,843 different cryptocurrencies in the world, which naturally attracts the special attention of both economists and lawyers (Investing.com, 2020). Having studied the data of the Federal Tax Service, it is possible to identify more than 100 legal entities in the territory of the Russian Federation with a name that includes "blockchain" (Federal Tax Service of Russia, 2020). However, the resolution of legal issues regarding the consideration of digital currencies as a means of payment, exchange, or as an object of property rights suggests that there is no single concept or opinion regarding the legal base of digital currencies or tokens. Also, there is no statute that speaks about the legitimacy of cryptocurrency. Thus, digital technologies and innovations, which are one of the most powerful examples of the impact on the global economy, have gone far from developing the legislative framework and legal regulation.

In the beginning of 2018, the All-Russian center for public opinion research conducted a survey, according to which only 13% of Russians are interested in cryptocurrencies and only 9% think it will be possible to purchase them in the future. More than half of Russians (56%) are familiar with the name "bitcoin" (however, in detail only 13%).

Also, 44% of Russians believe that the conversion of cryptocurrency to fiat money is considered illegal in Russia, and the level of their protection, if compared with

conventional money, is evaluated ambiguously. 36% believe that digital currency is harder to steal, 33% believe it is easier (WCIOM, 2018).

The government has been talking about the need for legal regulation of cryptocurrencies in Russia since 2014. In January 2014, the Bank of Russia published an information paper "On the use of "virtual currencies" in transactions bitcoin", according to which the cryptocurrency is a monetary surrogate in Russia. The Law "On the Central Bank of the Russian Federation (Bank of Russia)" prohibits their issuance and use. In October 2014, the Ministry of Finance developed a Draft Law "On liability for the use of monetary surrogates" (Ministry of Finance of the Russian Federation, 2014). Rosfinmonitoring and the Prosecutor General's Office of the Russian Federation also fully approved and supported the position of the Bank of Russia on classifying cryptocurrencies as a monetary surrogate in 2014 (Rosfinmonitoring, 2014, Prosecutor General of the Russian Federation, 2014).

Five years ago, on December 18, 2015, Draft Law No. 957581-6 was introduced to the State Duma of the Russian Federation. This is a draft of the new Code of Administrative Offences. The Draft Law contained a legal definition of a monetary surrogate as an object of property rights issued in the territory of the Russian Federation, including in electronic form, intended for use as a means of payment and exchange and not directly provided for as an official means of payment by the legislation of the Russian Federation. This Draft Law also provided for administrative responsibility for the issue and turnover of money surrogates in Russia (Committee of the State Duma on the financial market, 2015a).

In July 2017, the government approved the "Digital economy of the Russian Federation" program. The key point of the program is the development of "end-to-end technologies", including blockchain. End-to-end technologies are a process where a binding party completes a service from start to finish and provides a complete functional solution, without the need for a third party. End-to-end technologies were most widely developed in IT technologies. On December 15, 2017, the Order of the Federal Agency for Technical Regulation and Metrology No. 2831 "On the establishment of the technical committee for standardization 'Software and hardware for distributed registry and blockchain technologies'" was issued. December 2017 was marked by the creation of an expert council on the digital economy and blockchain technologies. The main objective of this council is to guarantee the necessary conditions for the development of a digital economy at the legislative level (RBC, 2017).



An important milestone in the development of legal regulation of cryptocurrencies in Russia was the meeting held on October 10, 2017 on the use of digital technologies in the financial sphere, held by the President of the Russian Federation Vladimir Putin. The President of the Russian Federation instructed the Government of the Russian Federation together with the Bank of Russia to guarantee the introduction of new amendments to the legislation of the Russian Federation. New changes should take into account the definition of the status of digital technologies, but they should also take into account the ruble as the single legitimate means of payment in the Russian Federation. Another change was the introduction of new requirements for mining. The President issued an instruction to determine the taxation procedure, establish requirements for the organization and determine the procedure for the registration of business entities. Another mandate was to regulate the public attraction of funds and cryptocurrencies by placing tokens by analogy with the legal regulation of the initial placement of securities (President of Russia, 2017). The Government of the Russian Federation had to fulfill this order until July 1, 2018. That is why in 2018 there was a legislative surge in the regulation of virtual currencies.

A unified approach to determining the legal status of cryptocurrencies has not yet developed in the world practice. In 2012, the European Central Bank in its report described virtual currencies as "unregulated funds that are issued and controlled by their developers, used and accepted by members of a certain virtual community" (European Central Bank, 2012). The legislature of Japan has decided that since April 1, 2017, cryptocurrency in the country is a legitimate means of payment. The legalization of cryptocurrency in the country is important for tax purposes. Thus, the income received by an individual as a cryptocurrency is subject to income tax, and the profit of a legal entity in a digital currency is subject to income tax. In Israel, cryptocurrencies and other virtual money are recognized as property for tax purposes. In Switzerland, assets do not require special permission to be used for purchasing goods or paying for services. China has banned the circulation of cryptocurrencies in the country.

In some cases, the state can formulate two approaches to the legal status of virtual currencies. For example, in the United States, for tax purposes, cryptocurrencies are defined as property, while in the financial sphere they are defined as a decentralized virtual currency.

As a result of the lack of legal regulation of cryptocurrencies in Russia, there is also insufficient judicial practice to resolve property disputes concerning cryptocurrencies that are not recognized as the object of "property rights" (Belgorod Regional Court, 2012),

are not included in the bankruptcy estate of the debtor, and are not subject to recovery during the bankruptcy procedure (Moscow Arbitration Court, 2016). This approach made it impossible to exercise judicial protection of cryptocurrency owners and created an opportunity for unscrupulous individuals to abuse their rights with impunity. In particular, according to the materials of judicial practice, "the presence of cryptocurrencies outside the legal field does not allow the plaintiff to implement legal mechanisms for imposing liability on the defendant in the form of payment of a penalty, compensation for moral damage and a fine, provided for by the Law of the Russian Federation of February 07, 1992 No. 2300-1 'On consumer protection'" (Ryazhsky District Court, 2017).

On January 25, 2018, the Ministry of Finance of the Russian Federation on its official website presented a Draft Law "On digital financial assets". This draft law legally defines such terms as: validator, cryptocurrency, token, mining, smart contract and other concepts. The ruble remains the legal means of payment, but cryptocurrencies and tokens are legally recognized as property, namely digital financial assets, confirmation of ownership of which is registration in the registry of digital transactions.

The Draft Law defines a "distributed register of digital transactions" as "a systematic database of digital transactions that are stored, simultaneously created and updated on all media for all participants in a decentralized registry based on specified algorithms that ensure its identity for all users of the registry." The draft law says that owners of digital financial assets have the right to make traces of exchanging digital financial assets of one type for digital financial assets of another type. This exchange includes digital financial assets, rubles, foreign currency and other property. An exchange is possible only through an asset data exchange operator. As a result of this, users have the opportunity to legally acquire and exchange cryptocurrency and tokens. But the question arises of the legal fixing of virtual currency as property. At what point does an entry made in a distributed registry become property? In addition, the draft law does not contain provisions that directly regulate the turnover of cryptocurrencies. On March 20, 2018, deputies of the State Duma A. G. Aksakov, I. B. Divinsky, O. A. Nikolaev, and member of the Federation Council N. A. Zhuravlev introduced the Draft Law No. 419059-7 "On digital financial assets".

In January 2018, the Draft Federal law No. 373645-7 "On the system of distributed national mining" was submitted to the State Duma, the purpose of which is the "regulation of the process of using computing power belonging to an individual, individual entrepreneur or legal entity for the production of a national digital financial asset based on

the principles of cryptography in the environment of distributed registers of digital transactions (mining), including the registration of economic entities engaged in such activities on the basis of remuneration, as well as determining the procedure for its taxation" (Committee of the State Duma on the financial market ConsultantPlus, 2018b).

Another Draft Federal Law related to cryptocurrency is under consideration in the State Duma in 2018: Draft No. 419090-7 "On alternative currencies ways to attract investment (crowdfunding)" (Committee of the State Duma on the financial market ConsultantPlus, 2018c). The project regulates relations to attract investment using digital technologies and defines the legal basis for the activities of investment platform operators. Tokens of the investment project are digital assets, certifying property rights, such as rights (claims) of the loan agreement, provided the person attracting investments, the right to demand placement of securities at a certain price, the right to demand transfer of a thing (things), the right to require the transfer of exclusive rights to results of intellectual activities or the rights of use of result of intellectual activity and the rights to require execution of works and/or provision of services.

The inclusion of cryptocurrency in the property allows you to include it in the inheritance mass. However, the main problem for the heirs is that before you claim your own rights to crypto assets, you first need to get information about their ownership. This is a very difficult process, and sometimes even impossible, since in the most popular cryptocurrency systems the owner is depersonalized and you can not get any confirmation of ownership in any way. Thus, without confirmation that the property belongs to a specific heir, it is impossible to include this property in the estate, as well as find it, because the owner of the virtual wallet is anonymous. Similar difficulties arise with the seizure of such property. Consequently, state bodies should have the technical capability to implement a mechanism for the compulsory transfer of such property.

There are many risks associated with anonymity, lack of control and provision of cryptocurrency, but there are also a number of advantages for the state, which entails the normative consolidation of the legal status of cryptocurrency. The first advantage is that cryptocurrency is a source of income to the national budget from entrepreneurial activities related to the circulation of cryptocurrencies.

The second advantage is associated with the legal definition of cryptocurrency and the right to conduct operations with it. This factor entails a decrease in the share of the shadow economy, counteraction to laundering and legalization of income, and uncontrolled withdrawal of capital outside the Russian Federation.

Considering this advantage in more detail, we can say that one of the main risks associated with cryptocurrencies today is the outflow of capital from the country. Against the background of the fact that some states cannot decide on the recognition of cryptocurrencies, citizens of these states still conduct transactions with them, but outside the countries where they live. This naturally leads to the fact that some of the money leaves the domestic turnover, leaving the territory of the state. Also, the control and regulation of cryptocurrencies within the country solve the problems of counterfeiting and theft of cash. In particular, according to the Rosfinmonitoring report on the national assessment of the risks of money laundering (2017-2018), in 2017, facts related to the use of the cryptocurrency "bitcoin" in the financial structure of drug trafficking in the territory of 23 subjects of the Russian Federation were established. (Rosfinmonitoring is a Federal Executive body in Russia that performs the functions of countering the legalization (laundering) of proceeds from crime and the financing of terrorism, as well as the development of state policy, regulatory and legal regulation and coordination of activities in this area of other Federal Executive bodies.)

Third, the undoubted advantage of using virtual currencies is the acceleration of settlements and payments, which entails the possibility of minimizing time and cost barriers to the economic growth of business entities. We will notice that earlier in mass media the question was raised about the possibility of the creation of Russia's own national cryptocurrency of CryptoRuble.

The Draft Law "On digital financial assets" was adopted in the first reading almost two years ago, since then the text has been finalized and has undergone significant changes.

The main decisions that were taken by the Russian authorities to regulate blockchain and cryptocurrency technology in 2020 are the following:

1. First, determining what digital financial assets are.
2. The second big problem that has been resolved is the definition of what constitutes a distributed registry where digital financial assets are traded and recorded.
3. The Draft Law also defines the basic infrastructure of the organization of exchange operators, what requirements are imposed on these institutions and their managers.

4. The Draft law also specifies the main responsibilities of both types of operators, in particular, what they are required to do in terms of ensuring information security and internal control systems.

Has the draft law found a consensus on cryptocurrency and its circulation?

The Central Bank's position remains unchanged on the issue of cryptocurrency circulation. The Bank of Russia believes that there are great risks in legalizing cryptocurrency circulation throughout the country, both from the point of view of financial stability and the anti-money laundering system, and from the point of view of consumer protection. Therefore, during the discussion on the bill, the Bank of Russia objected to the fact that the cryptocurrency was legalized as an object of circulation.

Thus, we can conclude that although the government of the Russian Federation is making advances towards the regulatory attitude of the cryptocurrency, it remains the subject of many unresolved issues. Digital development has gone much further than the country's legal regulation.

The process of legal regulation of cryptocurrencies should follow the path of a clear legislative definition of the concept of cryptocurrency, regulatory regulation of the exchange" of cryptocurrencies for the national currency of the Russian Federation and foreign currency, monitoring the activities of "miners" and providers of virtual currency exchange services, regulating settlement operations, determining the specifics of taxation.

### 3.3 Monetary transmission laws and anti-money laundering requirements

The main laws regulating the anti-money laundering rules in Russia are Federal Law No. 115 "On countering the legalization (laundering) of proceeds from crime and the financing of terrorism" of 7 August 2001 (the Anti-Money Laundering Law – AML Law) and a number of by-laws adopted by the Government of the Russian Federation, the Federal Financial Monitoring Service, the Bank of Russia, the Federal Tax Service and other state bodies responsible for implementing anti-money laundering legislation (The State Duma, 2002).

Currently there is no existing legislation on the fight against money laundering associated with bitcoin. The interim project proposed to amend the AML Law by including

digital asset trading operators and information system operators in the list of persons subject to the AML Law. For example, they will need to:

- identify the client by receiving, verifying, and periodically updating, and verifying certain information about the client, its directors, and ultimate beneficial owners;
- check the client for involvement in extremist or terrorist activities and adopt internal controls, including the development of internal control rules and compliance programs; and
- report suspicious transactions to anti-money laundering law enforcement agencies.

At the end of 2016, the Federal Tax Service prepared a letter "On monitoring the circulation of cryptocurrencies, including bitcoins, in the territory of the Russian Federation", which supported the position of recognizing cryptocurrencies as a monetary surrogate, and the use of cryptocurrencies in transactions was assessed as "the basis for considering the question of classifying such transactions (operations) as transactions aimed at legalizing (laundering) proceeds obtained by criminal means, and financing terrorism" (Federal Tax Service of Russia, 2016a).

Even though there is no legal regulation of cryptocurrency turnover in the territory of the Russian Federation, in 2017 the first criminal case was initiated under article 172 of the Criminal code of the Russian Federation "Illegal banking activities". According to official data, employees of the Ministry of internal Affairs and the FSB detained three people in the Kostroma region for "exchanging and transferring" virtual coins, which, according to investigators, "earned" on cashing and selling cryptocurrency illegally more than \$7.3 million USD.

In September 2017, the Bank of Russia issued an information letter warning about the possible illegality and associated risks of transactions with cryptocurrencies. The Bank of Russia noted that cryptocurrencies were issued by anonymous and unidentifiable individuals and, therefore, when performing transactions with cryptocurrencies, individuals may be involved in illegal activities, including money laundering and terrorist financing. The Bank of Russia warned that cryptocurrencies involve high-level risks, both when issuing cryptocurrencies and tokens at the initial offer of tokens or coins, and later, during exchange operations. The Bank of Russia also stressed that it believes that "the admission of cryptocurrencies and other financial instruments denominated in or related to cryptocurrencies to circulation and use in organized trade, as well as in the clearing and

settlement infrastructure for servicing operations with cryptocurrencies and related derivatives in Russia" is premature.

## 4. Russian Central Bank digital currencies

### 4.1 Use of digital currencies in the Russian Federation

Today, the development of national digital payment systems and of a national cryptocurrency is of great importance. The Central Bank of Russia, in cooperation with the FinTech consortium association, conducts a large number of pilot projects in the regulatory sandbox, analyzing and comparing the main advantages and disadvantages of projects. Also of great importance is the analysis of the legislative framework in which future projects could work without violating the law.

Over the past four years, a lot of discussion in the Russian Federation has been connected with the creation of a national currency, which is called "CryptoRuble", but the development of its own national currency has been called into question by comparing it with the Quick Payment System (SPB).

The history of discussions of CryptoRuble the Russian Federation began in May 2016, when the Kommersant newspaper reported that officials are actively talking about the concept of a national cryptocurrency, which should minimize the volume of anonymous transactions (Kommersant, 2016).

In June 2017, the Bank of Russia announced the start of work on the creation of a national cryptocurrency. Nevertheless, the head of the Central Bank said that the creation of a CryptoRuble is not one of the priorities of the department; this project is to be developed over medium-term or even the long-term.

Today, CryptoRuble is the name of digital currency project of the Russian Federation, which is being developed by decree of President Vladimir Putin. Issues of emission and control will be decided by the Central Bank of the Russian Federation in cooperation with the Ministry of Finance.

There are several main advantages that guide the heads of state and the main developers when creating a national cryptocurrency in the Russian Federation:

1. One of the main advantages of CryptoRuble is that it can ease the pressure on the economy caused by Western sanctions, as transactions are encrypted and therefore it becomes easier to send money unnoticed. Thus, it is expected that government agencies will be the first to test the work of the CryptoRuble (Davies, 2019).



2. The second main advantage is that the cryptocurrency is the basis for crowding out other cryptocurrencies from this market, since the government cannot exercise control over cryptocurrencies such as bitcoin and other altcoins. Russia has repeatedly expressed its dissatisfaction with cryptocurrencies, and President Vladimir Putin himself said in October 2017 that cryptocurrencies are mainly used for crime and money laundering (Frankenfield, 2019).
3. The new national currency may also provide additional tax revenue to the Russian government. CryptoRuble can be exchanged for fiat rubles, but if the owner is unable to explain the origin of the CryptoRuble, the funds are taxed at 13%. The same tax rate is applied to any profits from token trading (Frankenfield, 2019a).

However, there are fears that if the digital ruble is subject to demanding rules, it will not arouse the interest of citizens and even stock market players. The main characteristic of the CryptoRuble is that the government will have full control of it. Naturally, we are talking about the fact that investors cannot rely on the anonymity of transactions. According to President Vladimir Putin and other senior officials, a central regulatory measure is implemented to prevent the laundering of money obtained illegally (Katrish, 2018). In any case, the use of cryptocurrencies and digital assets in the country should be regulated, but the legal regulation of digital assets is still under development.

CryptoRuble will not be issued by mining. Its release will be carried out by the Central Bank of the Russian Federation. This may be a good solution for investors who may feel safer under this arrangement because the success of the currency will be tied to the Russian economy, and not dependent on purely speculative or volatile financial instruments.

On the other hand, the Chairman of the Bank of Russia fears that the introduction of a national cryptocurrency will negatively affect the country's economy and lead to a change in financial markets. For example, if citizens are allowed to keep digital money at the Central Bank, this could affect the deposits at commercial banks. In the event of negative news, there will be a withdrawal of deposits and flow of funds from one banking institution to another, which may be undesirable (Krupenchenkova, 2019).

Elvira Nabiullina – one of the country's main state and political figures – said that first Russia wants to study the experience of other countries with introducing and using a digital national cryptocurrency. Experts will closely monitor the development of affairs in

China and India, which were the first to decide to introduce their own cryptocurrencies. The brokerage company Citic Securities on April 16 predicted that China will officially launch the digital yuan at the end of 2020 (The Economist, 2020).

Comparing the Quick Payment System (SPB) with the introduction of a new national cryptocurrency, I would like to give a basic definition and highlight the main advantages that can put SPB in the foreground and slow down the introduction of a cryptocurrency.

The fast payment system (SBP) is today the most important infrastructure project at the national level aimed at promoting competition, improving the quality of payment services, expanding financial accessibility, and reducing the cost of payments for the population (Bank of Russia, 2020a).

In one year, Russians transferred almost \$1 billion USD through the system, having completed more than 8 million operations. According to the director of the department of the national payment system (NPC), the monthly average growth is about 25% both in terms of the number and volume of payments (Tetkin, 2019).

SBP is a system that allows you to transfer money by phone number, regardless of which bank the accounts of the sender and the recipient of funds are open in, as well as pay for goods and services using a QR code. Since the launch of SBP in January last year, 30 participants have connected to it and about 160 credit organizations are preparing to do so.

The principle of the technology – the transfer of funds without reference to a bank account and payment using QR codes – is similar to the use of cryptocurrencies. Therefore, the head of the Bank of Russia, Elvira Nabiullina, often speaks of the need to understand what the advantages of issuing a conditional "CryptoRuble" compared to the Quick Payment System are. The chairman of the financial regulator believes that the creation of national digital money carries many risks, and the obvious advantages are not enough.

A number of secured cryptocurrency projects are being tested in "regulatory sandboxes", bearing in mind that the presence of a digital analogue of the fiat ruble, among other things, can give transparency to the Russian market, including government procurements, and also have a positive economic effect under international sanctions (Krupenchenkova, 2019a).

Russia was one of the first in Europe to raise the issue of legalizing cryptocurrencies at the peak of their popularity, 2016-2017. At that time, several bills were created that defined cryptocurrency in legal terms, described the mechanisms of its circulation and use. To date, only a few of the bills have been passed by the government.

According to Elvira Nabiullina, interest in these documents has somewhat decreased after the cryptocurrency market collapsed in 2018.

However, officials do not disregard this area. According to experts, the State Duma will return to the discussion of the bill on Digital Assets in the fall of 2020. This document describes the mechanics of buying and selling cryptocurrency, and its use as a means of payment. However, in the text of the bill there are several points that strictly limit the action of foreign cryptocurrency companies in the country. If changes to these sections are not made, then the bill will actually limit the activity of cryptocurrency exchanges in Russia. Therefore, cryptocurrency proponents are eagerly awaiting discussion of the bill to propose alternative wordings.

Thus, we can say that the impact that central bank digital currencies can have on the modern monetary system largely depends on the method of their system integration. When replacing cash in circulation with Central Bank digital money, the effect on the monetary system and the policy of the Central Bank will be insignificant. The greatest effect will be achieved in the case of parallel circulation of Central Bank digital money and cash, since the ability to store money directly with the Central Bank can strengthen the transmission mechanism of monetary policy and reduce the volume of lending provided by commercial banks, which will lead to a change in the structure of liabilities as the Central Bank itself, and credit institutions. However, these changes are not critical and can be offset by monetary regulation and the availability of bank deposit insurance systems.

## 4.2 Ethereum in Russian Federation

Ethereum (ETH) is both a cryptocurrency and a functional decentralized system that has truly revolutionized the entire IT industry. The platform was launched on July 30, 2015. In 2016, the founder of the platform, Vitalik Buterin, said that in Russia the company seeks to popularize blockchain technology, and incentivize Russian software companies – Acronis, Kaspersky Lab, Yandex, and others – to provide Ethereum support in future versions of their products. In addition, Buterin expects to stimulate the development of Russian developer communities so that small startups are more interested in blockchain (Habibrahimov, 2016).

The wide development of the cryptocurrency market in 2016-2017 is associated with the launch and popularization of Ethereum. The new environment allowed users to

maximize the potential of the blockchain in the fintech sector and gave an impetus to launch new startups and projects, which in turn attracted huge investments. ETH tightly captured the status of the second most popular cryptocurrency in the world (Kodachigov, 2017) and the most revolutionary. Table 5 presents the 5 cryptocurrencies with the largest capitalization in 2020. An interesting fact is that from the beginning of March 2017 to June 13, Ethereum has risen in price by 24 times, and Russian miners are probably partially involved in these changes. In the early summer, video cards almost disappeared from many Russian stores, and their prices doubled in a month and a half. Sellers and specialists in stores admitted that they mined Ethereum, and not Bitcoin, using "farms" of video cards. Apparently, this is due to the fact that mining bitcoin has become unprofitable: it takes too much electricity to calculate the hash amount, the cost of which is sometimes difficult to cover.

Table 5. Cryptocurrency Rating 2020

	Cryptocurrency	Price, USD	Market capitalization, USD
1	Bitcoin	8 919.56	163 782 362 571
2	Ethereum	209.50	23 211 754 935
3	XRP	0.22	9 706 660 347
4	Tether	1.00	6 385 930 849
5	Bitcoin Cash	246.37	4 532 691 045

Source: compiled by the author based on: Cryptocurrency Rating // Forex rating. – 2019

This cryptocurrency has provided completely new opportunities for creating decentralized projects and startups based on blockchain and smart contracts. One of these startups was The DAO. This is a platform for finding projects for investment, built on smart contracts. ICO The DAO has become one of the most successful in history. During crowdfunding, it collected \$150 million USD investment. However, due to an error in the source code, part of the funds (\$60 million USD) was stolen.

Today, a large number of important projects in the Russian Federation are based on Ethereum technologies. We will analyze the most important of them in order to highlight the main advantages and look at their further development.

On October 5, 2016, the Central Bank of the Russian Federation announced the launch of the Masterchain platform, designed to exchange information between financial market participants. According to the participants in the consortium of Russian banks that developed this product, the Masterchain technologies are based on Ethereum protocols (Kommersant, 2016a).

An interesting project based on Ethereum technologies was the work of insurance companies that insure agricultural risks. For example, an insured event is considered to be an increase in the average monthly temperature (for example, above 30-35 degrees Celsius in July in the area of interest); if this happens, then the year is dry and the insured event occurred. A smart contract automatically transfers insurance compensation (payment) from the company to the policyholder. Relations of this kind must be formalized in order to avoid temporary losses in document flow, additional costs for conducting business, and to exclude fraud and bureaucratic delays (Goryacheva, 2017).

On June 3, 2017, the founder of Ethereum discussed the possibilities of the blockchain with Vladimir Putin (Vishnyakova, 2017). In August 2017, Vitalik Buterin and the head of Vnesheconombank, Sergey Gorkov, signed a partnership agreement that includes joint training of specialists in the blockchain field. Training programs will be implemented on the basis of the blockchain competency center, which Vnesheconombank, Ethereum, and BitFury, a mining company, agreed to create in June 2017 (Ovechkin, 2017). In October 2017, Sberbank joined the non-profit organization Enterprise Ethereum Alliance, becoming the first Russian bank in its composition (Sberbank, 2017).

In Russia, there is a national blockchain platform for the protection of intellectual property, the IPChain. The creation of this platform was initiated in 2017 by a partnership led by the Russian Copyright Society (RAO), the All-Russian Intellectual Property Society (WIPO), Skolkovo and several universities. The platform is a specialized platform designed to carry out various operations with copyright at the national and, in the future, international scales. The use of smart blockchain-based contracts gives several important advantages. Firstly, the blockchain is a network of increased trust and high reliability, which does not allow you to roll back or delete an entry about an action retroactively. Secondly, the blockchain opens the way for copyright holders to the world market. Registration of their rights using the international protocol Ethereum, allows them to prove authorship anywhere in the whole globe. Rights registration data is stored in a decentralized registry and can be quickly found.

More than 500 so-called Dapps, decentralized applications, which are add-ons for smart contracts with a user interface, sharpened to perform specific practical tasks in various directions, are openly available on the Ethereum platform today. Examples include a direct lending system that bypasses all banks and intermediaries (B2B Lending), a public register of taxes (system of fees and targeted use), a universal interface that allows you to draw up contracts with conditions, a gaming machine room, a full-featured notarial service, lottery organization, an e-government model, and many hundreds more (Golubitsky, 2017).

Note that this is not a complete list of the areas where Ethereum technologies can be used or are already being used. Ethereum is a universal tool that can be applied in all sectors of the economy, including financial services.

## 5. Main solutions and further development of Blockchain technologies in the financial sector in Russian Federation

In October 2019, Rostec Corporation (a Russian state-owned corporation that assists in the development, production and export of high-tech industrial products for civilian and military purposes) prepared and issued a roadmap for the development of end-to-end digital technologies (Rostec, 2019c).

The roadmap for the development of “end-to-end” digital technology “Distributed Register Systems” is a strategic tool that identifies priorities and prospects for the development of technology in Russia. The document includes the goals and expected results of the introduction and dissemination of technology, an assessment of its impact on social progress, economic development and technological leadership of the country by 2024, key projects and incentive measures for implementation, potential areas of international cooperation and other comprehensive initiatives for the development of distributed ledger technology.

Following the evaluation of the effectiveness of technology application and potential maximization of economic value (the amount of additional savings and revenue), the following priority sectors of the Russian Federation were identified for the introduction of technology: financial and insurance activities, transportation and logistics, public administration, health care activities, manufacturing.

The target level of effects from the development of technology is presented through the description of the impact on the relevant list of indicators of technological leadership, economic development and social progress, the achievement of which is influenced by the technology of the distributed registry.

In terms of technological leadership, the development of technology will allow the following goals to be achieved:

- Ensure the independence of the financial infrastructure of the Russian Federation from foreign solutions, increase the reliability and cybersecurity of the financial infrastructure. The projected reduction in the number of failures in financial infrastructure is 50% by 2024.

- Ensure increased security of the processes of storage and exchange of personal medical data. The projected reduction in the number of cases of leakage of personal medical data is 50% by 2024.

- Increase the availability and reliability of state information systems (GIS), and increase their protection against cyber attacks. The projected reduction in maintenance time per year is 30% by 2024.

In terms of economic development, the introduction of technology will:

- Achieve a direct economic effect, expressed as the amount of additional revenue and cost reduction due to the digitalization of processes and minimization of the number of intermediaries. The projected aggregate volume is \$11.5 billion USD by 2024.

- Achieve an indirect economic effect, expressed in the form of a reduction in the shadow economy and the turnover of counterfeit products by ensuring transparency, consistency and automated updating of data. The projected aggregate volume is \$12.5 billion USD by 2024.

Thus, the total economic effect will reach \$24 billion USD by 2024.

In terms of social progress, the development of distributed registry technology will contribute to the following goals:

- Increase the availability of financial services for the poorest segments of the population and reduce commissions on electronic banking for end users. The predicted effect is that 100% of the population will use banking services by 2024.

- Receive public services in real time and ensure the consistency and transparency of data in the provision of various public services. The projected increase in public confidence in public services is 30% by 2024.

- Reduce the circulation of counterfeit medicines and improve public health by reducing the illicit trafficking of prescription drugs and prescriptions. The projected reduction in the incidence of diseases resulting from the use of counterfeit drugs is 30% by 2024.

Existing risks and limitations of further technology development are divided into legislative and administrative, technological and infrastructural, economic, social, scientific and personnel. We will analyze each of them in more detail:

1. From the point of view of technological and infrastructural restrictions, the most significant for public systems of a distributed registry is insufficient bandwidth for the industrial implementation of technology-based solutions in B2C and B2B segments. The key risks are unauthorized changes to the smart contract due to possible technical malfunctions and errors, reduced network security as a result of separation (hard fork), various types of cyberattacks on the blockchain and the inability to restore access to the private key in the event of a password loss.



2. In terms of economic constraints, it is necessary to note the lack of ready-made industry solutions, which leads to the need to refine universal platforms, leading to an increase in the time and cost of implementing solutions. A key economic risk is a possible loss of funds in the event of a technical failure of the smart contract.

3. The main social constraints are user distrust regarding protects data privacy and the mathematical algorithms used to establish trust in a digital environment instead of trusted centralized intermediaries. The association of technology exclusively with the speculative component is also a social constraint for development.

Next we will present the current state and development targets until 2021 and 2024 regarding technology. The technology development targets are as follows:

1) Technology for organizing and synchronizing data:

- Ensure the leadership of the Russian Federation in the development of innovative methods of organizing and synchronizing data.

- Develop domestic proprietary and free methods of organizing and synchronizing data (such as HashGraph – developed by Swirlds Corporation – and Tempo – developed by Radix).

2) Technologies for ensuring the integrity and consistency of data:

- Improve the domestic cryptographic base used in distributed registry systems.
- Create mathematical algorithms that ensure data integrity and consistency, as well as maximum protection and reliability of distributed registry systems.

3) Technologies for creating and executing decentralized applications and smart contracts:

- Create a full-fledged database of decentralized applications and industry solutions, ready for implementation in complex business processes.

- Maximize the number of business processes automated through the use of smart contracts, industry solutions based on distributed registry systems, and decentralized applications.

The proposed technological and market indicators in the framework of fulfilling the tasks of development of organization technologies and data synchronization are in Table 6. The proposed technological and market indicators as part of the tasks of developing consensus technologies are in Table 7. The proposed technological and market indicators in the framework of fulfilling the tasks of developing technologies for the creation and execution of decentralized applications and smart contracts: are in Table 8.

Table 6 - Target market indicators in the framework of the tasks of development of organization technologies and data synchronization

Index	2019	2021	2024
Number of patented technologies for organizing and synchronizing data	0	15	50
Share of companies with full nodes in distributed registry systems	<1%	10%	55%
Number of system architects with experience in building distributed systems	100	500	3000

Source: compiled by the author based on: Development Road Map "End-to-end" Digital Technologies "Distributed Register System". // Moscow. – 2019. – P. 11

Table 7 - Proposed market indicators in the framework of the objectives of the development of technology for consensus

Index	2019	2021	2024
Number of patented consensus algorithms	0	15	50
The proportion of distributed registry platforms certified according to GOST	0%	10%	55%
The number of graduates in the field of cryptographic algorithms used in distributed registry systems, per year	250	750	2000

Source: compiled by the author based on: Development Road Map "End-to-end" Digital Technologies "Distributed Register System". // Moscow. – 2019. – P. 11

Table 8 - Target market indicators in the framework of the tasks of development of technologies for the creation and execution of decentralized applications and smart contracts

Index	2019	2021	2024
Number of developers of smart contracts and decentralized applications	100	500	3000
Number of commits in open source repositories of distributed registry systems	18900	50000	100000
The share of digitalized business processes through the implementation of smart contracts	5%	30%	75%
The number of service providers of distributed registry systems in priority sectors	15	150	500

Source: compiled by the author based on: Development Road Map "End-to-end" Digital Technologies "Distributed Register System". // Moscow. – 2019. – P. 12

To help to achieve the performance targets, the key objectives of technology development were formulated, which are divided into several main areas. Development of tools that expand the functionality of distributed registry systems, development of technologies for organizing and synchronizing data, development of consensus technologies, development of technologies for creating and executing decentralized applications and smart contracts, as well as the introduction of technology in the economy.

Also, one of the main events in the development of digital financial technologies in the Russian Federation was the creation of its own national blockchain platform “Masterchain”, announced on October 5, 2016, by the Central Bank of the Russian Federation. Masterchain is designed to exchange information between participants in the financial market. According to the consortium (organized by Central Bank) of Russian banks that developed this product, the Masterchain technologies are based on Ethereum protocols (Bank of Russia, 2016b). Masterchain is the first legally clean blockchain in Russia.

The main question is what the goals of the FinTech Association (AFT), which includes the 14 largest banks in Russia, in creating its own national blockchain platform are, and how it works now.

The platform is already working within the framework of Russian regulatory standards and using Russian cryptography. That is, the technology is completely legal,

adopted by both the Bank of Russia and leading market players, although so far only banking. The work of financial organizations within the framework of the AFL allows not only to find new technological solutions, but also to determine the legislative framework for their implementation.

The creators of Masterchain identified the main areas for which a national blockchain platform was created:

- Decentralized Depository System for Mortgage Accounting.
- Digital Letter of Credit.
- Distributed register of digital bank guarantees.
- "Know your customer" function.

Let us examine in more detail each of them.

### *1. Decentralized depository system for registering mortgages.*

For the convenience of handling mortgage bonds, Russian banks have depositories common to the entire market where they are kept. The legislation provides for their storage in electronic form. But now operations with them are a rather long and costly procedure. Masterchain should change this situation.

The decentralized depository system for registering mortgages, operating on the principles of the blockchain, is designed to speed up and reduce the cost of storage, modification and movement of mortgages.

In the future, the Rosreestr may also be connected to the network and then the state registration of rights will also be possible within the framework of the Masterchain. It is expected that the implementation will reduce the cost of storage, accounting and securitization by 2-5 times.

### *2. Digital letter of credit.*

It is easy to notice that the letter of credit is somewhat similar to a smart contract, that is, to a guaranteed transaction when certain conditions are met. However, a letter of credit is a smart contract of the pre-blockchain era. Masterchain will be able to make it easier and more convenient. Banks of the supplier and buyer in a transaction enter into a smart contract for the creation of a letter of credit. Having received a confirmation from the transport company about the delivery of goods, the buyer's bank automatically issues a letter of credit to the supplier's bank. This can be called a transitional scheme from a traditional business to a blockchain-based business. In the future, letters of credit

themselves will probably not be needed, and smart contracts will be able to be concluded not between banks, but between direct participants in the transaction.

### *3. Distributed register of digital bank guarantees.*

A bank guarantee is a necessary condition for the execution of many procedures and contracts, as well as an important part of government policy. Often, bank guarantees are required when participating in tenders and public procurement. In order to at least qualify for them, the company must either issue a significant amount of collateral or provide a guarantee from the bank. It is clear that the receipt and confirmation of this guarantee often becomes a long, bureaucratic task. There are also cases of falsification of these papers. Masterchain is changing this situation.

The final goal of the project is a complete departure from paper guarantees. In combination with the KYC system (detailed below), the project of digital bank guarantees can save companies from having to collect numerous papers to get a guarantee. However, the current pilot project is about convenient storage, verification and provision of issued guarantees. Participating banks will have their own nodes in Masterchain to collect information and channels for its issuance to interested parties. First of all, these are electronic trading floors. Access to information will be fast, the information itself will be up-to-date, complete and protected from fraud and forgery.

### *4. Know your customer.*

The security and reliability of the banking system often requires the exchange of information between its participants, in particular as regards their customers. But the banks themselves, for obvious reasons, are in no hurry to share this information, and in addition, its free movement may be contrary to Russian law regarding the protection of personal data. Not to mention the fact that databases freely accessible to employees of many institutions sooner or later "leak" and become publicly available. Partially, but far from completely, the specially created Credit Histories Bureau solves the problem. And Masterchain has every chance to solve the problem completely.

The pilot "KYC Project" (know your customer) implies both simplified identification and data exchange between banks for legal entities and individuals. The latter is carried out on a commercial basis (and on the basis of smart contracts) and without disclosing the client base or compromising important information. Banks have access to a distributed and anonymized storage system. Only under certain conditions and in clearly

defined scenarios can a bank obtain information about a specific person. As long as the person himself did not come to the bank, did not ask, for example, about a loan and did not give consent to the processing of personal data, no one can see the information related to that person from the distributed storage. The system is monitored by the regulator. And banks can only get the information that they need in this procedure. Now this is information about whether there is a person in the registry of fraudsters, whether the person exists at all, and whether the person is capable. Subsequently, other functions will be added.

Developers say that over time, the blockchain will be widespread. While this moment is still quite far away, four pilot projects are currently being implemented on the basis of Masterchain, and all in the banking sector. But Masterchain can be applied in any area close to the financial market, up to retail. The first to practice its application are banks, because they are the basis of the financial infrastructure. In addition, they have general regulatory measures in place, they are used to dealing with electronic systems and represent the most convenient testing ground for running such technologies.

## 6. Conclusion

Blockchain experts say this is one of the biggest innovations we can see today. This technology can be compared with the widespread digitalization of the economy. This technology provides a decentralized registry of all transactions in a computer network.

During our analysis of the technological capabilities of the blockchain in the Russian Federation and at the international level, the features and advantages of potential development were highlighted. On the basis of those features it can be concluded that the implementation of blockchain technologies will play a big role in the economic system. The result of the implementation is the automation of production and transactions, which will lead to the era of digital contracts (smart contracts) and paperless transactions, with significant resource savings. The blockchain can be applied in almost any industry. Today the technology has been successfully implemented in such areas as: financial and banking, healthcare, higher education, public administration, insurance, logistics, besides many others. However, when considering the possibility of using blockchain technologies in specific sectors of the economy, we identified some barriers that limit the potential development of blockchain technologies and digital currencies in the Russian Federation. The main barriers to development are regulation, protection and ensuring confidentiality of information, large amounts of energy spent, low transaction speed, data consistency (the problem of editing information), resistance to implementation by society, intermediary companies and the state.

Due to the use of blockchain technologies, economic processes are beginning to transform. In addition, in the future, blockchain can become the basis of the economy, creating a decentralized, transparent financial system that intermediaries, the state, corruption and predatory commissions cannot influence. The technology is also able to reduce the development of the shadow economy in the Russian Federation. However, there are factors that impede the development of blockchain technologies. Among them, we can single out the lack of full understanding or interest in the blockchain, the lack of a well-developed regulatory system, the use of cryptocurrencies as an accumulative or speculative asset.

Now the blockchain technology is one of the forms of implementation of the digital economy. The role of blockchain technologies in the digital economy is to perform all the functions that are associated with the storage, modification and access of data (that

is, those functions that the intermediary server traditionally performed in centralized systems), as well as the interaction between users.

The key problem that complicates the active use of blockchain technologies in any field is the difficulty or inability to evaluate the economic effect in absolute terms. Companies already using technologies are extremely cautious in disclosing information about losses, their volumes, facts of detected corruption cases, which leads to great difficulties in the process of assessing the potential effects of the implementation of the blockchain.



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